# *GPL Reference Guide for IBM SPSS Statistics*

**Note**
Before using this information and the product it supports, read the information in "Notices" on page 415.

**Product Information**

This edition applies to version 162261647161, release 0, modification 0 of IBM SPSS Modeler BatchIBM SPSS ModelerIBM SPSS Modeler ServerIBM SPSS StatisticsIBM SPSS Statistics ServerIBM SPSS AmosIBM SPSS SmartreaderIBM SPSS Statistics Base Integrated Student EditionIBM SPSS Collaboration and Deployment ServicesIBM SPSS Visualization DesignerIBM SPSS Modeler Text AnalyticsIBM SPSS Text Analytics for Surveys IBM Analytical Decision ManagementIBM SPSS Modeler Social Network AnalysisIBM SPSS Analytic Server and to all subsequent releases and modifications until otherwise indicated in new editions.

# Contents

# Chapter 1. Introduction to GPL

The Graphics Production Language (GPL) is a language for creating graphs. It is a concise and flexible language based on the grammar described in *The Grammar of Graphics*. Rather than requiring you to learn commands that are specific to different graph types, GPL provides a basic grammar with which you can build any graph. For more information about the theory that supports GPL, see *The Grammar of Graphics, 2nd Edition* [1].

## The Basics

The GPL example below creates a simple bar chart. A summary of the GPL follows the bar chart.

*Note*: To run the examples that appear in the GPL documentation, they must be incorporated into the syntax specific to your application. For more information, see "Using the Examples in Your Application" on page 329.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary)))
```

*Figure 1. GPL for a simple bar chart*

1. Wilkinson, L. 2005. *The Grammar of Graphics*, 2nd ed. New York: Springer-Verlag.

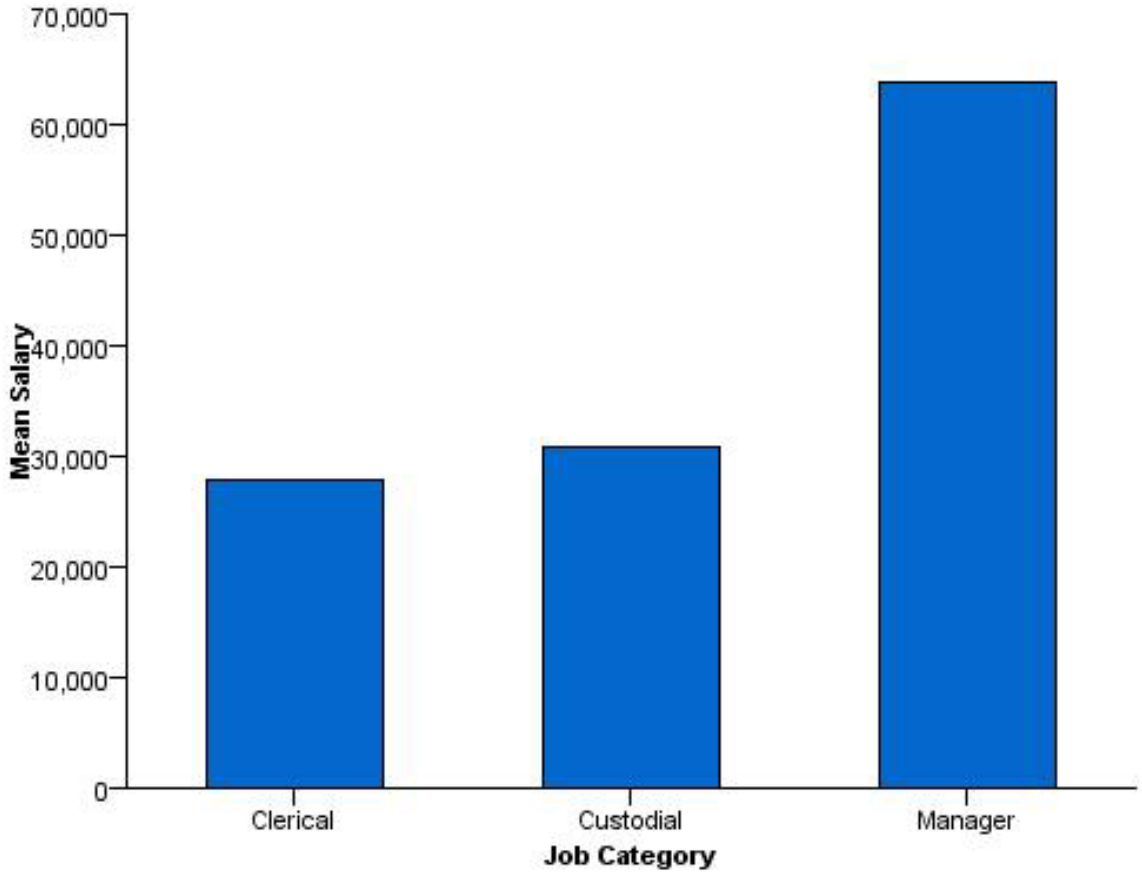


*Figure 2. Simple bar chart*

Each line in the example is a **statement**. One or more statements make up a block of GPL. Each statement specifies an aspect of the graph, such as the source data, relevant data transformations, coordinate systems, guides (for example, axis labels), graphic elements (for example, points and lines), and statistics.

Statements begin with a **label** that identifies the statement type. The label and the colon (:) that follows the label are the only items that delineate the statement.

Consider the statements in the example:

- **SOURCE**. This statement specifies the file or dataset that contains the data for the graph. In the example, it identifies `userSource`, which is a data source defined by the application that is calling the GPL. The data source could also have been a comma-separated values (CSV) file. In the example, it identifies a comma-separated values (CSV) file.
- **DATA**. This statement assigns a variable to a column or field in the data source. In the example, the `DATA` statements assign *jobcat* and *salary* to two columns in the data source. The statement identifies the appropriate columns in the data source by using the `name` function. The strings passed to the `name` function correspond to variable names in the `userSource`. These could also be the column header strings that appear in the first line of a CSV file. The strings passed to the `name` function correspond to the column header strings that appear in the first line of the CSV file. Note that *jobcat* is defined as a categorical variable. If a measurement level is not specified, it is assumed to be continuous.
- **SCALE**. This statement specifies the type of scale used for the graph dimensions and the range for the scale, among other options. In the example, it specifies a linear scale on the second dimension (the *y*

axis in this case) and indicates that the scale must include 0. Linear scales do not necessarily include 0, but many bar charts do. Therefore, it's explicitly defined to ensure the bars start at 0. You need to include a `SCALE` statement only when you want to modify the scale. In this example, no `SCALE` statement is specified for the first dimension. We are using the default scale, which is categorical because the underlying data are categorical.

- **GUIDE**. This statement handles all of the aspects of the graph that aren't directly tied to the data but help to interpret the data, such as axis labels and reference lines. In the example, the `GUIDE` statements specify labels for the *x* and *y* axes. A specific axis is identified by a `dim` function. The first two dimensions of any graph are the *x* and *y* axes. The `GUIDE` statement is not required. Like the `SCALE` statement, it is needed only when you want to modify a particular guide. In this case, we are adding labels to the guides. The axis guides would still be created if the `GUIDE` statements were omitted, but the axes would not have labels.
- **ELEMENT**. This statement identifies the graphic element type, variables, and statistics. The example specifies *interval*. An interval element is commonly known as a bar element. It creates the bars in the example. `position()` specifies the location of the bars. One bar appears at each category in the *jobcat*. Because statistics are calculated on the second dimension in a 2-D graph, the height of the bars is the mean of *salary* for each job category. The contents of `position()` use GPL algebra. See the topic "Brief Overview of GPL Algebra" for more information.

Details about all of the statements and functions appear in Chapter 2, "GPL Statement and Function Reference," on page 21.

## GPL Syntax Rules

When writing GPL, it is important to keep the following rules in mind.

- Except in quoted strings, whitespace is irrelevant, including line breaks. Although it is possible to write a complete GPL block on one line, line breaks are used for readability.
- All quoted strings must be enclosed in quotation marks/double-quotes (for example, `"text"`). You cannot use single quotes to enclose strings.
- To add a quotation mark within a quoted string, precede the quotation mark with an escape character (`\`) (for example, `"Respondents Answering \"Yes\""`).
- To add a line break within a quoted string, use `\n` (for example, `"Employment\nCategory"`).
- GPL is case sensitive. Statement labels and function names must appear in the case as documented. Other names (like variable names) are also case sensitive.
- Functions are separated by commas. For example:

  ```
  ELEMENT: point(position(x*y), color(z), size(size."5px"))
  ```

- GPL names must begin with an alpha character and can contain alphanumeric characters and underscores (_), including those in international character sets. GPL names are used in the `SOURCE`, `DATA`, `TRANS`, and `SCALE` statements to assign the result of a function to the name. For example, `gendervar` in the following example is a GPL name:

  ```
  DATA: gendervar=col(source(s), name("gender"), unit.category())
  ```

## GPL Concepts

This section contains conceptual information about GPL. Although the information is useful for understanding GPL, it may not be easy to grasp unless you first review some examples. You can find examples in Chapter 3, "GPL Examples," on page 329.

## Brief Overview of GPL Algebra

Before you can use all of the functions and statements in GPL, it is important to understand its algebra. The algebra determines how data are combined to specify the position of graphic elements in the graph. That is, the algebra defines the graph dimensions or the data frame in which the graph is drawn. For

example, the frame of a basic scatterplot is specified by the values of one variable crossed with the values of another variable. Another way of thinking about the algebra is that it identifies the variables you want to analyze in the graph.

The GPL algebra can specify one or more variables. If it includes more than one variable, you must use one of the following operators:

- **Cross (*)**. The cross operator crosses all of the values of one variable with all of the values of another variable. A result exists for every case (row) in the data. The cross operator is the most commonly used operator. It is used whenever the graph includes more than one axis, with a different variable on each axis. Each variable on each axis is crossed with each variable on the other axes (for example, `A*B` results in `A` on the *x* axis and `B` on the *y* axis when the coordinate system is 2-D). Crossing can also be used for paneling (faceting) when there are more crossed variables than there are dimensions in a coordinate system. That is, if the coordinate system were 2-D rectangular and three variables were crossed, the last variable would be used for paneling (for example, with `A*B*C`, `C` is used for paneling when the coordinate system is 2-D).
- **Nest (/)**. The nest operator nests all of the values of one variable in all of the values of another variable. The difference between crossing and nesting is that a result exists only when there is a corresponding value in the variable that nests the other variable. For example, `city/state` nests the *city* variable in the *state* variable. A result will exist for each city and its appropriate state, not for every combination of *city* and *state*. Therefore, there will not be a result for *Chicago* and *Montana*. Nesting always results in paneling, regardless of the coordinate system.
- **Blend (+)**. The blend operator combines all of the values of one variable with all of the values of another variable. For example, you may want to combine two salary variables on one axis. Blending is often used for repeated measures, as in `salary2004+salary2005`.

Crossing and nesting add dimensions to the graph specification. Blending combines the values into one dimension. How the dimensions are interpreted and drawn depends on the coordinate system. See "How Coordinates and the GPL Algebra Interact" on page 6 for details about the interaction between the coordinate system and the algebra.

## Rules

Like elementary mathematical algebra, GPL algebra has associative, distributive, and commutative rules. All operators are associative:

```
(X*Y)*Z = X*(Y*Z)
(X/Y)/Z = X/(Y/Z)
(X+Y)+Z = X+(Y+Z)
```

The cross and nest operators are also distributive:

```
X*(Y+Z) = X*Y+X*Z
X/(Y+Z) = X/Y+X/Z
```

However, GPL algebra operators are *not* commutative. That is,

```
X*Y ≠ Y*X
X/Y ≠ Y/X
```

## Operator Precedence

The nest operator takes precedence over the other operators, and the cross operator takes precedence over the blend operator. Like mathematical algebra, the precedence can be changed by using parentheses. You will almost always use parentheses with the blend operator because the blend operator has the lowest precedence. For example, to blend variables before crossing or nesting the result with other variables, you would do the following:

```
(A+B)*C
```

However, note that there are some cases in which you will cross *then* blend. For example, consider the following.

```
(A*C)+(B*D)
```

In this case, the variables are crossed first because there is no way to untangle the variable values after they are blended. `A` needs to be crossed with `C` and `B` needs to be crossed with `D`. Therefore, using `(A+B)*(C+D)` won't work. `(A*C)+(B*D)` crosses the correct variables and then blends the results together.

*Note*: In this last example, the parentheses are superfluous, because the cross operator's higher precedence ensures that the crossing occurs before the blending. The parentheses are used for readability.

## Analysis Variable

Statistics other than count-based statistics require an analysis variable. The analysis variable is the variable on which a statistic is calculated. In a 1-D graph, this is the first variable in the algebra. In a 2-D graph, this is the second variable. Finally, in a 3-D graph, it is the third variable.

In all of the following, *salary* is the analysis variable:

- **1-D.** `summary.sum(salary)`
- **2-D.** `summary.mean(jobcat*salary)`
- **3-D.** `summary.mean(jobcat*gender*salary)`

The previous rules apply only to algebra used in the `position` function. Algebra can be used elsewhere (as in the `color` and `label` functions), in which case the only variable in the algebra is the analysis variable. For example, in the following `ELEMENT` statement for a 2-D graph, the analysis variable is *salary* in the `position` function and the `label` function.

```
ELEMENT: interval(position(summary.mean(jobcat*salary)), label(summary.mean(salary)))
```

## Unity Variable

The unity variable (indicated by 1) is a placeholder in the algebra. It is not the same as the numeric value 1. When a scale is created for the unity variable, unity is located in the middle of the scale but no other values exist on the scale. The unity variable is needed only when there is no explicit variable in a specific dimension and you need to include the dimension in the algebra.

For example, assume a 2-D rectangular coordinate system. If you are creating a graph showing the count in each *jobcat* category, `summary.count(jobcat)` appears in the GPL specification. Counts are shown along the *y* axis, but there is no explicit variable in that dimension. If you want to panel the graph, you need to specify something in the second dimension before you can include the paneling variable. Thus, if you want to panel the graph by columns using `gender`, you need to change the specification to `summary.count(jobcat*1*gender)`. If you want to panel by rows instead, there would be another unity variable to indicate the missing third dimension. The specification would change to `summary.count(jobcat*1*1*gender)`.

You can't use the unity variable to compute statistics that require an analysis variable (like `summary.mean`). However, you can use it with count-based statistics (like `summary.count` and `summary.percent.count`).

## User Constants

The algebra can also include user constants, which are quoted string values (for example, `"2005"`). When a user constant is included in the algebra, it is like adding a new variable, with the variable's value equal to the constant for all cases. The effect of this depends on the algebra operators and the function in which the user constant appears.

In the position function, the constants can be used to create separate scales. For example, in the following GPL, two separate scales are created for the paneled graph. By nesting the values of each variable in a different string and blending the results, two different groups of cases with different scale ranges are created.

```
ELEMENT: line(position(date*(calls/"Calls"+orders/"Orders")))
```

For a full example, see "Line Chart with Separate Scales" on page 384.

If the cross operator is used instead of the nest operator, both categories will have the same scale range. The panel structures will also differ.

```
ELEMENT: line(position(date*calls*"Calls"+date*orders*"Orders"))
```

Constants can also be used in the position function to create a category of all cases when the constant is blended with a categorical variable. Remember that the value of the user constant is applied to all cases, so that's why the following works:

```
ELEMENT: interval(position(summary.mean((jobcat+"All")*salary)))
```

For a full example, see "Simple Bar Chart with Bar for All Categories" on page 334.

Aesthetic functions can also take advantage of user constants. Blending variables creates multiple graphic elements for the same case. To distinguish each group, you can mimic the blending in the aesthetic function—this time with user constants.

```
ELEMENT: point(position(jobcat*(salbegin+salary), color("Beginning"+"Current")))
```

User constants are not required to create most charts, so you can ignore them in the beginning. However, as you become more proficient with GPL, you may want to return to them to create custom graphs.

## How Coordinates and the GPL Algebra Interact

The algebra defines the dimensions of the graph. Each crossing results in an additional dimension. Thus, gender*jobcat*salary specifies three dimensions. How these dimensions are drawn depends on the coordinate system and any functions that may modify the coordinate system.

Some examples may clarify these concepts. The relevant GPL statements are extracted from the full specification.

### 1-D Graph

```
COORD: rect(dim(1))
ELEMENT: point(position(salary))
```

Full Specification

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
COORD: rect(dim(1))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: point(position(salary))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
COORD: rect(dim(1))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: point(position(salary))
```

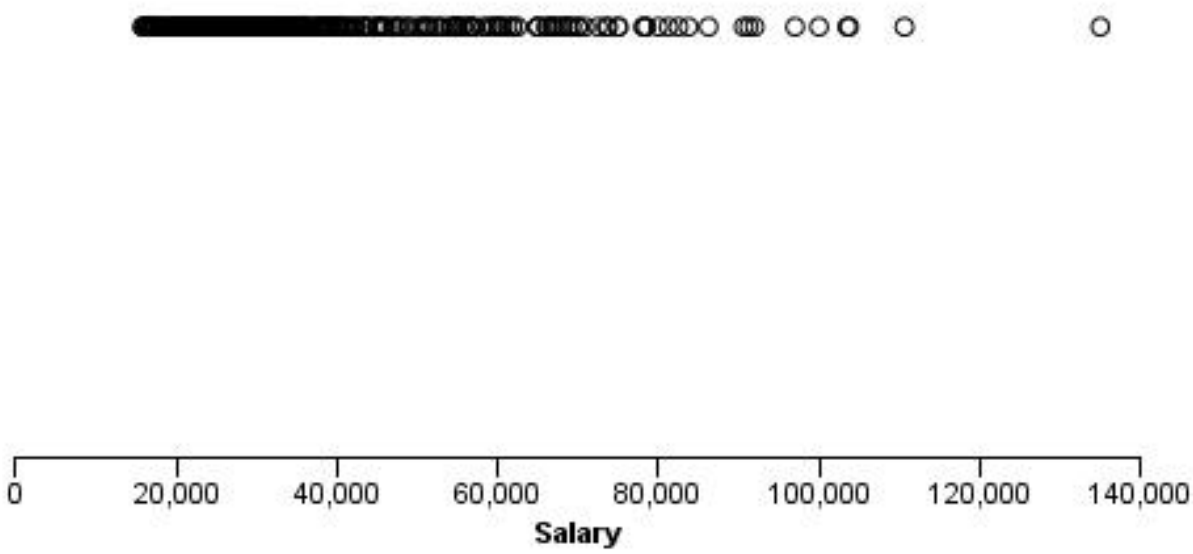


*Figure 3. Simple 1-D scatterplot*

- The coordinate system is explicitly set to one-dimensional, and only one variable appears in the algebra.
- The variable is plotted on one dimension.

## 2-D Graph

```
ELEMENT: point(position(salbegin*salary))
```

### Full Specification

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary))
```

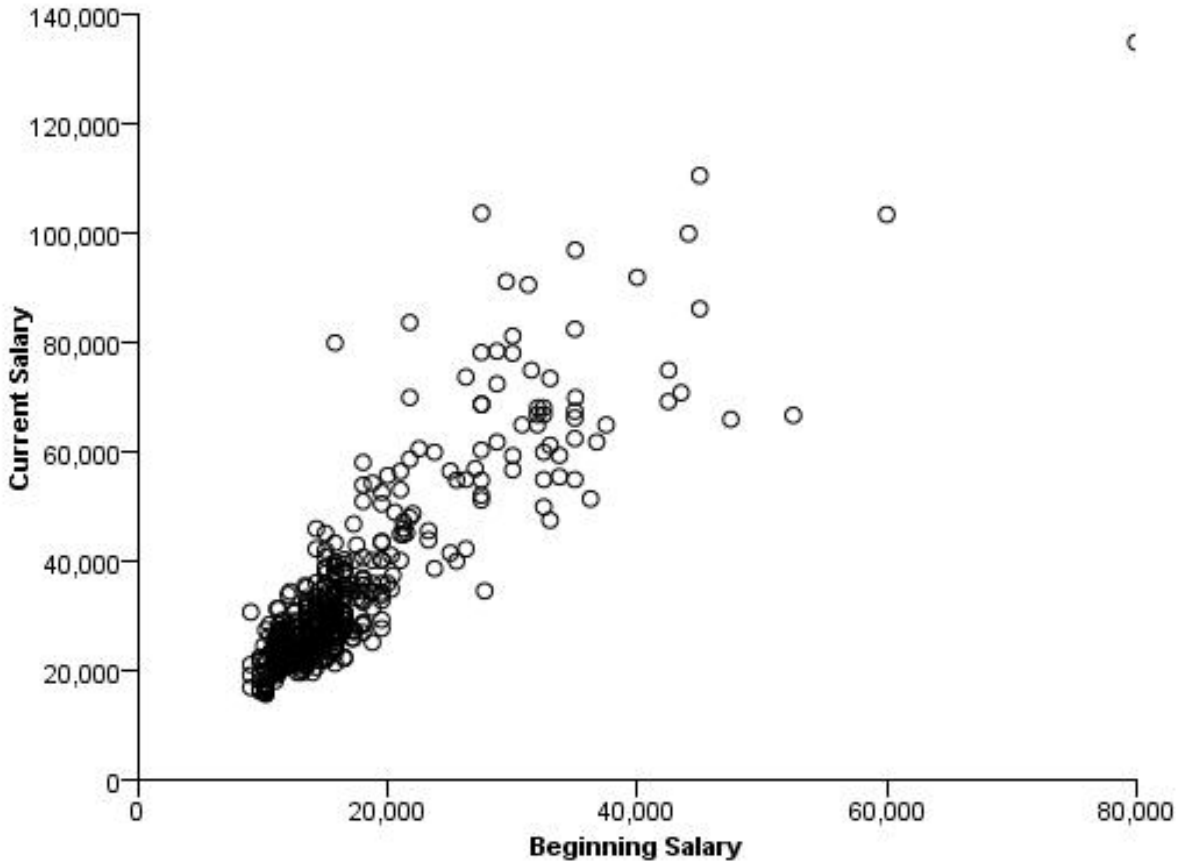


*Figure 4. Simple 2-D scatterplot*

- No coordinate system is specified, so it is assumed to be 2-D rectangular.
- The two crossed variables are plotted against each other.

## Another 2-D Graph

```
ELEMENT: interval(position(summary.count(jobcat)))
```

### Full Specification

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.count(jobcat)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.count(jobcat)))
```

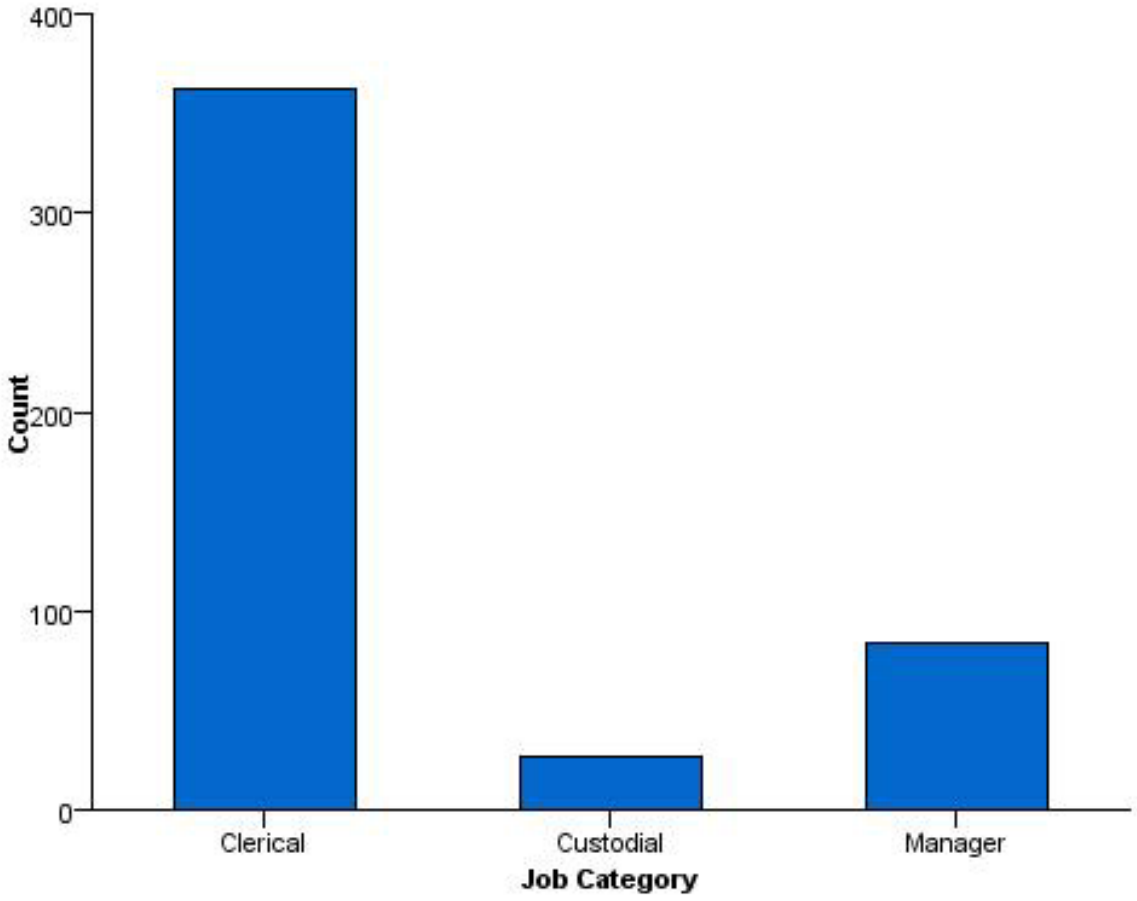


*Figure 5. Simple 2-D bar chart of counts*

- No coordinate system is specified, so it is assumed to be 2-D rectangular.
- Although there is only one variable in the specification, another for the result of the count statistic is implied (percent statistics behave similarly). The algebra could have been written as `jobcat*1`.
- The variable and the result of the statistic are plotted.

## A Faceted (Paneled) 2-D Graph

```
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)))
```

### Full Specification

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(3), label("Gender"))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
```

```
GUIDE: axis(dim(3), label("Gender"))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)))
```

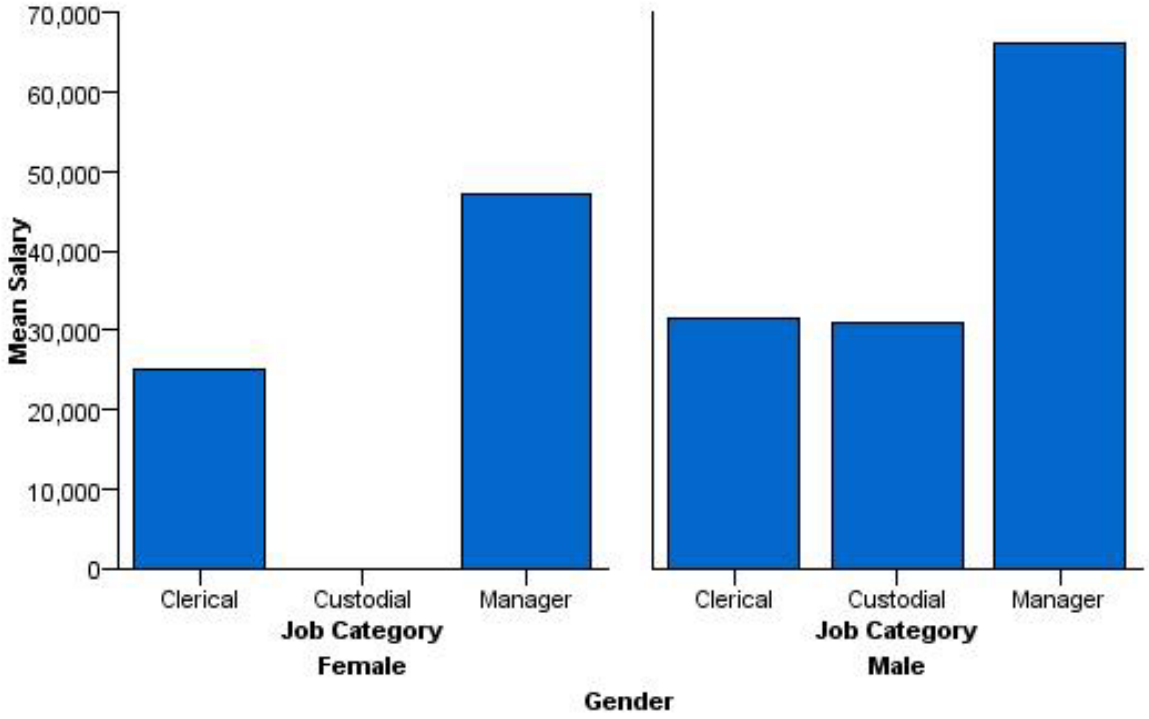


*Figure 6. Faceted 2-D bar chart*

- No coordinate system is specified, so it is assumed to be 2-D rectangular.
- There are three variables in the algebra, but only two dimensions. The last variable is used for faceting (also known as paneling).
- The second dimension variable in a 2-D chart is the analysis variable. That is, it is the variable on which the statistic is calculated.
- The first variable is plotted against the result of the summary statistic calculated on the second variable for each category in the faceting variable.

## A Faceted (Paneled) 2-D Graph with Nested Categories

```
ELEMENT: interval(position(summary.mean(jobcat/gender*salary)))
```

### Full Specification

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: linear(dim(2), include(0.0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1.1), label("Job Category"))
GUIDE: axis(dim(1), label("Gender"))
ELEMENT: interval(position(summary.mean(jobcat/gender*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
```

```
SCALE: linear(dim(2), include(0.0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1.1), label("Job Category"))
GUIDE: axis(dim(1), label("Gender"))
ELEMENT: interval(position(summary.mean(jobcat/gender*salary)))
```

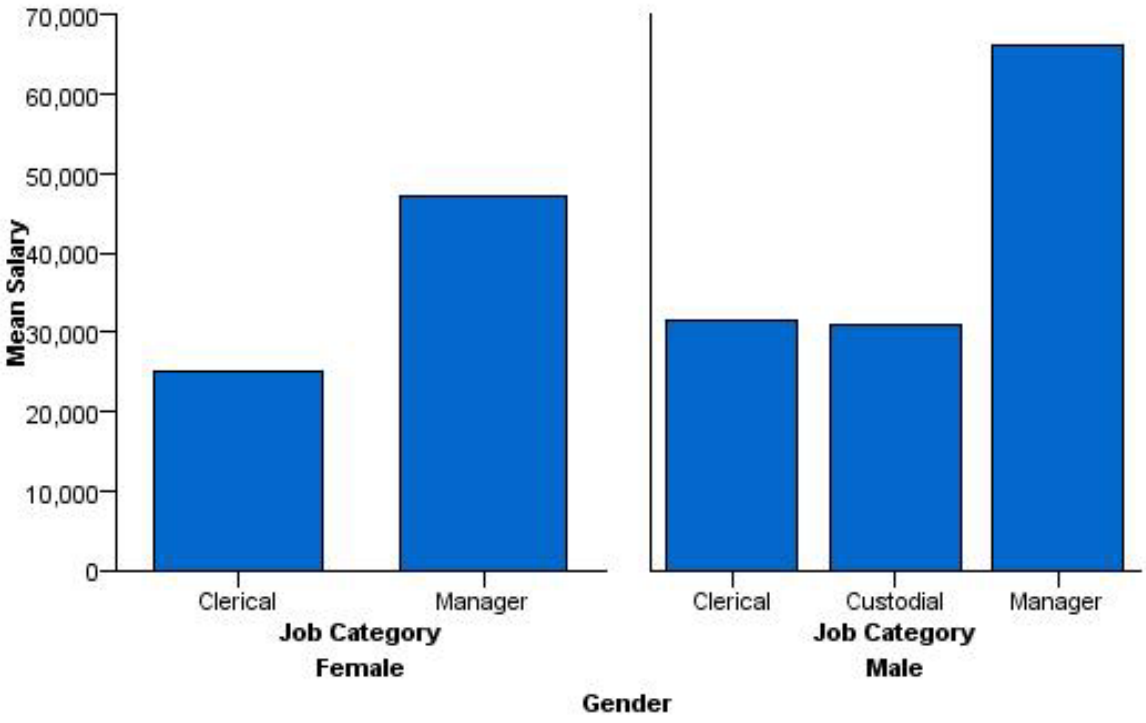


*Figure 7. Faceted 2-D bar chart with nested categories*

- This example is the same as the previous paneled example, except for the algebra.
- The second dimension variable is the same as in the previous example. Therefore, it is the variable on which the statistic is calculated.
- *jobcat* is nested in *gender*. Nesting always results in faceting, regardless of the available dimensions.
- With nested categories, only those combinations of categories that occur in the data are shown in the graph. In this case, there is no bar for *Female* and *Custodial* in the graph, because there is no case with this combination of categories in the data. Compare this result to the previous example that created facets by crossing categorical variables.

## A 3-D Graph

```
COORD: rect(dim(1,2,3))
ELEMENT: interval(position(summary.mean(jobcat*gender*salary)))
```

### Full Specification

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2,3))
SCALE: linear(dim(3), include(0))
GUIDE: axis(dim(3), label("Mean Salary"))
GUIDE: axis(dim(2), label("Gender"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*gender*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2,3))
SCALE: linear(dim(3), include(0))
GUIDE: axis(dim(3), label("Mean Salary"))
GUIDE: axis(dim(2), label("Gender"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*gender*salary)))
```

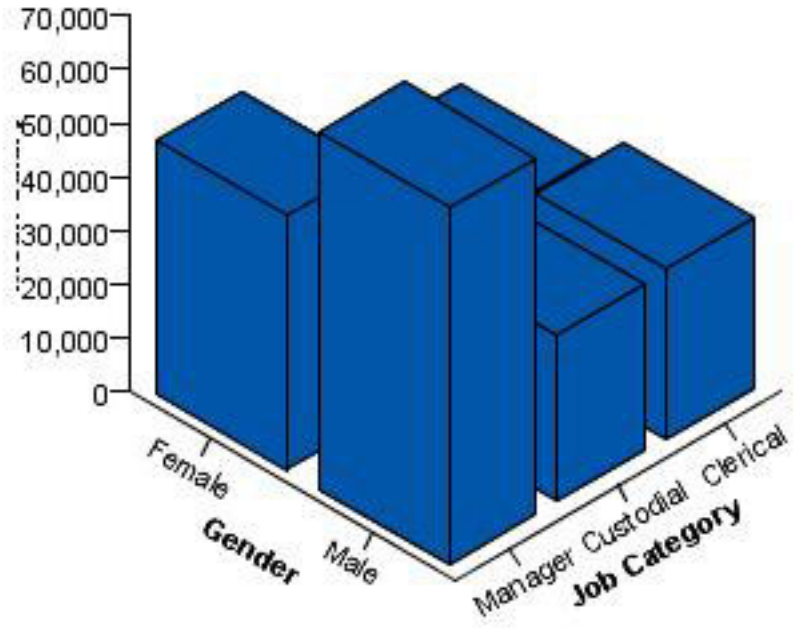


*Figure 8. 3-D bar chart*

- The coordinate system is explicitly set to three-dimensional, and there are three variables in the algebra.
- The three variables are plotted on the available dimensions.
- The *third* dimension variable in a 3-D chart is the analysis variable. This differs from the 2-D chart in which the second dimension variable is the analysis variable.

## A Clustered Graph

```
COORD: rect(dim(1,2), cluster(3))
ELEMENT: interval(position(summary.mean(gender*salary*jobcat)), color(gender))
```

Full Specification

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2), cluster(3))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Gender"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)), color(jobcat))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2), cluster(3))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Gender"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)), color(jobcat))
```

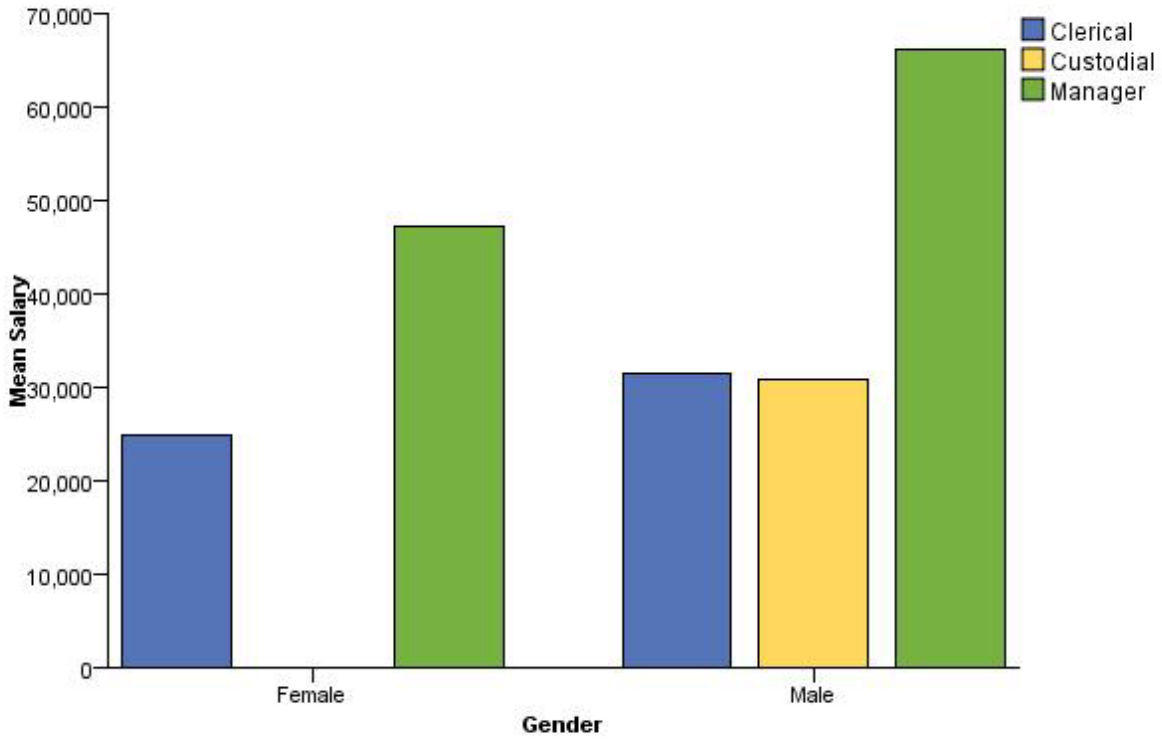


*Figure 9. Clustered 2-D bar chart*

- The coordinate system is explicitly set to two-dimensional, but it is modified by the `cluster` function.
- The `cluster` function indicates that clustering occurs along dim(3), which is the dimension associated with *jobcat* because it is the third variable in the algebra.
- The variable in dim(1) identifies the variable whose values determine the bars in each cluster. This is *gender*.
- Although the coordinate system was modified, this is still a 2-D chart. Therefore, the analysis variable is still the second dimension variable.
- The variables are plotted using the modified coordinate system. Note that the graph would be a paneled graph if you removed the `cluster` function. The charts would look similar and show the same results, but their coordinate systems would differ. Refer back to the paneled 2-D graph to see the difference.

## Common Tasks

This section provides information for adding common graph features. This GPL creates a simple 2-D bar chart. You can apply the steps to any graph, but the examples use the GPL in “The Basics” on page 1 as a "baseline."

## How to Add Stacking to a Graph

Stacking involves a couple of changes to the `ELEMENT` statement. The following steps use the GPL shown in “The Basics” on page 1 as a "baseline" for the changes.

1. Before modifying the `ELEMENT` statement, you need to define an additional *categorical* variable that will be used for stacking. This is specified by a `DATA` statement (note the `unit.category()` function):

   ```
   DATA: gender=col(source(s), name("gender"), unit.category())
   ```

2. The first change to the `ELEMENT` statement will split the graphic element into color groups for each *gender* category. This splitting results from using the `color` function:

   ```
   ELEMENT: interval(position(summary.mean(jobcat*salary)), color(gender))
   ```

3. Because there is no collision modifier for the interval element, the groups of bars are overlaid on each other, and there's no way to distinguish them. In fact, you may not even see graphic elements for one of the groups because the other graphic elements obscure them. You need to add the stacking collision modifier to re-position the groups (we also changed the statistic because stacking summed values makes more sense than stacking the mean values):

```
ELEMENT: interval.stack(position(summary.sum(jobcat*salary)), color(gender))
```

The complete GPL is shown below:

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: linear(dim(2), include(0.0))
GUIDE: axis(dim(2), label("Sum Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval.stack(position(summary.sum(jobcat*salary)), color(gender))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: linear(dim(2), include(0.0))
GUIDE: axis(dim(2), label("Sum Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval.stack(position(summary.sum(jobcat*salary)), color(gender))
```

Following is the graph created from the GPL.

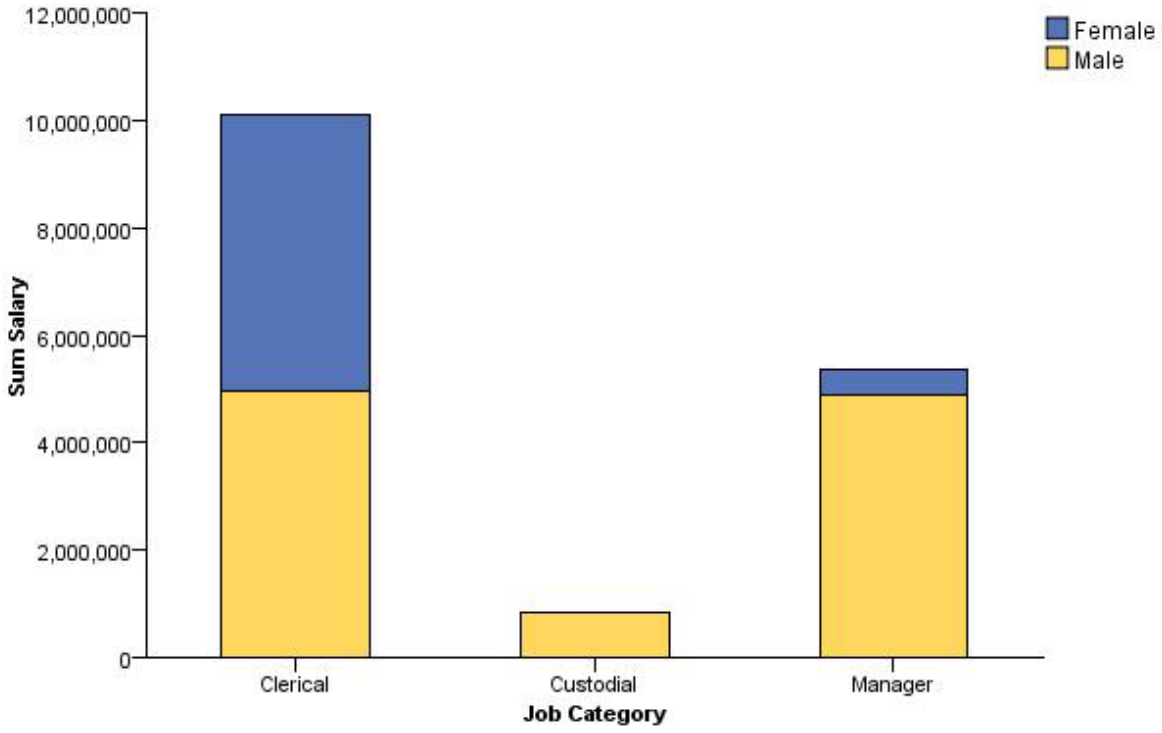


*Figure 10. Stacked bar chart*

### Legend Label

The graph includes a legend, but it has no label by default. To add or change the label for the legend, you use a `GUIDE` statement:

```
GUIDE: legend(aesthetic(aesthetic.color), label("Gender"))
```

## How to Add Faceting (Paneling) to a Graph

Faceted variables are added to the algebra in the `ELEMENT` statement. The following steps use the GPL shown in "The Basics" on page 1 as a "baseline" for the changes.

1. Before modifying the `ELEMENT` statement, we need to define an additional *categorical* variable that will be used for faceting. This is specified by a `DATA` statement (note the `unit.category()` function):

   ```
   DATA: gender=col(source(s), name("gender"), unit.category())
   ```

2. Now we add the variable to the algebra. We will cross the variable with the other variables in the algebra:

```
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)))
```

Those are the only necessary steps. The final GPL is shown below.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: linear(dim(2), include(0.0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
```

```
SCALE: linear(dim(2), include(0.0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)))
```

Following is the graph created from the GPL.

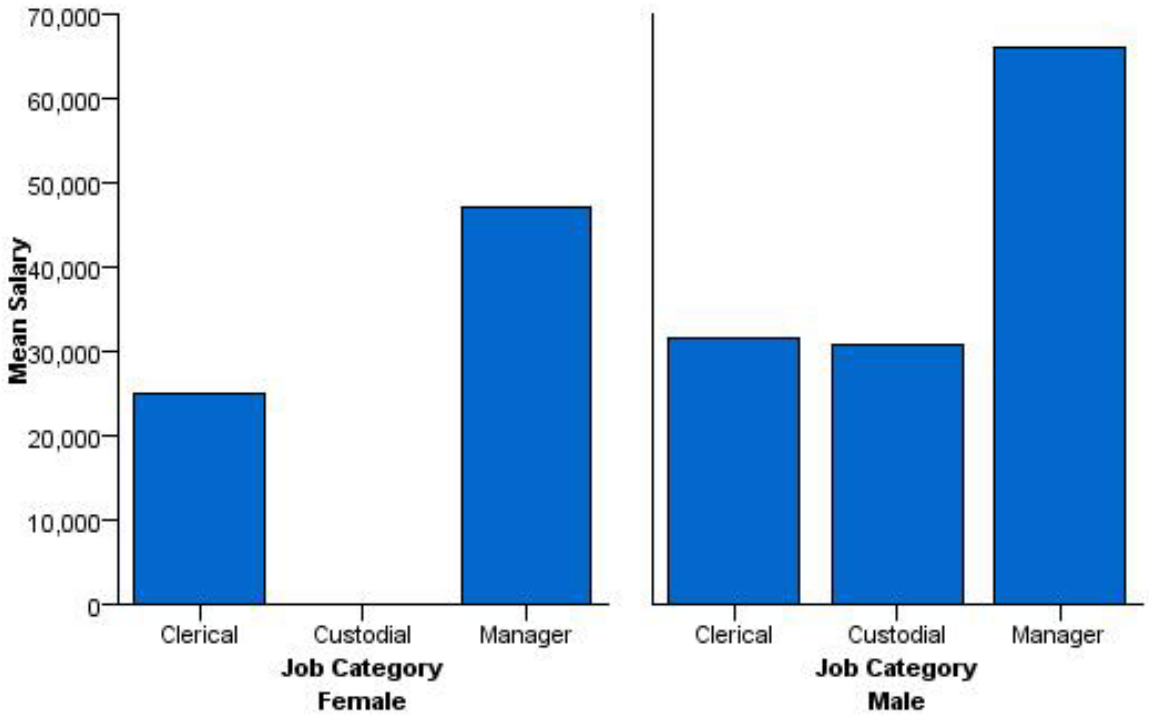


*Figure 11. Faceted bar chart*

## Additional Features

**Labeling.** If you want to label the faceted dimension, you treat it like the other dimensions in the graph by adding a `GUIDE` statement for its axis:

```
GUIDE: axis(dim(3), label("Gender"))
```

In this case, it is specified as the 3rd dimension. You can determine the dimension number by counting the crossed variables in the algebra. *gender* is the 3rd variable.

**Nesting.** Faceted variables can be nested as well as crossed. Unlike crossed variables, the nested variable is positioned next to the variable in which it is nested. So, to nest *gender* in *jobcat*, you would do the following:

```
ELEMENT: interval(position(summary.mean(jobcat/gender*salary)))
```

Because *gender* is used for nesting, it is not the 3rd dimension as it was when crossing to create facets. You can't use the same simple counting method to determine the dimension number. You still count the crossings, but you count each crossing *as a single factor*. The number that you obtain by counting each crossed factor is used for the nested variable (in this case, *1*). The other dimension is indicated by the nested variable dimension followed by a dot and the number 1 (in this case, *1.1*). So, you would use the following convention to refer to the *gender* and *jobcat* dimensions in the `GUIDE` statement:

```
GUIDE: axis(dim(1), label("Gender"))
GUIDE: axis(dim(1.1), label("Job Category"))
GUIDE: axis(dim(2), label("Mean Salary"))
```

## How to Add Clustering to a Graph

Clustering involves changes to the COORD statement and the ELEMENT statement. The following steps use the GPL shown in "The Basics" on page 1 as a "baseline" for the changes.

1. Before modifying the COORD and ELEMENT statements, you need to define an additional *categorical* variable that will be used for clustering. This is specified by a DATA statement (note the unit.category() function):

   ```
   DATA: gender=col(source(s), name("gender"), unit.category())
   ```

2. Now you will modify the COORD statement. If, like the baseline graph, the GPL does not already include a COORD statement, you first need to add one:

   ```
   COORD: rect(dim(1,2))
   ```

   In this case, the default coordinate system is now explicit.

3. Next add the cluster function to the coordinate system and specify the clustering dimension. In a 2-D coordinate system, this is the third dimension:

   ```
   COORD: rect(dim(1,2), cluster(3))
   ```

4. Now we add the clustering dimension variable to the algebra. This variable is in the 3rd position, corresponding to the clustering dimension specified by the cluster function in the COORD statement:

   ```
   ELEMENT: interval(position(summary.mean(jobcat*salary*gender)))
   ```

   Note that this algebra looks similar to the algebra for faceting. Without the cluster function added in the previous step, the resulting graph would be faceted. The cluster function essentially collapses the faceting into one axis. Instead of a facet for each *gender* category, there is a cluster on the *x* axis for each category.

5. Because clustering changes the dimensions, we update the GUIDE statement so that it corresponds to the clustering dimension.

   ```
   GUIDE: axis(dim(3), label("Gender"))
   ```

6. With these changes, the chart is clustered, but there is no way to distinguish the bars in each cluster. You need to add an aesthetic to distinguish the bars:

```
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)), color(jobcat))
```

The complete GPL looks like the following.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2), cluster(3))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Gender"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)), color(jobcat))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2), cluster(3))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Gender"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)), color(jobcat))
```

Following is the graph created from the GPL.

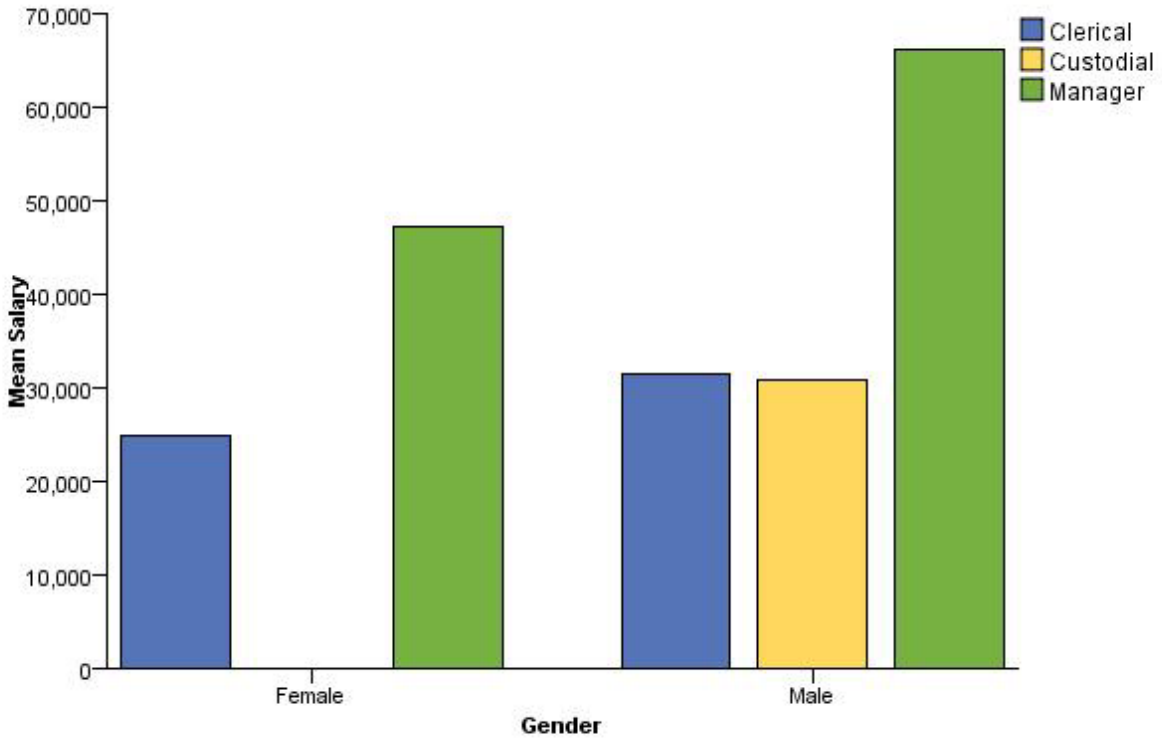


*Figure 12. Clustered bar chart*

### Legend Label

The graph includes a legend, but it has no label by default. To change the label for the legend, you use a `GUIDE` statement:

```
GUIDE: legend(aesthetic(aesthetic.color), label("Gender"))
```

## How to Use Aesthetics

GPL includes several different aesthetic functions for controlling the appearance of a graphic element. The simplest use of an aesthetic function is to define a uniform aesthetic for every instance of a graphic element. For example, you can use the `color` function to assign a color constant (like `color.red`) to the point element, thereby making *all* of the points in the graph red.

A more interesting use of an aesthetic function is to change the value of the aesthetic based on the value of another variable. For example, instead of a uniform color for the scatterplot points, the color could vary based on the value of the categorical variable *gender*. All of the points in the *Male* category will be one color, and all of the points in the *Female* category will be another. Using a categorical variable for an aesthetic creates groups of cases. In addition to identifying the graphic elements for the groups of cases, the grouping allows you to evaluate statistics for the individual groups, if needed.

An aesthetic may also vary based on a set of continuous values. Using continuous values for the aesthetic does not result in distinct groups of graphic elements. Instead, the aesthetic varies along the same continuous scale. There are no distinct groups on the scale, so the color varies gradually, just as the continuous values do.

The steps below use the following GPL as a "baseline" for adding the aesthetics. This GPL creates a simple scatterplot.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary))
```

*Figure 13. Baseline GPL for example*

1. First, you need to define an additional *categorical* variable that will be used for one of the aesthetics. This is specified by a `DATA` statement (note the `unit.category()` function):

   ```
   DATA: gender=col(source(s), name("gender"), unit.category())
   ```

2. Next you need to define another variable, this one being *continuous*. It will be used for the other aesthetic.

   ```
   DATA: prevexp=col(source(s), name("prevexp"))
   ```

3. Now you will add the aesthetics to the graphic element in the `ELEMENT` statement. First add the aesthetic for the categorical variable:

   ```
   ELEMENT: point(position(salbegin*salary), shape(gender))
   ```

   Shape is a good aesthetic for the categorical variable. It has distinct values that correspond well to categorical values.

4. Finally add the aesthetic for the continuous variable:

   ```
   ELEMENT: point(position(salbegin*salary), shape(gender), color(prevexp))
   ```

   Not all aesthetics are available for continuous variables. That's another reason why shape was a good aesthetic for the categorical variable. Shape is not available for continuous variables because there aren't enough shapes to cover a continuous spectrum. On the other hand, color gradually changes in the graph. It can capture the full spectrum of continuous values. Transparency or brightness would also work well.

The complete GPL looks like the following.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin = col(source(s), name("salbegin"))
DATA: salary = col(source(s), name("salary"))
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: prevexp = col(source(s), name("prevexp"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary), shape(gender), color(prevexp))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin = col(source(s), name("salbegin"))
DATA: salary = col(source(s), name("salary"))
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: prevexp = col(source(s), name("prevexp"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary), shape(gender), color(prevexp))
```

Following is the graph created from the GPL.

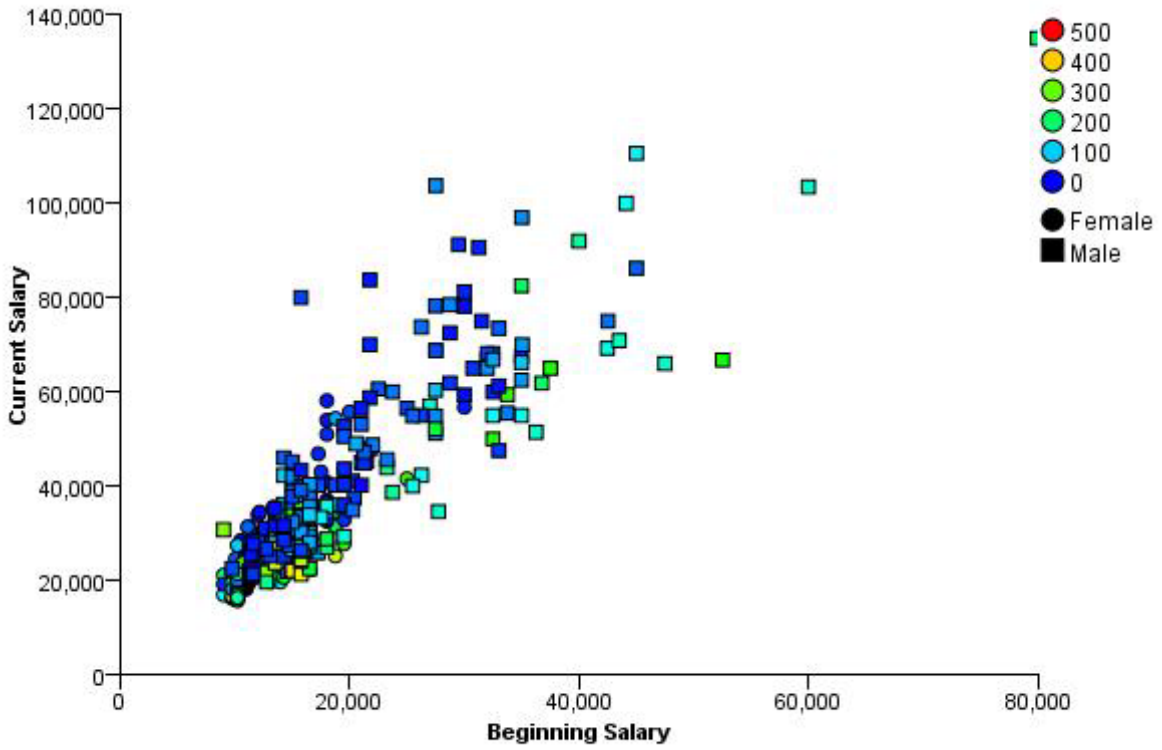


*Figure 14. Scatterplot with aesthetics*

## Legend Label

The graph includes legends, but the legends have no labels by default. To change the labels, you use `GUIDE` statements that reference each aesthetic:

```
GUIDE: legend(aesthetic(aesthetic.shape), label("Gender"))
GUIDE: legend(aesthetic(aesthetic.color), label("Previous Experience"))
```

When interpreting the color legend in the example, it's important to realize that the color aesthetic corresponds to a continuous variable. Only a handful of colors may be shown in the legend, and these colors do not reflect the whole spectrum of colors that could appear in the graph itself. They are more like mileposts at major divisions.

# Chapter 2. GPL Statement and Function Reference

This section provides detailed information about the various statements that make up GPL and the functions that you can use in each of the statements.

## GPL Statements

There are general categories of GPL statements.

**Data definition statements**. Data definition statements specify the data sources, variables, and optional variable transformations. All GPL code blocks include at least two data definition statements: one to define the actual data source and one to specify the variable extracted from the data source.

**Specification statements**. Specification statements define the graph. They define the axis scales, coordinate systems, text, graphic elements (for example, bars and points), and statistics. All GPL code blocks require at least one `ELEMENT` statement, but the other specification statements are optional. GPL uses a default value when the `SCALE`, `COORD`, and `GUIDE` statements are not included in the GPL code block.

**Control statements**. Control statements specify the layout for graphs. The `GRAPH` statement allows you to group multiple graphs in a single page display. For example, you may want to add histograms to the borders on a scatterplot. The `PAGE` statement allows you to set the size of the overall visualization. Control statements are optional.

**Comment statement**. The `COMMENT` statement is used for adding comments to the GPL. These are optional.

**Data Definition Statements**

"SOURCE Statement" on page 23
"DATA Statement" on page 24
"TRANS Statement" on page 24

**Specification Statements**

"COORD Statement" on page 25
"SCALE Statement" on page 29
"GUIDE Statement" on page 41
"ELEMENT Statement" on page 46

**Control Statements**

"PAGE Statement" on page 22
"GRAPH Statement" on page 22

**Comment Statements**

"COMMENT Statement"

## COMMENT Statement

Syntax

```
COMMENT: <text>
```

**<text>**. The comment text. This can consist of any string of characters except a statement label followed by a colon (:), unless the statement label and colon are enclosed in quotes (for example, `COMMENT: With "SCALE:" statement`).

Description

This statement is optional. You can use it to add comments to your GPL or to comment out a statement by converting it to a comment. The comment does not appear in the resulting graph.

Examples

```
COMMENT: This graph shows counts for each job category.
```

*Figure 15. Defining a comment*

## PAGE Statement

Syntax

```
PAGE: <function>
```

**<function>**. A function for specifying the PAGE statements that mark the beginning and end of the visualization.

Description

This statement is optional. It's needed only when you specify a size for the page display or visualization. The current release of GPL supports only one PAGE block.

If you are using GRAPH blocks in a PAGE block, note the following:

- SOURCE and DATA statements must appear directly in the PAGE block, followed by the GRAPH blocks. (See the second example, "Defining a page with multiple graphs.")
- TRANS, COORD, SCALE, GUIDE, and ELEMENT statements cannot appear directly in the PAGE block. These statements apply to individual graphs and must appear in the GRAPH block to which they apply.

Examples

```
PAGE: begin(scale(400px,300px))
SOURCE: s=csvSource(file("mydata.csv"))
DATA: x=col(source(s), name("x"))
DATA: y=col(source(s), name("y"))
ELEMENT: line(position(x*y))
PAGE: end()
```

*Figure 16. Example: Defining a page*

```
PAGE: begin(scale(400px,300px))
SOURCE: s=csvSource(file("mydata.csv"))
DATA: a=col(source(s), name("a"))
DATA: b=col(source(s), name("b"))
DATA: c=col(source(s), name("c"))
GRAPH: begin(scale(90%, 45%), origin(10%, 50%))
ELEMENT: line(position(a*c))
GRAPH: end()
GRAPH: begin(scale(90%, 45%), origin(10%, 0%))
ELEMENT: line(position(b*c))
GRAPH: end()
PAGE: end()
```

*Figure 17. Example: Defining a page with multiple graphs*

**Valid Functions**

“begin Function (For GPL Pages)” on page 69

“end Function” on page 125

## GRAPH Statement

Syntax

```
GRAPH: <function>
```

**<function>**. A function for specifying the GRAPH statements that mark the beginning and end of the individual graph.

Description

This statement is optional. It's needed only when you want to group multiple graphs in a single page display or you want to customize a graph's size. The GRAPH statement is essentially a wrapper around the GPL that defines a particular graph. There is no limit to the number of graphs that can appear in a GPL block.

Grouping graphs is useful for related graphs, like graphs on the borders of histograms. However, the graphs do not have to be related. You may simply want to group the graphs for presentation.

For information about organization of statements when there are multiple GRAPH statements, see "PAGE Statement" on page 22.

Examples

```
GRAPH: begin(scale(50%,50%))
```

*Figure 18. Scaling a graph*

```
GRAPH: begin(origin(10.0%, 20.0%), scale(80.0%, 80.0%))
ELEMENT: point(position(salbegin*salary))
GRAPH: end()
GRAPH: begin(origin(10.0%, 100.0%), scale(80.0%, 10.0%))
ELEMENT: interval(position(summary.count(bin.rect(salbegin))))
GRAPH: end()
GRAPH: begin(origin(90.0%, 20.0%), scale(10.0%, 80.0%))
COORD: transpose()
ELEMENT: interval(position(summary.count(bin.rect(salary))))
GRAPH: end()
```

*Figure 19. Example: Scatterplot with border histograms*

**Valid Functions**

"begin Function (For GPL Graphs)" on page 69

"end Function" on page 125

## SOURCE Statement

Syntax

```
SOURCE: <source name> = <function>
```

**<source name>**. User-defined name for the data source. Refer to "GPL Syntax Rules" on page 3 for information about which characters you can use in the name.

**<function>**. A function for extracting data from various data sources.

Description

Defines a data source for the graph. There can be multiple data sources, each specified by a different SOURCE statement.

Examples

```
SOURCE: mydata = csvSource(path("/Data/demo.csv"))
```

*Figure 20. Example: Reading a CSV file*

**Valid Functions**

"csvSource Function" on page 92
"savSource Function" on page 216
"sqlSource Function" on page 243
"userSource Function" on page 324

## DATA Statement

Syntax

```
DATA: <variable name> = <function>
```

**<variable name>**. User-defined name for the variable. Refer to "GPL Syntax Rules" on page 3 for information about which characters you can use in the name.

**<function>**. A function indicating the data sources.

Description

Defines a variable from a specific data source. The GPL statement must also include a `SOURCE` statement. The name identified by the `SOURCE` statement is used in the `DATA` statement to indicate the data source from which a particular variable is extracted.

Examples

```
DATA: age = col(source(mydata), name("age"))
```

*Figure 21. Example: Specifying a variable from a data source*

*age* is an arbitrary name. In this example, the variable name is the same as the name that appears in the data source. Using the same name avoids confusion. The *col* function takes a data source and data source variable name as its arguments. Note that the data source name was previously defined by a `SOURCE` statement and is not enclosed in quotes.

**Valid Functions**

"col Function" on page 84
"iter Function" on page 136

## TRANS Statement

Syntax

```
TRANS: <variable name> = <function>
```

**<variable name>**. A string that specifies a name for the variable that is created as a result of the transformation. Refer to "GPL Syntax Rules" on page 3 for information about which characters you can use in the name.

**<function>**. A valid function.

Description

Defines a new variable whose value is the result of a data transformation function.

Examples

```
TRANS: saldiff = eval(((salary-salbegin)/salary)*100)
```

*Figure 22. Example: Creating a transformation variable from other variables*

```
TRANS: casenum = index()
```

*Figure 23. Example: Creating an index variable*

**Valid Functions**

"collapse Function" on page 85
"eval Function" on page 126
"index Function" on page 136

## COORD Statement

Syntax

```
COORD: <coord>
```

**<coord>**. A valid coordinate type or transformation function.

Description

Specifies a coordinate system for the graph. You can also embed coordinate systems or wrap a coordinate system in a transformation. When transformations and coordinate systems are embedded in each other, they are applied in order, with the innermost being applied first. Thus, `mirror(transpose(rect(1,2)))` specifies that a 2-D rectangular coordinate system is transposed and then mirrored.

Examples

```
COORD: polar.theta()
```

*Figure 24. Example: Polar coordinates for pie charts*

```
COORD: rect(dim(1,2,3))
```

*Figure 25. Example: 3-D rectangular coordinates*

```
COORD: rect(dim(2), polar.theta(dim(1)))
```

*Figure 26. Example: Embedded coordinate systems for paneled pie chart*

```
COORD: transpose()
```

*Figure 27. Example: Transposed coordinate system*

**Coordinate Types and Transformations**

"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28
"mirror Function" on page 186
"project Function" on page 194
"reflect Function" on page 195
"transpose Function" on page 323
"wrap Function" on page 327

### GPL Coordinate Types

There are several coordinate types available in GPL.

**Coordinate Types**

"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26

"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28

**parallel Coordinate Type:** Syntax

```
parallel(dim(<numeric>), <coord>)
```

**<numeric>**. One or more numeric values (separated by commas) indicating the graph dimension or dimensions to which the parallel coordinate system applies. The number of values equals the number of dimensions for the coordinate system's frame, and the values are always in sequential order. For example, `parallel(dim(1,2,3,4))` indicates that the first four variables in the algebra are used for the parallel coordinates. Any others are used for faceting. If no dimensions are specified, all variables are used for the parallel coordinates. See the topic "dim Function" on page 124 for more information.

**<coord>**. A valid coordinate type or transformation function. This is optional.

Description

Creates a parallel coordinate system. A graph using this coordinate system consists of multiple, parallel axes showing data across multiple variables, resulting in a plot that is similar to a profile plot.

When you use a parallel coordinate system, you cross each continuous variable in the algebra. A line graphic element is the most common element type for this graph. The graphic element is always distinguished by some aesthetic so that any patterns are readily apparent.

Examples

```
TRANS: caseid = index()
COORD: parallel()
ELEMENT: line(position(var1*var2*var3*var4), split(caseid), color(catvar1))
```

The example includes the `split` function to create a separate line for each case in the data. Otherwise, there would be only one line that crossed back through the coordinate system to connect all the cases.

*Figure 28. Example: Parallel coordinates graph*

**Coordinate Types and Transformations**

"polar Coordinate Type"
"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28
"mirror Function" on page 186
"project Function" on page 194
"reflect Function" on page 195
"transpose Function" on page 323
"wrap Function" on page 327

**Applies To**

"COORD Statement" on page 25
"polar Coordinate Type"
"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28
"project Function" on page 194

**polar Coordinate Type:** Syntax

```
polar(dim(<numeric>), <function>, <coord>)
```

**<numeric>**. Numeric values (separated by commas) indicating the dimensions to which the polar coordinates apply. This is optional and is assumed to be the first two dimensions. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<coord>**. A valid coordinate type or transformation function. This is optional.

Description

Creates a polar coordinate system. This differs from the polar.theta coordinate system in that it is two dimensional. One dimension is associated with the radius, and the other is associated with the theta angle.

Examples

```
COORD: polar()
ELEMENT: line(position(date*close), closed(), preserveStraightLines())
```

*Figure 29. Example: Polar line chart*

**Valid Functions**

"reverse Function" on page 214
"startAngle Function" on page 244

**Coordinate Types and Transformations**

"parallel Coordinate Type" on page 26
"polar.theta Coordinate Type"
"rect Coordinate Type" on page 28
"mirror Function" on page 186
"project Function" on page 194
"reflect Function" on page 195
"transpose Function" on page 323
"wrap Function" on page 327

**Applies To**

"COORD Statement" on page 25
"parallel Coordinate Type" on page 26
"polar.theta Coordinate Type"
"rect Coordinate Type" on page 28
"project Function" on page 194

**polar.theta Coordinate Type:** Syntax

```
polar.theta(<function>, <coord>)
```

**<numeric>**. A numeric value indicating the dimension. This is optional and required only when `polar.theta` is not the first or innermost dimension. Otherwise, it is assumed to be the first dimension. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<coord>**. A valid coordinate type or transformation function. This is optional.

Description

Creates a polar.theta coordinate system, which is the coordinate system for creating pie charts. polar.theta differs from the polar coordinate system in that it is one dimensional. This is the dimension for the theta angle.

Examples

```
COORD: polar.theta()
ELEMENT: interval.stack(position(summary.count()), color(jobcat))
```

*Figure 30. Example: Pie chart*

**Valid Functions**

“reverse Function” on page 214
“startAngle Function” on page 244

**Coordinate Types and Transformations**

“parallel Coordinate Type” on page 26
“polar Coordinate Type” on page 26
“rect Coordinate Type”
“mirror Function” on page 186
“project Function” on page 194
“reflect Function” on page 195
“transpose Function” on page 323
“wrap Function” on page 327

**Applies To**

“COORD Statement” on page 25
“parallel Coordinate Type” on page 26
“polar Coordinate Type” on page 26
“rect Coordinate Type”
“project Function” on page 194

**rect Coordinate Type:** Syntax

```
rect(dim(<numeric>), <function>, <coord>)
```

**<numeric>**. One or more numeric values (separated by commas) indicating the graph dimension or dimensions to which the rectangular coordinate system applies. The number of values equals the number of dimensions for the coordinate system's frame, and the values are always in sequential order (for example, `dim(1,2,3)` and `dim(4,5)`). See the topic “dim Function” on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<coord>**. A valid coordinate type or transformation function. This is optional.

Description

Creates a rectangular coordinate system. By default, a rectangular coordinate system is 2-D, which is the equivalent of specifying `rect(dim(1,2))`. To create a 3-D coordinate system, use `rect(dim(1,2,3))`. Similarly, use `rect(dim(1))` to specify a 1-D coordinate system. Changing the coordinate system also changes which variable in the algebra is summarized for a statistic. The statistic function is calculated on the second crossed variable in a 2-D coordinate system and the third crossed variable in a 3-D coordinate system.

Examples

```
COORD: rect(dim(1,2))
ELEMENT: interval(position(summary.mean(jobcat*salary)))
```

*Figure 31. Example: 2-D bar chart*

```
COORD: rect(dim(1,2,3))
ELEMENT: interval(position(summary.mean(jobcat*gender*salary)))
```

*Figure 32. Example: 3-D bar chart*

**Valid Functions**

"cluster Function" on page 82
"sameRatio Function" on page 215

**Coordinate Types and Transformations**

"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"mirror Function" on page 186
"project Function" on page 194
"reflect Function" on page 195
"transpose Function" on page 323
"wrap Function" on page 327

**Applies To**

"COORD Statement" on page 25
"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"project Function" on page 194

## SCALE Statement

Syntax

```
SCALE: <scale type>
```

*or*

```
SCALE: <scale name> = <scale type>
```

**<scale type>**. A valid scale type.

**<scale name>**. A user-defined name for the scale. This is required only when you are creating a graph with dual scales. An example is a graph that shows the mean of a variable on one axis and the count on the other. The scale name is referenced by an axis and a graphic element to indicate which scale is associated with the axis and graphic element. Refer to "GPL Syntax Rules" on page 3 for information about which characters you can use in the name.

Description

Defines the scale for a particular dimension or aesthetic (such as color).

Examples

```
SCALE: linear(dim(2), max(50000))
```

*Figure 33. Example: Specifying a linear dimension scale*

```
SCALE: log(aesthetic(aesthetic.color))
ELEMENT: point(position(x*y), color(z))
```

*Figure 34. Example: Specifying a log aesthetic scale*

```
SCALE: y1 = linear(dim(2))
SCALE: y2 = linear(dim(2))
GUIDE: axis(dim(1), label("Employment Category"))
GUIDE: axis(scale(y1), label("Mean Salary"))
GUIDE: axis(scale(y2), label("Count"), opposite(), color(color.red))
ELEMENT: interval(scale(y1), position(summary.mean(jobcat*salary)))
ELEMENT: line(scale(y2), position(summary.count(jobcat)), color(color.red))
```

*Figure 35. Example: Creating a graph with dual scales*

**Scale Types**



## GPL Scale Types

There are several scale types available in GPL.

**Scale Types**



**asn Scale:** Syntax

```
asn(dim(<numeric>), <function>)
```

*or*

```
asn(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

Description

Creates an arcsine scale. Data values for this scale must fall in the closed interval [0, 1]. That is, for any data value $x$, $0 \leq x \leq 1$.

Example

```
SCALE: asn(dim(1))
```

*Figure 36. Example: Specifying an arcsine scale*

**Valid Functions**

"aestheticMaximum Function" on page 63

"aestheticMinimum Function" on page 64

"aestheticMissing Function" on page 65

**Applies To**

"SCALE Statement" on page 29

**atanh Scale:** Syntax

```
atanh(dim(<numeric>), <function>)
```

*or*

```
atanh(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

Description

Creates a Fisher's $z$ scale (also called the hyberbolic arctangent scale). Data values for this scale must fall in the open interval (-1, 1). That is, for any data value $x$, $-1 < x < 1$.

Example

```
SCALE: atanh(dim(1))
```

*Figure 37. Example: Specifying a Fisher's z scale*

**Valid Functions**

"aestheticMaximum Function" on page 63

"aestheticMinimum Function" on page 64

"aestheticMissing Function" on page 65

**Applies To**

"SCALE Statement" on page 29

**cat Scale:** Syntax

```
cat(dim(<numeric>), <function>)
```

*or*

```
cat(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function in the `ELEMENT` statement, often used for distinguishing groups of graphic elements, as in clusters and stacks.

Description

Creates a categorical scale that can be associated with a dimension (such as an axis or panel facet) or an aesthetic (as in the legend). A categorical scale is created for a categorical variable by default. You usually don't need to specify the scale unless you want to use a function to modify it (for example, to sort the categories).

Examples

```
SCALE: cat(dim(1), sort.natural())
```

*Figure 38. Example: Specifying the scale for a dimension and sorting categories*

```
SCALE: cat(aesthetic(aesthetic.color), include("IL"))
```

*Figure 39. Example: Specifying the scale for an aesthetic and including categories*

*Note*: The `exclude` function is not supported for aesthetic scales.

**Valid Functions**

"aestheticMissing Function" on page 65
"exclude Function" on page 130
"include Function" on page 135
"map Function" on page 184
"reverse Function" on page 214
"sort.data Function" on page 241
"sort.natural Function" on page 241
"sort.statistic Function" on page 242
"sort.values Function" on page 242

**Applies To**

"SCALE Statement" on page 29

**cLoglog Scale:** Syntax

```
cLoglog(dim(<numeric>), <function>)
```

*or*

```
cLoglog(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

Description

Creates a complementary log-log-transformed scale (also called a Weibull scale). The formula for the transformation is `log(log(1/(1-x))`. Data values for this scale must fall in the open interval (0, 1). That is, for any data value $x$, $0 < x < 1$.

Example

```
SCALE: cLoglog(dim(2))
```

*Figure 40. Example: Specifying a Weibull scale*

**Valid Functions**

"aestheticMaximum Function" on page 63
"aestheticMinimum Function" on page 64
"aestheticMissing Function" on page 65
"dataMaximum Function" on page 92
"dataMinimum Function" on page 93
"include Function" on page 135
"max Function" on page 185
"min Function" on page 185
"origin Function (For GPL Scales)" on page 191
"reverse Function" on page 214
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"asn Scale" on page 30
"atanh Scale" on page 31
"cat Scale" on page 32
"linear Scale" on page 34
"log Scale" on page 34
"logit Scale" on page 35
"pow Scale" on page 36
"prob Scale" on page 37
"probit Scale" on page 37
"safeLog Scale" on page 38
"safePower Scale" on page 39
"time Scale" on page 40

**Applies To**

"SCALE Statement" on page 29
"asn Scale" on page 30
"atanh Scale" on page 31
"cat Scale" on page 32

**linear Scale:** Syntax

```
linear(dim(<numeric>), <function>)
```

*or*

```
linear(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

Description

Creates a linear scale. A linear scale is created for a continuous variable by default. You usually don't need to specify the scale unless you want to add a function to modify it (for example, to specify the range).

Example

```
SCALE: linear(dim(2), max(50000))
```

*Figure 41. Example: Specifying a maximum value for the linear scale*

**Valid Functions**

"aestheticMaximum Function" on page 63
"aestheticMinimum Function" on page 64
"aestheticMissing Function" on page 65
"dataMaximum Function" on page 92
"dataMinimum Function" on page 93
"include Function" on page 135
"max Function" on page 185
"min Function" on page 185
"origin Function (For GPL Scales)" on page 191
"reverse Function" on page 214

**Applies To**

"SCALE Statement" on page 29

**log Scale:** Syntax

```
log(dim(<numeric>), <function>)
```

*or*

```
log(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

Description

Creates a logarithmic-transformed scale. The formula for the transformation is `log<base>(x)`, where `<base>` is defined by the `base` function. If a base is not explicitly specified, the default is base 10. Data values for this scale must be greater than 0.

Example

```
SCALE: log(dim(2), base(2))
```

*Figure 42. Example: Specifying the scale and a base*

**Valid Functions**

"aestheticMaximum Function" on page 63
"aestheticMinimum Function" on page 64
"aestheticMissing Function" on page 65
"dataMaximum Function" on page 92
"dataMinimum Function" on page 93
"include Function" on page 135
"base Function" on page 66
"max Function" on page 185
"min Function" on page 185
"origin Function (For GPL Scales)" on page 191
"reverse Function" on page 214

**Applies To**

"SCALE Statement" on page 29

**logit Scale:** Syntax

```
logit(dim(<numeric>), <function>)
```

*or*

```
logit(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

Description

Creates a logit-transformed scale. The formula for the transformation is `log(1/(1-x))`. Data values for this scale must fall in the open interval (0, 1). That is, for any data value $x$, $0 < x < 1$.

Example

```
SCALE: logit(dim(2))
```

*Figure 43. Example: Specifying a logit scale*

**Valid Functions**

"aestheticMaximum Function" on page 63

"aestheticMinimum Function" on page 64

"aestheticMissing Function" on page 65

**Applies To**

"SCALE Statement" on page 29

**pow Scale:** Syntax

```
pow(dim(<numeric>), <function>)
```

*or*

```
pow(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

Description

Creates a power scale. an exponent-transformed scale. The formula for the transformation is `power(x, <exponent>)`, where `<exponent>` is defined by the `exponent` function. If an exponent is not explicitly specified, the default is 0.5.

Example

```
SCALE: pow(dim(2), exponent(2))
```

*Figure 44. Example: Specifying the scale and an exponent*

**Valid Functions**

"aestheticMaximum Function" on page 63

"aestheticMinimum Function" on page 64

"aestheticMissing Function" on page 65

"dataMaximum Function" on page 92

"dataMinimum Function" on page 93

"exponent Function" on page 130

"include Function" on page 135

"max Function" on page 185

"min Function" on page 185

"origin Function (For GPL Scales)" on page 191

"reverse Function" on page 214

**Applies To**

"SCALE Statement" on page 29

**prob Scale:** Syntax

```
prob(dim(<numeric>), <distribution function>, <function>)
```

*or*

```
prob(aesthetic(aesthetic.<aesthetic type>), <distribution function>, <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<distribution function>**. A distribution function. This is required.

**<function>**. One or more valid functions. These are optional.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

Description

Creates a probability scale based on the inverse cumulative distribution function (CDF) for the specified distribution. Data values for this scale must fall in the open interval (0, 1). That is, for any data value $x$, $0 < x < 1$.

Example

```
SCALE: prob(dim(2), beta(2, 5))
```

*Figure 45. Example: Specifying a beta distribution for the probability scale*

**Distribution Functions**

"beta Function" on page 69
"chiSquare Function" on page 81
"exponential Function" on page 131
"f Function" on page 131
"gamma Function" on page 133
"logistic Function" on page 183
"normal Function" on page 190
"poisson Function" on page 192
"studentizedRange Function" on page 245
"t Function" on page 320
"uniform Function" on page 324
"weibull Function" on page 326

**Valid Functions**

"aestheticMaximum Function" on page 63
"aestheticMinimum Function" on page 64
"aestheticMissing Function" on page 65

**Applies To**

"SCALE Statement" on page 29

**probit Scale:** Syntax

```
probit(dim(<numeric>), <function>)
```

*or*

```
probit(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

Description

Creates a probit scale. The formula for the transformation is the inverse cumulative distribution function (CDF) of the normal distribution. Data values for this scale must fall in the closed interval [0, 1]. That is, for any data value $x$, $0 \leq x \leq 1$.

Note that `probit(dim(<numeric>))` is equivalent to `prob(dim(<numeric>), prob(normal(0, 1))`.

Example

```
probit(dim(2))
```

*Figure 46. Example: Specifying a probit scale*

**Valid Functions**

"aestheticMaximum Function" on page 63

"aestheticMinimum Function" on page 64

"aestheticMissing Function" on page 65

**Applies To**

"SCALE Statement" on page 29

**safeLog Scale:** Syntax

```
safeLog(dim(<numeric>), <function>)
```

*or*

```
safeLog(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

Description

Creates a "safe" logarithmic-transformed scale. Unlike a regular log scale, the safe log scale uses a modified function to handle 0 and negative values. If a base is not explicitly specified, the default is base 10.

Formula for Safe Log Transformation

The safe log formula is:

```
sign(x) * log(1 + abs(x))
```

So if you assume that the axis value is –99, the result of the transformation is:

```
sign(-99) * log(1 + abs(-99)) = -1 * log(1 + 99) = -1 * 2 = -2
```

Example

```
SCALE: safeLog(dim(2), base(2))
```

*Figure 47. Example: Specifying the scale and a base*

**Valid Functions**

"aestheticMaximum Function" on page 63
"aestheticMinimum Function" on page 64
"aestheticMissing Function" on page 65
"dataMaximum Function" on page 92
"dataMinimum Function" on page 93
"include Function" on page 135
"base Function" on page 66
"max Function" on page 185
"min Function" on page 185
"origin Function (For GPL Scales)" on page 191
"reverse Function" on page 214

**Applies To**

"SCALE Statement" on page 29

**safePower Scale:** Syntax

```
safePower(dim(<numeric>), <function>)
```

*or*

```
safePower(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

Description

Creates a "safe" power-transformed scale. Unlike a regular power scale, the safe power scale uses a modified function to handle negative values. If an exponent is not explicitly specified, the default is 0.5.

Formulas for Safe Power Transformation

When the exponent is a *positive* number, the safe power formulas are:

```
If (x>=0):
pow(1+x, exponent)-1
If (x<0):
1-pow(1-x, exponent)
```

When the exponent is a *negative* number, the safe power formulas are:

```
If (x>=0):
1-pow(1+x, exponent)
If (x<0):
pow(1-x, exponent)-1
```

So, if you assume the axis value is –99 and the exponent is 0.5, the result of the transformation is:

```
1 - pow(1 - (-99), 0.5) = 1 - pow(100, 0.5) = 1 - 10 = -9
```

So, if you assume the axis value is –99 and the exponent is –2, the result of the transformation is:

```
pow(1 - (-99), -2) - 1 = pow(100, -2) - 1 = 0.0001 - 1 = -0.999
```

Example

```
SCALE: safePower(dim(2), exponent(10))
```

*Figure 48. Example: Specifying the scale and an exponent*

**Valid Functions**

"aestheticMaximum Function" on page 63
"aestheticMinimum Function" on page 64
"aestheticMissing Function" on page 65
"dataMaximum Function" on page 92
"dataMinimum Function" on page 93
"exponent Function" on page 130
"include Function" on page 135
"max Function" on page 185
"min Function" on page 185
"origin Function (For GPL Scales)" on page 191
"reverse Function" on page 214

**Applies To**

"SCALE Statement" on page 29

**time Scale:** Syntax

```
time(dim(<numeric>), <function>)
```

*or*

```
time(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<aesthetic type>**. An aesthetic type indicating the aesthetic to which the scale applies. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

Description

Creates a time scale.

Example

```
SCALE: time(dim(1), max("12/31/2005"))
```

*Figure 49. Example: Specifying a maximum value for the time scale*

**Valid Functions**

"aestheticMaximum Function" on page 63
"aestheticMinimum Function" on page 64
"aestheticMissing Function" on page 65
"dataMaximum Function" on page 92
"dataMinimum Function" on page 93
"include Function" on page 135
"max Function" on page 185
"min Function" on page 185
"origin Function (For GPL Scales)" on page 191
"reverse Function" on page 214

**Applies To**

"SCALE Statement" on page 29

## GUIDE Statement

Syntax

```
GUIDE: <guide type>
```

**<guide type>**. A valid guide type.

Description

Specifies a guide for the graph. Guides provide additional information that can help a viewer interpret the graph. An axis is a guide because it provides labels for the categories and values in a graph (but is separate from the scale on which the data are drawn). A title is a guide because it describes the graph. A legend is a guide because it provides color swatches to match a category name to specific instances of a graphic element in the graph.

Examples

```
GUIDE: axis(dim(2), label("Mean Current Salary"))
```

*Figure 50. Example: Axis*

**Guide Types**

"axis Guide Type" on page 42
"form.line Guide Type" on page 43
"legend Guide Type" on page 43
"text.footnote Guide Type" on page 44
"text.subfootnote Guide Type" on page 44
"text.subsubfootnote Guide Type" on page 44
"text.subtitle Guide Type" on page 45
"text.subsubtitle Guide Type" on page 45
"text.title Guide Type" on page 45

## GPL Guide Types

There are several different types of guides.

**Guide Types**

"axis Guide Type" on page 42
"form.line Guide Type" on page 43

**axis Guide Type:** Syntax

```
axis(dim(<numeric>), <function>)
```

*or*

```
axis(scale(<scale name>), <function>)
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. Use the `null()` function to hide the axis.

**<scale name>**. The name of the scale to which the axis applies. See the topic "scale Function (For GPL Axes)" on page 216 for more information.

Description

Specifies the axis for a particular dimension. Do not confuse the axis with the scale. They are separate parts of the graph and are handled with separate GPL statements. The axis helps interpret the scale with labels and tick marks, but the axis does not change the positioning of graphic elements as changing the scale would. For information about scales, see "SCALE Statement" on page 29.

Examples

```
GUIDE: axis(dim(2), label("Mean Current Salary"))
```

*Figure 51. Example: Specifying an axis label for a dimension with one scale*

```
SCALE: y1 = linear(dim(2))
SCALE: y2 = linear(dim(2))
GUIDE: axis(scale(y1), label("Mean Salary"))
GUIDE: axis(scale(y2), label("Count"), opposite(), color(color.red))
```

*Figure 52. Example: Specifying axis labels for a dimension with two scales*

**Valid Functions**

"unit.percent Function" on page 324

**Applies To**

"GUIDE Statement" on page 41

**form.line Guide Type:** Syntax

```
form.line(<function>)
```

**<function>**. One or more valid functions. The `position` function is required.

Description

Specifies a vertical or horizontal reference line. For information about specifying the location of the line, see "position Function (For GPL Guides)" on page 193.

Examples

```
GUIDE: form.line(position(*, 5000))
```

*Figure 53. Example: Horizontal reference line*

```
GUIDE: form.line(position(5000, *))
```

*Figure 54. Example: Vertical reference line*

**Valid Functions**

"color.brightness Function (For GPL Guides)" on page 88
"color Function (For GPL Guides)" on page 87
"color.hue Function (For GPL Guides)" on page 90
"label Function (For GPL Guides)" on page 138
"position Function (For GPL Guides)" on page 193
"color.saturation Function (For GPL Guides)" on page 91
"scale Function (For GPL Graphic Elements and form.line)" on page 217
"shape Function (For GPL Guides)" on page 220
"size Function (For GPL Guides)" on page 222
"transparency Function (For GPL Guides)" on page 323

**Applies To**

"GUIDE Statement" on page 41

**legend Guide Type:** Syntax

```
legend(aesthetic(aesthetic.<aesthetic type>), <function>)
```

**<aesthetic type>**. An aesthetic associated with the legend. The aesthetic identifies the legend, which was created as the result of an aesthetic function in the `ELEMENT` statement.

**<function>**. One or more valid functions. Use the `null()` function to hide the legend.

Description

Specifies properties of the legend associated with a specific aesthetic, which is defined by an aesthetic function in the `ELEMENT` statement. The legend provides a visual representation of the scale created by the aesthetic function. Thus, a legend guide is related to the aesthetic scale in the same way an axis guide is related to a dimension scale. Note that using a uniform aesthetic value in the aesthetic function (for example, `color(color.blue)`) does not create a scale. Therefore, the legend is not used in that case.

Examples

```
GUIDE: legend(aesthetic(aesthetic.color), label("Gender"))
ELEMENT: interval(position(summary.count(jobcat)), color(gender))
```

*Figure 55. Example: Specifying a legend title*

**Valid Functions**

"label Function (For GPL Guides)" on page 138

**Applies To**

"GUIDE Statement" on page 41

**text.footnote Guide Type:** Syntax

```
text.footnote(<function>)
```

**<function>**. One or more valid functions.

Description

Specifies the footnote for the graph.

Examples

```
GUIDE: text.footnote(label("Some Text"))
```

*Figure 56. Example: Specifying the footnote text*

**Valid Functions**

"label Function (For GPL Guides)" on page 138

**Applies To**

"GUIDE Statement" on page 41

**text.subfootnote Guide Type:** Syntax

```
text.subfootnote(<function>)
```

**<function>**. One or more valid functions.

Description

Specifies the second-level footnote for the graph. That is, the subfootnote appears below the footnote.

Examples

```
GUIDE: text.subfootnote(label("Some Text"))
```

*Figure 57. Example: Specifying the second-level footnote text*

**Valid Functions**

"label Function (For GPL Guides)" on page 138

**Applies To**

"GUIDE Statement" on page 41

**text.subsubfootnote Guide Type:** Syntax

```
text.subsubfootnote(<function>)
```

**<function>**. One or more valid functions.

Description

Specifies the third-level footnote for the graph. That is, the subsubfootnote appears below the subfootnote.

Examples

```
GUIDE: text.subsubfootnote(label("Some Text"))
```

*Figure 58. Example: Specifying the third-level footnote text*

**Valid Functions**
"label Function (For GPL Guides)" on page 138
**Applies To**
"GUIDE Statement" on page 41

**text.subtitle Guide Type:** Syntax

```
text.subtitle(<function>)
```

**<function>**. One or more valid functions.

Description

Specifies the subtitle for the graph.

Examples

```
GUIDE: text.subtitle(label("Some Text"))
```

*Figure 59. Example: Specifying the subtitle text*

**Valid Functions**
"label Function (For GPL Guides)" on page 138
**Applies To**
"GUIDE Statement" on page 41

**text.subsubtitle Guide Type:** Syntax

```
text.subsubtitle(<function>)
```

**<function>**. One or more valid functions.

Description

Specifies the second-level subtitle for the graph.

Examples

```
GUIDE: text.subsubtitle(label("Some Text"))
```

*Figure 60. Example: Specifying the second-level subtitle text*

**Valid Functions**
"label Function (For GPL Guides)" on page 138
**Applies To**
"GUIDE Statement" on page 41

**text.title Guide Type:** Syntax

```
text.title(<function>)
```

**<function>**. One or more valid functions.

Description

Specifies the title for the graph.

Examples

```
GUIDE: text.title(label("Salary by Gender"))
```

*Figure 61. Example: Specifying the title text*

**Valid Functions**

"label Function (For GPL Guides)" on page 138

**Applies To**

"GUIDE Statement" on page 41

## ELEMENT Statement

Syntax

```
ELEMENT: <element type>
```

**<element type>**. A valid element type.

Description

Specifies a graphic element used to draw data on the graph. Graphic elements are the bars, points, lines, etc., that make up a graph.

There can be multiple `ELEMENT` statements in the same block of GPL to create multiple graphic elements. In this case, the variables in multiple `ELEMENT` statements share the same dimension and aesthetic scales.

For example, assume the GPL includes the following `ELEMENT` statements:

```
ELEMENT: point(position(x*y))
ELEMENT: point(position(x2*y2))
```

In the resulting graph, dimension 1 uses `x+x2`, and dimension 2 uses `y+y2`.

*Note*: This behavior is sometimes called an **implied blend** because we could have written the GPL as follows:

```
ELEMENT: point(position(x*y+x2*y2))
```

Examples

```
ELEMENT: point(position(x*y))
```

*Figure 62. Example: Scatterplot*

```
ELEMENT: line(position(x*y))
```

*Figure 63. Example: Line chart*

```
ELEMENT: interval(position(summary.mean(x*y)))
```

*Figure 64. Example: Bar chart of means*

**Graphic Element Types**

"area Element" on page 47

## GPL Graphic Element Types

There are several different types of elements for drawing data on a graph.

**area Element:** Syntax

```
area.<collision modifier>(<function>)
```

**<collision modifier>**. A method that specifies what should happen when two area graphic elements overlap each other. The collision modifier is optional.

**<function>**. One or more valid functions. The `position` function is required. The `scale` function is required when there are multiple scales in a single dimension (as in a "dual axis" graph).

Description

Specifies an area graphic element.

Examples

```
ELEMENT: area(position(summary.mean(jobcat*gender)))
```

*Figure 65. Example: Area chart*

**Collision Modifiers**



**Valid Functions**

**Applies To**

"ELEMENT Statement" on page 46

**bar Element:** Description

`bar` is an alias for `interval`. For the syntax and other examples, see "interval Element" on page 49.

Examples

```
ELEMENT: bar(position(summary.mean(jobcat*gender)))
```

*Figure 66. Example: Bar chart*

**edge Element:** Syntax

```
edge(<function>)
```

**<function>**. One or more valid functions. The `position` function is required. The `scale` function is required when there are multiple scales in a single dimension (as in a "dual axis" graph).

Description

Specifies a vertex-edge graphic element. The edge element is typically used in conjunction with a link or layout function, which calculates the actual links among the vertices. The edge element is a graphical representation of these links.

Examples

```
ELEMENT: edge(position(link.mst(x*y))
```

*Figure 67. Example: Minimum spanning tree*

```
ELEMENT: edge(position(link.hull(x*y))
```

*Figure 68. Example: Convex hull*

**Valid Functions**

"closed Function" on page 81
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"label Function (For GPL Graphic Elements)" on page 137
"missing.gap Function" on page 186
"missing.interpolate Function" on page 187
"missing.wings Function" on page 188
"position Function (For GPL Graphic Elements)" on page 192
"preserveStraightLines Function" on page 194
"scale Function (For GPL Graphic Elements and form.line)" on page 217
"shape Function (For GPL Graphic Elements)" on page 219
"size Function (For GPL Graphic Elements)" on page 221
"split Function" on page 243
"transparency Function (For GPL Graphic Elements)" on page 322
"visible Function" on page 325

**Applies To**

"ELEMENT Statement" on page 46

**interval Element:** Syntax

```
interval.<collision modifier>(<function>)
```

**<collision modifier>**. A method that specifies what should happen when two interval graphic elements overlap each other. The collision modifier is optional.

**<function>**. One or more valid functions. The `position` function is required. The `scale` function is required when there are multiple scales in a single dimension (as in a "dual axis" graph).

Description

Specifies an interval (bar) graphic element, as would be used in a bar chart, histogram, or error bar chart.

Examples

```
ELEMENT: interval(position(summary.mean(jobcat*salary)))
```

*Figure 69. Example: Bar chart*

```
ELEMENT: interval(position(bin.rect(summary.count(salary))))
```

*Figure 70. Example: Histogram*

```
ELEMENT: interval(position(region.confi.mean(jobcat*salary)), shape(shape.ibeam))
```

*Figure 71. Example: Error bar chart*

```
ELEMENT: interval.stack(position(summary.sum(jobcat*salary)), color(gender))
```

*Figure 72. Example: Stacked bar chart*

**Collision Modifiers**

"dodge Collision Modifier" on page 54
"stack Collision Modifier" on page 56

**Valid Functions**

"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"label Function (For GPL Graphic Elements)" on page 137
"position Function (For GPL Graphic Elements)" on page 192
"scale Function (For GPL Graphic Elements and form.line)" on page 217
"shape Function (For GPL Graphic Elements)" on page 219
"size Function (For GPL Graphic Elements)" on page 221
"split Function" on page 243
"texture.pattern Function" on page 320
"transparency Function (For GPL Graphic Elements)" on page 322
"visible Function" on page 325

**Applies To**

"ELEMENT Statement" on page 46

**line Element:** Syntax

```
line.<collision modifier>(<function>)
```

**<collision modifier>**. A method that specifies what should happen when two line graphic elements overlap each other. The collision modifier is optional.

**<function>**. One or more valid functions. The `position` function is required. The `scale` function is required when there are multiple scales in a single dimension (as in a "dual axis" graph).

Description

Specifies a line graphic element. The line is drawn through values in the order in which they appear in the *x*-axis domain. This is one of the features that distinguishes a line graphic element from the path graphic element. See "path Element" for more information about the path graphic element.

Examples

```
ELEMENT: line(position(salbegin*salary))
```

*Figure 73. Example: Line chart of continuous variables*

```
ELEMENT: line(position(summary.mean(jobcat*salary)))
```

*Figure 74. Example: Line chart of a summary statistic*

**Collision Modifiers**

"stack Collision Modifier" on page 56

**Valid Functions**

"closed Function" on page 81
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"jump Function" on page 136
"label Function (For GPL Graphic Elements)" on page 137
"missing.gap Function" on page 186
"missing.interpolate Function" on page 187
"missing.wings Function" on page 188
"position Function (For GPL Graphic Elements)" on page 192
"preserveStraightLines Function" on page 194
"scale Function (For GPL Graphic Elements and form.line)" on page 217
"shape Function (For GPL Graphic Elements)" on page 219
"size Function (For GPL Graphic Elements)" on page 221
"split Function" on page 243
"transparency Function (For GPL Graphic Elements)" on page 322
"visible Function" on page 325

**Applies To**

"ELEMENT Statement" on page 46

**path Element:** Syntax

```
path(<function>)
```

**<function>**. One or more valid functions. The `position` function is required. The `scale` function is required when there are multiple scales in a single dimension (as in a "dual axis" graph).

Description

Specifies a path graphic element. The path graphic element connects the data values in the order in which their associated cases appear in the dataset. Therefore, it can cross back on itself. This is one of the features that distinguishes the path graphic element from the line graphic element. Additionally, paths can have variable sizes, so another variable can control the thickness of the path at any particular point.

Examples

```
ELEMENT: path(position(salbegin*salary))
```

*Figure 75. Example: Line chart drawn through all values*

```
ELEMENT: path(position(salbegin*salary), size(educ))
```

*Figure 76. Example: Creating a line chart with variable widths*

**Valid Functions**


“closed Function” on page 81
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“label Function (For GPL Graphic Elements)” on page 137
“missing.gap Function” on page 186
“missing.interpolate Function” on page 187
“missing.wings Function” on page 188
“position Function (For GPL Graphic Elements)” on page 192
“preserveStraightLines Function” on page 194
“scale Function (For GPL Graphic Elements and form.line)” on page 217
“shape Function (For GPL Graphic Elements)” on page 219
“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243
“transparency Function (For GPL Graphic Elements)” on page 322
“visible Function” on page 325


**Applies To**


“ELEMENT Statement” on page 46


**point Element:** Syntax

```
point.<collision modifier>(<function>)
```

**<collision modifier>**. A method that specifies what should happen when two points overlap each other. The collision modifier is optional.

**<function>**. One or more valid functions. The `position` function is required. The `scale` function is required when there are multiple scales in a single dimension (as in a "dual axis" graph).

Description

Specifies a point graphic element, as would be used in a scatterplot.

Examples

```
ELEMENT: point(position(salbegin*salary))
```

*Figure 77. Example: Scatterplot*

```
ELEMENT: point.dodge.symmetric(position(bin.dot(salary)))
```

*Figure 78. Example: Dot plot*

**Collision Modifiers**

“dodge.asymmetric Collision Modifier” on page 54
“dodge.symmetric Collision Modifier” on page 55
“jitter Collision Modifier” on page 55
“stack Collision Modifier” on page 56

**Valid Functions**

“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“label Function (For GPL Graphic Elements)” on page 137
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“scale Function (For GPL Graphic Elements and form.line)” on page 217
“shape Function (For GPL Graphic Elements)” on page 219
“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243
“texture.pattern Function” on page 320
“transparency Function (For GPL Graphic Elements)” on page 322
“visible Function” on page 325

**Applies To**

“ELEMENT Statement” on page 46

**polygon Element:** Syntax

```
polygon(<function>)
```

**<function>**. One or more valid functions. The `position` function is required. The `scale` function is required when there are multiple scales in a single dimension (as in a "dual axis" graph).

Description

Specifies a polygonal graphic element. A polygon connects multiple points to create an enclosed space. For example, it may be used to draw a state or country in a map, or it may be used to draw the outline of a two-dimensional bin.

Examples

```
ELEMENT: polygon(position(bin.hex(x*y, dim(1,2)), color(summary.count())))
```

*Figure 79. Example: Hexagonal binning*

**Valid Functions**

“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90
"label Function (For GPL Graphic Elements)" on page 137
"position Function (For GPL Graphic Elements)" on page 192
"preserveStraightLines Function" on page 194
"scale Function (For GPL Graphic Elements and form.line)" on page 217
"shape Function (For GPL Graphic Elements)" on page 219
"size Function (For GPL Graphic Elements)" on page 221
"split Function" on page 243
"transparency Function (For GPL Graphic Elements)" on page 322
"visible Function" on page 325

**Applies To**

"ELEMENT Statement" on page 46

**schema Element:** Syntax

```
schema(<function>)
```

**<function>**. One or more valid functions. The `position` function is required. The `scale` function is required when there are multiple scales in a single dimension (as in a "dual axis" graph).

Description

Specifies a schema (boxplot) graphic element.

Examples

```
ELEMENT: schema(position(bin.quantile.letter(jobcat*salary)))
```

*Figure 80. Example: Boxplot*

**Valid Functions**

"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"label Function (For GPL Graphic Elements)" on page 137
"position Function (For GPL Graphic Elements)" on page 192
"scale Function (For GPL Graphic Elements and form.line)" on page 217
"size Function (For GPL Graphic Elements)" on page 221
"split Function" on page 243
"texture.pattern Function" on page 320
"transparency Function (For GPL Graphic Elements)" on page 322
"visible Function" on page 325

**Applies To**

"ELEMENT Statement" on page 46

## GPL Collision Modifiers

Collision modifiers specify what happens when two graphic elements overlap.

**difference Collision Modifier:** Syntax

```
<element type>.difference
```

**<element type>**. A valid element type.

Description

Clips graphic elements and draws the difference between dichotomous values. The aesthetic value associated with the greater value in a group determines the aesthetic for the result. This function is used to create a difference area graph. It is useful to compare the result to the one obtained when using the `stack` position modifier.

Examples

```
ELEMENT: area.difference(position(summary.sum(jobcat*salary)), color(gender))
```

*Figure 81. Example: Difference area chart*

**Valid Element Types**

"area Element" on page 47

**dodge Collision Modifier:** Syntax

```
<element type>.dodge
```

**<element type>**. A valid element type.

Description

Moves graphic elements next to other graphic elements that appear at the same value, rather than superimposing them. The graphic elements are arranged symmetrically. That is, the graphic elements are moved to opposite sides of a central position. For point elements, this function is the same as `dodge.symmetric`. (See "dodge.symmetric Collision Modifier" on page 55.)

Although dodged charts can look similar to clustered charts, they are not the same. Clustering changes the coordinates. Dodging only repositions graphic elements to avoid collisions. Therefore, a clustered chart allocates space for missing categories while a dodged chart does not.

Examples

```
ELEMENT: point.dodge(position(bin.dot(salary*jobcat)))
```

*Figure 82. Example: 2-D Dot plot*

```
ELEMENT: interval.dodge(position(summary.mean(jobcat*salary)), color(gender))
```

*Figure 83. Example: Dodged bar chart*

**Valid Element Types**

"interval Element" on page 49

"point Element" on page 51

**dodge.asymmetric Collision Modifier:** Syntax

```
<element type>.dodge.asymmetric
```

**<element type>**. A valid element type.

Description

Moves graphic elements next to other graphic elements that appear at the same value, rather than superimposing them. The graphic elements are arranged asymmetrically. That is, the graphic elements are

stacked on top of one another, with the graphic element on the bottom positioned at a specific value on the scale. `dodge.asymmetric` is typically used for 1-D dot plots.

Examples

```
ELEMENT: point.dodge.asymmetric(position(bin.dot(salary)))
```

*Figure 84. Example: 1-D Dot plot*

**Valid Element Types**

"point Element" on page 51

**dodge.symmetric Collision Modifier:** Syntax

```
<element type>.dodge.symmetric
```

**<element type>**. A valid element type.

Description

Moves graphic elements next to other graphic elements that appear at the same value, rather than superimposing them. The graphic elements are arranged symmetrically. That is, the graphic elements extend in two directions from a central position. `dodge.asymmetric` is typically used for 2-D dot plots.

Examples

```
ELEMENT: point.dodge.symmetric(position(bin.dot(salary*jobcat)))
```

*Figure 85. Example: 2-D Dot plot*

**Valid Element Types**

"point Element" on page 51

**jitter Collision Modifier:** Syntax

```
<element type>.jitter.<jitter type>
```

**<element type>**. A valid element type.

**<jitter type>**. A valid jitter type. This is optional. If no type is specified, `jitter.joint.uniform` is used.

Description

Repositions graphic elements randomly using a normal or uniform distribution.

Examples

```
ELEMENT: point.jitter(position(jobcat*gender))
```

*Figure 86. Example: Jittered categorical point chart*

*Table 1. Jitter types*

| Type | Meaning |
|---|---|
| `joint` | Same as `joint.uniform` |
| `conditional` | Same as `conditional.uniform` |
| `normal` | Same as `joint.normal` |
| `uniform` | Same as `joint.uniform` |
| `joint.normal` | Jitter points in all dimensions using a normal distribution |

*Table 1. Jitter types (continued)*

| Type | Meaning |
|---|---|
| `joint.uniform` | Jitter points in all dimensions using a uniform distribution |
| `conditional.normal` | Jitter points in the analysis dimension using a normal distribution |
| `conditional.uniform` | Jitter points in the analysis dimension using a uniform distribution |

**Valid Element Types**

"point Element" on page 51

**stack Collision Modifier:** Syntax

```
<element type>.stack
```

**<element type>**. A valid element type.

Description

Stacks graphic elements that would normally be superimposed when they have the same data values.

Examples

```
ELEMENT: interval.stack(position(summary.mean(jobcat*salary)), color(gender))
```

*Figure 87. Example: Stacked bar chart*

**Valid Element Types**

"area Element" on page 47
"interval Element" on page 49
"line Element" on page 49
"point Element" on page 51

## GPL Functions

Functions are used within GPL statements. Functions can also be embedded in other functions.

**Aesthetic Functions**

"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"shape Function (For GPL Graphic Elements)" on page 219
"size Function (For GPL Graphic Elements)" on page 221
"texture.pattern Function" on page 320
"transparency Function (For GPL Graphic Elements)" on page 322
"visible Function" on page 325

**Aesthetic Mapping Functions**

"aestheticMaximum Function" on page 63
"aestheticMinimum Function" on page 64
"aestheticMissing Function" on page 65
"map Function" on page 184

**Guide Aesthetic Functions**



**Data Functions**



**Data Source Functions**



**Binning Functions**

**Percentage Base Functions**



**Probability Scale Distribution Functions**



**Sort Functions**



**Statistic Functions**

**Transformation Functions**



**Other Functions**

"showAll Function" on page 221
"split Function" on page 243
"start Function" on page 244
"startAngle Function" on page 244
"ticks Function" on page 321
"to Function" on page 321
"unit.percent Function" on page 324
"values Function" on page 325
"weight Function" on page 326

## aestheticMaximum Function

Syntax

```
aestheticMinimum(<aesthetic type>.<aesthetic constant>)
```

*or*

```
aestheticMinimum(<aesthetic type>."aesthetic value")
```

**<aesthetic type>**. An aesthetic type indicating the specific aesthetic for which a maximum value is being specified. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

**<aesthetic constant>**. A constant for the aesthetic (for example, `size.huge`). Valid constants depend on the aesthetic.

**"aesthetic value"**. A specific value for the aesthetic (for example, `size."10px"`. Valid values depend on the aesthetic.

Description

Specifies an aesthetic value that is mapped to the maximum data value for a scale. The maximum data value may be a "nice value" based on the data (the default), the exact data maximum (if using the `dataMaximum` function on the scale), or a specified value (if using the `max` function on the scale). For example, a graphic element may be sized by a continuous value. By default, the continuous scale has a "nice value" maximum. The `aestheticMaximum` function can map a size to this maximum value.

Examples

```
SCALE: linear(aesthetic(aesthetic.size), aestheticMinimum(size."1px"),
              aestheticMaximum(size."5px"))
ELEMENT: point(position(x*y), size(z))
```

*Figure 88. Example: Specifying a minimum and maximum size for points in a bubble plot*

**Applies To**

"asn Scale" on page 30
"atanh Scale" on page 31
"cLoglog Scale" on page 32
"linear Scale" on page 34
"log Scale" on page 34
"logit Scale" on page 35
"pow Scale" on page 36
"prob Scale" on page 37
"probit Scale" on page 37

“safeLog Scale” on page 38
“safePower Scale” on page 39
“time Scale” on page 40

## aestheticMinimum Function

Syntax

```
aestheticMinimum(<aesthetic type>.<aesthetic constant>)
```

*or*

```
aestheticMinimum(<aesthetic type>."<aesthetic value>")
```

**<aesthetic type>**. An aesthetic type indicating the specific aesthetic for which a minimum value is being specified. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

**<aesthetic constant>**. A constant for the aesthetic (for example, `size.tiny`). Valid constants depend on the aesthetic.

**"aesthetic value"**. A specific value for the aesthetic (for example, `size."1px"`. Valid values depend on the aesthetic.

Description

Specifies an aesthetic value that is mapped to the minimum data value for a scale. The minimum data value may be a "nice value" based on the data (the default), the exact data minimum (if using the `dataMinimum` function on the scale), or a specified value (if using the `min` function on the scale). For example, a graphic element may be sized by a continuous value. By default, the continuous scale has a "nice value" minimum. The `aestheticMinimum` function can map a size to this minimum value.

Examples

```
SCALE: linear(aesthetic(aesthetic.size), aestheticMinimum(size."1px"),
              aestheticMaximum(size."5px"))
ELEMENT: point(position(x*y), size(z))
```

*Figure 89. Example: Specifying a minimum and maximum size for points in a bubble plot*

**Applies To**

“asn Scale” on page 30
“atanh Scale” on page 31
“cLoglog Scale” on page 32
“linear Scale” on page 34
“log Scale” on page 34
“logit Scale” on page 35
“pow Scale” on page 36
“prob Scale” on page 37
“probit Scale” on page 37
“safeLog Scale” on page 38
“safePower Scale” on page 39
“time Scale” on page 40

## aestheticMissing Function

Syntax

```
aestheticMissing(<aesthetic type>.<aesthetic constant>)
```

*or*

```
aestheticMissing(<aesthetic type>."<aesthetic value>")
```

**<aesthetic type>**. An aesthetic type indicating the specific aesthetic for which a missing value aesthetic is being specified. This is an aesthetic created as the result of an aesthetic function (such as `size`) in the `ELEMENT` statement.

**<aesthetic constant>**. A constant for the aesthetic (for example, `size.tiny`). Valid constants depend on the aesthetic.

**"aesthetic value"**. A specific value for the aesthetic (for example, `size."1px"`. Valid values depend on the aesthetic.

Description

Specifies an aesthetic value that is mapped to missing values for a scale.

Examples

```
SCALE: linear(aesthetic(aesthetic.color), aestheticMissing(color.black))
ELEMENT: point(position(x*y), color(z))
```

*Figure 90. Example: Specifying a missing value aesthetic for a scale*

**Applies To**


“asn Scale” on page 30
“atanh Scale” on page 31
“cat Scale” on page 32
“cLoglog Scale” on page 32
“linear Scale” on page 34
“log Scale” on page 34
“logit Scale” on page 35
“pow Scale” on page 36
“prob Scale” on page 37
“probit Scale” on page 37
“safeLog Scale” on page 38
“safePower Scale” on page 39
“time Scale” on page 40


## alpha Function

Syntax

```
alpha(<numeric>)
```

**<numeric>**. A numeric value between 0 and 1.

Description

Specifies a percentage value used to calculate a percentile value or confidence interval.

Examples

```
ELEMENT: interval(position(region.confi.mean(jobcat*salary, alpha(0.99))))
```

*Figure 91. Example: Specifying a 99% confidence interval*

**Applies To**

“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
“region.confi.proportion.count Function” on page 202
“region.confi.smooth Function” on page 205
“summary.percentile Function” on page 283

## base Function

Syntax

```
base(<numeric>)
```

**<numeric>**. A numeric value indicating the base for the logarithmic scale.

Description

Specifies a base for the logarithmic scale.

Examples

```
SCALE: log(dim(2), base(2))
```

*Figure 92. Example: Specifying a different base for a logarithmic scale*

**Applies To**

“log Scale” on page 34
“safeLog Scale” on page 38

## base.aesthetic Function

Syntax

```
base.aesthetic(aesthetic(aesthetic.<aesthetic type>))
```

**<aesthetic type>**. An aesthetic whose associated variable is used as the percentage base.

Description

Specifies that the percentage is based on the count across the result of an aesthetic function. Summing the percentages of all of the cases in a specific aesthetic group equals 100%. For example, all blue bars sum to 100%, and all red bars sum to 100%.

Examples

```
COORD: rect(dim(1,2), cluster(3))
ELEMENT: interval(position(summary.percent(summary.count(jobcat*1*gender),
                 base.aesthetic(aesthetic(aesthetic.color)))), color(jobcat))
```

*Figure 93. Example: Using a variable across clusters as the percentage base*

**Applies To**

"region.confi.percent.count Function" on page 200
"region.confi.proportion.count Function" on page 202
"summary.percent Function" on page 270
"summary.percent.count Function" on page 271
"summary.percent.count.cumulative Function" on page 274
"summary.percent.cumulative Function" on page 276
"summary.percent.sum Function" on page 278
"summary.percent.sum.cumulative Function" on page 281
"summary.proportion Function" on page 288
"summary.proportion.count Function" on page 289
"summary.proportion.count.cumulative Function" on page 292
"summary.proportion.cumulative Function" on page 294
"summary.proportion.sum Function" on page 294
"summary.proportion.sum.cumulative Function" on page 297

## base.all Function

Syntax

```
base.all()
```

*or*

```
base.all(acrossPanels())
```

Description

Specifies that the percentage is based on the total count. Summing the percentages of all of the graphic elements in the chart or in each panel equals 100%. If you are using paneling and want to specify the total count across all panels as the percentage base, use the `acrossPanels` function.

Examples

```
COORD: rect(dim(1,2))
ELEMENT: interval(position(summary.percent(summary.count(jobcat),
                 base.all())))
```

*Figure 94. Example: Specifying the total count as the percentage base*

```
COORD: rect(dim(1,2))
ELEMENT: interval(position(summary.percent(summary.count(jobcat*1*gender),
                 base.all())))
```

*Figure 95. Example: Specifying the total count in each panel as the percentage base*

```
COORD: rect(dim(1,2))
ELEMENT: interval(position(summary.percent(summary.count(jobcat*1*gender),
                 base.all(acrossPanels()))))
```

*Figure 96. Example: Specifying the total count across all panels as the percentage base*

**Applies To**

"region.confi.percent.count Function" on page 200
"region.confi.proportion.count Function" on page 202
"summary.percent Function" on page 270
"summary.percent.count Function" on page 271
"summary.percent.count.cumulative Function" on page 274
"summary.percent.cumulative Function" on page 276

"summary.percent.sum Function" on page 278
"summary.percent.sum.cumulative Function" on page 281
"summary.proportion Function" on page 288
"summary.proportion.count Function" on page 289
"summary.proportion.count.cumulative Function" on page 292
"summary.proportion.cumulative Function" on page 294
"summary.proportion.sum Function" on page 294
"summary.proportion.sum.cumulative Function" on page 297

## base.coordinate Function

Syntax

```
base.coordinate(dim(<numeric>))
```

**<numeric>**. A numeric value indicating the dimension to which the scale applies. See the topic "dim Function" on page 124 for more information.

Description

Specifies that the percentage is based on the individual values along a specific dimension. Summing the percentages of all of the graphic elements with a particular value on the specified dimension equals 100%. For example, you may do this to specify that the segments in each stacked bar sum to 100%.

Examples

```
ELEMENT: interval.stack(position(summary.percent(summary.count(jobcat*1*gender),
         base.coordinate(dim(1)))), color(gender))
```

*Figure 97. Example: Making each stack equal 100%*

```
COORD: rect(dim(1,2), cluster(3))
ELEMENT: interval(position(summary.percent(summary.count(gender*1*jobcat),
         base.coordinate(dim(3)))), color(gender))
```

*Figure 98. Example: Making each cluster equal 100%*

**Applies To**

"region.confi.percent.count Function" on page 200
"region.confi.proportion.count Function" on page 202
"summary.percent Function" on page 270
"summary.percent.count Function" on page 271
"summary.percent.count.cumulative Function" on page 274
"summary.percent.cumulative Function" on page 276
"summary.percent.sum Function" on page 278
"summary.percent.sum.cumulative Function" on page 281
"summary.proportion Function" on page 288
"summary.proportion.count Function" on page 289
"summary.proportion.count.cumulative Function" on page 292
"summary.proportion.cumulative Function" on page 294
"summary.proportion.sum Function" on page 294
"summary.proportion.sum.cumulative Function" on page 297

## begin Function (For GPL Graphs)

Syntax

```
begin(<function>)
```

**<function>**. One or more valid functions. These are optional.

Specifies the start of the GPL block that defines a particular graph.

Examples

```
GRAPH: begin(scale(50%,50%))
```

*Figure 99. Example: Scaling a graph by 50%*

```
GRAPH: begin()
ELEMENT: line(position(x*y))
GRAPH: end()
```

*Figure 100. Example: Defining a particular graph*

**Valid Functions**

"origin Function (For GPL Graphs)" on page 191

"scale Function (For GPL Graphs)" on page 217

**Applies To**

"GRAPH Statement" on page 22

## begin Function (For GPL Pages)

Syntax

```
begin(<function>)
```

**<function>**. One or more valid functions. These are optional.

Specifies the start of the GPL block that defines the page display or visualization.

Examples

```
PAGE: begin(scale(50%,50%))
```

*Figure 101. Example: Scaling a visualization*

**Valid Functions**

"scale Function (For GPL Pages)" on page 218

**Applies To**

"PAGE Statement" on page 22

## beta Function

Syntax

```
beta(<shape>, <shape>)
```

**<shape>**. Numeric values specifying the shape parameters for the distribution. Values must be greater than 0.

Description

Specifies a beta distribution for the probability scale.

Examples

```
SCALE: prob(dim(2), beta(2, 5))
```

*Figure 102. Example: Specifying a beta distribution for the probability scale*

**Applies To**

"prob Scale" on page 37

## bin.dot Function

Syntax

```
bin.dot.<position>(<algebra>, dim(<numeric>), <function>)
```

*or*

```
bin.dot.<position>(<binning function>, dim(<numeric>), <function>)
```

*or*

```
bin.dot.<position>(<statistic function>, dim(<numeric>), <function>)
```

**<position>**. The position at which a graphic element representing the bins is drawn. `center` is the graphical middle of the bin and makes it less likely that the graphic elements will overlap. `centroid` positions the graphic element at the centroid location of the values it represents. The coordinates of the centroid are the weighted means for each dimension. Specifying the position is optional. If none is specified, `center` is used.

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<numeric>**. One or more numeric values (separated by commas) indicating the graph dimension or dimensions in which to bin the data. Using `dim()` is optional. Specifying the dimensions is necessary only when you want to bin a specific non-default dimension or multiple dimensions, for example when binning a 2-D scatterplot. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<binning function>**. A binning function.

**<statistic function>**. A statistic function.

Description

Creates irregularly spaced bins of graphic elements that have nearly identical values. When data are sparse, `bin.dot` centers the bins on the data. This function is typically used to create a dot plot.

Examples

```
ELEMENT: point.stack.asymmetric(position(bin.dot(salary)))
```

*Figure 103. Example: Creating a 1-D dot plot*

Statistic Functions

See "GPL Functions" on page 56.

**Valid Functions**

"binCount Function" on page 79

"binStart Function" on page 80

**Binning Functions**



**Applies To**

## bin.hex Function

Syntax

```
bin.hex.<position>(<algebra>, dim(<numeric>), <function>)
```

*or*

```
bin.hex.<position>(<binning function>, dim(<numeric>), <function>)
```

*or*

```
bin.hex.<position>(<statistic function>, dim(<numeric>), <function>)
```

**<position>**. The position at which a graphic element representing the bins is drawn. `center` is the graphical middle of the bin and makes it less likely that the graphic elements will overlap. `centroid` positions the graphic element at the centroid location of the values it represents. The coordinates of the centroid are the weighted means for each dimension. Specifying the position is optional. If none is specified, `center` is used.

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<numeric>**. One or more numeric values (separated by commas) indicating the graph dimension or dimensions in which to bin the data. Using `dim()` is optional.Specifying the dimensions is necessary only when you want to bin a specific non-default dimension or multiple dimensions, for example when binning a 2-D scatterplot. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<binning function>**. A binning function.

**<statistic function>**. A statistic function.

Description

Creates hexagonal bins for grouping similar cases. `bin.hex` is most often used when creating binned scatterplots or other binned multivariate graphs.

Examples

```
ELEMENT: point(position(bin.hex(salbegin*salary, dim(1,2))), size(summary.count()))
```

*Figure 104. Example: Binned scatterplot*

```
ELEMENT: polygon(position(bin.hex(salbegin*salary, dim(1,2))), color(summary.count()))
```

*Figure 105. Example: Binned polygon*

Statistic Functions

See “GPL Functions” on page 56.
**Valid Functions**
“binCount Function” on page 79
“binStart Function” on page 80
“binWidth Function” on page 81
**Binning Functions**
“bin.dot Function” on page 70
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
**Applies To**
“bin.dot Function” on page 70
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“density.beta Function” on page 93
“density.chiSquare Function” on page 96
“density.exponential Function” on page 98
“density.f Function” on page 100
“density.gamma Function” on page 102
“density.logistic Function” on page 108
“density.normal Function” on page 110
“density.poisson Function” on page 112
“density.studentizedRange Function” on page 115
“density.t Function” on page 117
“density.uniform Function” on page 119
“density.weibull Function” on page 121
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159

"summary.sum.cumulative Function" on page 315
"summary.variance Function" on page 317

## bin.quantile.letter Function

Syntax

```
bin.quantile.letter(<algebra>)
```

*or*

```
bin.quantile.letter(<binning function>)
```

*or*

```
bin.quantile.letter(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. A statistic function.

Description

Calculates the five statistics (minimum, first quartile, median, third quartile, and maximum) used in box plots. The data are binned appropriately as a result of the statistical calculation. `bin.quantile.letter` is used with the schema element to generate a box plot.

Examples

```
ELEMENT: schema(position(bin.quantile.letter(jobcat*salary)))
```

*Figure 106. Example: Creating a box plot*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.rect Function" on page 77
"density.beta Function" on page 93
"density.chiSquare Function" on page 96
"density.exponential Function" on page 98
"density.f Function" on page 100
"density.gamma Function" on page 102
"density.logistic Function" on page 108
"density.normal Function" on page 110
"density.poisson Function" on page 112
"density.studentizedRange Function" on page 115

## bin.rect Function

Syntax

```
bin.rect.<position>(<algebra>, dim(<numeric>), <function>)
```

*or*

```
bin.rect.<position>(<binning function>, dim(<numeric>), <function>)
```

*or*

```
bin.rect.<position>(<statistic function>, dim(<numeric>), <function>)
```

**<position>**. The position at which a graphic element representing the bins is drawn. `center` is the graphical middle of the bin and makes it less likely that the graphic elements will overlap. `centroid` positions the graphic element at the centroid location of the values it represents. The coordinates of the centroid are the weighted means for each dimension. Specifying the position is optional. If none is specified, `center` is used.

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<numeric>**. One or more numeric values (separated by commas) indicating the graph dimension or dimensions in which to bin the data. Using `dim()` is optional. Specifying the dimensions is necessary only when you want to bin a specific non-default dimension or multiple dimensions--for example, when binning a 2-D scatterplot. See the topic "dim Function" on page 124 for more information.

**<function>**. One or more valid functions. These are optional.

**<binning function>**. A binning function.

**<statistic function>**. A statistic function.

Description

Creates rectangular bins for grouping similar cases. `bin.rect` is the binning method commonly used in histograms to calculate the count in each bin.

Examples

```
ELEMENT: interval(position(summary.count(bin.rect(salary))))
```

*Figure 107. Example: Histogram binning*

```
ELEMENT: interval(position(summary.count(bin.rect(salary, binWidth(5000)))))
```

*Figure 108. Example: Histogram binning with specified bin sizes*

```
ELEMENT: point(position(summary.count(bin.rect(salbegin*salary, dim(1,2)))),
               size(summary.count()))
```

*Figure 109. Example: Binned scatterplot*

Statistic Functions

See “GPL Functions” on page 56.

**Valid Functions**

“binCount Function” on page 79
“binStart Function” on page 80
“binWidth Function” on page 81

**Binning Functions**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75

**Applies To**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“density.beta Function” on page 93
“density.chiSquare Function” on page 96
“density.exponential Function” on page 98
“density.f Function” on page 100
“density.gamma Function” on page 102
“density.logistic Function” on page 108
“density.normal Function” on page 110
“density.poisson Function” on page 112
“density.studentizedRange Function” on page 115
“density.t Function” on page 117
“density.uniform Function” on page 119
“density.weibull Function” on page 121
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.spread.sd Function” on page 209

## binCount Function

Syntax

```
binCount(<integer> ...)
```

**<integer>**. An integer indicating the number of bins. If there are multiple binned dimensions, you can specify the number of bins for each dimension. Use commas to separate the multiple counts. For example, `binCount(15,10)` specifies 15 bins for dimension 1 and 10 for dimension 2. `0` specifies the default for a dimension. So, `binCount(0,10)` specifies the default number of bins for dimension 1 and 10 bins for dimension 2.

Description

Specifies the number of bins.

Examples

```
ELEMENT: interval(position(summary.count(bin.rect(salary, binCount(25)))))
```

*Figure 110. Example: Defining a specific number of bins*

```
ELEMENT: interval(position(bin.rect(salbegin*salary, dim(1,2), binCount(25,25))))
```

*Figure 111. Example: Defining a specific number of bins for multiple binned dimensions*

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.rect Function" on page 77

## binStart Function

Syntax

```
binStart(<value> ...)
```

**<value>**. An integer or quoted date literal indicating the value of the first bin. If there are multiple binned dimensions, you can specify the first bin for each dimension. Use commas to separate the multiple first bins. For example, `binStart(0,10)` specifies 0 as the first bin on dimension 1 and 10 as the first bin on dimension 2. If you specify a value for one dimension, you have to specify a value for all dimensions.

Description

Specifies the value of the first bin. You can use the function to make sure bins begin at a specified value, regardless of the data values. Note that the first bin may not be drawn if there are no actual data values in that bin. However, the bin is still included when determining the number of bins and their widths.

If the specified value is greater than the lowest data value on the dimension, this function does not really specify the starting value of the first bin because the function can never exclude smaller values from the bins. Rather, the function specifies the starting value for some other bin, depending on the width or number of bins. There may be one or more bins that precede the specified value.

Examples

```
ELEMENT: interval(position(summary.count(bin.rect(salary, binStart(10000)))))
```

*Figure 112. Example: Specifying the first bin on a continuous scale*

```
ELEMENT: interval(position(summary.count(bin.rect(saledate, binStart("01/20/2003")))))
```

*Figure 113. Example: Specifying the first bin on a date scale*

```
ELEMENT: interval(position(bin.rect(x*y, dim(1,2), binStart(2000,1000))))
```

*Figure 114. Example: Specifying the first bin for multiple binned dimensions*

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.rect Function" on page 77

## binWidth Function

Syntax

```
binWidth(<numeric> ...)
```

**<numeric>**. A positive numeric value indicating the width of the bins. If the data being binned are dates, the value indicates days or seconds, depending on the underlying data. To specify an explicit unit, append `d` or `s` to the value to indicate days or seconds, respectively. If there are multiple binned dimensions, you can specify the bin width for each dimension. Use commas to separate the multiple widths. For example, `binWidth(100,200)` specifies 100 as the bin width for dimension 1 and 200 as the bin width for dimension 2. `0` specifies the default for a dimension. So, `binWidth(0,200)` specifies the default bin width for dimension 1 and 200 as the bin width for dimension 2.

Description

Specifies the width of the bins.

Examples

```
ELEMENT: interval(position(summary.count(bin.rect(salary, binWidth(1000)))))
```

*Figure 115. Example: Defining a specific bin width*

```
ELEMENT: interval(position(bin.rect(salbegin*salary, dim(1,2), binWidth(1000,2000))))
```

*Figure 116. Example: Defining a specific bin width for multiple binned dimensions*

```
ELEMENT: interval(position(summary.count(bin.rect(date, binWidth(30d)))))
```

*Figure 117. Example: Defining a specific bin width for date data*

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.rect Function" on page 77

## chiSquare Function

Syntax

```
chiSquare(<degrees of freedom>)
```

**<degrees of freedom>**. Numeric value specifying the degrees of freedom parameter for the distribution. This value must be greater than 0.

Description

Specifies a chi-square distribution for the probability scale.

Examples

```
SCALE: prob(dim(2), chiSquare(5))
```

**Applies To**

"prob Scale" on page 37

## closed Function

Syntax

```
closed()
```

Description

Specifies that the end point of a graphic element is connected to its start point. In polar coordinates, this results in a closed loop around the center of the coordinate system.

Examples

```
ELEMENT: line(position(x*y), closed())
```

*Figure 118. Example: Creating a closed line*

**Applies To**

"area Element" on page 47
"edge Element" on page 48
"line Element" on page 49
"path Element" on page 50

## cluster Function

Syntax

```
cluster(<integer> ...)
```

**<integer>**. One or more integers indicating the variable or variables in the algebra along whose axis the clustering occurs.

Description

Clusters graphic elements along a specific axis. You can also cluster graphic elements on more than one axis in 3-D charts.

Examples

```
COORD: rect(dim(1,2), cluster(3))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)), color(jobcat))
```

*Figure 119. Example: Clustering on the first dimension in a 2-D coordinate system*

In this example, *jobcat* is clustered in *gender*. Compare the position of the numbers in `dim()` to the positions of the numbers in `cluster()`. In this case, the 1 in `dim` and 3 in `cluster` are the first numbers in their respective functions. Therefore, clustering occurs on dim(3) (*gender*), and dim(1) (*jobcat*) specifies the variable that defines the graphic elements in each cluster. If you removed the `cluster` function, the chart would look similar, but dim(3) would specify a paneling facet and dim(1) would be the *x* axis. The clustering collapses multiple panels into one, changing the way dimensions are displayed. For example, compare the following graphs.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2), cluster(3))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Gender"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)), color(jobcat))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2), cluster(3))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Gender"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)), color(jobcat))
```

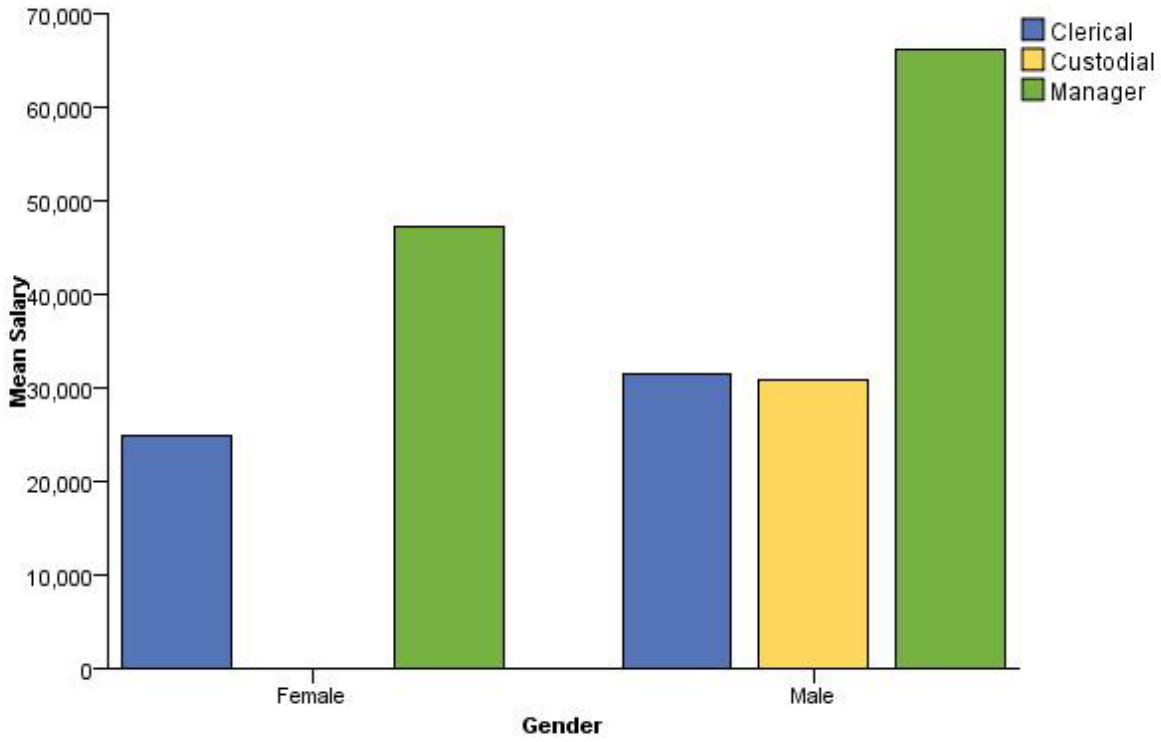


*Figure 120. Clustered bar chart*

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: linear(dim(2), include(0.0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: linear(dim(2), include(0.0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)))
```

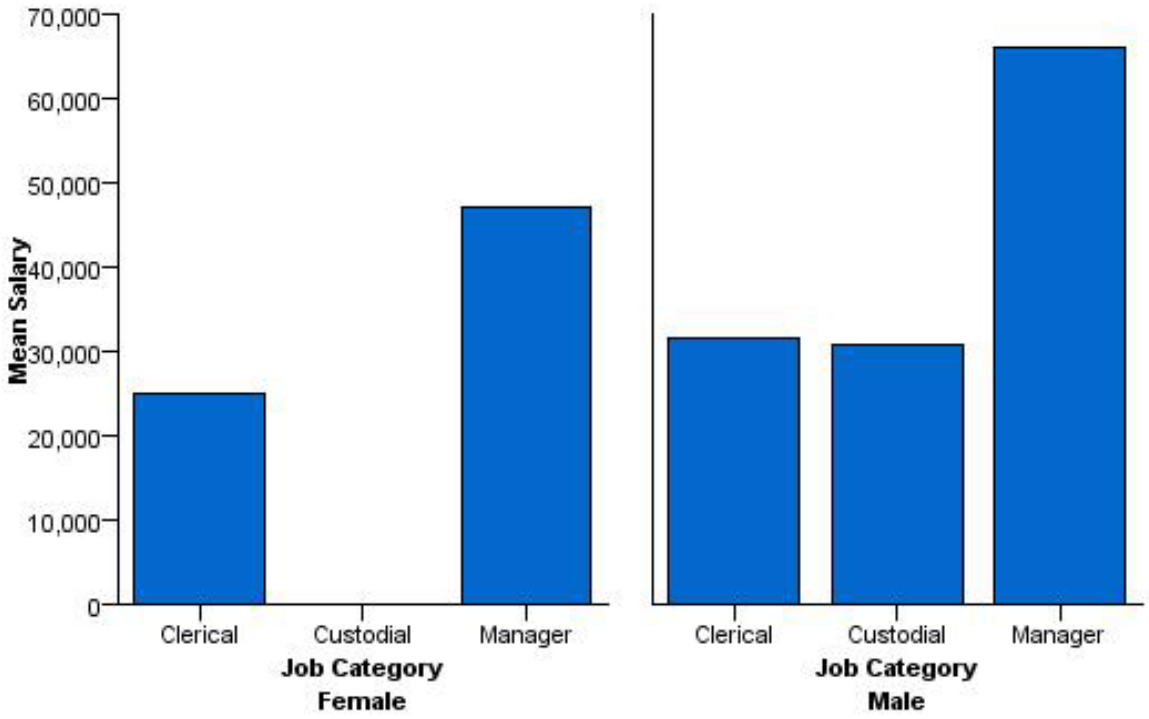


*Figure 121. Faceted bar chart*

```
COORD: rect(dim(1,2,3), cluster(4,0,0))
ELEMENT: interval(position(summary.mean(jobcat*gender*salary*minority)),
                  color(jobcat))
```

*Figure 122. Example: Clustering on the first dimension in a 3-D coordinate system*

In this example, *jobcat* is clustered in *minority*. The first parameter of `cluster` is 4. This indicates that the first variable (*jobcat*) in the algebra is clustered in the fourth variable (*minority*). As in the 2-D example, removing the `cluster` function would result in a paneled chart.

```
COORD: rect(dim(1,2,3), cluster(0,4,0))
ELEMENT: interval(position(summary.mean(minority*jobcat*salary*gender)),
                  color(gender))
```

*Figure 123. Example: Clustering on the second dimension in a 3-D coordinate system*

In this example, *jobcat* is clustered in *gender*. The first parameter of `cluster` is 0, which indicates that dim(1) (*minority*) is not affected by the clustering. The second parameter of `cluster` is 4. This indicates that the second variable (*jobcat*) in the algebra is clustered in the fourth variable (*gender*).

**Applies To**

"rect Coordinate Type" on page 28

## col Function

Syntax

```
col(source(<source name>), name("variable name"), <type>, <function>)
```

**<source name>**. A data source previously defined by a `SOURCE` statement.

**"variable name"**. The name of the variable in the data source.

**<type>**. A data type or measurement level. If no type is specified, the variable is assumed to be continuous.

**<function>**. One or more valid functions. These are optional.

Description

Extracts a column of data from a data source. This is used for creating variables from the data.

Examples

```
DATA: age = col(source(mydata), name("age"))
```

*Figure 124. Example: Specifying a continuous variable from a data source*

```
DATA: gender = col(source(mydata), name("gender"), unit.category())
```

*Figure 125. Example: Specifying a categorical variable from a data source*

```
DATA: date = col(source(mydata), name("date"), unit.time(), format("M/d/yyyy"))
```

*Figure 126. Example: Specifying a date variable from a data source*

Valid Types

**unit.category**. Specifies a categorical variable.

**unit.time**. Specifies a date variable. You will often need to specify the date format if using this type. *Note*: In IBM® SPSS® Statistics, dates from a `userSource` are passed to GPL as numeric values and are specified as continuous variables. Therefore, you should not use this type with a `userSource`.See the topic "format Function" on page 131 for more information.

**Valid Functions**

"in Function" on page 135

"format Function" on page 131

"notIn Function" on page 190

**Applies To**

"DATA Statement" on page 24

## collapse Function

Syntax

```
collapse(category(<algebra>), minimumPercent(<numeric>), sumVariable(<algebra>),
        otherValue("label"))
```

**<algebra>**. Graph algebra, although in this case, the algebra should identify only one variable. The variable in `category()` identifies the variable whose categories are collapsed. The variable in `sumVariable()` identifies the variable whose sum for the total compared to the sum for a particular category determines whether the category is collapsed.

**<numeric>.** A numeric value between 0 and 100 indicating a percentage. A category is collapsed if its sum is less than the specified percentage of the total sum for `sumVariable`.

**"label".** The label for the new variable containing the collapsed categories. This is the text that identifies the variable in the graph.

Description

Collapse small categories of a categorical variable to create a new categorical variable. The function collapses the categories by recoding them to the value specified by `otherValue`.

Examples

```
TRANS: educ_collapse = collapse(category(educ), minimumPercent(10), sumVariable(salary),
                                otherValue("Other"))
ELEMENT: interval(position(summary.sum(educ_collapse*salary))))
```

*Figure 127. Example: Collapsing categories whose sum is less than 10% of total*

**Applies To**

"TRANS Statement" on page 24

## color Function (For GPL Graphic Elements)

*Note:* If you are modifying the color for a guide, refer to "color Function (For GPL Guides)" on page 87.

Syntax

```
color(<algebra>)
```

*or*

```
color(color.<color constant>)
```

*or*

```
color(color."color value")
```

*or*

```
color(<statistic function>)
```

**<algebra>**. Graph algebra, using one variable or a blend of variables. Each unique variable value results in a different color. For example, if you were creating a stacked bar chart, the argument of the color function would be the variable that controls the stacking. Each stack segment would be a different color.

**<color constant>**. A constant indicating a specific color, such as `red`. See the topic "Color Constants" on page 413 for more information. Color constants can also be blended (for example, `color.blue+color.red`).

**"color value"**. A specific value that indicates the hexadecimal RGB color components (for example, `color."6666FF"`).

**<statistic function>**. A statistic function.

Description

Controls the color of the graphic elements. To specify the color explicitly for the fill or border of the graphic element, you can append `.interior` or `.exterior` to the function. Using `color` without a qualifier implies `color.interior`.

Examples

```
ELEMENT: line(position(x*y), color(color.red))
```

*Figure 128. Example: Specifying a color value with a constant*

```
ELEMENT: line(position(x*y), color(color."FF0000"))
```

*Figure 129. Example: Specifying a color value with RGB color components*

```
ELEMENT: interval(position(x*y), color.exterior(color.red))
```

*Figure 130. Example: Specifying a color value for the bar border*

```
ELEMENT: point(position(x*y), color(z))
```

*Figure 131. Example: Using the values of a variable to control color*

```
ELEMENT: interval(position(summary.mean(jobcat*salary)),
        color(summary.count()))
```

*Figure 132. Example: Using a statistical function to control color*

Statistic Functions

See "GPL Functions" on page 56.

**Applies To**

"area Element" on page 47
"edge Element" on page 48
"interval Element" on page 49
"line Element" on page 49
"path Element" on page 50
"point Element" on page 51
"polygon Element" on page 52
"schema Element" on page 53

## color Function (For GPL Guides)

*Note:* If you are modifying the color for a graphic element (like a bar or point), refer to "color Function (For GPL Graphic Elements)" on page 86.

Syntax

```
color(color.<color constant>)
```

*or*

```
color(color."color value")
```

**<color constant>**. A constant indicating a specific color, such as `red`. See the topic "Color Constants" on page 413 for more information.

**"color value"**. A specific value that indicates the hexadecimal RGB color components (for example, `color."6666FF"`).

Description

Controls the color of guides, such as axes and reference lines.

Examples

```
GUIDE: axis(dim(2), color(color.blue))
```

*Figure 133. Example: Specifying an axis color*

**Applies To**

"axis Guide Type" on page 42
"form.line Guide Type" on page 43

## color.brightness Function (For GPL Graphic Elements)

*Note:* If you are modifying the brightness for a guide, refer to "color.brightness Function (For GPL Guides)".

Syntax

```
color.brightness(<algebra>)
```

*or*

```
color.brightness(color.brightness."brightness value")
```

*or*

```
color.brightness(<statistic function>)
```

**<algebra>**. Graph algebra, using one variable or a blend of variables. Each variable value results in a different level of color brightness.

**"brightness value"**. A value between 0 and 1 that indicates the level of brightness. A value of 1 indicates full brightness, while a value of 0 indicates no brightness (black).

**<statistic function>**. A statistic function.

Description

Controls the color brightness of the graphic elements. To specify the color brightness explicitly for the fill or border of the graphic element, you can append `.interior` or `.exterior` to the function. Using `color.brightness` without a qualifier implies `color.brightness.interior`.

Examples

```
ELEMENT: point(position(x*y), color.brightness(z), color(color.blue))
```

*Figure 134. Example: Using the values of a variable to control color brightness*

```
ELEMENT: interval(position(summary.mean(jobcat*salary)),
         color.brightness(summary.count()))
```

*Figure 135. Example: Using a statistical function to control color brightness*

Statistic Functions

See "GPL Functions" on page 56.

**Applies To**

"area Element" on page 47
"edge Element" on page 48
"interval Element" on page 49
"line Element" on page 49
"path Element" on page 50
"point Element" on page 51
"polygon Element" on page 52
"schema Element" on page 53

## color.brightness Function (For GPL Guides)

*Note:* If you are modifying the brightness for a graphic element (like a bar or point), refer to "color.brightness Function (For GPL Graphic Elements)".

Syntax

```
color.brightness(color.brightness."brightness value")
```

**"brightness value"**. A value between 0 and 1 that indicates the level of brightness. A value of 1 indicates full brightness, while a value of 0 indicates no brightness (black).

Description

Controls the brightness of reference lines.

Examples

```
GUIDE: form.line(position(*,2000), color.brightness(color.brightness."0.5"))
```

*Figure 136. Example: Specifying a reference line brightness*

**Applies To**

"form.line Guide Type" on page 43

## color.hue Function (For GPL Graphic Elements)

*Note:* If you are modifying the hue for a guide, refer to "color.hue Function (For GPL Guides)" on page 90.

Syntax

```
color.hue(<algebra>)
```

*or*

```
color.hue(color.hue."hue value")
```

*or*

```
color.hue(<statistic function>)
```

**<algebra>**. Graph algebra, using one variable or a blend of variables. Each variable value results in a different color hue.

**"hue value"**. A value between 0 and 1 that indicates the hue level.

**<statistic function>**. A statistic function.

Description

Controls the color hue of the graphic elements. To specify the color hue explicitly for the fill or border of the graphic element, you can append `.interior` or `.exterior` to the function. Using `color.hue` without a qualifier implies `color.hue.interior`.

`color.hue` requires a base color other than white or black. Use `color.interior` or `color.exterior` to set the base color.

Examples

```
ELEMENT: point(position(x*y), color.hue(z), color(color.blue))
```

*Figure 137. Example: Using the values of a variable to control color hue*

```
ELEMENT: interval(position(summary.mean(jobcat*salary)),
         color.hue(summary.count()))
```

*Figure 138. Example: Using a statistical function to control color hue*

Statistic Functions

See “GPL Functions” on page 56.

**Applies To**

“area Element” on page 47
“edge Element” on page 48
“interval Element” on page 49
“line Element” on page 49
“path Element” on page 50
“point Element” on page 51
“polygon Element” on page 52
“schema Element” on page 53

## color.hue Function (For GPL Guides)

*Note:* If you are modifying the hue for a graphic element (like a bar or point), refer to “color.hue Function (For GPL Graphic Elements)” on page 89.

Syntax

```
color.hue(color.brightness."hue value")
```

**"hue value"**. A value between 0 and 1 that indicates the hue level.

Description

Controls the hue of reference lines.

Examples

```
GUIDE: form.line(position(*,2000), color.hue(color.hue."0.5"))
```

*Figure 139. Example: Specifying a reference line hue*

**Applies To**

“form.line Guide Type” on page 43

## color.saturation Function (For GPL Graphic Elements)

*Note:* If you are modifying the saturation for a guide, refer to “color.saturation Function (For GPL Guides)” on page 91.

Syntax

```
color.saturation(<algebra>)
```

*or*

```
color.saturation(color.saturation."saturation value")
```

*or*

```
color.saturation(<statistic function>)
```

**<algebra>**. Graph algebra, using one variable or a blend of variables. Each variable value results in a different level of color saturation.

**"saturation value"**. A value between 0 and 1 that indicates the saturation level. A value of 1 indicates full saturation, while a value of 0 indicates no saturation (gray).

**<statistic function>**. A statistic function.

Description

Controls the color saturation of the graphic elements. To specify the color saturation explicitly for the fill or border of the graphic element, you can append `.interior` or `.exterior` to the function. Using `color.saturation` without a qualifier implies `color.saturation.interior`.

Examples

```
ELEMENT: point(position(x*y), color.saturation(z), color(color.blue))
```

*Figure 140. Example: Using the values of a variable to control color saturation*

```
ELEMENT: interval(position(summary.mean(jobcat*salary)),
        color.saturation(summary.count()))
```

*Figure 141. Example: Using a statistical function to control color*

Statistic Functions

See "GPL Functions" on page 56.

**Applies To**

"area Element" on page 47
"edge Element" on page 48
"interval Element" on page 49
"line Element" on page 49
"path Element" on page 50
"point Element" on page 51
"polygon Element" on page 52
"schema Element" on page 53

## color.saturation Function (For GPL Guides)

*Note:* If you are modifying the saturation for a graphic element (like a bar or point), refer to "color.saturation Function (For GPL Graphic Elements)" on page 90.

Syntax

```
color.saturation(color.saturation."saturation value")
```

**"saturation value"**. A value between 0 and 1 that indicates the saturation level. A value of 1 indicates full saturation, while a value of 0 indicates no saturation (gray).

Description

Controls the saturation of reference lines.

Examples

```
GUIDE: form.line(position(*,2000), color.saturation(color.saturation."0.5"))
```

*Figure 142. Example: Specifying a reference line saturation*

**Applies To**

"form.line Guide Type" on page 43

## csvSource Function

Syntax

```
csvSource(file("file path"), key("key name"), <function>)
```

**"file path"**. The path to the CSV file. This can be an absolute or relative path. The path is relative to the location of the application that parses the GPL code. Backslashes must be escaped with another backslash. You can also use forward slashes.

**"key name"**. The name of a variable in the file that acts as a key. The key is used to link multiple sources, especially a dataset and a map file.

**<function>**. One or more valid functions. These are optional.

Description

Reads the contents of a comma-separated values (CSV) file. This function is used to assign the contents of the file to a data source.

Examples

```
SOURCE: mydata = csvSource(file("/Data/Employee data.csv"))
```

*Figure 143. Example: Reading a CSV file*

**Valid Functions**

"missing.listwise Function" on page 187
"missing.pairwise Function" on page 188
"weight Function" on page 326

**Applies To**

"SOURCE Statement" on page 23

## dataMaximum Function

Syntax

```
dataMaximum()
```

Description

Specifies that the maximum of the scale is exactly the same as the maximum of the data. Otherwise, a "nice" maximum is used. For example, if the last data value is 97, a "nice" maximum for the scale may be 100. `dataMaximum` forces the scale to end at 97.

Examples

```
SCALE: linear(dim(2), dataMaximum())
```

*Figure 144. Example: Specifying a maximum on the 2nd dimension (y axis)*

**Applies To**

"cLoglog Scale" on page 32
"linear Scale" on page 34
"log Scale" on page 34
"pow Scale" on page 36

"safeLog Scale" on page 38
"safePower Scale" on page 39
"time Scale" on page 40

## dataMinimum Function

Syntax

```
dataMinimum()
```

Description

Specifies that minimum of the scale is exactly the same as the minimum of the data. Otherwise, a "nice" minimum is used. For example, if the first data value is 2, a "nice" minimum for the scale may be 0. `dataMinimum` forces the scale to begin at 2.

Examples

```
SCALE: linear(dim(2), dataMinimum())
```

*Figure 145. Example: Specifying a minimum on the 2nd dimension (y axis)*

**Applies To**

"cLoglog Scale" on page 32
"linear Scale" on page 34
"log Scale" on page 34
"pow Scale" on page 36
"safeLog Scale" on page 38
"safePower Scale" on page 39
"time Scale" on page 40

## delta Function

Syntax

```
delta(<numeric>)
```

**<numeric>**. A positive numeric value indicating the difference between major ticks on the axis. If the underlying data along the axis are dates, the value indicates days.

Description

Specifies the difference between major ticks on an axis. Major ticks are the location at which labels are displayed along the axis.

Examples

```
GUIDE: axis(dim(1), delta(1000))
```

*Figure 146. Example: Specifying the distance between major ticks*

**Applies To**

"axis Guide Type" on page 42

## density.beta Function

Syntax

```
density.beta(<algebra>, shape1(<numeric>), shape2(<numeric>), <function>)
```

*or*

```
density.beta(<binning function>, shape1(<numeric>), shape2(<numeric>, <function>))
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra is optional.

**<binning function>**. A binning function. The binning function is optional.

**<numeric>**. `shape1` and `shape2` define the parameters for the distribution. These take numeric values and are **required**.

**<function>**. A valid function. Use `scaledToData("false")` when comparing densities with very different same sizes.

Description

Calculates the probability density for the beta distribution. This is often used to add a distribution curve. The distribution is defined on the closed interval [0, 1]. If you don't see the graphic element for the distribution, check the parameters for the distribution and the range for the *x* axis scale.

Because this function does not estimate parameters from the data, it can be used only for comparison and not for fitting.

Examples

```
ELEMENT: line(position(density.beta(x, shape1(2), shape2(5))))
```

*Figure 147. Example: Adding a beta distribution curve*

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Valid Functions**

"scaledToData Function" on page 218

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165

"summary.sd Function" on page 304
"summary.se Function" on page 306
"summary.se.kurtosis Function" on page 308
"summary.se.skewness Function" on page 311
"summary.sum Function" on page 313
"summary.sum.cumulative Function" on page 315
"summary.variance Function" on page 317
"transparency Function (For GPL Graphic Elements)" on page 322

## density.chiSquare Function

Syntax

```
density.chiSquare(<algebra>, degreesOfFreedom(<integer>), <function>)
```

*or*

```
density.chiSquare(<binning function>, degreesOfFreedom(<integer>), <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra is optional.

**<binning function>**. A binning function. The binning function is optional.

**<integer>**. `degreesOfFreedom` defines the parameter for the distribution. This takes a positive integer and is **required**.

**<function>**. A valid function. Use `scaledToData("false")` when comparing densities with very different same sizes.

Description

Calculates the probability density of the chi-square distribution. This is often used to add a distribution curve. If you don't see the graphic element for the distribution, check the parameter for the distribution and the range for the *x* axis scale.

Because this function does not estimate parameters from the data, it can be used only for comparison and not for fitting.

Examples

```
ELEMENT: line(position(density.chiSquare(x, degreesoffreedom(5))))
```

*Figure 148. Example: Adding a chi-square distribution curve*

**Binning Functions**
"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
**Valid Functions**
"scaledToData Function" on page 218
**Applies To**
"bin.dot Function" on page 70
"bin.hex Function" on page 72

## density.exponential Function

Syntax

```
density.exponential(<algebra>, rate(<numeric>), <function>)
```

*or*

```
density.exponential(<binning function>, rate(<numeric>), <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra is optional.

**<binning function>**. A binning function. The binning function is optional.

**<numeric>**. `rate` defines the parameter for the distribution. This takes a numeric value greater than or equal to 0 and is optional. If the parameter is not specified, it is calculated from the underlying data.

**<function>**. A valid function. Use `scaledToData("false")` when comparing densities with very different same sizes.

Description

Calculates the probability density of the exponential distribution. This is often used to add a distribution curve. If you don't see the graphic element for the distribution, check the parameter for the distribution and the range for the *x* axis scale.

Examples

```
ELEMENT: line(position(density.exponential(x, rate(1.5))))
```

*Figure 149. Example: Adding a chi-square distribution curve*

**Binning Functions**

**Valid Functions**

**Applies To**

## density.f Function

Syntax

```
density.f(<algebra>, degreesOfFreedom1(<integer>), degreesOfFreedom2(<integer>), <function>)
```

*or*

```
density.f(<binning function>, degreesOfFreedom1(<integer>), degreesOfFreedom2(<integer>), <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra is optional.

**<binning function>**. A binning function. The binning function is optional.

**<integer>**. `degreesOfFreedom1` and `degreesOfFreedom2` define the parameters for the distribution. These take positive integers and are **required**.

**<function>**. A valid function. Use `scaledToData("false")` when comparing densities with very different same sizes.

Description

Calculates the probability density of the F distribution. This is often used to add a distribution curve. If you don't see the graphic element for the distribution, check the parameters for the distribution and the range for the *x* axis scale.

Because this function does not estimate parameters from the data, it can be used only for comparison and not for fitting.

Examples

```
ELEMENT: line(position(density.f(x, degreesoffreedom1(5), degreesoffreedom2(2))))
```

*Figure 150. Example: Adding an F distribution curve*

**Binning Functions**


"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77


**Valid Functions**


"scaledToData Function" on page 218


**Applies To**


"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181
"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196
"region.confi.mean Function" on page 198
"region.confi.percent.count Function" on page 200
"region.confi.proportion.count Function" on page 202

## density.gamma Function

Syntax

```
density.gamma(<algebra>, rate(<numeric>), <function>)
```

*or*

```
density.gamma(<binning function>, rate(<numeric>), <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra is optional.

**<binning function>**. A binning function. The binning function is optional.

**<numeric>**. `rate` defines the parameter for the distribution. This takes a positive numeric value and is **required**.

**<function>**. A valid function. Use `scaledToData("false")` when comparing densities with very different same sizes.

Description

Calculates the probability density of the gamma distribution. This is often used to add a distribution curve. If you don't see the graphic element for the distribution, check the parameters for the distribution and the range for the *x* axis scale.

Because this function does not estimate parameters from the data, it can be used only for comparison and not for fitting.

Examples

```
ELEMENT: line(position(density.gamma(x, rate(2.5))))
```

*Figure 151. Example: Adding a gamma distribution curve*

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Valid Functions**

"scaledToData Function" on page 218

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
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"color Function (For GPL Graphic Elements)" on page 86
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"link.alpha Function" on page 154
"link.complete Function" on page 156
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"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165

## density.kernel Function

Syntax

```
density.kernel.<kernel function>(<algebra>, fixedWindow(<numeric>), <function>)
```

*or*

```
density.kernel.<kernel function>(<algebra>, nearestNeighbor(<integer>), <function>)
```

*or*

```
density.kernel.<kernel function>.joint(<algebra>, fixedWindow(<numeric>), <function>)
```

*or*

```
density.kernel.<kernel function>.joint(<algebra>, nearestNeighbor(<integer>), <function>)
```

**<kernel function>**. A kernel function. This specifies how data are weighted by the density function, depending on how close the data are to the current point.

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<numeric>**. `fixedWindow` specifies the proportion of data points to include when calculating the smooth function. This takes a numeric value between 0 and 1 and is **optional**. You also have the option of using the `nearestNeighbor` function to calculate smoother's bandwidth.

**<integer>**. `nearestNeighbor` specifies the *k* number of nearest neighbors to includes when calculating the smooth function. This takes a positive integer and is **optional**. You also have the option of using the `fixedWindow` function to calculate the smoother's bandwidth.

**<function>**. One or more valid functions. These are optional. Use `scaledToData("false")` when comparing densities with very different same sizes.

**joint**. Used to create densities based on values in the first (*x* axis) and second (*y* axis) dimensions. Without the `joint` modifier, the density is based only on values in the first (*x* axis) dimension. You would typically use the modifier for 3-D densities.

Description

Calculates the probability density using a nonparametric kernel function. This is often used to add a distribution curve that does not assume a particular model (like normal or Poisson). You can use the `fixedWindow` function or the `nearestNeighbor` function to specify the smoother's bandwidth. If you do not specify an explicit bandwidth, the internal algorithm uses a fixed window whose size is determined by the underlying data values and the specific kernel function.

Examples

```
ELEMENT: line(position(density.kernel.epanechnikov(x)))
```

*Figure 152. Example: Adding the default kernel distribution*

```
ELEMENT: line(position(density.kernel.epanechnikov(x, fixedWindow(0.05))))
```

*Figure 153. Example: Adding a kernel distribution using a fixed window*

```
ELEMENT: line(position(density.kernel.epanechnikov(x, nearestNeighbor(100))))
```

*Figure 154. Example: Adding a kernel distribution using k nearest neighbors*

```
COORD: rect(dim(1,2,3))
ELEMENT: interval(position(density.kernel.epanechnikov.joint(x*y)))
```

*Figure 155. Example: Creating a 3-D graph showing kernel densities*

Kernel Functions

**uniform.** All data receive equal weights.

**epanechnikov.** Data near the current point receive higher weights than extreme data receive. This function weights extreme points more than the triweight, biweight, and tricube kernels but less than the Gaussian and Cauchy kernels.

**biweight.** Data far from the current point receive more weight than the triweight kernel allows but less weight than the Epanechnikov kernel permits.

**tricube.** Data close to the current point receive higher weights than both the Epanechnikov and biweight kernels allow.

**triweight.** Data close to the current point receive higher weights than any other kernel allows. Extreme cases get very little weight.

**gaussian.** Weights follow a normal distribution, resulting in higher weighting of extreme cases than the Epanechnikov, biweight, tricube, and triweight kernels.

**cauchy.** Extreme values receive more weight than the other kernels, with the exception of the uniform kernel, allow.

**Valid Functions**


“marron Function” on page 184

“scaledToData Function” on page 218

“segments Function” on page 219


**Applies To**


“bin.dot Function” on page 70

“bin.hex Function” on page 72

“bin.quantile.letter Function” on page 75

“bin.rect Function” on page 77

“color Function (For GPL Graphic Elements)” on page 86

“color.brightness Function (For GPL Graphic Elements)” on page 88

“color.hue Function (For GPL Graphic Elements)” on page 89

“color.saturation Function (For GPL Graphic Elements)” on page 90

“link.alpha Function” on page 154

“link.complete Function” on page 156

“link.delaunay Function” on page 159

## density.logistic Function

Syntax

```
density.logistic(<algebra>, location(<numeric>), scaleDensity(<numeric>), <function>)
```

*or*

```
density.logistic(<binning function>, location(<numeric>), scaleDensity(<numeric>), <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra is optional.

**<binning function>**. A binning function. The binning function is optional.

**<integer>**. `location` and `scaleDensity` define the parameters for the distribution. These take numeric values and are **required**.

**<function>**. A valid function. Use `scaledToData("false")` when comparing densities with very different same sizes.

Description

Calculates the probability density of the logistic distribution. This is often used to add a distribution curve. If you don't see the graphic element for the distribution, check the parameters for the distribution and the range for the *x* axis scale.

Because this function does not estimate parameters from the data, it can be used only for comparison and not for fitting.

Examples

```
ELEMENT: line(position(density.logistic(x, location(5), scaleDensity(2))))
```

*Figure 156. Example: Adding a logistic distribution curve*

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Valid Functions**

"scaledToData Function" on page 218

**Applies To**

## density.normal Function

Syntax

```
density.normal(<algebra>, mean(<numeric>), standardDeviation(<numeric>), <function>)
```

*or*

```
density.normal(<binning function>, mean(<numeric>), standardDeviation(<numeric>), <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<numeric>**. `mean` and `standardDeviation` define the parameters for the distribution. These take numeric values. You can use both of them or neither. If no parameters are specified, they are calculated from the underlying data.

**<function>**. A valid function. Use `scaledToData("false")` when comparing densities with very different same sizes.

Description

Calculates the probability density of the normal distribution. This is often used to add a distribution curve.

Examples

```
ELEMENT: interval(position(summary.count(bin.rect(x))))
ELEMENT: line(position(density.normal(x)))
```

*Figure 157. Example: Adding a normal curve to a histogram*

```
ELEMENT: line(position(density.normal(x, mean(50000), standardDeviation(15000))))
```

*Figure 158. Example: Creating a normal curve with specific parameters*

**Binning Functions**


"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77


**Valid Functions**


"scaledToData Function" on page 218


**Applies To**


"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
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"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
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"region.confi.count Function" on page 196
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"region.spread.range Function" on page 207
"region.spread.sd Function" on page 209
"region.spread.se Function" on page 212
"size Function (For GPL Graphic Elements)" on page 221

## density.poisson Function

Syntax

```
density.poisson(<algebra>, rate(<numeric>), <function>)
```

*or*

```
density.poisson(<binning function>, rate(<numeric>), <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra is optional.

**<binning function>**. A binning function. The binning function is optional.

**<numeric>**. `rate` defines the parameter for the distribution. This takes a positive numeric value and is optional. If the parameter is not specified, it is calculated from the underlying data.

**<function>**. A valid function. Use `scaledToData("false")` when comparing densities with very different same sizes.

Description

Calculates the probability density of the Poisson distribution. This is often used to add a distribution curve. If you don't see the graphic element for the distribution, check the parameter for the distribution and the range for the *x* axis scale.

Examples

```
ELEMENT: line(position(density.poisson(x, rate(5.5))))
```

*Figure 159. Example: Adding a Poisson distribution curve*

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Valid Functions**

"scaledToData Function" on page 218

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
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"color Function (For GPL Graphic Elements)" on page 86
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"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181
"position Function (For GPL Graphic Elements)" on page 192

## density.studentizedRange Function

Syntax

```
density.studentizedRange(<algebra>, degreesOfFreedom(<integer>), k(<numeric>), <function>)
```

*or*

```
density.studentizedRange(<binning function>, degreesOfFreedom(<integer>), k(<numeric>), <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra is optional.

**<binning function>**. A binning function. The binning function is optional.

**<integer>** and **<numeric>**. `degreesOfFreedom` and `k` define the parameters for the distribution. `degreesOfFreedom` takes an integer, and `k` takes a numeric value. These are **required**.

**<function>**. A valid function. Use `scaledToData("false")` when comparing densities with very different same sizes.

Description

Calculates the probability density of the Studentized range distribution. This is often used to add a distribution curve. If you don't see the graphic element for the distribution, check the parameters for the distribution and the range for the *x* axis scale.

Because this function does not estimate parameters from the data, it can be used only for comparison and not for fitting.

Examples

```
ELEMENT: line(position(density.studentizedRange(x, degreesOfFreedom(5), k(2.5))))
```

*Figure 160. Example: Adding a Studentized range distribution curve*

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Valid Functions**

"scaledToData Function" on page 218

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
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"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
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"link.alpha Function" on page 154
"link.complete Function" on page 156
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"summary.proportion.sum.cumulative Function" on page 297
"summary.proportionTrue Function" on page 299
"summary.range Function" on page 302
"summary.sd Function" on page 304
"summary.se Function" on page 306
"summary.se.kurtosis Function" on page 308
"summary.se.skewness Function" on page 311
"summary.sum Function" on page 313
"summary.sum.cumulative Function" on page 315
"summary.variance Function" on page 317
"transparency Function (For GPL Graphic Elements)" on page 322

## density.t Function

Syntax

```
density.t(<algebra>, degreesOfFreedom(<integer>), <function>)
```

*or*

```
density.t(<binning function>, degreesOfFreedom(<integer>), <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra is optional.

**<binning function>**. A binning function. The binning function is optional.

**<integer>**. `degreesOfFreedom` defines the parameter for the distribution. `degreesOfFreedom` takes an integer and is **required**.

**<function>**. A valid function. Use `scaledToData("false")` when comparing densities with very different same sizes.

Description

Calculates the probability density of the Student's *t* distribution. This is often used to add a distribution curve. If you don't see the graphic element for the distribution, check the parameters for the distribution and the range for the *x* axis scale.

Because this function does not estimate parameters from the data, it can be used only for comparison and not for fitting.

Examples

```
ELEMENT: line(position(density.t(x, degreesOfFreedom(5))))
```

*Figure 161. Example: Adding a Student's t distribution curve*

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Valid Functions**

"scaledToData Function" on page 218

**Applies To**

## density.uniform Function

Syntax

```
density.uniform(<algebra>, min(<numeric>), max(<numeric>), <function>)
```

*or*

```
density.uniform(<binning function>, min(<numeric>), max(<numeric>), <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function. The binning function is optional.

**<numeric>**. `min` and `max` define the parameters for the distribution. These take numeric values. You can use all of them or none of them. Any missing parameters are calculated from the underlying data.

**<function>**. A valid function. Use `scaledToData("false")` when comparing densities with very different same sizes.

Description

Calculates the probability density of the uniform distribution using the method-of-moments estimate. This is often used to add a distribution curve.

Examples

```
ELEMENT: line(position(density.uniform(x)))
```

*Figure 162. Example: Adding a uniform distribution curve*

**Binning Functions**


“bin.dot Function” on page 70
“bin.hex Function” on page 72
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“bin.rect Function” on page 77


**Valid Functions**


“scaledToData Function” on page 218


**Applies To**


“bin.dot Function” on page 70
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“color Function (For GPL Graphic Elements)” on page 86
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“link.alpha Function” on page 154
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“link.delaunay Function” on page 159
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“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
“region.spread.sd Function” on page 209
“region.spread.se Function” on page 212
“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243
“summary.count Function” on page 245
“summary.count.cumulative Function” on page 247

## density.weibull Function

Syntax

```
density.weibull(<algebra>, rate(<numeric>), scaleDensity(<numeric>), <function>)
```

*or*

```
density.weibull(<binning function>, rate(<numeric>), scaleDensity(<numeric>), <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra is optional.

**<binning function>**. A binning function. The binning function is optional.

**<integer>**. `rate` and `scaleDensity` define the parameters for the distribution. These take numeric values and are **required**.

**<function>**. A valid function. Use `scaledToData("false")` when comparing densities with very different same sizes.

Description

Calculates the probability density of the Weibull distribution. This is often used to add a distribution curve. If you don't see the graphic element for the distribution, check the parameters for the distribution and the range for the *x* axis scale.

Because this function does not estimate parameters from the data, it can be used only for comparison and not for fitting.

Examples

```
ELEMENT: line(position(density.logistic(x, location(5), scaleDensity(2))))
```

*Figure 163. Example: Adding a Weibull distribution curve*

**Binning Functions**


“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77


**Valid Functions**


“scaledToData Function” on page 218


**Applies To**


“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
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“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
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“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
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"transparency Function (For GPL Graphic Elements)" on page 322

## dim Function

Syntax

```
dim(<numeric> ...)
```

**<numeric>**. A numeric value identifying the dimension or dimensions. If you are specifying multiple dimensions, use commas to separate the numeric values.

Description

Specifies the dimension or dimensions to which a coordinate type, scale, guide, or function applies.

To figure out the numeric value associated with a dimension, look at the algebra. Counting the crossings gives the main dimension values. The coordinate system (including any clustering of the coordinate system) doesn't matter.

Consider the following algebra:

```
a*b*c*d
```

The variables in the algebra correspond to the following dimensions:

*Table 2. Variables and dimensions.*

| Variable | Dimension |
|---|---|
| a | dim(1) |
| b | dim(2) |
| c | dim(3) |
| d | dim(4) |

Blended variables cannot be separated. The blend of the two variables corresponds to one dimension. Consider the following:

```
a*(b+c)*d
```

The variables in the algebra correspond to the following dimensions:

*Table 3. Variables and dimensions with blended variables.*

| Variable | Dimension |
|---|---|
| a | dim(1) |
| b+c | dim(2) |
| d | dim(3) |

With nesting, you still count crossed variables, but nested groups are counted only once. To refer to each variable in the nested group, you count from the outside in, using a dot convention. The outermost variable in the nested group gets the primary dimension number (for example, `dim(1)`), and the next variable gets the primary dimension number followed by a dot and a 1 (for example, `dim(1.1)`). Consider the following:

```
a*b/c*d
```

The variables in the algebra correspond to the following dimensions:

| Variable | Dimension |
|---|---|
| a | dim(1) |
| c | dim(2) |
| b | dim(2.1) |
| d | dim(3) |

Examples

```
COORD: rect(dim(1,2))
```

*Figure 164. Example: Specifying a two-dimensional, rectangular coordinate system*

```
GUIDE: axis(dim(2), label("Mean Salary"))
```

*Figure 165. Example: Specifying an axis label for the second dimension*

**Applies To**


"base.coordinate Function" on page 68
"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.rect Function" on page 77
"reflect Function" on page 195
"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28
"axis Guide Type" on page 42
"asn Scale" on page 30
"atanh Scale" on page 31
"cat Scale" on page 32
"cLoglog Scale" on page 32
"linear Scale" on page 34
"log Scale" on page 34
"logit Scale" on page 35
"pow Scale" on page 36
"prob Scale" on page 37
"probit Scale" on page 37
"safeLog Scale" on page 38
"safePower Scale" on page 39
"time Scale" on page 40


## end Function

Syntax

```
end()
```

Description

Specifies the end of the GPL block that defines a particular graph or page.

Examples

```
GRAPH: begin()
ELEMENT: line(position(x*y))
GRAPH: end()
```

*Figure 166. Example: Defining a particular graph*

```
PAGE: begin(scale(400px,300px))
SOURCE: s=csvSource(file("mydata.csv"))
DATA: x=col(source(s), name("x"))
DATA: y=col(source(s), name("y"))
ELEMENT: line(position(x*y))
PAGE: end()
```

*Figure 167. Example: Defining a page*

**Applies To**

"GRAPH Statement" on page 22

"PAGE Statement" on page 22

## eval Function

Syntax

```
eval(<expression>)
```

**<expression>**. A mathematical expression, such as `log(salary)`.

Description

Evaluates a mathematical expression for each case in the data. You can use many different mathematical functions in the expression. See the topic "eval Operators and Functions" on page 127 for more information. If needed, you can wrap the result of a function in another function. Therefore, `datetostring(date())` is a valid expression.

The `eval` function is also useful for evaluating a Boolean expression whose result can be used in the `summary.countTrue`, `summary.percentTrue`, and `summary.proportionTrue` functions. This combination allows you to plot the number or percent of cases greater than or less than a specific value.

Examples

```
TRANS: saldiff = eval(salary-salbegin)
ELEMENT: point(position(summary.mean(jobcat*saldiff)))
```

*Figure 168. Example: Plotting the difference between two variables*

```
DATA: x = iter(-100,100,1)
TRANS: y = eval(x**2)
ELEMENT: line(position(x*y))
```

*Figure 169. Example: Creating a graph from an equation*

```
TRANS: salGreaterThan = eval(salary>50000)
ELEMENT: interval(position(summary.percentTrue(jobcat*salGreaterThan)))
```

*Figure 170. Example: Plotting percent greater than a value*

**Applies To**

"TRANS Statement" on page 24

"collapse Function" on page 85

## eval Operators and Functions

Following are the operators and functions that you can use with the `eval` function. See "eval Function" on page 126 for information about the `eval` function.

*Table 4. Operators*

| Operator | Meaning | Notes |
|---|---|---|
| + | Addition or string concatenation | Using + with numbers adds the numbers. Using it with strings concatenates the strings. |
| - | Subtraction | |
| * | Multiplication | |
| / | Division | |
| () | Grouping | Grouped expressions are calculated before other expressions. |
| ** | Exponentiation | |
| == | Equal | |
| != | Not equal | |
| < | Less than | |
| > | Greater than | |
| <= | Less than or equal to | |
| >= | Greater than or equal to | |
| && | Logical AND | |
| \|\| | Logical OR | |
| ? : | Conditional | These operators are shorthand for *then-else* when evaluating a Boolean operand. For example, `x>15?"High":"Low"` returns "High" if x > 15. Otherwise, the expression returns "Low". |

*Table 5. Mathematical Functions*

| Function | Result | Notes |
|---|---|---|
| abs(n) | The absolute value of *n* | |
| acos(n) | The inverse cosine (arcosine) of *n* | |
| asin(n) | The inverse sine (arcsine) of *n* | |
| atan(n) | The inverse tangent (arctangent) of *n* | |
| atanh(n) | The hyperbolic inverse tangent (hyperbolic arctangent) of *n* | |
| ceil(n) | The smallest integer that is greater than *n* | Round up |
| cos(n) | The cosine of *n* | |
| cosh(n) | The hyperbolic cosine of *n* | |
| exp(n) | *e* raised to the power *n*, where *e* is the base of the natural logarithms | |
| floor(n) | The largest integer that is less than *n* | Round down |
| gamma(n) | The complete Gamma function of *n* | |

*Table 5. Mathematical Functions (continued)*

| Function | Result | Notes |
|---|---|---|
| int(n) | The value of *n* truncated to an integer (toward 0) | |
| lgamma(n) | The logarithm of the complete Gamma function of *n* | |
| log(n) | The natural (base-e) logarithm of *n* | |
| log2(n) | The base-2 logarithm of *n* | |
| log10(n) | The base-10 logarithm of *n* | |
| mod(n, modulus) | The remainder when *n* is divided by *modulus* | |
| pow(n, power) | The value of *n* raised to the power of *power* | |
| round(n) | The integer that results from rounding the absolute value of *n* and then reaffixing the sign. Numbers ending in 0.5 exactly are rounded away from 0. For example, `round(-4.5)` rounds to -5. | |
| sin(n) | The sine of *n* | |
| sinh(n) | The hyperbolic sine of *n* | |
| sqrt(n) | The positive square root of *n* | |
| tan(n) | The tangent of *n* | |
| tanh(n) | The hyperbolic tangent of *n* | |

*Table 6. String Functions*

| Function | Result | Notes |
|---|---|---|
| concatenate(string1, string2) | A string that is the concatenation of *string1* and *string2* | |
| datetostring(date) | The string that results when *date* is converted to a string | |

*Table 6. String Functions (continued)*

| Function | Result | Notes |
|---|---|---|
| indexof(haystack,needle[,divisor]) | A number that indicates the position of the first occurrence of *needle* in *haystack*. The optional third argument, *divisor*, is a number of characters used to divide *needle* into separate strings. Each substring is used for searching and the function returns the first occurrence of any of the substrings. For example, indexof(x, “abcd”) will return the value of the starting position of the complete string "abcd" in the string variable x; indexof(x, “abcd”, 1) will return the value of the position of the first occurrence of any of the values in the string; and indexof(x, “abcd”, 2) will return the value of the first occurrence of either "ab" or "cd". Divisor must be a positive integer and must divide evenly into the length of needle. Returns 0 if *needle* does not occur within *haystack*. | |
| length(string) | A number indicating the length of *string* | |
| lowercase(string) | *string* with uppercase letters changed to lowercase and other characters unchanged | |
| ltrim(string[, char]) | *string* with any leading instances of *char* removed. If *char* is not specified, leading blanks are removed. Char must resolve to a single character. | |
| midstring(string , start, end) | The substring beginning at position *start* of *string* and ending at *end* | |
| numbertostring(n) | The string that results when *n* is converted to a string | |
| replace(target, old, new) | In *target*, instances of *old* are replaced with *new*. All arguments are strings. | |
| rtrim(string[, char]) | *string* with any trailing instances of *char* removed. If *char* is not specified, trailing blanks are removed. Char must resolve to a single character. | |
| stringtodate(string) | The value of the string expression *string* as a date | |
| stringtonumber(string) | The value of the string expression *string* as a number | |
| substring(string, start, length) | The substring beginning at position *start* of *string* and running for length *length* | |
| trim(string) | *string* with any leading and trailing blanks removed | |

*Table 6. String Functions (continued)*

| Function | Result | Notes |
|---|---|---|
| uppercase(string) | *string* with lowercase letters changed to uppercase and other characters unchanged | |

*Table 7. Date and Time Functions*

| Function | Result | Notes |
|---|---|---|
| date() | The current date | |
| time() | The current time | |

*Table 8. Constants*

| Constant | Meaning | Notes |
|---|---|---|
| true | True | |
| false | False | |
| pi | pi | |
| e | Euler's number or the base of the natural logarithm | |

# exclude Function

Syntax

```
exclude("category name" ...)
```

**<category name>**. The string representing the category on the axis. If specifying multiple categories, separate them with commas.

Description

Excludes the categories from the axis. These categories are not displayed on the axis. This function can be used only with categorical scales for dimensions, not scales for aesthetics.

Examples

```
SCALE: cat(dim(1), exclude("No Response"))
```

*Figure 171. Example: Exclude a category*

```
SCALE: cat(dim(1), exclude("No Response", "Didn't Ask"))
```

*Figure 172. Example: Excluding multiple categories*

**Applies To**

"cat Scale" on page 32

# exponent Function

Syntax

```
exponent(<numeric>)
```

**<numeric>**. A numeric value (including negative values) indicating the exponent for the power scale.

Description

Specifies an exponent for a power scale.

Examples

```
SCALE: power(dim(2), exponent(3))
```

*Figure 173. Example: Specifying a different power exponent*

**Applies To**

"pow Scale" on page 36
"safePower Scale" on page 39

## exponential Function

Syntax

```
exponential(<rate>)
```

**<rate>**. Numeric value specifying the rate parameter for the distribution.

Description

Specifies an exponential distribution for the probability scale.

Examples

```
SCALE: prob(dim(2), exponential(1.5))
```

*Figure 174. Example: Specifying an exponential distribution for the probability scale*

**Applies To**

"prob Scale" on page 37

## f Function

Syntax

```
f(<degrees of freedom>, <degrees of freedom>)
```

**<degrees of freedom>**. Numeric values specifying the degrees of freedom parameters for the distribution. Values must be greater than 0.

Description

Specifies an *F* distribution for the probability scale.

Examples

```
SCALE: prob(dim(2), f(5, 2))
```

**Applies To**

"prob Scale" on page 37

## format Function

Syntax

```
format("date format")
```

**<format>**. The date format of the data.

Description

Indicates the input format for a date variable in the source. This function does not change the format for the date; it only specifies the format that GPL should expect. Use one or more of the following abbreviations and date separators to indicate the exact format.

*Table 9. Abbreviations for date formats*

| Abbreviation | Meaning |
|---|---|
| M | Month |
| d | Day |
| y | Year |
| m | Minute |
| s | Second |

*Note*: In IBM SPSS Statistics, dates from a `userSource` are passed to GPL as numeric values. Therefore, this function does not have any affect on a `userSource`.

Examples

```
DATA: date = col(source(mydata), name("date"), unit.time(), format("M/d/yyyy"))
```

*Figure 175. Example: Indicating a date format of the form 1/31/2006*

**Applies To**

"col Function" on page 84

## format.date Function

Syntax

```
format.date()
```

Description

Specifies that the data are formatted as dates when displayed in an axis' tick marks. The underlying data must be dates or times.

Examples

```
GUIDE: axis(dim(1), format.date())
```

*Figure 176. Example: Displaying dates on an axis*

**Applies To**

"axis Guide Type" on page 42

## format.dateTime Function

Syntax

```
format.dateTime()
```

Description

Specifies that the are formatted as dates and times when displayed in an axis' tick marks. The underlying data must be dates or times.

Examples

```
GUIDE: axis(dim(1), format.dateTime())
```

*Figure 177. Example: Displaying dates and times on an axis*

**Applies To**

"axis Guide Type" on page 42

## format.time Function

Syntax

```
format.time()
```

Description

Specifies that the data are formatted times when displayed in an axis' tick marks. The underlying data must be dates or times.

Examples

```
GUIDE: axis(dim(1), format.time())
```

*Figure 178. Example: Displaying times on an axis*

**Applies To**

"axis Guide Type" on page 42

## from Function

Syntax

```
from(<variable name>)
```

**<variable name>**. The name of a variable previously defined in the GPL by a `DATA` statement.

Description

Specifies one of the pair of nodes that defines an edge relation. The is the node that defines the starting point for the edge.

Examples

```
ELEMENT: edge(position(layout.dag(node(id), from(fromVar), to(toVar))))
```

*Figure 179. Example: Creating a directed acyclic graph*

**Applies To**

"layout.circle Function" on page 139
"layout.dag Function" on page 141
"layout.data Function" on page 143
"layout.grid Function" on page 145
"layout.network Function" on page 147
"layout.random Function" on page 150
"layout.tree Function" on page 152

## gamma Function

Syntax

```
gamma(<rate>)
```

**<rate>**. Numeric value specifying the shape parameter for the distribution. This values must be greater than 0.

Description

Specifies a gamma distribution for the probability scale.

Examples

```
SCALE: prob(dim(2), gamma(2.5))
```

*Figure 180. Example: Specifying a gamma distribution for the probability scale*

**Applies To**

"prob Scale" on page 37

## gap Function

Syntax

```
gap(<value>)
```

**<value>**. A number with units (for example, 0px).

Description

Specifies the size of the gap between adjacent axes in a faceted graph. This function is used to close the space between adjacent axes in population pyramids and matrix scatterplots.

Examples

```
GUIDE: axis(dim(3), gap(0px))
```

*Figure 181. Example: Forcing adjacent axes to touch*

**Applies To**

"axis Guide Type" on page 42

## gridlines Function

Syntax

```
gridlines()
```

Description

Specifies that grid lines should be drawn for the axis. These are lines drawn from the major tick marks to the opposite side of the graph. They can assist in determining the exact location of a graphic element in the graph.

Examples

```
GUIDE: axis(dim(2), gridlines())
```

*Figure 182. Example: Displaying grid lines*

**Applies To**

"axis Guide Type" on page 42

## in Function

Syntax

```
in(min(<value>), max(<value>))
```

**<value>**. Numeric values for defining the range that determines which values to include.

Description

Includes only the continuous values that are in the range specified by the `min` and `max` parameters. This function is valid only for continuous variables.

Examples

```
DATA: gender = col(source(mydata), name("salary"),
                        in(min(0), max(50000)))
```

*Figure 183. Example: Including only a subset of continuous values*

**Applies To**

"col Function" on page 84

## include Function

Syntax

```
include(<value> ...)
```

**<value>**. The string representing the category on the axis or a numeric value on the axis. If specifying multiple values, separate them with commas.

Description

Includes the categories or values on the axis or legend, even if the data do not include the categories or values. These categories or values are always displayed on the axis or legend. For example, you may use `include(0)` in a bar chart to ensure bars begin at 0.

Examples

```
SCALE: cat(dim(1), include("No Response"))
```

*Figure 184. Example: Include a category*

```
SCALE: cat(dim(1), include("No Response", "Didn't Ask"))
```

*Figure 185. Example: Including multiple categories*

```
SCALE: linear(dim(2), include(0))
```

*Figure 186. Example: Include a value*

```
SCALE: linear(dim(2), include(0, 100))
```

*Figure 187. Example: Including multiple values*

**Applies To**

"cat Scale" on page 32
"cLoglog Scale" on page 32
"linear Scale" on page 34
"log Scale" on page 34
"pow Scale" on page 36

"safeLog Scale" on page 38
"safePower Scale" on page 39
"time Scale" on page 40

## index Function

Syntax

```
index()
```

Description

Creates a new variable by indexing each case with an integer. The new variable is essentially a case number.

Examples

```
TRANS: casenum = index()
ELEMENT: point(position(x*y), label(casenum))
```

*Figure 188. Example: Create an index variable and label by the variable*

**Applies To**

"TRANS Statement" on page 24
"collapse Function" on page 85

## iter Function

Syntax

```
iter(<from>, <to>, <step>)
```

**<from>**. The first value in the new column. Subsequent values are iterated from this one.

**<to>**. The maximum value that the new column can contain.

**<step>**. A value defining the amount by which values are iterated.

Description

Creates a new column of data with values in a specified range. Intermediate values are calculated by adding the step value to the previous value. For example, `iter(1,5,1)` generates the values 1, 2, 3, 4, 5. `iter(1,10,2)` generates the values 1, 3, 5, 7, 9. Note that 10 is not included in the second example because it cannot be iterated from the previous value.

Examples

```
DATA: x = iter(-100,100,1)
TRANS: y = eval(x**2)
ELEMENT: line(position(x*y))
```

*Figure 189. Example: Creating a graph from an equation*

**Applies To**

"DATA Statement" on page 24

## jump Function

Syntax

```
jump()
```

Description

Used with `smooth.step`, `smooth.step.left`, `smooth.step.center`, and `smooth.step.right` to indicate that the interpolation line or area jumps to the next value. There is no vertical line connecting the values.

Examples

```
ELEMENT: line(position(smooth.step(educ*salary)), jump())
```

*Figure 190. Example: Specifying an interpolation line*

**Applies To**

"area Element" on page 47

"line Element" on page 49

## label Function (For GPL Graphic Elements)

*Note:* If you are modifying the label for a guide (like an axis), refer to "label Function (For GPL Guides)" on page 138.

Syntax

```
label("label text", <function>)
```

*or*

```
label(<algebra>, <function>)
```

*or*

```
label(<statistic function>, <function>)
```

**"label text"**. The text that appears in the label. Multiple strings are concatenated when each string is separated by a comma (for example, `label("This is a ", "long label")`).

**<function>**. One or more valid functions. These are optional.

**<algebra>**. Graph algebra, using one variable or a blend of variables.

**<statistic function>**. A valid statistic function.

Description

Specifies a label for a graphic element. The label appears on the graphic element. Multiple label functions can be specified. The result of each label function is displayed on a separate line in the graph.

Examples

```
ELEMENT: point(position(salbegin*salary), label(gender))
```

*Figure 191. Example: Labeling by another variable*

```
ELEMENT: point(position(summary.count(jobcat)), label(summary.count()))
```

*Figure 192. Example: Labeling by the result of a statistic*

```
ELEMENT: interval(position(summary.mean(jobcat*salary)), label(summary.mean(salary)))
```

*Figure 193. Example: Labeling by the result of a statistic*

```
ELEMENT: interval(position(summary.mean(jobcat*salary)), label("Count:"), label(summary.count()))
```

*Figure 194. Example: Creating a multi-line label*

Statistic Functions

See “GPL Functions” on page 56.

**Valid Functions**

“showAll Function” on page 221

**Applies To**

“area Element” on page 47
“edge Element” on page 48
“interval Element” on page 49
“line Element” on page 49
“path Element” on page 50
“point Element” on page 51
“polygon Element” on page 52
“schema Element” on page 53

## label Function (For GPL Guides)

*Note:* If you are modifying the label for a graphic element (like a bar or point), refer to “label Function (For GPL Graphic Elements)” on page 137.

Syntax

```
label("label text" ...)
```

**"label text"**. The text that appears in the label. You can specify multiple strings by separating the strings with commas (for example, `label("This is a ", "long label")`). The strings are concatenated in the resulting graph.

Description

Specifies a label for a guide (for example, an axis or legend). This is text that is displayed on the resulting graph.

Examples

```
GUIDE: axis(dim(1), label("Job Category"))
```

*Figure 195. Example: Specifying an axis title*

```
GUIDE: legend(aesthetic(aesthetic.color), label("Gender"))
```

*Figure 196. Example: Specifying a legend title*

```
GUIDE: text.title(label("Sales By Region"))
```

*Figure 197. Example: Specifying a graph title*

**Applies To**

“axis Guide Type” on page 42
“form.line Guide Type” on page 43
“legend Guide Type” on page 43
“text.footnote Guide Type” on page 44
“text.subfootnote Guide Type” on page 44

"text.subsubfootnote Guide Type" on page 44
"text.subtitle Guide Type" on page 45
"text.subsubtitle Guide Type" on page 45
"text.title Guide Type" on page 45

## layout.circle Function

Syntax

```
layout.circle(<function>))
```

*or*

```
layout.circle(<algebra>, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra for network graphs is `1*1` because the position of elements is determined by the layout method and is not tied to a coordinate value (such as a value on a dimension). This algebra is implied and needs to be specified for network graphs only when faceting is needed.

**<functions>**. Valid functions. The `from` and `to` functions are required. The `node` function is optional for edges, allowing you to draw edges without a separate node data source.

Description

Lays out graphic elements in a circle. The function is used for network graphs, which are visual representations of data that consist of nodes and relations between nodes (edges). The circle l layout is a layout that can be applied to any graph. It lays out a graph assuming that links are undirected and treats all nodes identically. Nodes are placed only around the perimeter of a circle

*Note:* Network graphs that display nodes and edges require two data sources, one for the unique nodes and one for the edges. If the edge data source includes weights and the weight variable is indicated in the `SOURCE` statement, the weights influence the length of edges in the graph, with higher weights having shorter edges.

Examples

```
ELEMENT: edge(position(layout.circle(node(id), from(fromVar), to(toVar))))
ELEMENT: point(position(layout.circle(node(id), from(fromVar), to(toVar))), label(id))
```

*Figure 198. Example: Creating a circular network diagram*

**Valid Functions**

"from Function" on page 133
"node Function" on page 189
"to Function" on page 321

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154

## layout.dag Function

Syntax

```
layout.dag(<function>))
```

*or*

```
layout.dag(<algebra>, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra for network graphs is `1*1` because the position of elements is determined by the layout method and is not tied to a coordinate value (such as a value on a dimension). This algebra is implied and needs to be specified for network graphs only when faceting is needed.

**<functions>**. Valid functions. The `from` and `to` functions are required. The `node` function is optional for edges, allowing you to draw edges without a separate node data source.

Description

Lays out graphic elements as a directed acyclic graph (DAG). The function is used for network graphs, which are visual representations of data that consist of nodes and relations between nodes (edges). The DAG layout should be used only for directed graphs *without* a primary root node (compare with `layout.tree`). This layout produces tree-like structures from parent nodes down to leaf nodes, so the layout works well with hierarchical data.

*Note:* Network graphs that display nodes and edges require two data sources, one for the unique nodes and one for the edges. If the edge data source includes weights and the weight variable is indicated in the `SOURCE` statement, the weights influence the length of edges in the graph, with higher weights having shorter edges.

Examples

```
ELEMENT: edge(position(layout.dag(node(id), from(fromVar), to(toVar))))
ELEMENT: point(position(layout.dag(node(id), from(fromVar), to(toVar))), label(id))
```

*Figure 199. Example: Creating a directed acyclic graph*

**Valid Functions**

"from Function" on page 133
"node Function" on page 189
"to Function" on page 321

**Applies To**

## layout.data Function

Syntax

```
layout.data(<algebra>, <function>)
```

*or*

```
layout.data(<function>))
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. Unlike other network graphs, the algebra determines the position of elements and ties the position to a specific coordinate value (such as a value on a dimension). You can omit the algebra for edges if you are using algebra in another `ELEMENT` statement to specify the position of the points.

**<functions>**. Valid functions. The `from` and `to` functions are required. The `node` function is optional for edges, allowing you to draw edges without a separate node data source.

Description

Lays out graphic elements in the coordinate positions specified by the data. The function is used for network graphs, which are visual representations of data that consist of nodes and relations between nodes (edges).

*Note:* Network graphs that display nodes and edges require two data sources, one for the unique nodes and one for the edges. If the edge data source includes weights and the weight variable is indicated in the `SOURCE` statement, the weights influence the length of edges in the graph, with higher weights having shorter edges.

Examples

```
ELEMENT: point(position(layout.data(x*y, node(id), from(fromVar), to(toVar))), label(id))
ELEMENT: edge(position(layout.data(node(id), from(fromVar), to(toVar))))
```

*Figure 200. Example: Creating a network diagram*

**Valid Functions**


“from Function” on page 133
“node Function” on page 189
“to Function” on page 321


**Applies To**


“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
“region.confi.proportion.count Function” on page 202
“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
“region.spread.sd Function” on page 209
“region.spread.se Function” on page 212
“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243
“summary.count Function” on page 245
“summary.count.cumulative Function” on page 247
“summary.countTrue Function” on page 250

## layout.grid Function

Syntax

```
layout.grid(<function>))
```

*or*

```
layout.grid(<algebra>, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra for network graphs is `1*1` because the position of elements is determined by the layout method and is not tied to a coordinate value (such as a value on a dimension). This algebra is implied and needs to be specified for network graphs only when faceting is needed.

**<functions>**. Valid functions. The `from` and `to` functions are required. The `node` function is optional for edges, allowing you to draw edges without a separate node data source.

Description

Lays out graphic elements in a grid. The function is used for network graphs, which are visual representations of data that consist of nodes and relations between nodes (edges). The grid layout is a general layout that can be applied to any graph. It lays out a graph assuming that links are undirected and treats all nodes identically. Nodes are placed only at grid points within the space.

*Note:* Network graphs that display nodes and edges require two data sources, one for the unique nodes and one for the edges. If the edge data source includes weights and the weight variable is indicated in the `SOURCE` statement, the weights influence the length of edges in the graph, with higher weights having shorter edges.

Examples

```
ELEMENT: edge(position(layout.grid(node(id), from(fromVar), to(toVar))))
ELEMENT: point(position(layout.grid(node(id), from(fromVar), to(toVar))), label(id))
```

*Figure 201. Example: Creating a grid network diagram*

**Valid Functions**


“from Function” on page 133
“node Function” on page 189
“to Function” on page 321


**Applies To**


“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
“region.confi.proportion.count Function” on page 202

## layout.network Function

Syntax

```
layout.network(<function>))
```

*or*

```
layout.network(<algebra>, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra for network graphs is `1*1` because the position of elements is determined by the layout method and is not tied to a coordinate value (such as a value on a dimension). This algebra is implied and needs to be specified for network graphs only when faceting is needed.

**<functions>**. Valid functions. The `from` and `to` functions are required. The `node` function is optional for edges, allowing you to draw edges without a separate node data source.

Description

Lays out graphic elements in a network. The function is used for network graphs, which are visual representations of data that consist of nodes and relations between nodes (edges). The network layout is a general layout that can be applied to any graph. It lays out a graph assuming that links are undirected and treats all nodes identically. Nodes are placed freely within the space.

*Note:* Network graphs that display nodes and edges require two data sources, one for the unique nodes and one for the edges. If the edge data source includes weights and the weight variable is indicated in the `SOURCE` statement, the weights influence the length of edges in the graph, with higher weights having shorter edges.

Examples

```
ELEMENT: edge(position(layout.network(node(id), from(fromVar), to(toVar))))
ELEMENT: point(position(layout.network(node(id), from(fromVar), to(toVar))), label(id))
```

*Figure 202. Example: Creating a network diagram*

**Valid Functions**

"from Function" on page 133
"node Function" on page 189
"to Function" on page 321

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"layout.tree Function" on page 152
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170

"summary.se.kurtosis Function" on page 308
"summary.se.skewness Function" on page 311
"summary.sum Function" on page 313
"summary.sum.cumulative Function" on page 315
"summary.variance Function" on page 317
"transparency Function (For GPL Graphic Elements)" on page 322

## layout.random Function

Syntax

```
layout.random(<function>))
```

*or*

```
layout.random(<algebra>, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra for network graphs is `1*1` because the position of elements is determined by the layout method and is not tied to a coordinate value (such as a value on a dimension). This algebra is implied and needs to be specified for network graphs only when faceting is needed.

**<functions>**. Valid functions. The `from` and `to` functions are required. The `node` function is optional for edges, allowing you to draw edges without a separate node data source.

Description

Lays out graphic elements randomly. The function is used for network graphs, which are visual representations of data that consist of nodes and relations between nodes (edges). The network layout is a general layout that can be applied to any graph. It lays out a graph assuming that links are undirected and treats all nodes identically. Nodes are placed randomly within the space.

*Note:* Network graphs that display nodes and edges require two data sources, one for the unique nodes and one for the edges. If the edge data source includes weights and the weight variable is indicated in the `SOURCE` statement, the weights influence the length of edges in the graph, with higher weights having shorter edges.

Examples

```
ELEMENT: edge(position(layout.random(node(id), from(fromVar), to(toVar))))
ELEMENT: point(position(layout.random(node(id), from(fromVar), to(toVar))), label(id))
```

*Figure 203. Example: Creating a random network diagram*

**Valid Functions**

"from Function" on page 133
"node Function" on page 189
"to Function" on page 321

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89

## layout.tree Function

Syntax

```
layout.tree(<function>))
```

*or*

```
layout.tree(<algebra>, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra. The algebra for network graphs is `1*1` because the position of elements is determined by the layout method and is not tied to a coordinate value (such as a value on a dimension). This algebra is implied and needs to be specified for network graphs only when faceting is needed.

**<functions>**. Valid functions. The `from` and `to` functions are required. The `node` function is optional for edges, allowing you to draw edges without a separate node data source. Also, you should use the `root` function when you want to ensure the correct node is used as the root node.

Description

Lays out graphic elements as a directed tree. The function is used for network graphs, which are visual representations of data that consist of nodes and relations between nodes (edges). The tree layout should be used only for directed graphs *with* a primary root node (compare with `layout.dag`). This layout produces tree-like structures from parent nodes down to leaf nodes, so the layout works well with hierarchical data. If the root node is not specified by the `root` function, the function picks the most likely node as the root.

*Note:* Network graphs that display nodes and edges require two data sources, one for the unique nodes and one for the edges. If the edge data source includes weights and the weight variable is indicated in the `SOURCE` statement, the weights influence the length of edges in the graph, with higher weights having shorter edges.

Examples

```
ELEMENT: edge(position(layout.tree(node(id), from(fromVar), to(toVar), root("A"))))
ELEMENT: point(position(layout.tree(node(id), from(fromVar), to(toVar), root("A"))), label(id))
```

*Figure 204. Example: Creating a tree*

**Valid Functions**

“from Function” on page 133
“root Function” on page 215
“to Function” on page 321

**Applies To**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
“region.confi.proportion.count Function” on page 202
“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
“region.spread.sd Function” on page 209
“region.spread.se Function” on page 212
“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243
“summary.count Function” on page 245
“summary.count.cumulative Function” on page 247
“summary.countTrue Function” on page 250
“summary.first Function” on page 252
“summary.kurtosis Function” on page 254
“summary.last Function” on page 257
“summary.max Function” on page 259
“summary.mean Function” on page 261

## link.alpha Function

Syntax

```
link.alpha(<algebra>, radius(<numeric>))
```

*or*

```
link.alpha(<binning function>, radius(<numeric>))
```

*or*

```
link.alpha(<statistic function>, radius(<numeric>))
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<numeric>**. A numeric value indicating the This is **required**.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.alpha`.

Description

Calculates the alpha shape for the values. This function is typically used with the edge graphic element. The alpha shape is a generalization of the convex hull. If the radius is sufficiently large, the result is a convex hull. For smaller radius values, the shape shrinks and becomes concave. It also may not connect or contain some data values.

Examples

```
ELEMENT: edge(position(link.alpha(x*y, radius(50))))
```

*Figure 205. Example: Creating an alpha shape graph*

Statistic Functions

See “GPL Functions” on page 56.

**Binning Functions**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77

**Applies To**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
“region.confi.proportion.count Function” on page 202
“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
“region.spread.sd Function” on page 209

## link.complete Function

Syntax

```
link.complete(<algebra>)
```

*or*

```
link.complete(<binning function>)
```

*or*

```
link.complete(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.complete`.

Description

Calculates the complete graph for the values. This function is typically used with the edge graphic element. The complete graph connects every data value with every other data value.

Examples

```
ELEMENT: edge(position(link.complete(x*y)))
```

*Figure 206. Example: Creating a complete graph*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179

"summary.variance Function" on page 317
"transparency Function (For GPL Graphic Elements)" on page 322

## link.delaunay Function

Syntax

```
link.delaunay(<algebra>)
```

*or*

```
link.delaunay(<binning function>)
```

*or*

```
link.delaunay(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.delaunay`.

Description

Calculates the Delaunay triangulation for the values. This function is typically used with the edge graphic element. The triangulation connects all values so that the connecting segments form triangles.

Examples

```
ELEMENT: edge(position(link.delaunay(x*y)))
```

*Figure 207. Example: Creating a Delaunay triangulation*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.distance Function" on page 161

## link.distance Function

Syntax

```
link.distance(<algebra>, radius(<numeric>))
```

*or*

```
link.distance(<binning function>, radius(<numeric>))
```

*or*

```
link.distance(<statistic function>, radius(<numeric>))
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<numeric>**. A numeric value indicating the distance to determine whether values are connected.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.distance`.

Description

Calculates the distance graph for the values. This function is typically used with the edge graphic element. The distance graph connects any two values whose distance is less than or equal to the specified radius.

Examples

```
ELEMENT: edge(position(link.distance(x*y), radius(5000)))
```

*Figure 208. Example: Creating a distance graph*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

## link.gabriel Function

Syntax

```
link.gabriel(<algebra>)
```

*or*

```
link.gabriel(<binning function>)
```

*or*

```
link.gabriel(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.gabriel`.

Description

Calculates the Gabriel graph for the values. This function is typically used with the edge graphic element. A Gabriel graph connects values if they are Gabriel neighbors. Gabriel neighbors are defined by imagining a circle whose diameter is the line connecting two values. The values are Gabriel neighbors if the circle doesn't contain any other values.

Examples

```
ELEMENT: edge(position(link.gabriel(x*y)))
```

*Figure 209. Example: Creating a Gabriel graph*

Statistic Functions

See “GPL Functions” on page 56.

**Binning Functions**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77

**Applies To**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
“region.confi.proportion.count Function” on page 202
“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
“region.spread.sd Function” on page 209
“region.spread.se Function” on page 212
“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243
“summary.count Function” on page 245
“summary.count.cumulative Function” on page 247
“summary.countTrue Function” on page 250

## link.hull Function

Syntax

```
link.hull(<algebra>)
```

*or*

```
link.hull(<binning function>)
```

*or*

```
link.hull(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.hull`.

Description

Calculates the convex hull around the values. This function is typically used with the edge graphic element. A convex hull connects the least number of outermost values so that the hull contains all values. The hull contains all possible connections between any two values. Note that the convex hull is the boundary of the Delaunay triangulation.

Examples

```
ELEMENT: edge(position(link.hull(x*y)))
```

*Figure 210. Example: Creating a convex hull*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181
"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196
"region.confi.mean Function" on page 198
"region.confi.percent.count Function" on page 200

## link.influence Function

Syntax

```
link.influence(<algebra>)
```

*or*

```
link.influence(<binning function>)
```

*or*

```
link.influence(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.influence`.

Description

Calculates a sphere of influence graph for the values. This function is typically used with the edge graphic element. The sphere of influence graph connects values if the distance between two values is less than or equal to the sum of the nearest neighbor distances for the two values. The nearest neighbor distance for a value is the distance between it and the value closest to it.

Examples

```
ELEMENT: edge(position(link.influence(x*y)))
```

*Figure 211. Example: Creating a sphere of influence graph*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

## link.join Function

Syntax

```
link.join(<algebra>)
```

*or*

```
link.join(<binning function>)
```

*or*

```
link.join(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.join`.

Description

Joins sets of points from a blend. `link.join` may be used for repeated measures or observations over time, among others. In all cases, there is a blend that defines the relation. This distinguishes `link.join` from the other link functions.

Examples

```
ELEMENT: edge(position(link.join(x1*y1 + x2*y2)), label(a))
ELEMENT: point(position(x1*y1 + x2*y2), label("Before"+"After"))
```

*Figure 212. Example: Creating a bridge plot*

This example assumes data that is in a format like the following:

*Table 10. Example data.*

| a | x1 | y1 | x2 | y2 |
|---|---|---|---|---|
| Bill | 45 | 50 | 58 | 67 |
| Alice | 32 | 40 | 33 | 40 |
| Bob | 22 | 31 | 26 | 35 |
| Audrey | 55 | 59 | 52 | 64 |

```
TRANS: zero = eval(0)
ELEMENT: edge(position(link.join(zero*zero + x*y)), shape(shape.arrow))
```

*Figure 213. Example: Drawing vectors from the origin*

Statistic Functions

See “GPL Functions” on page 56.

**Binning Functions**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77

**Applies To**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
“region.confi.proportion.count Function” on page 202
“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
“region.spread.sd Function” on page 209
“region.spread.se Function” on page 212
“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243
“summary.count Function” on page 245
“summary.count.cumulative Function” on page 247

## link.mst Function

Syntax

```
link.mst(<algebra>)
```

*or*

```
link.mst(<binning function>)
```

*or*

```
link.mst(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.mst`.

Description

Calculates the minimum spanning tree (MST) to connect the values specified by the algebra. This function is typically used with the edge graphic element. The MST connects all values by the shortest distance and never intersects a value twice.

Examples

```
ELEMENT: edge(position(link.mst(x*y)))
```

*Figure 214. Example: Creating a minimal spanning tree*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181
"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196
"region.confi.mean Function" on page 198

## link.neighbor Function

Syntax

```
link.neighbor(<algebra>, neighborCount(<integer>))
```

*or*

```
link.neighbor(<binning function>, neighborCount(<integer>))
```

*or*

```
link.neighbor(<statistic function>, neighborCount(<integer>))
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<integer>**. An integer defining the number of neighboring values to connect to a value.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.neighbor`.

Description

Calculates the nearest neighbor graph for the values. This function is typically used with the edge graphic element. The nearest neighbor graph connects a value *p* to the specified number of values with the shortest distance to *p*.

Examples

```
ELEMENT: edge(position(link.neighbor(x*y, neighborCount(3))))
```

*Figure 215. Example: Creating a nearest neighbor graph*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

## link.relativeNeighborhood Function

Syntax

```
link.relativeNeighborhood(<algebra>)
```

*or*

```
link.relativeNeighborhood(<binning function>)
```

*or*

```
link.relativeNeighborhood(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.relativeNeighborhood`.

Description

Calculates the relative neighborhood graph for the values. This function is typically used with the edge graphic element. A relative neighborhood graph connects values if they are relative neighbors. Relative neighbors are defined by imagining two circles whose centers are the two values, where the radius of the circles is the distance between the values. If the area created by the intersection of the two circles does not contain any other values, the values are relative neighbors.

Examples

```
ELEMENT: edge(position(link.relativeNeighborhood(x*y)))
```

*Figure 216. Example: Creating a relative neighborhood graph*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

## link.sequence Function

Syntax

```
link.sequence(<algebra>)
```

*or*

```
link.sequence(<binning function>)
```

*or*

```
link.sequence(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.sequence`.

Description

Connects the values in the order in which their associated cases appear in the dataset. This function is typically used with the edge graphic element. In many cases, the result is the same as what you obtain by using the path graphic element without a statistic.

Examples

```
ELEMENT: edge(position(link.sequence(x*y)))
```

*Figure 217. Example: Creating a sequence graph*

Statistic Functions

See “GPL Functions” on page 56.

**Binning Functions**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77

**Applies To**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
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“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
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“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243
“summary.count Function” on page 245
“summary.count.cumulative Function” on page 247
“summary.countTrue Function” on page 250

## link.tsp Function

Syntax

```
link.tsp(<algebra>)
```

*or*

```
link.tsp(<binning function>)
```

*or*

```
link.tsp(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `link.tsp`.

Description

Calculates the solution to the travelling salesman problem (TSP) for the values. This function is typically used with the edge or path graphic element. The solution to the TSP is the shortest path that traverses all values once and starts and ends at the same value.

Examples

```
ELEMENT: edge(position(link.tsp(x*y)))
```

*Figure 218. Example: Drawing the solution to the travelling salesman problem*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"link.gabriel Function" on page 163

"link.hull Function" on page 165

"link.influence Function" on page 168

"link.join Function" on page 170

"link.mst Function" on page 172

"link.neighbor Function" on page 175

"link.relativeNeighborhood Function" on page 177

"link.sequence Function" on page 179

"position Function (For GPL Graphic Elements)" on page 192

"region.confi.count Function" on page 196

"region.confi.mean Function" on page 198

"region.confi.percent.count Function" on page 200

"region.confi.proportion.count Function" on page 202

## logistic Function

Syntax

```
logistic(<location>, <scale>)
```

**<location>**. Numeric value specifying the location parameter for the distribution.

**<scale>**. Numeric value specifying the scale parameter for the distribution. This value must be greater than 0.

Description

Specifies a logistic distribution for the probability scale.

Examples

```
SCALE: prob(dim(2), logistic(5, 2))
```

*Figure 219. Example: Specifying a logistic distribution for the probability scale*

**Applies To**

"prob Scale" on page 37

## map Function

Syntax

```
map((<value>, <aesthetic>) ...)
```

**<value>**. A categorical value that is being mapped to a specific aesthetic.

**<aesthetic>**. A valid aesthetic value or constant (for example, `color.red` or `size."5px"`) that will be used for the categorical value.

*Note:* A value and aesthetic pair is enclosed in parentheses. If you are specifying multiple pairs, use commas to separate the pairs.

Description

Maps a specific categorical value to a specific aesthetic value. For example, if you were creating a bar chart showing the median income in each U.S. state, you could use the map function to force the color of the bar corresponding to Illinois to be blue.

Examples

```
SCALE: cat(aesthetic(aesthetic.color), map(("IL", color.blue)))
```

*Figure 220. Example: Mapping a category to a color*

```
SCALE: cat(aesthetic(aesthetic.color), map(("IL", color.blue), ("CA", color.green)))
```

*Figure 221. Example: Mapping multiple categories to colors*

**Applies To**

"cat Scale" on page 32

## marron Function

Syntax

```
marron()
```

Description

Uses the Marron adjustment to normalize the default fixed window across different kernel functions. Different kernel functions have different optimal windows. Therefore, normalizing the fixed window is useful when you need to compare the results of multiple kernel functions.

Examples

```
ELEMENT: line(position(density.kernel.epanechnikov(x, marron())))
```

*Figure 222. Example: Adding a kernel distribution*

**Applies To**

"density.kernel Function" on page 105

## max Function

Syntax

```
max(<numeric>)
```

**<numeric>**. A numeric value indicating the maximum scale value.

Description

Specifies a maximum value for a scale.

Examples

```
SCALE: linear(dim(2), max(50000))
```

*Figure 223. Example: Specifying a maximum on the 2nd dimension (y axis)*

**Applies To**

"cLoglog Scale" on page 32
"linear Scale" on page 34
"log Scale" on page 34
"pow Scale" on page 36
"safeLog Scale" on page 38
"safePower Scale" on page 39
"time Scale" on page 40

## min Function

Syntax

```
min(<numeric>)
```

**<numeric>**. A numeric value indicating the minimum scale value.

Description

Specifies a minimum value for a scale.

Examples

```
SCALE: linear(dim(2), min(0))
```

*Figure 224. Example: Specifying a minimum on the 2nd dimension (y axis)*

**Applies To**

"cLoglog Scale" on page 32
"linear Scale" on page 34
"log Scale" on page 34
"pow Scale" on page 36
"safeLog Scale" on page 38
"safePower Scale" on page 39
"time Scale" on page 40

## mirror Function

Syntax

```
mirror(<coord>)
```

**<coord>**. A valid coordinate type or transformation function. This is optional.

Description

Mirrors facets in the *x* axis dimension. This is useful for creating population pyramids.

Examples

```
COORD: transpose(mirror(rect(dim(1, 2))))
```

*Figure 225. Example: Mirroring dimensions in a population pyramid*

**Coordinate Types and Transformations**
"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28
"project Function" on page 194
"reflect Function" on page 195
"transpose Function" on page 323
"wrap Function" on page 327
**Applies To**
"COORD Statement" on page 25
"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28
"project Function" on page 194

## missing.gap Function

Syntax

```
missing.gap()
```

Description

Specifies that the graphic element ends at a valid value and does not continue until the next valid value. There is a gap between valid values.

Examples

```
ELEMENT: line(position(x*y), missing.gap())
```

*Figure 226. Example: Specifying gaps for missing values*

**Applies To**

"area Element" on page 47
"edge Element" on page 48
"line Element" on page 49
"path Element" on page 50

## missing.interpolate Function

Syntax

```
missing.interpolate()
```

Description

Specifies that the graphic element is interpolated through missing values. That is, the graphic element is continuous from one valid value to another, regardless of missing values between the valid values.

Examples

```
ELEMENT: line(position(x*y), missing.interpolate())
```

*Figure 227. Example: Interpolating through missing values*

**Applies To**

"area Element" on page 47
"edge Element" on page 48
"line Element" on page 49
"path Element" on page 50

## missing.listwise Function

Syntax

```
missing.listwise()
```

Description

Specifies that a case is excluded from the graph if the case is missing a value for any variable in the dataset. It does not matter if the variable is actually used in the graph.

Examples

```
SOURCE: s = csvSource(file("mydata.csv"), missing.listwise())
```

*Figure 228. Example: Excluding missing values listwise*

**Applies To**

"csvSource Function" on page 92
"sqlSource Function" on page 243
"userSource Function" on page 324

## missing.pairwise Function

Syntax

```
missing.pairwise()
```

Description

Specifies that a case is excluded from the graph if the case is missing a value for any of the variables actually used in the graph. For example, if variables *x*, *y*, and *z* are used in the graph, a case is excluded only if it is missing a value for one of these variables. The missingness of other variables is not considered. `missing.pairwise` is the default behavior for handling missing values.

Examples

```
SOURCE: s = csvSource(file("mydata.csv"), missing.pairwise())
```

*Figure 229. Example: Excluding missing values pairwise*

**Applies To**

"csvSource Function" on page 92
"sqlSource Function" on page 243
"userSource Function" on page 324

## missing.wings Function

Syntax

```
missing.wings()
```

Description

Specifies that the graphic element continues after a valid value in the direction of the next valid value but then breaks just before and after the missing value. This is like interpolating through the missing value and erasing the graphic element at the missing value. For line charts, the result looks similar to wings.

Examples

```
ELEMENT: line(position(x*y), missing.wings())
```

*Figure 230. Example: Specifying wings for missing values*

**Applies To**

"area Element" on page 47
"edge Element" on page 48
"line Element" on page 49
"path Element" on page 50

## multiple Function

Syntax

```
multiple(<numeric>)
```

**<numeric>**. A positive numeric value.

Description

Specifies a multiplier for statistic functions.

Examples

```
ELEMENT: interval(position(region.spread.sd(x*y, multiple(2))), shape(shape.ibeam))
```

*Figure 231. Example: Specifying 2 standard deviations*

**Applies To**

"region.spread.sd Function" on page 209
"region.spread.se Function" on page 212

## noConstant Function

Syntax

```
noConstant()
```

Description

Specifies that no constant value is used in the smoother equation. Therefore, the smoother is calculated through the origin.

Examples

```
ELEMENT: line(position(smooth.linear(salbegin*salary, noConstant())))
```

*Figure 232. Example: Creating a linear fit line through the origin*

**Applies To**

"region.confi.smooth Function" on page 205
"smooth.cubic Function" on page 222
"smooth.linear Function" on page 225
"smooth.quadratic Function" on page 235

## node Function

Syntax

```
node(<variable name>)
```

**<variable name>**. The name of a variable previously defined in the GPL by a `DATA` statement.

Description

Specifies the variable containing the unique nodes in the dataset.

Examples

```
ELEMENT: edge(position(layout.dag(node(id), from(fromVar), to(toVar))))
```

*Figure 233. Example: Creating a directed acyclic graph*

**Applies To**

"layout.circle Function" on page 139
"layout.dag Function" on page 141
"layout.data Function" on page 143
"layout.grid Function" on page 145
"layout.network Function" on page 147
"layout.random Function" on page 150

"layout.tree Function" on page 152

## notIn Function

Syntax

```
notIn("category name" ...)
```

**<category name>**. The string representing the category to be excluded. If specifying multiple categories, separate them with commas.

Description

Excludes the categories from the variable. These categories are not displayed or used in statistical calculations. This function is valid only for variables defined as categorical.

Examples

```
DATA: gender = col(source(mydata), name("gender"), unit.category(), notIn("Missing"))
```

*Figure 234. Example: Excluding a category from a variable*

**Applies To**

"col Function" on page 84

## normal Function

Syntax

```
normal(<mean>, <standard deviation>)
```

**<mean>**. Numeric value indicating the mean parameter for the distribution.

**<standard deviation>**. Numeric value indicating the standard deviation parameter for the distribution.

Description

Specifies a normal distribution for the probability scale.

Examples

```
SCALE: prob(dim(2), normal(50000, 15000))
```

*Figure 235. Example: Specifying a normal distribution for the probability scale*

**Applies To**

"prob Scale" on page 37

## opposite Function

Syntax

```
opposite()
```

Description

Positions an axis on the side opposite from the one on which it normally appears. For example, using opposite with the *y* axis would position it on the right side. `opposite` can also be used to create two axes, in which case the opposite one is often an alternate scale or a transformed version of the original.

Examples

```
GUIDE: axis(dim(2), label("Count"), opposite())
```

*Figure 236. Example: Moving the y-axis to the opposite side*

```
GUIDE: axis(dim(2), label("Cumulative Count"))
GUIDE: axis(dim(2), label("Cumulative Percent"), opposite(), unit.percent())
```

*Figure 237. Example: Adding a derived axis*

**Applies To**

"axis Guide Type" on page 42

## origin Function (For GPL Graphs)

*Note:* If you are modifying the origin for a scale, refer to "origin Function (For GPL Scales)".

Syntax

```
origin(<value>, <value>)
```

**<value>**. Indicates an absolute value or a percentage for the origin of the graph. The value is relative to the top left corner of the page and does not include axis labels. The first value indicates the *x* value relative to this position, and the second value indicates the *y* value relative to this position. Units or a percent sign can be included with the value (e.g., `30px`, `5cm`, or `25%`). If units are omitted, they are assumed to be pixels. Percentages are proportional to the whole page.

Description

Specifies the position of the graph relative to the top left corner of the page.

Examples

```
GRAPH: start(origin(2in, 4in))
```

*Figure 238. Example: Positioning a graph with absolute units*

```
GRAPH: start(origin(10%, 100%))
```

*Figure 239. Example: Positioning a graph with percentages*

**Applies To**

"begin Function (For GPL Graphs)" on page 69

## origin Function (For GPL Scales)

*Note:* If you are modifying the origin for a graph, refer to "origin Function (For GPL Graphs)".

Syntax

```
origin(<numeric>)
```

**<numeric>**. A numeric value indicating the value of the scale's origin.

Description

Specifies the origin for a scale. The origin is typically used to specify a value from which area or interval graphic elements extend. The graphic elements originate at the origin and extend toward their value. For example, if your bar chart includes values of 367 and 48 and the origin is 100, one bar extends *up* from 100 to 367 (in default coordinates), while the other bar extends *down* to 48.

Examples

```
SCALE: linear(dim(2), origin(100))
```

*Figure 240. Example: Specifying the origin*

**Applies To**

"cLoglog Scale" on page 32
"linear Scale" on page 34
"log Scale" on page 34
"pow Scale" on page 36
"safeLog Scale" on page 38
"safePower Scale" on page 39
"time Scale" on page 40

## poisson Function

Syntax

```
poisson(<rate>)
```

**<rate>**. Numeric value specifying the rate parameter for the distribution. This value must be greater than 0.

Description

Specifies a poisson distribution for the probability scale.

Examples

```
SCALE: prob(dim(2), poisson(5.5))
```

*Figure 241. Example: Specifying a poisson distribution for the probability scale*

**Applies To**

"prob Scale" on page 37

## position Function (For GPL Graphic Elements)

*Note:* If you are specifying a position for a reference line (`form.line`), refer to "position Function (For GPL Guides)" on page 193.

Syntax

```
position(<algebra>)
```

*or*

```
position(<binning function>)
```

*or*

```
position(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. A statistic function.

Description

Specifies the position of the graphic element in the graph. When a statistic function is used in position, the statistic function is calculated on the second crossed variable in a 2-D coordinate system and the third crossed variable in a 3-D coordinate system.

Examples

```
ELEMENT: point(position(x*y))
```

*Figure 242. Example: Scatterplot*

```
ELEMENT: interval(position(summary.mean(x*y)))
```

*Figure 243. Example: Bar chart of means*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"area Element" on page 47

"edge Element" on page 48

"interval Element" on page 49

"line Element" on page 49

"path Element" on page 50

"point Element" on page 51

"polygon Element" on page 52

"schema Element" on page 53

## position Function (For GPL Guides)

*Note:* If you are specifying a position for a graphic element, refer to "position Function (For GPL Graphic Elements)" on page 192.

Syntax

```
position(<x coordinate>, <y coordinate>)
```

**<coordinate>**. A numeric value or an asterisk (*) indicating the position of the line in relation to a particular axis. The asterisk is a wildcard character that represents all values on the associated axis. For example, `*,10` indicates a line at all *x*-axis values and at 10 on the *y* axis. In other words, these coordinates specify a horizontal reference line at 10.

Description

Specifies the position of a reference line (`form.line` guide).

Examples

```
GUIDE: form.line(position(*, 5000))
```

*Figure 244. Example: Horizontal reference line*

```
GUIDE: form.line(position(5000, *))
```

*Figure 245. Example: Vertical reference line*

**Applies To**

"form.line Guide Type" on page 43

## preserveStraightLines Function

Syntax

```
preserveStraightLines()
```

Description

Specifies that the graphic element is not curved in the space between points. Rather, the graphic element is drawn straight from point to point. This function is relevant only for graphic elements drawn in polar coordinates.

Examples

```
ELEMENT: line(position(x*y), preserveStraightLines())
```

*Figure 246. Example: Drawing straight lines*

**Applies To**

"area Element" on page 47
"edge Element" on page 48
"line Element" on page 49
"path Element" on page 50
"polygon Element" on page 52

## project Function

Syntax

```
project.<projection>()
```

**<projection>**. A valid projection name.

Description

Transforms the coordinate system using a map projection.

Examples

```
SOURCE: mapsrc = mapSource(file("World.smz"), layer("World"))
DATA: lon*lat = mapVariables(source(mapsrc))
COORD: project.mercator()
ELEMENT: polygon(position(lon*lat))
```

*Figure 247. Example: Creating a map*

Valid Projection Names

Valid projection names are: lambert, mercator, transverseMercator, winkelTripel

**Applies To**

"COORD Statement" on page 25
"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28

## proportion Function

Syntax

```
proportion(<numeric>)
```

**<numeric>**. A numeric value between 0 and 1.

Description

Specifies the proportion of data points to include when calculating the smooth function. This specifies the size of the window used for the smoother.

Examples

```
ELEMENT: line(position(smooth.loess(salbegin*salary, proportion(0.9))))
```

*Figure 248. Example: Creating a loess fit line with specific smoother window*

**Applies To**

"smooth.cubic Function" on page 222
"smooth.linear Function" on page 225
"smooth.loess Function" on page 227
"smooth.mean Function" on page 230
"smooth.median Function" on page 232
"smooth.quadratic Function" on page 235

## reflect Function

Syntax

```
reflect(dim(<numeric>), <coord>)
```

**<numeric>**. A numeric value indicating the dimension across which the graph is reflected. See the topic "dim Function" on page 124 for more information.

**<coord>**. A valid coordinate type or transformation function. This is optional.

Description

Reflects the coordinate system across the specified dimension.

Examples

```
COORD: rect(dim(1,2), reflect(dim(2)))
ELEMENT: interval(position(x*y))
```

*Figure 249. Example: Creating an icicle plot*

**Coordinate Types and Transformations**

"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26

"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28
"mirror Function" on page 186
"project Function" on page 194
"transpose Function" on page 323
"wrap Function" on page 327

**Applies To**

"COORD Statement" on page 25
"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28
"project Function" on page 194

## region.confi.count Function

Syntax

```
region.confi.count(<algebra>, <function>)
```

*or*

```
region.confi.count(<statistic function>, <function>)
```

**<algebra>**. Graph algebra, such as `x` or `x*y`. In the second case, the confidence interval for the count is calculated for cases with non-missing `y`-variable values. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<function>**. One or more valid functions. These are optional. If no `alpha` function is specified, 0.95 is used for the alpha.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `region.confi.count`.

Description

Calculates the confidence interval around the count. The function creates two values. When using the `interval`, `area`, or `edge` graphic elements, this function results in one graphic element showing the range of the confidence interval. All other graphic elements result in two separate elements, one showing the confidence interval below the count and one showing the confidence interval above the count.

Examples

```
ELEMENT: interval(position(region.confi.count(jobcat)), shape(shape.ibeam))
```

*Figure 250. Example: Creating error bars*

Statistic Functions

See "GPL Functions" on page 56.

**Valid Functions**

"alpha Function" on page 65

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72

## region.confi.mean Function

Syntax

```
region.confi.mean(<algebra>, <function>)
```

*or*

```
region.confi.mean(<statistic function>, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<function>**. One or more valid functions. These are optional. If no `alpha` function is specified, 0.95 is used for the alpha.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `region.confi.mean`.

Description

Calculates the confidence interval around the mean. The function creates two values. When using the `interval`, `area`, or `edge` graphic elements, this function results in one graphic element showing the range of the confidence interval. All other graphic elements result in two separate elements, one showing the confidence interval below the mean and one showing the confidence interval above the mean.

Examples

```
ELEMENT: interval(position(region.confi.mean(jobcat*salary)), shape(shape.ibeam))
```

*Figure 251. Example: Creating error bars*

Statistic Functions

See "GPL Functions" on page 56.

**Valid Functions**



**Applies To**

## region.confi.percent.count Function

Syntax

```
region.confi.percent.count(<algebra>, <function>, <base function>)
```

*or*

```
region.confi.percent.count(<statistic function>, <function>, <base function>)
```

**<algebra>**. Graph algebra, such as `x` or `x*y`. In the second case, the confidence interval for the percentage is calculated for cases with non-missing `y`-variable values. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<function>**. One or more valid functions. These are optional. If no `alpha` function is specified, 0.95 is used for the alpha.

**<base function>**. A function that specifies the percentage base for `region.confi.percent.count`. This is optional. The default is `base.all()`.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `region.confi.percent.count`.

Description

Calculates the confidence interval around the percentage within each group compared to the total number of cases. The function creates two values. When using the `interval`, `area`, or `edge` graphic elements, this function results in one graphic element showing the range of the confidence interval. All

other graphic elements result in two separate elements, one showing the confidence interval below the percentage value and one showing the confidence interval above the percentage value.

Examples

```
ELEMENT: interval(position(region.confi.percent.count(jobcat)), shape(shape.ibeam))
```

*Figure 252. Example: Creating error bars*

Statistic Functions

See "GPL Functions" on page 56.

**Valid Functions**

"alpha Function" on page 65

**Base Functions**

"base.aesthetic Function" on page 66
"base.all Function" on page 67
"base.coordinate Function" on page 68

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
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"region.spread.range Function" on page 207
"region.spread.sd Function" on page 209
"region.spread.se Function" on page 212

## region.confi.proportion.count Function

Syntax

```
region.confi.proportion.count(<algebra>, <function>, <base function>)
```

*or*

```
region.confi.proportion.count(<statistic function>, <function>, <base function>)
```

**<algebra>**. Graph algebra, such as `x` or `x*y`. In the second case, the confidence interval for the proportion is calculated for cases with non-missing `y`-variable values. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<function>**. One or more valid functions. These are optional. If no `alpha` function is specified, 0.95 is used for the alpha.

**<base function>**. A function that specifies the percentage base for `region.confi.proportion.count`. This is optional. The default is `base.all()`.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `region.confi.proportion.count`.

Description

Calculates the confidence interval around the proportion within each group compared to the total number of cases. The function creates two values. When using the `interval`, `area`, or `edge` graphic elements, this function results in one graphic element showing the range of the confidence interval. All other graphic elements result in two separate elements, one showing the confidence interval below the proportion value and one showing the confidence interval above the proportion value.

Examples

```
ELEMENT: interval(position(region.confi.proportion.count(jobcat)), shape(shape.ibeam))
```

*Figure 253. Example: Creating error bars*

Statistic Functions

See "GPL Functions" on page 56.

**Valid Functions**

"alpha Function" on page 65

**Base Functions**

"base.aesthetic Function" on page 66

"base.all Function" on page 67

"base.coordinate Function" on page 68

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"link.gabriel Function" on page 163

"link.hull Function" on page 165

"summary.se Function" on page 306
"summary.se.kurtosis Function" on page 308
"summary.se.skewness Function" on page 311
"summary.sum Function" on page 313
"summary.sum.cumulative Function" on page 315
"summary.variance Function" on page 317
"transparency Function (For GPL Graphic Elements)" on page 322

## region.confi.smooth Function

Syntax

```
region.confi.smooth.<smooth function>(<algebra>, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<smooth function>**. The smooth function for which to calculate the confidence interval. Valid values are `cubic`, `linear`, and `quadratic`.

**<function>**. One or more valid functions. These are optional. If no `alpha` function is specified, 0.95 is used for the alpha.

Description

Calculates the confidence interval around a smoother function. The function creates two values. When using the `interval`, `area`, or `edge` graphic elements, this function results in one graphic element showing the range of the confidence interval. All other graphic elements result in two separate elements, one showing the confidence interval below the smoother function and one showing the confidence interval above the smoother function.

Examples

```
ELEMENT: line(position(region.confi.smooth.linear(salbegin*salary)))
```

*Figure 254. Example: Showing the confidence interval around a fit line*

**Valid Functions**

"alpha Function" on page 65
"noConstant Function" on page 189

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161

"summary.range Function" on page 302
"summary.sd Function" on page 304
"summary.se Function" on page 306
"summary.se.kurtosis Function" on page 308
"summary.se.skewness Function" on page 311
"summary.sum Function" on page 313
"summary.sum.cumulative Function" on page 315
"summary.variance Function" on page 317
"transparency Function (For GPL Graphic Elements)" on page 322

## region.spread.range Function

Syntax

```
region.spread.range(<algebra>)
```

*or*

```
region.spread.range(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `region.spread.range`.

Description

Calculates the minimum and maximum for a variable or variables identified by the algebra. That is, `region.spread.range` calculates the range of the variables. When using the `interval`, `area`, or `edge` graphic elements, this function results in one graphic element showing the range. All other graphic elements result in two separate elements, one showing the start of the range and one showing the end of the range.

Examples

```
ELEMENT: interval(position(region.spread.range(jobcat*salary)))
```

*Figure 255. Example: Range bar showing minimum and maximum of one variable*

```
ELEMENT: interval(position(region.spread.range(jobcat*(salbegin+salary))))
```

*Figure 256. Example: Range bar showing minimum of one variable to maximum of another*

Statistic Functions

See "GPL Functions" on page 56.

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90

## region.spread.sd Function

Syntax

```
region.spread.sd(<algebra>, <function>)
```

*or*

```
region.spread.sd(<binning function>, <function>)
```

*or*

```
region.spread.sd(<statistic function>, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `region.spread.sd`.

**<function>**. One or more valid functions. These are optional. If no `multiple` function is specified, 1 is used for the multiplier.

Description

Calculates the mean minus the standard deviation and the mean plus the standard deviation for the variables identified by the algebra. The function creates two values. When using the `interval`, `area`, or `edge` graphic elements, this function results in one graphic element showing the range of the standard deviation around the mean. All other graphic elements result in two separate elements, one showing the standard deviation below the mean and one showing the standard deviation above the mean.

Examples

```
ELEMENT: interval(position(region.spread.sd(jobcat*salary)))
```

*Figure 257. Example: Creating an error bar*

```
ELEMENT: interval(position(region.spread.sd(jobcat*salary, multiple(2))))
```

*Figure 258. Example: Creating an error bar for 2 standard deviations*

Statistic Functions

See "GPL Functions" on page 56.

**Valid Functions**

"multiple Function" on page 188

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"link.gabriel Function" on page 163

"link.hull Function" on page 165

"link.influence Function" on page 168

## region.spread.se Function

Syntax

```
region.spread.se(<algebra>, <function>)
```

*or*

```
region.spread.se(<binning function>, <function>)
```

*or*

```
region.spread.se(<statistic function>, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `region.spread.se`.

**<function>**. One or more valid functions. These are optional. If no `multiple` function is specified, 1 is used for the multiplier.

Description

Calculates the mean minus the standard error and the mean plus the standard error for the variable identified by the algebra. The function creates two values. When using the `interval`, `area`, or `edge` graphic elements, this function results in one graphic element showing the range of the standard error around the mean. All other graphic elements result in two separate elements, one showing the standard error below the mean and one showing the standard error above the mean.

Examples

```
ELEMENT: interval(position(region.spread.se(jobcat*salary)))
```

*Figure 259. Example: Creating an error bar*

```
ELEMENT: interval(position(region.spread.se(jobcat*salary, multiple(2))))
```

*Figure 260. Example: Creating an error bar for 2 standard errors*

Statistic Functions

See "GPL Functions" on page 56.

**Valid Functions**

"multiple Function" on page 188

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
**Applies To**
"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181
"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196
"region.confi.mean Function" on page 198
"region.confi.percent.count Function" on page 200
"region.confi.proportion.count Function" on page 202
"region.confi.smooth Function" on page 205
"region.spread.range Function" on page 207
"region.spread.sd Function" on page 209
"size Function (For GPL Graphic Elements)" on page 221
"split Function" on page 243
"summary.count Function" on page 245
"summary.count.cumulative Function" on page 247
"summary.countTrue Function" on page 250
"summary.first Function" on page 252
"summary.kurtosis Function" on page 254
"summary.last Function" on page 257
"summary.max Function" on page 259
"summary.mean Function" on page 261
"summary.median Function" on page 263
"summary.min Function" on page 265
"summary.mode Function" on page 268

## reverse Function

Syntax

```
reverse()
```

Description

When used in conjunction with a scale, this function reverses the scale. For categorical scales, this function can be used in conjunction with an explicit sorting function.

When used in conjunction with a polar coordinate system, this function reverses the direction of the coordinate system. Thus, it would draw pie slices in a counterclockwise direction.

Examples

```
SCALE: cat(dim(1), sort.natural(), reverse())
```

*Figure 261. Example: Using reverse alpha-numeric sorting*

```
SCALE: linear(dim(2), reverse())
```

*Figure 262. Example: Reversing a linear scale*

```
SCALE: linear(aesthetic(aesthetic.color.brightness), reverse())
```

*Figure 263. Example: Reversing the direction of an aesthetic scale*

```
COORD: polar.theta(reverse())
```

*Figure 264. Example: Reversing the direction of a coordinate system*

**Applies To**

"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"cat Scale" on page 32
"cLoglog Scale" on page 32
"linear Scale" on page 34
"log Scale" on page 34
"pow Scale" on page 36
"safeLog Scale" on page 38
"safePower Scale" on page 39
"time Scale" on page 40

## root Function

Syntax

```
root("variable value")
```

**"variable value"**. A variable value.

Description

Specifies which node is the root node. This corresponds to a value for the variable identified by the `node` function.

Examples

```
ELEMENT: edge(position(layout.tree(node(id), from(fromVar), to(toVar), root("A"))))
```

*Figure 265. Example: Specifying a root node*

**Applies To**

"layout.tree Function" on page 152

## sameRatio Function

Syntax

```
sameRatio()
```

Description

Specifies that the same distance on each scale in a rectangular coordinate system represents the same difference in data values. For example, 2cm on both scales represent a difference of 1000.

Examples

```
COORD: rect(dim(1,2), sameRatio())
ELEMENT: point(position(salbegin*salary))
```

*Figure 266. Example: Creating a scatterplot with equal scales*

**Applies To**

"rect Coordinate Type" on page 28

## savSource Function

Syntax

```
savSource(file("file path"))
```

*Note*: This function works with the IBM SPSS Statistics data file driver. You must have the driver installed and configured before using the function. The driver is available with the installation media for your product. You can also use the `userSource` function to read IBM SPSS Statistics data directly. See the topic "userSource Function" on page 324 for more information. For more information about installing and configuring the driver, see the *IBM SPSS Visualization Designer User's Guide*.

**"file path"**. The absolute path to the SAV file. To ensure that the file is located correctly, this should be an absolute path. Backslashes must be escaped with another backslash (for example, `C:\\data\\myfile.csv`). You can also use forward slashes (for example, `C:/data/myfile.csv`).

Description

Reads the contents of a SAV data file for IBM SPSS Statistics. This function is used to assign the contents of the file to a data source.

Examples

```
SOURCE: mydata = savSource(file("/Data/Employee data.sav"))
```

*Figure 267. Example: Reading a SAV file*

**Applies To**

"SOURCE Statement" on page 23

## scale Function (For GPL Axes)

*Note:* If you are specifying a size for a graph, refer to "scale Function (For GPL Graphs)" on page 217. If you are specifying a scale associated with a graphic element (like a bar or line) or a reference line (`form.line`), refer to "scale Function (For GPL Graphic Elements and form.line)" on page 217. If you are specifying a size for a page, refer to "scale Function (For GPL Pages)" on page 218.

Syntax

```
scale(<scale name>)
```

**<scale name>**. A scale previously defined by a `SCALE` statement. This is used when there are multiple scales in a single dimension (as in a "dual axis" graph).

Description

Specifies the scale to which an axis applies.

Examples

```
SCALE: y2= linear(dim(2))
GUIDE: axis(scale(y2), label("Count"))
```

*Figure 268. Example: Associating an axis with a named scale*

**Applies To**

"axis Guide Type" on page 42

## scale Function (For GPL Graphs)

*Note:* If you are specifying a scale associated with an axis, refer to "scale Function (For GPL Axes)" on page 216. If you are specifying a scale associated with a graphic element (like a bar or line) or a reference line (`form.line`), refer to "scale Function (For GPL Graphic Elements and form.line)". If you are specifying a size for a page, refer to "scale Function (For GPL Pages)" on page 218.

Syntax

```
scale(<value>, <value>)
```

**<value>**. Indicates an absolute value or a percentage for the graph size. The first value indicates the *x* component of the size (width), and the second value indicates the *y* component of the size (height). Units or a percent sign can be included with either value (e.g., `30px`, `5cm`, or `25%`). If units are omitted, they are assumed to be pixels. Percentages are proportional to the whole page.

Description

Specifies the size of the data area of a graph, not including axes and legends.

Examples

```
GRAPH: begin(scale(2in, 4in))
```

*Figure 269. Example: Sizing a graph with absolute units*

```
GRAPH: begin(scale(80%, 100%))
```

*Figure 270. Example: Sizing a graph with percentages*

**Applies To**

"begin Function (For GPL Graphs)" on page 69

## scale Function (For GPL Graphic Elements and form.line)

*Note:* If you are specifying a scale associated with an axis, refer to "scale Function (For GPL Axes)" on page 216. If you are specifying a size for a graph, refer to "scale Function (For GPL Graphs)". If you are specifying a size for a page, refer to "scale Function (For GPL Pages)" on page 218.

Syntax

```
scale(<scale name> ...)
```

**<scale name>**. A scale previously defined by a `SCALE` statement. This is used when there are multiple scales in a single dimension (as in a "dual-axis" graph). You can specify multiple scales if the scales are associated with different dimensions. Use commas to separate the multiple scales.

Description

Specifies the scale to which a graphic element or reference line (`form.line`) applies.

Examples

```
SCALE: y2= linear(dim(2))
ELEMENT: line(scale(y2), position(summary.count(x)))
```

*Figure 271. Example: Associating a graphic element with a named scale*

**Applies To**

"form.line Guide Type" on page 43

"area Element" on page 47

"edge Element" on page 48
"interval Element" on page 49
"line Element" on page 49
"path Element" on page 50
"point Element" on page 51
"polygon Element" on page 52
"schema Element" on page 53

## scale Function (For GPL Pages)

*Note:* If you are specifying a scale associated with an axis, refer to "scale Function (For GPL Axes)" on page 216. If you are specifying a scale associated with a graphic element (like a bar or line) or a reference line (`form.line`), refer to "scale Function (For GPL Graphic Elements and form.line)" on page 217. If you are specifying a size for a graph, refer to "scale Function (For GPL Graphs)" on page 217.

Syntax

```
scale(<value>, <value>)
```

**<value>**. Indicates an absolute value for the page size. The first value indicates the *x* component of the size (width), and the second value indicates the *y* component of the size (height). Units can be included with either value (e.g., `600px`, `15cm`, or `5in`). If units are omitted, they are assumed to be pixels.

Description

Specifies the size of the graph.

Examples

```
PAGE: begin(scale(500px, 400px))
```

*Figure 272. Example: Sizing a visualization*

**Applies To**

"begin Function (For GPL Pages)" on page 69

## scaledToData Function

Syntax

```
scaledToData("true")
```

*or*

```
scaledToData("false")
```

Description

Indicates whether a density function is scaled to the number of cases in the data being displayed. By default, density functions are scaled to the data. This is appropriate when a graph contains both a histogram and a density function, because you want to be able to compare the histogram and the density function on the same scale. However, if you want to compare density functions across multiple graphs displaying very different sample sizes, you may want to use `scaledToData("false")`.

Examples

```
ELEMENT: line(position(density.normal(salary, scaledToData("false"))), color(color.black))
ELEMENT: line(position(density.normal(salary_subset, scaledToData("false"))), color(color.blue))
```

*Figure 273. Example: Comparing different densities on the same scale*

**Applies To**


“density.beta Function” on page 93
“density.chiSquare Function” on page 96
“density.exponential Function” on page 98
“density.f Function” on page 100
“density.gamma Function” on page 102
“density.kernel Function” on page 105
“density.logistic Function” on page 108
“density.normal Function” on page 110
“density.poisson Function” on page 112
“density.studentizedRange Function” on page 115
“density.t Function” on page 117
“density.uniform Function” on page 119
“density.weibull Function” on page 121


## segments Function

Syntax

```
segments(<integer>)
```

**<integer>**. A positive integer.

Description

Specifies the number of segments that are calculated and drawn for the density function. Excluding this function will result in a default number of segments, which should be sufficient for most cases.

Examples

```
ELEMENT: line(position(density.kernel.epanechnikov(x, segments(150))))
```

*Figure 274. Example: Adding a kernel distribution*

**Applies To**


“density.kernel Function” on page 105


## shape Function (For GPL Graphic Elements)

*Note:* If you are modifying the shape for a guide, refer to “shape Function (For GPL Guides)” on page 220.

Syntax

```
shape(<algebra>)
```

*or*

```
shape(shape.<constant>)
```

**<algebra>**. Graph algebra using one categorical variable or a blend of categorical variables.

**<constant>**. A constant indicating a specific shape, such as `shape.square`. See the topic “Shape Constants” on page 413 for more information.

Description

Controls the shape of a graphic element. What shape controls depends on the graphic element type. The shape of a line specifies whether the line is solid or dashed. The border around a bar has a similar shape. The shape of a point or interval specifies whether the point or interval is shaped like a square or a line. All of these shapes are controlled by the shape function, but you can append .interior or .exterior to the function to ensure that you are specifying the desired one. shape.interior specifies the overall shape of the graphic element, including the dashing of edge, line, and path elements. shape.exterior specifies the shape of the exterior of the graphic element, which is often the border on graphic elements with fills. shape.exterior does not apply to edge, line, and path elements. Using shape without a qualifier implies shape.interior.

Examples

```
ELEMENT: point(position(salbegin*salary), shape.interior(shape.square))
```

*Figure 275. Example: Specifying a shape value*

```
ELEMENT: point(position(salbegin*salary), shape.interior(jobcat))
```

*Figure 276. Example: Using the values of a variable to control shape*

```
ELEMENT: line(position(salbegin*salary), shape.interior(jobcat))
```

*Figure 277. Example: Using the values of a variable to control line dashing*

```
ELEMENT: interval(position(gender*salary*jobcat), shape.exterior(gender))
```

*Figure 278. Example: Using the values of a variable to control border dashing*

**Applies To**

"edge Element" on page 48
"interval Element" on page 49
"line Element" on page 49
"path Element" on page 50
"point Element" on page 51
"polygon Element" on page 52

## shape Function (For GPL Guides)

*Note:* If you are modifying the shape for a graphic element (like a bar or point), refer to "shape Function (For GPL Graphic Elements)" on page 219.

Syntax

```
shape(shape.<shape constant>)
```

**<shape constant>**. A constant indicating a specific shape, such as shape.dash. See the topic "Shape Constants" on page 413 for more information.

Description

Controls the dashing of reference lines.

Examples

```
GUIDE: form.line(position(*,2000), shape(shape.dash))
```

*Figure 279. Example: Specifying a dashed reference line*

**Applies To**

"form.line Guide Type" on page 43

## showAll Function

Syntax

```
showAll()
```

Description

Display all labels, even if they overlap. Without this function, some overlapping labels may not be displayed, depending on the available space.

Examples

```
ELEMENT: point(position(x*y), label(z, showAll()))
```

*Figure 280. Example: Displaying all labels*

**Applies To**

"label Function (For GPL Graphic Elements)" on page 137

## size Function (For GPL Graphic Elements)

*Note:* If you are modifying the size for a guide, refer to "size Function (For GPL Guides)" on page 222.

Syntax

```
size(<algebra>)
```

*or*

```
size(size."size value")
```

*or*

```
size(size.<constant>)
```

*or*

```
size(<statistic function>)
```

**<algebra>**. Graph algebra using one variable or a blend of variables. This is not available for line elements.

**"size value"**. A specific value that indicates a size. This can be a percentage of the available space (for example, 40%) or a number with units (for example, 2in).

**<constant>**. A size constant. See the topic "Size Constants" on page 413 for more information.

**<statistic function>**. A statistic function.

Description

Specifies the size of the individual graphic elements.

Examples

```
ELEMENT: point(position(x*y), size(z))
```

*Figure 281. Example: Using a variable to control size*

```
ELEMENT: interval(position(x*y), size(size."60%"))
```

*Figure 282. Example: Specifying a percentage for size*

```
ELEMENT: interval(position(x*y), size(size."6px"))
```

*Figure 283. Example: Specifying a value for size*

```
ELEMENT: interval(position(x*y), size(size.large))
```

*Figure 284. Example: Specifying a constant for size*

Statistic Functions

See "GPL Functions" on page 56.

**Applies To**

"edge Element" on page 48
"interval Element" on page 49
"line Element" on page 49
"path Element" on page 50
"point Element" on page 51
"polygon Element" on page 52
"schema Element" on page 53

## size Function (For GPL Guides)

*Note:* If you are modifying the size for a graphic element (like a bar or point), refer to "size Function (For GPL Graphic Elements)" on page 221.

Syntax

```
size(size."size value")
```

*or*

```
size(size.<constant>)
```

**"size value"**. A specific value that indicates a size. This can be a percentage of the available space (for example, 40%) or a number with units (for example, 2in).

**<constant>**. A size constant. See the topic "Size Constants" on page 413 for more information.

Description

Controls the thickness of reference lines.

Examples

```
GUIDE: form.line(position(*,1000), size(size."15px"))
```

*Figure 285. Example: Specifying a reference line with a thickness of 15 pixels*

**Applies To**

"form.line Guide Type" on page 43

## smooth.cubic Function

Syntax

```
smooth.cubic(<algebra>, <function>)
```

*or*

```
smooth.cubic.<kernel>(<algebra, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<kernel>**. A kernel function for the smoother. This specifies how data are weighted by the smoother, depending on how close the data are to the current point. If no kernel is specified, Epanechnikov is used.

**<function>**. One or more valid functions. These are optional. If no `proportion` function is specified, 1 is used for the proportion.

Description

Uses regression to determine values that best fit the data to a cubic polynomial.

Examples

```
ELEMENT: line(position(smooth.cubic(salbegin*salary)))
```

*Figure 286. Example: Creating a cubic fit line*

Kernel Functions

**uniform.** All data receive equal weights.

**epanechnikov.** Data near the current point receive higher weights than extreme data receive. This function weights extreme points more than the triweight, biweight, and tricube kernels but less than the Gaussian and Cauchy kernels.

**biweight.** Data far from the current point receive more weight than the triweight kernel allows but less weight than the Epanechnikov kernel permits.

**tricube.** Data close to the current point receive higher weights than both the Epanechnikov and biweight kernels allow.

**triweight.** Data close to the current point receive higher weights than any other kernel allows. Extreme cases get very little weight.

**gaussian.** Weights follow a normal distribution, resulting in higher weighting of extreme cases than the Epanechnikov, biweight, tricube, and triweight kernels.

**cauchy.** Extreme values receive more weight than the other kernels, with the exception of the uniform kernel, allow.

**Valid Functions**

"noConstant Function" on page 189

"proportion Function" on page 195

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

## smooth.linear Function

Syntax

```
smooth.linear(<algebra>, <function>)
```

*or*

```
smooth.linear.<kernel>(<algebra, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<kernel>**. A kernel function for the smoother. This specifies how data are weighted by the smoother, depending on how close the data are to the current point. If no kernel is specified, Epanechnikov is used.

**<function>**. One or more valid functions. These are optional. If no `proportion` function is specified, 1 is used for the proportion.

Description

Uses regression to determine values that best fit the data to a linear slope.

Examples

```
ELEMENT: line(position(smooth.linear(salbegin*salary)))
```

*Figure 287. Example: Creating a linear fit line*

Kernel Functions

**uniform.** All data receive equal weights.

**epanechnikov.** Data near the current point receive higher weights than extreme data receive. This function weights extreme points more than the triweight, biweight, and tricube kernels but less than the Gaussian and Cauchy kernels.

**biweight.** Data far from the current point receive more weight than the triweight kernel allows but less weight than the Epanechnikov kernel permits.

**tricube.** Data close to the current point receive higher weights than both the Epanechnikov and biweight kernels allow.

**triweight.** Data close to the current point receive higher weights than any other kernel allows. Extreme cases get very little weight.

**gaussian.** Weights follow a normal distribution, resulting in higher weighting of extreme cases than the Epanechnikov, biweight, tricube, and triweight kernels.

**cauchy.** Extreme values receive more weight than the other kernels, with the exception of the uniform kernel, allow.

**Valid Functions**


"noConstant Function" on page 189

"proportion Function" on page 195


**Applies To**


"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"link.gabriel Function" on page 163

"link.hull Function" on page 165

"link.influence Function" on page 168

"link.join Function" on page 170

"link.mst Function" on page 172

"link.neighbor Function" on page 175

"link.relativeNeighborhood Function" on page 177

"link.sequence Function" on page 179

"link.tsp Function" on page 181

"position Function (For GPL Graphic Elements)" on page 192

"region.confi.count Function" on page 196

"region.confi.mean Function" on page 198

"region.confi.percent.count Function" on page 200

"region.confi.proportion.count Function" on page 202

"region.confi.smooth Function" on page 205

"region.spread.range Function" on page 207

"region.spread.sd Function" on page 209

"region.spread.se Function" on page 212

"size Function (For GPL Graphic Elements)" on page 221

"split Function" on page 243

## smooth.loess Function

Syntax

```
smooth.loess(<algebra>, <function>)
```

*or*

```
smooth.loess.<kernel>(<algebra>, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<kernel>**. A kernel function for the smoother. This specifies how data are weighted by the smoother, depending on how close the data are to the current point. If no kernel is specified, tricube is used.

**<function>**. One or more valid functions. These are optional. If no `proportion` function is specified, 1 is used for the proportion.

Description

Uses iterative weighted least squares to determine values that best fit the data.

Examples

```
ELEMENT: line(position(smooth.loess(salbegin*salary)))
```

*Figure 288. Example: Creating a loess fit line*

```
ELEMENT: line(position(smooth.loess.uniform(salbegin*salary)))
```

*Figure 289. Example: Creating a loess fit line with specific kernel*

Kernel Functions

**uniform.** All data receive equal weights.

**epanechnikov.** Data near the current point receive higher weights than extreme data receive. This function weights extreme points more than the triweight, biweight, and tricube kernels but less than the Gaussian and Cauchy kernels.

**biweight.** Data far from the current point receive more weight than the triweight kernel allows but less weight than the Epanechnikov kernel permits.

**tricube.** Data close to the current point receive higher weights than both the Epanechnikov and biweight kernels allow.

**triweight.** Data close to the current point receive higher weights than any other kernel allows. Extreme cases get very little weight.

**gaussian.** Weights follow a normal distribution, resulting in higher weighting of extreme cases than the Epanechnikov, biweight, tricube, and triweight kernels.

**cauchy.** Extreme values receive more weight than the other kernels, with the exception of the uniform kernel, allow.

**Valid Functions**

“proportion Function” on page 195

**Applies To**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156

## smooth.mean Function

Syntax

```
smooth.mean(<algebra>, <function>)
```

*or*

```
smooth.mean.<kernel>(<algebra, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<kernel>**. A kernel function for the smoother. This specifies how data are weighted by the smoother, depending on how close the data are to the current point. If no kernel is specified, Epanechnikov is used.

**<function>**. One or more valid functions. These are optional. If no `proportion` function is specified, 1 is used for the proportion.

Description

Calculates the smoothed mean of *y* in a 2-D (*x**y*) frame and *z* in a 3-D (*x**y**z*) frame. To force a straight line (a constant value), use the uniform kernel function.

Examples

```
ELEMENT: line(position(smooth.mean.uniform(salbegin*salary)))
```

*Figure 290. Example: Creating a line at the mean of the y axis*

Kernel Functions

**uniform.** All data receive equal weights.

**epanechnikov.** Data near the current point receive higher weights than extreme data receive. This function weights extreme points more than the triweight, biweight, and tricube kernels but less than the Gaussian and Cauchy kernels.

**biweight.** Data far from the current point receive more weight than the triweight kernel allows but less weight than the Epanechnikov kernel permits.

**tricube.** Data close to the current point receive higher weights than both the Epanechnikov and biweight kernels allow.

**triweight.** Data close to the current point receive higher weights than any other kernel allows. Extreme cases get very little weight.

**gaussian.** Weights follow a normal distribution, resulting in higher weighting of extreme cases than the Epanechnikov, biweight, tricube, and triweight kernels.

**cauchy.** Extreme values receive more weight than the other kernels, with the exception of the uniform kernel, allow.

**Valid Functions**

"proportion Function" on page 195

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
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"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196
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"region.confi.smooth Function" on page 205
"region.spread.range Function" on page 207
"region.spread.sd Function" on page 209
"region.spread.se Function" on page 212
"size Function (For GPL Graphic Elements)" on page 221
"split Function" on page 243
"summary.count Function" on page 245
"summary.count.cumulative Function" on page 247
"summary.countTrue Function" on page 250

## smooth.median Function

Syntax

```
smooth.median(<algebra>, <function>)
```

*or*

```
smooth.median.<kernel>(<algebra, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<kernel>**. A kernel function for the smoother. This specifies how data are weighted by the smoother, depending on how close the data are to the current point. If no kernel is specified, Epanechnikov is used.

**<function>**. One or more valid functions. These are optional. If no `proportion` function is specified, 1 is used for the proportion.

Description

Calculates the smoothed median of *y* in a 2-D (*x***y*) frame and *z* in a 3-D (*x***y***z*) frame. To force a straight line (a constant value), use the uniform kernel function.

Examples

```
ELEMENT: line(position(smooth.median.uniform(salbegin*salary)))
```

*Figure 291. Example: Creating a line at the median of the y axis*

Kernel Functions

**uniform.** All data receive equal weights.

**epanechnikov.** Data near the current point receive higher weights than extreme data receive. This function weights extreme points more than the triweight, biweight, and tricube kernels but less than the Gaussian and Cauchy kernels.

**biweight.** Data far from the current point receive more weight than the triweight kernel allows but less weight than the Epanechnikov kernel permits.

**tricube.** Data close to the current point receive higher weights than both the Epanechnikov and biweight kernels allow.

**triweight.** Data close to the current point receive higher weights than any other kernel allows. Extreme cases get very little weight.

**gaussian.** Weights follow a normal distribution, resulting in higher weighting of extreme cases than the Epanechnikov, biweight, tricube, and triweight kernels.

**cauchy.** Extreme values receive more weight than the other kernels, with the exception of the uniform kernel, allow.

**Valid Functions**


“proportion Function” on page 195
“smooth.cubic Function” on page 222
“smooth.linear Function” on page 225
“smooth.loess Function” on page 227
“smooth.mean Function” on page 230
“smooth.quadratic Function” on page 235


**Applies To**


“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159

## smooth.quadratic Function

Syntax

```
smooth.quadratic(<algebra>, <function>)
```

*or*

```
smooth.quadratic.<kernel>(<algebra, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<kernel>**. A kernel function for the smoother. This specifies how data are weighted by the smoother, depending on how close the data are to the current point. If no kernel is specified, Epanechnikov is used.

**<function>**. One or more valid functions. These are optional. If no `proportion` function is specified, 1 is used for the proportion.

Description

Uses regression to determine values that best fit the data to a quadratic polynomial.

Examples

```
ELEMENT: line(position(smooth.quadratic(salbegin*salary)))
```

*Figure 292. Example: Creating a quadratic fit line*

Kernel Functions

**uniform.** All data receive equal weights.

**epanechnikov.** Data near the current point receive higher weights than extreme data receive. This function weights extreme points more than the triweight, biweight, and tricube kernels but less than the Gaussian and Cauchy kernels.

**biweight.** Data far from the current point receive more weight than the triweight kernel allows but less weight than the Epanechnikov kernel permits.

**tricube.** Data close to the current point receive higher weights than both the Epanechnikov and biweight kernels allow.

**triweight.** Data close to the current point receive higher weights than any other kernel allows. Extreme cases get very little weight.

**gaussian.** Weights follow a normal distribution, resulting in higher weighting of extreme cases than the Epanechnikov, biweight, tricube, and triweight kernels.

**cauchy.** Extreme values receive more weight than the other kernels, with the exception of the uniform kernel, allow.

**Valid Functions**

"noConstant Function" on page 189

"proportion Function" on page 195

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"link.gabriel Function" on page 163

"link.hull Function" on page 165

"link.influence Function" on page 168

"link.join Function" on page 170

"link.mst Function" on page 172

"link.neighbor Function" on page 175

"link.relativeNeighborhood Function" on page 177

"link.sequence Function" on page 179

"link.tsp Function" on page 181

"position Function (For GPL Graphic Elements)" on page 192

"region.confi.count Function" on page 196

"region.confi.mean Function" on page 198

"region.confi.percent.count Function" on page 200

"region.confi.proportion.count Function" on page 202

"region.confi.smooth Function" on page 205

"region.spread.range Function" on page 207

"region.spread.sd Function" on page 209

"region.spread.se Function" on page 212

"size Function (For GPL Graphic Elements)" on page 221

"split Function" on page 243

"summary.count Function" on page 245

"summary.count.cumulative Function" on page 247

"summary.countTrue Function" on page 250

"summary.first Function" on page 252

"summary.kurtosis Function" on page 254

## smooth.spline Function

Syntax

```
smooth.spline(<algebra>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

Description

Calculates the cubic spline for the data. You should use a cubic spline curve only when you believe there is no error in your data.

Examples

```
ELEMENT: line(position(smooth.spline(salbegin*salary)))
```

*Figure 293. Example: Creating a cubic spline curve*

**Applies To**

## smooth.step Function

Syntax

```
smooth.step(<algebra>)
```

*or*

```
smooth.step.<position>(<algebra>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<position>**. The position of the data value in relation to the drawn line. Valid values are `right`, `left`, and `center`, with `right` being the default.

Description

Uses step interpolation to draw the graphic element through the data values. Use the `jump` function to specify that no connecting lines are drawn between the lines at each data value.

Examples

```
ELEMENT: line(position(smooth.step.center(salbegin*salary)))
```

*Figure 294. Example: Creating a step interpolation line*

**Applies To**

"bin.dot Function" on page 70

## sort.data Function

Syntax

```
sort.data()
```

Description

Sorts the categorical values in the order they appear in the data.

*Note:* If the data are pre-aggregated (for example, by using a statistic function in the IBM SPSS Statistics `GGRAPH` command), this function will not work as expected because the categorical values may be sorted during aggregation. Therefore, the GPL no longer knows the order in which the categorical values appeared in the original data.

Examples

```
SCALE: cat(dim(1), sort.data())
```

*Figure 295. Example: Sorting the categories*

**Applies To**

"cat Scale" on page 32

## sort.natural Function

Syntax

```
sort.natural()
```

Description

Sorts the categorical values in alphanumeric order.

Examples

```
SCALE: cat(dim(1), values("Male", "Female"), sort.natural())
```

*Figure 296. Example: Sorting the categories*

**Applies To**

"cat Scale" on page 32

## sort.statistic Function

Syntax

```
sort.statistic(<statistic function>)
```

**<statistic function>**. A statistic function.

Description

Sorts the categorical values based on the result of the statistic function for each category.

Examples

```
SCALE: cat(dim(1), sort.statistic(summary.mean(salary)))
```

*Figure 297. Example: Sorting the categories*

Statistic Functions

See "GPL Functions" on page 56.

**Applies To**

"cat Scale" on page 32

## sort.values Function

Syntax

```
sort.values("category name" ...)
```

**"category name"**. The name of a category in the data. Delineate each name with a comma.

Description

Sorts the categorical values based on the order in which they appear in this function. You do not need to specify every category. The categories will be ordered as they appear, and any other categories that are not specified will appear in the order they appear in the data. If you are using this function with a data file from IBM SPSS Statistics, you need to specify the data values for the categories, not the data labels that appear in the resulting visualization.

Examples

```
SCALE: cat(dim(1), sort.values("Male"))
```

*Figure 298. Example: Sorting the categories explicitly*

In this example, *Male* will appear first. It is not necessary to specify that *Female* will appear next.

**Applies To**

"cat Scale" on page 32

## split Function

Syntax

```
split(<algebra>)
```

*or*

```
color(<statistic function>)
```

**<algebra>**. The name of a categorical variable.

**<statistic function>**. A statistic function.

Description

Splits the graphic element into multiple graphic elements or groups of graphic elements for each category in a categorical variable. This result is similar to that obtained by the aesthetic functions, but there is no specific aesthetic associated with each group of graphic elements.

Examples

```
ELEMENT: line(position(salbegin*salary), split(gender))
```

*Figure 299. Example: Creating groups of lines*

Statistic Functions

See "GPL Functions" on page 56.

**Applies To**

"area Element" on page 47
"edge Element" on page 48
"interval Element" on page 49
"line Element" on page 49
"path Element" on page 50
"point Element" on page 51
"polygon Element" on page 52
"schema Element" on page 53

## sqlSource Function

Syntax

```
sqlSource(url("url"), user("user name"), password("user password"), query("sql query"))
```

**"url"**. The URL string for connecting to the database. The URL is typically of the form *jdbc:<jdbc vendor>:<vendor information>://<host name>:<port number>*, where items between angled brackets (<>) are variables specific to each database driver vendor. Consult your database vendor's documentation for more information.

**"user name"**. A user name for accessing the database.

**"user password"**. The user's password.

**"sql query"**. A SQL query string for extracting data from the database.

Description

Reads data from a database using a SQL query string.

Examples

```
SOURCE: mydata = sqlSource(url("jdbc:microsoft:sqlserver://localhost:1433"), user("fred"),
   password("secret"), query("select * from employeeData"))
```

*Figure 300. Example: Reading from a database*

**Valid Functions**

"missing.listwise Function" on page 187

"missing.pairwise Function" on page 188

"weight Function" on page 326

**Applies To**

"SOURCE Statement" on page 23

## start Function

Syntax

```
start(<value>)
```

**<value>**. A numeric value indicating the location of the first major tick.

Description

Specifies the value at which the first major tick appears.

Examples

```
GUIDE: axis(dim(1), start(1000))
```

*Figure 301. Example: Specifying the first major tick*

**Applies To**

"axis Guide Type" on page 42

## startAngle Function

Syntax

```
startAngle(<integer>)
```

**<integer>**. An integer indicating the number of degrees relative to 12:00.

Description

Indicates the angle at which the coordinate system begins. Often used to indicate the position of the first slice in a pie chart. The specified degrees are relative to the 12:00 position, and rotation is counterclockwise.

Examples

```
COORD: polar.theta(startAngle(90))
```

*Figure 302. Example: Specifying the first slice at 9:00*

```
COORD: polar.theta(startAngle(-90))
```

*Figure 303. Example: Specifying the first slice at 3:00 (90 degrees)*

**Applies To**

"polar Coordinate Type" on page 26

"polar.theta Coordinate Type" on page 27

## studentizedRange Function

Syntax

```
studentizedRange(<degrees of freedom>, <k>)
```

**<degrees of freedom>**. Numeric value indicating the degrees of freedom parameter for the distribution. The value must be greater than 0.

**<k>**. Numeric value indicating the k (number of groups) parameter for the distribution. The value must be greater than 0.

Description

Specifies a Studentized range distribution for the probability scale.

Examples

```
SCALE: prob(dim(2), studentizedRange(5, 2.5))
```

*Figure 304. Example: Specifying a Studentized range distribution for the probability scale*

**Applies To**

"prob Scale" on page 37

## summary.count Function

Syntax

```
summary.count(<algebra>)
```

*or*

```
summary.count(<binning function>)
```

*or*

```
summary.count(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x` or `x*y`. In the second case, the count is calculated for cases with non-missing `y`-variable values. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.count`.

Description

Calculates the number of cases identified by the algebra or function. If using a function, a typical one would be a binning function. `summary.count` subsequently calculates the number of cases in each bin.

Examples

```
ELEMENT: interval(position(summary.count(jobcat)))
```

*Figure 305. Example: Specifying a bar chart of counts*

```
ELEMENT: interval(position(summary.count(jobcat*salary)))
```

*Figure 306. Example: Counting non-missing cases for a continuous variable*

```
ELEMENT: interval(position(summary.count(bin.rect(salary))))
```

*Figure 307. Example: Specifying a histogram*

Statistic Functions

See “GPL Functions” on page 56.

**Binning Functions**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77

**Applies To**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
“region.confi.proportion.count Function” on page 202
“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
“region.spread.sd Function” on page 209
“region.spread.se Function” on page 212
“size Function (For GPL Graphic Elements)” on page 221

## summary.count.cumulative Function

Syntax

```
summary.count.cumulative(<algebra>)
```

*or*

```
summary.count.cumulative(<binning function>)
```

*or*

```
summary.count.cumulative(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x` or `x*y`. In the second case, the count is calculated for cases with non-missing `y`-variable values. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.count.cumulative`.

Description

Calculates the cumulative number of cases identified by the algebra or function. If using a function, a typical one would be a binning function. `summary.count` subsequently calculates the number of cases in each bin.

If the graph is paneled (faceted), the cumulation begins again with each panel.

*Note:* If there are multiple `ELEMENT` statements, you cannot use cumulative statistics for some graphic elements but not for others. This behavior is prohibited because the results of each statistic function would be blended on the same scale. The units for cumulative statistics do not match the units for non-cumulative statistics, so blending these results is impossible.

Examples

```
ELEMENT: interval(position(summary.count.cumulative(jobcat)))
```

*Figure 308. Example: Specifying a bar chart of cumulative counts*

```
ELEMENT: interval(position(summary.count.cumulative(bin.rect(salary))))
```

*Figure 309. Example: Specifying a cumulative histogram*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161

## summary.countTrue Function

Syntax

```
summary.countTrue(<algebra>)
```

*or*

```
summary.countTrue(<binning function>)
```

*or*

```
summary.countTrue(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.countTrue`.

Description

Calculates the number of cases that evaluate to a *true* value. If the function is evaluating graph algebra, the analysis variable is typically the Boolean result of expression evaluated by the `eval` function. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
TRANS: salGreaterThan = eval(salary>50000)
ELEMENT: interval(position(summary.countTrue(jobcat*salGreaterThan)))
```

*Figure 310. Example: Plotting count greater than a value*

```
TRANS: salLessThan = eval(salary<50000)
TRANS: salEqualTo = eval(salary==50000)
TRANS: salGreaterThan = eval(salary>50000)
ELEMENT: interval(position(summary.countTrue("Less than 50000"*salLessThan)))
ELEMENT: interval(position(summary.countTrue("Equal to 50000"*salEqualTo)))
ELEMENT: interval(position(summary.countTrue("Greater than 50000"*salGreaterThan)))
```

*Figure 311. Example: Plotting count less than, equal to, and greater than a value*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
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"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196
"region.confi.mean Function" on page 198
"region.confi.percent.count Function" on page 200
"region.confi.proportion.count Function" on page 202
"region.confi.smooth Function" on page 205
"region.spread.range Function" on page 207
"region.spread.sd Function" on page 209
"region.spread.se Function" on page 212
"size Function (For GPL Graphic Elements)" on page 221
"split Function" on page 243
"summary.count Function" on page 245
"summary.count.cumulative Function" on page 247
"summary.first Function" on page 252
"summary.kurtosis Function" on page 254
"summary.last Function" on page 257
"summary.max Function" on page 259
"summary.mean Function" on page 261
"summary.median Function" on page 263
"summary.min Function" on page 265

## summary.first Function

Syntax

```
summary.first(<algebra>)
```

*or*

```
summary.first(<binning function>)
```

*or*

```
summary.first(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.max`.

Description

Gets the first value that appears in the data. If the function is evaluating graph algebra, the first value of the analysis variable is returned for each subgroup. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.first(jobcat*salary)))
```

*Figure 312. Example: Calculating the first salary value for each jobcat category*

Statistic Functions

See “GPL Functions” on page 56.
**Binning Functions**
“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
**Applies To**
“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
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“region.confi.proportion.count Function” on page 202
“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
“region.spread.sd Function” on page 209
“region.spread.se Function” on page 212
“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243

## summary.kurtosis Function

Syntax

```
summary.kurtosis(<algebra>)
```

*or*

```
summary.kurtosis(<binning function>)
```

*or*

```
summary.kurtosis(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.kurtosis`.

Description

Calculates the kurtosis, which measures whether the data peak more compared to the normal distribution. If the function is evaluating graph algebra, the kurtosis of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.kurtosis(jobcat*salary)))
```

*Figure 313. Example: Calculating the kurtosis of salary for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181
"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196

## summary.last Function

Syntax

```
summary.last(<algebra>)
```

*or*

```
summary.last(<binning function>)
```

*or*

```
summary.last(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.max`.

Description

Gets the last value that appears in the data. If the function is evaluating graph algebra, the last value of the analysis variable is returned for each subgroup. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.last(jobcat*salary)))
```

*Figure 314. Example: Calculating the last salary value for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

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"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"link.gabriel Function" on page 163

"summary.sd Function" on page 304
"summary.se Function" on page 306
"summary.se.kurtosis Function" on page 308
"summary.se.skewness Function" on page 311
"summary.sum Function" on page 313
"summary.sum.cumulative Function" on page 315
"summary.variance Function" on page 317
"transparency Function (For GPL Graphic Elements)" on page 322

## summary.max Function

Syntax

```
summary.max(<algebra>)
```

*or*

```
summary.max(<binning function>)
```

*or*

```
summary.max(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.max`.

Description

Calculates the maximum value. If the function is evaluating graph algebra, the maximum value of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.max(jobcat*salary)))
```

*Figure 315. Example: Calculating the maximum salary for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

## summary.mean Function

Syntax

```
summary.mean(<algebra>)
```

*or*

```
summary.mean(<binning function>)
```

*or*

```
summary.mean(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.mean`.

Description

Calculates the arithmetic mean. If the function is evaluating graph algebra, the mean of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.mean(jobcat*salary)))
```

*Figure 316. Example: Calculating the mean salary for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181
"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196
"region.confi.mean Function" on page 198
"region.confi.percent.count Function" on page 200
"region.confi.proportion.count Function" on page 202
"region.confi.smooth Function" on page 205
"region.spread.range Function" on page 207
"region.spread.sd Function" on page 209
"region.spread.se Function" on page 212
"size Function (For GPL Graphic Elements)" on page 221
"split Function" on page 243
"summary.count Function" on page 245
"summary.count.cumulative Function" on page 247
"summary.countTrue Function" on page 250
"summary.first Function" on page 252
"summary.kurtosis Function" on page 254
"summary.last Function" on page 257
"summary.max Function" on page 259
"summary.median Function" on page 263

## summary.median Function

Syntax

```
summary.median(<algebra>)
```

*or*

```
summary.median(<binning function>)
```

*or*

```
summary.median(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.median`.

Description

Calculates the median, which is the value above and below which half of the cases fall. The result is equivalent to `summary.percentile` with an alpha of 0.5. If the function is evaluating graph algebra, the

median of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.median(jobcat*salary)))
```

*Figure 317. Example: Calculating the median salary for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181
"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196
"region.confi.mean Function" on page 198
"region.confi.percent.count Function" on page 200
"region.confi.proportion.count Function" on page 202
"region.confi.smooth Function" on page 205
"region.spread.range Function" on page 207
"region.spread.sd Function" on page 209
"region.spread.se Function" on page 212

## summary.min Function

Syntax

```
summary.min(<algebra>)
```

*or*

```
summary.min(<binning function>)
```

*or*

```
summary.min(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.min`.

Description

Calculates the minimum value. If the function is evaluating graph algebra, the minimum value of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.min(jobcat*salary)))
```

*Figure 318. Example: Calculating the minimum salary for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181

## summary.mode Function

Syntax

```
summary.mode(<algebra>)
```

*or*

```
summary.mode(<binning function>)
```

*or*

```
summary.mode(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.mode`.

Description

Calculates the mode, which is the most frequent value. If there is a tie, the smallest value is returned. If the function is evaluating graph algebra, the mode of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.mode(jobcat*educationalLevel)))
```

*Figure 319. Example: Calculating the mode of educationalLevel for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"link.gabriel Function" on page 163

"summary.sd Function" on page 304
"summary.se Function" on page 306
"summary.se.kurtosis Function" on page 308
"summary.se.skewness Function" on page 311
"summary.sum Function" on page 313
"summary.sum.cumulative Function" on page 315
"summary.variance Function" on page 317
"transparency Function (For GPL Graphic Elements)" on page 322

## summary.percent Function

Description

`summary.percent` is an alias for `summary.percent.sum`. See the topic "summary.percent.sum Function" on page 278 for more information.

Examples

```
ELEMENT: interval(position(summary.percent(jobcat*salary)))
```

*Figure 320. Example: Calculating percentages of a summed variable*

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181
"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196
"region.confi.mean Function" on page 198
"region.confi.percent.count Function" on page 200
"region.confi.proportion.count Function" on page 202

## summary.percent.count Function

Syntax

```
summary.percent.count(<algebra>, <base function>)
```

*or*

```
summary.percent.count(<binning function>, <base function>)
```

*or*

```
summary.percent.count(<statistic function>, <base function>)
```

**<algebra>**. Graph algebra, such as `x` or `x*y`. In the second case, the percentage is calculated for cases with non-missing y-variable values. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<base function>**. A function that specifies the percentage base for `summary.percent.count`. This is optional. The default is `base.all()`.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.percent.count`.

Description

Calculates the percentage of cases within each subgroup compared to the total number of cases.

Examples

```
ELEMENT: interval(position(summary.percent.count(jobcat)))
```

*Figure 321. Example: Calculating percentages of counts*

```
ELEMENT: interval(position(summary.percent.count(bin.rect(salary))))
```

*Figure 322. Example: Graphing a histogram of percentages*

Statistic Functions

See "GPL Functions" on page 56.

**Base Functions**

"base.aesthetic Function" on page 66

"base.all Function" on page 67

"base.coordinate Function" on page 68

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

## summary.percent.count.cumulative Function

```
summary.percent.count.cumulative(<algebra>, <base function>)
```

*or*

```
summary.percent.count.cumulative(<binning function>, <base function>)
```

*or*

```
summary.percent.count.cumulative(<statistic function>, <base function>)
```

**<algebra>**. Graph algebra, such as `x` or `x*y`. In the second case, the percentage is calculated for cases with non-missing `y`-variable values. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<base function>**. A function that specifies the percentage base for `summary.percent.count.cumulative`. This is optional. The default is `base.all()`.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.percent.count.cumulative`.

Description

Calculates the cumulative percentage of cases within each group compared to the total number of cases.

*Note:* If there are multiple `ELEMENT` statements, you cannot use cumulative statistics for some graphic elements but not for others. This behavior is prohibited because the results of each statistic function would be blended on the same scale. The units for cumulative statistics do not match the units for non-cumulative statistics, so blending these results is impossible.

Examples

```
ELEMENT: interval(position(summary.percent.count.cumulative(jobcat)))
```

*Figure 323. Example: Calculating cumulative percentages of counts*

```
ELEMENT: interval(position(summary.percent.count.cumulative(bin.rect(salary))))
```

*Figure 324. Example: Calculating a cumulative histogram of percentages*

Statistic Functions

See “GPL Functions” on page 56.
**Base Functions**
“base.aesthetic Function” on page 66
“base.all Function” on page 67
“base.coordinate Function” on page 68
**Binning Functions**
“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
**Applies To**
“bin.dot Function” on page 70
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“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
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“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
“region.confi.proportion.count Function” on page 202
“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
“region.spread.sd Function” on page 209
“region.spread.se Function” on page 212
“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243
“summary.count Function” on page 245
“summary.count.cumulative Function” on page 247

## summary.percent.cumulative Function

Description

`summary.percent.cumulative` is an alias for `summary.percent.sum.cumulative`. See the topic "summary.percent.sum.cumulative Function" on page 281 for more information.

*Note:* If there are multiple `ELEMENT` statements, you cannot use cumulative statistics for some graphic elements but not for others. This behavior is prohibited because the results of each statistic function would be blended on the same scale. The units for cumulative statistics do not match the units for non-cumulative statistics, so blending these results is impossible.

Examples

```
ELEMENT: interval(position(summary.percent.cumulative(jobcat*salary)))
```

*Figure 325. Example: Calculating cumulative percentages of a summed variable*

**Base Functions**


"base.aesthetic Function" on page 66
"base.all Function" on page 67
"base.coordinate Function" on page 68


**Binning Functions**


"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
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**Applies To**


"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
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"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181
"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196
"region.confi.mean Function" on page 198
"region.confi.percent.count Function" on page 200
"region.confi.proportion.count Function" on page 202
"region.confi.smooth Function" on page 205
"region.spread.range Function" on page 207
"region.spread.sd Function" on page 209
"region.spread.se Function" on page 212
"size Function (For GPL Graphic Elements)" on page 221
"split Function" on page 243

## summary.percent.sum Function

Syntax

```
summary.percent.sum(<algebra>, <base function>)
```

*or*

```
summary.percent.sum(<binning function>, <base function>)
```

*or*

```
summary.percent.sum(<statistic function>, <base function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<base function>**. A function that specifies the percentage base for `summary.percent.sum`. This is optional. The default is `base.all()`.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.percent.sum`.

Description

Calculates the percentage within each subgroup based on a summed variable compared to the sum across all groups. `summary.percent` is an alias for this function. To obtain percentages of counts, use the `summary.percent.count` function. See the topic "summary.percent.count Function" on page 271 for more information.

Examples

```
ELEMENT: interval(position(summary.percent.sum(jobcat*salary)))
```

*Figure 326. Example: Calculating percentages of a summed variable*

Statistic Functions

See "GPL Functions" on page 56.
**Base Functions**
"base.aesthetic Function" on page 66
"base.all Function" on page 67
"base.coordinate Function" on page 68
**Binning Functions**
"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
**Applies To**
"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170

"summary.se.skewness Function" on page 311
"summary.sum Function" on page 313
"summary.sum.cumulative Function" on page 315
"summary.variance Function" on page 317
"transparency Function (For GPL Graphic Elements)" on page 322

## summary.percent.sum.cumulative Function

```
summary.percent.sum.cumulative(<algebra>, <base function>)
```

*or*

```
summary.percent.sum.cumulative(<binning function>, <base function>)
```

*or*

```
summary.percent.sum.cumulative(<statistic function>, <base function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<base function>**. A function that specifies the percentage base for `summary.percent.sum.cumulative`. This is optional. The default is `base.all()`.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.percent.sum.cumulative`.

Description

Calculates the cumulative percentage within each subgroup based on a summed variable compared to the sum across all groups. `summary.percent.cumulative` is an alias for this function. To obtain cumulative percentages of counts, use the `summary.percent.count.cumulative` function. See the topic "summary.percent.count.cumulative Function" on page 274 for more information.

*Note:* If there are multiple `ELEMENT` statements, you cannot use cumulative statistics for some graphic elements but not for others. This behavior is prohibited because the results of each statistic function would be blended on the same scale. The units for cumulative statistics do not match the units for non-cumulative statistics, so blending these results is impossible.

Examples

```
ELEMENT: interval(position(summary.percent.sum.cumulative(jobcat*salary)))
```

*Figure 327. Example: Calculating cumulative percentages of a summed variable*

Statistic Functions

See "GPL Functions" on page 56.

**Base Functions**
"base.aesthetic Function" on page 66
"base.all Function" on page 67
"base.coordinate Function" on page 68

**Binning Functions**
"bin.dot Function" on page 70
"bin.hex Function" on page 72

**Applies To**

## summary.percentile Function

Syntax

```
summary.percentile(<algebra>, <function>)
```

*or*

```
summary.percentile(<binning function>, <function>)
```

*or*

```
summary.percentile(<statistic function>, <function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<function>**. One or more valid functions. These are optional. If no `alpha` function is specified, 0.95 is used for the alpha. If the alpha is 0.5, the result is equivalent to `summary.median`.

Description

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.percentile`.

Description

Calculates the percentile value at the specified alpha. If the function is evaluating graph algebra, the percentile value of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.percentile(jobcat*salary, alpha(0.25))))
```

*Figure 328. Example: Calculating the 25th percentile of salary for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Valid Functions**

"alpha Function" on page 65

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181
"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196
"region.confi.mean Function" on page 198
"region.confi.percent.count Function" on page 200
"region.confi.proportion.count Function" on page 202
"region.confi.smooth Function" on page 205

## summary.percentTrue Function

Syntax

```
summary.percentTrue(<algebra>)
```

*or*

```
summary.percentTrue(<binning function>)
```

*or*

```
summary.percentTrue(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.percentTrue`.

Description

Calculate the percentage of cases within each subgroup that evaluate to a *true* value compared to the total number of cases. If the function is evaluating graph algebra, the analysis variable is typically the Boolean result of expression evaluated by the `eval` function. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
TRANS: salGreaterThan = eval(salary>50000)
ELEMENT: interval(position(summary.percentTrue(jobcat*salGreaterThan)))
```

*Figure 329. Example: Plotting percentage greater than a value*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"link.gabriel Function" on page 163

"link.hull Function" on page 165

"link.influence Function" on page 168

"link.join Function" on page 170

"link.mst Function" on page 172

"summary.sum Function" on page 313
"summary.sum.cumulative Function" on page 315
"summary.variance Function" on page 317
"transparency Function (For GPL Graphic Elements)" on page 322

## summary.proportion Function

Description

`summary.proportion` is an alias for `summary.proportion.sum`. See the topic "summary.proportion.sum Function" on page 294 for more information.

Examples

```
ELEMENT: interval(position(summary.proportion(jobcat*salary)))
```

*Figure 330. Example: Calculating proportions of a summed variable*

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
"color Function (For GPL Graphic Elements)" on page 86
"color.brightness Function (For GPL Graphic Elements)" on page 88
"color.hue Function (For GPL Graphic Elements)" on page 89
"color.saturation Function (For GPL Graphic Elements)" on page 90
"link.alpha Function" on page 154
"link.complete Function" on page 156
"link.delaunay Function" on page 159
"link.distance Function" on page 161
"link.gabriel Function" on page 163
"link.hull Function" on page 165
"link.influence Function" on page 168
"link.join Function" on page 170
"link.mst Function" on page 172
"link.neighbor Function" on page 175
"link.relativeNeighborhood Function" on page 177
"link.sequence Function" on page 179
"link.tsp Function" on page 181
"position Function (For GPL Graphic Elements)" on page 192
"region.confi.count Function" on page 196
"region.confi.mean Function" on page 198
"region.confi.percent.count Function" on page 200
"region.confi.proportion.count Function" on page 202
"region.confi.smooth Function" on page 205
"region.spread.range Function" on page 207
"region.spread.sd Function" on page 209
"region.spread.se Function" on page 212

## summary.proportion.count Function

Syntax

```
summary.proportion.count(<algebra>, <base function>)
```

*or*

```
summary.proportion.count(<binning function>, <base function>)
```

*or*

```
summary.proportion.count(<statistic function>, <base function>)
```

**<algebra>**. Graph algebra, such as `x` or `x*y`. In the second case, the proportion is calculated for cases with non-missing `y`-variable values. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<base function>**. A function that specifies the percentage base for `summary.proportion.count`. This is optional. The default is `base.all()`.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.proportion.count`.

Description

Calculates the proportion of cases within each subgroup compared to the total number of cases. This function is similar to `summary.percent.count` except it reports a value between 0 and 1 instead of 0 and 100.

Examples

```
ELEMENT: interval(position(summary.proportion.count(jobcat)))
```

*Figure 331. Example: Calculating proportions of counts*

Statistic Functions

See "GPL Functions" on page 56.

**Base Functions**

"base.aesthetic Function" on page 66

"base.all Function" on page 67

"base.coordinate Function" on page 68

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"link.gabriel Function" on page 163

"link.hull Function" on page 165

## summary.proportion.count.cumulative Function

```
summary.proportion.count.cumulative(<algebra>, <base function>)
```

*or*

```
summary.proportion.count.cumulative(<binning function>, <base function>)
```

*or*

```
summary.proportion.count.cumulative(<statistic function>, <base function>)
```

**<algebra>**. Graph algebra, such as `x` or `x*y`. In the second case, the proportion is calculated for cases with non-missing y-variable values. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<base function>**. A function that specifies the percentage base for `summary.proportion.count.cumulative`. This is optional. The default is `base.all()`.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.proportion.count.cumulative`.

Description

Calculates the cumulative proportion of cases within each group compared to the total number of cases. This function is similar to `summary.percent.count.cumulative` except it reports a value between 0 and 1 instead of 0 and 100.

*Note:* If there are multiple `ELEMENT` statements, you cannot use cumulative statistics for some graphic elements but not for others. This behavior is prohibited because the results of each statistic function would be blended on the same scale. The units for cumulative statistics do not match the units for non-cumulative statistics, so blending these results is impossible.

Examples

```
ELEMENT: interval(position(summary.proportion.count.cumulative(jobcat)))
```

*Figure 332. Example: Calculating cumulative proportions of counts*

Statistic Functions

See "GPL Functions" on page 56.

**Base Functions**



**Binning Functions**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
**Applies To**
“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
“region.confi.proportion.count Function” on page 202
“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
“region.spread.sd Function” on page 209
“region.spread.se Function” on page 212
“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243
“summary.count Function” on page 245
“summary.count.cumulative Function” on page 247
“summary.countTrue Function” on page 250
“summary.first Function” on page 252
“summary.kurtosis Function” on page 254
“summary.last Function” on page 257
“summary.max Function” on page 259
“summary.mean Function” on page 261

## summary.proportion.cumulative Function

Description

`summary.proportion.cumulative` is an alias for `summary.proportion.sum.cumulative`. See the topic "summary.proportion.sum.cumulative Function" on page 297 for more information.

*Note:* If there are multiple `ELEMENT` statements, you cannot use cumulative statistics for some graphic elements but not for others. This behavior is prohibited because the results of each statistic function would be blended on the same scale. The units for cumulative statistics do not match the units for non-cumulative statistics, so blending these results is impossible.

Examples

```
ELEMENT: interval(position(summary.proportion.cumulative(jobcat*salary)))
```

*Figure 333. Example: Calculating cumulative proportions of a summed variable*

## summary.proportion.sum Function

Syntax

```
summary.proportion.sum(<algebra>, <base function>)
```

*or*

```
summary.proportion.sum(<binning function>, <base function>)
```

*or*

```
summary.proportion.sum(<statistic function>, <base function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<base function>**. A function that specifies the percentage base for `summary.proportion.sum`. This is optional. The default is `base.all()`.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.proportion.sum`.

Description

Calculates the proportion within each subgroup based on a summed variable compared to the sum across all groups. `summary.proportion` is an alias for this function. `summary.proportion.sum` is similar to `summary.percent.sum` except it reports a value between 0 and 1 instead of 0 and 100.

To obtain proportions of counts, use the `summary.proportion.count` function. See the topic "summary.proportion.count Function" on page 289 for more information.

Examples

```
ELEMENT: interval(position(summary.proportion.sum(jobcat*salary)))
```

*Figure 334. Example: Calculating proportions of a summed variable*

Statistic Functions

See "GPL Functions" on page 56.

**Base Functions**

"base.aesthetic Function" on page 66

"base.all Function" on page 67

"base.coordinate Function" on page 68

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

## summary.proportion.sum.cumulative Function

```
summary.proportion.sum.cumulative(<algebra>, <base function>)
```

*or*

```
summary.proportion.sum.cumulative(<binning function>, <base function>)
```

*or*

```
summary.proportion.sum.cumulative(<statistic function>, <base function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<base function>**. A function that specifies the percentage base for `summary.proportion.sum.cumulative`. This is optional. The default is `base.all()`.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.proportion.sum.cumulative`.

Description

Calculates the cumulative proportion within each subgroup based on a summed variable compared to the sum across all groups. `summary.proportion.cumulative` is an alias for this function. `summary.proportion.sum.cumulative` is similar to `summary.percent.sum.cumulative` except it reports a value between 0 and 1 instead of 0 and 100.

To obtain cumulative proportions of counts, use the `summary.proportion.count.cumulative` function. See the topic "summary.proportion.count.cumulative Function" on page 292 for more information.

*Note:* If there are multiple `ELEMENT` statements, you cannot use cumulative statistics for some graphic elements but not for others. This behavior is prohibited because the results of each statistic function would be blended on the same scale. The units for cumulative statistics do not match the units for non-cumulative statistics, so blending these results is impossible.

Examples

```
ELEMENT: interval(position(summary.proportion.sum.cumulative(jobcat*salary)))
```

*Figure 335. Example: Calculating cumulative proportions of a summed variable*

Statistic Functions

## summary.proportionTrue Function

Syntax

```
summary.proportionTrue(<algebra>)
```

*or*

```
summary.proportionTrue(<binning function>)
```

*or*

```
summary.proportionTrue(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.proportionTrue`.

Description

Calculate the proportion of cases within each subgroup that evaluate to a *true* value compared to the total number of cases. This function is similar to `summary.percentTrue` except it reports a value between 0 and 1 instead of 0 and 100. If `summary.proportionTrue` is evaluating graph algebra, the analysis variable is typically the Boolean result of expression evaluated by the `eval` function. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
TRANS: salGreaterThan = eval(salary>50000)
ELEMENT: interval(position(summary.proportionTrue(jobcat*salGreaterThan)))
```

*Figure 336. Example: Plotting proportion greater than a value*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"link.gabriel Function" on page 163

"link.hull Function" on page 165

"link.influence Function" on page 168

"link.join Function" on page 170

"link.mst Function" on page 172

"link.neighbor Function" on page 175

"link.relativeNeighborhood Function" on page 177

"link.sequence Function" on page 179

"link.tsp Function" on page 181

"position Function (For GPL Graphic Elements)" on page 192

"region.confi.count Function" on page 196

## summary.range Function

Syntax

```
summary.range(<algebra>)
```

*or*

```
summary.range(<binning function>)
```

*or*

```
summary.range(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.range`.

Description

Calculates the range, which is the difference between the minimum and maximum values. If the function is evaluating graph algebra, the range of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

This function returns only one value. If you want to display the interval between the minimum and maximum values, use `region.spread.range`. See the topic "region.spread.range Function" on page 207 for more information.

Examples

```
ELEMENT: interval(position(summary.range(jobcat*salary)))
```

*Figure 337. Example: Calculating the range of salary for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

## summary.sd Function

Syntax

```
summary.sd(<algebra>)
```

*or*

```
summary.sd(<binning function>)
```

*or*

```
summary.sd(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.sd`.

Description

Calculates the standard deviation, which is the square root of the variance. If the function is evaluating graph algebra, the standard deviation of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.sd(jobcat*salary)))
```

*Figure 338. Example: Calculating the standard deviation of salary for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.
**Binning Functions**
"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77
**Applies To**

## summary.se Function

Syntax

```
summary.se(<algebra>)
```

*or*

```
summary.se(<binning function>)
```

*or*

```
summary.se(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.se`.

Description

Calculates the standard error of the mean, which is the standard deviation of the sample means. If the function is evaluating graph algebra, the standard error of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.se(jobcat*salary)))
```

*Figure 339. Example: Calculating the standard error of salary for each jobcat category*

Statistic Functions

See “GPL Functions” on page 56.

**Binning Functions**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77

**Applies To**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
“region.confi.proportion.count Function” on page 202
“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
“region.spread.sd Function” on page 209
“region.spread.se Function” on page 212
“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243
“summary.count Function” on page 245
“summary.count.cumulative Function” on page 247

## summary.se.kurtosis Function

Syntax

```
summary.se.kurtosis(<algebra>)
```

*or*

```
summary.se.kurtosis(<binning function>)
```

*or*

```
summary.se.kurtosis(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.se.kurtosis`.

Description

Calculates the standard error of the kurtosis, which is the standard deviation of the sample kurtosis values. If the function is evaluating graph algebra, the standard error of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.se.kurtosis(jobcat*salary)))
```

*Figure 340. Example: Calculating the standard error of the kurtosis of salary for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"link.gabriel Function" on page 163

"link.hull Function" on page 165

"link.influence Function" on page 168

"link.join Function" on page 170

"link.mst Function" on page 172

"link.neighbor Function" on page 175

"link.relativeNeighborhood Function" on page 177

"link.sequence Function" on page 179

"link.tsp Function" on page 181

"position Function (For GPL Graphic Elements)" on page 192

"region.confi.count Function" on page 196

"region.confi.mean Function" on page 198

## summary.se.skewness Function

Syntax

```
summary.se.skewness(<algebra>)
```

*or*

```
summary.se.skewness(<binning function>)
```

*or*

```
summary.se.skewness(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.se.skewness`.

Description

Calculates the standard error of the skewness, which is the standard deviation of the sample skewness values. If the function is evaluating graph algebra, the standard error of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.se.skewness(jobcat*salary)))
```

*Figure 341. Example: Calculating the standard error of the skewness of salary for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"summary.proportionTrue Function" on page 299
"summary.range Function" on page 302
"summary.sd Function" on page 304
"summary.se Function" on page 306
"summary.se.kurtosis Function" on page 308
"summary.sum Function"
"summary.sum.cumulative Function" on page 315
"summary.variance Function" on page 317
"transparency Function (For GPL Graphic Elements)" on page 322

## summary.sum Function

Syntax

```
summary.sum(<algebra>)
```

*or*

```
summary.sum(<binning function>)
```

*or*

```
summary.sum(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.sum`.

Description

Calculates the sum. If the function is evaluating graph algebra, the sum of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.sum(jobcat*salary)))
```

*Figure 342. Example: Calculating the sum of salary for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75
"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70
"bin.hex Function" on page 72
"bin.quantile.letter Function" on page 75

## summary.sum.cumulative Function

Syntax

```
summary.sum.cumulative(<algebra>)
```

*or*

```
summary.sum.cumulative(<binning function>)
```

*or*

```
summary.sum.cumulative(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.sum.cumulative`.

Description

Calculates the cumulative sum. If the function is evaluating graph algebra, the cumulative sum of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

*Note:* If there are multiple `ELEMENT` statements, you cannot use cumulative statistics for some graphic elements but not for others. This behavior is prohibited because the results of each statistic function would be blended on the same scale. The units for cumulative statistics do not match the units for non-cumulative statistics, so blending these results is impossible.

Examples

```
ELEMENT: interval(position(summary.sum(jobcat*salary)))
```

*Figure 343. Example: Calculating the cumulative sum*

Statistic Functions

See “GPL Functions” on page 56.

**Binning Functions**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77

**Applies To**

“bin.dot Function” on page 70
“bin.hex Function” on page 72
“bin.quantile.letter Function” on page 75
“bin.rect Function” on page 77
“color Function (For GPL Graphic Elements)” on page 86
“color.brightness Function (For GPL Graphic Elements)” on page 88
“color.hue Function (For GPL Graphic Elements)” on page 89
“color.saturation Function (For GPL Graphic Elements)” on page 90
“link.alpha Function” on page 154
“link.complete Function” on page 156
“link.delaunay Function” on page 159
“link.distance Function” on page 161
“link.gabriel Function” on page 163
“link.hull Function” on page 165
“link.influence Function” on page 168
“link.join Function” on page 170
“link.mst Function” on page 172
“link.neighbor Function” on page 175
“link.relativeNeighborhood Function” on page 177
“link.sequence Function” on page 179
“link.tsp Function” on page 181
“position Function (For GPL Graphic Elements)” on page 192
“region.confi.count Function” on page 196
“region.confi.mean Function” on page 198
“region.confi.percent.count Function” on page 200
“region.confi.proportion.count Function” on page 202
“region.confi.smooth Function” on page 205
“region.spread.range Function” on page 207
“region.spread.sd Function” on page 209
“region.spread.se Function” on page 212
“size Function (For GPL Graphic Elements)” on page 221
“split Function” on page 243
“summary.count Function” on page 245
“summary.count.cumulative Function” on page 247

## summary.variance Function

Syntax

```
summary.variance(<algebra>)
```

*or*

```
summary.variance(<binning function>)
```

*or*

```
summary.variance(<statistic function>)
```

**<algebra>**. Graph algebra, such as `x*y`. Refer to "Brief Overview of GPL Algebra" on page 3 for an introduction to graph algebra.

**<binning function>**. A binning function.

**<statistic function>**. Another statistic function. The result of the embedded statistic is used to calculate `summary.variance`.

Description

Calculates the variance, which is the sum of squared deviations from the mean divided by one less than the number of cases. If the function is evaluating graph algebra, the variance of the analysis variable is returned. For more information about analysis variables, see the discussion in "Brief Overview of GPL Algebra" on page 3.

Examples

```
ELEMENT: interval(position(summary.variance(jobcat*salary)))
```

*Figure 344. Example: Calculating the variance of salary for each jobcat category*

Statistic Functions

See "GPL Functions" on page 56.

**Binning Functions**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

**Applies To**

"bin.dot Function" on page 70

"bin.hex Function" on page 72

"bin.quantile.letter Function" on page 75

"bin.rect Function" on page 77

"color Function (For GPL Graphic Elements)" on page 86

"color.brightness Function (For GPL Graphic Elements)" on page 88

"color.hue Function (For GPL Graphic Elements)" on page 89

"color.saturation Function (For GPL Graphic Elements)" on page 90

"link.alpha Function" on page 154

"link.complete Function" on page 156

"link.delaunay Function" on page 159

"link.distance Function" on page 161

"link.gabriel Function" on page 163

"link.hull Function" on page 165

"link.influence Function" on page 168

"link.join Function" on page 170

"link.mst Function" on page 172

"link.neighbor Function" on page 175

"link.relativeNeighborhood Function" on page 177

"link.sequence Function" on page 179

"link.tsp Function" on page 181

"position Function (For GPL Graphic Elements)" on page 192

"region.confi.count Function" on page 196

"region.confi.mean Function" on page 198

## t Function

Syntax

```
t(<degree of freedom>)
```

**<degrees of freedom>**. Numeric value indicating the degrees of freedom. This values must be greater than 0.

Description

Specifies a Student's *t* distribution for the probability scale.

Examples

```
SCALE: prob(dim(2), t(5))
```

*Figure 345. Example: Specifying a Student's t distribution for the probability scale*

**Applies To**

"prob Scale" on page 37

## texture.pattern Function

Syntax

```
texture.pattern(<algebra>)
```

*or*

```
texture.pattern(texture.pattern.<pattern constant>)
```

*or*

```
texture.pattern(<statistic function>)
```

**<algebra>**. Graph algebra using one categorical variable or a blend of categorical variables. Each unique variable value results in a different pattern. For example, if you were creating a stacked bar chart, the argument of the `texture.pattern` function would be the variable that controls the stacking. Each stack segment would have a different pattern.

**<pattern constant>**. A constant indicating a specific pattern, such as `stripes`. See the topic "Pattern Constants" on page 413 for more information.

**<statistic function>**. A statistic function.

Description

Controls the fill pattern of the associated graphic element. The color of the lines in the pattern is specified by `color.exterior`. The color of the pattern's background is specified by `color.interior`. `texture.pattern.solid` contains no lines or foreground. Therefore, using `texture.pattern.solid` results in a solid element whose color is specified by `color.interior`.

Examples

```
ELEMENT: line(position(x*y), texture.pattern(texture.pattern.checkered))
```

*Figure 346. Example: Specifying a pattern*

```
ELEMENT: point(position(x*y), texture.pattern(z))
```

*Figure 347. Example: Using the values of a variable to control pattern*

Statistic Functions

See “GPL Functions” on page 56.

**Applies To**

“area Element” on page 47
“interval Element” on page 49
“point Element” on page 51
“schema Element” on page 53

## ticks Function

Syntax

```
ticks()
```

*or*

```
ticks(null())
```

Description

Specifies that major ticks should be drawn for the axis. Ticks are drawn by default, so this function is typically used only with `null()` to hide the tick marks.

Examples

```
GUIDE: axis(dim(2), ticks(null()))
```

*Figure 348. Example: Hiding tick marks*

**Applies To**

“axis Guide Type” on page 42

## to Function

Syntax

```
to(<variable name>)
```

**<variable name>**. The name of a variable previously defined in the GPL by a `DATA` statement.

Description

Specifies one of the pair of nodes that defines an edge relation. The is the node that defines the end point for the edge.

Examples

```
ELEMENT: edge(position(layout.dag(node(id), from(fromVar), to(toVar))))
```

*Figure 349. Example: Creating a directed acyclic graph*

**Applies To**

“layout.circle Function” on page 139
“layout.dag Function” on page 141
“layout.data Function” on page 143
“layout.grid Function” on page 145
“layout.network Function” on page 147
“layout.random Function” on page 150

"layout.tree Function" on page 152

## transparency Function (For GPL Graphic Elements)

*Note:* If you are modifying the transparency for a guide, refer to "transparency Function (For GPL Guides)" on page 323.

Syntax

```
transparency(<algebra>)
```

*or*

```
transparency(transparency."transparency value")
```

*or*

```
transparency(<statistic function>)
```

**<algebra>**. Graph algebra using one variable or a blend of variables. The variable value results in a different transparency value. For example, if you were creating a stacked bar chart, the argument of the `transparency` function would be the variable that controls the stacking. Each stack segment would have a different degree of transparency.

**"transparency value"**. A value between 0 and 1 that indicates the level of transparency. A value of 1 indicates full transparency, while a value of 0 indicates no transparency (completely opaque).

**<statistic function>**. A statistic function.

Description

Specifies the transparency of the associated graphic element. You can use another variable or variables to control the transparency or set a fixed value. To specify the transparency explicitly for the fill or border of the graphic element, you can append `.interior` or `.exterior` to the function. Using `transparency` without a qualifier implies `transparency.interior`.

Examples

```
ELEMENT: point(position(x*y), transparency(z))
```

*Figure 350. Example: Using a variable to control transparency*

```
ELEMENT: interval(position(x*y), transparency(transparency."0.6"))
```

*Figure 351. Example: Specifying a value for transparency*

```
ELEMENT: interval(position(x*y),
         transparency.interior(transparency."0.8"))
```

*Figure 352. Example: Specifying a transparency for the fill*

Statistic Functions

See "GPL Functions" on page 56.

**Applies To**

"area Element" on page 47
"edge Element" on page 48
"interval Element" on page 49
"path Element" on page 50
"point Element" on page 51
"polygon Element" on page 52

"schema Element" on page 53

## transparency Function (For GPL Guides)

*Note:* If you are modifying the transparency for a graphic element (like a bar or point), refer to "transparency Function (For GPL Graphic Elements)" on page 322.

Syntax

```
transparency(transparency."transparency value")
```

**"transparency value"**. A value between 0 and 1 that indicates the level of transparency. A value of 1 indicates full transparency, while a value of 0 indicates no transparency (completely opaque).

Description

Controls the transparency of reference lines.

Examples

```
GUIDE: form.line(position(*,2000), transparency(transparency."0.5"))
```

*Figure 353. Example: Specifying a transparency for a reference line*

**Applies To**

"form.line Guide Type" on page 43

## transpose Function

Syntax

```
transpose(<coord>)
```

**<coord>**. A valid coordinate type or transformation function. This is optional.

Description

Transposes the coordinate system.

Examples

```
COORD: transpose()
```

*Figure 354. Example: Transposing a 2-D rectangular coordinate system*

```
COORD: transpose(rect(dim(1,2), cluster(3)))
```

*Figure 355. Example: Transposing a clustered coordinate system*

**Coordinate Types and Transformations**

"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28
"mirror Function" on page 186
"project Function" on page 194
"reflect Function" on page 195
"wrap Function" on page 327

**Applies To**

"COORD Statement" on page 25
"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28
"project Function" on page 194

## uniform Function

Syntax

```
uniform(<minimum>, <maximum>)
```

**<minimum>**. Numeric value indicating the minimum.

**<maximum>**. Numeric value indicating the maximum.

Description

Specifies a uniform distribution for the probability scale.

Examples

```
SCALE: prob(dim(2), uniform(5000, 20000))
```

*Figure 356. Example: Specifying a uniform distribution for the probability scale*

**Applies To**

"prob Scale" on page 37

## unit.percent Function

Syntax

```
unit.percent()
```

Description

Transforms the values on an axis into percents. The percent value is in relation to the largest value of the variable displayed on the axis. This transformation makes most sense when a cumulative value is displayed on the main axis.

Examples

```
GUIDE: axis(dim(2), label("Percent"), unit.percent())
```

*Figure 357. Example: Adding a percent axis*

**Applies To**

"axis Guide Type" on page 42

## userSource Function

Syntax

```
userSource(id("source name"), <function>)
```

**"source name"**. The name of the data source as defined by the application that is calling GPL. For example, if you were using GPL with IBM SPSS Statistics `GGRAPH` syntax, the source name is the name as defined in the `DATASET` subcommand.

**<function>**. One or more valid functions. These are optional.

Description

Reads the contents of a data source that an IBM Corp. application passes to GPL.

Examples

```
SOURCE: mydata = userSource(id("graphdataset"))
```

*Figure 358. Example: Reading a userSource*

**Valid Functions**

"missing.listwise Function" on page 187
"missing.pairwise Function" on page 188
"weight Function" on page 326

**Applies To**

"SOURCE Statement" on page 23
"csvSource Function" on page 92
"savSource Function" on page 216
"sqlSource Function" on page 243

## values Function

Syntax

```
values("category name", "category name" ...)
```

**"category name"**. The string representing the category on the axis.

Description

Specifies the categorical values on an axis. Only these specified values are included on the axis, even if these values do not occur in the data or other values do occur in the data.

Examples

```
SCALE: cat(dim(1), values("Male", "Female"))
```

*Figure 359. Example: Specifying the categories*

**Applies To**

"cat Scale" on page 32

## visible Function

Syntax

```
visible(<algebra>)
```

**<algebra>**. The name of a categorical variable.

Description

Controls the visibility of the graphic element, based on categories in a categorical variable. You can use this function in conjunction with the `map` function to hide specific categories of data. The specific constants for the visible aesthetic are `visible.true` and `visible.false`.

Examples

```
SCALE: cat(aesthetic(aesthetic.visible), map(("m", visible.false)))
ELEMENT: line(position(salbegin*salary), visible(gender))
```

*Figure 360. Example: Hiding categories*

**Applies To**

"area Element" on page 47
"edge Element" on page 48
"interval Element" on page 49
"line Element" on page 49
"path Element" on page 50
"point Element" on page 51
"polygon Element" on page 52
"schema Element" on page 53

## weibull Function

Syntax

```
weibull(<rate>, <scale>)
```

**<rate>**. Numeric value specifying the rate parameter for the distribution.

**<scale>**. Numeric value specifying the scale parameter for the distribution. This value must be greater than 0.

Description

Specifies a Weibull distribution for the probability scale.

Examples

```
SCALE: prob(dim(2), weibull(5, 2))
```

*Figure 361. Example: Specifying a Weibull distribution for the probability scale*

**Applies To**

"prob Scale" on page 37

## weight Function

Syntax

```
weight(<variable name>)
```

**<variable name>**. The name of a variable defined in the GPL by a `DATA` statement.

Description

Specifies that a variable in the dataset contains weights. The weights affect the statistic functions that GPL calculates. Weights can be also used with network graphs to affect the distance between nodes.

In general, the weights act as frequency weights (that is, as if there were multiple occurrences of the records). This function is not suitable for sample weights (in which one case represents many).

Examples

```
SOURCE: mydata = csvSource(file("/Data/Edge data.csv"), weight(weightedVar))
DATA: weightedVar = col(source(mydata), name("weights"))
```

*Figure 362. Example: Specifying a weighted variable*

**Applies To**

"csvSource Function" on page 92
"sqlSource Function" on page 243
"userSource Function" on page 324

## wrap Function

Syntax

```
wrap(<coord>)
```

**<coord>**. A valid coordinate type or transformation function. This is optional.

Description

Combines faceted dimensions and wraps the facets depending on the available space for the graph. This function is useful when there are many facets because it forces the graph to utilize the available space. Without this function, faceted graphs can only shrink or grow to fit the space.

Examples

```
COORD: rect(dim(1,2), wrap())
```

*Figure 363. Example: Wrapping facets*

**Coordinate Types and Transformations**

"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28
"mirror Function" on page 186
"project Function" on page 194
"reflect Function" on page 195
"transpose Function" on page 323

**Applies To**

"COORD Statement" on page 25
"parallel Coordinate Type" on page 26
"polar Coordinate Type" on page 26
"polar.theta Coordinate Type" on page 27
"rect Coordinate Type" on page 28
"project Function" on page 194

# Chapter 3. GPL Examples

This section provides examples organized by broad categories of graph types. You can run the examples by incorporating them into the syntax specific to your application. See the topic "Using the Examples in Your Application" for more information.

## Using the Examples in Your Application

If you want to run the examples in your application, you need to incorporate them into the syntax specific to your application.

Using the Examples in IBM SPSS Statistics

The sample files installed with the product can be found in the *Samples* subdirectory of the installation directory. There is a separate folder within the Samples subdirectory for each of the following languages: English, French, German, Italian, Japanese, Korean, Polish, Russian, Simplified Chinese, Spanish, and Traditional Chinese.

Not all sample files are available in all languages. If a sample file is not available in a language, that language folder contains an English version of the sample file.

1. First, you need the right data source. The examples use three different userSources (*Employeedata*, *stocks*, and *customer_subset*), which correspond to IBM SPSS Statistics SAV files located in the directory identified above.
2. With the data source open, create a `GGRAPH` syntax command.
   - Modify the `GRAPHDATASET` subcommand by setting the `NAME` keyword to the `id` of the `userSource` in the GPL example. The `VARIABLES` keyword also needs to include all the variables identified in the GPL `DATA` statements.
   - Modify the `GRAPHSPEC` subcommand so that the `SOURCE` keyword equals `INLINE`.
3. Follow the `GGRAPH` command with `BEGIN GPL`, the GPL shown in the example, `END GPL`, and a period.

So if you want to run the simple bar chart example, your syntax would look like the following:

```
GGRAPH
 /GRAPHDATASET NAME="Employeedata" VARIABLES=jobcat salary
 /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary)))
END GPL.
```

Using the Examples in IBM SPSS Visualization Designer

1. Create or open a visualization in IBM SPSS Visualization Designer.
2. If the ViZml/GPL palette is not displayed, from the menus choose:

   **View** > **Palettes** > **ViZml/GPL**
3. Click the GPL tab.
4. Enter the GPL into the palette. You can also copy and paste examples from the online help.
5. Modify the `file` function for `csvSource` to reference the full path to the CSV file. All of the sample data files are located in the *data* subfolder of the product installation folder. For example:

```
SOURCE: s = csvSource(file("C:/Program Files/IBM/SPSS/Visualization Designer/data/Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary)))
```

6. After entering and modifying the GPL, click the execute button.

*Figure 364. Execute button*

## Summary Bar Chart Examples

This section provides examples of different types of summary bar charts.

## Simple Bar Chart

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary)))
```

*Figure 365. GPL for simple bar chart*

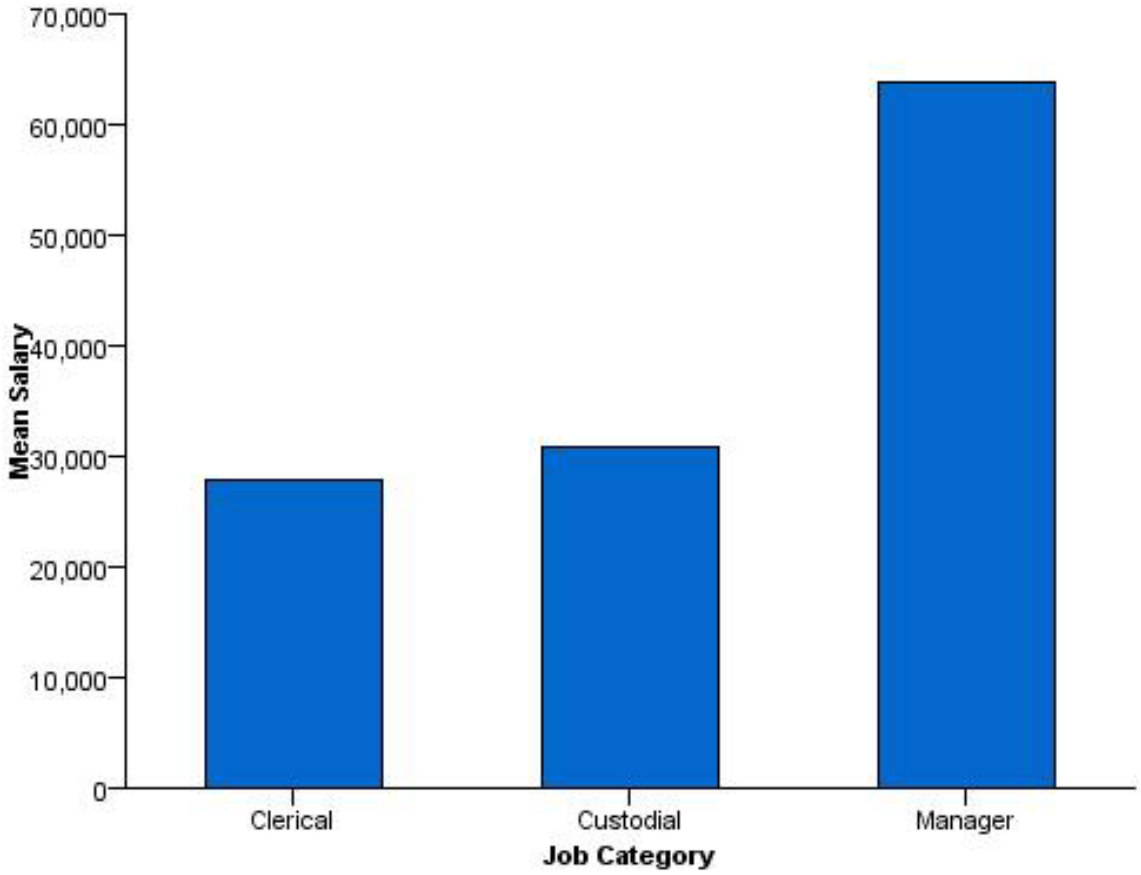



*Figure 366. Simple bar chart*

## Simple Bar Chart of Counts

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.count(jobcat)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.count(jobcat)))
```

*Figure 367. GPL for simple bar chart of counts*

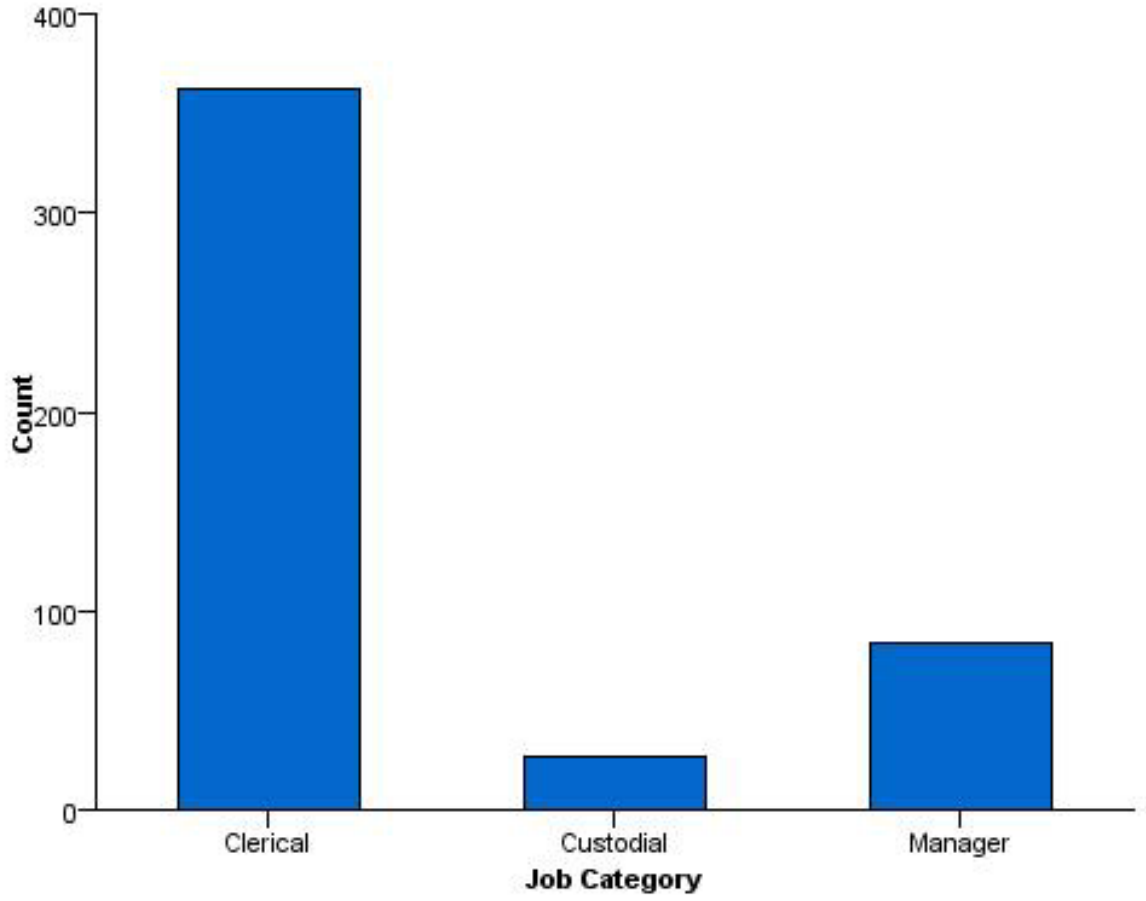



*Figure 368. Simple bar chart of counts*

## Simple Horizontal Bar Chart

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), min(0.0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
COORD: transpose()
ELEMENT: interval(position(summary.mean(jobcat*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), min(0.0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
COORD: transpose()
ELEMENT: interval(position(summary.mean(jobcat*salary)))
```

*Figure 369. GPL for simple horizontal bar chart*

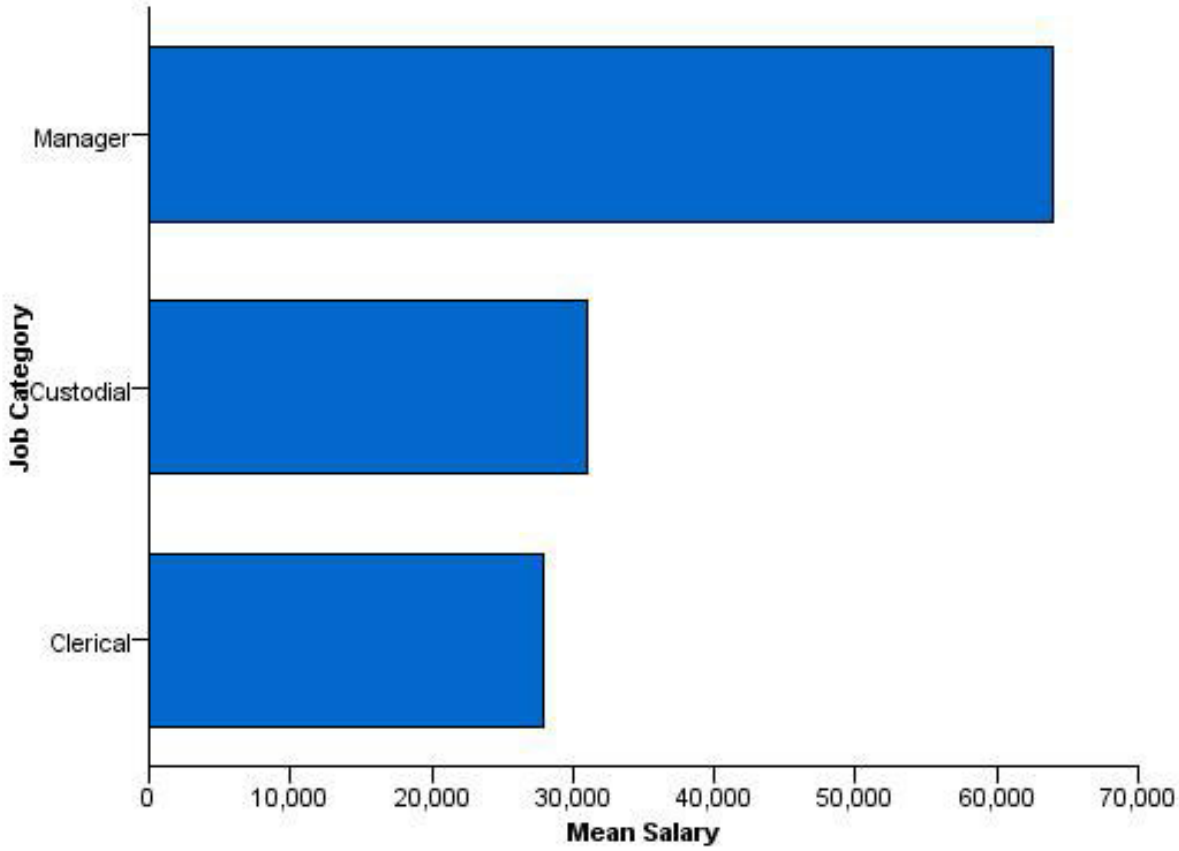



*Figure 370. Simple horizontal bar chart*

## Simple Bar Chart With Error Bars

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary)))
ELEMENT: interval(position(region.confi.mean(jobcat*salary)),
                  shape(shape.ibeam), size(size.".4in"), color(color.black))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary)))
ELEMENT: interval(position(region.confi.mean(jobcat*salary)),
                  shape(shape.ibeam), size(size.".4in"), color(color.black))
```

*Figure 371. GPL for simple bar chart with error bars*

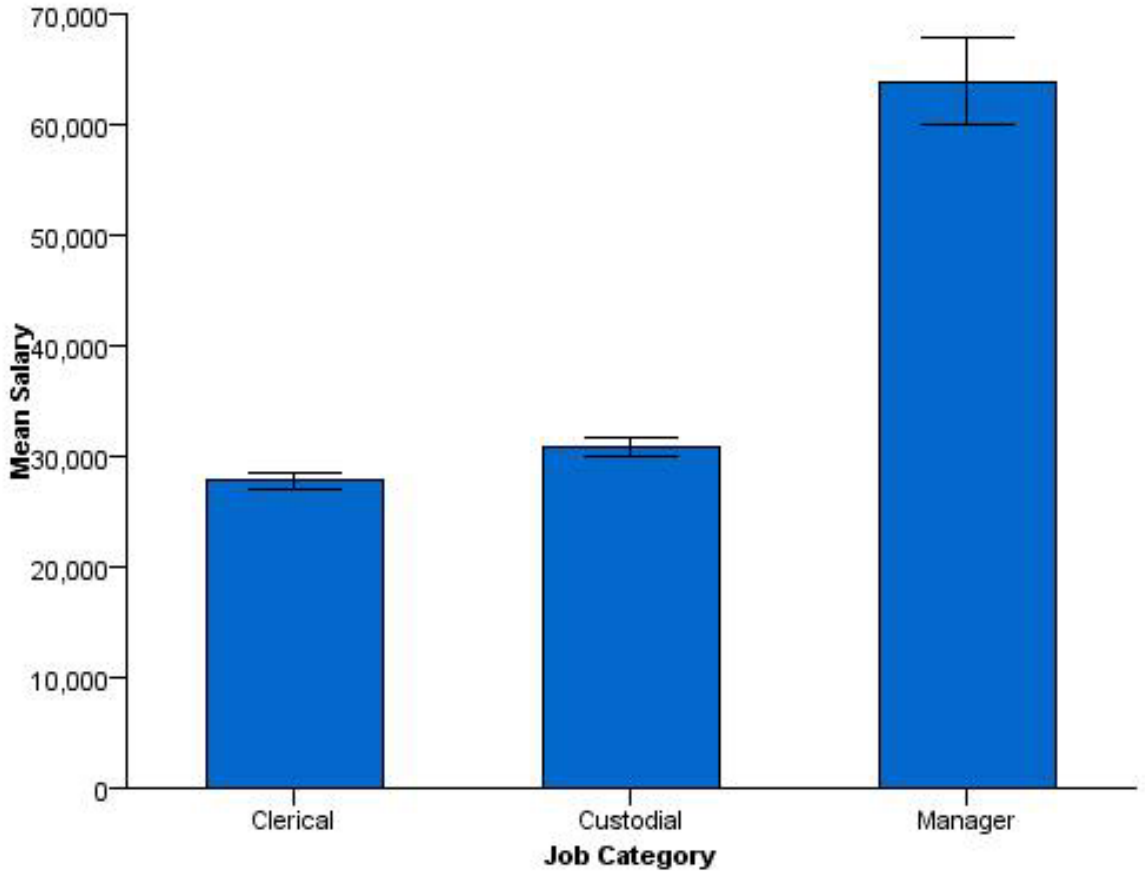



*Figure 372. Simple bar chart with error bars*

## Simple Bar Chart with Bar for All Categories

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean((jobcat+"All")*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean((jobcat+"All")*salary)))
```

*Figure 373. GPL for simple bar chart with bar for all categories*

*Note:* Using "All" as the string is arbitrary. Any string would work (e.g., "Total" or "All Categories"). Because it is blended with the *jobcat* categorical variable, the string acts like a new categorical value. This value is the same for all cases in the dataset. Therefore, the bar associated with that string shows the result for all cases in the dataset.

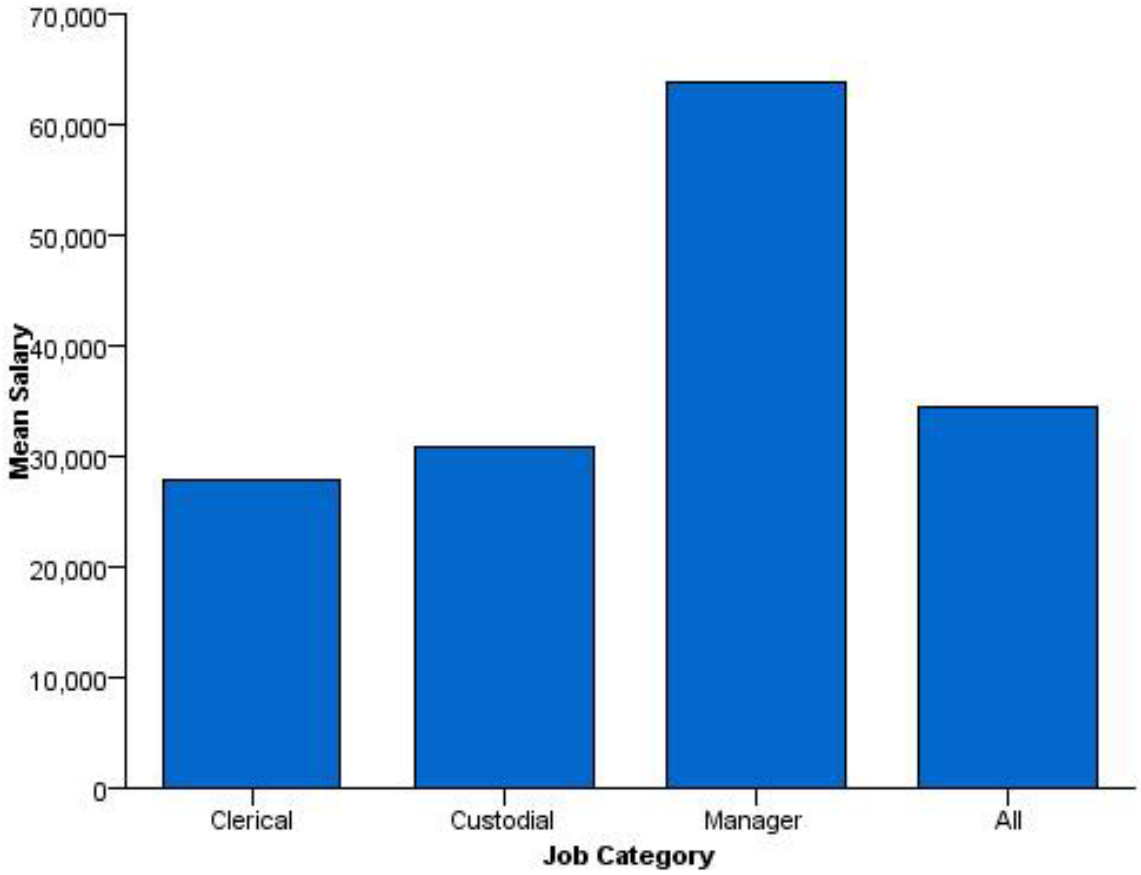



*Figure 374. Simple bar chart with a bar for all categories*

## Stacked Bar Chart

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval.stack(position(summary.count(jobcat)),
         color(gender))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval.stack(position(summary.count(jobcat)),
         color(gender))
```

*Figure 375. GPL for stacked bar chart*

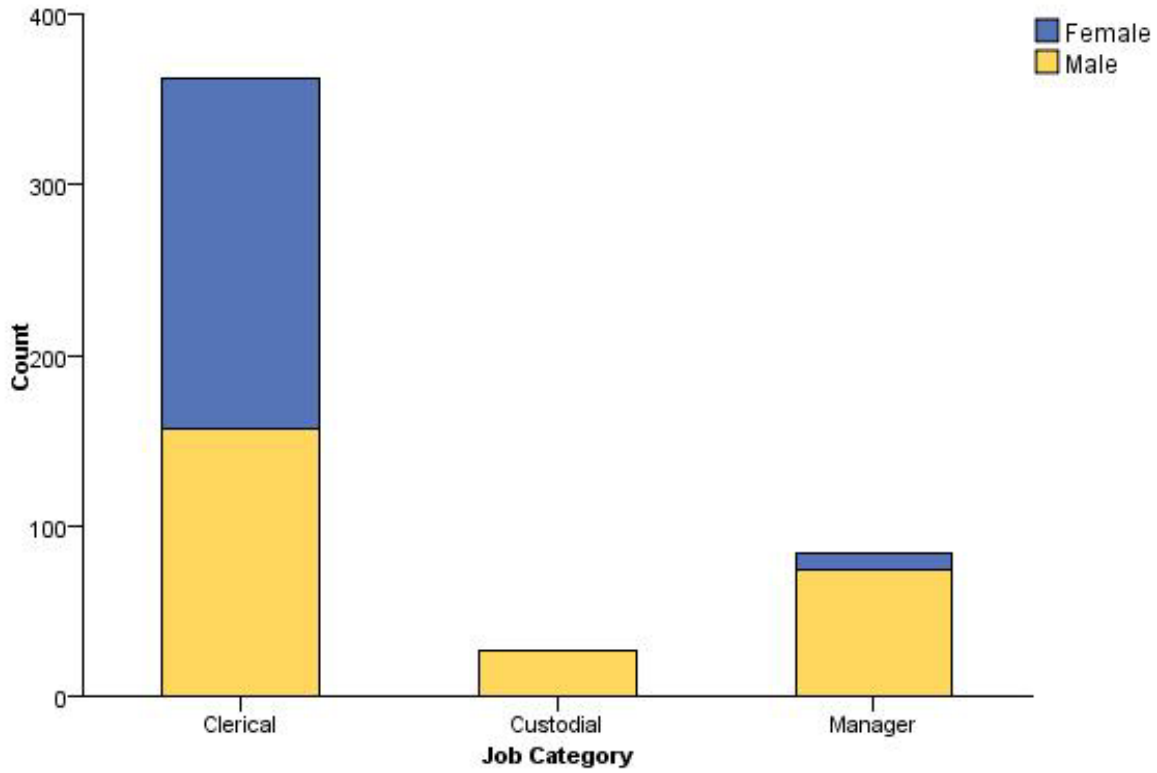



*Figure 376. Stacked bar chart*

## Clustered Bar Chart

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2), cluster(3))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Gender"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)), color(jobcat))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2), cluster(3))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Gender"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)), color(jobcat))
```

*Figure 377. GPL for clustered bar chart*

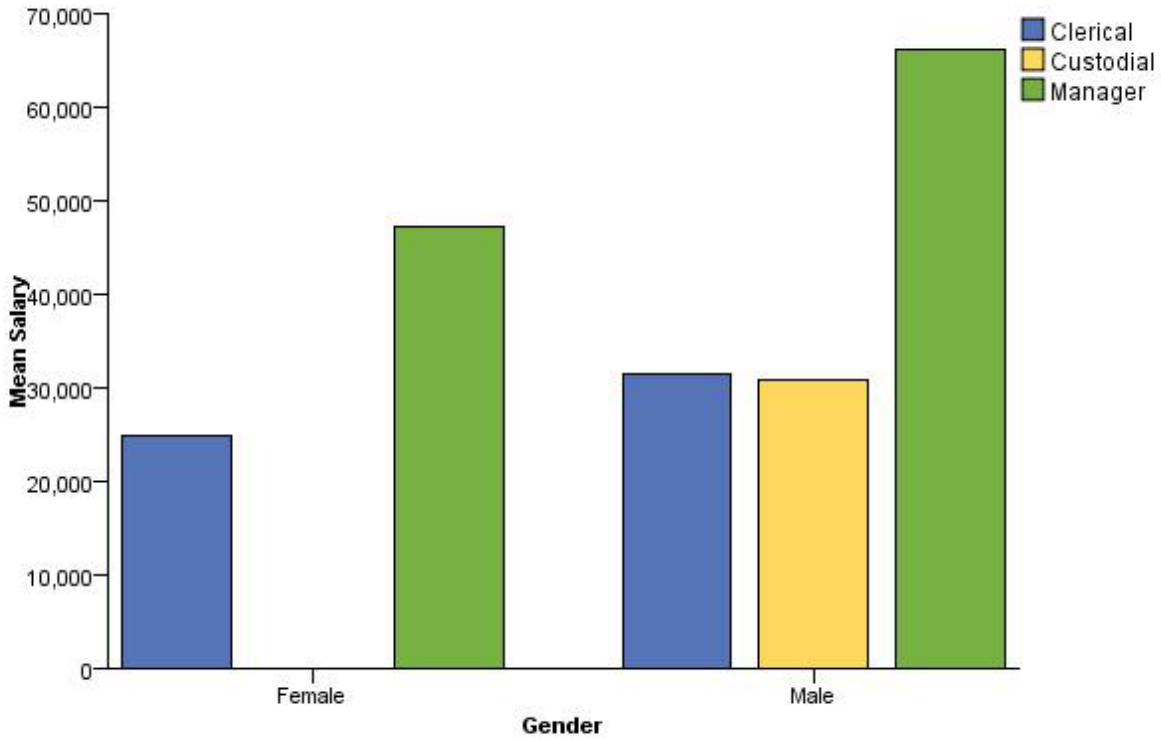



*Figure 378. Clustered bar chart*

Following is another option for creating a graph that appears clustered. It uses the `dodge` collision modifier. (See “dodge Collision Modifier” on page 54.) Note that the difference between this and the previous example is that empty space is not allocated for missing categories (in this case, the combination of "Female" and "Custodial").

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Gender"))
ELEMENT: interval.dodge(position(summary.mean(gender*salary)),
                        size(size."25%"), color(jobcat))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Gender"))
ELEMENT: interval.dodge(position(summary.mean(gender*salary)),
                        size(size."25%"), color(jobcat))
```

*Figure 379. GPL for dodged bar chart*

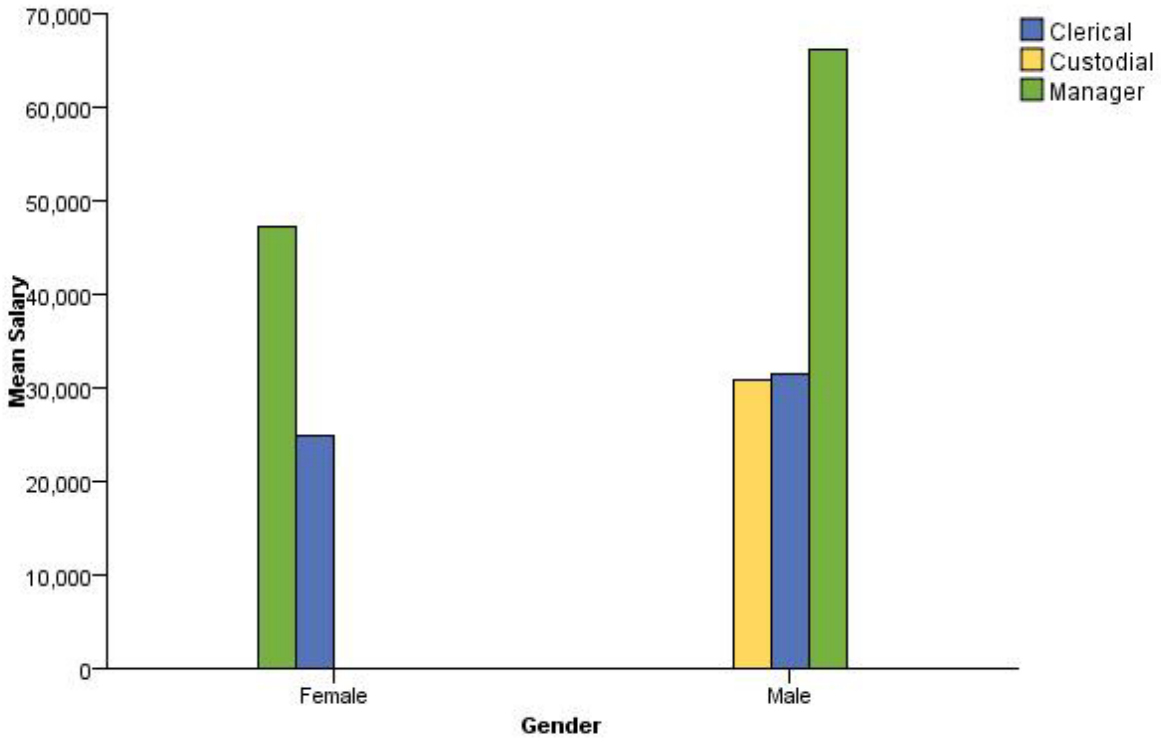



*Figure 380. Dodged bar chart*

# Clustered and Stacked Bar Chart

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: minority = col(source(s), name("minority"), unit.category())
DATA: salary = col(source(s), name("salary"))
COORD: rect(dim(1, 2), cluster(3, 0))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Sum Salary"))
GUIDE: axis(dim(3), label("Job Category"))
GUIDE: legend(aesthetic(aesthetic.color.interior), label("Gender"))
GUIDE: legend(aesthetic(aesthetic.texture.pattern.interior),
             label("Minority Classification"))
ELEMENT: interval.stack(position(summary.sum(gender*salary*jobcat)),
                        color.exterior(color.black),
                        color.interior(gender), texture.pattern.interior(minority))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: minority = col(source(s), name("minority"), unit.category())
DATA: salary = col(source(s), name("salary"))
COORD: rect(dim(1, 2), cluster(3, 0))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Sum Salary"))
GUIDE: axis(dim(3), label("Job Category"))
GUIDE: legend(aesthetic(aesthetic.color.interior), label("Gender"))
GUIDE: legend(aesthetic(aesthetic.texture.pattern.interior),
             label("Minority Classification"))
ELEMENT: interval.stack(position(summary.sum(gender*salary*jobcat)),
                        color.exterior(color.black),
                        color.interior(gender), texture.pattern.interior(minority))
```

*Figure 381. GPL for clustered and stacked bar chart*

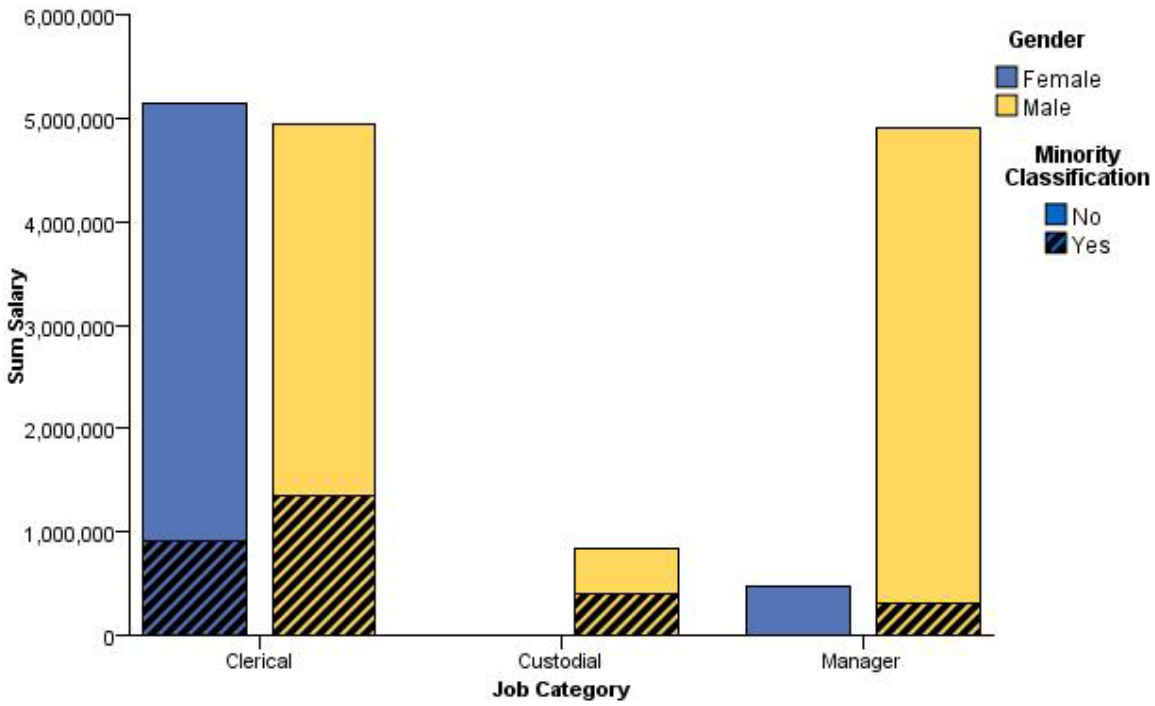



*Figure 382. Clustered and stacked bar chart*

# Bar Chart Using an Evaluation Function

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin = col(source(s), name("salbegin"))
DATA: salary = col(source(s), name("salary"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
TRANS: saldiff = eval(((salary-salbegin)/salary)*100)
COORD: rect(dim(1, 2), cluster(3))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Percentage Salary Increase"))
GUIDE: axis(dim(3), label("Employment Category"))
GUIDE: legend(aesthetic(aesthetic.color.interior), label("Gender"))
ELEMENT: interval(position(summary.mean(gender*saldiff*jobcat)),
                  color.interior(gender))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin = col(source(s), name("salbegin"))
DATA: salary = col(source(s), name("salary"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
TRANS: saldiff = eval(((salary-salbegin)/salary)*100)
COORD: rect(dim(1, 2), cluster(3))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(2), label("Mean Percentage Salary Increase"))
GUIDE: axis(dim(3), label("Employment Category"))
GUIDE: legend(aesthetic(aesthetic.color.interior), label("Gender"))
ELEMENT: interval(position(summary.mean(gender*saldiff*jobcat)),
                  color.interior(gender))
```

*Figure 383. GPL using an evaluation function to calculate mean percentage increase*

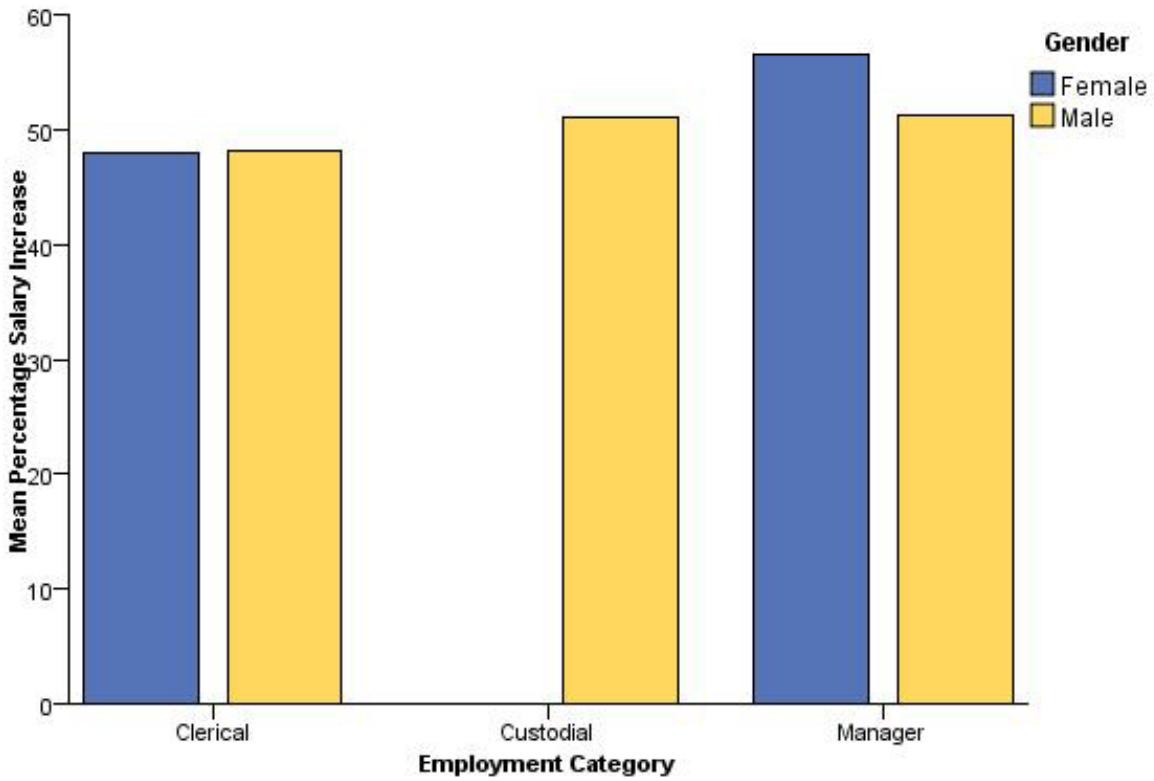



*Figure 384. GPL using an evaluation function to calculate mean percentage increase*

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
TRANS: greaterThan = eval(salary < 40000)
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(1), label("Employment Category"))
GUIDE: axis(dim(2), label("% < 40000 Salary"))
ELEMENT: interval(position(summary.percentTrue(jobcat*greaterThan)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
TRANS: greaterThan = eval(salary < 40000)
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(1), label("Employment Category"))
GUIDE: axis(dim(2), label("% < 40000 Salary"))
ELEMENT: interval(position(summary.percentTrue(jobcat*greaterThan)))
```

*Figure 385. GPL using an evaluation function to calculate percent less than a value*

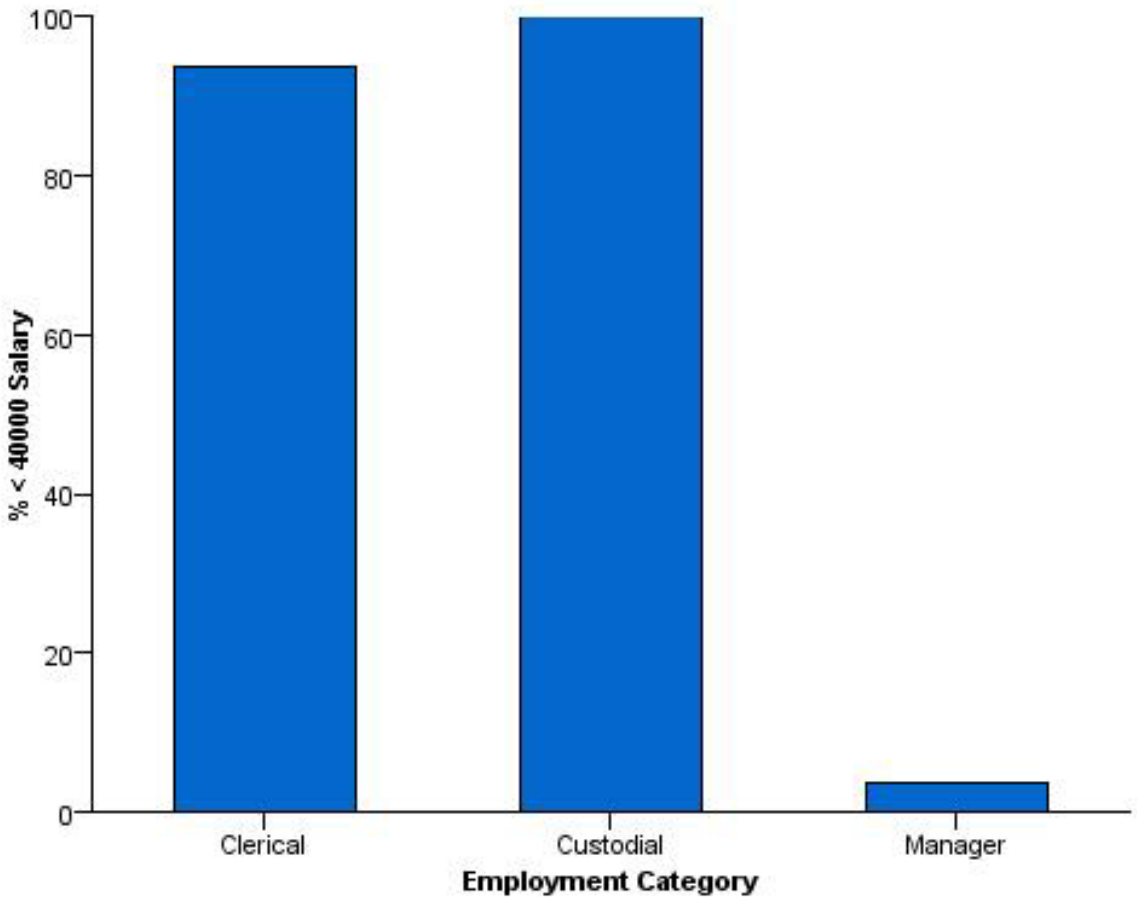



*Figure 386. GPL using an evaluation function to calculate percent less than a value*

## Bar Chart with Mapped Aesthetics

This example demonstrates how you can map a specific categorical value in the graph to a specific aesthetic value. In this case, "Female" bars are colored green in the resulting graph.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
COORD: rect(dim(1, 2), cluster(3))
SCALE: cat(aesthetic(aesthetic.color), map(("Female", color.green)))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Job Category"))
ELEMENT: interval(position(summary.mean(gender*salary*jobcat)),
                  color(gender))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
COORD: rect(dim(1, 2), cluster(3))
SCALE: cat(aesthetic(aesthetic.color), map(("Female", color.green)))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Job Category"))
ELEMENT: interval(position(summary.mean(gender*salary*jobcat)),
                  color(gender))SCALE: cat(aesthetic(aesthetic.color), map(("f", color.green)))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Job Category"))
ELEMENT: interval(position(summary.mean(gender*salary*jobcat)),
                  color(gender))
```

*Figure 387. GPL for bar chart with mapped aesthetics*

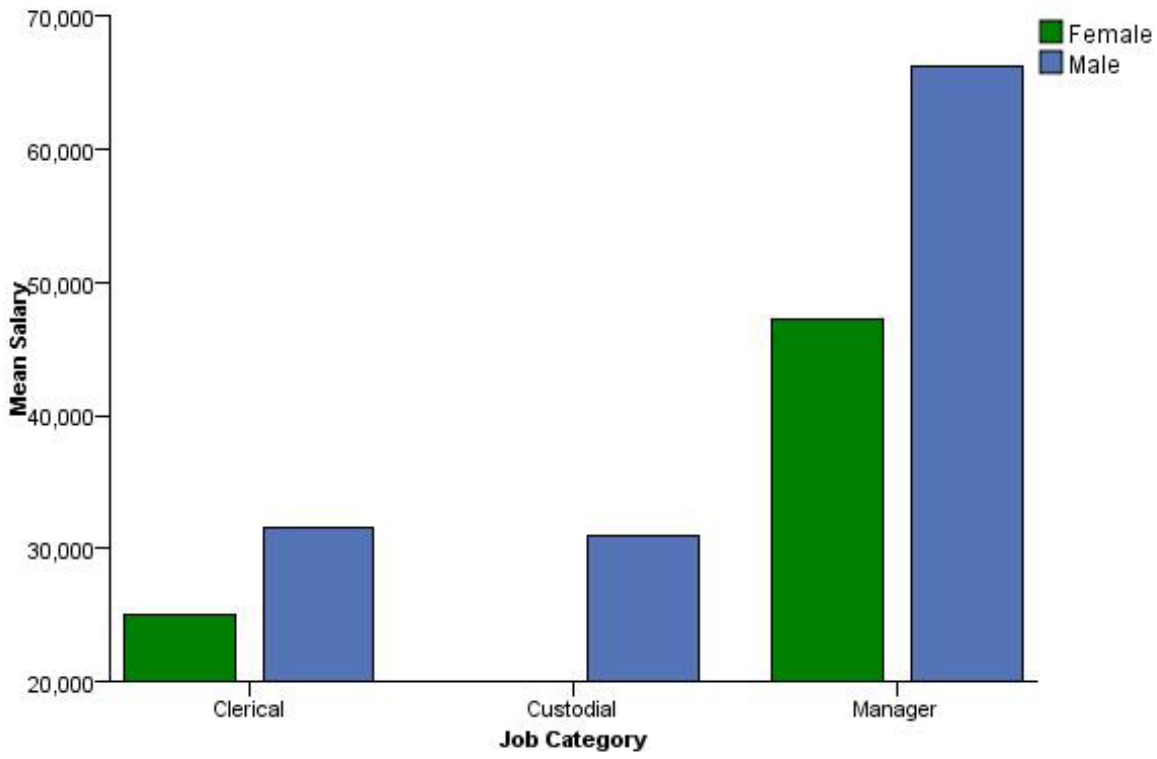



*Figure 388. Bar chart with mapped aesthetics*

## Faceted (Paneled) Bar Chart

Although the following examples create bar charts, faceting is common to all graphs.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(3), label("Gender"))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(3), label("Gender"))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)))
```

*Figure 389. GPL for faceted bar chart*

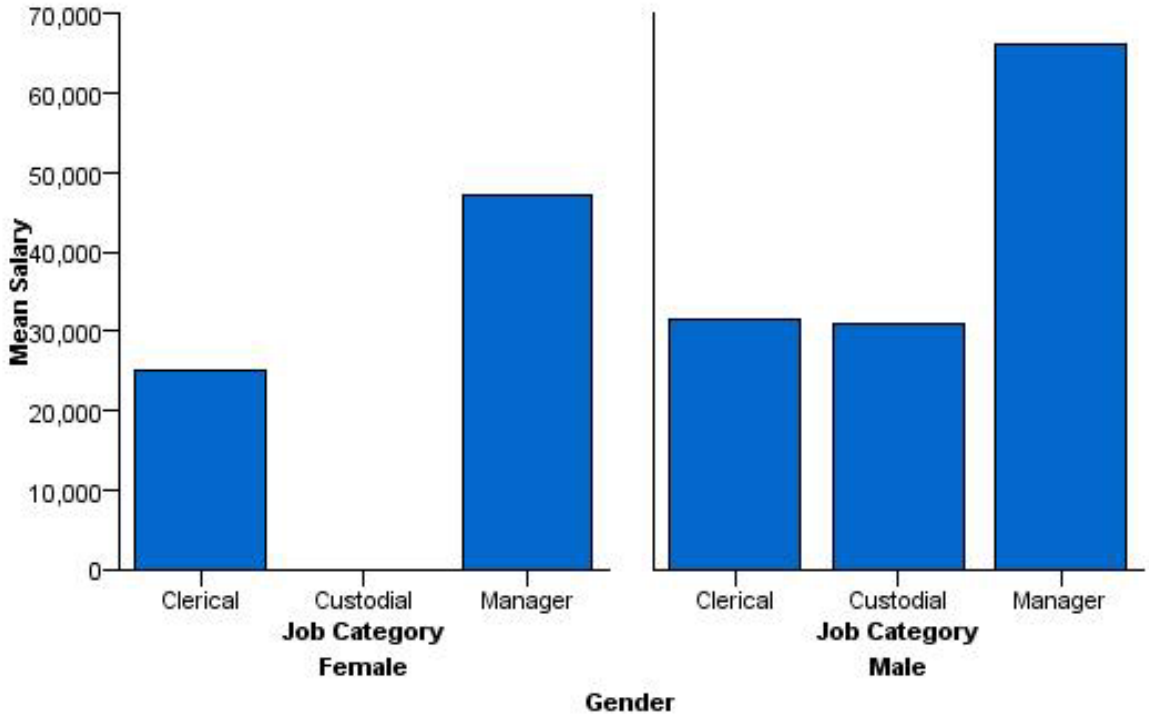



*Figure 390. Faceted bar chart*

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: linear(dim(2), include(0.0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1.1), label("Job Category"))
GUIDE: axis(dim(1), label("Gender"))
ELEMENT: interval(position(summary.mean(jobcat/gender*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: linear(dim(2), include(0.0))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1.1), label("Job Category"))
GUIDE: axis(dim(1), label("Gender"))
ELEMENT: interval(position(summary.mean(jobcat/gender*salary)))
```

*Figure 391. GPL for faceted bar chart with nested categories*

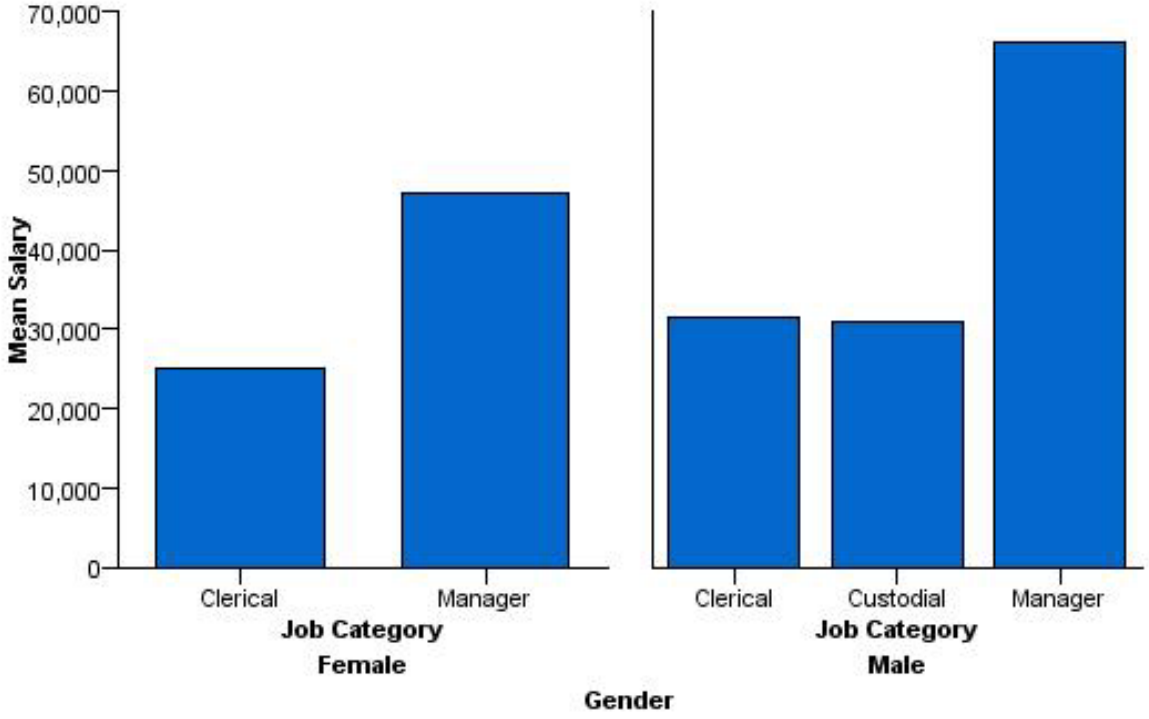



*Figure 392. Faceted bar chart with nested categories*

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: minority=col(source(s), name("minority"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(4), label("Minority"))
GUIDE: axis(dim(3), label("Gender"))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender*minority)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: minority=col(source(s), name("minority"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), include(0))
GUIDE: axis(dim(4), label("Minority"))
GUIDE: axis(dim(3), label("Gender"))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender*minority)))
```

*Figure 393. GPL for multi-faceted bar chart*

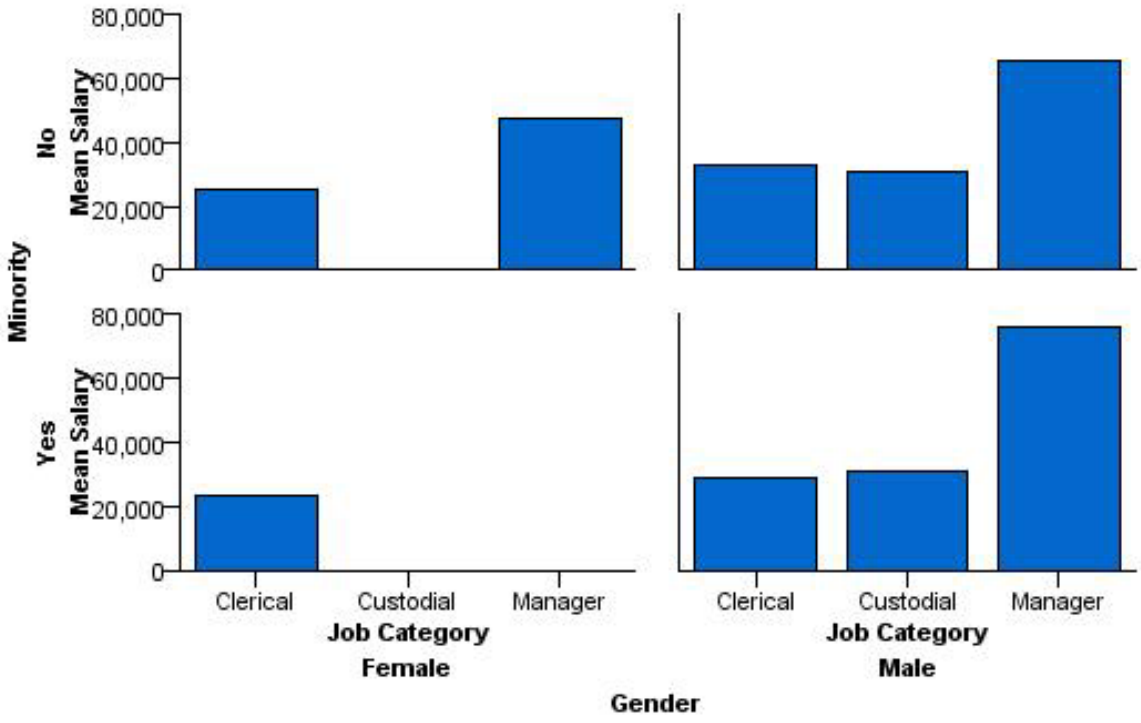



*Figure 394. Multi-faceted bar chart*

# 3-D Bar Chart

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2,3))
SCALE: linear(dim(3), include(0))
GUIDE: axis(dim(3), label("Mean Salary"))
GUIDE: axis(dim(2), label("Gender"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*gender*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2,3))
SCALE: linear(dim(3), include(0))
GUIDE: axis(dim(3), label("Mean Salary"))
GUIDE: axis(dim(2), label("Gender"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(summary.mean(jobcat*gender*salary)))
```

*Figure 395. GPL for 3-D bar chart*

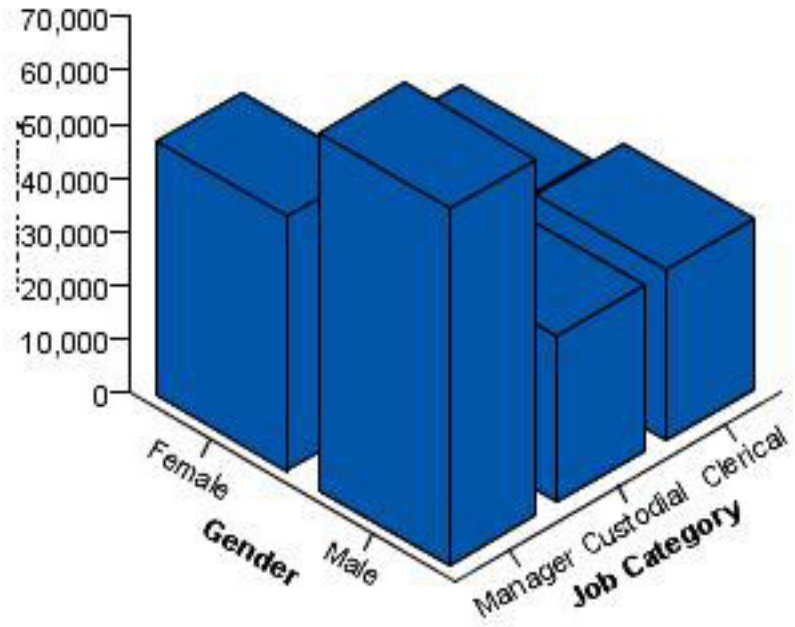



*Figure 396. 3-D bar chart*

## Error Bar Chart

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
GUIDE: axis(dim(2), label("Mean +- 1 SD Current Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(region.confi.mean(jobcat*salary)),
                  shape(shape.ibeam), size(size.".4in"))
ELEMENT: point(position(summary.mean(jobcat*salary)),
               shape(shape.circle), color(color.red), size(size."6px"))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
GUIDE: axis(dim(2), label("Mean +- 1 SD Current Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(region.confi.mean(jobcat*salary)),
                  shape(shape.ibeam), size(size.".4in"))
ELEMENT: point(position(summary.mean(jobcat*salary)),
               shape(shape.circle), color(color.red), size(size."6px"))
```

*Figure 397. GPL for error bar chart*

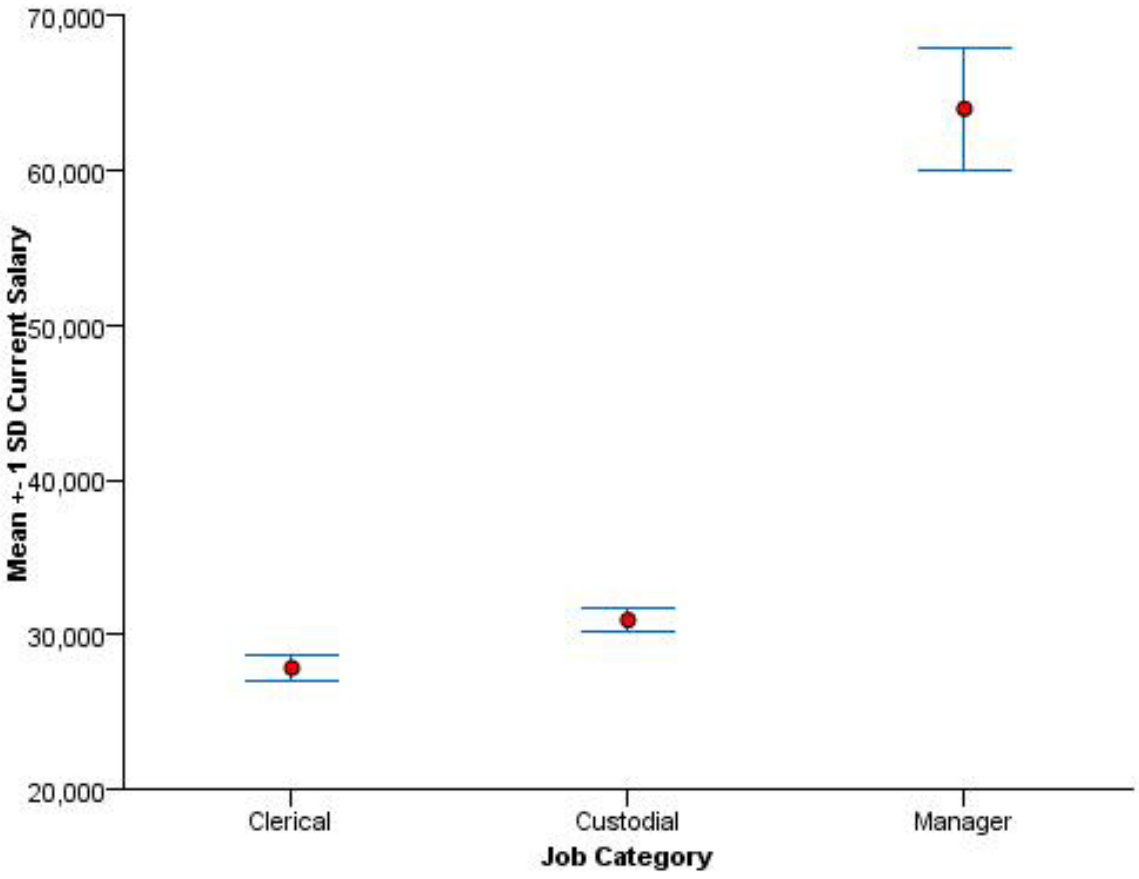



*Figure 398. Error bar chart*

## Histogram Examples

This section provides examples of different types of histograms.

## Histogram

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: interval(position(summary.count(bin.rect(salary))))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: interval(position(summary.count(bin.rect(salary))))
```

*Figure 399. GPL for histogram*

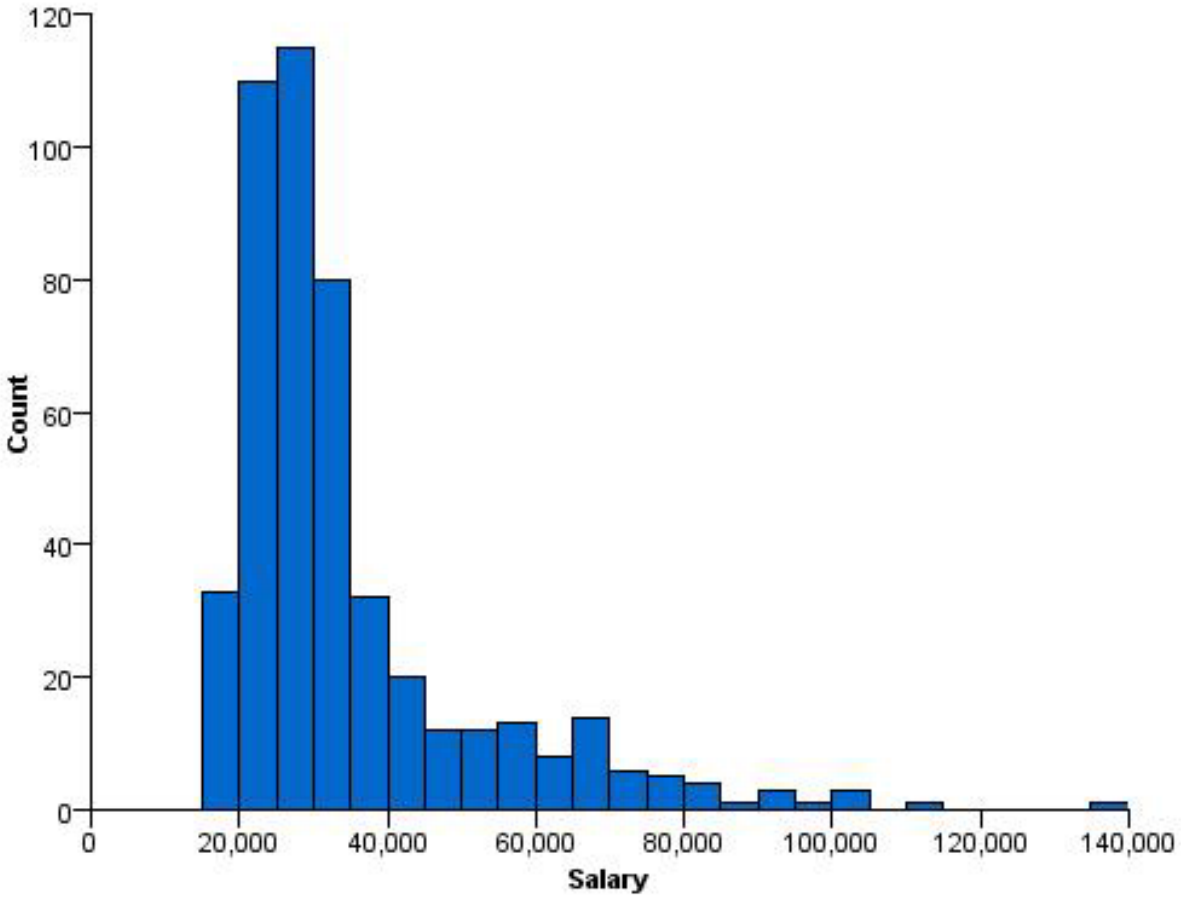



*Figure 400. Histogram*

## Histogram with Distribution Curve

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: interval(position(summary.count(bin.rect(salary))))
ELEMENT: line(position(density.normal(salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: interval(position(summary.count(bin.rect(salary))))
ELEMENT: line(position(density.normal(salary)))
```

*Figure 401. GPL for histogram with normal curve*

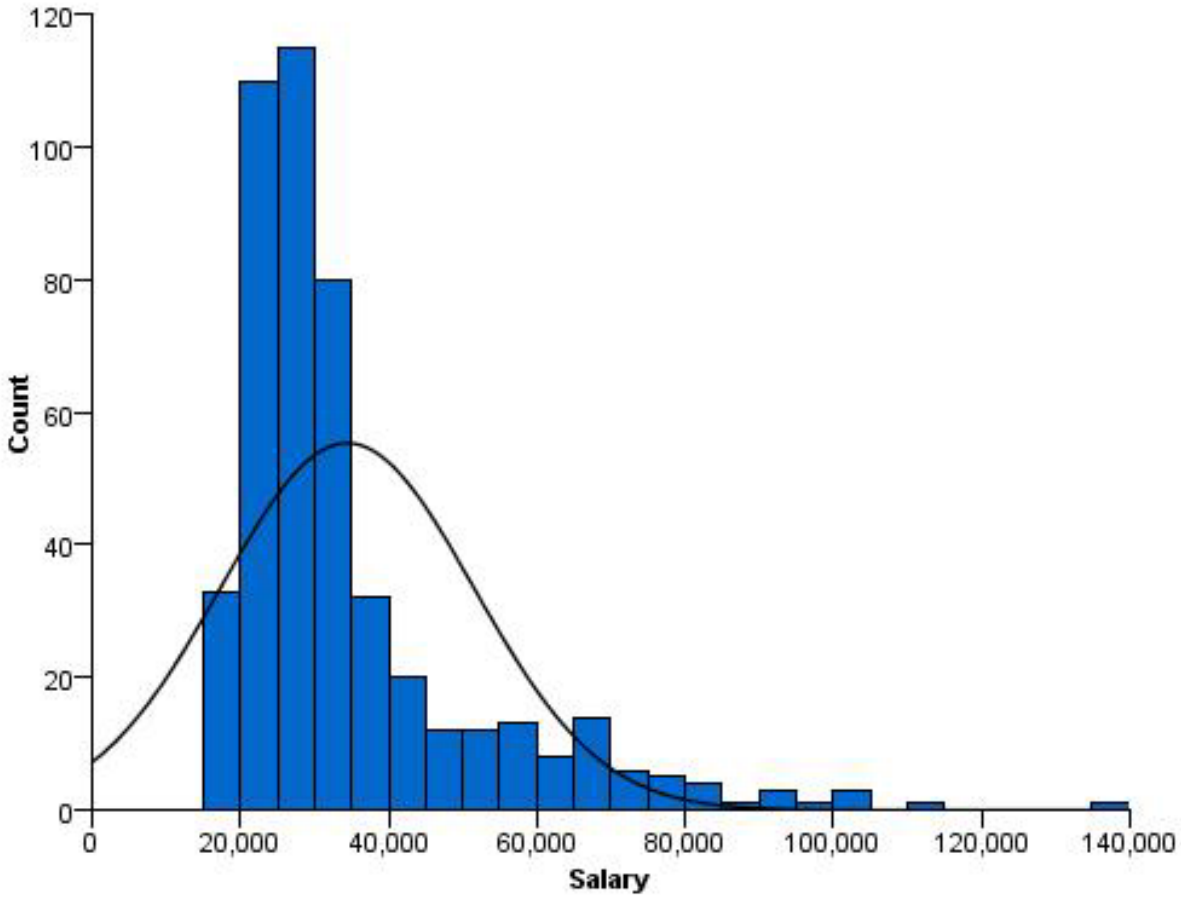



*Figure 402. Histogram with normal curve*

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: interval(position(summary.count(bin.rect(salary))))
ELEMENT: line(position(density.kernel.epanechnikov(salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: interval(position(summary.count(bin.rect(salary))))
ELEMENT: line(position(density.kernel.epanechnikov(salary)))
```

*Figure 403. GPL for histogram with kernel density curve*

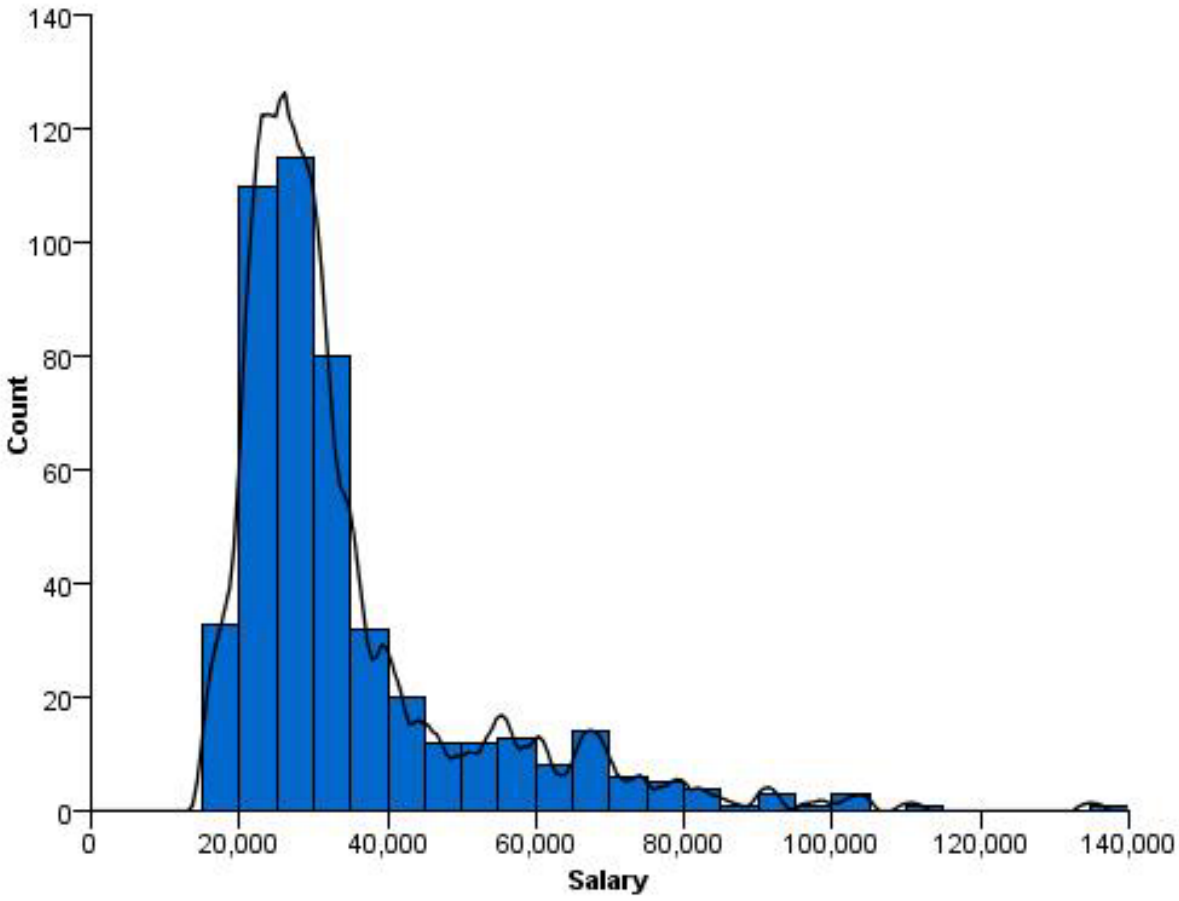



*Figure 404. Histogram with kernel density curve*

## Percentage Histogram

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Percent"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: interval(position(summary.percent.count(bin.rect(salary))))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Percent"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: interval(position(summary.percent.count(bin.rect(salary))))
```

*Figure 405. GPL for percentage histogram*

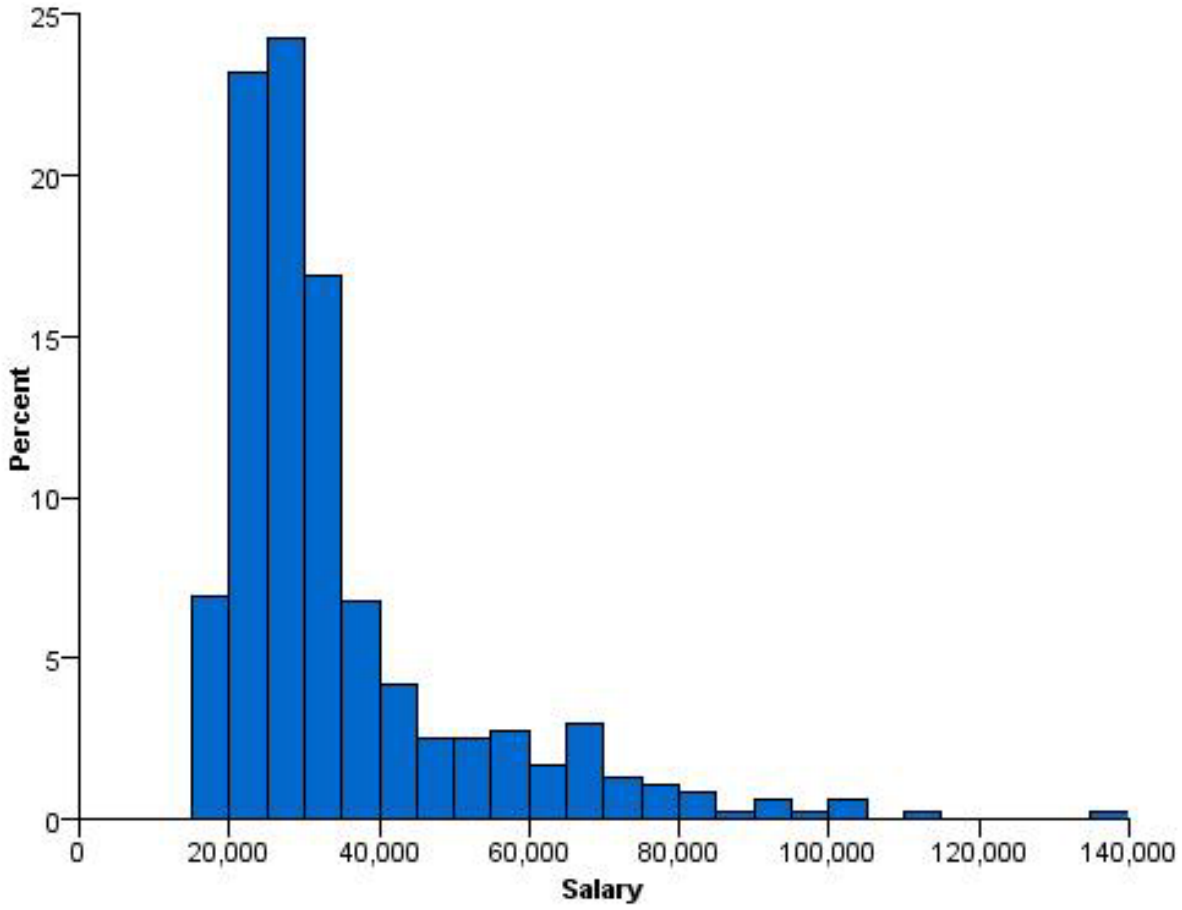



*Figure 406. Percentage histogram*

# Frequency Polygon

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: area(position(summary.count(bin.rect(salary))))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: area(position(summary.count(bin.rect(salary))))
```

*Figure 407. GPL for frequency polygon*

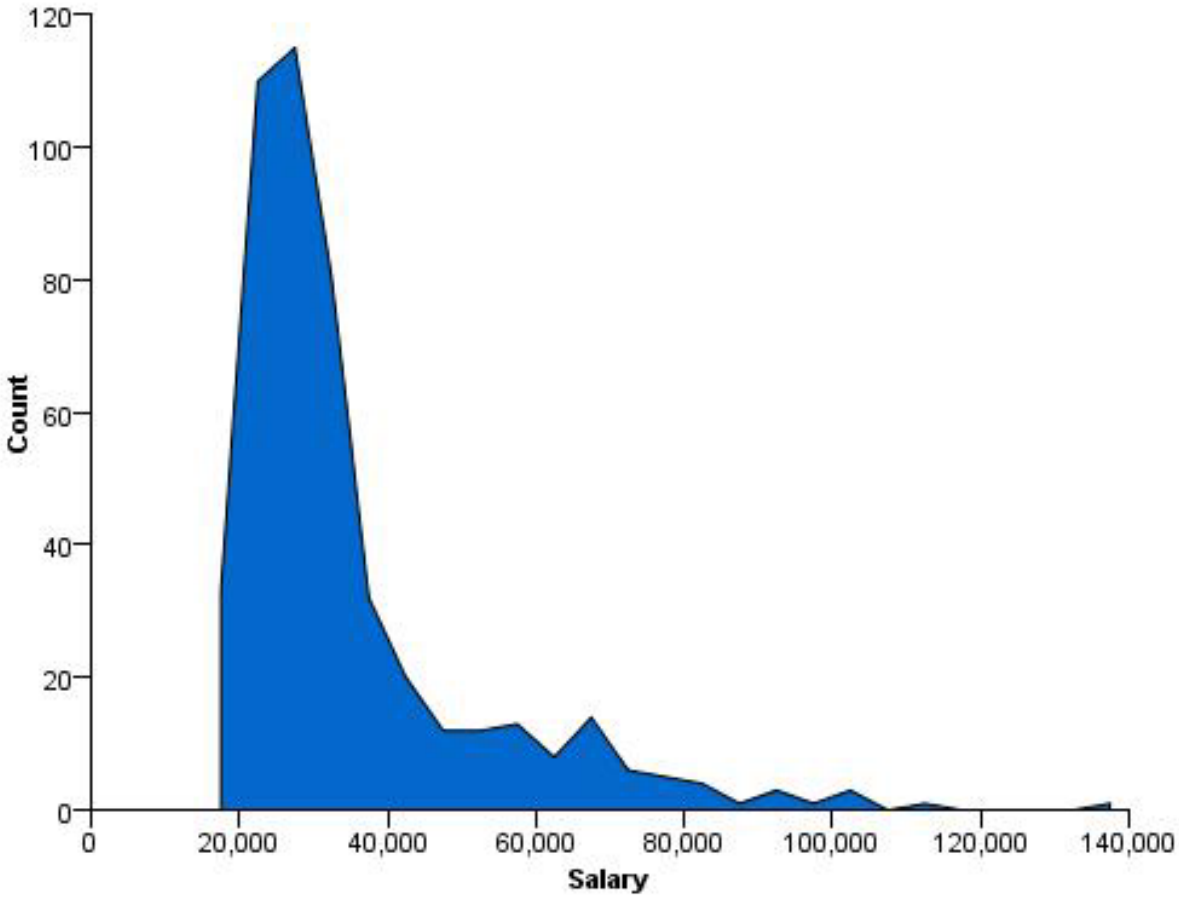



*Figure 408. Frequency polygon*

# Stacked Histogram

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary=col(source(s), name("salary"))
DATA: gender=col(source(s), name("gender"), unit.category())
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: interval.stack(position(summary.count(bin.rect(salary))),
                        color(gender))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary=col(source(s), name("salary"))
DATA: gender=col(source(s), name("gender"), unit.category())
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: interval.stack(position(summary.count(bin.rect(salary))),
                        color(gender))
```

*Figure 409. GPL for stacked histogram*

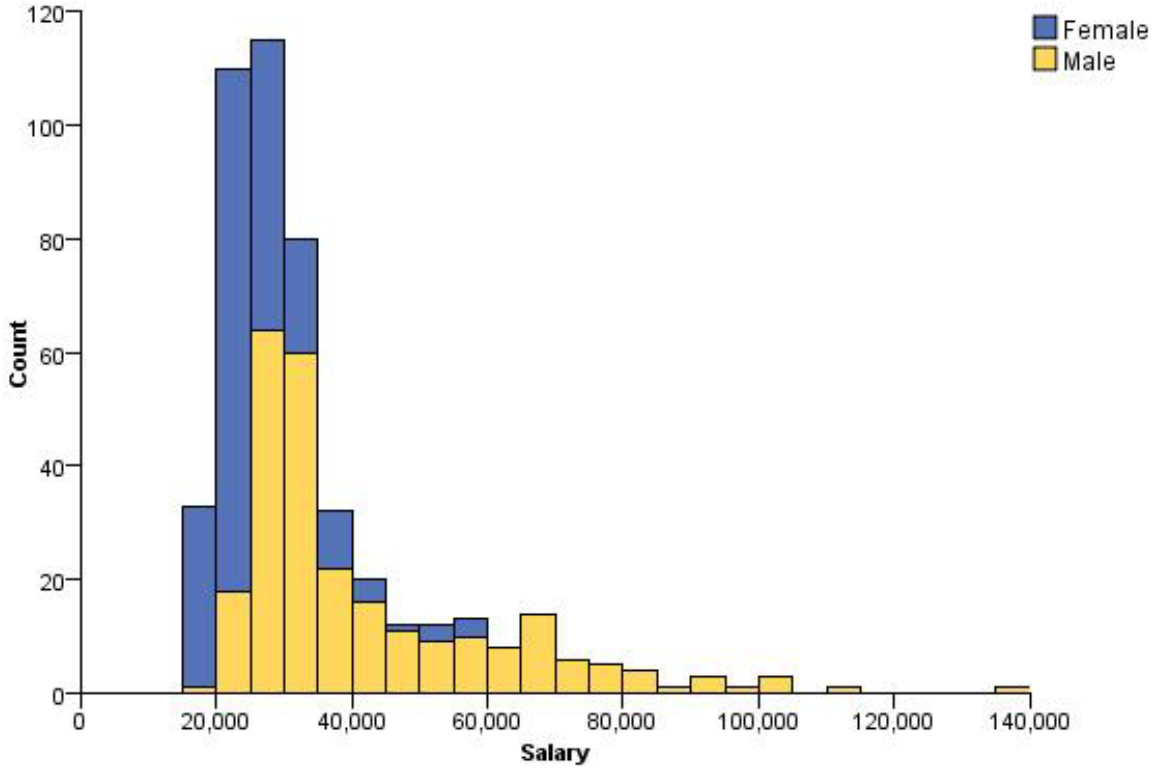



*Figure 410. Stacked histogram*

# Faceted (Paneled) Histogram

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
DATA: gender = col(source(s), name("gender"), unit.category())
GUIDE: axis(dim(1), label("Salary"))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(4), label("Gender"))
ELEMENT: interval(position(summary.count(bin.rect(salary*1*1*gender))))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
DATA: gender = col(source(s), name("gender"), unit.category())
GUIDE: axis(dim(1), label("Salary"))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(4), label("Gender"))
ELEMENT: interval(position(summary.count(bin.rect(salary*1*1*gender))))
```

*Figure 411. GPL for faceted histogram*

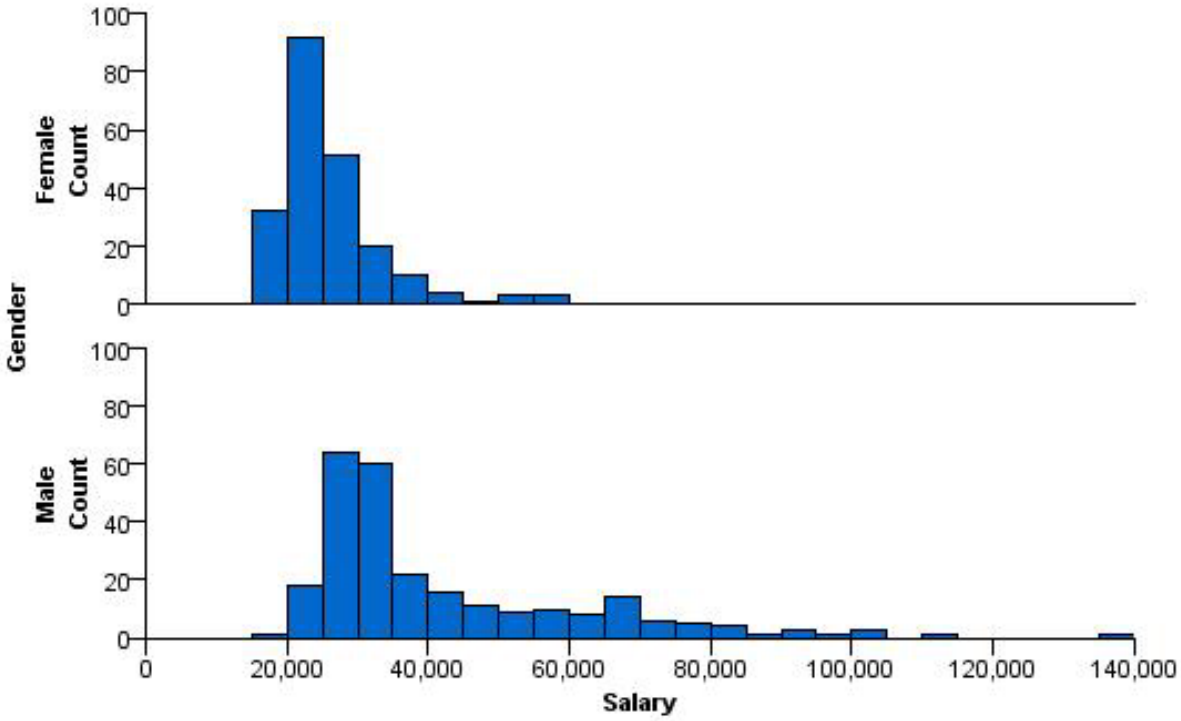



*Figure 412. Faceted histogram*

# Population Pyramid

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
COORD: transpose(mirror())
GUIDE: axis(dim(1), label("Current Salary"))
GUIDE: axis(dim(1), label(""), opposite())
GUIDE: axis(dim(2), label("Frequency"))
GUIDE: axis(dim(3), label("Gender"), opposite(), gap(0px))
GUIDE: legend(aesthetic(aesthetic.color.interior), null())
ELEMENT: interval(position(summary.count(bin.rect(salary*1*gender))), color(gender))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
COORD: transpose(mirror())
GUIDE: axis(dim(1), label("Current Salary"))
GUIDE: axis(dim(1), label(""), opposite())
GUIDE: axis(dim(2), label("Frequency"))
GUIDE: axis(dim(3), label("Gender"), opposite(), gap(0px))
GUIDE: legend(aesthetic(aesthetic.color.interior), null())
ELEMENT: interval(position(summary.count(bin.rect(salary*1*gender))), color(gender))
```

*Figure 413. GPL for population pyramid*

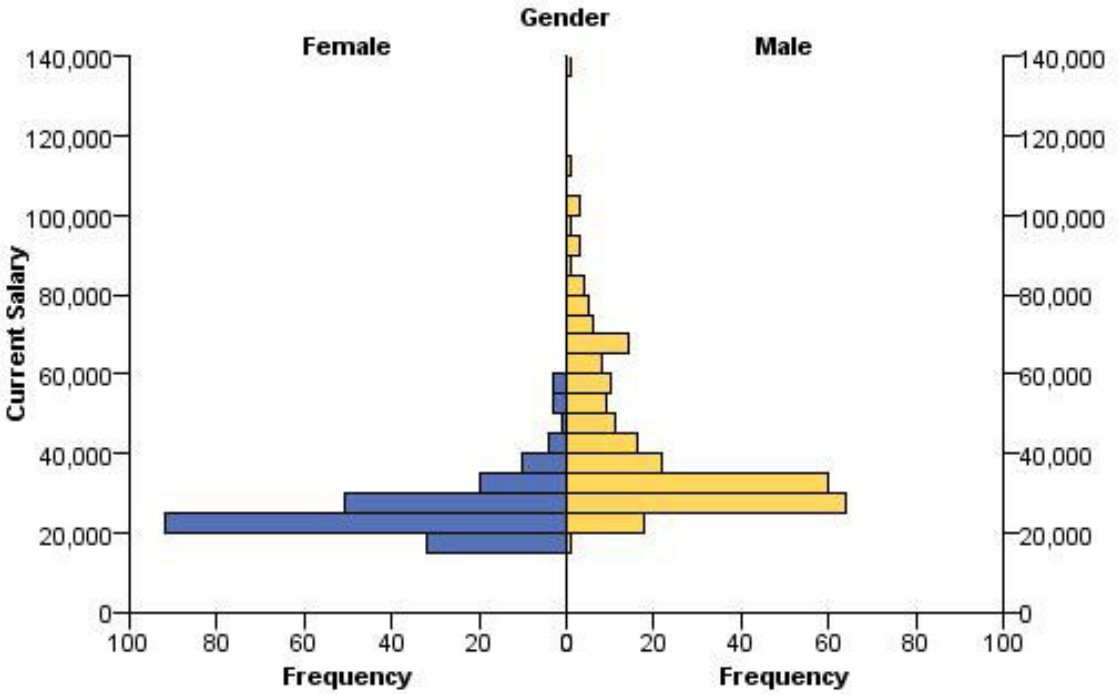



*Figure 414. Population pyramid*

# Cumulative Histogram

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Cumulative Percent"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: interval(position(summary.percent.count.cumulative(bin.rect(salary))))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Cumulative Percent"))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: interval(position(summary.percent.count.cumulative(bin.rect(salary))))
```

*Figure 415. GPL for cumulative histogram*

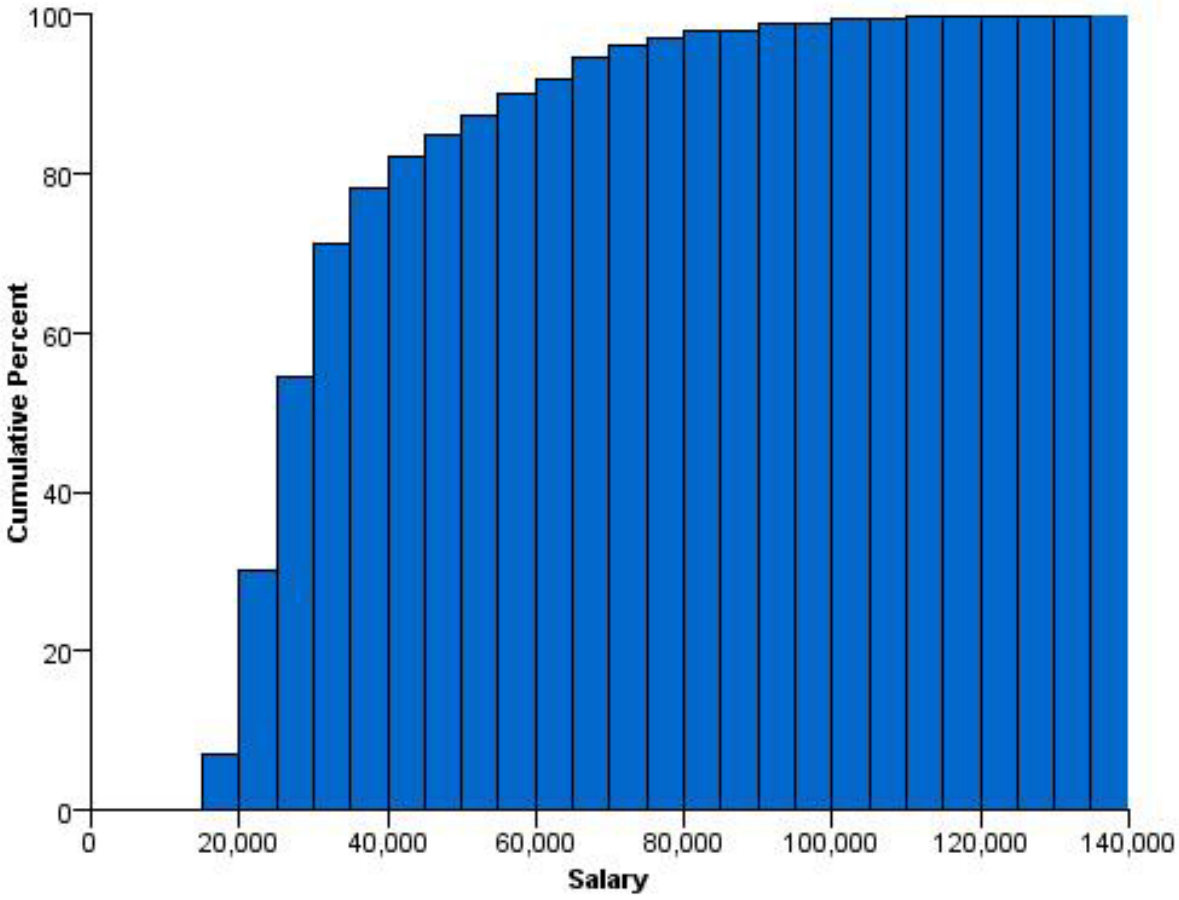



*Figure 416. Cumulative histogram*

## 3-D Histogram

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
COORD: rect(dim(1, 2, 3))
GUIDE: axis(dim(1), label("Employment Category"))
GUIDE: axis(dim(2), label("Salary"))
GUIDE: axis(dim(3), label("Count"))
ELEMENT: interval(position(summary.count(bin.rect(jobcat*salary, dim(2)))))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
COORD: rect(dim(1, 2, 3))
GUIDE: axis(dim(1), label("Employment Category"))
GUIDE: axis(dim(2), label("Salary"))
GUIDE: axis(dim(3), label("Count"))
ELEMENT: interval(position(summary.count(bin.rect(jobcat*salary, dim(2)))))
```

*Figure 417. GPL for 3-D histogram*

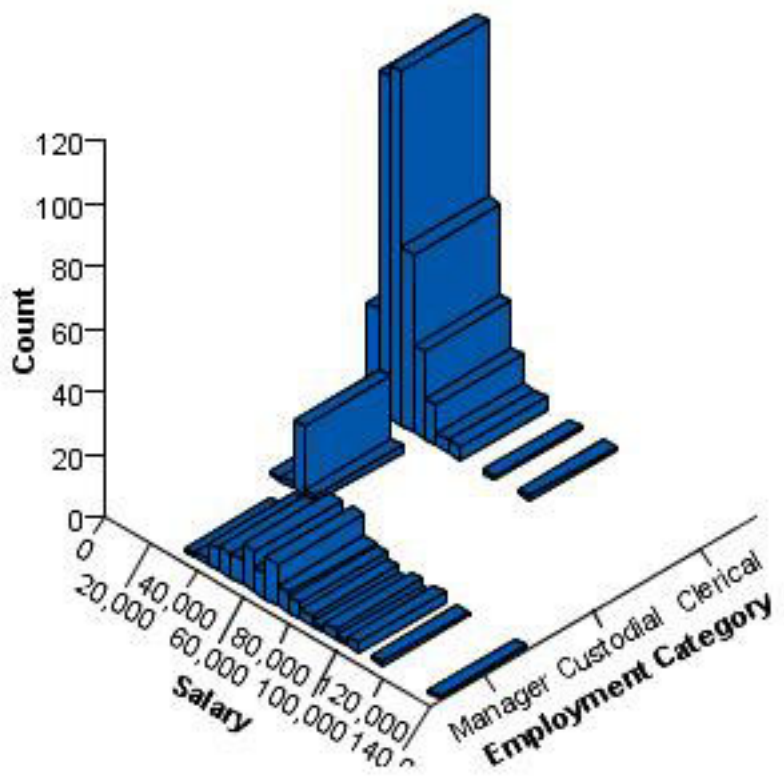



*Figure 418. 3-D histogram*

## High-Low Chart Examples

This section provides examples of different types of high-low charts.

## Simple Range Bar for One Variable

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), min(0.0))
GUIDE: axis(dim(2), label("Min Current Salary - Max Current Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(region.spread.range(jobcat*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), min(0.0))
GUIDE: axis(dim(2), label("Min Current Salary - Max Current Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(region.spread.range(jobcat*salary)))
```

*Figure 419. GPL for simple range bar for one variable*

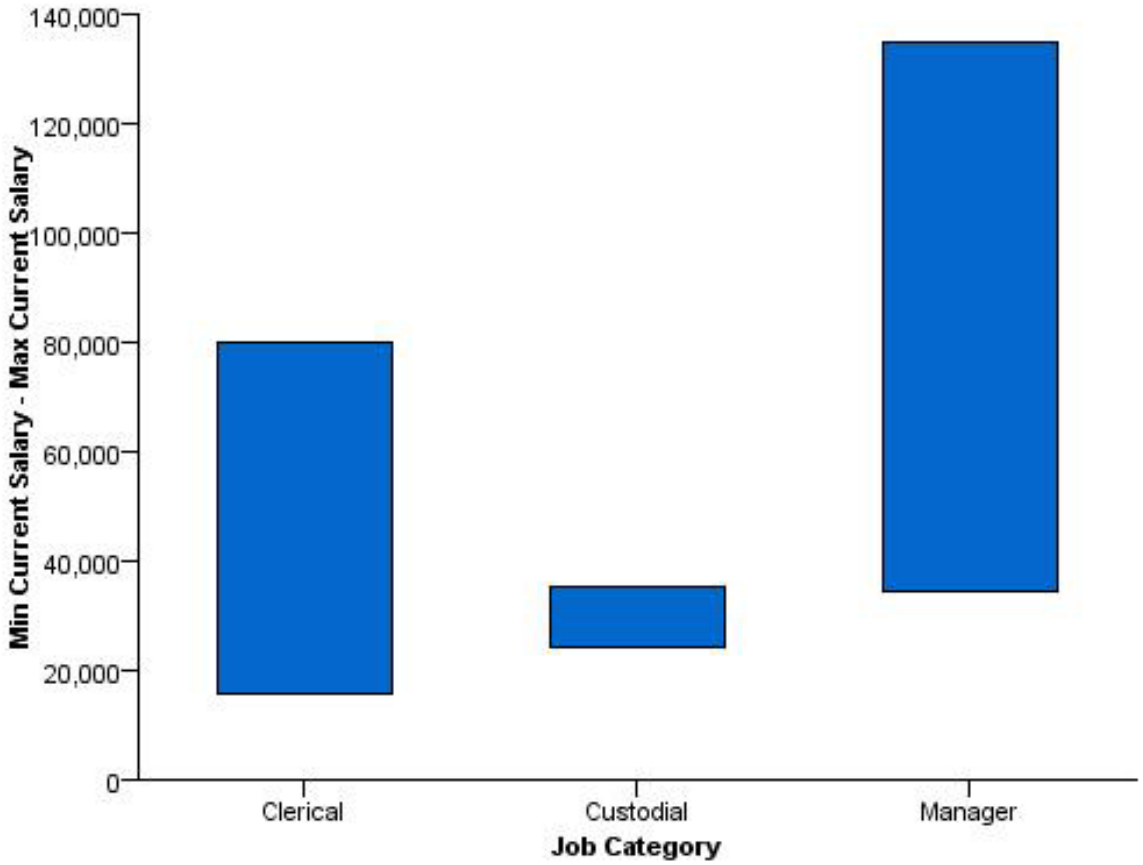



*Figure 420. Simple range bar for one variable*

## Simple Range Bar for Two Variables

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), min(0.0))
GUIDE: axis(dim(2), label("Min Beginning Salary - Max Current Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(region.spread.range(jobcat*(salbegin+salary))))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
SCALE: linear(dim(2), min(0.0))
GUIDE: axis(dim(2), label("Min Beginning Salary - Max Current Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: interval(position(region.spread.range(jobcat*(salbegin+salary))))
```

*Figure 421. GPL for simple range bar for two variables*

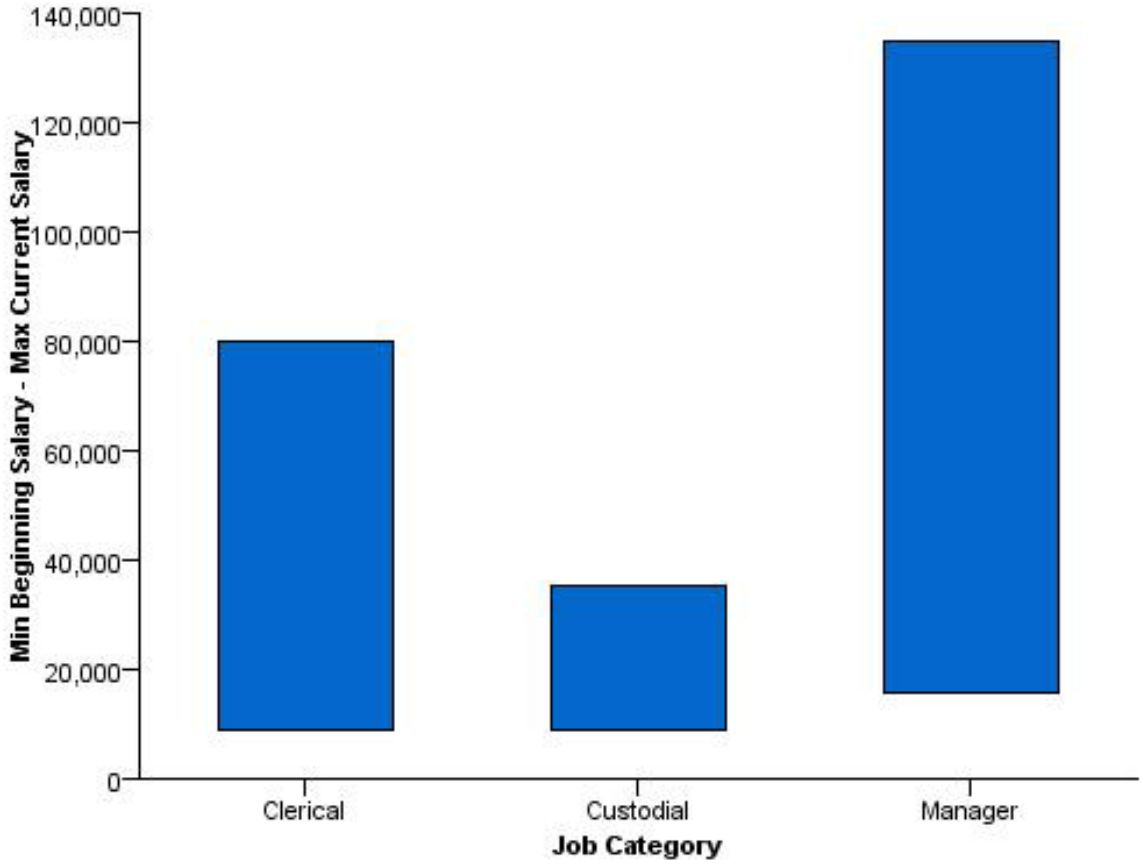



*Figure 422. Simple range bar for two variables*

# High-Low-Close Chart

```
SOURCE: s = csvSource(file("stocks.csv"))
DATA: Date = col(source(s), name("Date"), unit.time(), format("MM/dd/yy"))
DATA: Close = col(source(s), name("Close"))
DATA: High = col(source(s), name("High"))
DATA: Low = col(source(s), name("Low"))
GUIDE: axis(dim(1), label("Date"))
GUIDE: axis(dim(2), label("Close"))
SCALE: time(dim(1), dataMaximum())
ELEMENT: interval(position(region.spread.range(Date*(Low+High))))
ELEMENT: point(position(Date*Close), color.exterior(color.red), size(size."2px"))
```

```
SOURCE: s = userSource(id("stocks"))
DATA: Date = col(source(s), name("Date"), unit.time(), format("MM/dd/yy"))
DATA: Close = col(source(s), name("Close"))
DATA: High = col(source(s), name("High"))
DATA: Low = col(source(s), name("Low"))
GUIDE: axis(dim(1), label("Date"))
GUIDE: axis(dim(2), label("Close"))
SCALE: time(dim(1), dataMaximum())
ELEMENT: interval(position(region.spread.range(Date*(Low+High))))
ELEMENT: point(position(Date*Close), color.exterior(color.red), size(size."2px"))
```

*Figure 423. GPL for high-low-close chart*

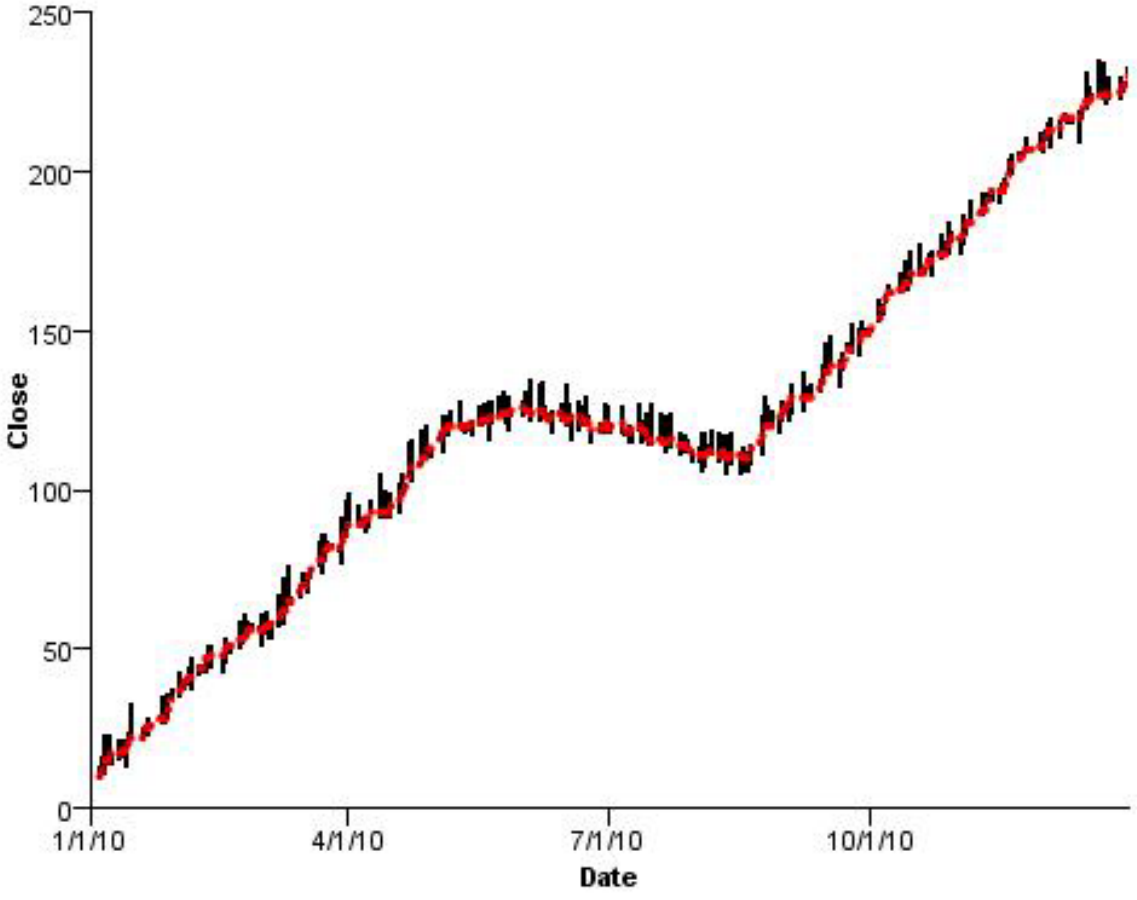



*Figure 424. High-low-close chart*

## Scatter/Dot Examples

This section provides examples of different types of scatterplots and dot plots.

## Simple 1-D Scatterplot

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
COORD: rect(dim(1))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: point(position(salary))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
COORD: rect(dim(1))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: point(position(salary))
```

*Figure 425. GPL for simple 1-D scatterplot*

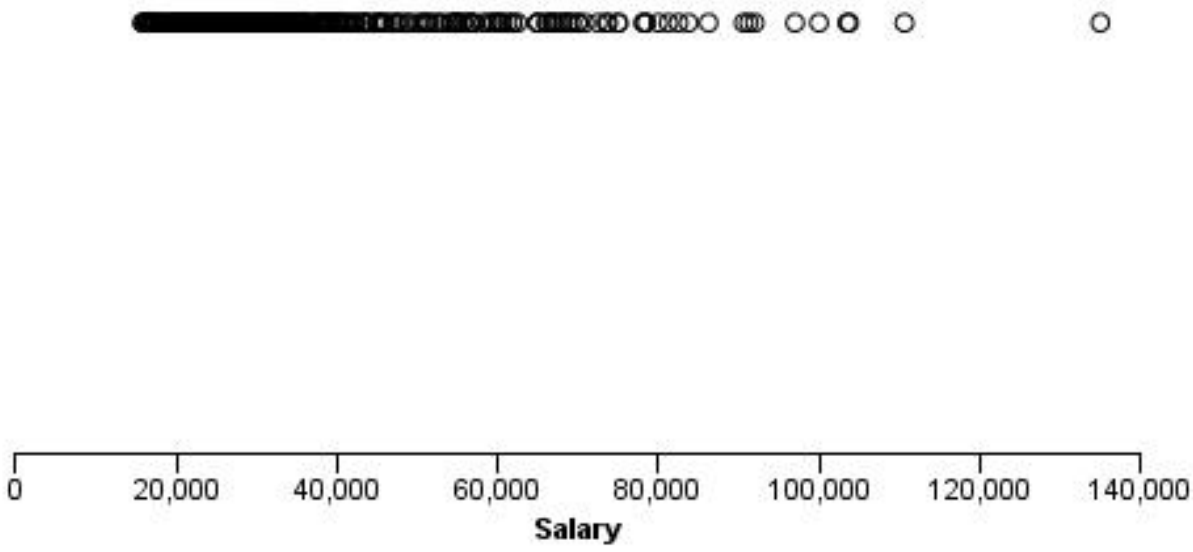



*Figure 426. Simple 1-D scatterplot*

## Simple 2-D Scatterplot

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary))
```

*Figure 427. GPL for simple 2-D scatterplot*

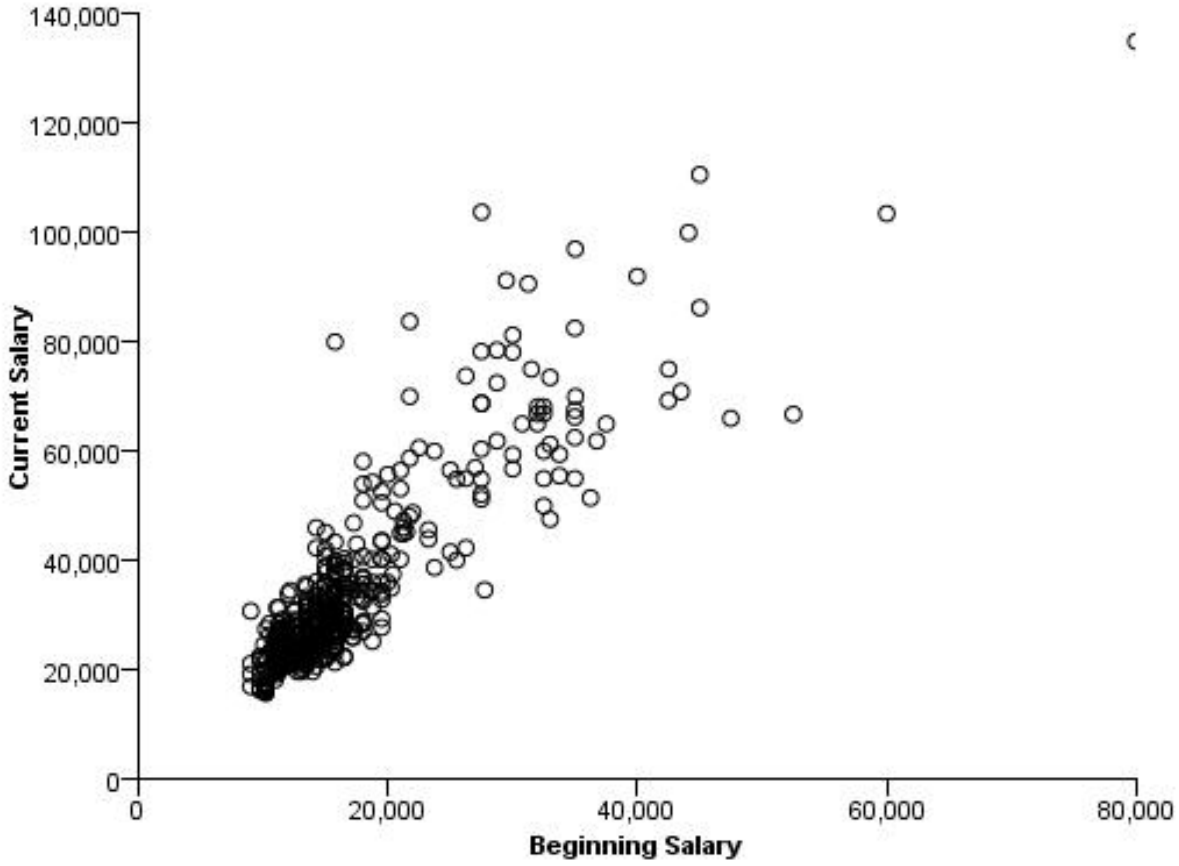



*Figure 428. Simple 2-D scatterplot*

## Simple 2-D Scatterplot with Fit Line

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary))
ELEMENT: line(position(smooth.linear(salbegin*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary))
ELEMENT: line(position(smooth.linear(salbegin*salary)))
```

*Figure 429. GPL for simple scatterplot with fit line*

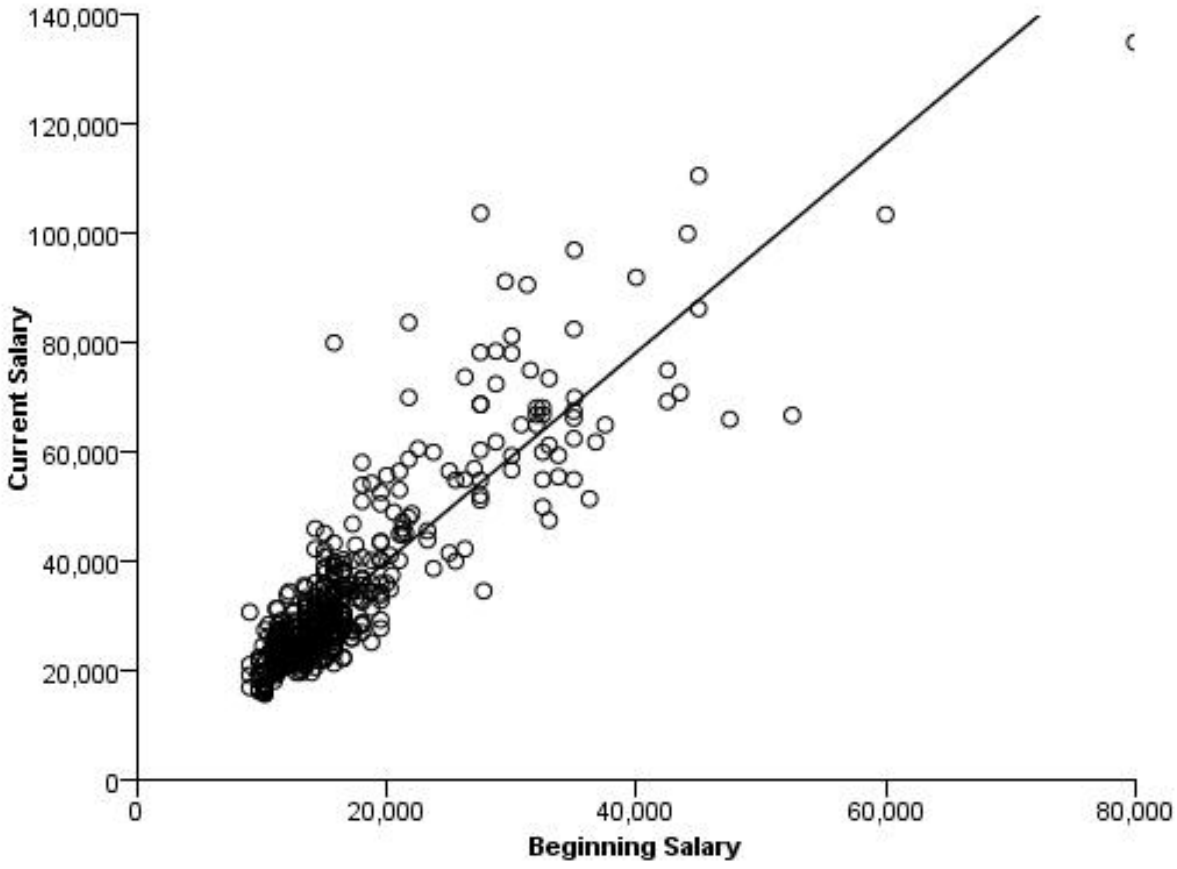



*Figure 430. Simple scatterplot with fit line*

# Grouped Scatterplot

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
DATA: gender=col(source(s), name("gender"), unit.category())
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary), color(gender))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
DATA: gender=col(source(s), name("gender"), unit.category())
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary), color(gender))
```

*Figure 431. GPL for grouped scatterplot*

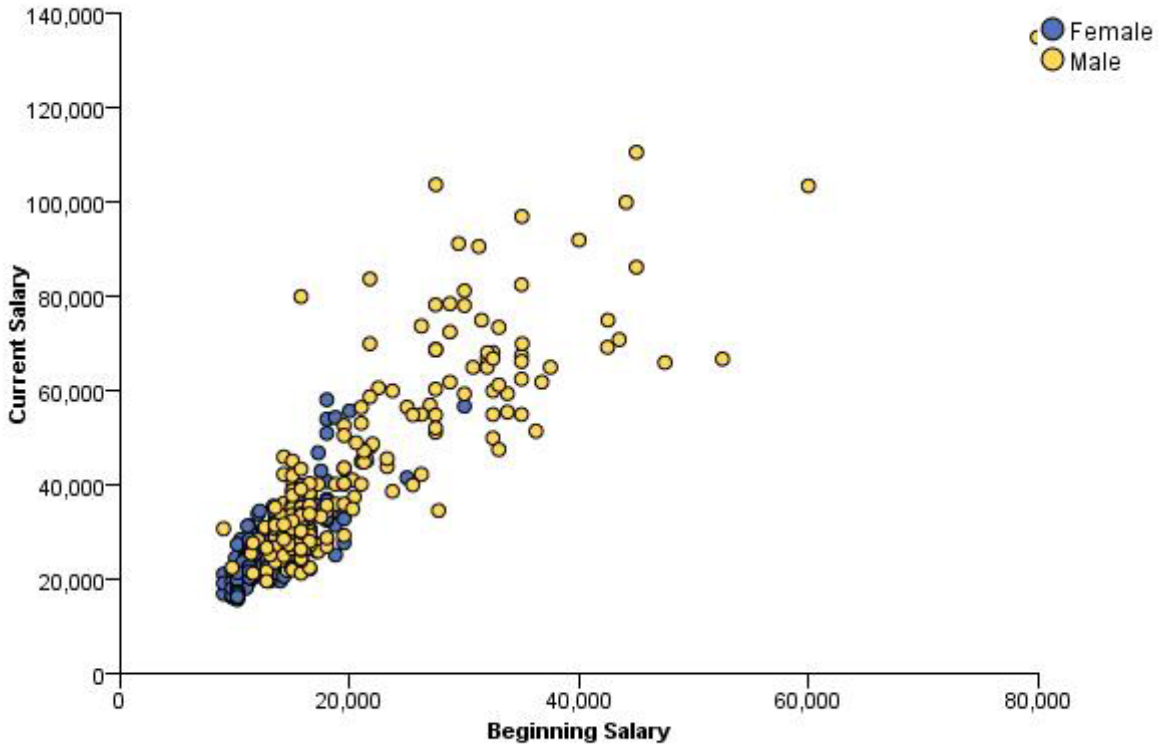



*Figure 432. Grouped scatterplot*

# Grouped Scatterplot with Convex Hull

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
DATA: gender=col(source(s), name("gender"), unit.category())
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: legend(aesthetic(aesthetic.color.exterior), label("Gender"))
GUIDE: legend(aesthetic(aesthetic.color.interior), null())
ELEMENT: point(position(salbegin*salary), color.exterior(gender))
ELEMENT: edge(position(link.hull(salbegin*salary)), color.interior(gender))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
DATA: gender=col(source(s), name("gender"), unit.category())
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: legend(aesthetic(aesthetic.color.exterior), label("Gender"))
GUIDE: legend(aesthetic(aesthetic.color.interior), null())
ELEMENT: point(position(salbegin*salary), color.exterior(gender))
ELEMENT: edge(position(link.hull(salbegin*salary)), color.interior(gender))
```

*Figure 433. GPL for grouped scatterplot with convex hull*

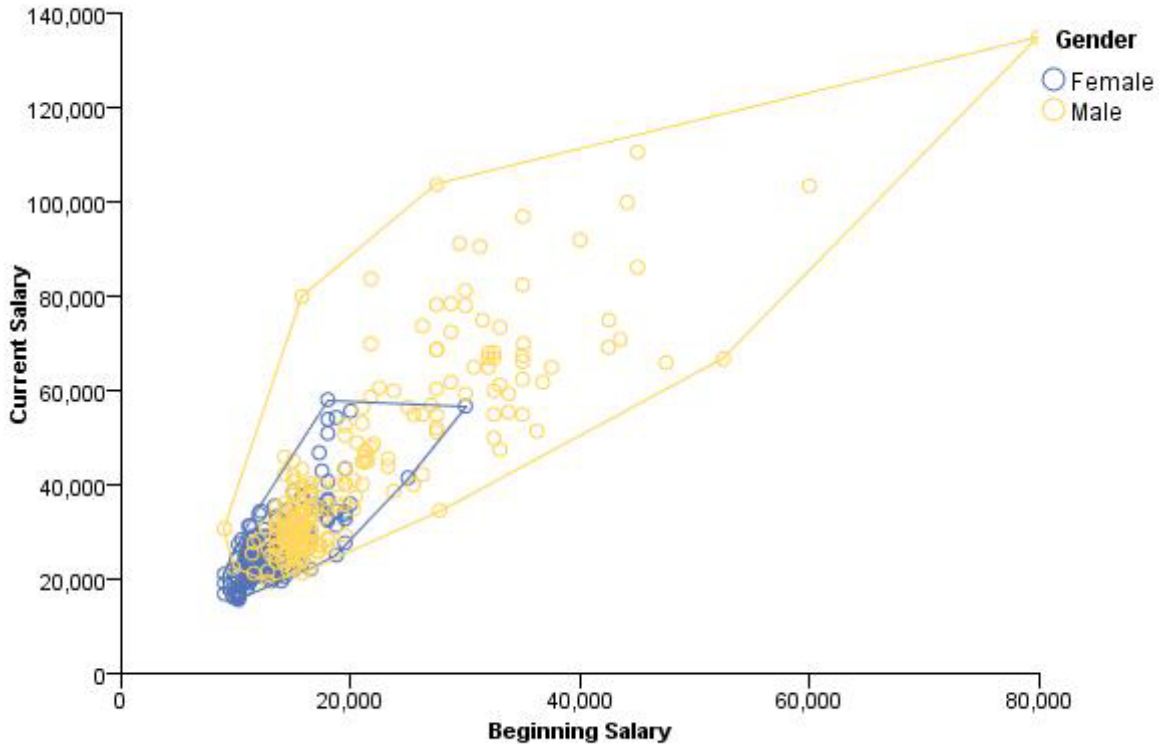



*Figure 434. Grouped scatterplot with convex hull*

# Scatterplot Matrix (SPLOM)

```
SOURCE: s = csvSource(file("customer_subset.csv"))
DATA: age=col(source(s), name("age"))
DATA: income=col(source(s), name("income"))
DATA: creddebt=col(source(s), name("creddebt"))
GUIDE: axis(dim(1.1), ticks(null()))
GUIDE: axis(dim(2.1), ticks(null()))
GUIDE: axis(dim(1), gap(0px))
GUIDE: axis(dim(2), gap(0px))
ELEMENT: point(position((age/"Age"+income/"Income"+creddebt/"CC Debt")*
                        (age/"Age"+income/"Income"+creddebt/"CC Debt")))
```

```
SOURCE: s = userSource(id("customer_subset"))
DATA: age=col(source(s), name("age"))
DATA: income=col(source(s), name("income"))
DATA: creddebt=col(source(s), name("creddebt"))
GUIDE: axis(dim(1.1), ticks(null()))
GUIDE: axis(dim(2.1), ticks(null()))
GUIDE: axis(dim(1), gap(0px))
GUIDE: axis(dim(2), gap(0px))
ELEMENT: point(position((age/"Age"+income/"Income"+creddebt/"CC Debt")*
                        (age/"Age"+income/"Income"+creddebt/"CC Debt")))
```

*Figure 435. GPL for scatterplot matrix*

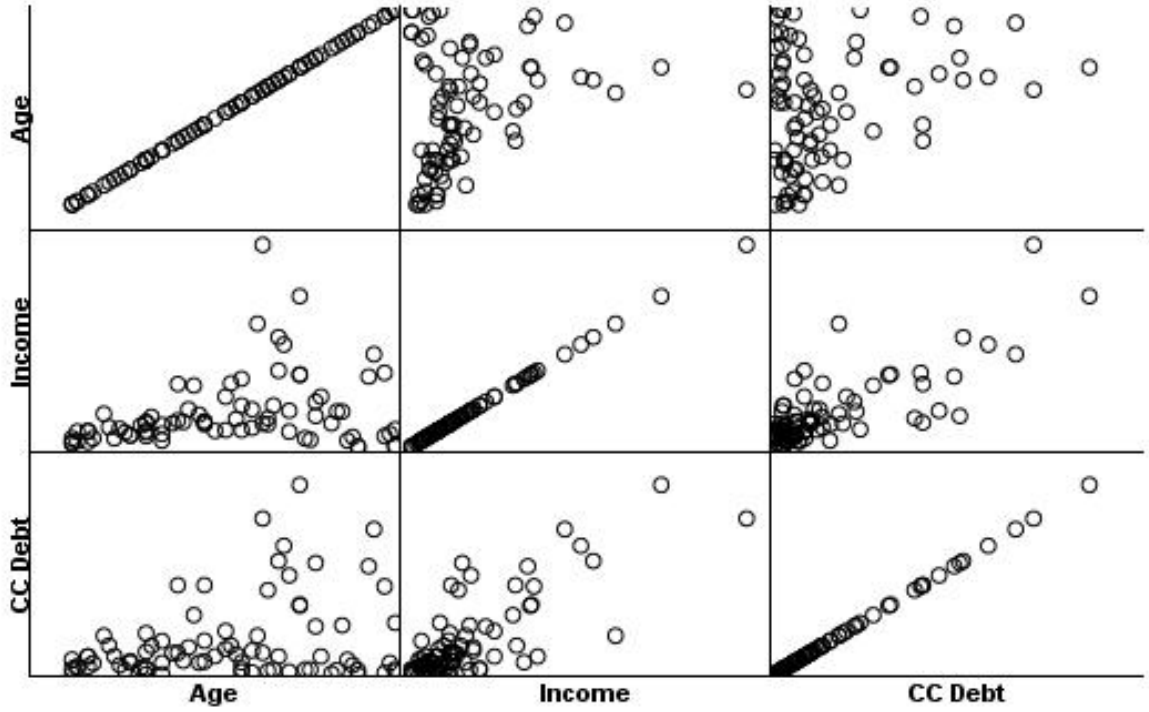



*Figure 436. Scatterplot Matrix*

# Bubble Plot

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
DATA: prevexp=col(source(s), name("prevexp"))
SCALE: linear(aesthetic(aesthetic.size),
              aestheticMinimum(size."5px"), aestheticMaximum(size."35px"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: legend(aesthetic(aesthetic.size), label("Previous Experience (months)"))
ELEMENT: point(position(salbegin*salary), size(prevexp))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
DATA: prevexp=col(source(s), name("prevexp"))
SCALE: linear(aesthetic(aesthetic.size),
              aestheticMinimum(size."5px"), aestheticMaximum(size."35px"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: legend(aesthetic(aesthetic.size), label("Previous Experience (months)"))
ELEMENT: point(position(salbegin*salary), size(prevexp))
```

*Figure 437. GPL for bubble plot*

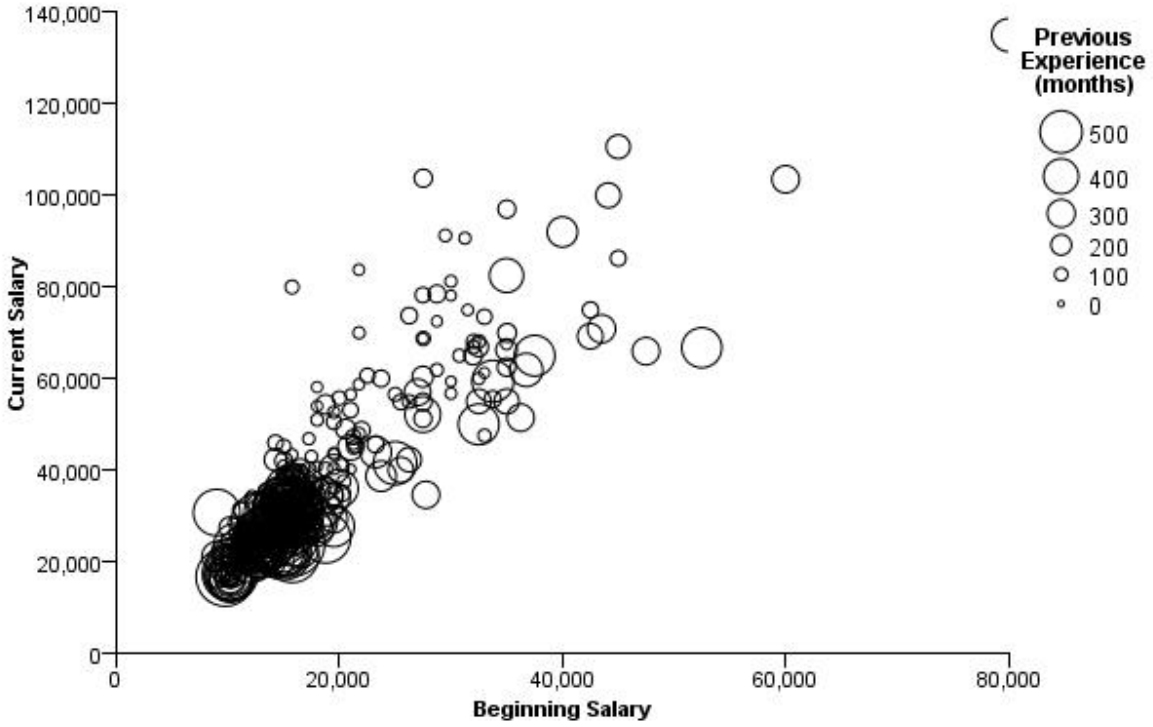



*Figure 438. Bubble plot*

# Binned Scatterplot

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: legend(aesthetic(aesthetic.color), label("Count"))
ELEMENT: point(position(bin.rect(salbegin*salary, dim(1,2))),
               color(summary.count()))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: legend(aesthetic(aesthetic.color), label("Count"))
ELEMENT: point(position(bin.rect(salbegin*salary, dim(1,2))),
               color(summary.count()))
```

*Figure 439. GPL for binned scatterplot*

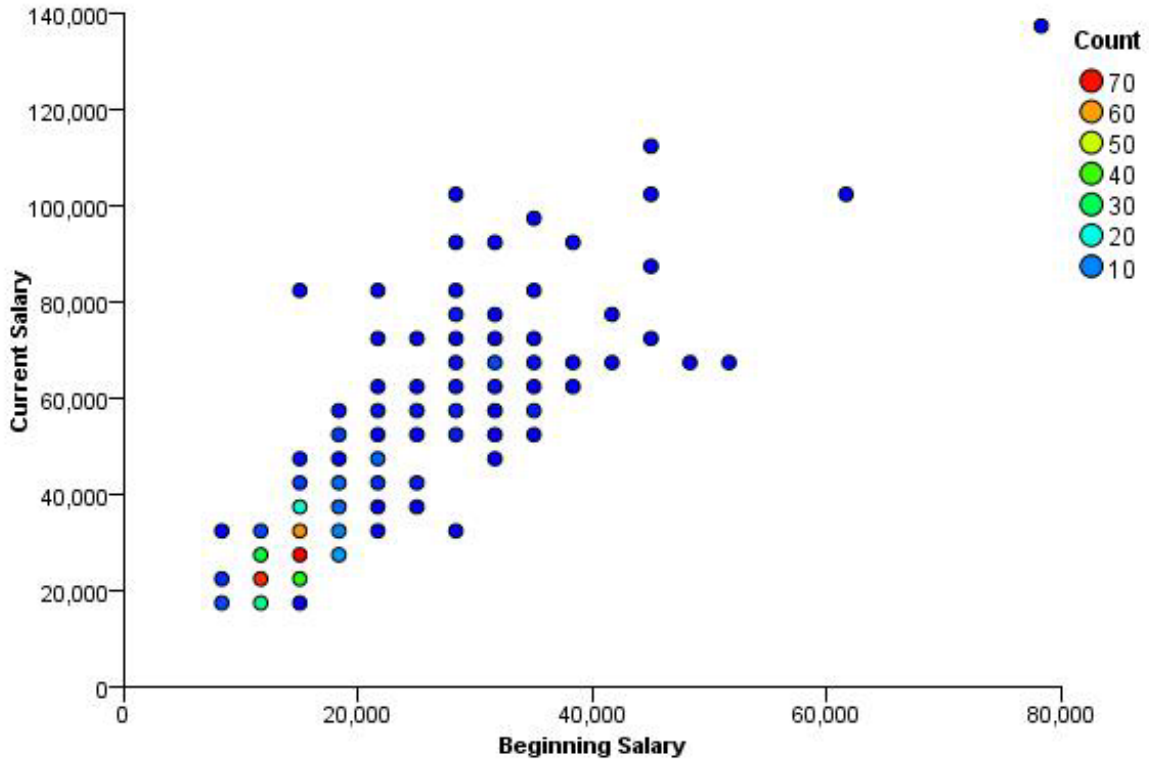



*Figure 440. Binned scatterplot*

# Binned Scatterplot with Polygons

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: legend(aesthetic(aesthetic.color), label("Count"))
ELEMENT: polygon(position(bin.hex(salbegin*salary, dim(1,2))),
                 color(summary.count()))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: legend(aesthetic(aesthetic.color), label("Count"))
ELEMENT: polygon(position(bin.hex(salbegin*salary, dim(1,2))),
                 color(summary.count()))
```

*Figure 441. GPL for binned scatterplot with polygons*

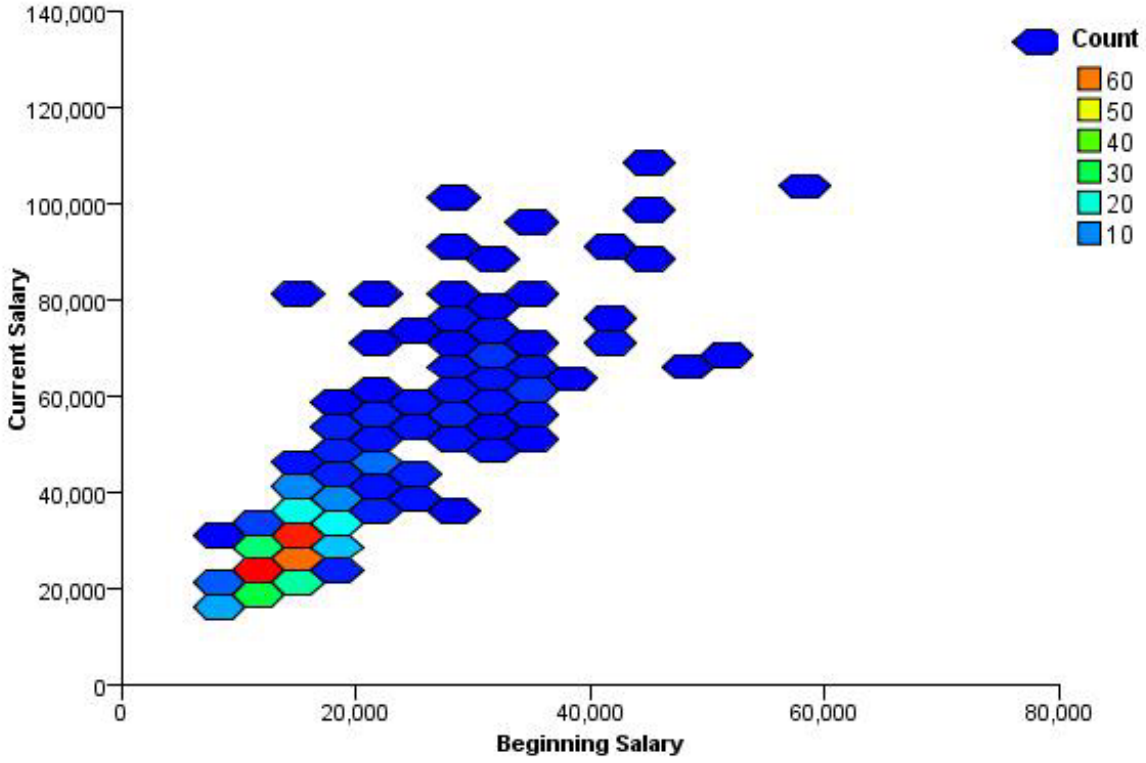


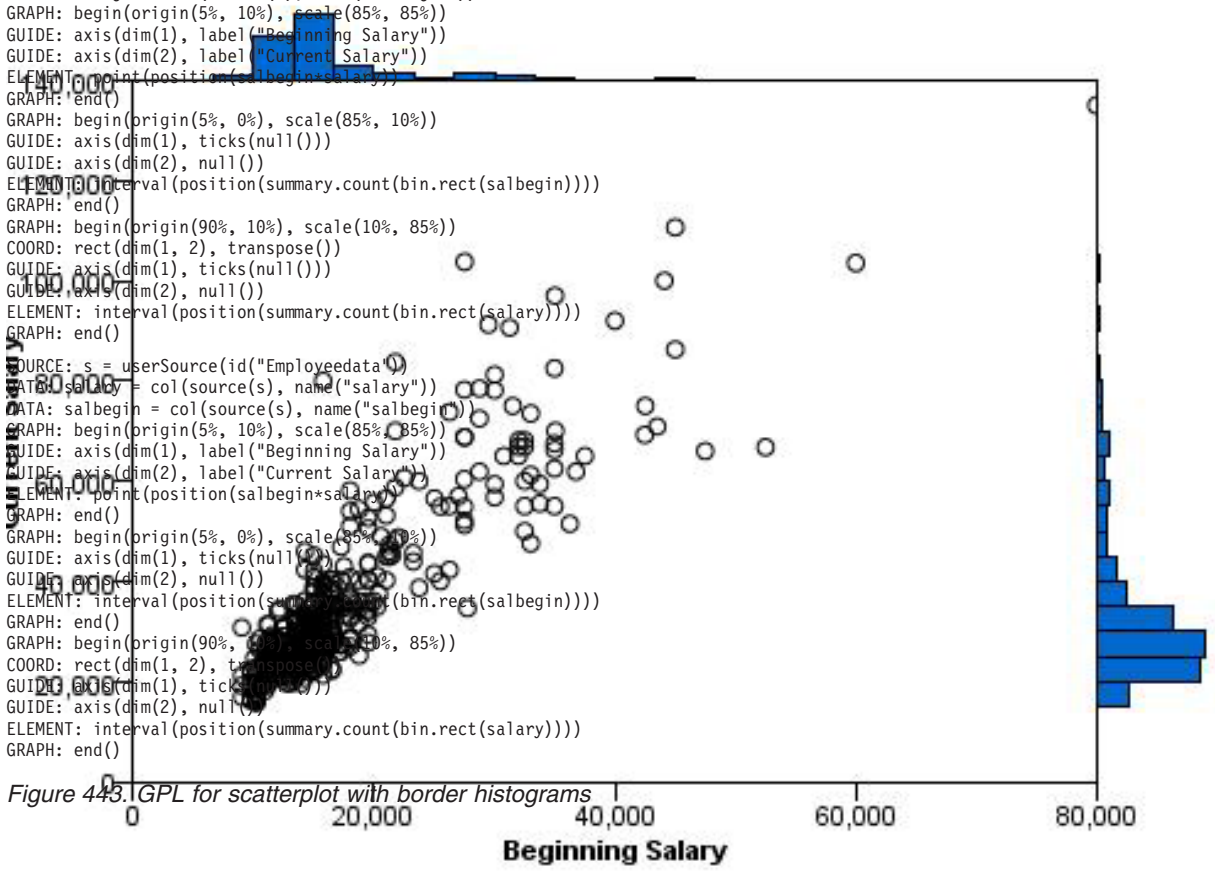

*Figure 442. Binned scatterplot with polygons*

# Scatterplot with Border Histograms

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
DATA: salbegin = col(source(s), name("salbegin"))
GRAPH: begin(origin(5%, 10%), scale(85%, 85%))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: axis(dim(2), label("Current Salary"))
ELEMENT: point(position(salbegin*salary))
GRAPH: end()
GRAPH: begin(origin(5%, 0%), scale(85%, 10%))
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), null())
ELEMENT: interval(position(summary.count(bin.rect(salbegin))))
GRAPH: end()
GRAPH: begin(origin(90%, 10%), scale(10%, 85%))
COORD: rect(dim(1, 2), transpose())
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), null())
ELEMENT: interval(position(summary.count(bin.rect(salary))))
GRAPH: end()

SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
DATA: salbegin = col(source(s), name("salbegin"))
GRAPH: begin(origin(5%, 10%), scale(85%, 85%))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: axis(dim(2), label("Current Salary"))
ELEMENT: point(position(salbegin*salary))
GRAPH: end()
GRAPH: begin(origin(5%, 0%), scale(85%, 10%))
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), null())
ELEMENT: interval(position(summary.count(bin.rect(salbegin))))
GRAPH: end()
GRAPH: begin(origin(90%, 10%), scale(10%, 85%))
COORD: rect(dim(1, 2), transpose())
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), null())
ELEMENT: interval(position(summary.count(bin.rect(salary))))
GRAPH: end()
```

*Figure 443. GPL for scatterplot with border histograms*



# Scatterplot with Border Boxplots

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
DATA: salbegin = col(source(s), name("salbegin"))
GRAPH: begin(origin(5%, 10%), scale(85%, 85%))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: axis(dim(2), label("Current Salary"))
ELEMENT: point(position(salbegin*salary))
GRAPH: end()
GRAPH: begin(origin(5%, 0%), scale(85%, 10%))
COORD: rect(dim(1))
GUIDE: axis(dim(1), ticks(null()))
ELEMENT: schema(position(bin.quantile.letter(salbegin)), size(size."80%"))
GRAPH: end()
GRAPH: begin(origin(90%, 10%), scale(10%, 85%))
COORD: transpose(rect(dim(1)))
GUIDE: axis(dim(1), ticks(null()))
ELEMENT: schema(position(bin.quantile.letter(salary)), size(size."80%"))
GRAPH: end()
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
DATA: salbegin = col(source(s), name("salbegin"))
GRAPH: begin(origin(5%, 10%), scale(85%, 85%))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: axis(dim(2), label("Current Salary"))
ELEMENT: point(position(salbegin*salary))
GRAPH: end()
GRAPH: begin(origin(5%, 0%), scale(85%, 10%))
COORD: rect(dim(1))
GUIDE: axis(dim(1), ticks(null()))
ELEMENT: schema(position(bin.quantile.letter(salbegin)), size(size."80%"))
GRAPH: end()
GRAPH: begin(origin(90%, 10%), scale(10%, 85%))
COORD: transpose(rect(dim(1)))
GUIDE: axis(dim(1), ticks(null()))
ELEMENT: schema(position(bin.quantile.letter(salary)), size(size."80%"))
GRAPH: end()
```

*Figure 444. GPL for scatterplot with border boxplots*

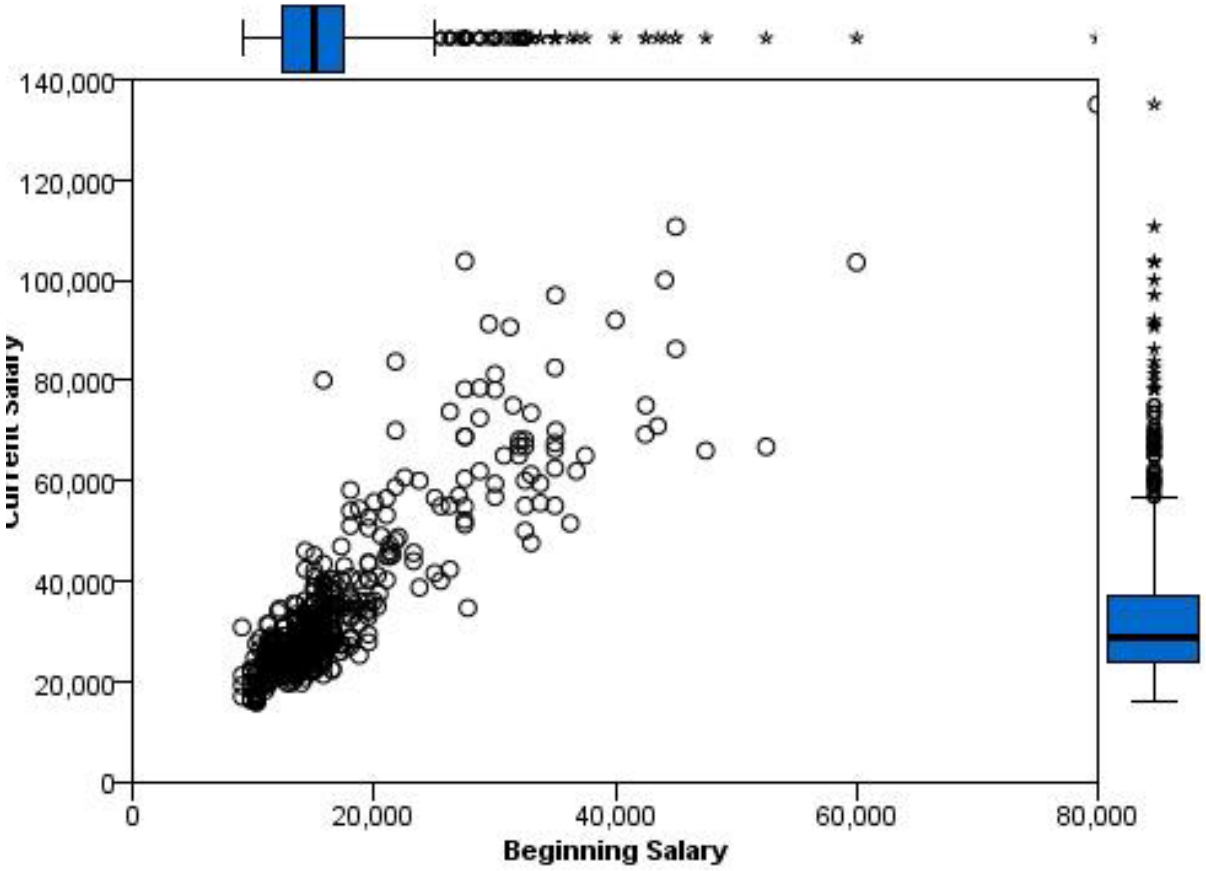



*Figure 445. Scatterplot with border boxplots*

## Dot Plot

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
COORD: rect(dim(1))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: point.dodge.asymmetric(position(bin.dot(salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
COORD: rect(dim(1))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: point.dodge.asymmetric(position(bin.dot(salary)))
```

*Figure 446. GPL for dot plot*

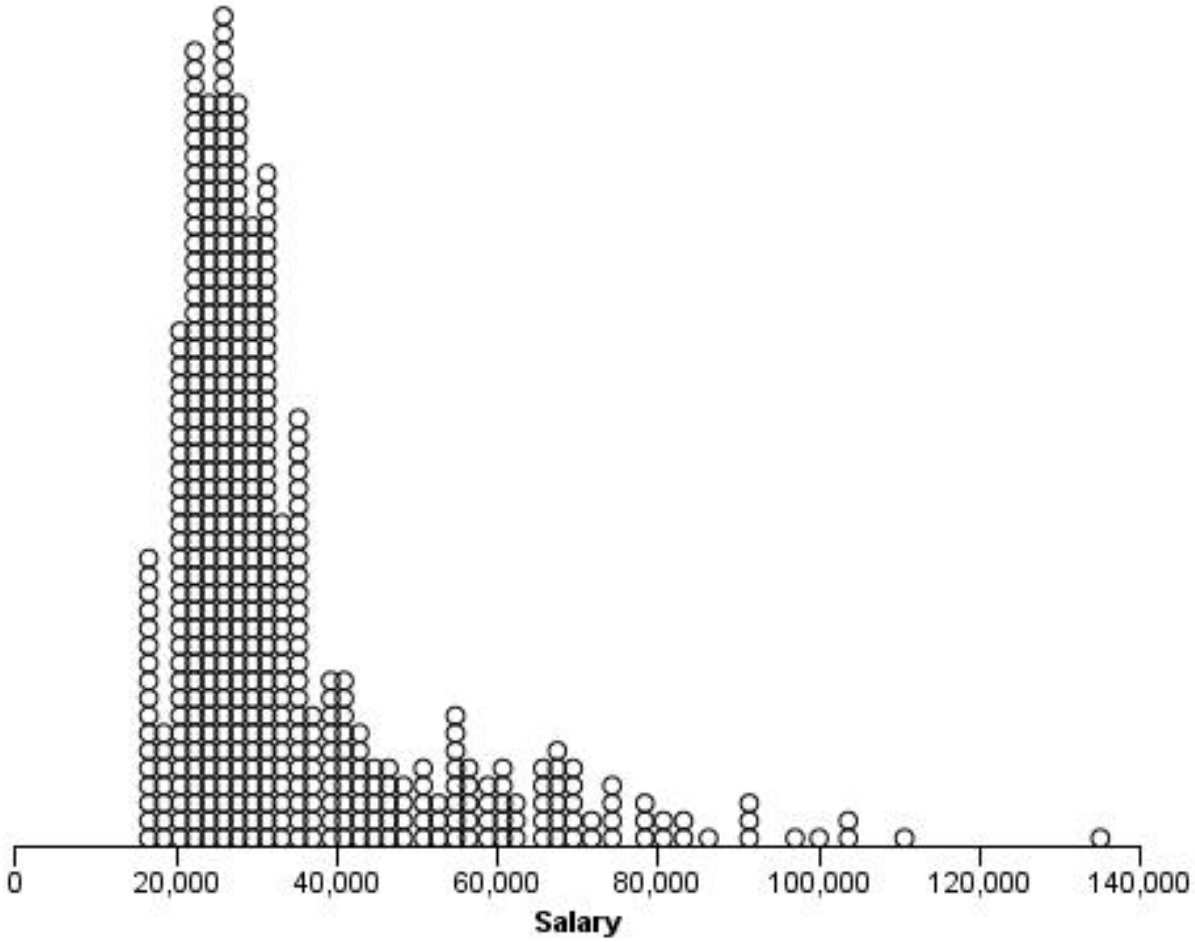



*Figure 447. Dot plot*

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
GUIDE: axis(dim(1), label("Salary"))
COORD: rect(dim(1))
ELEMENT: point.dodge.asymmetric(position(bin.dot(salary)),
                                color(gender), shape(shape.square))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: salary = col(source(s), name("salary"))
GUIDE: axis(dim(1), label("Salary"))
COORD: rect(dim(1))
ELEMENT: point.dodge.asymmetric(position(bin.dot(salary)),
                                color(gender), shape(shape.square))
```

*Figure 448. GPL for grouped dot plot*

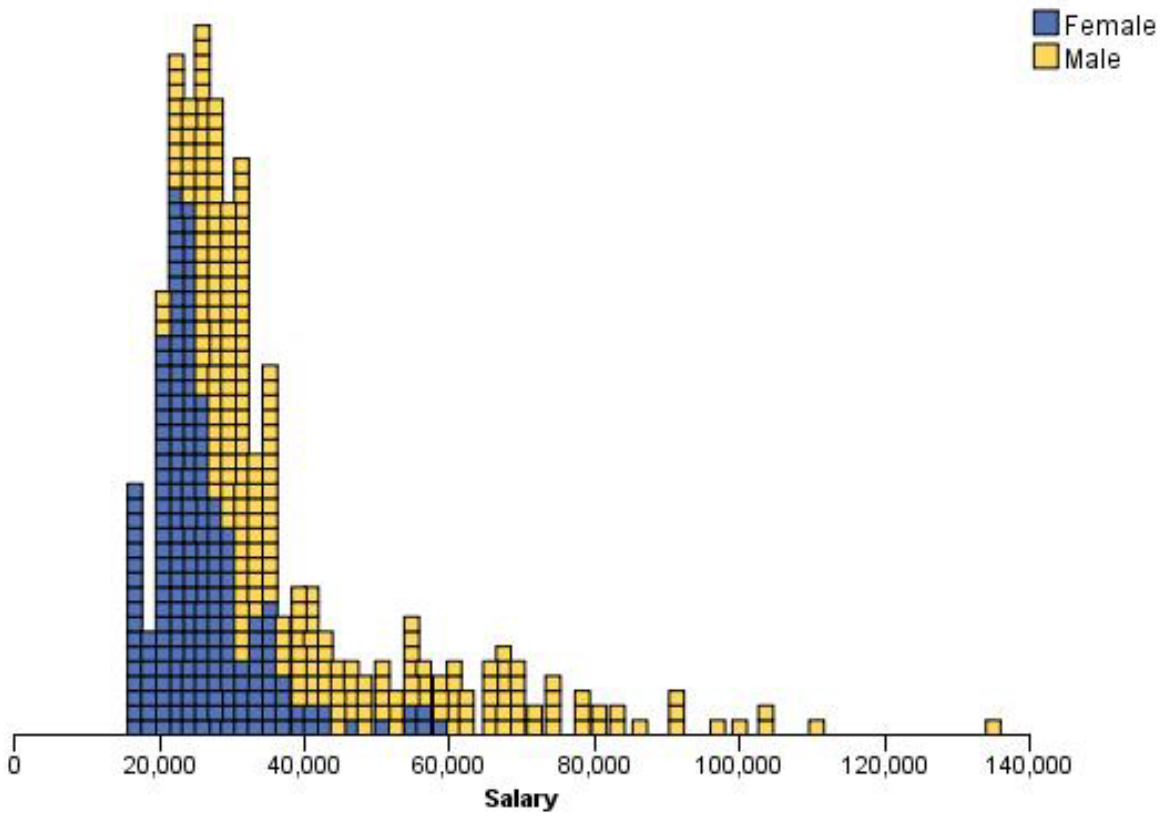



*Figure 449. Grouped dot plot*

## 2-D Dot Plot

```
SOURCE: s = csvSource(file("customer_subset.csv"))
DATA: region = col(source(s), name("region"), unit.category())
DATA: income = col(source(s), name("income"))
GUIDE: axis(dim(1), label("Income"))
GUIDE: axis(dim(2), label("Region"))
ELEMENT: point.dodge.symmetric(position(bin.dot(income*region)))
```

```
SOURCE: s = userSource(id("customer_subset"))
DATA: region = col(source(s), name("region"), unit.category())
DATA: income = col(source(s), name("income"))
GUIDE: axis(dim(1), label("Income"))
GUIDE: axis(dim(2), label("Region"))
ELEMENT: point.dodge.symmetric(position(bin.dot(income*region)))
```

*Figure 450. GPL for 2-D dot plot*

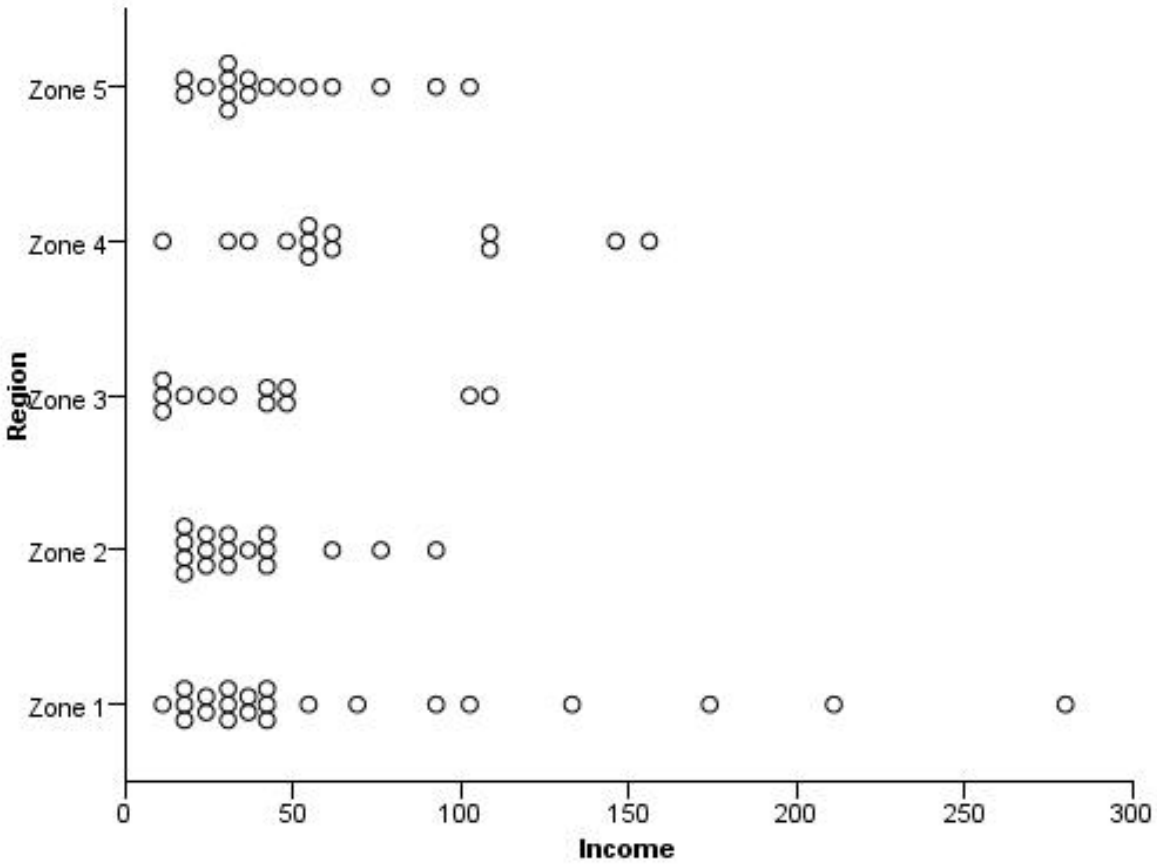



*Figure 451. 2-D dot plot*

```
SOURCE: s = csvSource(file("customer_subset.csv"))
DATA: region = col(source(s), name("region"), unit.category())
DATA: income = col(source(s), name("income"))
GUIDE: axis(dim(1), label("Region"))
GUIDE: axis(dim(2), label("Income"))
ELEMENT: point.dodge.symmetric(position(bin.dot(region*income, dim(2))))
```

```
SOURCE: s = userSource(id("customer_subset"))
DATA: region = col(source(s), name("region"), unit.category())
DATA: income = col(source(s), name("income"))
GUIDE: axis(dim(1), label("Region"))
GUIDE: axis(dim(2), label("Income"))
ELEMENT: point.dodge.symmetric(position(bin.dot(region*income, dim(2))))
```

*Figure 452. GPL for alternate 2-D dot plot*

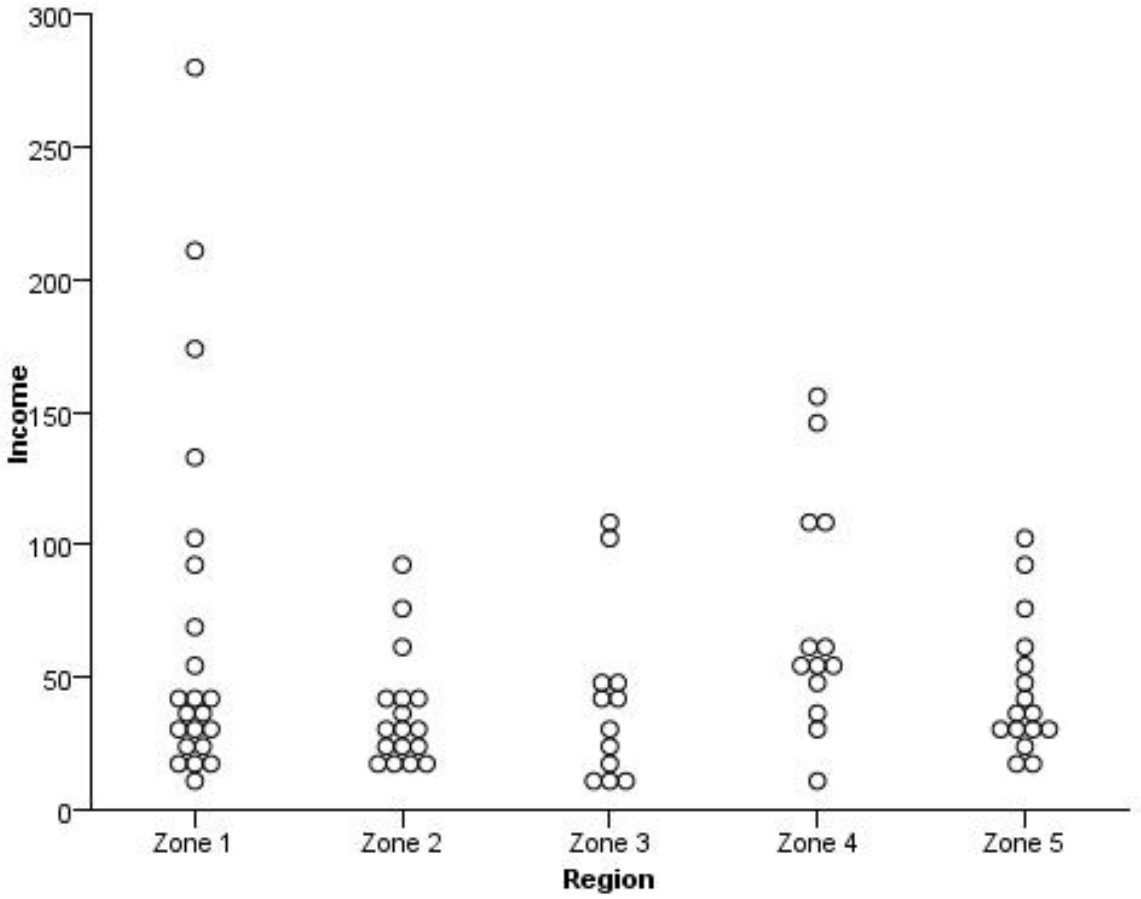



*Figure 453. Alternate 2-D dot plot*

## Jittered Categorical Scatterplot

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
GUIDE: axis(dim(2), label("Gender"))
GUIDE: axis(dim(1), label("Employment Category"))
ELEMENT: point.jitter(position(jobcat*gender))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
GUIDE: axis(dim(2), label("Gender"))
GUIDE: axis(dim(1), label("Employment Category"))
ELEMENT: point.jitter(position(jobcat*gender))
```

*Figure 454. GPL for jittered categorical scatterplot*


*Figure 455. Jittered categorical scatterplot*

## Line Chart Examples

This section provides examples of different types of line charts.

## Simple Line Chart

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: line(position(salbegin*salary))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: line(position(salbegin*salary))
```

*Figure 456. GPL for simple line chart*

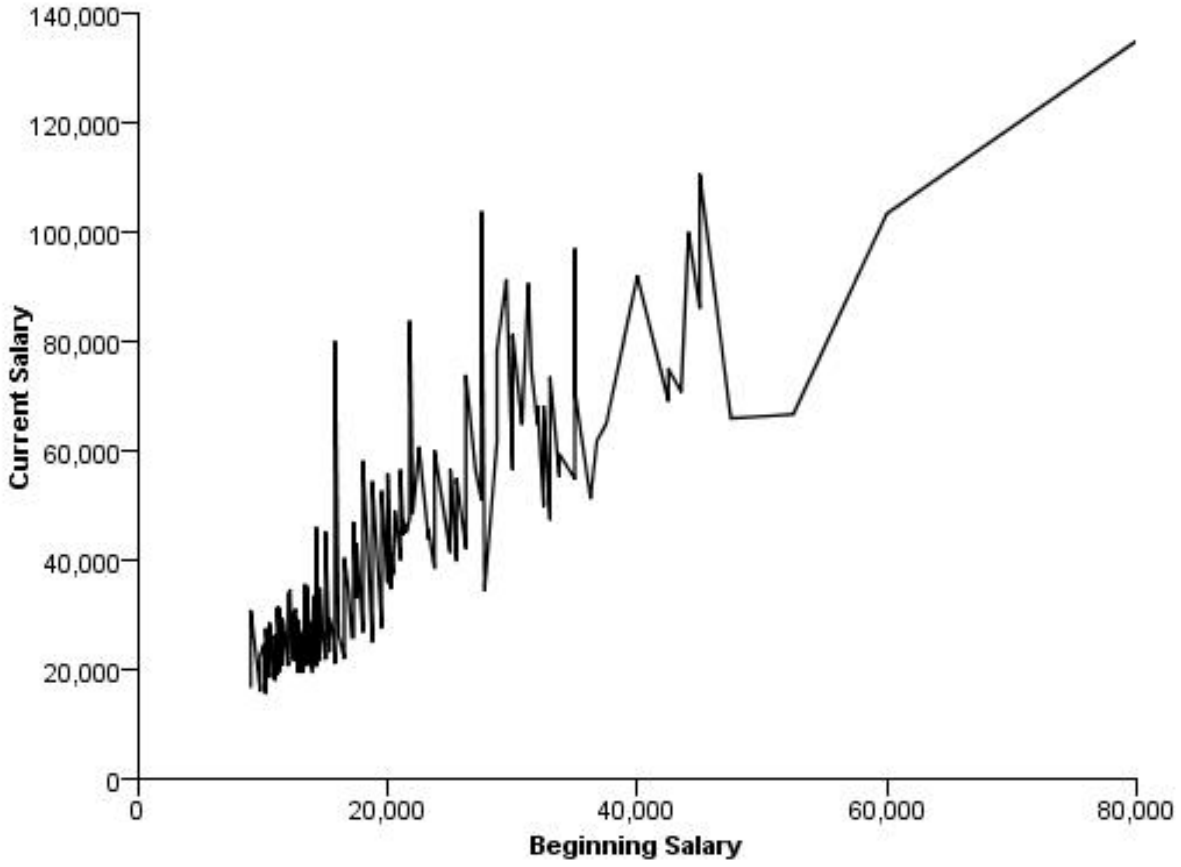



*Figure 457. Simple line chart*

## Simple Line Chart with Points

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: line(position(salbegin*salary))
ELEMENT: point(position(salbegin*salary))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: line(position(salbegin*salary))
ELEMENT: point(position(salbegin*salary))
```

*Figure 458. GPL for simple line chart with points*

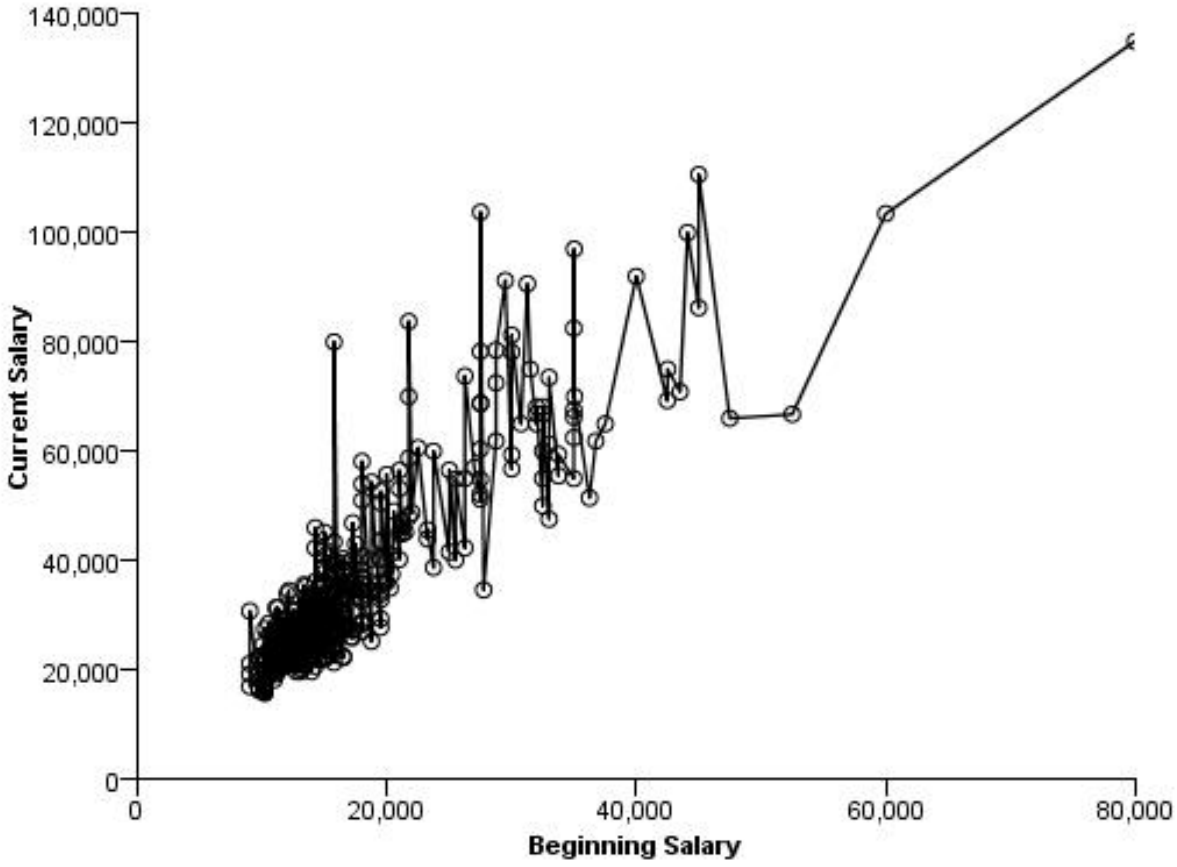



*Figure 459. Simple line chart with points*

## Line Chart of Date Data

```
SOURCE: s = csvSource(file("stocks.csv"))
DATA: Date = col(source(s), name("Date"), unit.time(), format("MM/dd/yy"))
DATA: Close = col(source(s), name("Close"))
GUIDE: axis(dim(1), label("Date"))
GUIDE: axis(dim(2), label("Close"))
SCALE: time(dim(1), dataMaximum())
ELEMENT: line(position(Date*Close))
```

```
SOURCE: s = userSource(id("stocks"))
DATA: Date = col(source(s), name("Date"), unit.time(), format("MM/dd/yy"))
DATA: Close = col(source(s), name("Close"))
GUIDE: axis(dim(1), label("Date"))
GUIDE: axis(dim(2), label("Close"))
SCALE: time(dim(1), dataMaximum())
ELEMENT: line(position(Date*Close))
```

*Figure 460. GPL for line chart of date data*

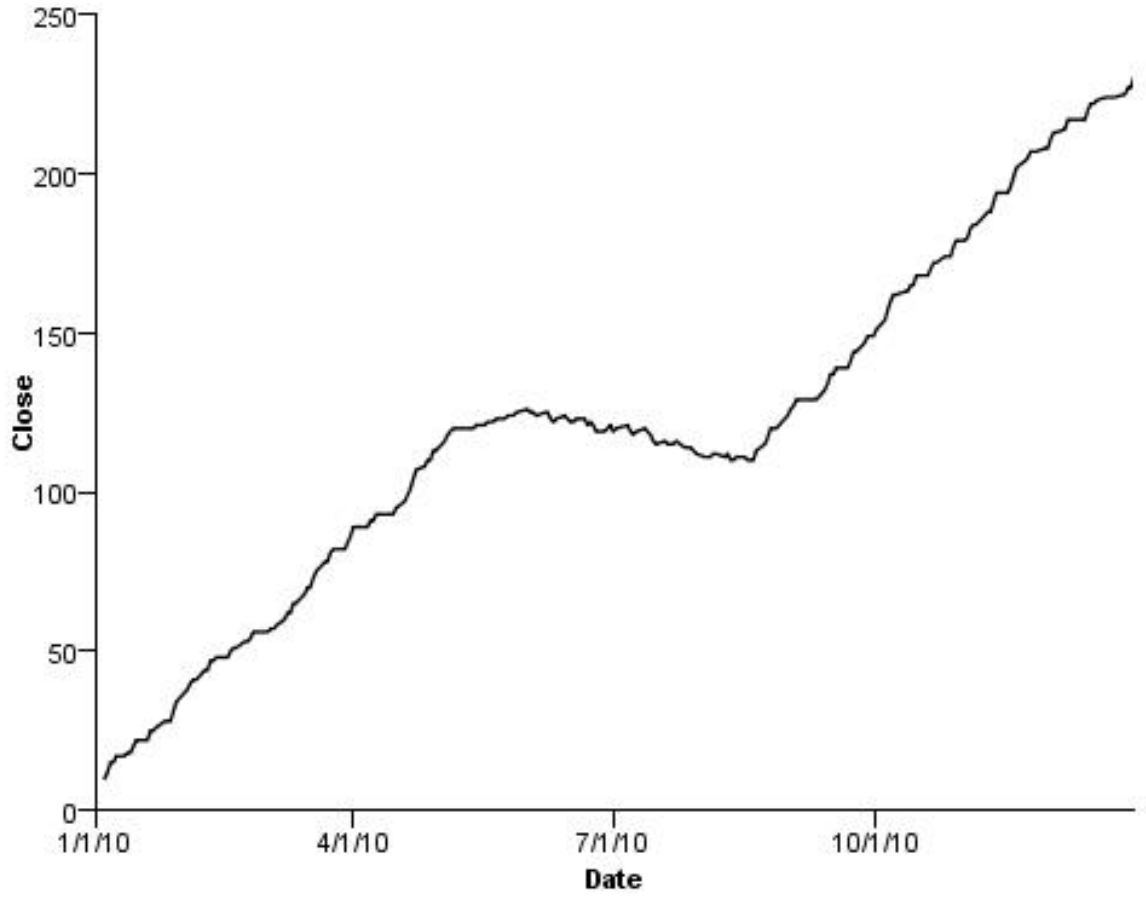



*Figure 461. Line chart of date data*

## Line Chart With Step Interpolation

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: line(position(smooth.step.center(salbegin*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: line(position(smooth.step.center(salbegin*salary)))
```

*Figure 462. GPL for line chart with step interpolation*

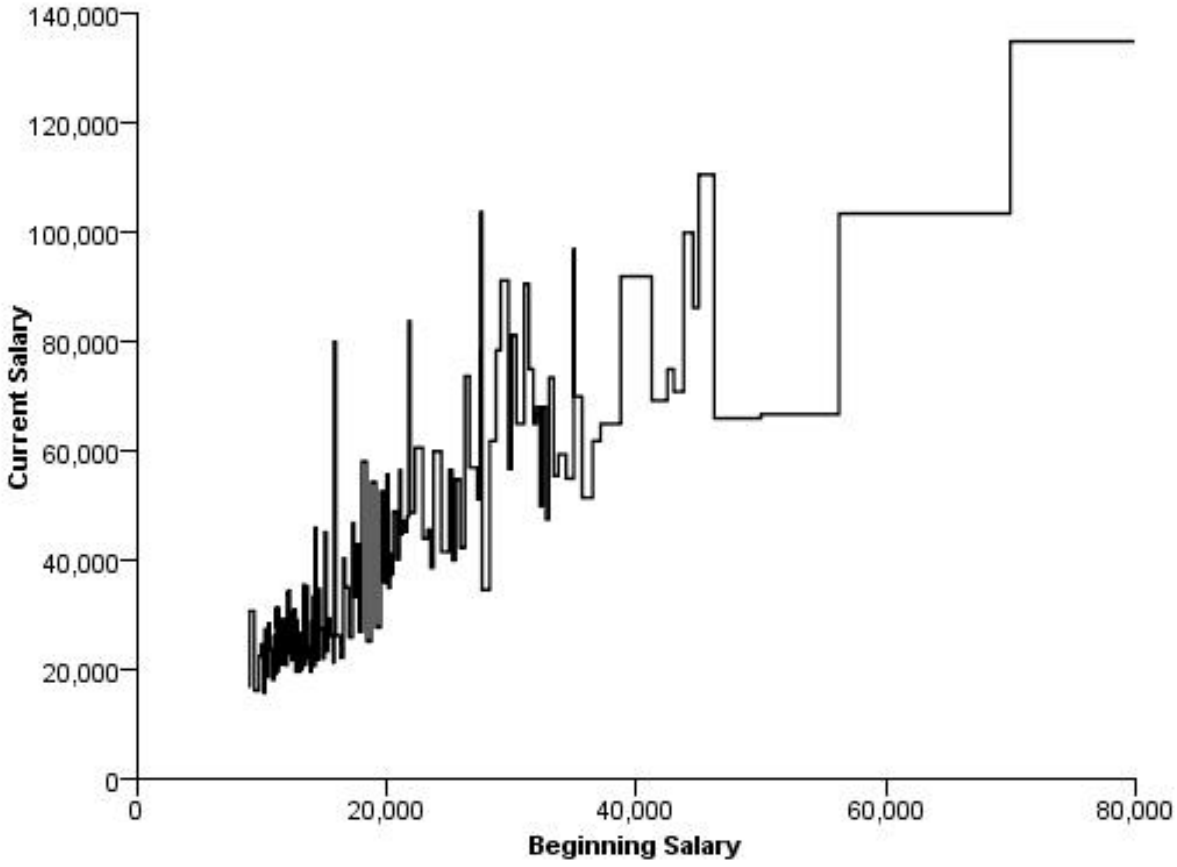



*Figure 463. Line chart with step interpolation*

## Fit Line

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary))
ELEMENT: line(position(smooth.linear(salbegin*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary))
ELEMENT: line(position(smooth.linear(salbegin*salary)))
```

*Figure 464. GPL for linear fit line overlaid on scatterplot*

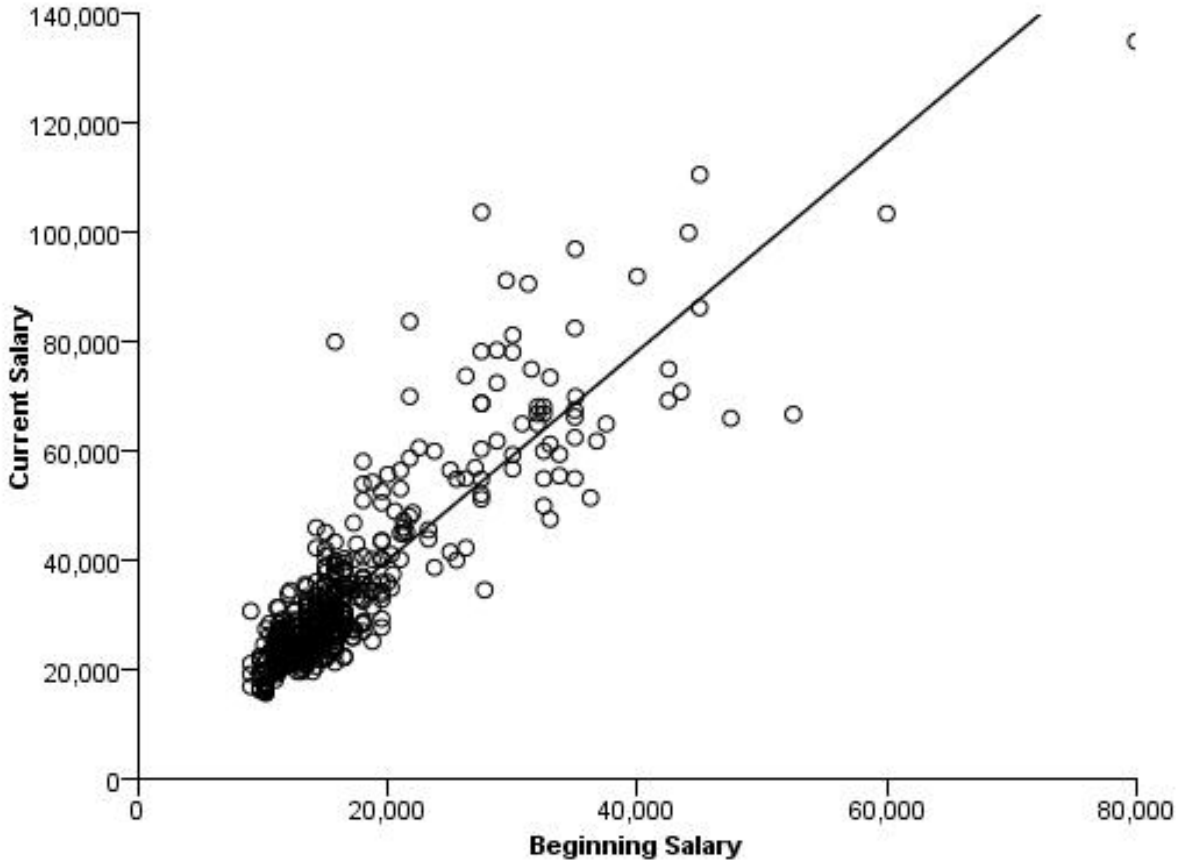



*Figure 465. Linear fit line overlaid on scatterplot*

## Line Chart from Equation

```
DATA: x = iter(0,10,0.01)
TRANS: y = eval(sin(x)*cos(x)*(x-5))
ELEMENT: line(position(x*y))
```

*Figure 466. GPL for line chart from equation*

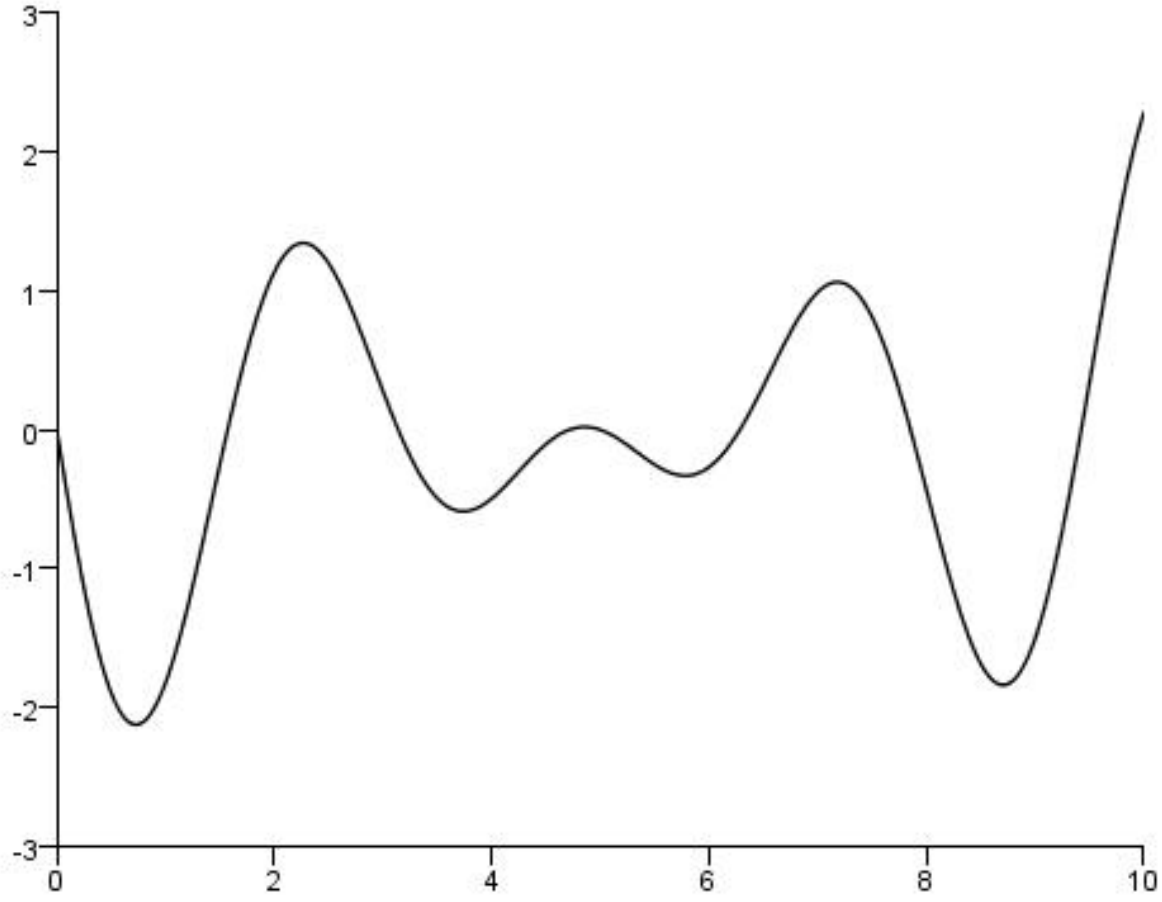



*Figure 467. Line chart from equation*

```
DATA: x = iter(0,6.28,0.01)
TRANS: y = eval(cos(6*x))
COORD: polar()
SCALE: linear(dim(1), min(0.0), max(6.28))
GUIDE: axis(dim(2), null())
ELEMENT: line(position(x*y))
```

*Figure 468. GPL for line chart from equation in polar coordinates*

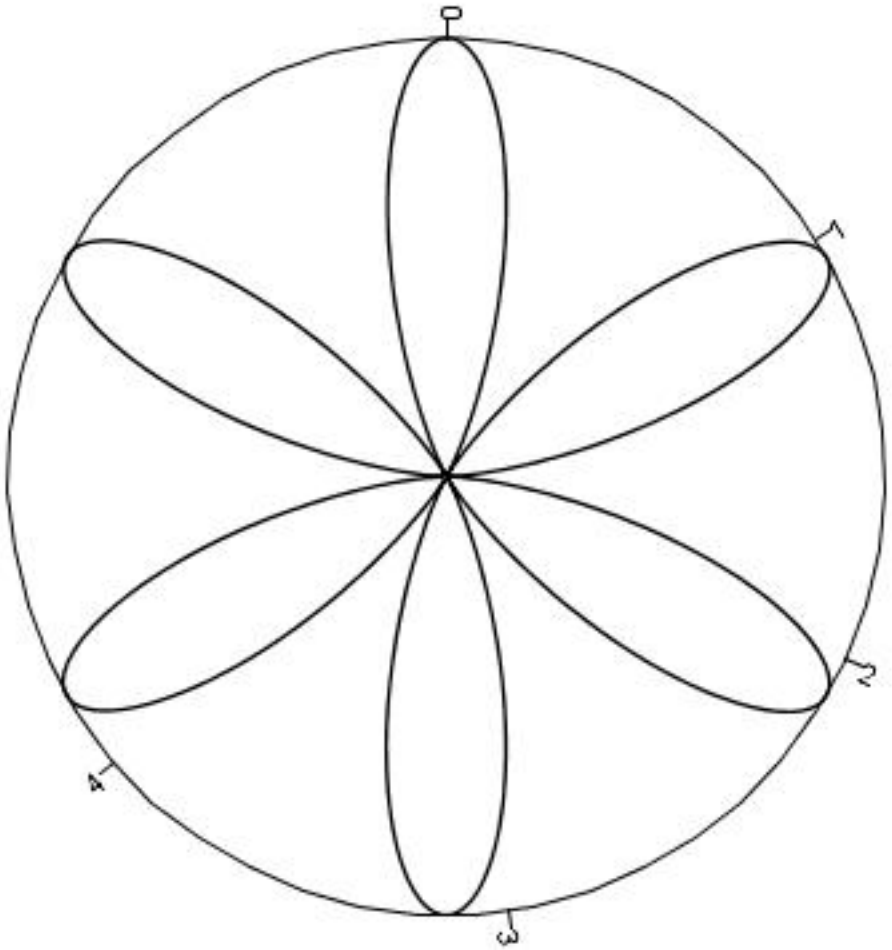


*Figure 469. Line chart from equation in polar coordinates*

## Line Chart with Separate Scales

```
SOURCE: s = csvSource(file("stocks.csv"))
DATA: date = col(source(s), name("Date"), unit.time(), format("MM/dd/yy"))
DATA: close = col(source(s), name("Close"))
DATA: volume = col(source(s), name("Volume"))
SCALE: time(dim(1), dataMaximum())
ELEMENT: line(position(date*(close/"Close"+volume/"Volume")))
```

```
SOURCE: s = userSource(id("stocks"))
DATA: date = col(source(s), name("Date"), unit.time(), format("MM/dd/yy"))
DATA: close = col(source(s), name("Close"))
DATA: volume = col(source(s), name("Volume"))
SCALE: time(dim(1), dataMaximum())
ELEMENT: line(position(date*(close/"Close"+volume/"Volume")))
```

*Figure 470. GPL for line chart with separate scales*

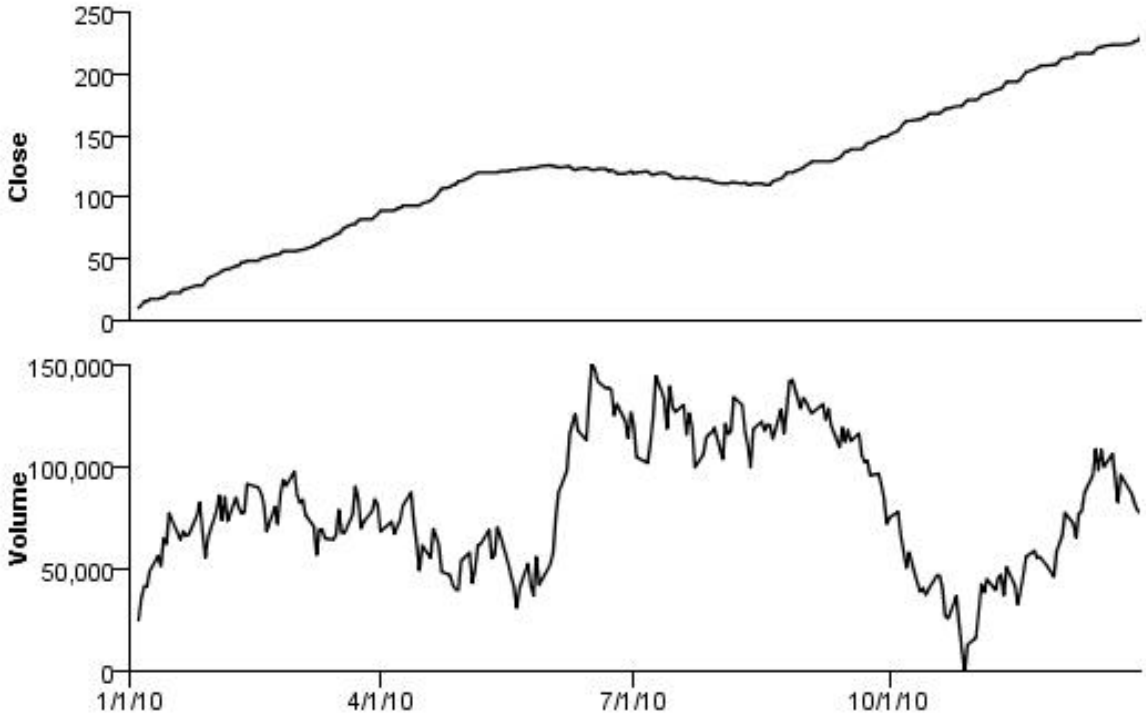



*Figure 471. Line chart with separate scales*

## Pie Chart Examples

This section provides examples of different types of pie charts.

## Pie Chart

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
COORD: polar.theta()
SCALE: linear(dim(1), dataMinimum(), dataMaximum())
GUIDE: axis(dim(1), null())
ELEMENT: interval.stack(position(summary.count(1)), color(jobcat))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
COORD: polar.theta()
SCALE: linear(dim(1), dataMinimum(), dataMaximum())
GUIDE: axis(dim(1), null())
ELEMENT: interval.stack(position(summary.count(1)), color(jobcat))
```

*Figure 472. GPL for pie chart*

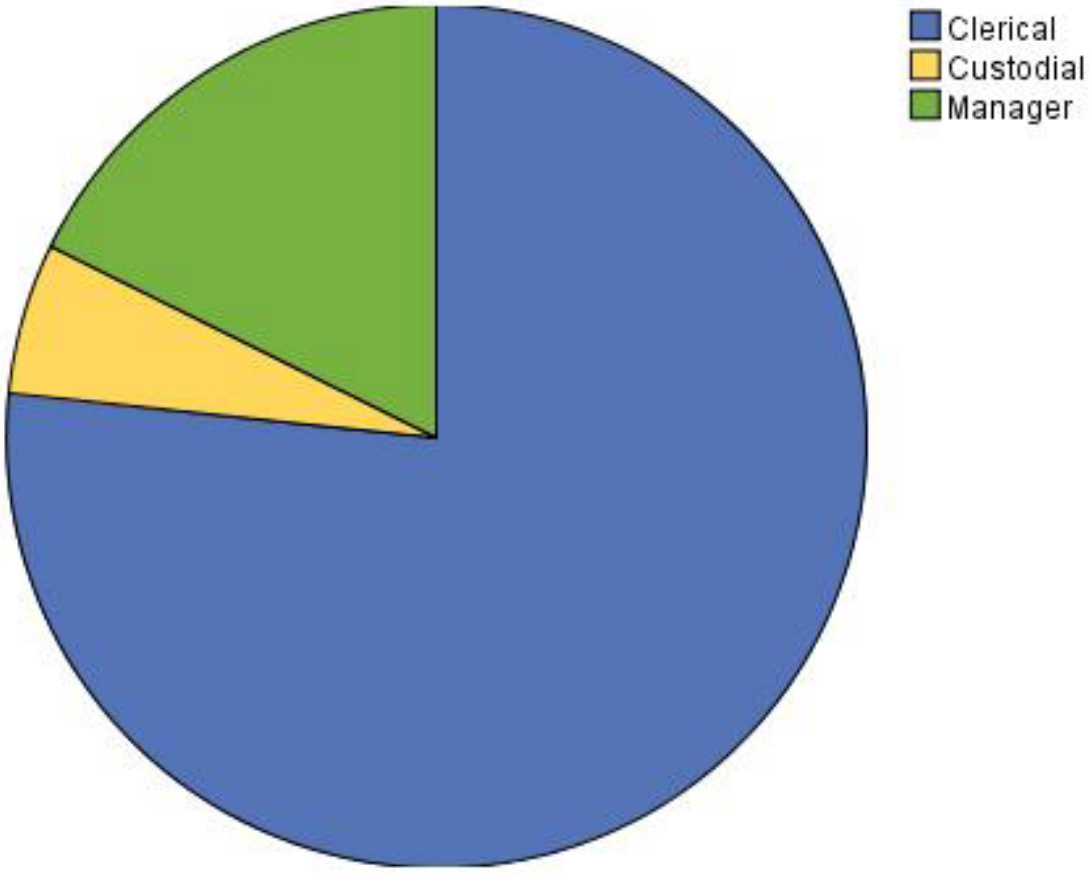



*Figure 473. Pie chart*

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
COORD: polar.theta()
SCALE: linear(dim(1), dataMinimum(), dataMaximum())
GUIDE: axis(dim(1), null())
GUIDE: legend(aesthetic(aesthetic.color), null())
ELEMENT: interval.stack(position(summary.count(1)), color(jobcat),
                        label(jobcat))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
COORD: polar.theta()
SCALE: linear(dim(1), dataMinimum(), dataMaximum())
GUIDE: axis(dim(1), null())
GUIDE: legend(aesthetic(aesthetic.color), null())
ELEMENT: interval.stack(position(summary.count(1)), color(jobcat),
                        label(jobcat))
```

*Figure 474. GPL for pie chart with labels*

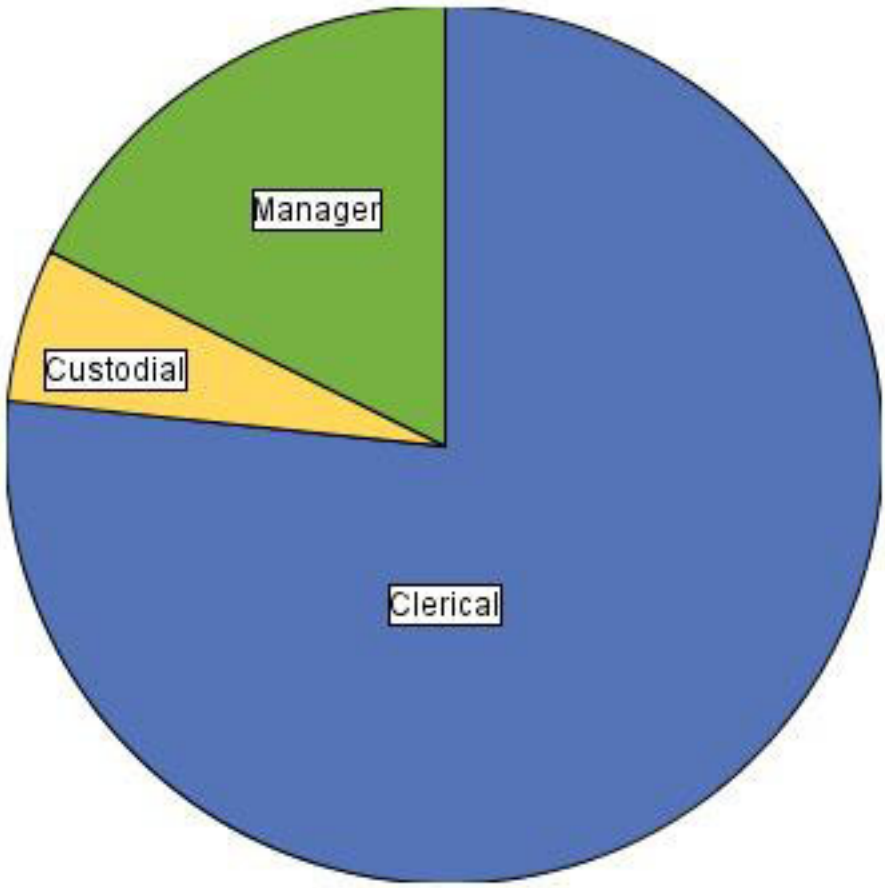



*Figure 475. Pie chart with labels*

## Paneled Pie Chart

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
COORD: polar.theta()
SCALE: linear(dim(1), dataMinimum(), dataMaximum())
GUIDE: axis(dim(1), null())
GUIDE: axis(dim(2), label("Gender"))
ELEMENT: interval.stack(position(summary.percent.count(1*gender))),
                        color(jobcat))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
COORD: polar.theta()
SCALE: linear(dim(1), dataMinimum(), dataMaximum())
GUIDE: axis(dim(1), null())
GUIDE: axis(dim(2), label("Gender"))
ELEMENT: interval.stack(position(summary.percent.count(1*gender))),
                        color(jobcat))
```

*Figure 476. GPL for paneled pie chart*

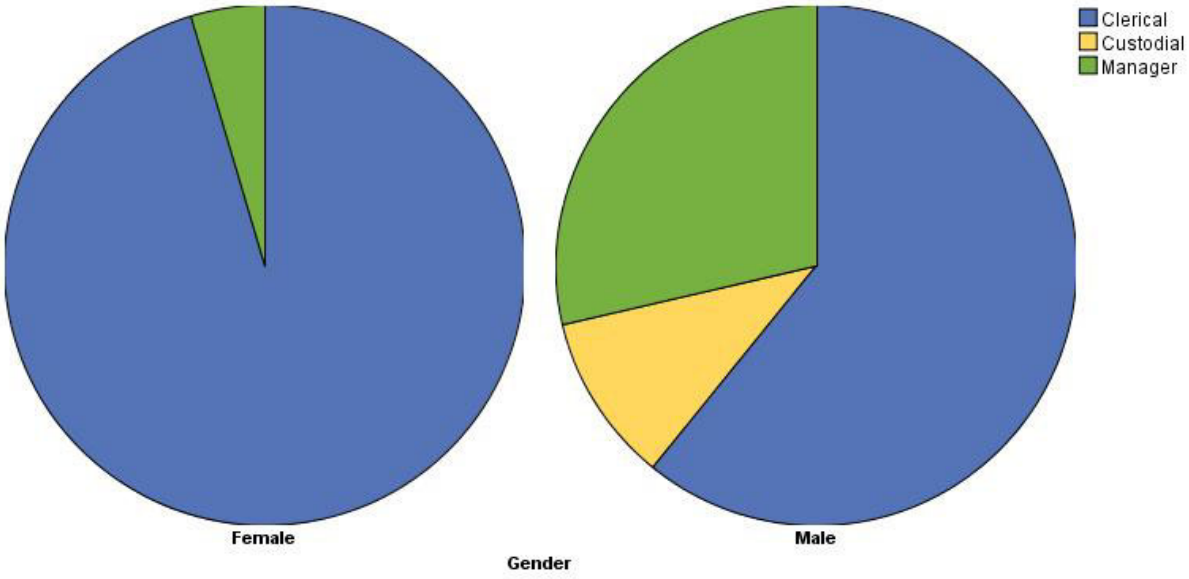



*Figure 477. Paneled pie chart*

## Stacked Pie Chart

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
COORD: polar(transpose())
GUIDE: axis(dim(1), null())
GUIDE: axis(dim(2), null())
GUIDE: legend(aesthetic(aesthetic.texture.pattern.interior), label("Employment Category"))
GUIDE: legend(aesthetic(aesthetic.color.interior), label("Gender"))
ELEMENT: interval.stack(position(summary.percent.count(jobcat*1, base.coordinate(dim(1)))),
                        texture.pattern(jobcat), color(gender), size(size."100%"))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
COORD: polar(transpose())
GUIDE: axis(dim(1), null())
GUIDE: axis(dim(2), null())
GUIDE: legend(aesthetic(aesthetic.texture.pattern.interior), label("Employment Category"))
GUIDE: legend(aesthetic(aesthetic.color.interior), label("Gender"))
ELEMENT: interval.stack(position(summary.percent.count(jobcat*1, base.coordinate(dim(1)))),
                        texture.pattern(jobcat), color(gender), size(size."100%"))
```

*Figure 478. GPL for stacked pie chart*

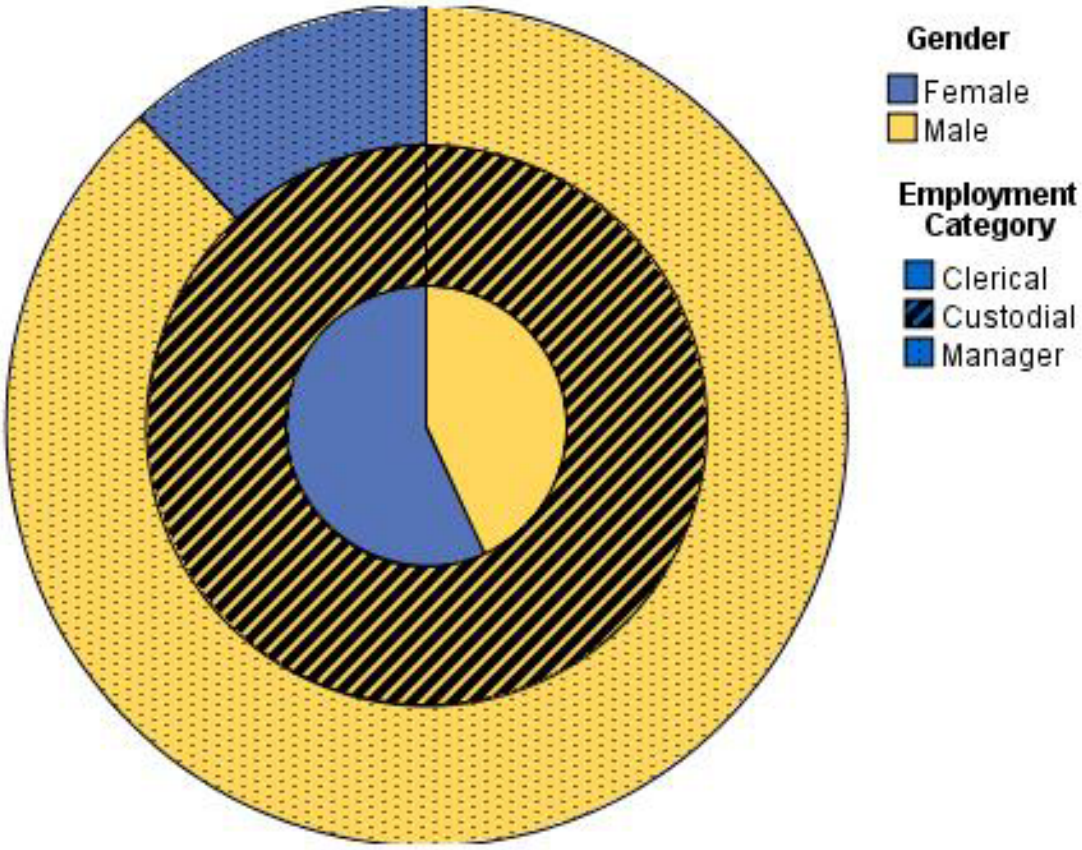



*Figure 479. Stacked pie chart*

## Boxplot Examples

This section provides examples of different types of box plots.

## 1-D Boxplot

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
COORD: rect(dim(1))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: schema(position(bin.quantile.letter(salary)), size(size."50%"))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
COORD: rect(dim(1))
GUIDE: axis(dim(1), label("Salary"))
ELEMENT: schema(position(bin.quantile.letter(salary)), size(size."50%"))
```

*Figure 480. GPL for 1-D box plot*

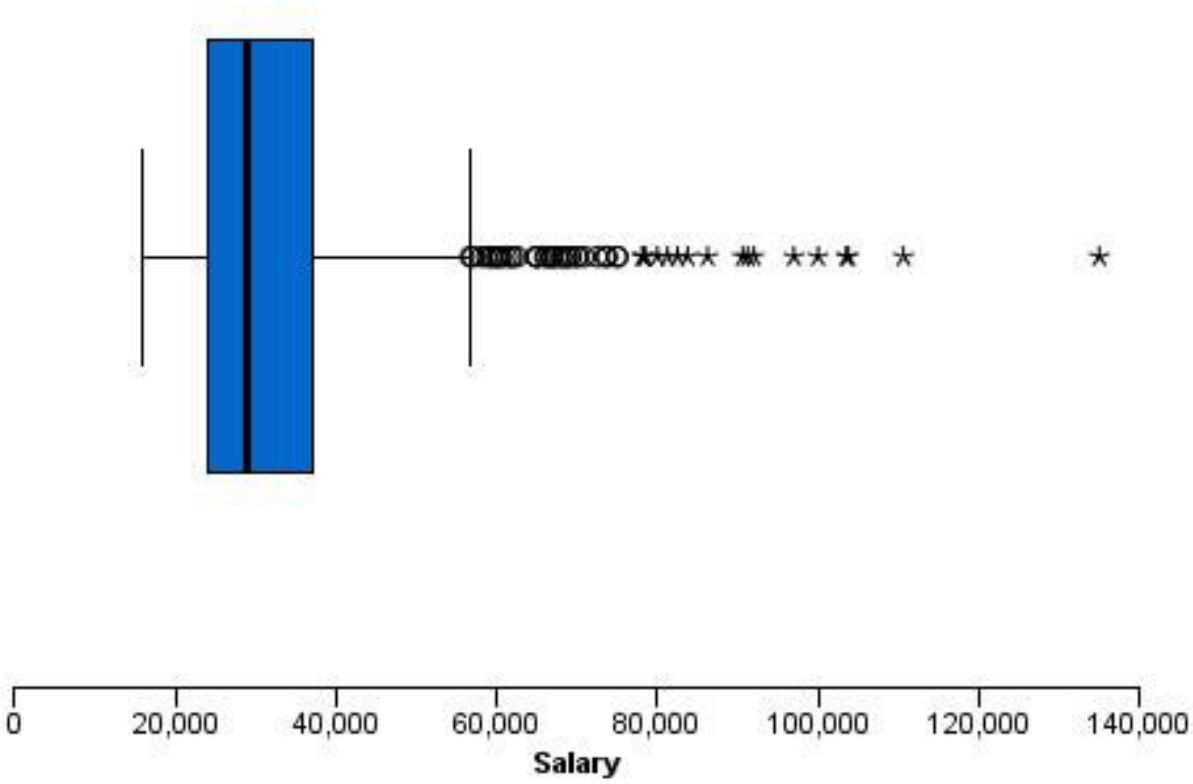



*Figure 481. 1-D boxplot*

## Boxplot

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: schema(position(bin.quantile.letter(jobcat*salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
GUIDE: axis(dim(2), label("Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: schema(position(bin.quantile.letter(jobcat*salary)))
```

*Figure 482. GPL for boxplot*

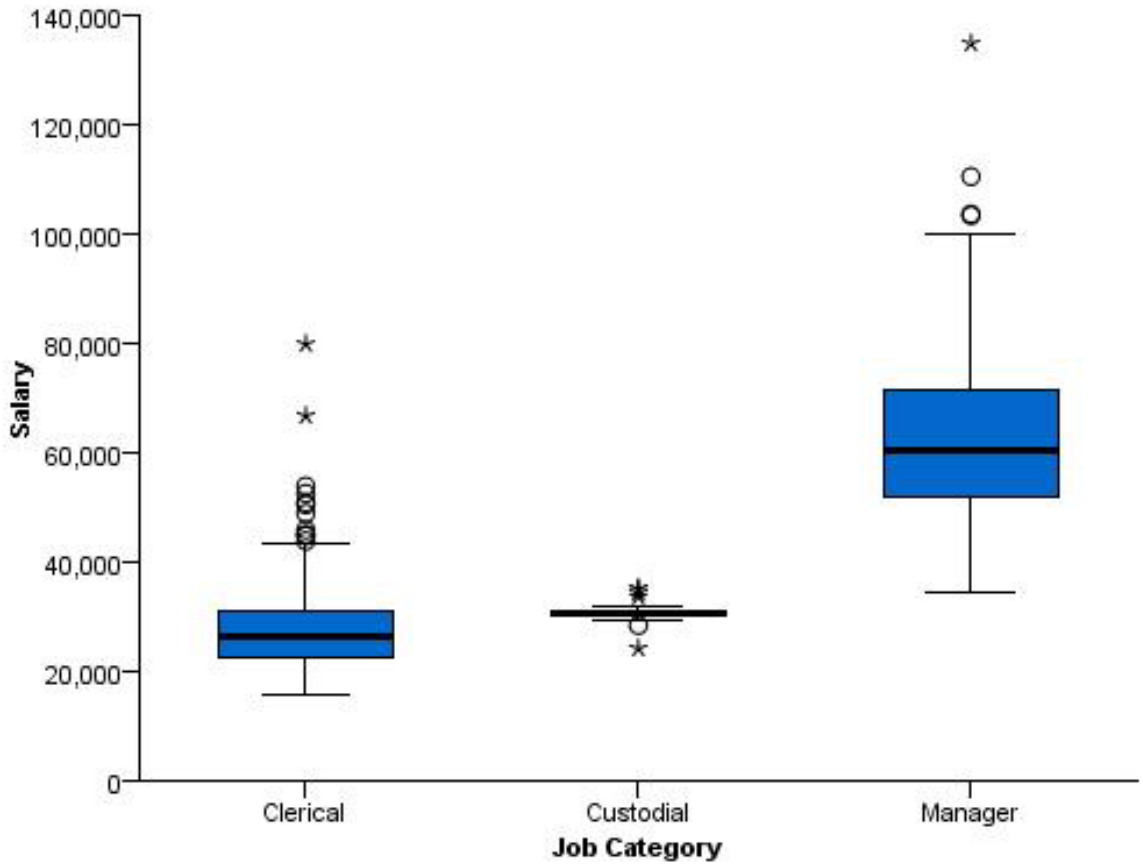



*Figure 483. Boxplot*

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
DATA: id = col(source(s), name("id"), unit.category())
GUIDE: axis(dim(2), label("Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: schema(position(bin.quantile.letter(jobcat*salary)), label(id))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: salary=col(source(s), name("salary"))
DATA: id = col(source(s), name("id"), unit.category())
GUIDE: axis(dim(2), label("Salary"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: schema(position(bin.quantile.letter(jobcat*salary)), label(id))
```

*Figure 484. GPL for boxplot with labeled outliers*

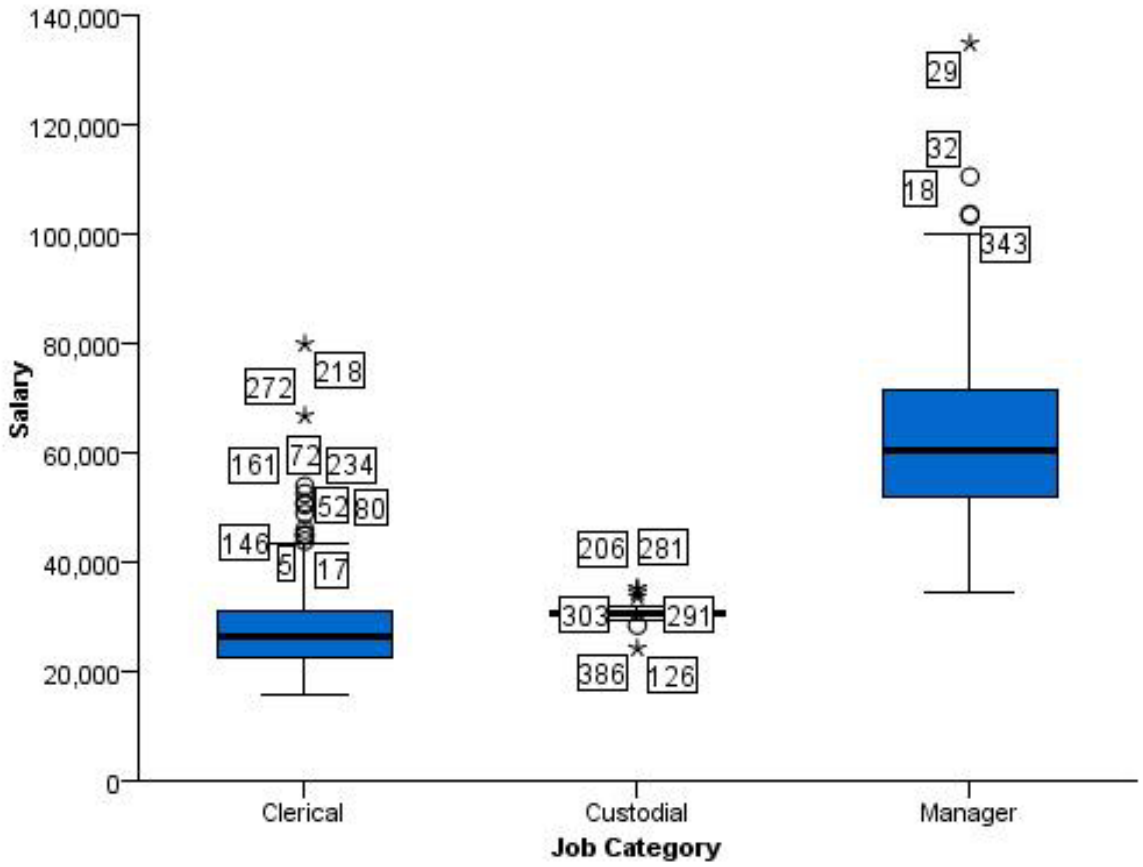



*Figure 485. Boxplot with labeled outliers*

## Clustered Boxplot

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2), cluster(3))
GUIDE: axis(dim(2), label("Salary"))
GUIDE: axis(dim(3), label("Job Category"))
ELEMENT: schema(position(bin.quantile.letter(gender*salary*jobcat)), color(gender))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat=col(source(s), name("jobcat"), unit.category())
DATA: gender=col(source(s), name("gender"), unit.category())
DATA: salary=col(source(s), name("salary"))
COORD: rect(dim(1,2), cluster(3))
GUIDE: axis(dim(2), label("Salary"))
GUIDE: axis(dim(3), label("Job Category"))
ELEMENT: schema(position(bin.quantile.letter(gender*salary*jobcat)), color(gender))
```

*Figure 486. GPL for clustered boxplot*

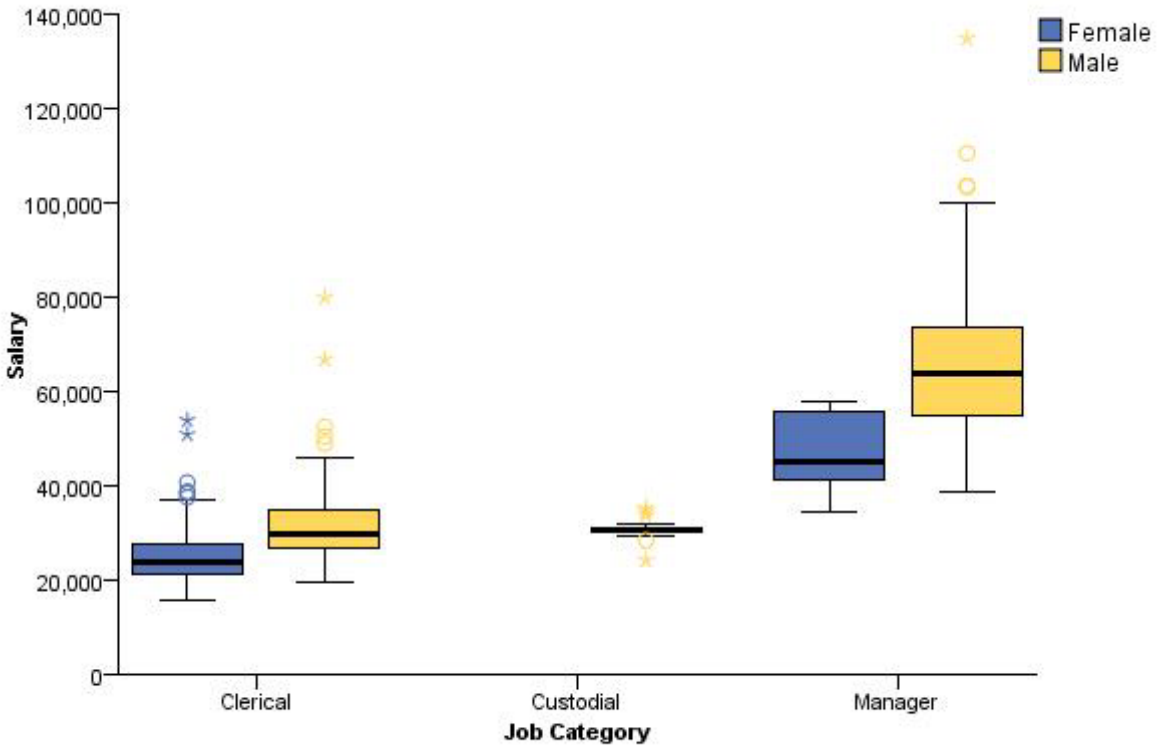



*Figure 487. Clustered boxplot*

## Boxplot With Overlaid Dot Plot

```
SOURCE: s = csvSource(file("customer_subset.csv"))
DATA: region = col(source(s), name("region"), unit.category())
DATA: income = col(source(s), name("income"))
GUIDE: axis(dim(2), label("Income"))
GUIDE: axis(dim(1), label("Region"))
SCALE: linear(dim(2), include(0))
ELEMENT: schema(position(bin.quantile.letter(region*income)))
ELEMENT: point.dodge.symmetric(position(bin.dot(region*income, dim(2))),
                               color(color.red))
```

```
SOURCE: s = userSource(id("customer_subset"))
DATA: region = col(source(s), name("region"), unit.category())
DATA: income = col(source(s), name("income"))
GUIDE: axis(dim(2), label("Income"))
GUIDE: axis(dim(1), label("Region"))
SCALE: linear(dim(2), include(0))
ELEMENT: schema(position(bin.quantile.letter(region*income)))
ELEMENT: point.dodge.symmetric(position(bin.dot(region*income, dim(2))),
                               color(color.red))
```

*Figure 488. GPL for boxplot with overlaid dot plot*

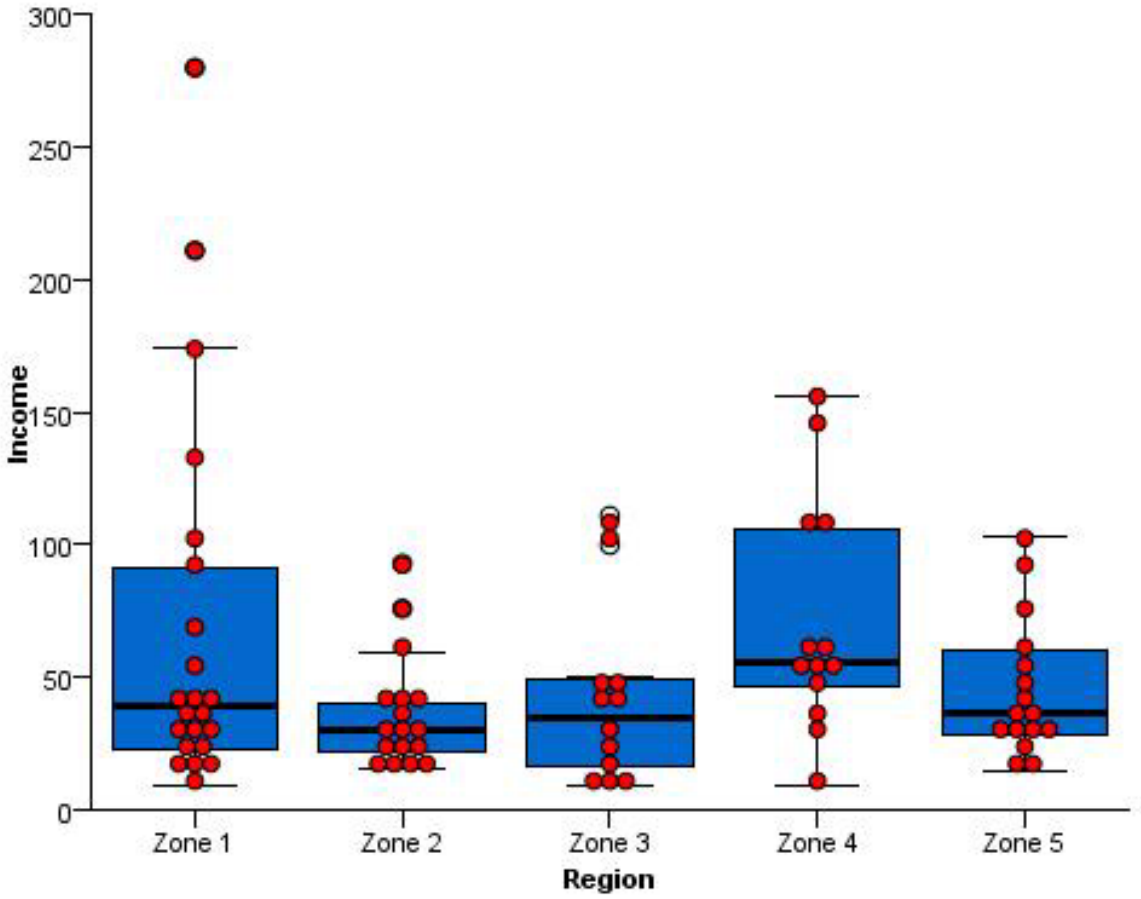



*Figure 489. Boxplot with overlaid dot plot*

## Multi-Graph Examples

This section provides examples of multiple graphs in the same page display.

# Scatterplot with Border Histograms

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
DATA: salbegin = col(source(s), name("salbegin"))
GRAPH: begin(origin(5%, 10%), scale(85%, 85%))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: axis(dim(2), label("Current Salary"))
ELEMENT: point(position(salbegin*salary))
GRAPH: end()
GRAPH: begin(origin(5%, 0%), scale(85%, 10%))
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), null())
ELEMENT: interval(position(summary.count(bin.rect(salbegin))))
GRAPH: end()
GRAPH: begin(origin(90%, 10%), scale(10%, 85%))
COORD: rect(dim(1, 2), transpose())
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), null())
ELEMENT: interval(position(summary.count(bin.rect(salary))))
GRAPH: end()
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
DATA: salbegin = col(source(s), name("salbegin"))
GRAPH: begin(origin(5%, 10%), scale(85%, 85%))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: axis(dim(2), label("Current Salary"))
ELEMENT: point(position(salbegin*salary))
GRAPH: end()
GRAPH: begin(origin(5%, 0%), scale(85%, 10%))
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), null())
ELEMENT: interval(position(summary.count(bin.rect(salbegin))))
GRAPH: end()
GRAPH: begin(origin(90%, 10%), scale(10%, 85%))
COORD: rect(dim(1, 2), transpose())
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), null())
ELEMENT: interval(position(summary.count(bin.rect(salary))))
GRAPH: end()
```

*Figure 490. GPL for scatterplot with border histograms*

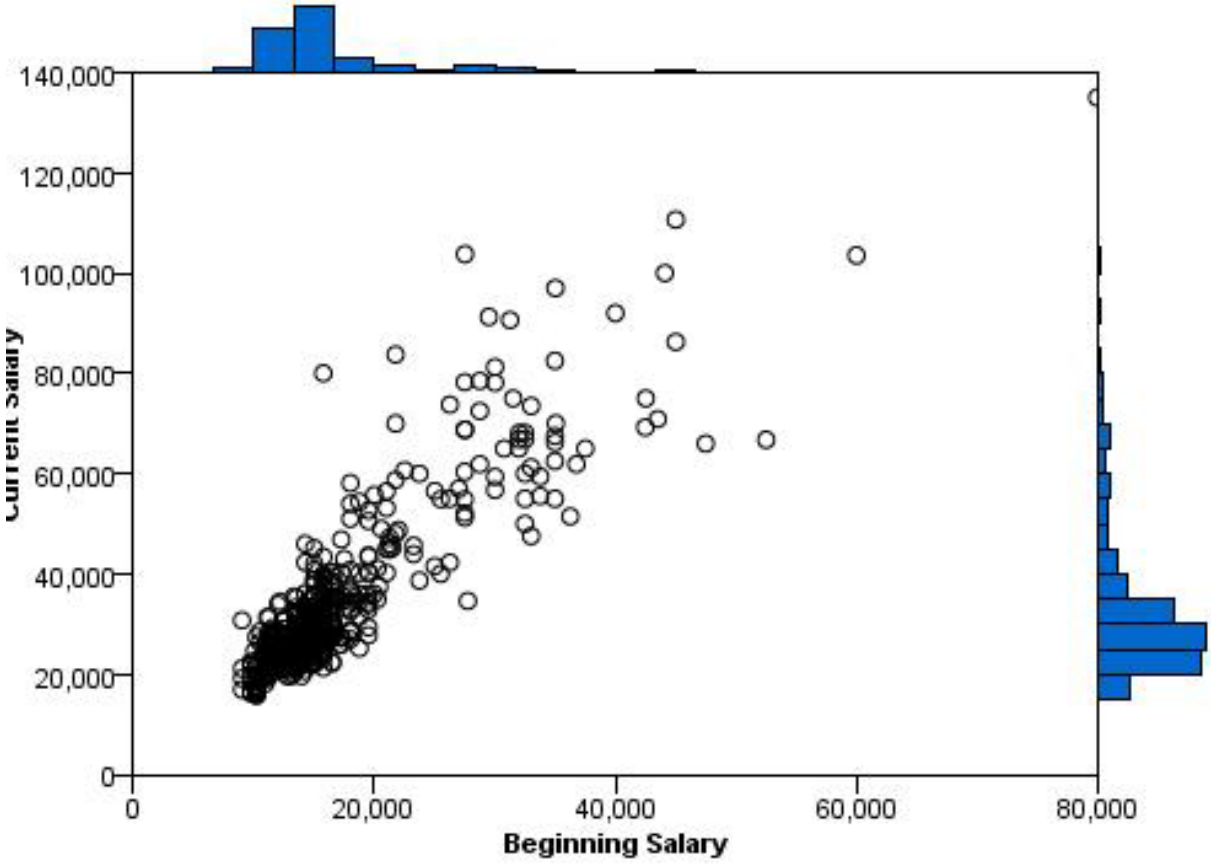



*Figure 491. Scatterplot with border histograms*

# Scatterplot with Border Boxplots

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
DATA: salbegin = col(source(s), name("salbegin"))
GRAPH: begin(origin(5%, 10%), scale(85%, 85%))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: axis(dim(2), label("Current Salary"))
ELEMENT: point(position(salbegin*salary))
GRAPH: end()
GRAPH: begin(origin(5%, 0%), scale(85%, 10%))
COORD: rect(dim(1))
GUIDE: axis(dim(1), ticks(null()))
ELEMENT: schema(position(bin.quantile.letter(salbegin)), size(size."80%"))
GRAPH: end()
GRAPH: begin(origin(90%, 10%), scale(10%, 85%))
COORD: transpose(rect(dim(1)))
GUIDE: axis(dim(1), ticks(null()))
ELEMENT: schema(position(bin.quantile.letter(salary)), size(size."80%"))
GRAPH: end()
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
DATA: salbegin = col(source(s), name("salbegin"))
GRAPH: begin(origin(5%, 10%), scale(85%, 85%))
GUIDE: axis(dim(1), label("Beginning Salary"))
GUIDE: axis(dim(2), label("Current Salary"))
ELEMENT: point(position(salbegin*salary))
GRAPH: end()
GRAPH: begin(origin(5%, 0%), scale(85%, 10%))
COORD: rect(dim(1))
GUIDE: axis(dim(1), ticks(null()))
ELEMENT: schema(position(bin.quantile.letter(salbegin)), size(size."80%"))
GRAPH: end()
GRAPH: begin(origin(90%, 10%), scale(10%, 85%))
COORD: transpose(rect(dim(1)))
GUIDE: axis(dim(1), ticks(null()))
ELEMENT: schema(position(bin.quantile.letter(salary)), size(size."80%"))
GRAPH: end()
```

*Figure 492. GPL for scatterplot with border boxplots*

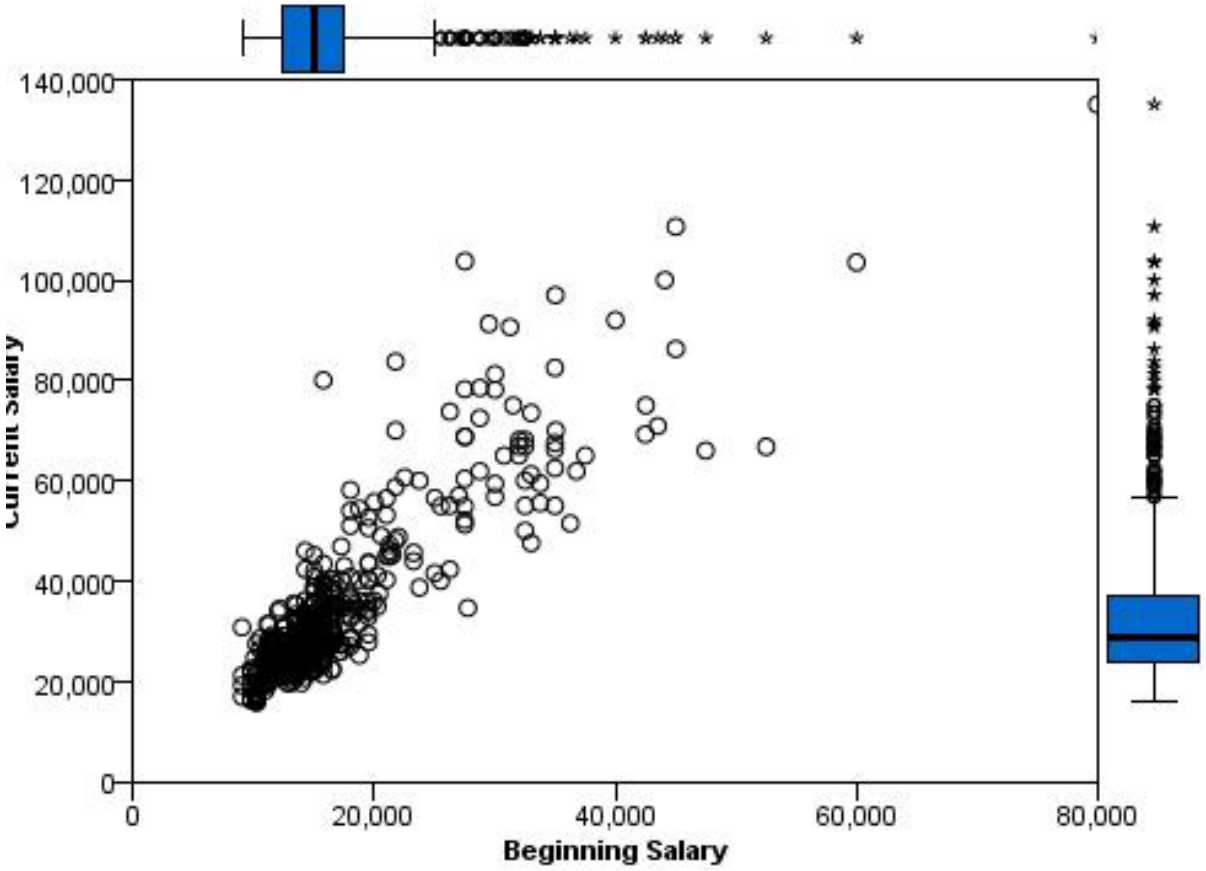



*Figure 493. Scatterplot with border boxplots*

# Stocks Line Chart with Volume Bar Chart

```
SOURCE: s = csvSource(file("stocks.csv"))
DATA: date = col(source(s), name("Date"), unit.time(), format("MM/dd/yy"))
DATA: close = col(source(s), name("Close"))
DATA: volume = col(source(s), name("Volume"))
GRAPH: begin(origin(10%, 0%), scale(90%, 60%))
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), label("Close"))
ELEMENT: line(position(date*close))
GRAPH: end()
GRAPH: begin(origin(10%, 70%), scale(90%, 25%))
GUIDE: axis(dim(1), label("Date"))
GUIDE: axis(dim(2), label("Volume"))
ELEMENT: interval(position(date*volume))
GRAPH: end()
```

```
SOURCE: s = userSource(id("stocks"))
DATA: date = col(source(s), name("Date"), unit.time(), format("MM/dd/yy"))
DATA: close = col(source(s), name("Close"))
DATA: volume = col(source(s), name("Volume"))
GRAPH: begin(origin(10%, 0%), scale(90%, 60%))
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), label("Close"))
ELEMENT: line(position(date*close))
GRAPH: end()
GRAPH: begin(origin(10%, 70%), scale(90%, 25%))
GUIDE: axis(dim(1), label("Date"))
GUIDE: axis(dim(2), label("Volume"))
ELEMENT: interval(position(date*volume))
GRAPH: end()
```

*Figure 494. GPL for stocks and volume chart*

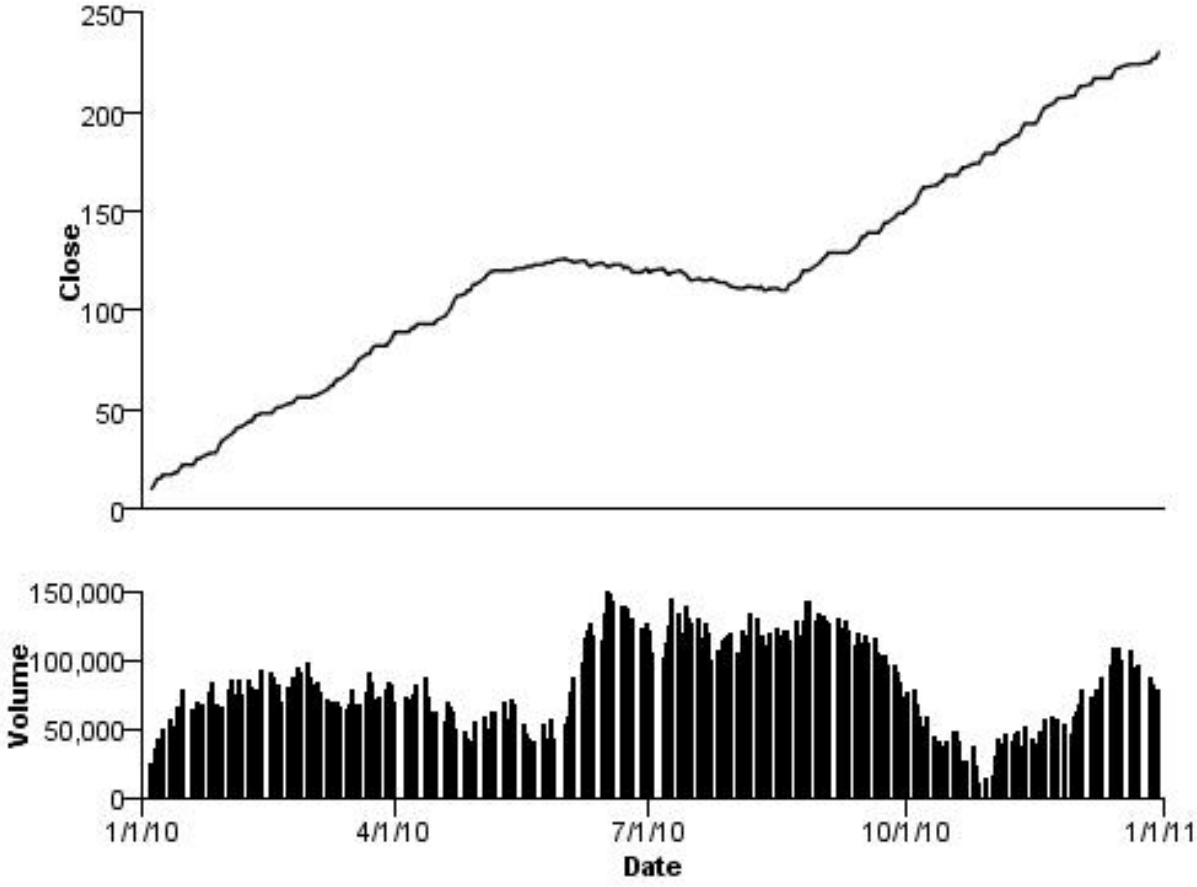



*Figure 495. Stocks and volume chart*

## Dual Axis Graph

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: y1 = linear(dim(2), include(0.0))
SCALE: y2 = linear(dim(2), include(0.0))
GUIDE: axis(dim(1), label("Employment Category"))
GUIDE: axis(scale(y1), label("Mean Salary"))
GUIDE: axis(scale(y2), label("Count"), opposite(), color(color.red))
ELEMENT: interval(position(summary.mean(jobcat*salary)), scale(y1))
ELEMENT: line(position(summary.count(jobcat)), color(color.red), scale(y2))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: salary = col(source(s), name("salary"))
SCALE: y1 = linear(dim(2), include(0.0))
SCALE: y2 = linear(dim(2), include(0.0))
GUIDE: axis(dim(1), label("Employment Category"))
GUIDE: axis(scale(y1), label("Mean Salary"))
GUIDE: axis(scale(y2), label("Count"), opposite(), color(color.red))
ELEMENT: interval(position(summary.mean(jobcat*salary)), scale(y1))
ELEMENT: line(position(summary.count(jobcat)), color(color.red), scale(y2))
```

*Figure 496. GPL for dual axis graph*

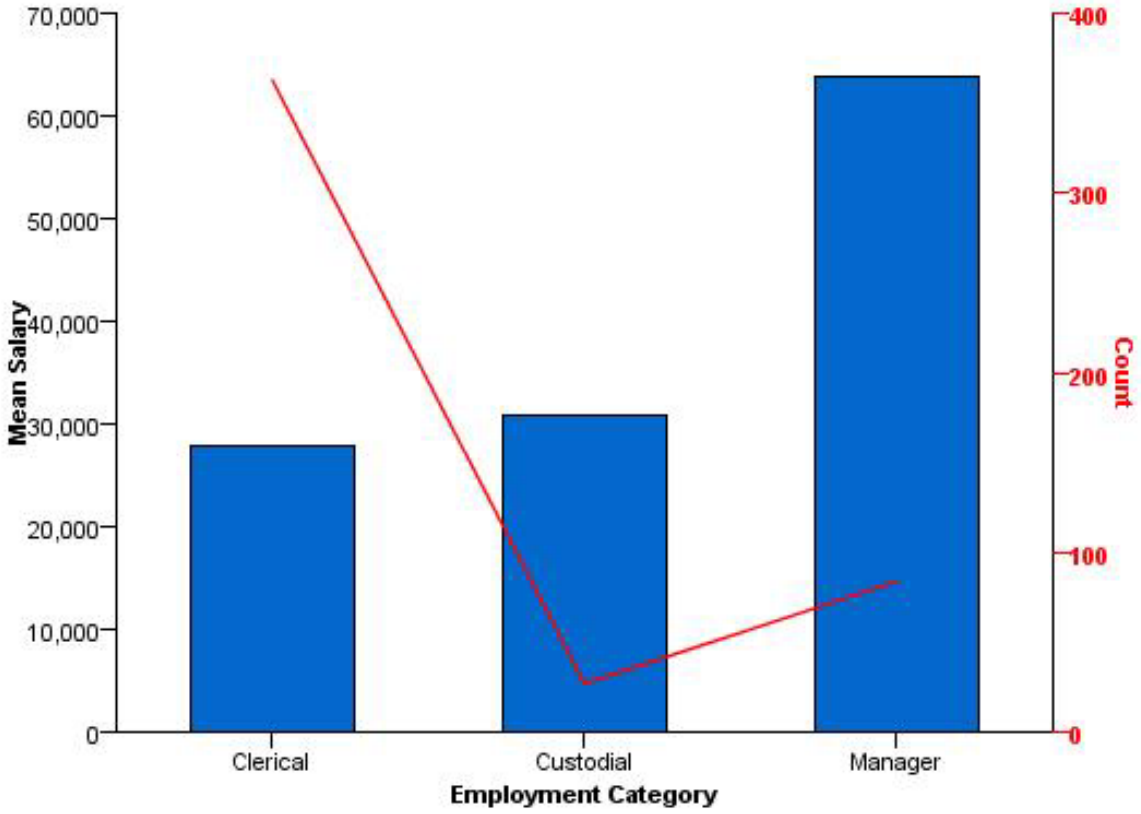



*Figure 497. Dual axis graph*

# Histogram with Dot Plot

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
GRAPH: begin(origin(5.0%, 5.0%), scale(90.0%, 90.0%))
COORD: rect(dim(1, 2))
ELEMENT: interval(position(summary.count(bin.rect(salary))),
                  transparency.interior(transparency."0.9"))
GRAPH: end()
GRAPH: begin(origin(5.0%, 5.0%), scale(90.0%, 90.0%))
COORD: rect(dim(1))
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), ticks(null()))
ELEMENT: point.dodge.asymmetric(position(bin.dot(salary)))
GRAPH: end()
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
GRAPH: begin(origin(5.0%, 5.0%), scale(90.0%, 90.0%))
COORD: rect(dim(1, 2))
ELEMENT: interval(position(summary.count(bin.rect(salary))),
                  transparency.interior(transparency."0.9"))
GRAPH: end()
GRAPH: begin(origin(5.0%, 5.0%), scale(90.0%, 90.0%))
COORD: rect(dim(1))
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), ticks(null()))
ELEMENT: point.dodge.asymmetric(position(bin.dot(salary)))
GRAPH: end()
```

*Figure 498. GPL for histogram with dot plot*

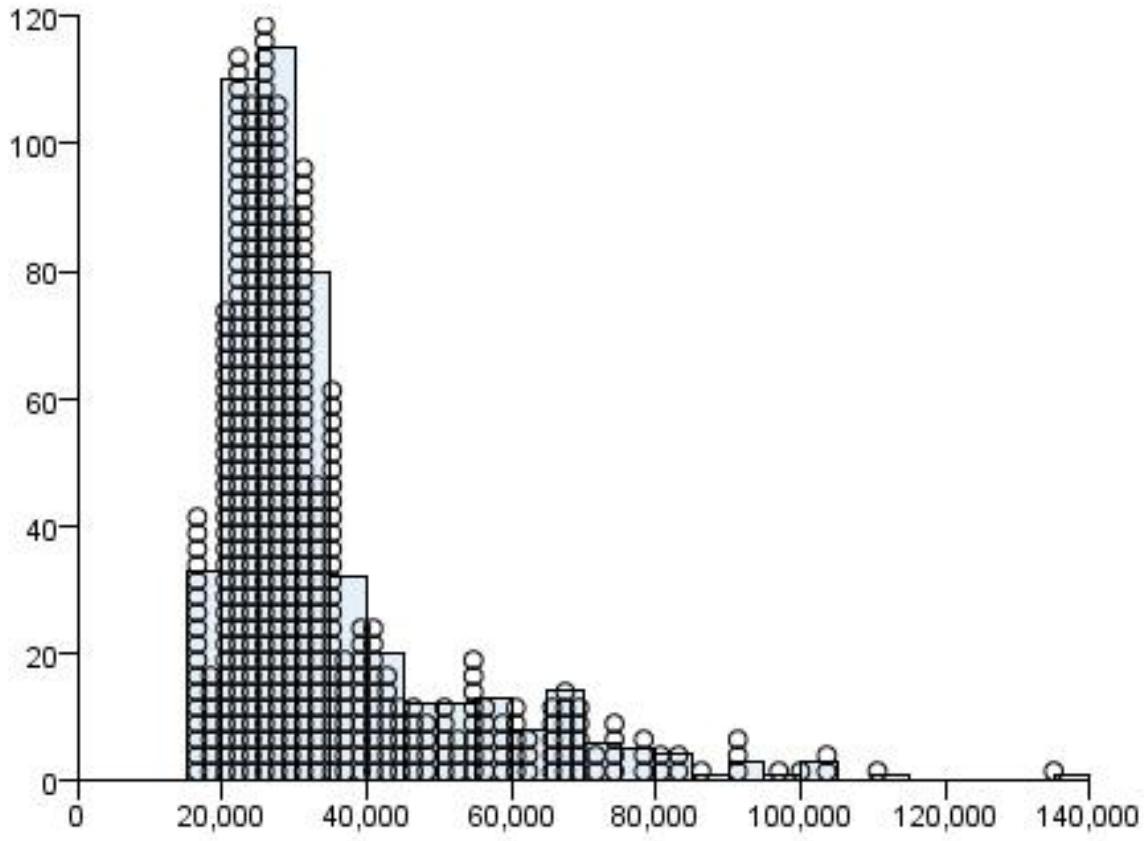



*Figure 499. Histogram with dot plot*

## Other Examples

This section provides examples that demonstrate other features of GPL that are not specific to chart types.

## Collapsing Small Categories

If you are creating a graph with several, small categories (that is, categories with a small sum), you may want to collapse those categories into a larger, common category. Following is an example that collapses small categories in a pie chart.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: educ = col(source(s), name("educ"), unit.category())
DATA: salary = col(source(s), name("salary"))
TRANS: educ_collapsed = collapse(category(educ), minimumPercent(5.0),
                                 sumVariable(salary), otherValue("Other"))
COORD: polar.theta()
SCALE: linear(dim(1), dataMinimum(), dataMaximum())
GUIDE: axis(dim(1), null())
GUIDE: legend(aesthetic(aesthetic.color.interior),
                        label("Educational Level (years)"))
ELEMENT: interval.stack(position(summary.sum(salary)),
                        color.interior(educ_collapsed))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: educ = col(source(s), name("educ"), unit.category())
DATA: salary = col(source(s), name("salary"))
TRANS: educ_collapsed = collapse(category(educ), minimumPercent(5.0),
                                 sumVariable(salary), otherValue("Other"))
COORD: polar.theta()
SCALE: linear(dim(1), dataMinimum(), dataMaximum())
GUIDE: axis(dim(1), null())
GUIDE: legend(aesthetic(aesthetic.color.interior),
                        label("Educational Level (years)"))
ELEMENT: interval.stack(position(summary.sum(salary)),
                        color.interior(educ_collapsed))
```

*Figure 500. GPL for collapsing small categories*

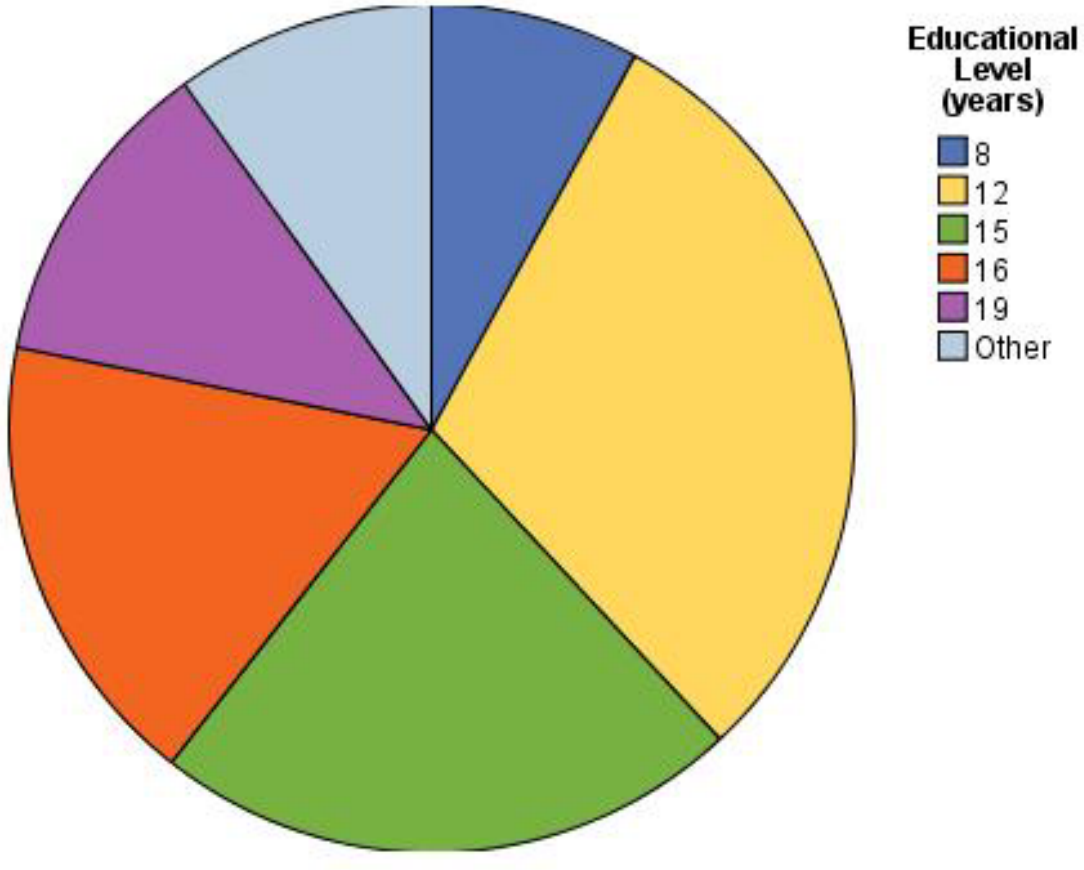



*Figure 501. Graph with collapsed categories*

## Mapping Aesthetics

This example demonstrates how you can map a specific categorical value in the graph to a specific aesthetic value. In this case, "Female" bars are colored green in the resulting graph.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salary = col(source(s), name("salary"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
COORD: rect(dim(1, 2), cluster(3))
SCALE: cat(aesthetic(aesthetic.color), map(("Female", color.green)))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Job Category"))
ELEMENT: interval(position(summary.mean(gender*salary*jobcat)),
                  color(gender))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salary = col(source(s), name("salary"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: gender = col(source(s), name("gender"), unit.category())
COORD: rect(dim(1, 2), cluster(3))
SCALE: cat(aesthetic(aesthetic.color), map(("Female", color.green)))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Job Category"))
ELEMENT: interval(position(summary.mean(gender*salary*jobcat)),
                  color(gender))
SCALE: cat(aesthetic(aesthetic.color), map(("f", color.green)))
GUIDE: axis(dim(2), label("Mean Salary"))
GUIDE: axis(dim(3), label("Job Category"))
ELEMENT: interval(position(summary.mean(gender*salary*jobcat)),
                  color(gender))
```

*Figure 502. GPL for mapping aesthetics*

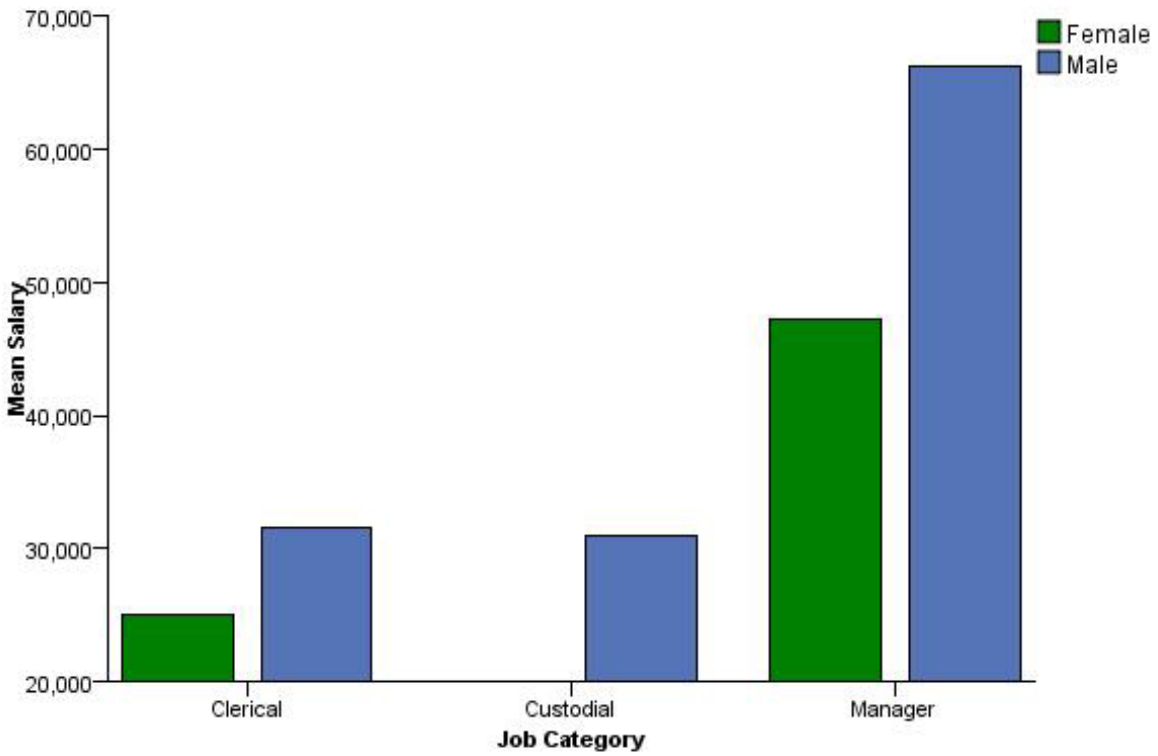



*Figure 503. Graph with mapped aesthetics*

## Faceting by Separate Variables

This example demonstrates how you can create facets based on separate variables, so that each facet shows the different variable information. Note that you can do something similar with nesting. See the topic "Line Chart with Separate Scales" on page 384 for more information.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: salary = col(source(s), name("salary"))
DATA: salbegin = col(source(s), name("salbegin"))
ELEMENT: schema(position(bin.quantile.letter(jobcat*salbegin*"Beginning Salary"+
                                        jobcat*salary*"Current Salary")))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: salary = col(source(s), name("salary"))
DATA: salbegin = col(source(s), name("salbegin"))
ELEMENT: schema(position(bin.quantile.letter(jobcat*salbegin*"Beginning Salary"+
                                        jobcat*salary*"Current Salary")))
```

*Figure 504. GPL for faceting by separate variables*

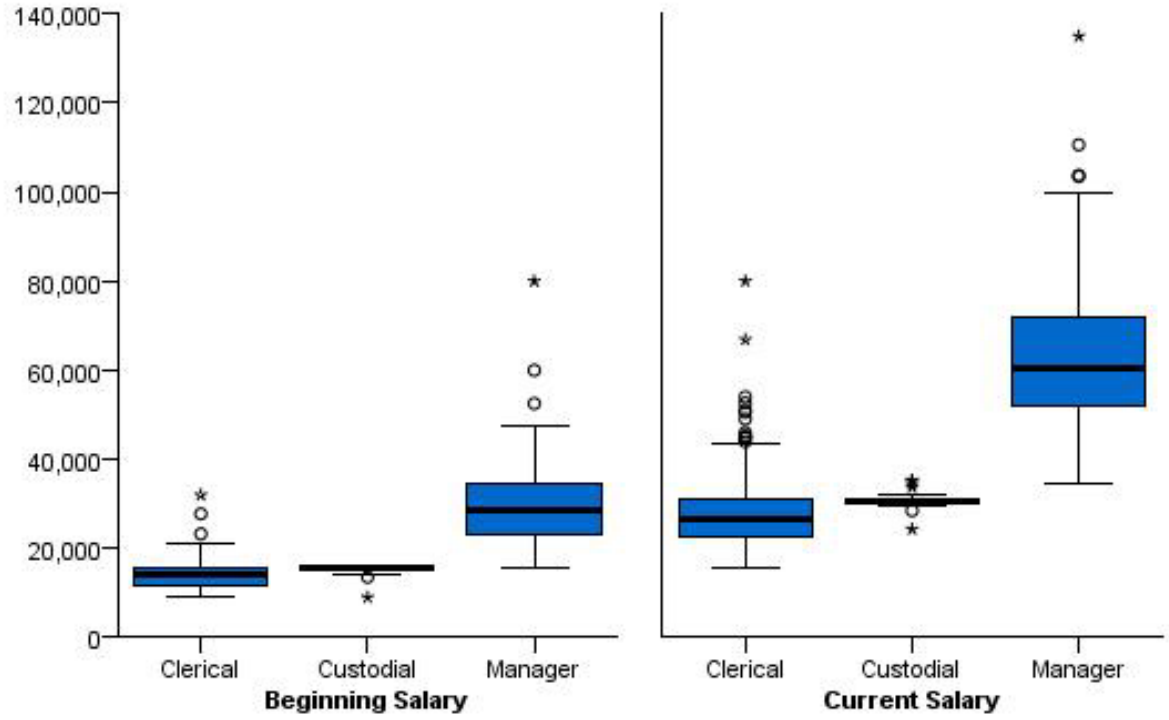



*Figure 505. Faceting by separate variables*

## Grouping by Separate Variables

This example demonstrates how you can create groups based on separate variables, so that each instance of the graphic element shows the different variable information. In this example, you are comparing the results of two variables across a categorical variable.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
DATA: educ=col(source(s), name("educ"), unit.category())
GUIDE: axis(dim(1), label("Educational Level (years)"))
ELEMENT: line(position(summary.mean(educ*salary)),color("Current Salary"))
ELEMENT: line(position(summary.mean(educ*salbegin)),color("Beginning Salary"))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin=col(source(s), name("salbegin"))
DATA: salary=col(source(s), name("salary"))
DATA: educ=col(source(s), name("educ"), unit.category())
GUIDE: axis(dim(1), label("Educational Level (years)"))
ELEMENT: line(position(summary.mean(educ*salary)),color("Current Salary"))
ELEMENT: line(position(summary.mean(educ*salbegin)),color("Beginning Salary"))
```

*Figure 506. GPL for grouping by separate variables*

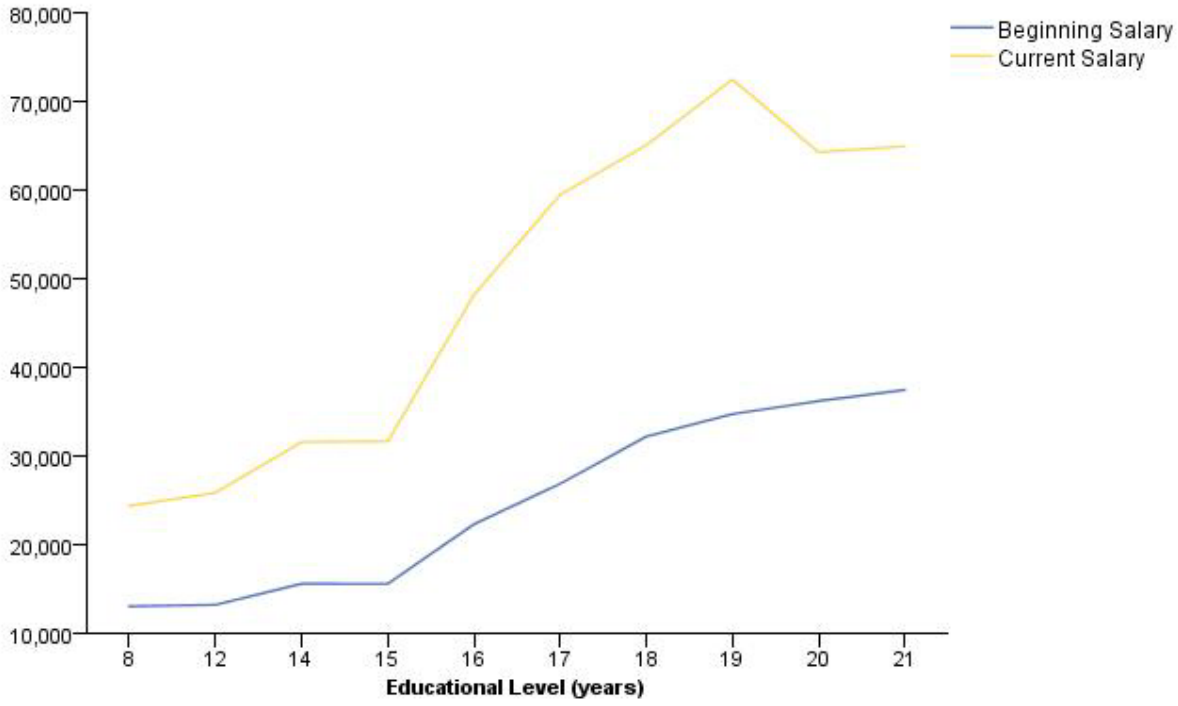



*Figure 507. Grouping by separate variables*

## Clustering Separate Variables

This example demonstrates how you can cluster separate variables.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: salary = col(source(s), name("salary"))
DATA: salbegin = col(source(s), name("salbegin"))
COORD: rect(cluster(3))
SCALE: linear(dim(2), include(0.0))
GUIDE: axis(dim(2), label("Mean"))
GUIDE: axis(dim(3), label("Job Category"))
ELEMENT: interval(position(summary.mean("Beginning Salary"*salbegin*jobcat)),
                  color("Beginning Salary"))
ELEMENT: interval(position(summary.mean("Current Salary"*salary*jobcat)),
                  color("Current Salary"))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: salary = col(source(s), name("salary"))
DATA: salbegin = col(source(s), name("salbegin"))
COORD: rect(cluster(3))
SCALE: linear(dim(2), include(0.0))
GUIDE: axis(dim(2), label("Mean"))
GUIDE: axis(dim(3), label("Job Category"))
ELEMENT: interval(position(summary.mean("Beginning Salary"*salbegin*jobcat)),
                  color("Beginning Salary"))
ELEMENT: interval(position(summary.mean("Current Salary"*salary*jobcat)),
                  color("Current Salary"))
```

*Figure 508. GPL for clustering separate variables*

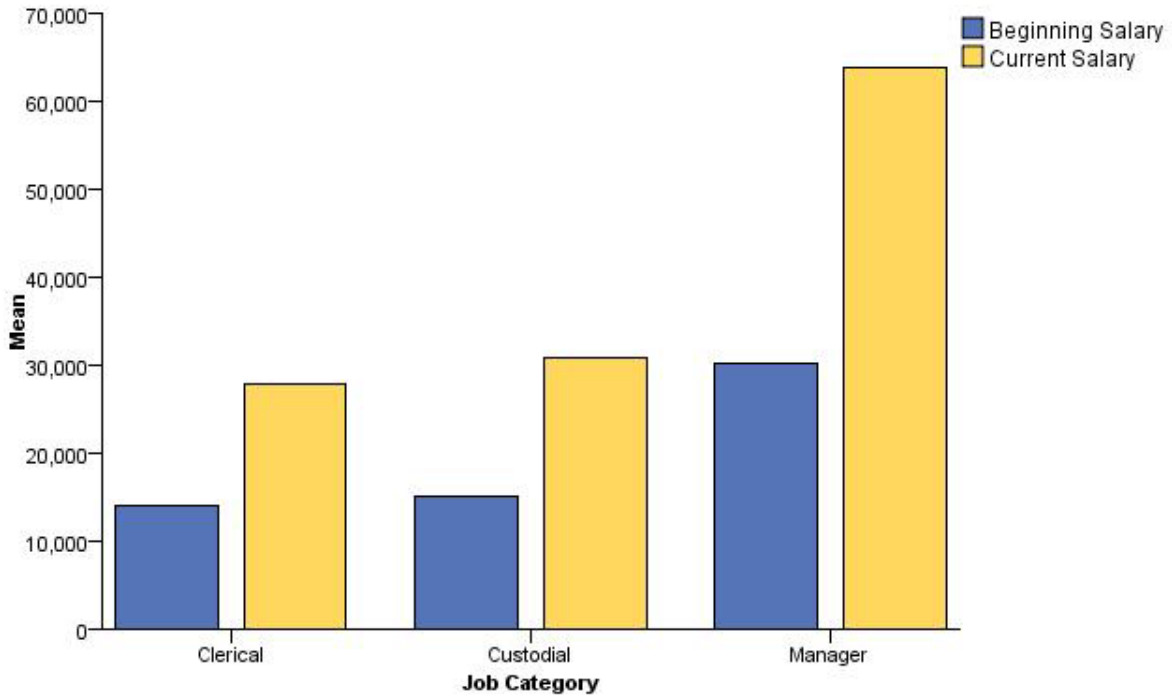



*Figure 509. Clustering separate variables*

## Binning over Categorical Values

This example demonstrates how you use binning to show the distribution of a continuous variable over categorical values.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: salary = col(source(s), name("salary"))
GUIDE: axis(dim(1), label("Employment Category"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: legend(aesthetic(aesthetic.color), label("Count"))
ELEMENT: polygon(position(bin.rect(jobcat*salary, dim(2))), color(summary.count()))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: jobcat = col(source(s), name("jobcat"), unit.category())
DATA: salary = col(source(s), name("salary"))
GUIDE: axis(dim(1), label("Employment Category"))
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: legend(aesthetic(aesthetic.color), label("Count"))
ELEMENT: polygon(position(bin.rect(jobcat*salary, dim(2))), color(summary.count()))
```

*Figure 510. GPL for binning over categorical values*

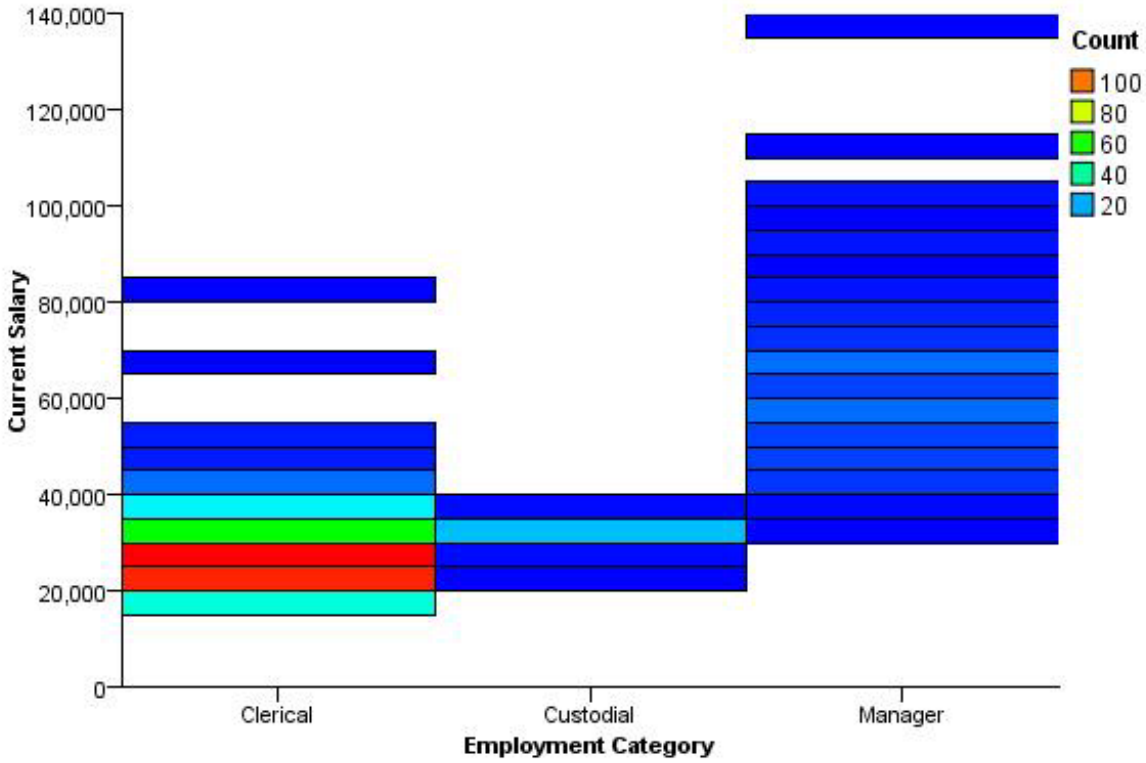



*Figure 511. Binning over categorical values*

# Categorical Heat Map

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: educ = col(source(s), name("educ"), unit.category())
DATA: salary = col(source(s), name("salary"))
GUIDE: axis(dim(1), label("Educational Level"))
GUIDE: axis(dim(2), label("Gender"))
GUIDE: legend(aesthetic(aesthetic.color), label("Mean Salary"))
ELEMENT: point(position(educ*gender), shape(shape.square), size(size."10%"),
               color(summary.mean(salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: educ = col(source(s), name("educ"), unit.category())
DATA: salary = col(source(s), name("salary"))
GUIDE: axis(dim(1), label("Educational Level"))
GUIDE: axis(dim(2), label("Gender"))
GUIDE: legend(aesthetic(aesthetic.color), label("Mean Salary"))
ELEMENT: point(position(educ*gender), shape(shape.square), size(size."10%"),
               color(summary.mean(salary)))
```

*Figure 512. GPL for categorical heat map*

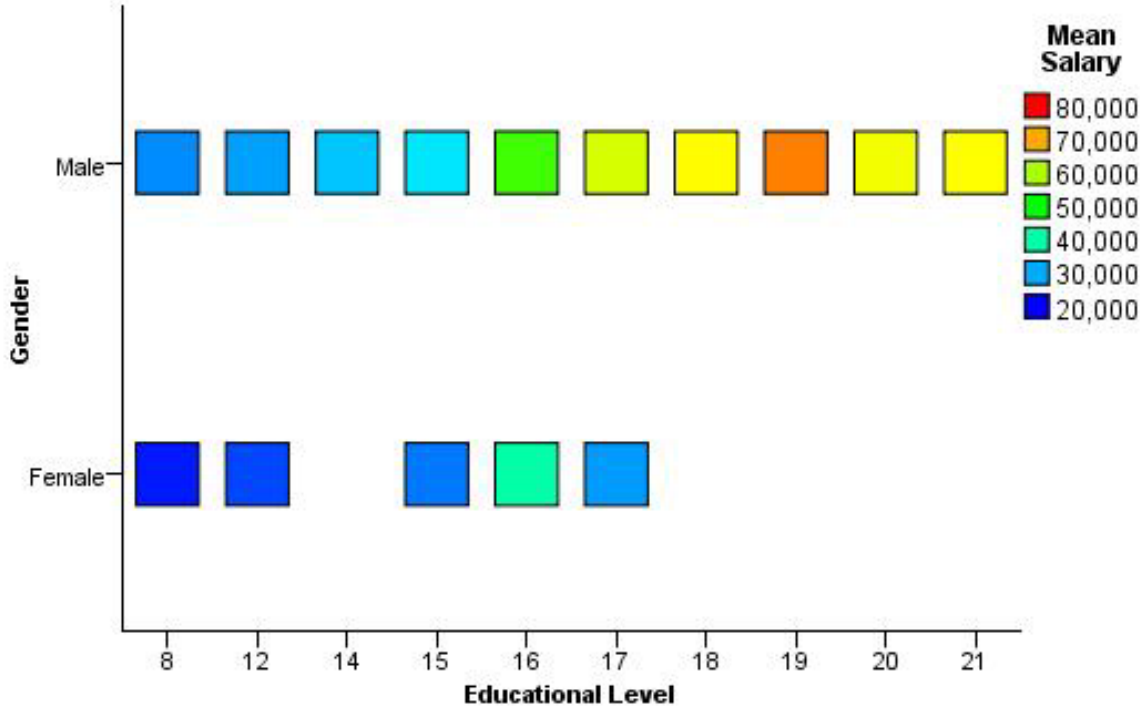



*Figure 513. Categorical heat map*

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: educ = col(source(s), name("educ"), unit.category())
DATA: salary = col(source(s), name("salary"))
GUIDE: axis(dim(1), label("Educational Level"))
GUIDE: axis(dim(2), label("Gender"))
GUIDE: legend(aesthetic(aesthetic.color), label("Mean Salary"))
ELEMENT: polygon(position(educ*gender), color(summary.mean(salary)))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: gender = col(source(s), name("gender"), unit.category())
DATA: educ = col(source(s), name("educ"), unit.category())
DATA: salary = col(source(s), name("salary"))
GUIDE: axis(dim(1), label("Educational Level"))
GUIDE: axis(dim(2), label("Gender"))
GUIDE: legend(aesthetic(aesthetic.color), label("Mean Salary"))
ELEMENT: polygon(position(educ*gender), color(summary.mean(salary)))
```

*Figure 514. GPL for alternate categorical heat map*

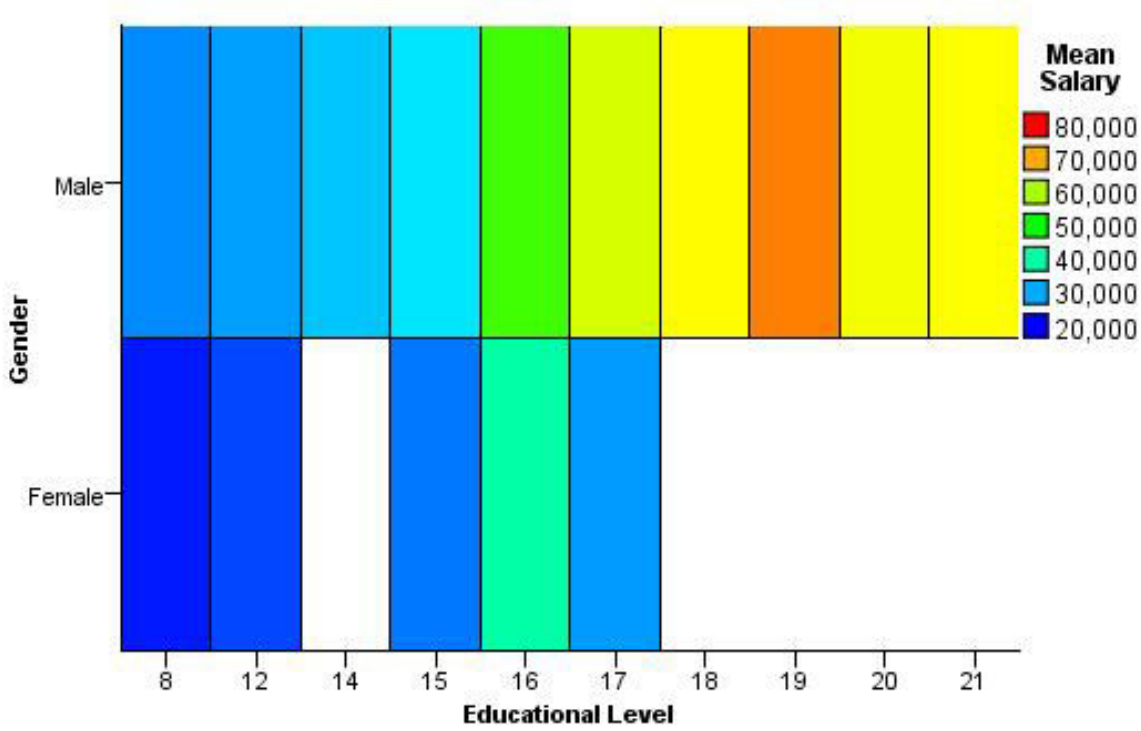



*Figure 515. Alternate categorical heat map*

## Creating Categories Using the eval Function

This example demonstrates how you can use the `eval` function to create categories based on an expression.

```
SOURCE: s = csvSource(file("Employee data.csv"))
DATA: salbegin = col(source(s), name("salbegin"))
DATA: salary = col(source(s), name("salary"))
DATA: educ = col(source(s), name("educ"))
TRANS: college = eval(educ>12 ? "College" : "No College")
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary), color(college))
```

```
SOURCE: s = userSource(id("Employeedata"))
DATA: salbegin = col(source(s), name("salbegin"))
DATA: salary = col(source(s), name("salary"))
DATA: educ = col(source(s), name("educ"))
TRANS: college = eval(educ>12 ? "College" : "No College")
GUIDE: axis(dim(2), label("Current Salary"))
GUIDE: axis(dim(1), label("Beginning Salary"))
ELEMENT: point(position(salbegin*salary), color(college))
```

*Figure 516. GPL for creating categories with the eval function*

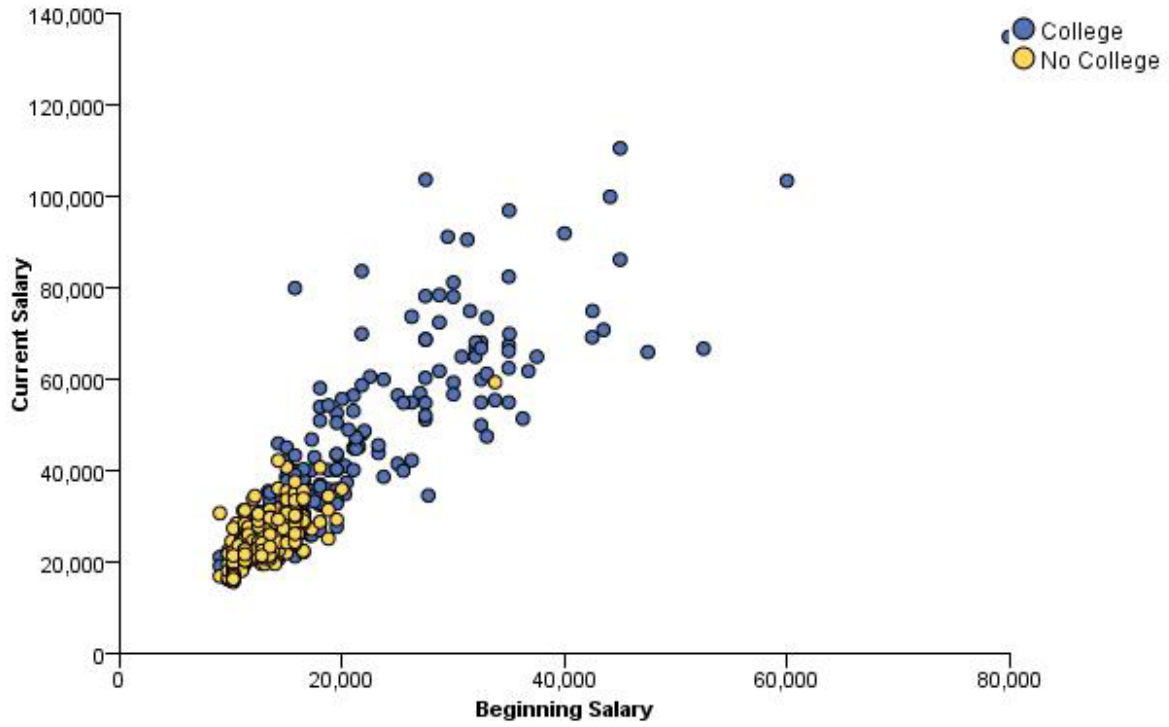



*Figure 517. Creating categories with the eval function*

# Chapter 4. GPL Constants

## Color Constants

Color constants: aliceblue, aqua, azure, bisque, black, blanchedalmond, blue, blueviolet, brown, burlywood, cadetblue, chartreuse, chocolate, coral, cornflowerblue, cornsilk, crimson, cyan, darkblue, darkcyan, darkgoldenrod, darkgray, darkgreen, darkgrey, darkkhaki, darkmagenta, darkolivegreen, darkorange, darkorchid, darkred, darksalmon, darkseagreen, darkslateblue, darkslategray, darkslategrey, darkturquoise, darkviolet, deeppink, deepskyblue, dimgray, dimgrey, dodgerblue, firebrick, floralwhite, forestgreen, fuchsia, gainsboro, ghostwhite, gold, goldenrod, gray, grey, green, greenyellow, honeydew, hotpink, indianred, indigo, ivory, khaki, lavender, lavenderblush, lawngreen, lemonchiffon, lightblue, lightcoral, lightcyan, lightgoldenrodyellow, lightgray, lightgreen, lightgrey, lightpink, lightsalmon, lightseagreen, lightskyblue, lightslategray, lightslategrey, lightsteelblue, lightyellow, lime, limegreen, linen, magenta, maroon, mediumaquamarine, mediumblue, mediumorchid, mediumpurple, mediumseagreen, mediumslateblue, mediumspringgreen, mediumturquoise, mediumvioletred, midnightblue, mintcream, mistyrose, moccasin, navajowhite, navy, oldlace, olive, olivedrab, orange, orangered, orchid, palegoldenrod, palegreen, paleturquoise, palevioletred, papayawhip, peachpuff, peru, pink, plum, powderblue, purple, red, rosybrown, royalblue, saddlebrown, salmon, sandybrown, seagreen, seashell, sienna, silver, skyblue, slateblue, slategray, slategrey, snow, springgreen, steelblue, tan, teal, thistle, tomato, turquoise, violet, wheat, white, whitesmoke, yellow, yellowgreen

## Shape Constants

The following constants are all the valid constants for the different graphic element types. Note that the constants for the edge graphic element appear in multiple tables.

shape.interior constants for interval elements: ibeam, line, square

shape.interior constants for edge and point elements: arrow, bowtie, circle, cross, decagon, elbow, elbowArrow, female, flower, flower3, flower4, flower5, flower6, flower7, flower8, flower9, flower10, heptagon, hexagon, hollowBowtie, hollowCircle, hollowDecagon, hollowHeptagon, hollowHexagon, hollowNonagon, hollowOctagon, hollowPentagon, hollowPolygon, hollowRoundRectangle, hollowSquare, hollowStar, hollowStar3, hollowStar4, hollowStar5, hollowStar6, hollowStar7, hollowStar8, hollowStar9, hollowStar10, hollowTriangle, ibeam, line, male, nonagon, octagon, pentagon, plus, polygon, roundRectangle, square, star, star3, star4, star5, star6, star7, star8, star9, star10, triangle

The following constants can also be used with the `shape.exterior` function to specify the border dashing of all other graphic elements. (An exception is the edge element, for which `shape.interior` defines the overall shape *or* dashing.) These constants are also used with the `shape` function that specifies the dashing of `form.line` guides.

shape.interior constants for edge, line, and path elements: dash, dash_1_dot, dash_2_dots, dash_3_dots, dash_2x, dash_3x, dash_4_dots, dash_dash2x, half_dash, solid

## Size Constants

Size constants: tiny, small, medium, large, huge

## Pattern Constants

Pattern constants: checkered, grid, grid2, grid3, grid4, grid5, mesh, mesh2, mesh3, mesh4, mesh5, pluses, pluses2, solid

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