SPSS 15.0 GPL Reference Guide

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Printed in the United States of America.

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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* (Wilkinson, 2005).

Note: If you have used GPL previously, refer to What's Changed in GPL on p. 20.

The Basics

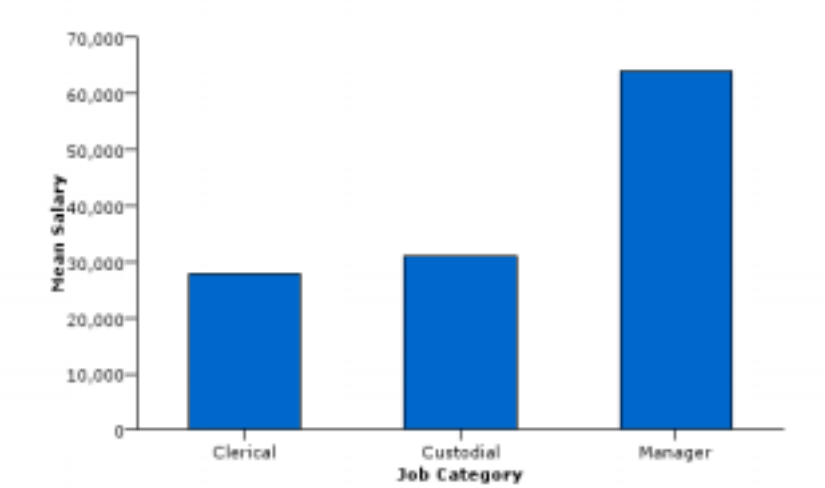
The GPL example below creates a simple bar chart. (See Figure 1-2 on p. 2.) A summary of the GPL follows the bar chart.

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 in Chapter 3 on p. 217.

Figure 1-1
GPL for a simple bar chart

```
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 1-2
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 colon (:) that follow it 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.
- **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. 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. For more information, see Brief Overview of GPL Algebra on p. 4.

Details about all of the statements and functions appear in *Statement and Function Reference* on p. 22.

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())
  ```

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 *Examples* on p. 217.

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 Algebra Interact on p. 7 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 p. 257.

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 p. 221.

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 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.

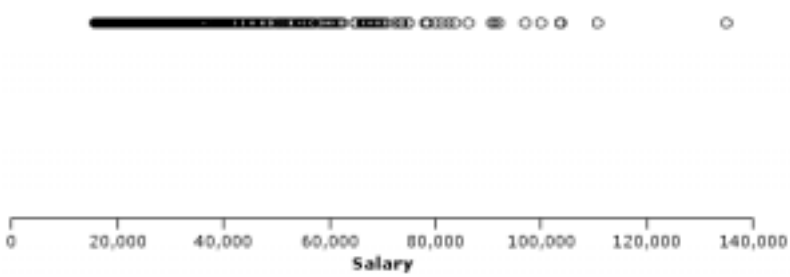
1-D Graph

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

Full Specification

```
SOURCE: s = 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 1-3
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 = 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 1-4
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.

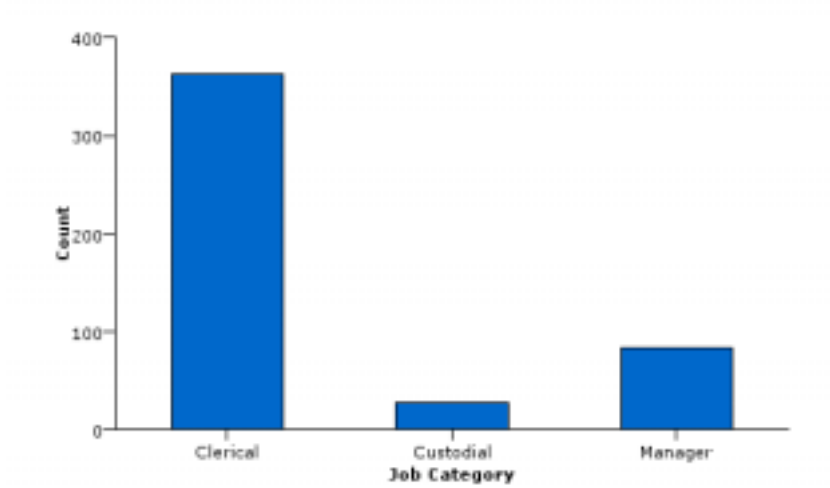
Another 2-D Graph

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

Full Specification

```
SOURCE: s = 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 1-5
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.

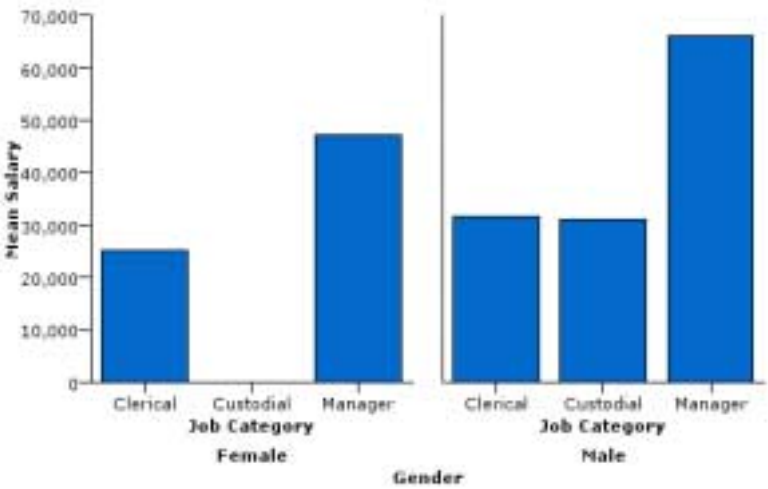
A Faceted (Paneled) 2-D Graph

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

Full Specification

```
SOURCE: s = 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 1-6
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.

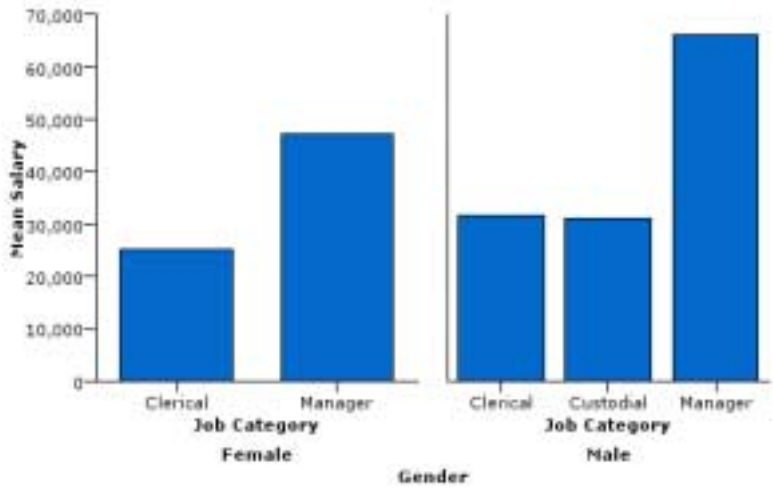
A Faceted (Paneled) 2-D Graph with Nested Categories

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

Full Specification

```
SOURCE: s = 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 1-7
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.

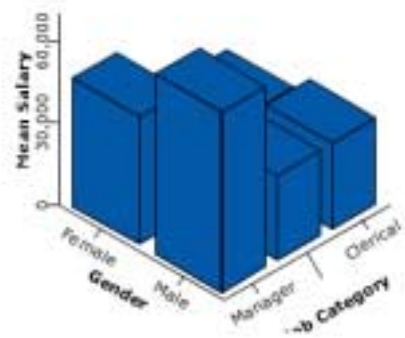
A 3-D Graph

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

Full Specification

```
SOURCE: s = 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 1-8
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.

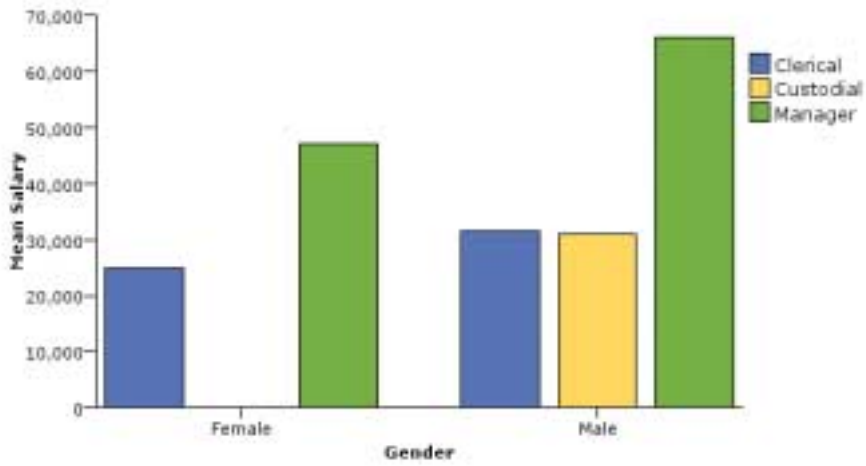
A Clustered Graph

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

Full Specification

```
SOURCE: s = 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 1-9
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 p. 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 p. 1 as a "baseline" for the changes.

E 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())
```

E 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))
```

E 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):

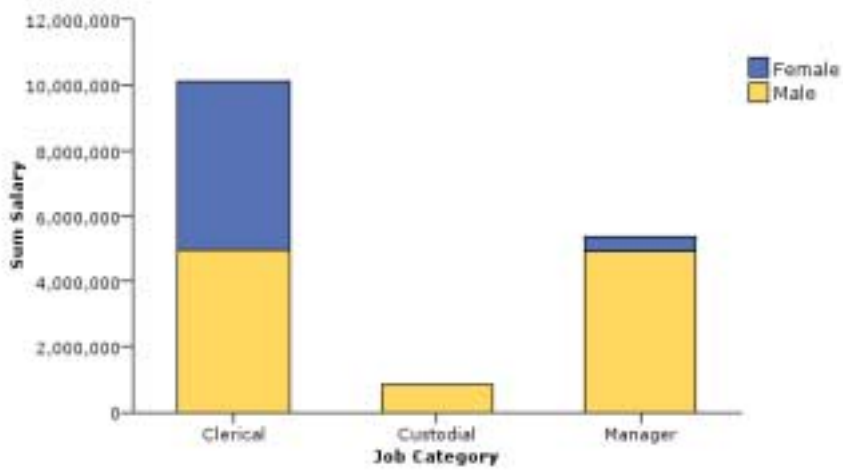
```
ELEMENT: interval.stack(position(summary.sum(jobcat*salary)), color(gender))
```

The complete GPL is shown below:

```
SOURCE: s = 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 1-10
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 p. 1 as a "baseline" for the changes.

E 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())
```

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

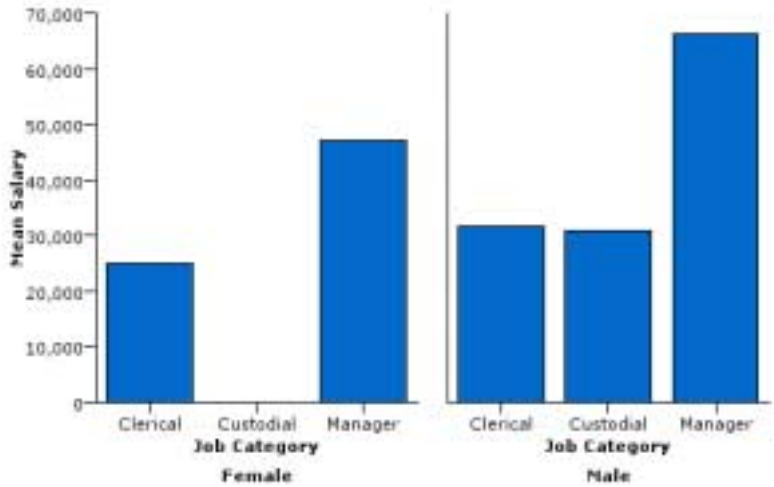
```
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)))
```

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

```
SOURCE: s = 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 1-11
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 p. 1 as a "baseline" for the changes.

E 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())
```

E 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.

E 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))
```

E 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.

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

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

E 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:

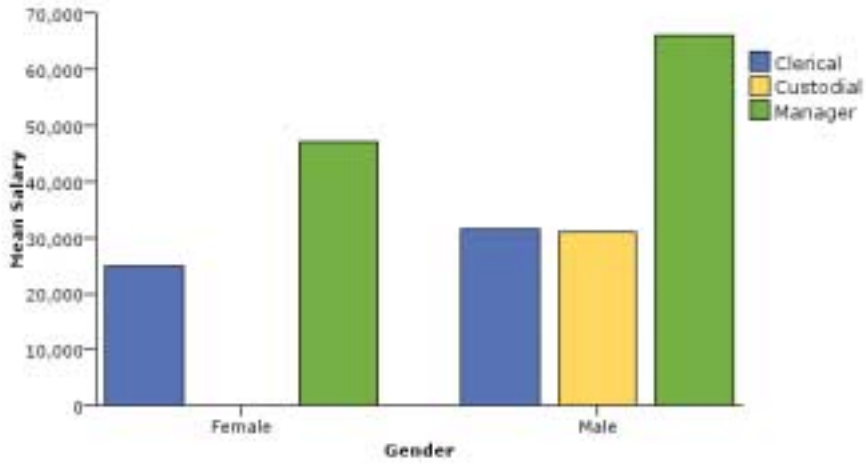
```
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)), color(jobcat))
```

The complete GPL looks like the following.

```
SOURCE: s = 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. Compare this to "Faceted bar chart" on p. 16.

Figure 1-12
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.

Figure 1-13
Baseline GPL for example

```
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))
```

E 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())
```

E 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"))
```

E 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.

E Finally add the aesthetic for the continuous variable:

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

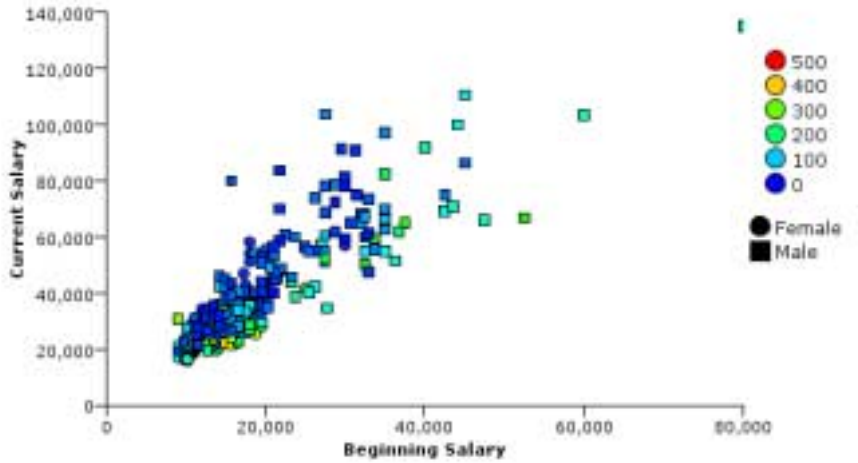
Not all aesthetics are available for continuous variables. That's another reason why shape was a good aesthetic for the categorical variable. Shape is not available for continuous variables because there aren't enough shapes to cover a continuous spectrum. On the other hand, color gradually changes in 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 = 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 1-14
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.

What's Changed in GPL

In addition to many new features, following are the important changes since the last release. These changes may affect GPL that you created previously.

- References to nested dimensions now use a dot convention (for example, `1.1`). For more information, see dim Function in Chapter 2 on p. 102.
- `region.spread.confi` was removed. Use `region.confi.count`, `region.confi.mean`, or `region.confi.percent` instead.
- Previously, you could use `dim(1)` in a `GUIDE` statement to refer to a clustered dimension. This is incorrect. For general information about referring to dimensions, see dim Function on p. 102. For an example of a clustered chart that uses the correct dimension reference, see Clustered Bar Chart on p. 223.
- If there are multiple `ELEMENT` statements in a single graph, 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. The exception is when the `ELEMENT` statements are linked to independent axes.

- GPL is now case sensitive. For more information, see Syntax Rules on p. 3.
- `summary.percent` is now an alias for `summary.percent.sum`. If you want to calculate a percentage based on count, use `summary.percent.count(catVarName)`. The old convention, `summary.percent(summary.count(catVarName))`, is deprecated.
- The `origin` function for graphs is relative to top left corner instead of bottom left corner as it was previously. For more information, see origin Function (For Graphs) in Chapter 2 on p. 152.
- The unit of measurement for `binWidth` defaults to seconds *or* days, depending on the underlying format. Previously, the unit was always days. Include a qualifier to specify a different unit (for example, `30d`). For more information, see binWidth Function in Chapter 2 on p. 74.

Chapter
2

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.

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, DATA Statement, TRANS Statement

Specification Statements

COORD Statement, SCALE Statement, GUIDE Statement, ELEMENT Statement

Control Statements

PAGE Statement, GRAPH Statement

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

Figure 2-1
Defining a comment

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

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.

Examples

Figure 2-2
Example: Defining a page

```
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 2-3
Example: Defining a page with multiple graphs

```
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()
```

Valid Functions

begin Function (For Pages), end Function

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.

Examples

Figure 2-4
Scaling a graph

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

Figure 2-5
Example: Scatterplot with border histograms

```
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()
```

Valid Functions

begin Function (For Graphs), end Function

SOURCE Statement

Syntax

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

<source name>. User-defined name for the data source. Refer to Syntax Rules on p. 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

Figure 2-6
Example: Reading a CSV file

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

Valid Functions

csvSource Function, mapSource Function, userSource Function

DATA Statement

Syntax

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

<variable name>. User-defined name for the variable. Refer to Syntax Rules on p. 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

Figure 2-7
Example: Specifying a variable from a data source

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

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, iter Function, mapVariables Function

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 Syntax Rules on p. 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

Figure 2-8
Example: Creating a transformation variable from other variables

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

Figure 2-9
Example: Creating an index variable

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

Valid Functions

collapse Function, eval Function, index Function

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

Figure 2-10
Example: Polar coordinates for pie charts

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

Figure 2-11
Example: 3-D rectangular coordinates

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

Figure 2-12
Example: Embedded coordinate systems for paneled pie chart

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

Figure 2-13
Example: Transposed coordinate system

```
COORD: transpose()
```

Coordinate Types and Transformations

parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, mirror Function, project Function, reflect Function, transpose Function, wrap Function

Coordinate Types

There are several coordinate types available in GPL.

Coordinate Types

parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type

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. For more information, see dim Function on p. 102.

<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

Figure 2-14
Example: Parallel coordinates graph

```
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.

Coordinate Types and Transformations

polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, mirror Function, project Function, reflect Function, transpose Function, wrap Function

Applies To

COORD Statement, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, project Function

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. For more information, see dim Function on p. 102.

<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

Figure 2-15
Example: Polar line chart

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

Valid Functions

reverse Function, startAngle Function

Coordinate Types and Transformations

parallel Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, mirror Function, project Function, reflect Function, transpose Function, wrap Function

Applies To

COORD Statement, parallel Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, project Function

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. For more information, see dim Function on p. 102.

<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

Figure 2-16
Example: Pie chart

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

Valid Functions

reverse Function, startAngle Function

Coordinate Types and Transformations

parallel Coordinate Type, polar Coordinate Type, rect Coordinate Type, mirror Function, project Function, reflect Function, transpose Function, wrap Function

Applies To

COORD Statement, parallel Coordinate Type, polar Coordinate Type, rect Coordinate Type, project Function

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)`). For more information, see dim Function on p. 102.

<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

Figure 2-17
Example: 2-D bar chart

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

Figure 2-18
Example: 3-D bar chart

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

Valid Functions

cluster Function, sameRatio Function

Coordinate Types and Transformations

parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, mirror Function, project Function, reflect Function, transpose Function, wrap Function

Applies To

COORD Statement, parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, project Function

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 Syntax Rules on p. 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

Figure 2-19
Example: Specifying a linear dimension scale

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

Figure 2-20
Example: Specifying a log aesthetic scale

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

Figure 2-21
Example: Creating a graph with dual scales

```
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))
```

Scale Types

asn Scale, atanh Scale, cat Scale, linear Scale, log Scale, logit Scale, pow Scale, prob Scale, probit Scale, safeLog Scale, safePower Scale, time Scale

Scale Types

There are several scale types available in GPL.

Scale Types

asn Scale, atanh Scale, cat Scale, linear Scale, log Scale, logit Scale, pow Scale, prob Scale, probit Scale, safeLog Scale, safePower Scale, time Scale

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. For more information, see dim Function on p. 102.

<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

Figure 2-22
Example: Specifying an arcsine scale

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

Valid Functions

aestheticMaximum Function, aestheticMinimum Function, aestheticMissing Function

Applies To

SCALE Statement

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. For more information, see dim Function on p. 102.

<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

Figure 2-23
Example: Specifying a Fisher's z scale

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

Applies To

SCALE Statement

Valid Functions

aestheticMaximum Function, aestheticMinimum Function, aestheticMissing Function

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. For more information, see dim Function on p. 102.

<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

Figure 2-24
Example: Specifying the scale for a dimension and sorting categories

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

Figure 2-25
Example: Specifying the scale for an aesthetic and including categories

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

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

Applies To

SCALE Statement

Valid Functions

aestheticMissing Function, values Function, exclude Function, include Function, map Function, reverse Function, sort.data Function, sort.natural Function, sort.statistic Function, sort.values Function

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. For more information, see dim Function on p. 102.

<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

Figure 2-26
Example: Specifying a maximum value for the linear scale

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

Applies To

SCALE Statement

Valid Functions

aestheticMaximum Function, aestheticMinimum Function, aestheticMissing Function, dataMaximum Function, dataMinimum Function, include Function, max Function, min Function, origin Function (For Scales), reverse Function

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. For more information, see dim Function on p. 102.

<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 scale. If a base is not explicitly specified, the default is base 10. Data values for this scale must be greater than 0.

Example

Figure 2-27
Example: Specifying the scale and a base

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

Applies To

SCALE Statement

Valid Functions

aestheticMaximum Function, aestheticMinimum Function, aestheticMissing Function, dataMaximum Function, dataMinimum Function, include Function, base Function, max Function, min Function, origin Function (For Scales), reverse Function

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. For more information, see dim Function on p. 102.

<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 scale. Data values for this scale must fall in the open interval (0, 1). That is, for any data value x, $0 < x < 1$.

Example

Figure 2-28
Example: Specifying a logit scale

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

Applies To

SCALE Statement

Valid Functions

aestheticMaximum Function, aestheticMinimum Function, aestheticMissing Function

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. For more information, see dim Function on p. 102.

<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. If an exponent is not explicitly specified, the default is 0.5.

Example

Figure 2-29
Example: Specifying the scale and an exponent

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

Applies To

SCALE Statement

Valid Functions

aestheticMaximum Function, aestheticMinimum Function, aestheticMissing Function, dataMaximum Function, dataMinimum Function, exponent Function, include Function, max Function, min Function, origin Function (For Scales), reverse Function

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. For more information, see dim Function on p. 102.

<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 a probability 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

Figure 2-30
Example: Specifying a beta distribution for the probability scale

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

Applies To

SCALE Statement

Distribution Functions

beta Function, chiSquare Function, exponential Function, f Function, gamma Function, logistic Function, normal Function, poisson Function, studentizedRange Function, t Function, uniform Function, weibull Function

Valid Functions

aestheticMaximum Function, aestheticMinimum Function, aestheticMissing Function

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. For more information, see dim Function on p. 102.

<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. 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

Figure 2-31
Example: Specifying a probit scale

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

Applies To

SCALE Statement

Valid Functions

aestheticMaximum Function, aestheticMinimum Function, aestheticMissing Function

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. For more information, see dim Function on p. 102.

<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 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.

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

Figure 2-32
Example: Specifying the scale and a base

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

Applies To

SCALE Statement

Valid Functions

aestheticMaximum Function, aestheticMinimum Function, aestheticMissing Function, dataMaximum Function, dataMinimum Function, include Function, base Function, max Function, min Function, origin Function (For Scales), reverse Function

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. For more information, see dim Function on p. 102.

<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 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.

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

Figure 2-33
Example: Specifying the scale and an exponent

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

Applies To

SCALE Statement

Valid Functions

aestheticMaximum Function, aestheticMinimum Function, aestheticMissing Function, dataMaximum Function, dataMinimum Function, exponent Function, include Function, max Function, min Function, origin Function (For Scales), reverse Function

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. For more information, see dim Function on p. 102.

<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

Figure 2-34
Example: Specifying a maximum value for the time scale

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

Applies To

SCALE Statement

Valid Functions

aestheticMaximum Function, aestheticMinimum Function, aestheticMissing Function, dataMaximum Function, dataMinimum Function, include Function, max Function, min Function, origin Function (For Scales), reverse Function

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

Figure 2-35
Example: Axis

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

Guide Types

axis Guide Type, legend Guide Type, text.footnote Guide Type, text.subfootnote Guide Type, text.subsubfootnote Guide Type, text.subtitle Guide Type, text.title Guide Type

Guide Types

There are several different types of guides.

Guide Types

axis Guide Type, legend Guide Type, text.footnote Guide Type, text.subfootnote Guide Type, text.subsubfootnote Guide Type, text.subtitle Guide Type, text.title Guide Type

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. For more information, see dim Function on p. 102.

<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. For more information, see scale Function (For Axes) on p. 169.

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 p. 31.

Examples

Figure 2-36
Example: Specifying an axis label for a dimension with one scale

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

Figure 2-37
Example: Specifying axis labels for a dimension with two scales

```
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))
```

Applies To

GUIDE Statement

Valid Functions

color Function (For Axes), delta Function, gap Function, gridlines Function, label Function (For Guides), opposite Function, unit.percent Function, start Function, ticks Function

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

Figure 2-38
Example: Specifying a legend title

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

Applies To

GUIDE Statement

Valid Functions

label Function (For Guides)

text.footnote Guide Type

Syntax

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

<function>. One or more valid functions.

Description

Specifies the footnote for the graph.

Examples

Figure 2-39
Example: Specifying the footnote text

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

Applies To

GUIDE Statement

Valid Functions

label Function (For Guides)

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

Figure 2-40
Example: Specifying the second-level footnote text

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

Applies To

GUIDE Statement

Valid Functions

label Function (For Guides)

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

Figure 2-41
Example: Specifying the third-level footnote text

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

Applies To

GUIDE Statement

Valid Functions

label Function (For Guides)

text.subtitle Guide Type

Syntax

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

<function>. One or more valid functions.

Description

Specifies the subtitle for the graph.

Examples

Figure 2-42
Example: Specifying the subtitle text

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

Applies To

GUIDE Statement

Valid Functions

label Function (For Guides)

text.title Guide Type

Syntax

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

<function>. One or more valid functions.

Description

Specifies the title for the graph.

Examples

Figure 2-43
Example: Specifying the title text

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

Applies To

GUIDE Statement

Valid Functions

label Function (For Guides)

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

Figure 2-44
Example: Scatterplot

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

Figure 2-45
Example: Line chart

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

Figure 2-46
Example: Bar chart of means

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

Graphic Element Types

area Element, edge Element, interval Element, line Element, path Element, point Element, polygon Element, schema Element

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

Figure 2-47
Example: Area chart

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

Collision Modifiers

difference Collision Modifier, stack Collision Modifier

Valid Functions

color.brightness Function, closed Function, color Function (For Graphic Elements), color.hue Function, jump Function, label Function (For Graphic Elements), missing.gap Function, missing.interpolate Function, missing.wings Function, texture.pattern Function, position Function, preserveStraightLines Function, color.saturation Function, scale Function (For Graphic Elements), split Function, transparency Function

Applies To

ELEMENT Statement

bar Element

Description

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

Examples

Figure 2-48
Example: Bar chart

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

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

Figure 2-49
Example: Minimum spanning tree

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

Figure 2-50
Example: Convex hull

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

Valid Functions

color.brightness Function, closed Function, color Function (For Graphic Elements), color.hue Function, label Function (For Graphic Elements), missing.gap Function, missing.interpolate Function, missing.wings Function, position Function, preserveStraightLines Function, color.saturation Function, scale Function (For Graphic Elements), shape Function, size Function, split Function, transparency Function

Applies To

ELEMENT Statement

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

Figure 2-51
Example: Bar chart

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

Figure 2-52
Example: Histogram

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

Figure 2-53
Example: Error bar chart

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

Figure 2-54
Example: Stacked bar chart

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

Collision Modifiers

dodge Collision Modifier, stack Collision Modifier

Valid Functions

color.brightness Function, color Function (For Graphic Elements), color.hue Function, label Function (For Graphic Elements), texture.pattern Function, position Function, color.saturation Function, scale Function (For Graphic Elements), shape Function, size Function, split Function, transparency Function

Applies To

ELEMENT Statement

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 on p. 51 for more information about the path graphic element.

Examples

Figure 2-55
Example: Line chart of continuous variables

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

Figure 2-56
Example: Line chart of a summary statistic

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

Collision Modifiers

stack Collision Modifier

Valid Functions

color.brightness Function, closed Function, color Function (For Graphic Elements), color.hue Function, jump Function, label Function (For Graphic Elements), missing.gap Function, missing.interpolate Function, missing.wings Function, position Function, preserveStraightLines Function, color.saturation Function, scale Function (For Graphic Elements), shape Function, size Function, split Function, transparency Function

Applies To

ELEMENT Statement

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

Figure 2-57
Example: Line chart drawn through all values

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

Figure 2-58
Example: Creating a line chart with variable widths

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

Valid Functions

color.brightness Function, closed Function, color Function (For Graphic Elements), color.hue Function, label Function (For Graphic Elements), missing.gap Function, missing.interpolate Function, missing.wings Function, position Function, preserveStraightLines Function, color.saturation Function, scale Function (For Graphic Elements), shape Function, size Function, split Function, transparency Function

Applies To

ELEMENT Statement

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

Figure 2-59
Example: Scatterplot

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

Figure 2-60
Example: Dot plot

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

Collision Modifiers

dodge.asymmetric Collision Modifier, dodge.symmetric Collision Modifier, jitter Collision Modifier, stack Collision Modifier

Valid Functions

color.brightness Function, color Function (For Graphic Elements), color.hue Function, label Function (For Graphic Elements), texture.pattern Function, position Function, color.saturation Function, scale Function (For Graphic Elements), shape Function, size Function, split Function, transparency Function

Applies To

ELEMENT Statement

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

Figure 2-61
Example: Hexagonal binning

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

Valid Functions

color.brightness Function, color Function (For Graphic Elements), color.hue Function, label Function (For Graphic Elements), position Function, preserveStraightLines Function, color.saturation Function, scale Function (For Graphic Elements), shape Function, size Function, split Function, transparency Function

Applies To

ELEMENT Statement

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

Figure 2-62
Example: Boxplot

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

Valid Functions

color.brightness Function, color Function (For Graphic Elements), color.hue Function, label Function (For Graphic Elements), texture.pattern Function, position Function, color.saturation Function, scale Function (For Graphic Elements), size Function, split Function, transparency Function

Applies To

ELEMENT Statement

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

Figure 2-63
Example: Difference area chart

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

Valid Element Types

area Element

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 p. 56.)

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

Figure 2-64
Example: 2-D Dot plot

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

Figure 2-65
Example: Dodged bar chart

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

Valid Element Types

interval Element, point Element

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

Figure 2-66
Example: 1-D Dot plot

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

Valid Element Types

point Element

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

Figure 2-67
Example: 2-D Dot plot

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

Valid Element Types

point Element

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

Figure 2-68
Example: Jittered categorical point chart

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

Table 2-1
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
`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

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

Figure 2-69
Example: Stacked bar chart

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

Valid Element Types

area Element, interval Element, line Element, point Element

Functions

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

Aesthetic Functions

color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, shape Function, size Function, texture.pattern Function, transparency Function

Data Functions

col Function, iter Function, mapVariables Function

Data Source Functions

csvSource Function, mapSource Function, userSource Function

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Graph Control Functions

begin Function (For Graphs), end Function

Missing Value Functions for Lines and Areas

missing.gap Function, missing.interpolate Function, missing.wings Function

Percentage Base Functions

base.aesthetic Function, base.all Function, base.coordinate Function

Sort Functions

sort.data Function, sort.natural Function, sort.statistic Function, sort.values Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Transformation Functions

collapse Function, eval Function, index Function

Other Functions

aestheticMaximum Function, aestheticMinimum Function, aestheticMissing Function, base Function, begin Function (For Graphs), begin Function (For Pages), beta Function, binCount Function, binStart Function, binWidth Function, chiSquare Function, closed Function, cluster Function, color Function (For Axes), dataMinimum Function, dataMaximum Function, delta Function, dim Function, end Function, exclude Function, exponent Function, exponential Function, f Function, format Function, from Function, gamma Function, gap Function, gridlines Function, in Function, include Function, jump Function, label Function (For Graphic Elements), label Function (For Guides), logistic Function, map Function, marron Function, max Function, min Function, noConstant Function, node Function, notIn Function, normal Function, opposite Function, origin Function (For Graphs), origin Function (For Scales), poisson Function, position Function, preserveStraightLines Function, proportion Function, reverse Function, root Function, sameRatio Function, scale Function (For Axes), scale Function (For Graphs), scale Function (For Graphic Elements), scale Function (For Pages), segments Function, showAll Function, split Function, start Function, startAngle Function, studentizedRange Function, t Function, ticks Function, to Function, uniform Function, unit.percent Function, values Function, weibull Function, weight Function

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

Figure 2-70
Example: Specifying a minimum and maximum size for points in a bubble plot

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

Applies To

asn Scale, atanh Scale, linear Scale, log Scale, logit Scale, pow Scale, prob Scale, probit Scale, safeLog Scale, safePower Scale, time Scale

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

Figure 2-71
Example: Specifying a minimum and maximum size for points in a bubble plot

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

Applies To

asn Scale, atanh Scale, linear Scale, log Scale, logit Scale, pow Scale, prob Scale, probit Scale, safeLog Scale, safePower Scale, time Scale

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

Figure 2-72
Example: Specifying a missing value aesthetic for a scale

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

Applies To

asn Scale, atanh Scale, cat Scale, linear Scale, log Scale, logit Scale, pow Scale, prob Scale, probit Scale, safeLog Scale, safePower Scale, time Scale

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

Figure 2-73
Example: Specifying a different base for a logarithmic scale

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

Applies To

log Scale, safeLog Scale

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

Figure 2-74
Example: Using a variable across clusters as the percentage base

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

Applies To

region.confi.percent.count Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function

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

Figure 2-75
Example: Specifying the total count as the percentage base

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

Figure 2-76
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())))
```

Figure 2-77
Example: Specifying the total count across all panels as the percentage base

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

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

Applies To

region.confi.percent.count Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function

base.coordinate Function

Syntax

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

<numeric>. A numeric value indicating the dimension to which the scale applies. For more information, see dim Function on p. 102.

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

Figure 2-78
Example: Making each stack equal 100%

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

Figure 2-79
Example: Making each cluster 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))
```

Applies To

region.confi.percent.count Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function

begin Function (For 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

Figure 2-80
Example: Scaling a graph by 50%

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

Figure 2-81
Example: Defining a particular graph

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

Valid Functions

origin Function (For Graphs), scale Function (For Graphs)

Applies To

GRAPH Statement

begin Function (For 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

Figure 2-82
Example: Scaling a visualization

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

Valid Functions

scale Function (For Pages)

Applies To

PAGE Statement

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

Figure 2-83
Example: Specifying a beta distribution for the probability scale

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

Applies To

prob Scale

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 p. 4 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. For more information, see dim Function on p. 102.

<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

Figure 2-84
Example: Creating a 1-D dot plot

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

Binning Functions

bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Valid Functions

binCount Function, binStart Function, binWidth Function

Applies To

bin.hex Function, bin.quantile.letter Function, bin.rect Function, density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function,

link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.spread.sd Function, region.spread.se Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

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 p. 4 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. For more information, see dim Function on p. 102.

<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

Figure 2-85
Example: Binned scatterplot

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

Figure 2-86
Example: Binned polygon

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

Binning Functions

bin.dot Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Valid Functions

binCount Function, binStart Function, binWidth Function

Applies To

bin.dot Function, bin.quantile.letter Function, bin.rect Function, density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.spread.sd Function, region.spread.se Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

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 p. 4 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

Figure 2-87
Example: Creating a box plot

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

Binning Functions

bin.dot Function, bin.hex Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count

Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.rect Function, density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.spread.sd Function, region.spread.se Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

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 p. 4 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. For more information, see dim Function on p. 102.

<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

Figure 2-88
Example: Histogram binning

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

Figure 2-89
Example: Histogram binning with specified bin sizes

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

Figure 2-90
Example: Binned scatterplot

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Valid Functions

binCount Function, binStart Function, binWidth Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.spread.sd Function, region.spread.se Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

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

Figure 2-91
Example: Defining a specific number of bins

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

Figure 2-92
Example: Defining a specific number of bins for multiple binned dimensions

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

Applies To

bin.dot Function, bin.hex Function, bin.rect Function

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

Figure 2-93
Example: Specifying the first bin on a continuous scale

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

Figure 2-94
Example: Specifying the first bin on a date scale

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

Figure 2-95
Example: Specifying the first bin for multiple binned dimensions

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

Applies To

bin.dot Function, bin.hex Function, bin.rect Function

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

Figure 2-96
Example: Defining a specific bin width

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

Figure 2-97
Example: Defining a specific bin width for multiple binned dimensions

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

Figure 2-98
Example: Defining a specific bin width for date data

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

Applies To

bin.dot Function, bin.hex Function, bin.rect Function

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

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

Figure 2-99
Example: Creating a closed line

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

Applies To

area Element, edge Element, line Element, path Element

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

Figure 2-100
Example: Clustering on the first dimension in a 2-D coordinate system

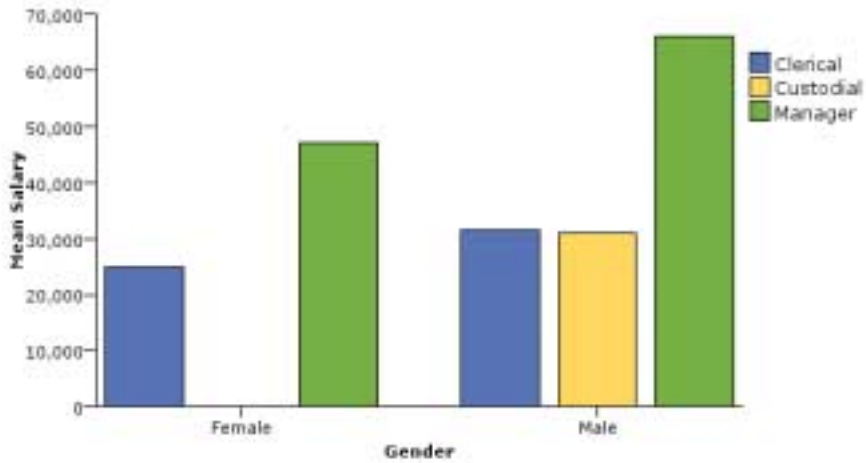
```
COORD: rect(dim(1,2), cluster(3))
ELEMENT: interval(position(summary.mean(jobcat*salary*gender)), color(jobcat))
```

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 = 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 2-101
Clustered bar chart




```
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 2-102
Faceted bar chart

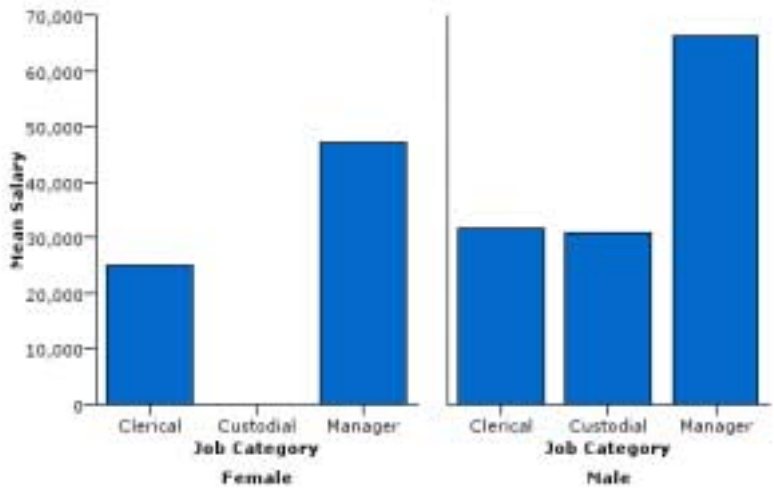


Figure 2-103
Example: Clustering on the first dimension in a 3-D coordinate system

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

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.

Figure 2-104
Example: Clustering on the second dimension in a 3-D coordinate system

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

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

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

Figure 2-105
Example: Specifying a continuous variable from a data source

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

Figure 2-106
Example: Specifying a categorical variable from a data source

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

Figure 2-107
Example: Specifying a date variable from a data source

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

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. For more information, see format Function on p. 110.

Valid Functions

in Function, format Function, notIn Function

Applies To

DATA Statement

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

Figure 2-108
Example: Collapsing categories whose sum is less than 10% of total

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

Applies To

TRANS Statement

color Function (For Axes)

Note: If you are modifying the color for a graphic element (like a bar or point), refer to color Function (For Graphic Elements) on p. 81.

Syntax

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

or

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

<color constant>. A constant indicating a specific color, such as `red`. For more information, see Color Constants in Appendix A on p. 279.

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

Description

Controls the color of the tick marks, tick labels, and axis label for a specific axis.

Examples

Figure 2-109
Example: Specifying an axis color

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

Applies To

axis Guide Type

color Function (For Graphic Elements)

Note: If you are modifying the color for an axis, refer to color Function (For Axes) on p. 80.

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`. For more information, see Color Constants in Appendix A on p. 279. 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

Figure 2-110
Example: Specifying a color value with a constant

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

Figure 2-111
Example: Specifying a color value with RGB color components

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

Figure 2-112
Example: Specifying a color value for the bar border

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

Figure 2-113
Example: Using the values of a variable to control color

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

Figure 2-114
Example: Using a statistical function to control color

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

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

area Element, edge Element, interval Element, line Element, path Element, point Element, polygon Element, schema Element

color.brightness Function

Syntax

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

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.

<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

Figure 2-115
Example: Using the values of a variable to control color brightness

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

Figure 2-116
Example: Using a statistical function to control color brightness

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

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

area Element, edge Element, interval Element, line Element, path Element, point Element, polygon Element, schema Element

color.hue Function

Syntax

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

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.

<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`.

Examples

Figure 2-117
Example: Using the values of a variable to control color hue

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

Figure 2-118
Example: Using a statistical function to control color hue

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

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function,

summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

area Element, edge Element, interval Element, line Element, path Element, point Element, polygon Element, schema Element

color.saturation Function

Syntax

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

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.

<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

Figure 2-119
Example: Using the values of a variable to control color saturation

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

Figure 2-120
Example: Using a statistical function to control color

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

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function,

link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

area Element, edge Element, interval Element, line Element, path Element, point Element, polygon Element, schema Element

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

Figure 2-121
Example: Reading a CSV file

```
SOURCE: mydata = csvSource(file("C:\\Data\\Employee data.csv"))
```

Valid Functions

weight Function

Applies To

SOURCE Statement, mapSource Function

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

Figure 2-122
Example: Specifying a minimum on the 2nd dimension (y axis)

```
SCALE: linear(dim(2), dataMinimum())
```

Applies To

linear Scale, log Scale, pow Scale, safeLog Scale, safePower Scale, time Scale

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

Figure 2-123
Example: Specifying a maximum on the 2nd dimension (y axis)

```
SCALE: linear(dim(2), dataMaximum())
```

Applies To

linear Scale, log Scale, pow Scale, safeLog Scale, safePower Scale, time Scale

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

Figure 2-124
Example: Specifying the distance between major ticks

```
GUIDE: axis(dim(1), delta(1000))
```

Applies To

axis Guide Type

density.beta Function

Syntax

```
density.beta(<algebra>, shape1(<numeric>), shape2(<numeric>))
```

or

```
density.beta(<binning function>, shape1(<numeric>), shape2(<numeric>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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**.

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

Figure 2-125
Example: Adding a beta distribution curve

```
ELEMENT: line(position(density.beta(x, shape1(2), shape2(5))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

density.chiSquare Function

Syntax

```
density.chiSquare(<algebra>, degreesOfFreedom(<integer>))
```

or

```
density.chiSquare(<binning function>, degreesOfFreedom(<integer>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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**.

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

Figure 2-126
Example: Adding a chi-square distribution curve

```
ELEMENT: line(position(density.chiSquare(x, degreesoffreedom(5))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

density.exponential Function

Syntax

```
density.exponential(<algebra>, rate(<numeric>))
```

or

```
density.exponential(<binning function>, rate(<numeric>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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.

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

Figure 2-127
Example: Adding a chi-square distribution curve

```
ELEMENT: line(position(density.exponential(x, rate(1.5))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

density.f Function

Syntax

```
density.f(<algebra>, degreesOfFreedom1(<integer>), degreesOfFreedom2(<integer>))
```

or

```
density.f(<binning function>, degreesOfFreedom1(<integer>), degreesOfFreedom2(<integer>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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**.

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

Figure 2-128
Example: Adding an F distribution curve

```
ELEMENT: line(position(density.f(x, degreesoffreedom1(5), degreesoffreedom2(2))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

density.gamma Function

Syntax

```
density.gamma(<algebra>, rate(<numeric>))
```

or

```
density.gamma(<binning function>, rate(<numeric>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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**.

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

Figure 2-129
Example: Adding a gamma distribution curve

```
ELEMENT: line(position(density.gamma(x, rate(2.5))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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.

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

Figure 2-130
Example: Adding the default kernel distribution

```
ELEMENT: line(position(density.kernel.epanechnikov(x)))
```

Figure 2-131
Example: Adding a kernel distribution using a fixed window

```
ELEMENT: line(position(density.kernel.epanechnikov(x, fixedWindow(0.05))))
```

Figure 2-132
Example: Adding a kernel distribution using k nearest neighbors

```
ELEMENT: line(position(density.kernel.epanechnikov(x, nearestNeighbor(100))))
```

Figure 2-133
Example: Creating a 3-D graph showing kernel densities

```
COORD: rect(dim(1,2,3))
ELEMENT: interval(position(density.kernel.epanechnikov.joint(x*y)))
```

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, segments Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

density.logistic Function

Syntax

```
density.logistic(<algebra>, location(<numeric>), scaleDensity(<numeric>))
```

or

```
density.logistic(<binning function>, location(<numeric>), scaleDensity(<numeric>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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**.

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

Figure 2-134
Example: Adding a logistic distribution curve

```
ELEMENT: line(position(density.logistic(x, location(5), scaleDensity(2))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

density.normal Function

Syntax

```
density.normal(<algebra>, mean(<numeric>), standardDeviation(<numeric>))
```

or

```
density.normal(<binning function>, mean(<numeric>), standardDeviation(<numeric>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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.

Description

Calculates the probability density of the normal distribution. This is often used to add a distribution curve.

Examples

Figure 2-135
Example: Adding a normal curve to a histogram

```
ELEMENT: interval(position(summary.count(bin.rect(x))))
ELEMENT: line(position(density.normal(x)))
```

Figure 2-136
Example: Creating a normal curve with specific parameters

```
ELEMENT: line(position(density.normal(x, mean(50000), standardDeviation(15000))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

density.poisson Function

Syntax

```
density.poisson(<algebra>, rate(<numeric>))
```

or

```
density.poisson(<binning function>, rate(<numeric>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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.

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

Figure 2-137
Example: Adding a Poisson distribution curve

```
ELEMENT: line(position(density.poisson(x, rate(5.5))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

density.studentizedRange Function

Syntax

```
density.studentizedRange(<algebra>, degreesOfFreedom(<integer>), k(<numeric>))
```

or

```
density.studentizedRange(<binning function>, degreesOfFreedom(<integer>), k(<numeric>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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**.

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

Figure 2-138
Example: Adding a Studentized range distribution curve

```
ELEMENT: line(position(density.studentizedRange(x, degreesOfFreedom(5), k(2.5))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

density.t Function

Syntax

```
density.t(<algebra>, degreesOfFreedom(<integer>))
```

or

```
density.t(<binning function>, degreesOfFreedom(<integer>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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**.

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

Figure 2-139
Example: Adding a Student's t distribution curve

```
ELEMENT: line(position(density.t(x, degreesOfFreedom(5))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

density.uniform Function

Syntax

```
density.uniform(<algebra>, min(<numeric>), max(<numeric>))
```

or

```
density.uniform(<binning function>, min(<numeric>), max(<numeric>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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.

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

Figure 2-140
Example: Adding a uniform distribution curve

```
ELEMENT: line(position(density.uniform(x)))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

density.weibull Function

Syntax

```
density.weibull(<algebra>, rate(<numeric>), scaleDensity(<numeric>))
```

or

```
density.weibull(<binning function>, rate(<numeric>), scaleDensity(<numeric>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 for an introduction to graph algebra. The algebra is optional.

<binning function>. A binning function. The binning function is optional. I

<integer>. `rate` and `scaleDensity` define the parameters for the distribution. These take numeric values and are **required**.

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

Figure 2-141
Example: Adding a Weibull distribution curve

```
ELEMENT: line(position(density.logistic(x, location(5), scaleDensity(2))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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:

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:

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

Figure 2-142
Example: Specifying a two-dimensional, rectangular coordinate system

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

Figure 2-143
Example: Specifying an axis label for the second dimension

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

Applies To

parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, asn Scale, atanh Scale, cat Scale, linear Scale, log Scale, logit Scale, pow Scale, prob Scale, probit Scale, safeLog Scale, safePower Scale, time Scale, axis Guide Type, base.coordinate Function, bin.dot Function, bin.hex Function, bin.rect Function, reflect Function

end Function

Syntax

```
end()
```

Description

Specifies the end of the GPL block that defines a particular graph or page.

Examples

Figure 2-144
Example: Defining a particular graph

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

Figure 2-145
Example: Defining a page

```
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()
```

Applies To

GRAPH Statement, PAGE Statement

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. For more information, see Operators and Functions on p. 105. If needed, you can wrap the result of a function in another function. Therefore, `datetostring(date())` is a valid expression.

Examples

Figure 2-146
Example: Plotting the difference between two variables

```
TRANS: saldiff = eval(salary-salbegin)
ELEMENT: point(position(summary.mean(jobcat*saldiff)))
```

Figure 2-147
Example: Creating a graph from an equation

```
DATA: x = iter(-100,100,1)
TRANS: y = eval(x**2)
ELEMENT: line(position(x*y))
```

Applies To

TRANS Statement, collapse Function

Operators and Functions

Following are the operators and functions that you can use with the `eval` function. See eval Function on p. 104 for information about the `eval` function.

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".

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*	
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*	

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	
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.	

Function	Result	Notes
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	
uppercase(string)	*string* with lowercase letters changed to uppercase and other characters unchanged	

Date and Time Functions

Function	Result	Notes
date()	The current date	
time()	The current time	

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

Figure 2-148
Example: Exclude a category

```
SCALE: cat(dim(1), exclude("No Response"))
```

Figure 2-149
Example: Excluding multiple categories

```
SCALE: cat(dim(1), exclude("No Response", "Didn't Ask"))
```

Applies To

cat Scale

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

Figure 2-150
Example: Specifying a different power exponent

```
SCALE: power(dim(2), exponent(3))
```

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

Figure 2-151
Example: Specifying an exponential distribution for the probability scale

```
SCALE: prob(dim(2), exponential(1.5))
```

Applies To

prob Scale

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

format Function

Syntax

```
format("date format")
```

<format>. The date format of the data.

Description

Indicates the date format for a variable in the source. Use one or more of the following abbreviations and date separators to indicate the exact format.

Table 2-2
Abbreviations for date formats

Abbreviation	Meaning
M	Month
d	Day
y	Year
m	Minute
s	Second

Examples

Figure 2-152
Example: Indicating a date format

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

Applies To

col Function

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

Figure 2-153
Example: Creating a directed acyclic graph

```
ELEMENT: edge(position(layout.dag(node(id), from(fromVar), to(toVar))))
```

Applies To

layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function

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

Figure 2-154
Example: Specifying a gamma distribution for the probability scale

```
SCALE: prob(dim(2), gamma(2.5))
```

Applies To

prob Scale

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

Figure 2-155
Example: Forcing adjacent axes to touch

```
GUIDE: axis(dim(3), gap(0px))
```

Applies To

axis Guide Type

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

Figure 2-156
Example: Displaying grid lines

```
GUIDE: axis(dim(2), gridlines())
```

Applies To

axis Guide Type

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

Figure 2-157
Example: Including only a subset of continuous values

```
DATA: gender = col(source(mydata), name("salary"),
                          in(min(0), max(50000)))
```

Applies To

col Function

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

Figure 2-158
Example: Include a category

```
SCALE: cat(dim(1), include("No Response"))
```

Figure 2-159
Example: Including multiple categories

```
SCALE: cat(dim(1), include("No Response", "Didn't Ask"))
```

Figure 2-160
Example: Include a value

```
SCALE: linear(dim(2), include(0))
```

Figure 2-161
Example: Including multiple values

```
SCALE: linear(dim(2), include(0, 100))
```

Applies To

cat Scale, linear Scale, log Scale, pow Scale, safeLog Scale, safePower Scale, time Scale

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

Figure 2-162
Example: Create an index variable and label by the variable

```
TRANS: casenum = index()
ELEMENT: point(position(x*y), label(casenum))
```

Applies To

TRANS Statement, collapse Function

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

Figure 2-163
Example: Creating a graph from an equation

```
DATA: x = iter(-100,100,1)
TRANS: y = eval(x**2)
ELEMENT: line(position(x*y))
```

Applies To

DATA Statement

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

Figure 2-164
Example: Specifying an interpolation line

```
ELEMENT: line(position(smooth.step(educ*salary)), jump())
```

Applies To

area Element, line Element

label Function (For Graphic Elements)

Note: If you are modifying the label for a guide (like an axis), refer to label Function (For Guides) on p. 117.

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, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 for an introduction to graph algebra.

<statistic function>. A valid statistic function.

Description

Specifies a label for a graphic element. The label appears on the graphic element.

Examples

Figure 2-165
Example: Labeling by another variable

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

Figure 2-166
Example: Labeling by the result of a statistic

```
ELEMENT: point(position(summary.count(jobcat)), label(summary.count()))
```

Figure 2-167
Example: Labeling by the result of a statistic

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

Valid Functions

showAll Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

area Element, edge Element, interval Element, line Element, path Element, point Element, polygon Element, schema Element

label Function (For Guides)

Note: If you are modifying the label for a graphic element (like a bar or point), refer to label Function (For Graphic Elements) on p. 115.

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

Figure 2-168
Example: Specifying an axis title

```
GUIDE: axis(dim(1), label("Job Category"))
```

Figure 2-169
Example: Specifying a legend title

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

Figure 2-170
Example: Specifying a graph title

```
GUIDE: text.title(label("Sales By Region"))
```

Applies To

axis Guide Type, legend Guide Type, text.footnote Guide Type, text.subfootnote Guide Type, text.subsubfootnote Guide Type, text.subtitle Guide Type, text.title Guide Type

layout.circle Function

Note: This function is available only if your SPSS Inc. product is licensed to use it. For SPSS Base users, the function is part of an anticipated advanced visualization add-on module.

Syntax

```
layout.circle(<function>))
```

or

```
layout.circle(<algebra>, <function>)
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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).

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

Figure 2-171
Example: Creating a circular network diagram

```
ELEMENT: edge(position(layout.circle(node(id), from(fromVar), to(toVar))))
ELEMENT: point(position(layout.circle(node(id), from(fromVar), to(toVar))), label(id))
```

Valid Functions

from Function, node Function, to Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

layout.dag Function

Note: This function is available only if your SPSS Inc. product is licensed to use it. For SPSS Base users, the function is part of an anticipated advanced visualization add-on module.

Syntax

```
layout.dag(<function>))
```

or

```
layout.dag(<algebra>, <function>)
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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). Other layout options are available for the graph, but the DAG method is appropriate when the data are tree-like (directed) and there is no root node.

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

Figure 2-172
Example: Creating a directed acyclic graph

```
ELEMENT: edge(position(layout.dag(node(id), from(fromVar), to(toVar))))
ELEMENT: point(position(layout.dag(node(id), from(fromVar), to(toVar))), label(id))
```

Valid Functions

from Function, node Function, to Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence

Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

layout.grid Function

Syntax

Note: This function is available only if your SPSS Inc. product is licensed to use it. For SPSS Base users, the function is part of an anticipated advanced visualization add-on module.

```
layout.grid(<function>))
```

or

```
layout.grid(<algebra>, <function>)
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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).

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

Figure 2-173
Example: Creating a grid network diagram

```
ELEMENT: edge(position(layout.grid(node(id), from(fromVar), to(toVar))))
ELEMENT: point(position(layout.grid(node(id), from(fromVar), to(toVar))), label(id))
```

Valid Functions

from Function, node Function, to Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

layout.network Function

Note: This function is available only if your SPSS Inc. product is licensed to use it. For SPSS Base users, the function is part of an anticipated advanced visualization add-on module.

Syntax

```
layout.network(<function>))
```

or

```
layout.network(<algebra>, <function>)
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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).

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

Figure 2-174
Example: Creating a network diagram

```
ELEMENT: edge(position(layout.network(node(id), from(fromVar), to(toVar))))
ELEMENT: point(position(layout.network(node(id), from(fromVar), to(toVar))), label(id))
```

Valid Functions

from Function, node Function, to Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

layout.random Function

Note: This function is available only if your SPSS Inc. product is licensed to use it. For SPSS Base users, the function is part of an anticipated advanced visualization add-on module.

Syntax

```
layout.random(<function>))
```

or

```
layout.random(<algebra>, <function>)
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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).

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

Figure 2-175
Example: Creating a random network diagram

```
ELEMENT: edge(position(layout.random(node(id), from(fromVar), to(toVar))))
ELEMENT: point(position(layout.random(node(id), from(fromVar), to(toVar))), label(id))
```

Valid Functions

from Function, node Function, to Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

layout.tree Function

Note: This function is available only if your SPSS Inc. product is licensed to use it. For SPSS Base users, the function is part of an anticipated advanced visualization add-on module.

Syntax

```
layout.tree(<function>))
```

or

```
layout.tree(<algebra>, <function>)
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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). Other layout options are available for the graph, but the tree method is appropriate when the data are tree-like (directed) and there is a root node. 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

Figure 2-176
Example: Creating a tree

```
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))
```

Valid Functions

from Function, node Function, root Function, to Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-177
Example: Creating an alpha shape graph

```
ELEMENT: edge(position(link.alpha(x*y, radius(50))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function,

region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-178
Example: Creating a complete graph

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-179
Example: Creating a Delaunay triangulation

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step

Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-180
Example: Creating a distance graph

```
ELEMENT: edge(position(link.distance(x*y), radius(5000)))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-181
Example: Creating a Gabriel graph

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess

Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-182
Example: Creating a convex hull

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-183
Example: Creating a sphere of influence graph

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess

Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-184
Example: Creating a bridge plot

```
ELEMENT: edge(position(link.join(x1*y1 + x2*y2)), label(a))
ELEMENT: point(position(x1*y1 + x2*y2), label("Before"+"After"))
```

This example assumes data that is in a format like the following:

Table 2-3
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

Figure 2-185
Example: Drawing vectors from the origin

```
TRANS: zero = eval(0)
ELEMENT: edge(position(link.join(zero*zero + x*y)), shape(shape.arrow))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-186
Example: Creating a minimal spanning tree

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-187
Example: Creating a nearest neighbor graph

```
ELEMENT: edge(position(link.neighbor(x*y, neighborCount(3))))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-188
Example: Creating a relative neighborhood graph

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-189
Example: Creating a sequence graph

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-190
Example: Drawing the solution to the travelling salesman problem

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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

Figure 2-191
Example: Specifying a logistic distribution for the probability scale

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

Applies To

prob Scale

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

Figure 2-192
Example: Mapping a category to a color

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

Figure 2-193
Example: Mapping multiple categories to colors

```
SCALE: cat(aesthetic(aesthetic.color), map(("IL", color.blue), ("CA", color.green)))
```

Applies To

cat Scale

mapSource Function

Syntax

```
mapSource(file("file path"), layer("layer name"), key("key name"))
```

"file path". The path to the map 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.

"layer name". The name of the map layer.

"key name". The name of a variable in the file that acts as a key. This is optional, but you can't link the map with a dataset unless you use it.

Description

Reads the contents of an ESRI format map file. This function is used to assign the contents of a specific layer in the file to a data source.

Examples

Figure 2-194
Example: Reading a map file

```
SOURCE: mapdata = mapSource(file("C:\\Data\\usStates.smz"), layer("States"), key("STATE"))
```

Applies To

SOURCE Statement, csvSource Function

mapVariables Function

Note: This function is available only if your SPSS Inc. product is licensed to use it. For SPSS Base users, the function is part of an anticipated advanced visualization add-on module.

Syntax

```
mapVariables(source(<source name>))
```

<source name>. A map data source previously defined by a `SOURCE` statement and the `mapSource` function.

Description

Extracts the longitude and latitude information from a map data source. Although you can use any name for the result, `lon*lat` is recommended.

Examples

Figure 2-195
Example: Using map variables to draw a map

```
SOURCE: mapdata = mapSource(file("C:\\Data\\usStates.smz"), layer("States"), key("STATE"))
DATA: lon*lat = mapVariables(source(mapdata))
ELEMENT: polygon(position(lon*lat))
```

Applies To

DATA Statement

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

Figure 2-196
Example: Adding a kernel distribution

```
ELEMENT: line(position(density.kernel.epanechnikov(x, marron())))
```

Applies To

density.kernel Function

max Function

Syntax

```
max(<numeric>)
```

<numeric>. A numeric value indicating the maximum scale value.

Description

Specifies a maximum value for a scale.

Examples

Figure 2-197
Example: Specifying a maximum on the 2nd dimension (y axis)

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

Applies To

linear Scale, log Scale, pow Scale, safeLog Scale, safePower Scale, time Scale

min Function

Syntax

```
min(<numeric>)
```

<numeric>. A numeric value indicating the minimum scale value.

Description

Specifies a minimum value for a scale.

Examples

Figure 2-198
Example: Specifying a minimum on the 2nd dimension (y axis)

```
SCALE: linear(dim(2), min(0))
```

Applies To

linear Scale, log Scale, pow Scale, safeLog Scale, safePower Scale, time Scale

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

Figure 2-199
Example: Mirroring dimensions in a population pyramid

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

Coordinate Types and Transformations

parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, project Function, reflect Function, transpose Function, wrap Function

Applies To

COORD Statement, parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, project Function

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

Figure 2-200
Example: Specifying gaps for missing values

```
ELEMENT: line(position(x*y), missing.gap())
```

Applies To

area Element, edge Element, line Element, path Element

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

Figure 2-201
Example: Interpolating through missing values

```
ELEMENT: line(position(x*y), missing.interpolate())
```

Applies To

area Element, edge Element, line Element, path Element

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

Figure 2-202
Example: Specifying wings for missing values

```
ELEMENT: line(position(x*y), missing.wings())
```

Applies To

area Element, edge Element, line Element, path Element

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

Figure 2-203
Example: Creating a linear fit line through the origin

```
ELEMENT: line(position(smooth.linear(salbegin*salary, noConstant())))
```

Applies To

smooth.linear Function

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

Figure 2-204
Example: Creating a directed acyclic graph

```
ELEMENT: edge(position(layout.dag(node(id), from(fromVar), to(toVar))))
```

Applies To

layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function

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

Figure 2-205
Example: Excluding a category from a variable

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

Applies To

col Function

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

Figure 2-206
Example: Specifying a normal distribution for the probability scale

```
SCALE: prob(dim(2), normal(50000, 15000))
```

Applies To

prob Scale

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

Figure 2-207
Example: Moving the y-axis to the opposite side

```
GUIDE: axis(dim(2), label("Count"), opposite())
```

Figure 2-208
Example: Adding a derived axis

```
GUIDE: axis(dim(2), label("Cumulative Count"))
GUIDE: axis(dim(2), label("Cumulative Percent"), opposite(), unit.percent())
```

Applies To

axis Guide Type

origin Function (For Graphs)

Note: If you are modifying the origin for a scale, refer to origin Function (For Scales) on p. 153.

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

Figure 2-209
Example: Positioning a graph with absolute units

```
GRAPH: start(origin(2in, 4in))
```

Figure 2-210
Example: Positioning a graph with percentages

```
GRAPH: start(origin(10%, 100%))
```

Applies To

begin Function (For Graphs)

origin Function (For Scales)

Note: If you are modifying the origin for a graph, refer to origin Function (For Graphs) on p. 152.

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

Figure 2-211
Example: Specifying the origin

```
SCALE: linear(dim(2), origin(100))
```

Applies To

linear Scale, log Scale, pow Scale, safeLog Scale, safePower Scale, time Scale

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

Figure 2-212
Example: Specifying a poisson distribution for the probability scale

```
SCALE: prob(dim(2), poisson(5.5))
```

Applies To

prob Scale

position Function

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 p. 4 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

Figure 2-213
Example: Scatterplot

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

Figure 2-214
Example: Bar chart of means

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

area Element, edge Element, interval Element, line Element, path Element, point Element, polygon Element, schema Element

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

Figure 2-215
Example: Drawing straight lines

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

Applies To

area Element, edge Element, line Element, path Element, polygon Element

project Function

Syntax

```
project.<projection>()
```

<projection>. A valid projection name.

Description

Transforms the coordinate system using a map projection.

Examples

Figure 2-216
Example: Creating a map

```
SOURCE: mapsrc = mapSource(file("World.smz"), layer("World"))
DATA: lon*lat = mapVariables(source(mapsrc))
COORD: project.mercator()
ELEMENT: polygon(position(lon*lat))
```

Valid Projection Names

lambert

mercator

transverseMercator

winkelTripel

Applies To

COORD Statement, parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type

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

Figure 2-217
Example: Creating a loess fit line with specific smoother window

```
ELEMENT: line(position(smooth.loess(salbegin*salary, proportion(0.9))))
```

Applies To

smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.quadratic Function

reflect Function

Syntax

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

<numeric>. A numeric value indicating the dimension across which the graph is reflected. For more information, see dim Function on p. 102.

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

Description

Reflects the coordinate system across the specified dimension.

Examples

Figure 2-218
Example: Creating an icicle plot

```
COORD: rect(dim(1,2), reflect(dim(2)))
ELEMENT: interval(position(x*y))
```

Coordinate Types and Transformations

parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, mirror Function, project Function, transpose Function, wrap Function

Applies To

COORD Statement, parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, project Function

region.confi.count Function

Syntax

```
region.confi.count(<algebra>, alpha(<numeric>))
```

or

```
region.confi.count(<statistic function>, alpha(<numeric>))
```

<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 p. 4 for an introduction to graph algebra.

<statistic function>. Another statistic function. The result of the embedded statistic is used to calculate `region.confi.count`.

<numeric>. A numeric value between 0 and 1 indicating the alpha for the confidence interval calculation. This is optional. If omitted, the alpha is 0.95.

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

Figure 2-219
Example: Creating error bars

```
ELEMENT: interval(position(region.confi.count(jobcat)), shape(shape.ibeam))
```

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree

Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

region.confi.mean Function

Syntax

```
region.confi.mean(<algebra>, alpha(<numeric>))
```

or

```
region.confi.mean(<statistic function>, alpha(<numeric>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 for an introduction to graph algebra.

<numeric>. A numeric value between 0 and 1 indicating the alpha for the confidence interval calculation. This is optional. If omitted, the alpha is 0.95.

<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

Figure 2-220
Example: Creating error bars

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

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

region.confi.percent.count Function

Syntax

```
region.confi.percent.count(<algebra>, alpha(<numeric>), <base function>)
```

or

```
region.confi.percent.count(<statistic function>, alpha(<numeric>), <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 p. 4 for an introduction to graph algebra.

<numeric>. A numeric value between 0 and 1 indicating the alpha for the confidence interval calculation. This is optional. If omitted, the alpha is 0.95.

<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 valu and one showing the confidence interval above the percentage valu.

Examples

Figure 2-221
Example: Creating error bars

```
ELEMENT: interval(position(region.confi.percent.count(jobcat)), shape(shape.ibeam))
```

Base Functions

base.aesthetic Function, base.all Function, base.coordinate Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function,

link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

region.confi.smooth Function

Syntax

```
region.confi.smooth.<smooth function>(<algebra>, alpha(<numeric>))
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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`.

<numeric>. A numeric value between 0 and 1 indicating the alpha for the confidence interval calculation. This is optional. If omitted, the alpha is 0.95.

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

Figure 2-222
Example: Showing the confidence interval around a fit line

```
ELEMENT: line(position(region.confi.smooth.linear(salbegin*salary)))
```

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

`region.spread.range` 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

Figure 2-223
Example: Range bar showing minimum and maximum of one variable

```
ELEMENT: interval(position(region.spread.range(jobcat*salary)))
```

Figure 2-224
Example: Range bar showing minimum of one variable to maximum of another

```
ELEMENT: interval(position(region.spread.range(jobcat*(salbegin+salary))))
```

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

region.spread.sd Function

Syntax

```
region.spread.sd(<algebra>)
```

or

```
region.spread.sd(<binning function>)
```

or

```
region.spread.sd(<statistic function>)
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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`.

Description

`region.spread.sd` calculates 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

Figure 2-225
Example: Creating an error bar

```
ELEMENT: interval(position(region.spread.sd(jobcat*salary)))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function,

region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

region.spread.se Function

Syntax

```
region.spread.se(<algebra>)
```

or

```
region.spread.se(<binning function>)
```

or

```
region.spread.se(<statistic function>)
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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`.

Description

`region.spread.se` calculates 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

Figure 2-226
Example: Creating an error bar

```
ELEMENT: interval(position(region.spread.se(jobcat*salary)))
```

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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

Figure 2-227
Example: Using reverse alpha-numeric sorting

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

Figure 2-228
Example: Reversing a linear scale

```
SCALE: linear(dim(2), reverse())
```

Figure 2-229
Example: Reversing the direction of a coordinate system

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

Applies To

polar Coordinate Type, polar.theta Coordinate Type, cat Scale, linear Scale, log Scale, pow Scale, safeLog Scale, safePower Scale, time Scale

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

Figure 2-230
Example: Specifying a root node

```
ELEMENT: edge(position(layout.tree(node(id), from(fromVar), to(toVar), root("A"))))
```

Applies To

layout.tree Function

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

Figure 2-231
Example: Creating a scatterplot with equal scales

```
COORD: rect(dim(1,2), sameRatio())
ELEMENT: point(position(salbegin*salary))
```

Applies To

rect Coordinate Type

scale Function (For Axes)

Note: If you are specifying a size for a graph, refer to scale Function (For Graphs) on p. 170. If you are specifying a scale associated with a graphic element (like a bar or line), refer to scale Function (For Graphic Elements) on p. 170. If you are specifying a size for a page, refer to scale Function (For Pages) on p. 171.

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

Figure 2-232
Example: Associating an axis with a named scale

```
SCALE: y2= linear(dim(2))
GUIDE: axis(scale(y2), label("Count"))
```

Applies To

axis Guide Type

scale Function (For Graphs)

Note: If you are specifying a scale associated with an axis, refer to scale Function (For Axes) on p. 169. If you are specifying a scale associated with a graphic element (like a bar or line), refer to scale Function (For Graphic Elements) on p. 170. If you are specifying a size for a page, refer to scale Function (For Pages) on p. 171.

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

Figure 2-233
Example: Sizing a graph with absolute units

```
GRAPH: begin(scale(2in, 4in))
```

Figure 2-234
Example: Sizing a graph with percentages

```
GRAPH: begin(scale(80%, 100%))
```

Applies To

begin Function (For Graphs)

scale Function (For Graphic Elements)

Note: If you are specifying a scale associated with an axis, refer to scale Function (For Axes) on p. 169. If you are specifying a size for a graph, refer to scale Function (For Graphs) on p. 170. If you are specifying a size for a page, refer to scale Function (For Pages) on p. 171.

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 applies.

Examples

Figure 2-235
Example: Associating a graphic element with a named scale

```
SCALE: y2= linear(dim(2))
ELEMENT: line(scale(y2), position(summary.count(x)))
```

Applies To

area Element, edge Element, interval Element, line Element, path Element, point Element, polygon Element, schema Element

scale Function (For Pages)

Note: If you are specifying a scale associated with an axis, refer to scale Function (For Axes) on p. 169. If you are specifying a scale associated with a graphic element (like a bar or line), refer to scale Function (For Graphic Elements) on p. 170. If you are specifying a size for a graph, refer to scale Function (For Graphs) on p. 170.

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

Figure 2-236
Example: Sizing a visualization

```
PAGE: begin(scale(500px, 400px))
```

Applies To

begin Function (For Pages)

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

Figure 2-237
Example: Adding a kernel distribution

```
ELEMENT: line(position(density.kernel.epanechnikov(x, segments(150))))
```

Applies To

density.kernel Function

shape Function

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`. For more information, see Shape Constants in Appendix A on p. 280.

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 line elements. `shape.exterior` specifies the shape of the exterior of the graphic element, which is often the border on graphic elements with fills. Using `shape` without a qualifier implies `shape.interior`.

Examples

Figure 2-238
Example: Specifying a shape value

```
ELEMENT: point(position(salbegin*salary), shape.interior(shape.square))
```

Figure 2-239
Example: Using the values of a variable to control shape

```
ELEMENT: point(position(salbegin*salary), shape.interior(jobcat))
```

Figure 2-240
Example: Using the values of a variable to control line dashing

```
ELEMENT: line(position(salbegin*salary), shape.interior(jobcat))
```

Figure 2-241
Example: Using the values of a variable to control border dashing

```
ELEMENT: interval(position(gender*salary*jobcat), shape.exterior(gender))
```

Applies To

edge Element, interval Element, line Element, path Element, point Element, polygon Element

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

Figure 2-242
Example: Displaying all labels

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

Applies To

label Function (For Graphic Elements)

size Function

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. For more information, see Size Constants in Appendix A on p. 280.

<statistic function>. A statistic function.

Description

Specifies the size of the individual graphic elements.

Examples

Figure 2-243
Example: Using a variable to control size

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

Figure 2-244
Example: Specifying a percentage for size

```
ELEMENT: interval(position(x*y), size(size."60%"))
```

Figure 2-245
Example: Specifying a value for size

```
ELEMENT: interval(position(x*y), size(size."6px"))
```

Figure 2-246
Example: Specifying a constant for size

```
ELEMENT: interval(position(x*y), size(size.large))
```

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean

Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

edge Element, interval Element, line Element, path Element, point Element, polygon Element, schema Element

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 p. 4 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

Figure 2-247
Example: Creating a cubic fit line

```
ELEMENT: line(position(smooth.cubic(salbegin*salary)))
```

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

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-248
Example: Creating a linear fit line

```
ELEMENT: line(position(smooth.linear(salbegin*salary)))
```

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, noConstant Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count,

summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-249
Example: Creating a loess fit line

```
ELEMENT: line(position(smooth.loess(salbegin*salary)))
```

Figure 2-250
Example: Creating a loess fit line with specific kernel

```
ELEMENT: line(position(smooth.loess.uniform(salbegin*salary)))
```

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

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-251
Example: Creating a line at the mean of the y axis

```
ELEMENT: line(position(smooth.mean.uniform(salbegin*salary)))
```

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

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-252
Example: Creating a line at the median of the y axis

```
ELEMENT: line(position(smooth.median.uniform(salbegin*salary)))
```

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

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence

Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

smooth.spline Function

Syntax

```
smooth.spline(<algebra>)
```

<algebra>. Graph algebra, such as `x*y`. Refer to Brief Overview of GPL Algebra on p. 4 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

Figure 2-253
Example: Creating a cubic spline curve

```
ELEMENT: line(position(smooth.spline(salbegin*salary)))
```

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-254
Example: Creating a step interpolation line

```
ELEMENT: line(position(smooth.step.center(salbegin*salary)))
```

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-255
Example: Creating a quadratic fit line

```
ELEMENT: line(position(smooth.quadratic(salbegin*salary)))
```

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

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean

Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 SPSS 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

Figure 2-256
Example: Sorting the categories

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

Applies To

cat Scale

sort.natural Function

Syntax

```
sort.natural()
```

Description

Sorts the categorical values in alphanumeric order.

Examples

Figure 2-257
Example: Sorting the categories

```
SCALE: cat(dim(1), values("Male", "Female"), sort.natural())
```

Applies To

cat Scale

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

Figure 2-258
Example: Sorting the categories

```
SCALE: cat(dim(1), sort.statistic(summary.mean(salary)))
```

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

cat Scale

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.

Examples

Figure 2-259
Example: Sorting the categories explicitly

```
SCALE: cat(dim(1), sort.values("Male"))
```

In this example, *Male* will appear first. It is not necessary to specify that *Female* will appear next.

Applies To

cat Scale

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

Figure 2-260
Example: Creating groups of lines

```
ELEMENT: line(position(salbegin*salary), split(gender))
```

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

area Element, edge Element, interval Element, line Element, path Element, point Element, polygon Element, schema Element

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

Figure 2-261
Example: Specifying the first major tick

```
GUIDE: axis(dim(1), start(1000))
```

Applies To

axis Guide Type

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

Figure 2-262
Example: Specifying the first slice at 9:00

```
COORD: polar.theta(startAngle(90))
```

Figure 2-263
Example: Specifying the first slice at 3:00 (90 degrees)

```
COORD: polar.theta(startAngle(-90))
```

Applies To

polar Coordinate Type, polar.theta Coordinate Type

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

Figure 2-264
Example: Specifying a Studentized range distribution for the probability scale

```
SCALE: prob(dim(2), studentizedRange(5, 2.5))
```

Applies To

prob Scale

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 p. 4 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

Figure 2-265
Example: Specifying a bar chart of counts

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

Figure 2-266
Example: Counting non-missing cases for a continuous variable

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

Figure 2-267
Example: Specifying a histogram

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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

Figure 2-268
Example: Specifying a bar chart of cumulative counts

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

Figure 2-269
Example: Specifying a cumulative histogram

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count

Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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 for variables identified by the algebra. The actual variable whose maximum is being calculated depends on the coordinate system. In a 2-D coordinate system, it is the second crossed variable in the algebra. In a 3-D coordinate system, it is the third crossed variable.

Examples

Figure 2-270
Example: Calculating the maximum

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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 mean for the variables identified by the algebra. The actual variable whose mean is being calculated depends on the coordinate system. In a 2-D coordinate system, it is the second crossed variable in the algebra. In a 3-D coordinate system, it is the third crossed variable.

Examples

Figure 2-271
Example: Calculating the mean

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function,

smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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 for variables identified by the algebra. The actual variable whose minimum is being calculated depends on the coordinate system. In a 2-D coordinate system, it is the second crossed variable in the algebra. In a 3-D coordinate system, it is the third crossed variable.

Examples

Figure 2-272
Example: Calculating the minimum

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

summary.percent Function

Description

`summary.percent` is an alias for `summary.percent.sum`. For more information, see summary.percent.sum on p. 202.

Examples

Figure 2-273
Example: Calculating percentages of a summed variable

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

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

summary.percent.count

Syntax

```
summary.percent.count(<algebra>, <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 p. 4 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()`.

<statistic function>. Another statistic function. The result of the embedded statistic is used to calculate `summary.percent.count`.

Description

Calculates the percentage within each group compared to the total number of cases.

Examples

Figure 2-274
Example: Calculating percentages of counts

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

Base Functions

base.aesthetic Function, base.all Function, base.coordinate Function

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function,

summary.min Function, summary.percent Function, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

summary.percent.count.cumulative Function

```
summary.percent.count.cumulative(<algebra>, <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 p. 4 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()`.

<statistic function>. Another statistic function. The result of the embedded statistic is used to calculate `summary.percent.count.cumulative`.

Description

Calculates the cumulative percentage 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

Figure 2-275
Example: Calculating cumulative percentages of counts

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

Base Functions

base.aesthetic Function, base.all Function, base.coordinate Function

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function,

layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

summary.percent.cumulative Function

Description

`summary.percent.cumulative` is an alias for `summary.percent.sum.cumulative`. For more information, see summary.percent.sum.cumulative Function on p. 203.

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

Figure 2-276
Example: Calculating cumulative percentages of a summed variable

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

summary.percent.sum

Syntax

```
summary.percent.sum(<algebra>, <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 p. 4 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()`.

<statistic function>. Another statistic function. The result of the embedded statistic is used to calculate `summary.percent.sum`.

Description

Calculates the percentage within each group 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. For more information, see summary.percent.count on p. 198.

Examples

Figure 2-277
Example: Calculating percentages of a summed variable

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

Base Functions

base.aesthetic Function, base.all Function, base.coordinate Function

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range

Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function, transparency Function

summary.percent.sum.cumulative Function

```
summary.percent.sum.cumulative(<algebra>, <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 p. 4 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()`.

<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 group 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. For more information, see summary.percent.count.cumulative Function on p. 200.

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

Figure 2-278
Example: Calculating cumulative percentages of a summed variable

```
ELEMENT: interval(position(summary.percent.sum.cumulative(jobcat*salary)))
```

Base Functions

base.aesthetic Function, base.all Function, base.coordinate Function

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.sum Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count

Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.sum Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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 for the variables identified by the algebra. The actual variable being summed depends on the coordinate system. In a 2-D coordinate system, it is the second crossed variable in the algebra. In a 3-D coordinate system, it is the third crossed variable.

Examples

Figure 2-279
Example: Calculating the sum

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function,

link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum.cumulative Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum.cumulative Function, transparency Function

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 p. 4 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 for the variables identified by the algebra. The actual variable being summed depends on the coordinate system. In a 2-D coordinate system, it is the second crossed variable in the algebra. In a 3-D coordinate system, it is the third crossed variable.

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

Figure 2-280
Example: Calculating the cumulative sum

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

Binning Functions

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function

Applies To

bin.dot Function, bin.hex Function, bin.quantile.letter Function, bin.rect Function, color Function (For Graphic Elements), color.brightness Function, color.hue Function, color.saturation Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, position Function, region.confi.count Function, region.confi.mean

Function, region.confi.percent.count Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, size Function, split Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, transparency Function

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

Figure 2-281
Example: Specifying a Student's t distribution for the probability scale

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

Applies To

prob Scale

texture.pattern Function

Syntax

```
texture.pattern(<algebra>)
```

or

```
texture.pattern(texture.pattern.<pattern constant>)
```

<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`. For more information, see Pattern Constants in Appendix A on p. 280.

Description

Controls the fill pattern of the associated graphic element. Note that the color of the pattern is controlled by `color.exterior`.

Examples

Figure 2-282
Example: Specifying a pattern

```
ELEMENT: line(position(x*y), texture.pattern(texture.pattern.checkered))
```

Figure 2-283
Example: Using the values of a variable to control pattern

```
ELEMENT: point(position(x*y), texture.pattern(z))
```

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

area Element, interval Element, point Element, schema Element

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

Figure 2-284
Example: Hiding tick marks

```
GUIDE: axis(dim(2), ticks(null()))
```

Applies To

axis Guide Type

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

Figure 2-285
Example: Creating a directed acyclic graph

```
ELEMENT: edge(position(layout.dag(node(id), from(fromVar), to(toVar))))
```

Applies To

layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function

transparency Function

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

Figure 2-286
Example: Using a variable to control transparency

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

Figure 2-287
Example: Specifying a value for transparency

```
ELEMENT: interval(position(x*y), transparency(transparency."0.6"))
```

Figure 2-288
Example: Specifying a transparency for the fill

```
ELEMENT: interval(position(x*y),
         transparency.interior(transparency."0.8"))
```

Statistic Functions

density.beta Function, density.chiSquare Function, density.exponential Function, density.f Function, density.gamma Function, density.kernel Function, density.logistic Function, density.normal Function, density.poisson Function, density.studentizedRange Function, density.t Function, density.uniform Function, density.weibull Function, layout.circle Function, layout.dag Function, layout.grid Function, layout.network Function, layout.random Function, layout.tree Function, link.alpha Function, link.complete Function, link.delaunay Function, link.distance Function, link.gabriel Function, link.hull Function, link.influence Function, link.join Function, link.mst Function, link.neighbor Function, link.relativeNeighborhood Function, link.sequence Function, link.tsp Function, region.confi.count Function, region.confi.mean Function, region.confi.percent.count Function, region.confi.smooth Function, region.spread.range Function, region.spread.sd Function, region.spread.se Function, smooth.cubic Function, smooth.linear Function, smooth.loess Function, smooth.mean Function, smooth.median Function, smooth.spline Function, smooth.step Function, smooth.quadratic Function, summary.count Function, summary.count.cumulative Function, summary.max Function, summary.mean

Function, summary.min Function, summary.percent Function, summary.percent.count, summary.percent.count.cumulative Function, summary.percent.cumulative Function, summary.percent.sum, summary.percent.sum.cumulative Function, summary.sum Function, summary.sum.cumulative Function

Applies To

area Element, edge Element, interval Element, line Element, path Element, point Element, polygon Element, schema Element

transpose Function

Syntax

```
transpose(<coord>)
```

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

Description

Transposes the coordinate system.

Examples

Figure 2-289
Example: Transposing a 2-D rectangular coordinate system

```
COORD: transpose()
```

Figure 2-290
Example: Transposing a clustered coordinate system

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

Coordinate Types and Transformations

parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, mirror Function, project Function, reflect Function, wrap Function

Applies To

COORD Statement, parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, project Function

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

Figure 2-291
Example: Specifying a uniform distribution for the probability scale

```
SCALE: prob(dim(2), uniform(5000, 20000))
```

Applies To

prob Scale

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

Figure 2-292
Example: Adding a percent axis

```
GUIDE: axis(dim(2), label("Percent"), unit.percent())
```

Applies To

axis Guide Type

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 SPSS `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 SPSS application passes to GPL.

Examples

Figure 2-293
Example: Reading a userSource

```
SOURCE: mydata = userSource(id("graphdataset"))
```

Valid Functions

weight Function

Applies To

SOURCE Statement, csvSource Function, mapSource Function

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

Figure 2-294
Example: Specifying the categories

```
SCALE: cat(dim(1), values("Male", "Female"))
```

Applies To

cat Scale

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

Figure 2-295
Example: Specifying a Weibull distribution for the probability scale

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

Applies To

prob Scale

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

Figure 2-296
Example: Specifying a weighted variable

```
SOURCE: mydata = csvSource(file("C:\\Data\\Edge data.csv"), weight(weightedVar))
DATA: weightedVar = col(source(mydata), name("weights"))
```

Applies To

csvSource Function, userSource Function

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

Figure 2-297
Example: Wrapping facets

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

Coordinate Types and Transformations

parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, mirror Function, project Function, reflect Function, transpose Function

Applies To

COORD Statement, parallel Coordinate Type, polar Coordinate Type, polar.theta Coordinate Type, rect Coordinate Type, project Function

Chapter
3

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. For more information, see Using the Examples in Your Application on p. 217.

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 SPSS

E First, you need the right data source. The examples use four different userSources, which correspond to SPSS SAV files. The following table identifies the specific location of these files, relative to the SPSS installation directory.

Table 3-1
userSource files used in the examples

userSource	Location
Cars	<installdir>\Cars.sav
Employeedata	<installdir>\Employee data.sav
stocks2004	<installdir>\Tutorial\sample_files\stocks2004.sav
World95	<installdir>\World95.sav

E 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`.

E 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.
```

Summary Bar Chart Examples

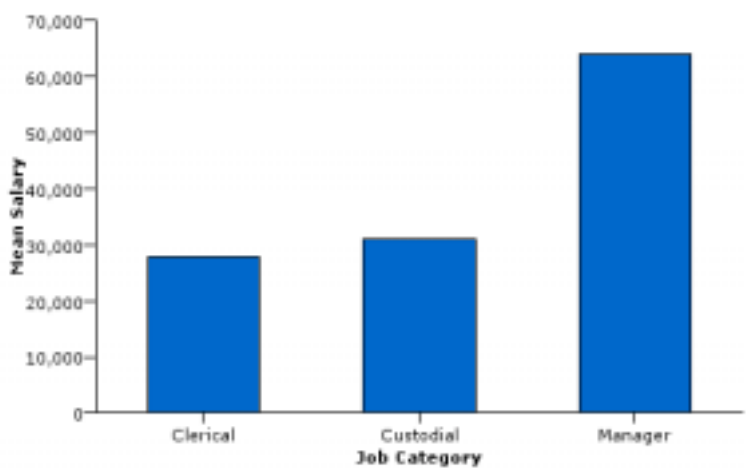
This section provides examples of different types of summary bar charts.

Simple Bar Chart

Figure 3-1
GPL for simple bar chart

```
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 3-2
Simple bar chart

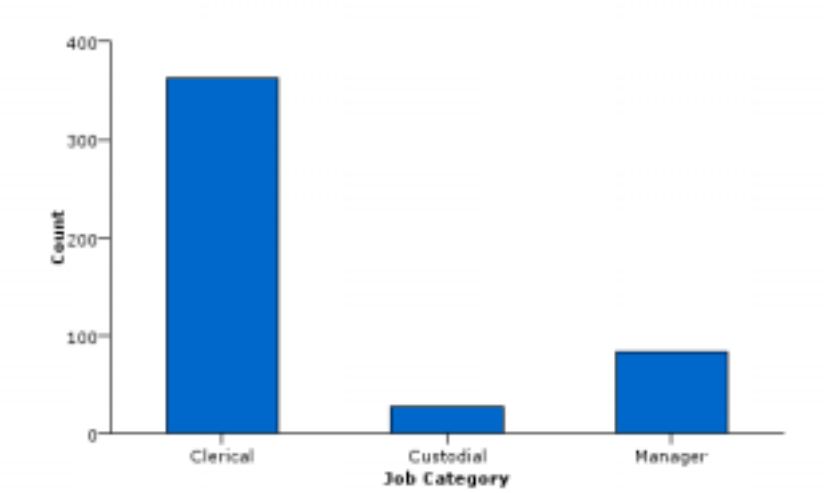


Simple Bar Chart of Counts

Figure 3-3
GPL for simple bar chart of counts

```
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 3-4
Simple bar chart of counts

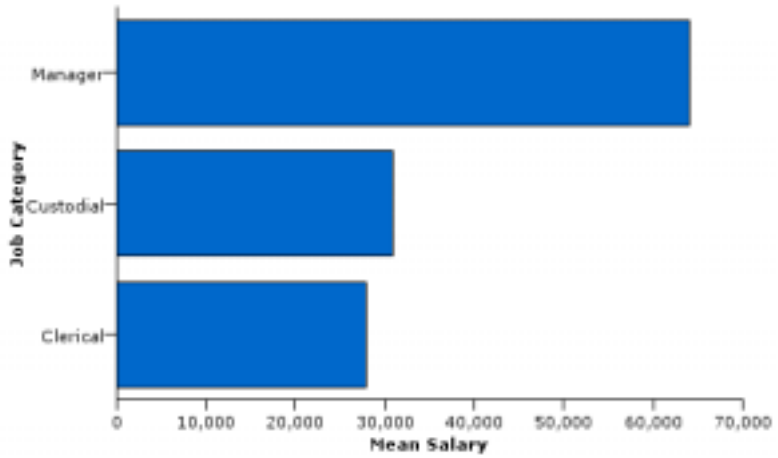


Simple Horizontal Bar Chart

Figure 3-5
GPL for simple horizontal bar chart

```
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 3-6
Simple horizontal bar chart

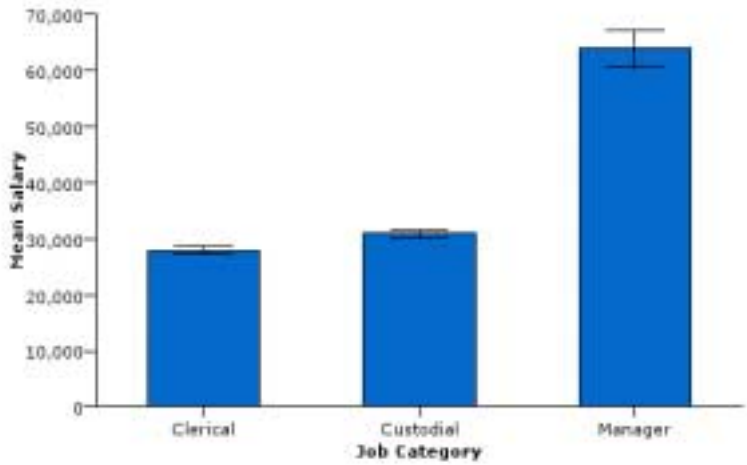


Simple Bar Chart With Error Bars

Figure 3-7
GPL for simple bar chart with error bars

```
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 3-8
Simple bar chart with error bars



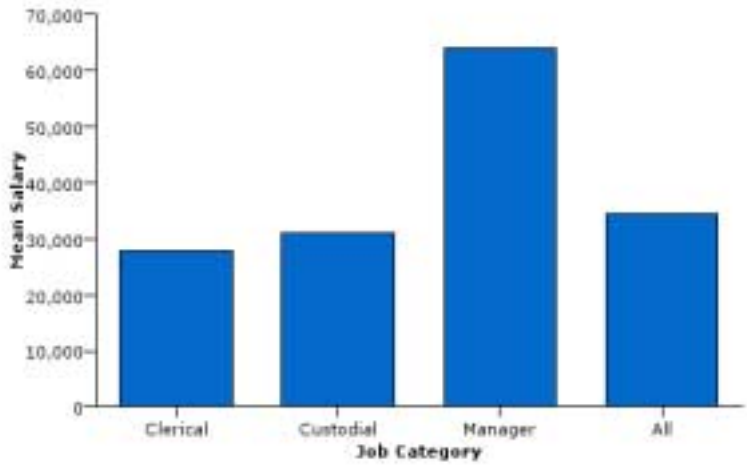
Simple Bar Chart with Bar for All Categories

Figure 3-9
GPL for simple bar chart with bar for all categories

```
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)))
```

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 3-10
Simple bar chart with error bars

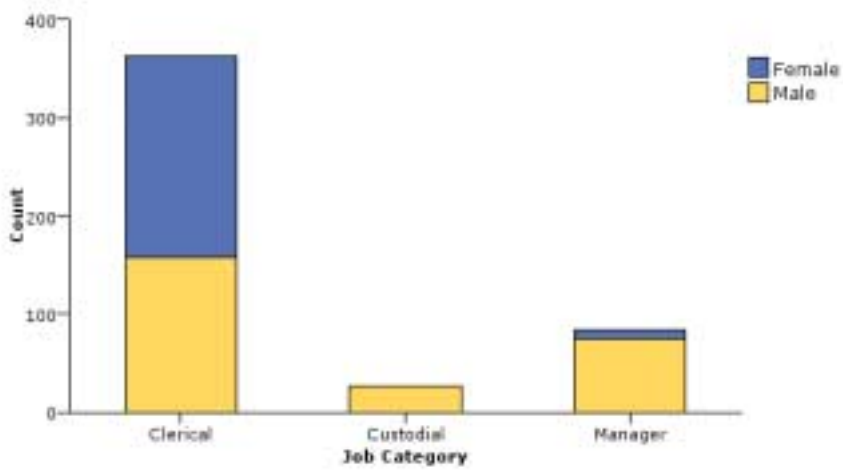


Stacked Bar Chart

Figure 3-11
GPL for stacked bar chart

```
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 3-12
Stacked bar chart

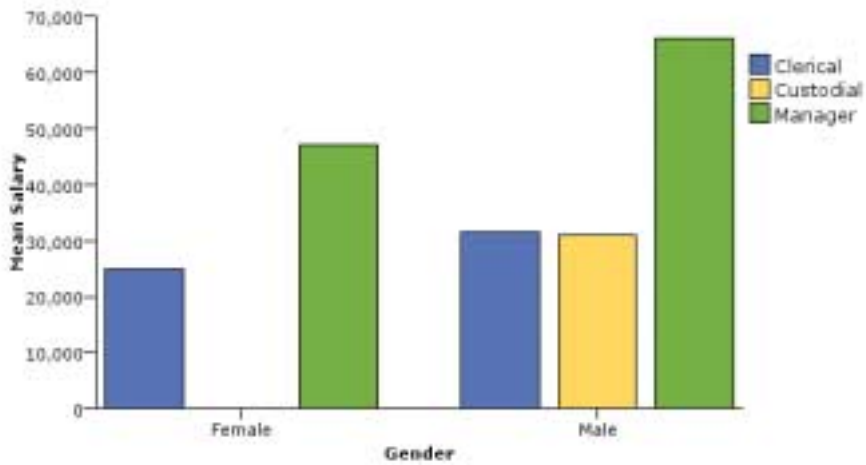


Clustered Bar Chart

Figure 3-13
GPL for clustered bar chart

```
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 3-14
Clustered bar chart

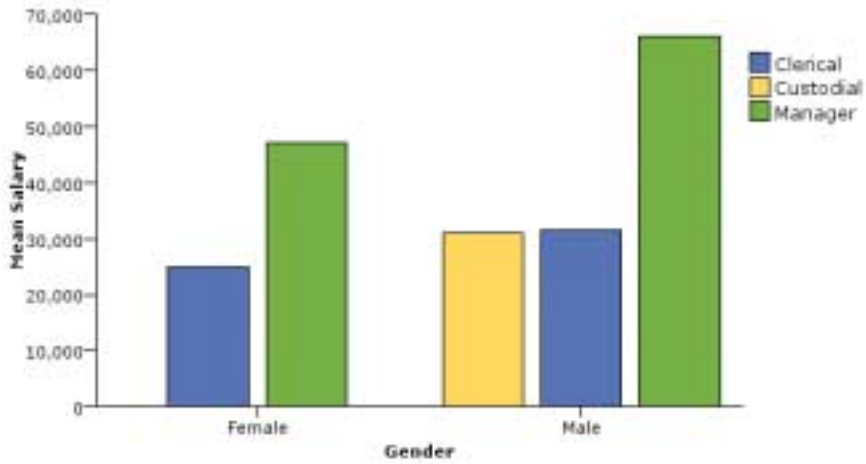


Following is another option for creating a graph that appears clustered. It uses the dodge collision modifier. (See dodge Collision Modifier on p. 55.) Note that the difference between this and the previous example is that empty space is not allocated for missing categories (in this case, the combination of “Female” and “Custodial”).

Figure 3-15
GPL for dodged bar chart

```
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 3-16
Dodged bar chart

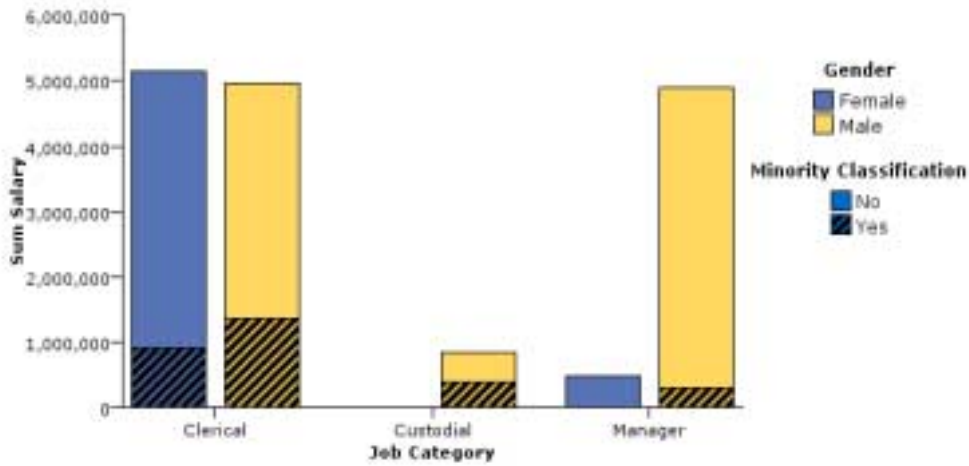


Clustered and Stacked Bar Chart

Figure 3-17
GPL for clustered and stacked bar chart

```
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 3-18
Clustered and stacked bar chart

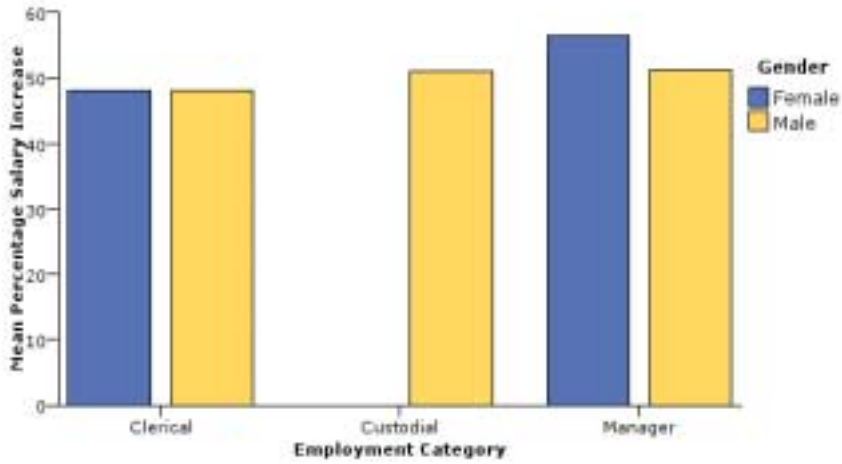


Bar Chart Using an Evaluation Function

Figure 3-19
GPL for bar chart using an evaluation function

```
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 3-20
GPL for bar chart using an evaluation function



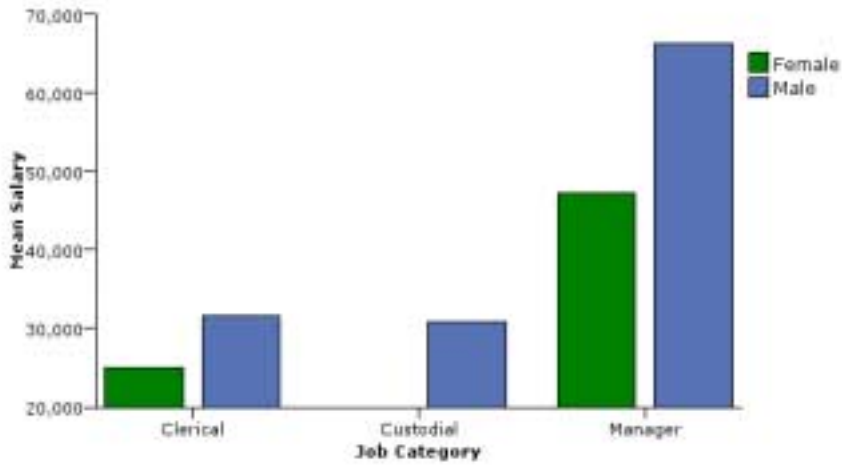
Bar Chart with Mapped Aesthetics

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.

Figure 3-21
GPL for bar chart with mapped aesthetics

```
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(("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 3-22
Bar chart with mapped aesthetics



Faceted (Paneled) Bar Chart

Although the following examples create bar charts, faceting is common to all graphs.

Figure 3-23
GPL for faceted bar chart

```
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 3-24
Faceted bar chart

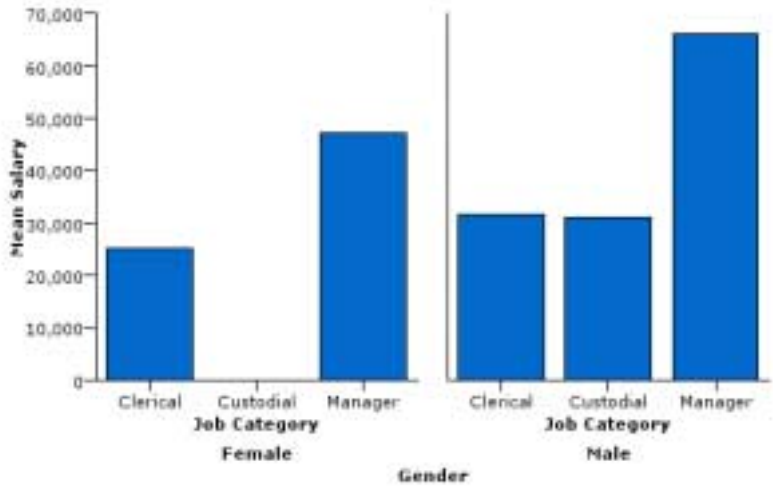


Figure 3-25
GPL for faceted bar chart with nested categories

```
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 3-26
Faceted bar chart with nested categories

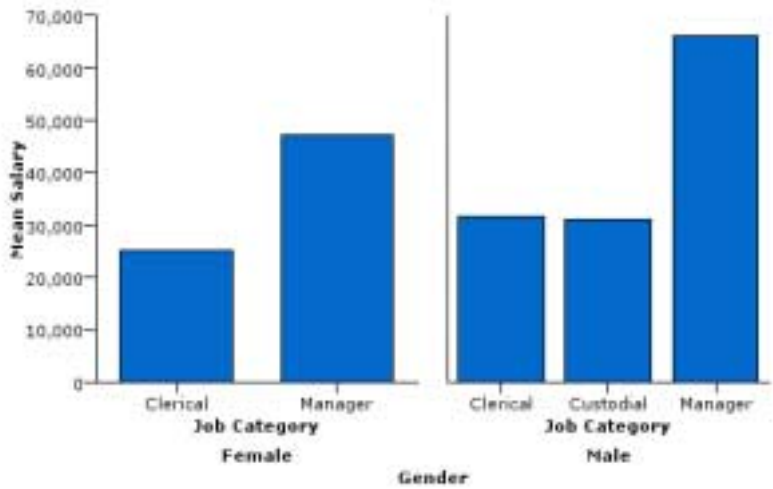
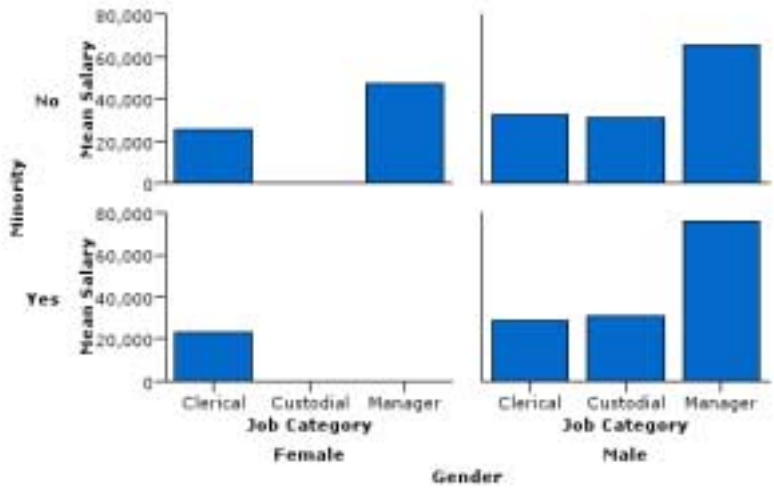


Figure 3-27
GPL for multi-faceted bar chart

```
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 3-28
Multi-faceted bar chart

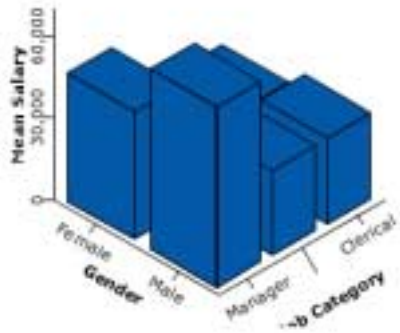


3-D Bar Chart

Figure 3-29
GPL for 3-D bar chart

```
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 3-30
3-D bar chart

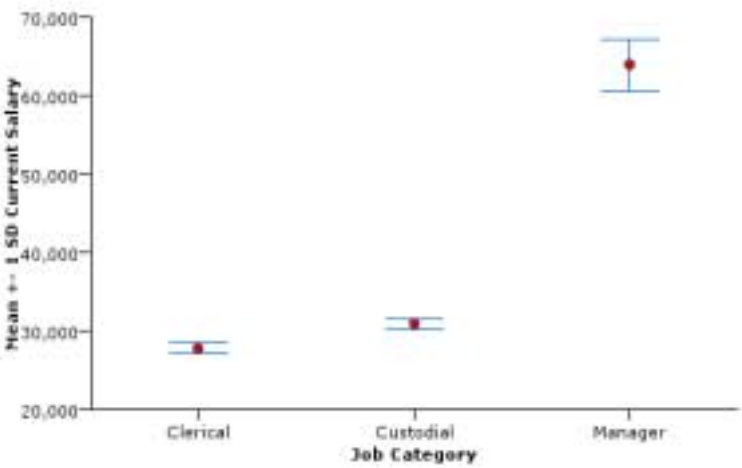


Error Bar Chart

Figure 3-31
GPL for error bar chart

```
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 3-32
Error bar chart



Histogram Examples

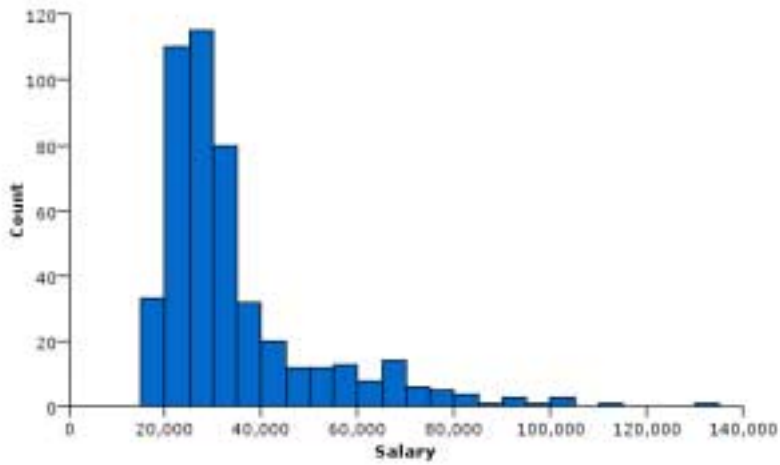
This section provides examples of different types of histograms.

Histogram

Figure 3-33
GPL for histogram

```
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 3-34
Histogram



Histogram with Distribution Curve

Figure 3-35
GPL for histogram with normal curve

```
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 3-36
Histogram with normal curve

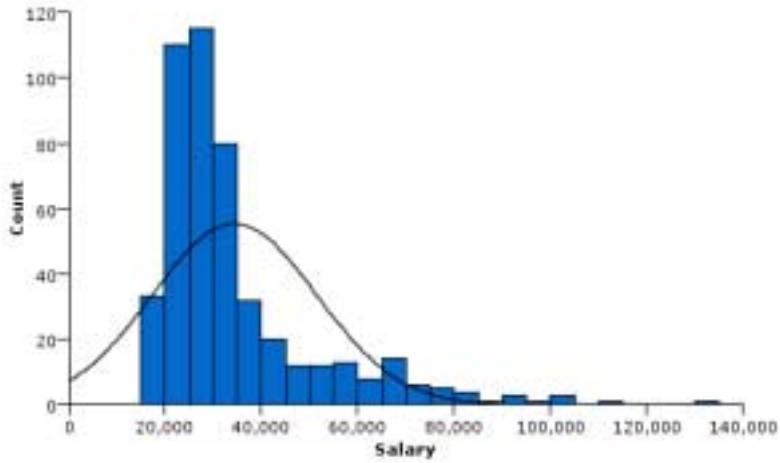
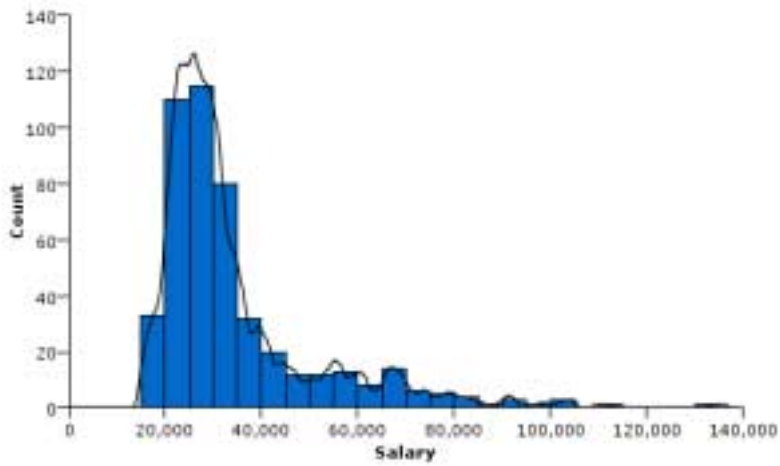


Figure 3-37
GPL for histogram with kernel density curve

```
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 3-38
Histogram with kernel density curve

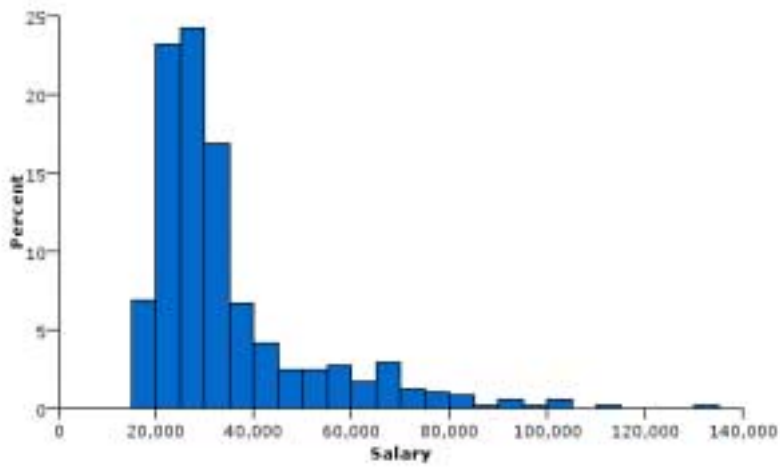


Percentage Histogram

Figure 3-39
GPL for percentage histogram

```
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 3-40
Percentage histogram

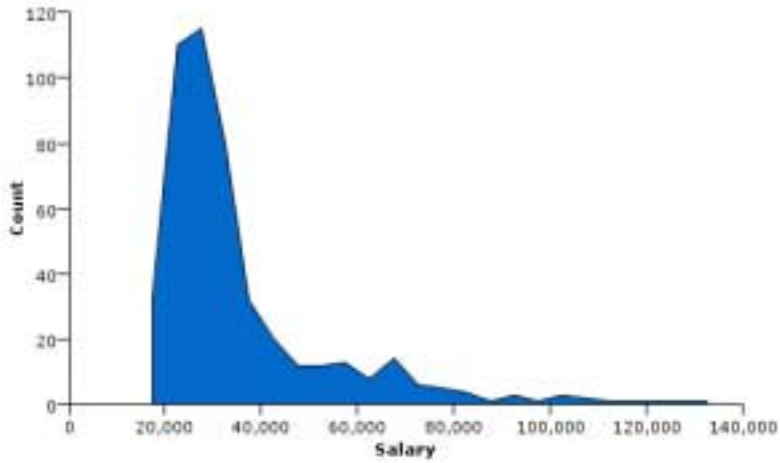


Frequency Polygon

Figure 3-41
GPL for frequency polygon

```
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 3-42
Frequency polygon

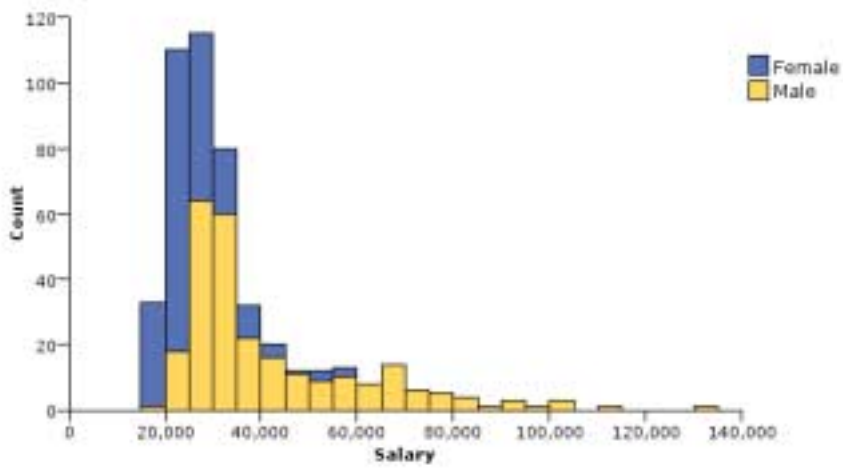


Stacked Histogram

Figure 3-43
GPL for stacked histogram

```
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 3-44
Stacked histogram

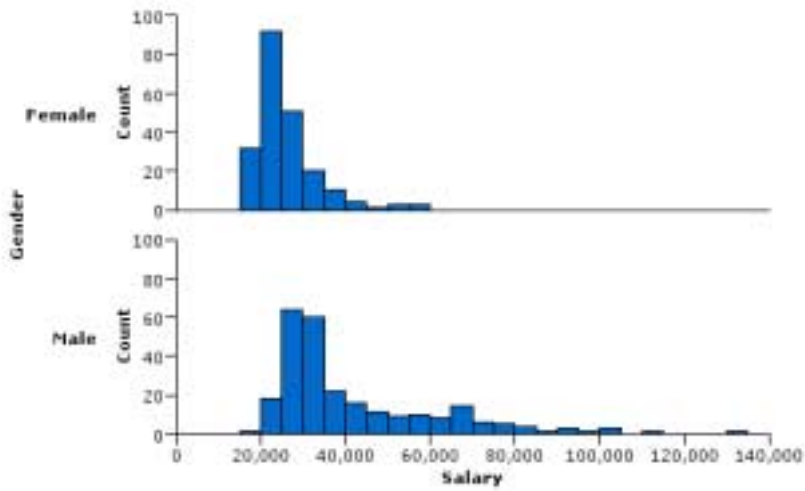


Faceted (Paneled) Histogram

Figure 3-45
GPL for faceted histogram

```
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 3-46
Faceted histogram

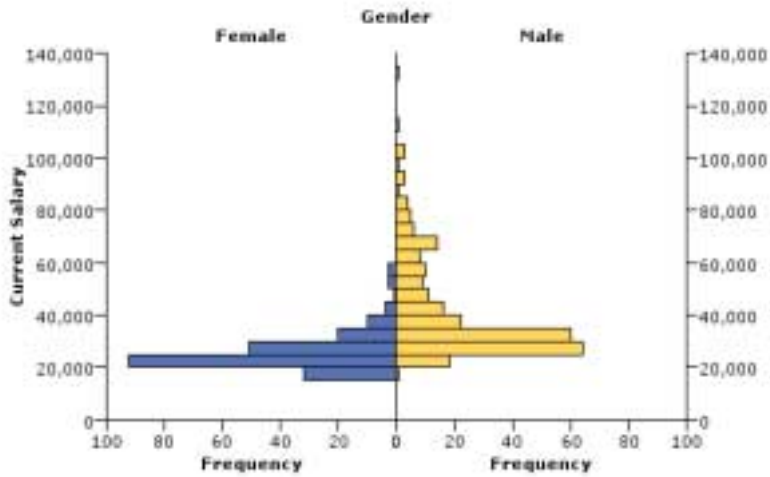


Population Pyramid

Figure 3-47
GPL for population pyramid

```
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), 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 3-48
Population pyramid

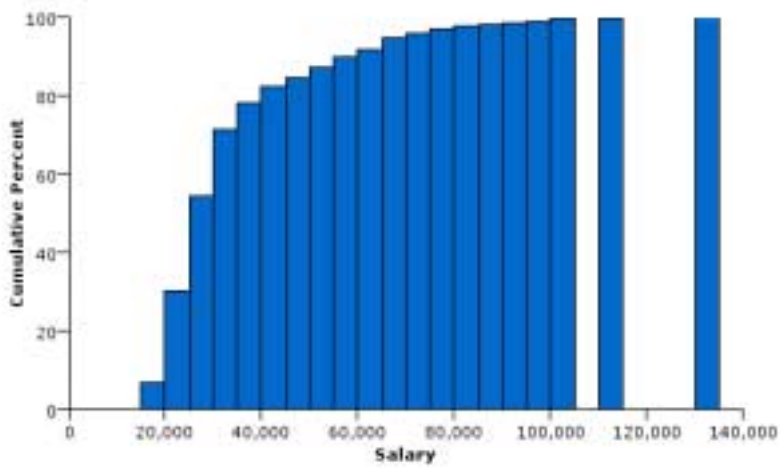


Cumulative Histogram

Figure 3-49
GPL for cumulative histogram

```
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 3-50
Cumulative histogram

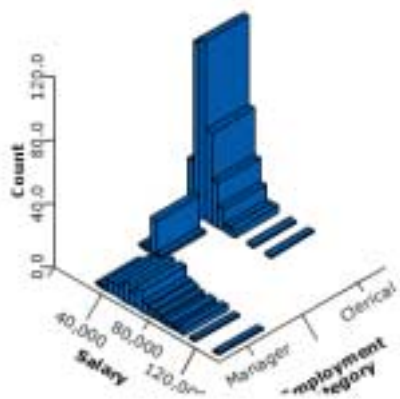


3-D Histogram

Figure 3-51
GPL for 3-D histogram

```
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 3-52
3-D histogram



High-Low Chart Examples

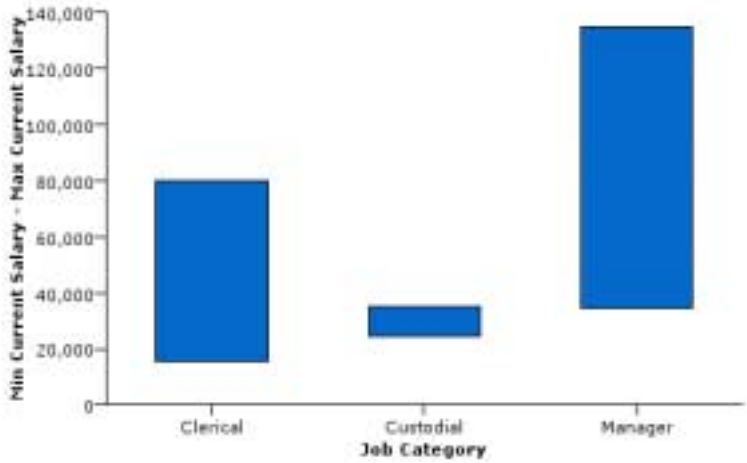
This section provides examples of different types of high-low charts.

Simple Range Bar for One Variable

Figure 3-53
GPL for simple range bar for one variable

```
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 3-54
Simple range bar for one variable

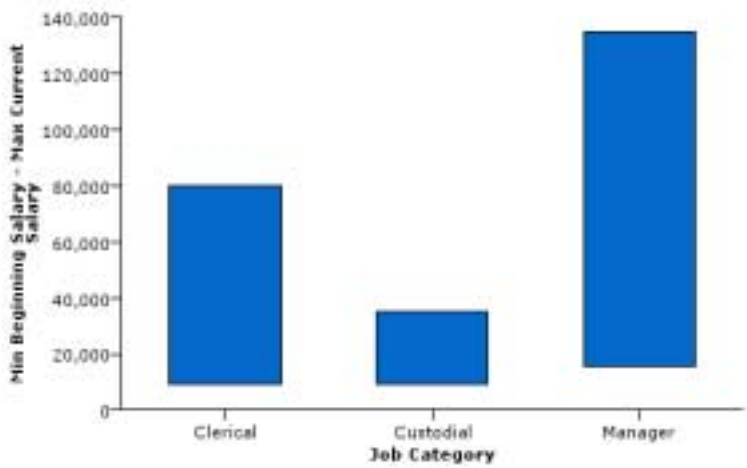


Simple Range Bar for Two Variables

Figure 3-55
GPL for simple range bar for two variables

```
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 3-56
Simple range bar for two variables

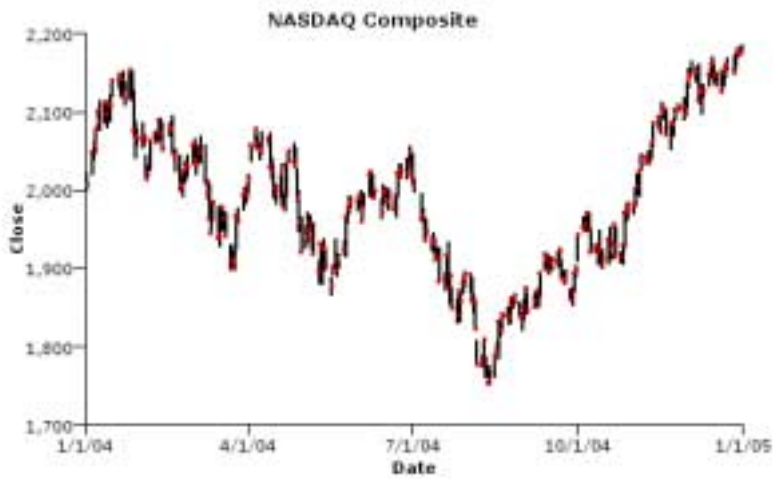


High-Low-Close Chart

Figure 3-57
GPL for high-low-close chart

```
SOURCE: s = userSource(id("stocks2004"))
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: text.title(label("NASDAQ Composite"))
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 3-58
High-low-close chart

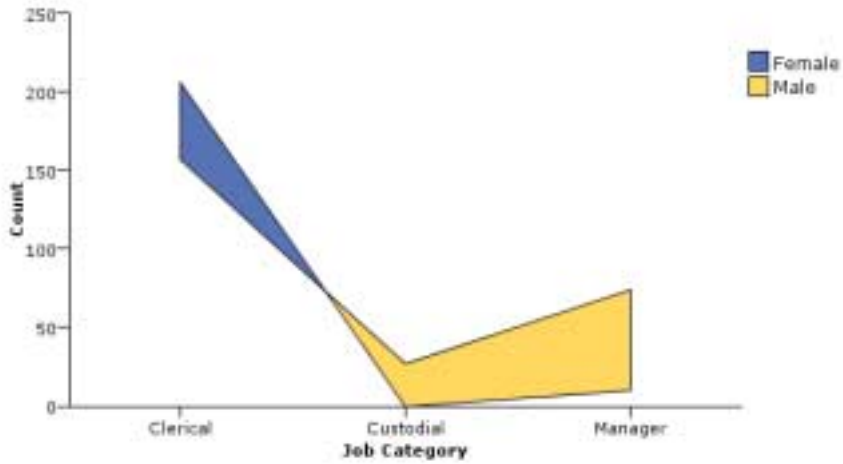


Difference Area Chart

Figure 3-59
GPL for difference area chart

```
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(0.0))
GUIDE: axis(dim(2), label("Count"))
GUIDE: axis(dim(1), label("Job Category"))
ELEMENT: area.difference(position(summary.count(jobcat)), color(gender))
```

Figure 3-60
Difference area chart



Scatter/Dot Examples

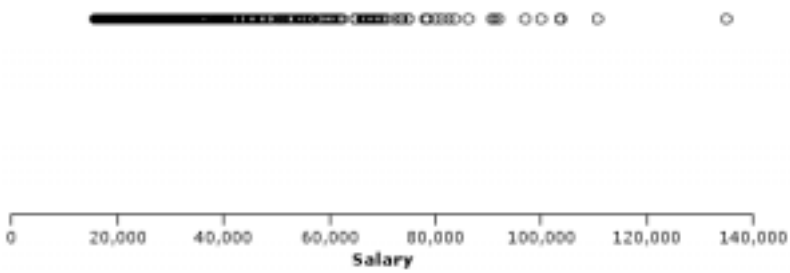
This section provides examples of different types of scatterplots and dot plots.

Simple 1-D Scatterplot

Figure 3-61
GPL for simple 1-D scatterplot

```
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 3-62
Simple 1-D scatterplot

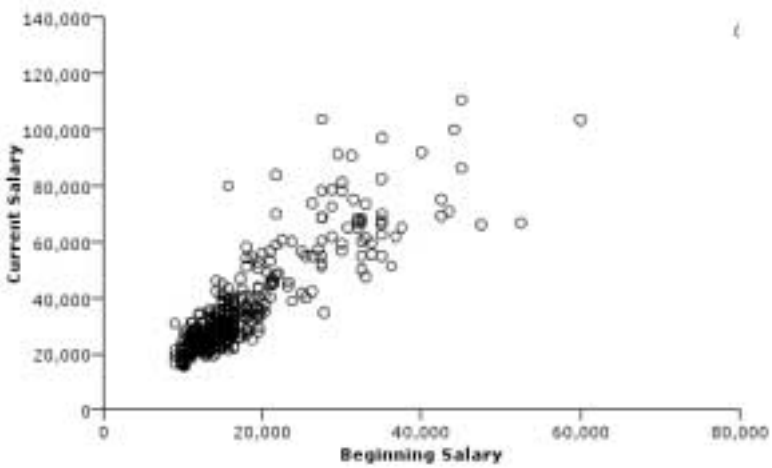


Simple 2-D Scatterplot

Figure 3-63
GPL for simple 2-D scatterplot

```
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 3-64
Simple 2-D scatterplot

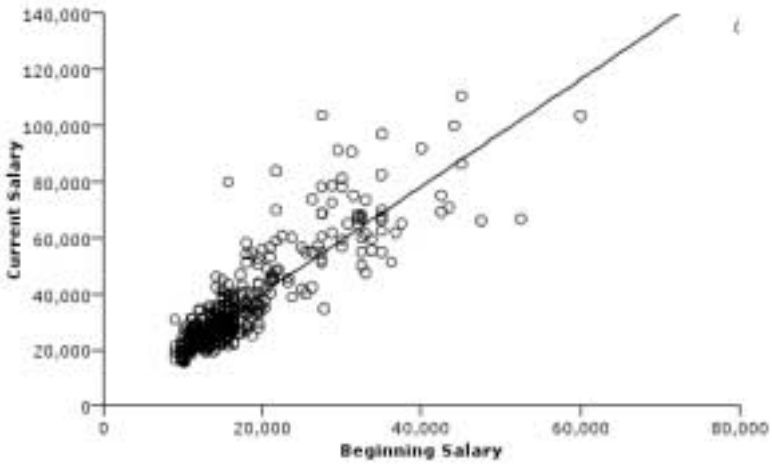


Simple 2-D Scatterplot with Fit Line

Figure 3-65
GPL for simple scatterplot with fit line

```
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 3-66
Simple scatterplot with fit line

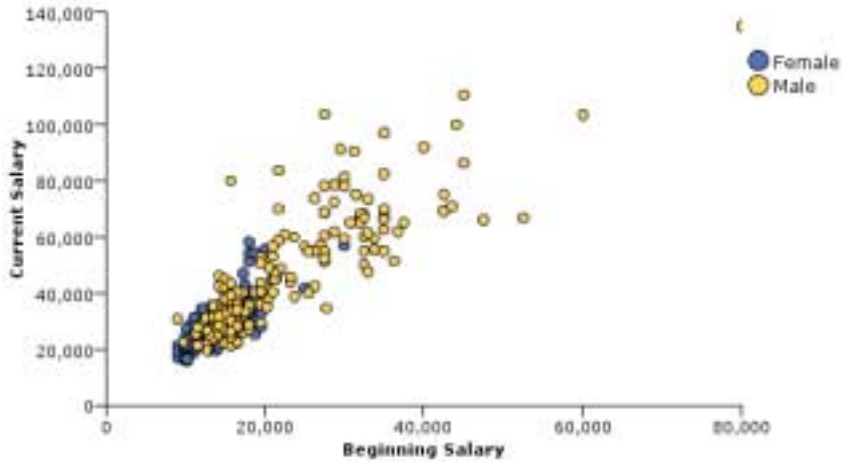


Grouped Scatterplot

Figure 3-67
GPL for grouped scatterplot

```
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 3-68
Grouped scatterplot

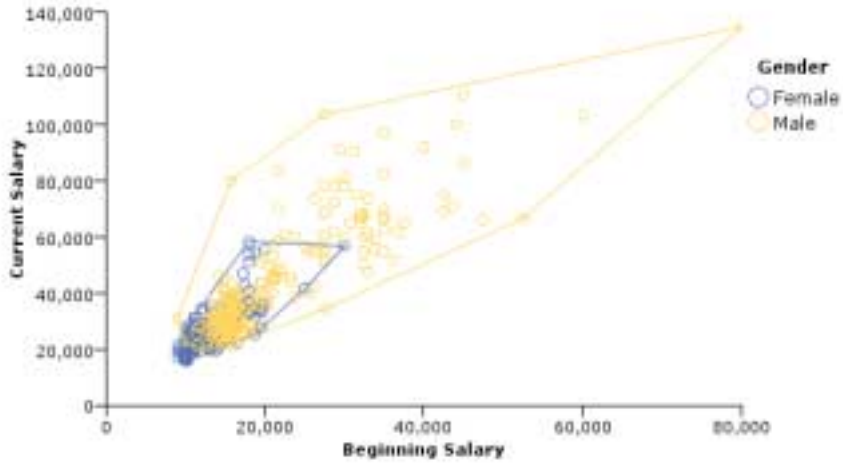


Grouped Scatterplot with Convex Hull

Figure 3-69
GPL for grouped scatterplot with convex hull

```
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 3-70
Grouped scatterplot with convex hull

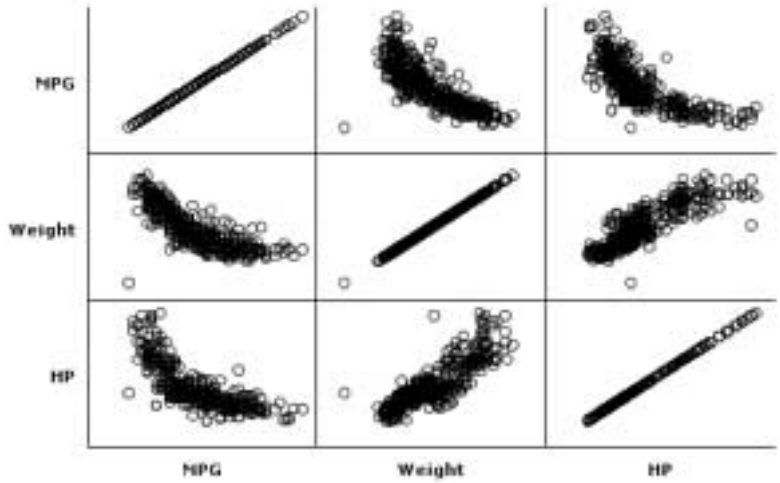


Scatterplot Matrix (SPLOM)

Figure 3-71
GPL for scatterplot matrix

```
SOURCE: s = userSource(id("Cars"))
DATA: weight=col(source(s), name("weight"))
DATA: mpg=col(source(s), name("mpg"))
DATA: horse=col(source(s), name("horse"))
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((mpg/"MPG"+weight/"Weight"+horse/"HP")*
                        (mpg/"MPG"+weight/"Weight"+horse/"HP")))
```

Figure 3-72
Scatterplot Matrix

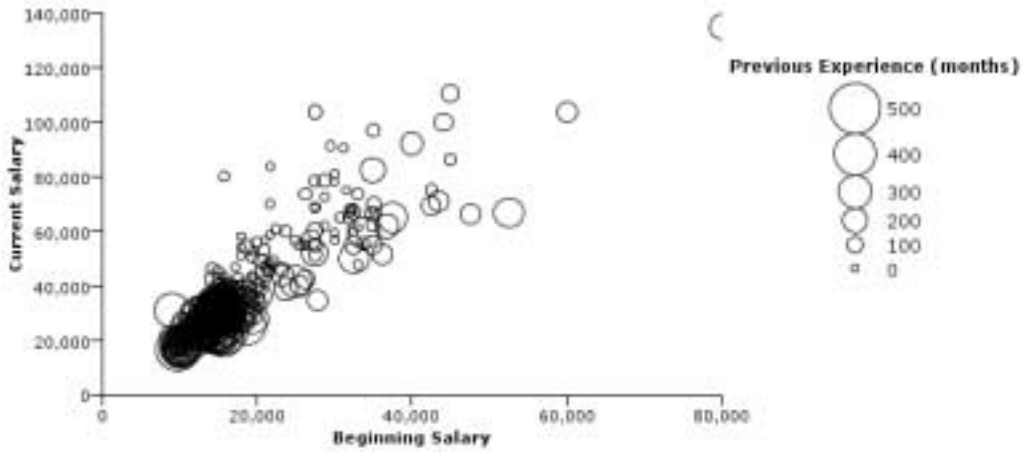


Bubble Plot

Figure 3-73
GPL for bubble plot

```
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 3-74
Bubble plot

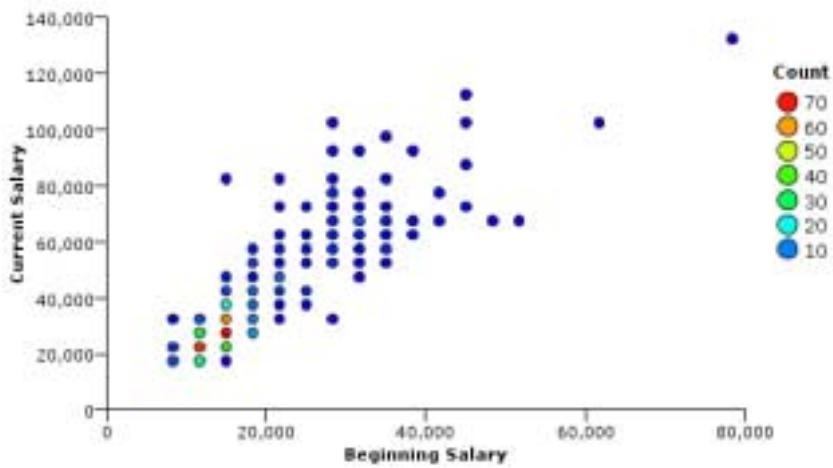


Binned Scatterplot

Figure 3-75
GPL for binned scatterplot

```
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 3-76
Binned scatterplot

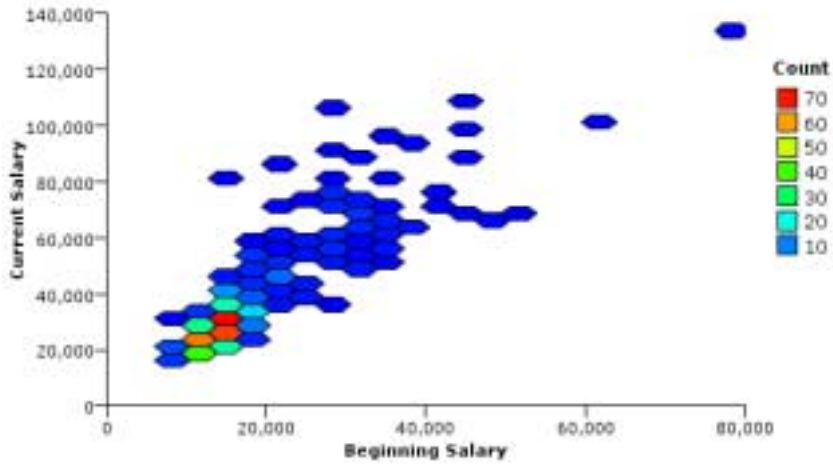


Binned Scatterplot with Polygons

Figure 3-77
GPL for binned scatterplot with polygons

```
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 3-78
Binned scatterplot with polygons

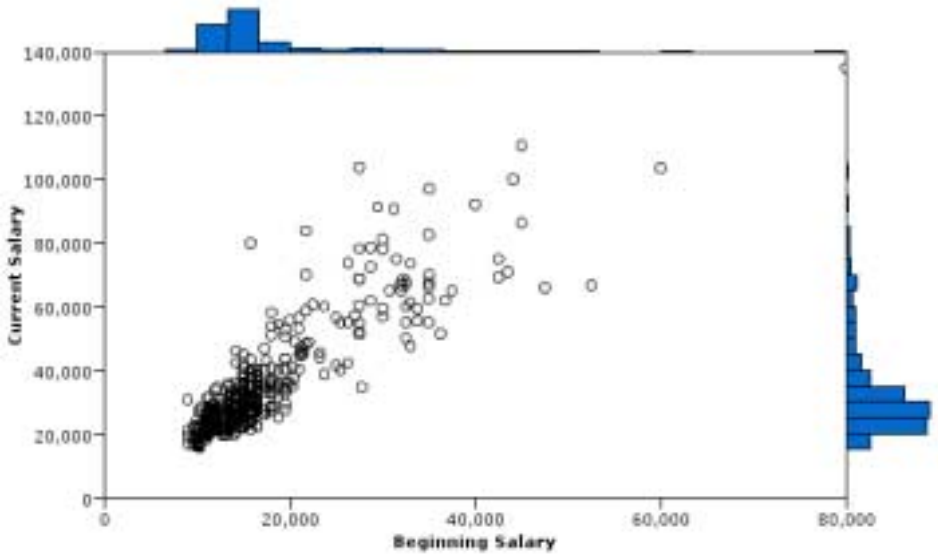


Scatterplot with Border Histograms

Figure 3-79
GPL for scatterplot with border histograms

```
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 3-80
Scatterplot with border histograms

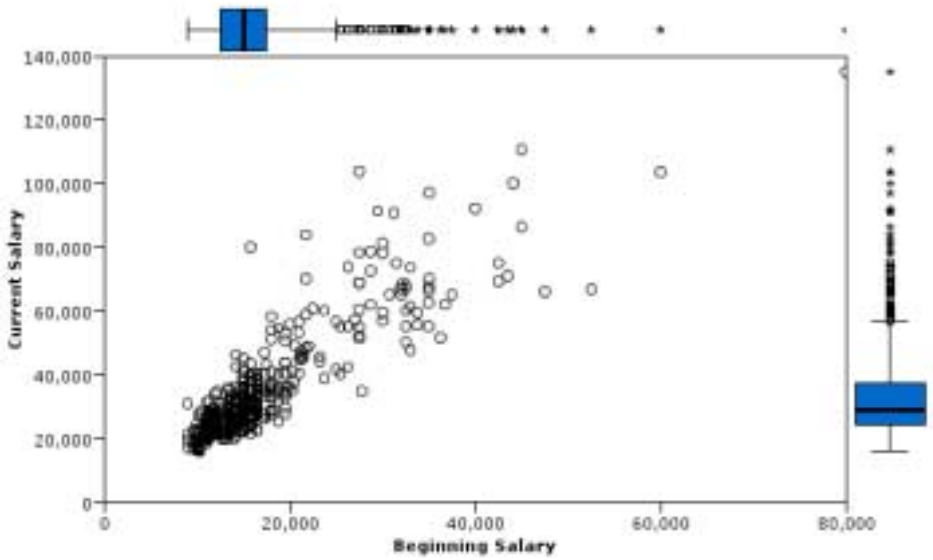


Scatterplot with Border Boxplots

Figure 3-81
GPL for scatterplot with border boxplots

```
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 3-82
Scatterplot with border boxplots



Dot Plot

Figure 3-83
GPL for dot plot

```
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 3-84
Dot plot

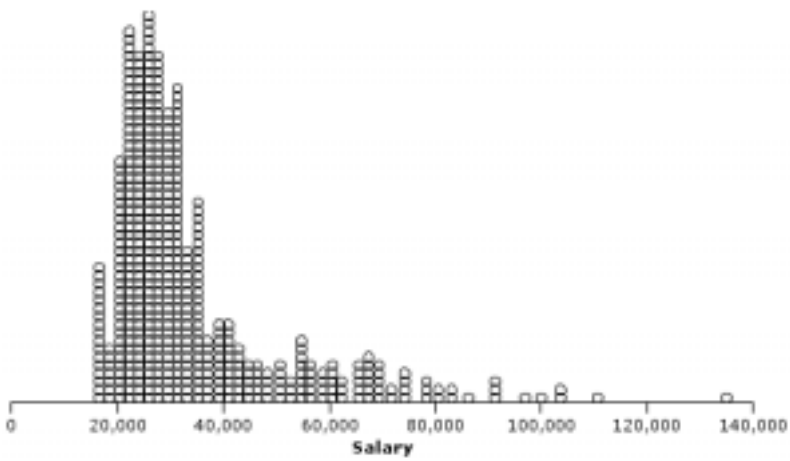
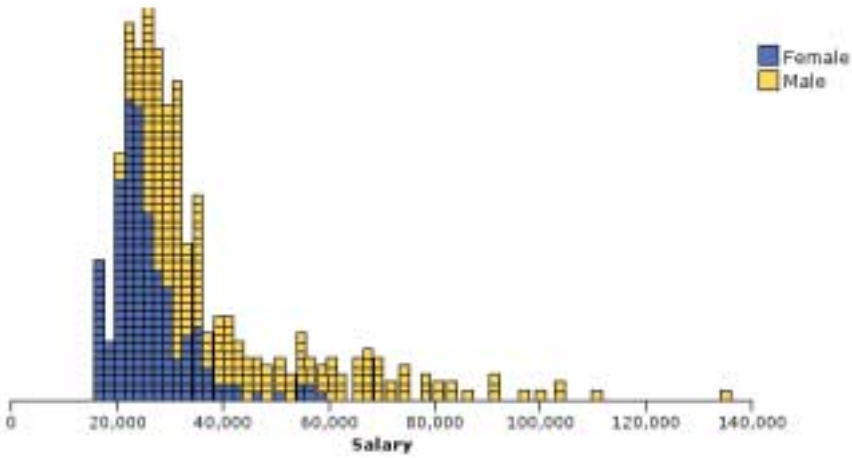


Figure 3-85
GPL for grouped dot plot

```
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 3-86
Grouped dot plot



2-D Dot Plot

Figure 3-87
GPL for 2-D dot plot

```
SOURCE: s = userSource(id("Cars"))
DATA: origin = col(source(s), name("origin"), unit.category())
DATA: mpg = col(source(s), name("mpg"))
GUIDE: axis(dim(1), label("Miles Per Gallon"), delta(5.0))
GUIDE: axis(dim(2), label("Country of Origin"))
ELEMENT: point.dodge.symmetric(position(bin.dot(mpg*origin)))
```

Figure 3-88
2-D dot plot

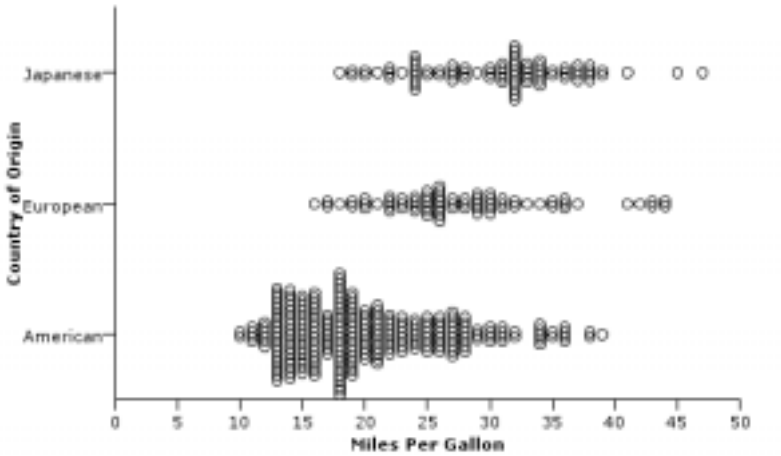
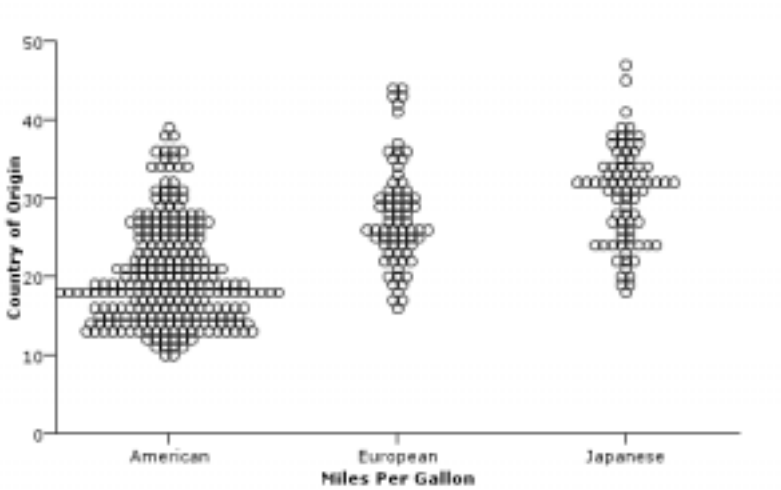


Figure 3-89
GPL for alternate 2-D dot plot

```
SOURCE: s = userSource(id("Cars"))
DATA: origin = col(source(s), name("origin"), unit.category())
DATA: mpg = col(source(s), name("mpg"))
GUIDE: axis(dim(1), label("Miles Per Gallon"), delta(5.0))
GUIDE: axis(dim(2), label("Country of Origin"))
ELEMENT: point.dodge.symmetric(position(bin.dot(origin*mpg, dim(2))))
```

Figure 3-90
Alternate 2-D dot plot

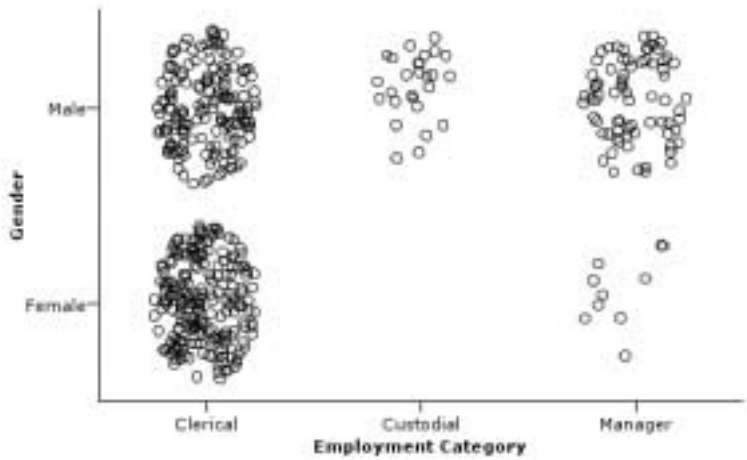


Jittered Categorical Scatterplot

Figure 3-91
GPL for jittered categorical scatterplot

```
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 3-92
Jittered categorical scatterplot



Line Chart Examples

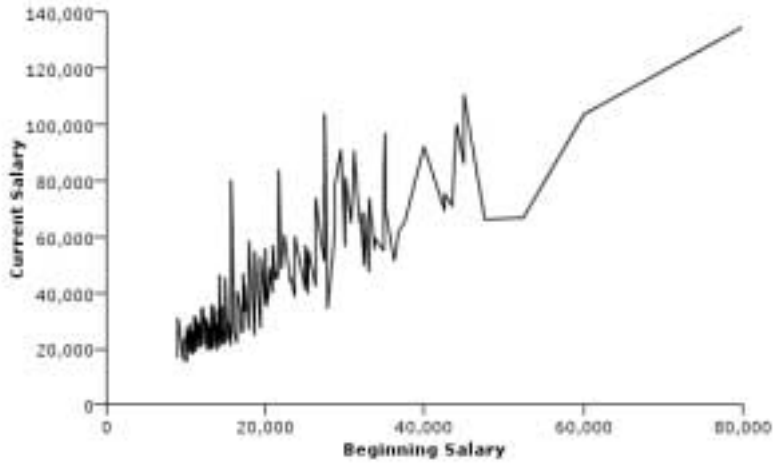
This section provides examples of different types of line charts.

Simple Line Chart

Figure 3-93
GPL for simple line chart

```
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 3-94
Simple line chart

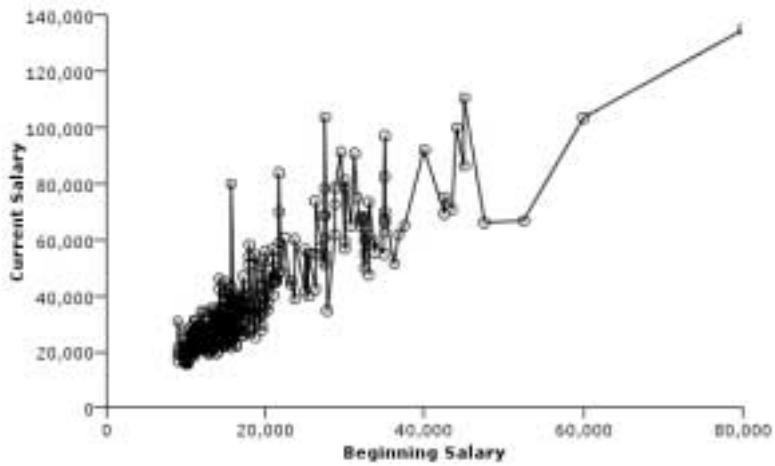


Simple Line Chart with Points

Figure 3-95
GPL for simple line chart with points

```
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 3-96
Simple line chart with points

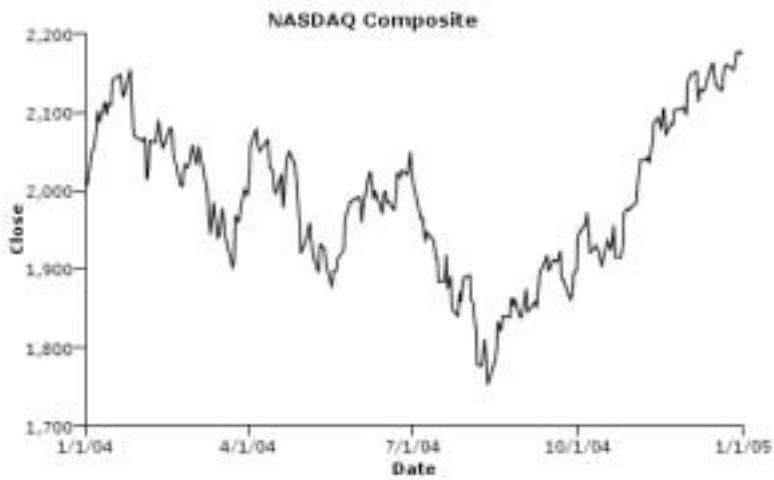


Line Chart of Date Data

Figure 3-97
GPL for line chart of date data

```
SOURCE: s = userSource(id("stocks2004"))
DATA: Date = col(source(s), name("Date"), unit.time(), format("MM/dd/yy"))
DATA: Close = col(source(s), name("Close"))
GUIDE: text.title(label("NASDAQ Composite"))
GUIDE: axis(dim(1), label("Date"))
GUIDE: axis(dim(2), label("Close"))
SCALE: time(dim(1), dataMaximum())
ELEMENT: line(position(Date*Close))
```

Figure 3-98
Line chart of date data

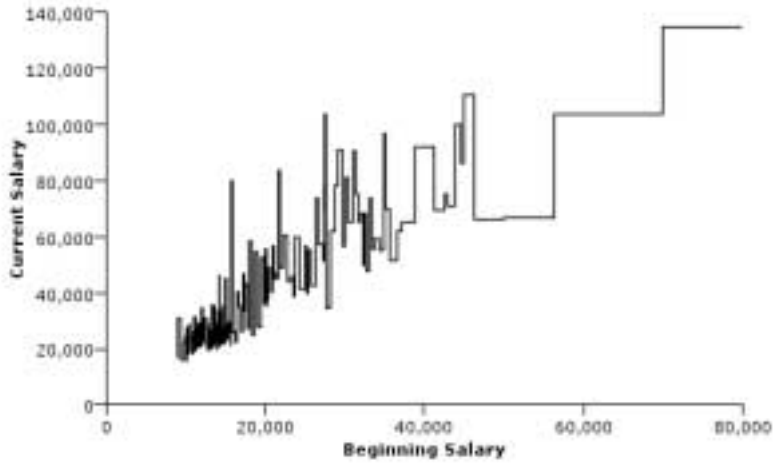


Line Chart With Step Interpolation

Figure 3-99
GPL for line chart with step interpolation

```
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 3-100
Line chart with step interpolation

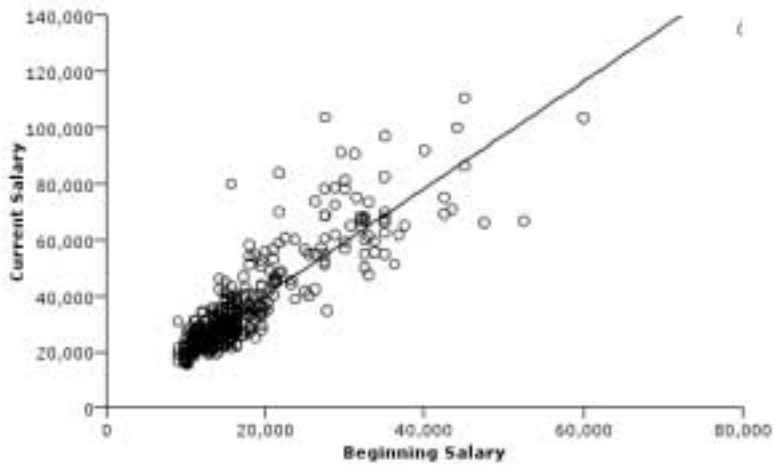


Fit Line

Figure 3-101
GPL for linear fit line overlaid on scatterplot

```
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 3-102
Linear fit line overlaid on scatterplot



Line Chart from Equation

Figure 3-103
GPL for 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 3-104
Line chart from equation

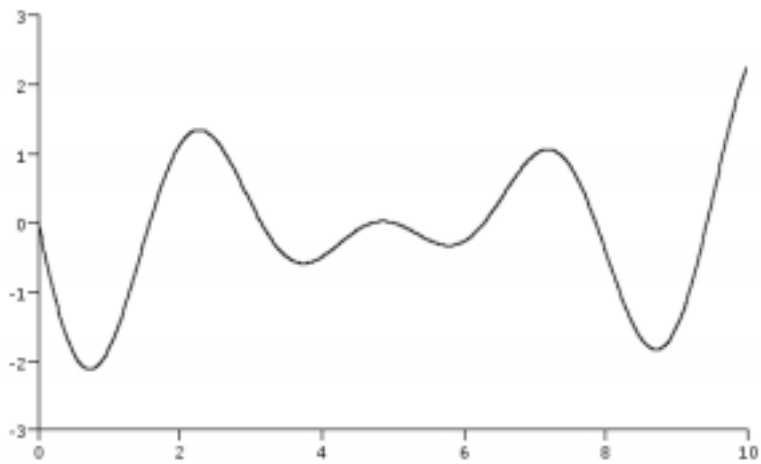
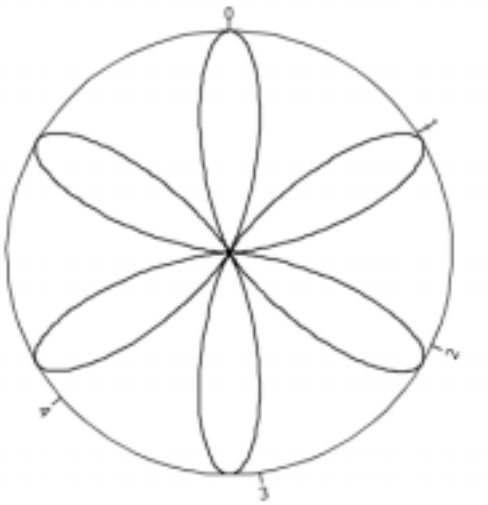


Figure 3-105
GPL for line chart from equation in polar coordinates

```
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 3-106
Line chart from equation in polar coordinates

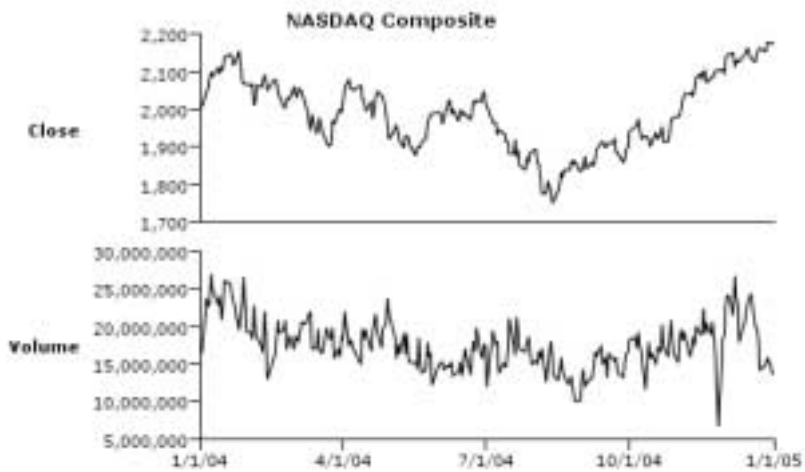


Line Chart with Separate Scales

Figure 3-107
GPL for line chart with separate scales

```
SOURCE: s = userSource(id("stocks2004"))
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"))
GUIDE: text.title(label("NASDAQ Composite"))
SCALE: time(dim(1), dataMaximum())
ELEMENT: line(position(date*(close/"Close"+volume/"Volume")))
```

Figure 3-108
Line chart with separate scales



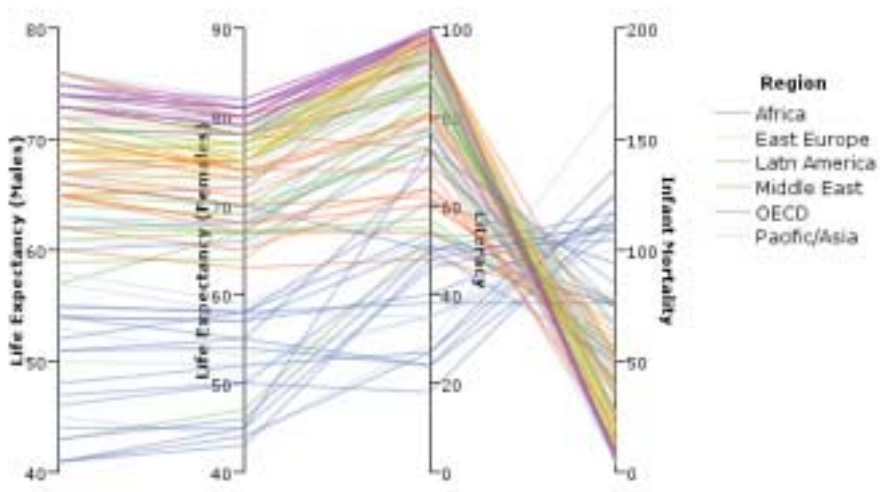
Line Chart in Parallel Coordinates

The following example creates a line chart in parallel coordinates. If we didn't use the result of the `index` function to split the line, every case would be connected, so there would be only one line in the resulting graph. The line would appear to zigzag back and forth between the last axis and the first one. The explicit transparency setting is not required. It is used so that it is easier to read the axis labels.

Figure 3-109
GPL for line chart in parallel coordinates

```
SOURCE: s = userSource(id("World95"))
DATA: lifeexpm=col(source(s), name("lifeexpm"))
DATA: lifeexpf=col(source(s), name("lifeexpf"))
DATA: babymort=col(source(s), name("babymort"))
DATA: literacy=col(source(s), name("literacy"))
DATA: region=col(source(s), name("region"), unit.category())
TRANS: caseid = index()
COORD: parallel()
GUIDE: axis(dim(1), label("Life Expectancy (Males)"))
GUIDE: axis(dim(2), label("Life Expectancy (Females)"))
GUIDE: axis(dim(3), label("Literacy"))
GUIDE: axis(dim(4), label("Infant Mortality"))
GUIDE: legend(aesthetic(aesthetic.color), label("Region"))
ELEMENT: line(position(lifeexpm*lifeexpf*literacy*babymort),
              split(caseid), color(region),
              transparency(transparency."0.5"))
```

Figure 3-110
Line chart in parallel coordinates

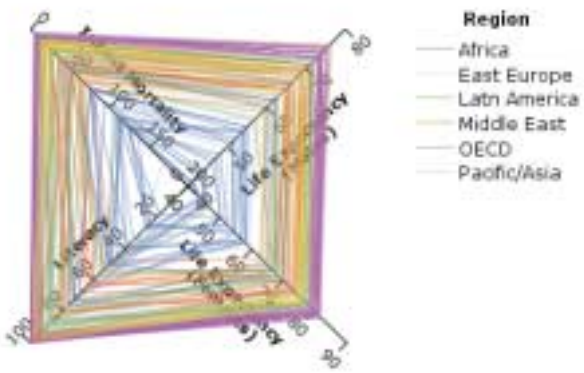


Here is the same chart plotted in polar coordinates. We also reversed the scale for dimension 4 to emphasize the relationship among the variables. As you can see, there are distinct bands of color representing the different regions. Also note the `preserveStraightLines` and `closed` functions, which improve the look of the graph in polar coordinates.

Figure 3-111
GPL for line chart in polar parallel coordinates

```
SOURCE: s = userSource(id("World95"))
DATA: lifeexpm=col(source(s), name("lifeexpm"))
DATA: lifeexpf=col(source(s), name("lifeexpf"))
DATA: babymort=col(source(s), name("babymort"))
DATA: literacy=col(source(s), name("literacy"))
DATA: region=col(source(s), name("region"), unit.category())
TRANS: caseid = index()
COORD: polar(parallel())
SCALE: linear(dim(4), reverse())
GUIDE: axis(dim(1), label("Life Expectancy (Males)"))
GUIDE: axis(dim(2), label("Life Expectancy (Females)"))
GUIDE: axis(dim(3), label("Literacy"))
GUIDE: axis(dim(4), label("Infant Mortality"))
GUIDE: legend(aesthetic(aesthetic.color), label("Region"))
ELEMENT: line(position(lifeexpm*lifeexpf*literacy*babymort),
              split(caseid), color(region),
              transparency(transparency."0.5"),
              preserveStraightLines(), closed())
```

Figure 3-112
Line chart in polar parallel coordinates



Pie Chart Examples

This section provides examples of different types of pie charts.

Pie Chart

Figure 3-113
GPL for pie chart

```
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()), color(jobcat))
```

Figure 3-114
Pie chart

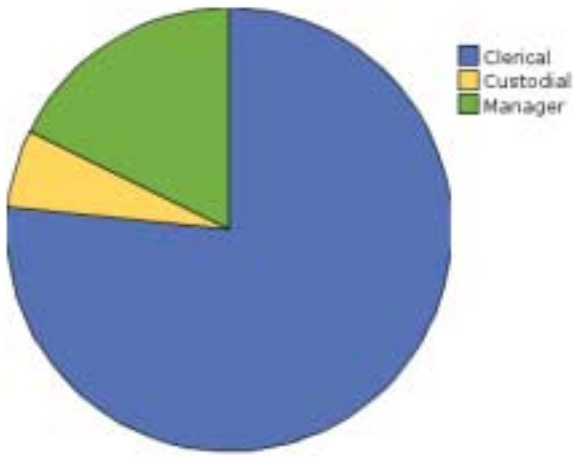
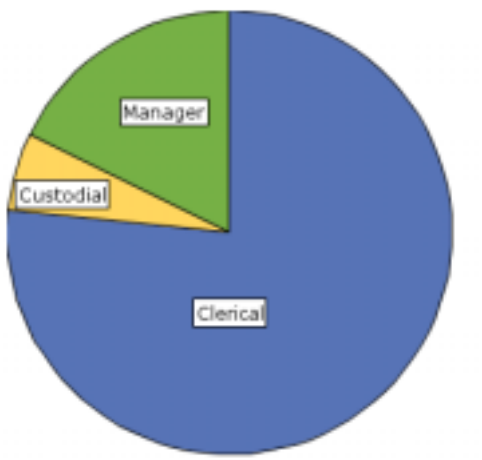


Figure 3-115
GPL for pie chart with labels

```
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()), color(jobcat),
                        label(jobcat))
```

Figure 3-116
Pie chart with labels

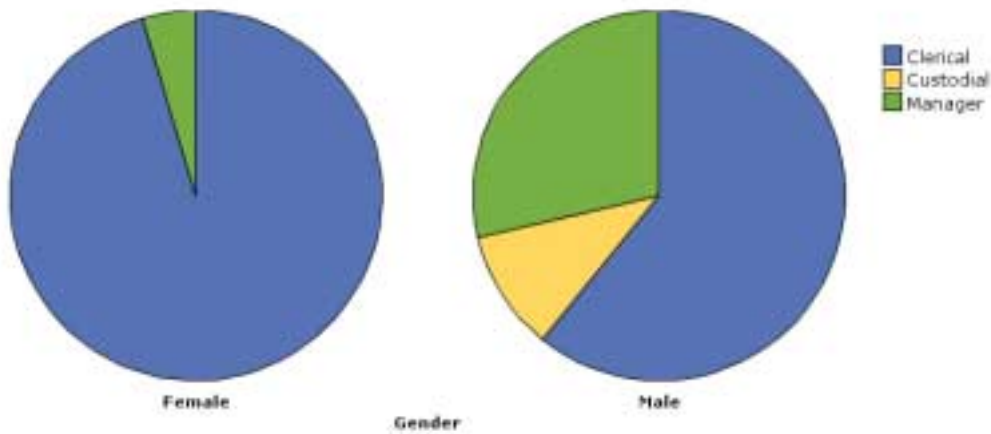


Paneled Pie Chart

Figure 3-117
GPL for paneled pie chart

```
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 3-118
Paneled pie chart



Boxplot Examples

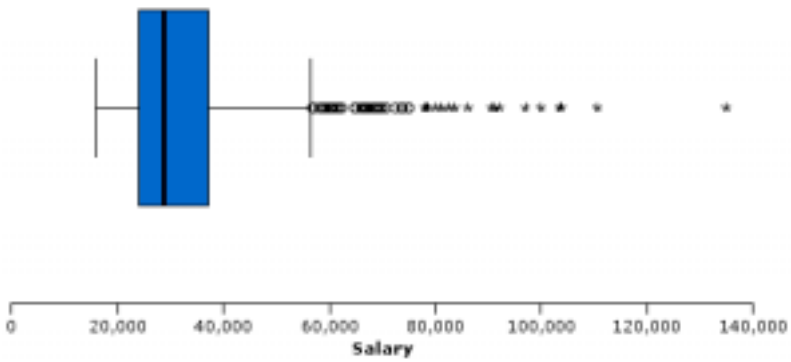
This section provides examples of different types of box plots.

1-D Boxplot

Figure 3-119
GPL for 1-D box plot

```
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 3-120
1-D boxplot



Boxplot

Figure 3-121
GPL for boxplot

```
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 3-122
Boxplot

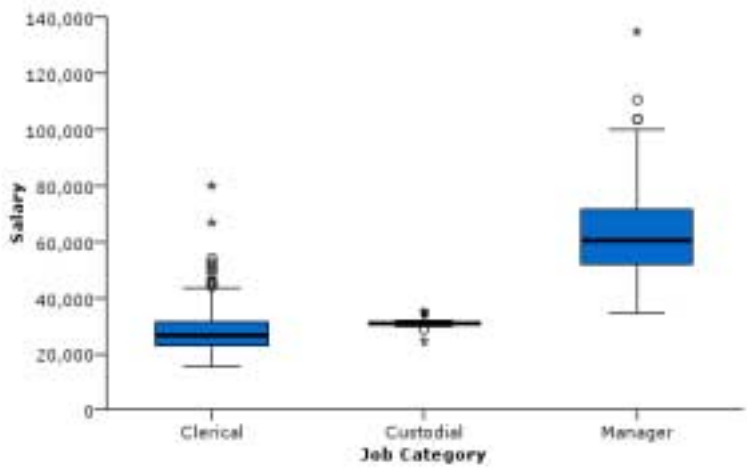
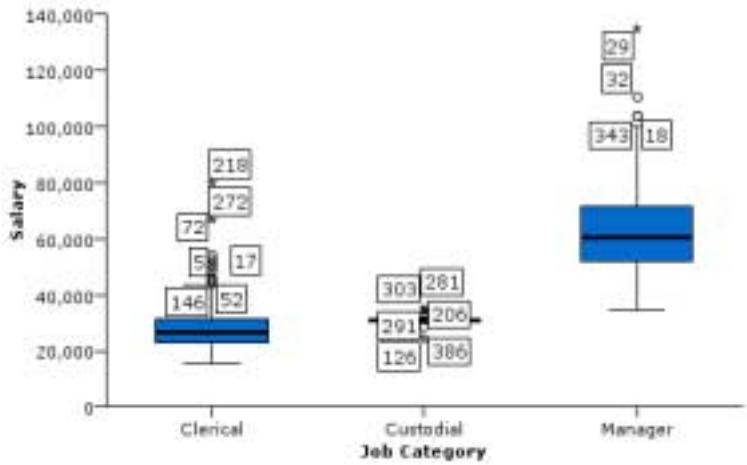


Figure 3-123
GPL for boxplot with labeled outliers

```
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 3-124
Boxplot with labeled outliers

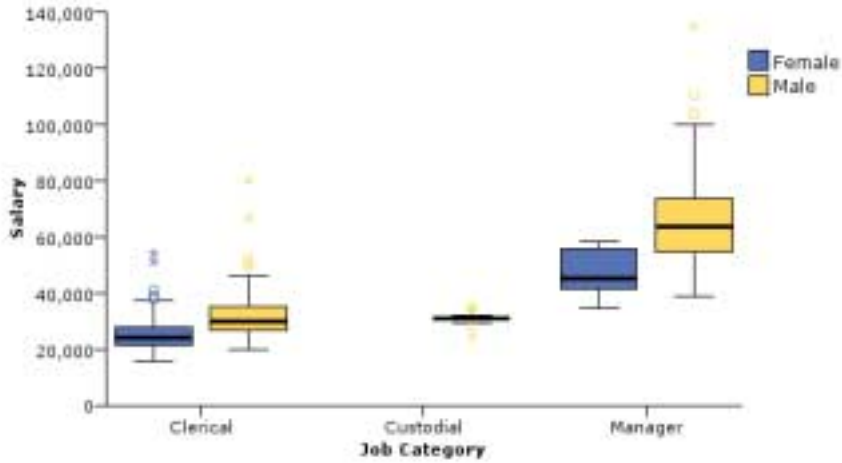


Clustered Boxplot

Figure 3-125
GPL for clustered boxplot

```
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 3-126
Clustered boxplot

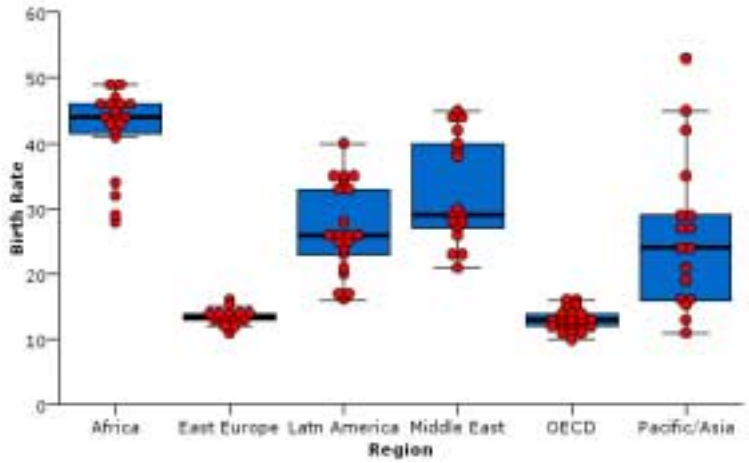


Boxplot With Overlaid Dot Plot

Figure 3-127
GPL for boxplot with overlaid dot plot

```
SOURCE: s = userSource(id("World95"))
DATA: region = col(source(s), name("region"), unit.category())
DATA: birth = col(source(s), name("birth_rt"))
GUIDE: axis(dim(2), label("Birth Rate"))
GUIDE: axis(dim(1), label("Region"))
SCALE: linear(dim(2), include(0))
ELEMENT: schema(position(bin.quantile.letter(region*birth)))
ELEMENT: point.dodge.symmetric(position(bin.dot(region*birth, dim(2))),
                               color(color.red))
```

Figure 3-128
Boxplot with overlaid dot plot



Multi-Graph Examples

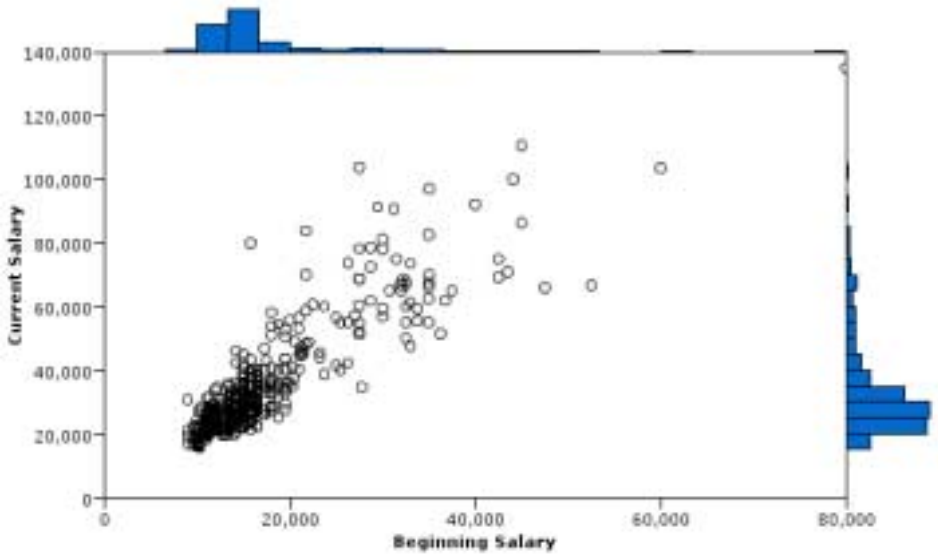
This section provides examples of multiple graphs in the same page display.

Scatterplot with Border Histograms

Figure 3-129
GPL for scatterplot with border histograms

```
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 3-130
Scatterplot with border histograms

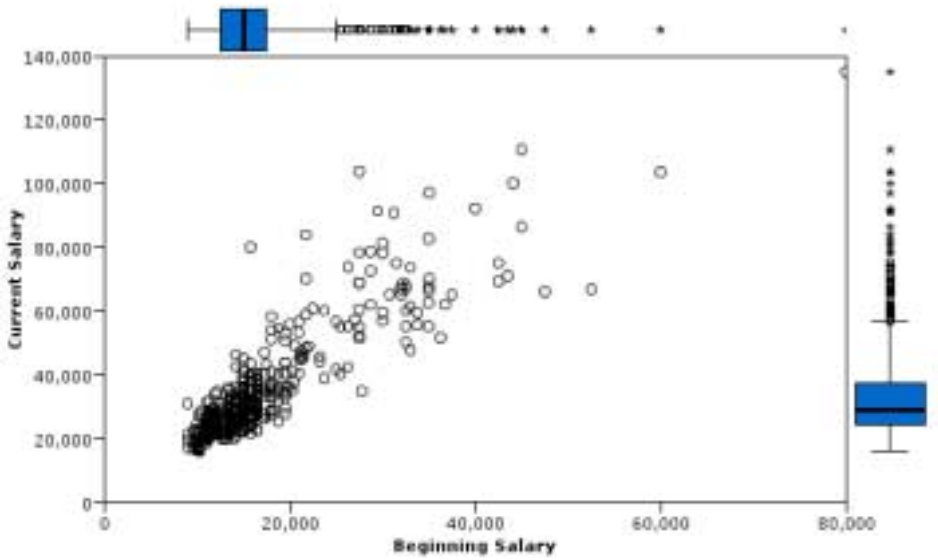


Scatterplot with Border Boxplots

Figure 3-131
GPL for scatterplot with border boxplots

```
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 3-132
Scatterplot with border boxplots

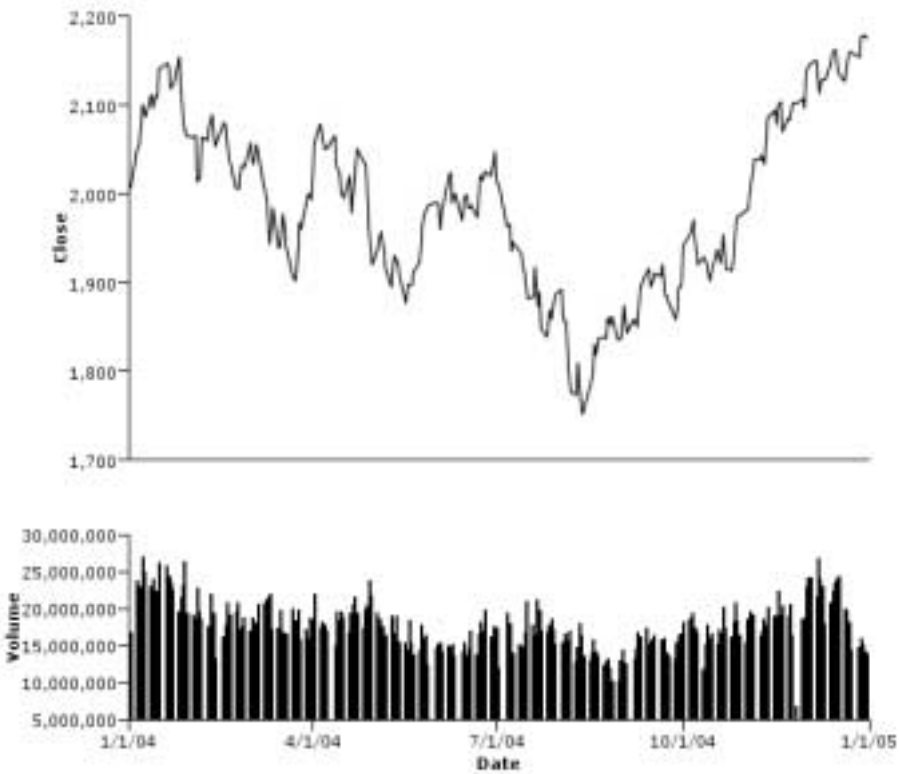


Stocks Line Chart with Volume Bar Chart

Figure 3-133
GPL for stocks and volume chart

```
SOURCE: s = userSource(id("stocks2004"))
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(5%, 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(5%, 70%), scale(90%, 25%))
GUIDE: axis(dim(1), label("Date"))
GUIDE: axis(dim(2), label("Volume"))
ELEMENT: interval(position(date*volume))
GRAPH: end()
```

Figure 3-134
Stocks and volume chart

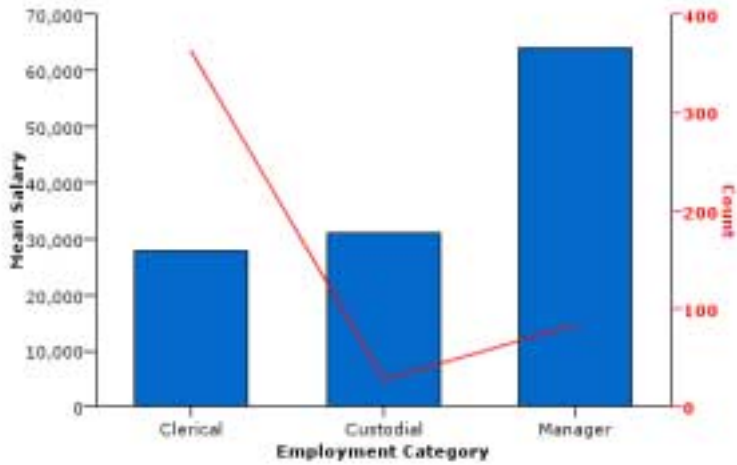


Dual Axis Graph

Figure 3-135
GPL for dual axis graph

```
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 3-136
Dual axis graph

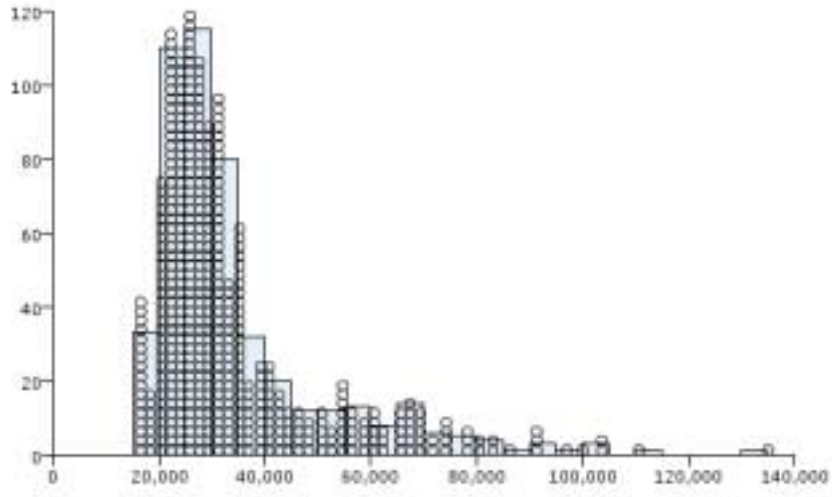


Histogram with Dot Plot

Figure 3-137
GPL for histogram with dot plot

```
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 3-138
Histogram with dot plot



Other Examples

This section provides examples that demonstrate other features of GPL that are not specific to chart types.

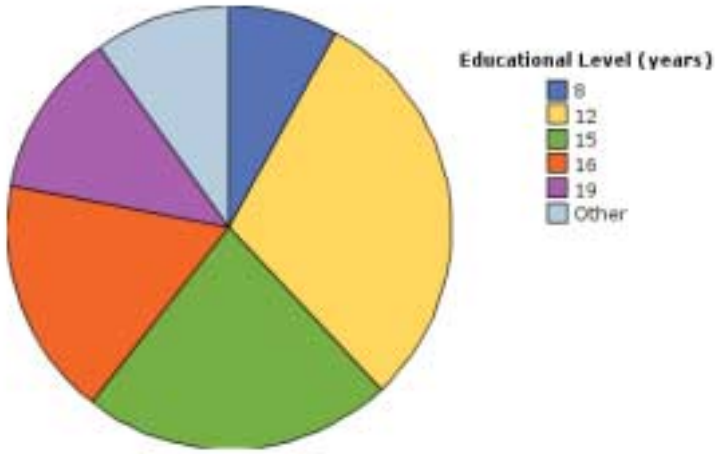
Collapsing Small Categories

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.

Figure 3-139
GPL for collapsing small categories

```
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 3-140
Graph with collapsed categories



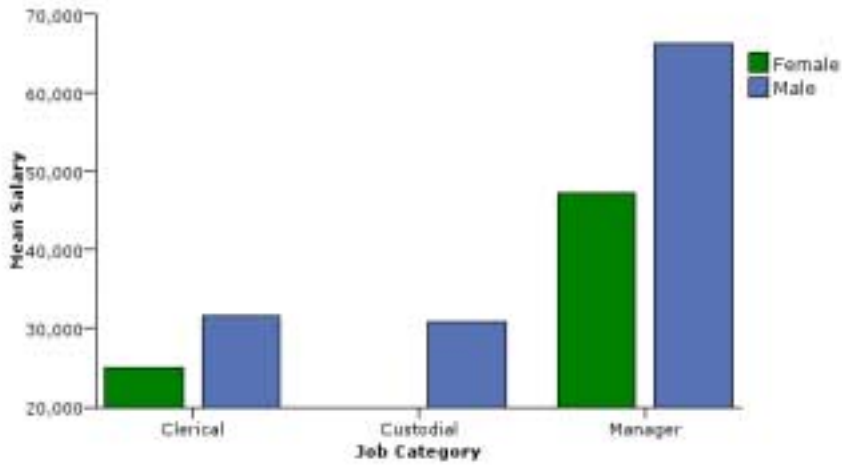
Mapping Aesthetics

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.

Figure 3-141
GPL for mapping aesthetics

```
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(("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 3-142
Graph with mapped aesthetics



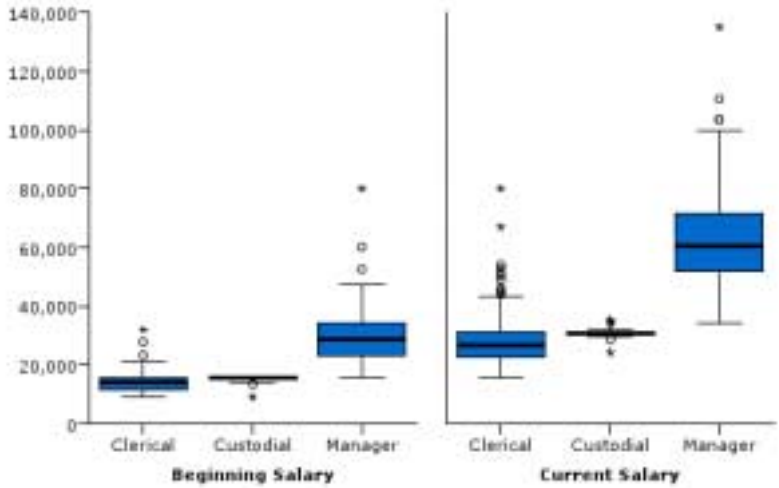
Faceting by Separate Variables

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. For more information, see Line Chart with Separate Scales on p. 257.

Figure 3-143
GPL for faceting by separate variables

```
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 3-144
Faceting by separate variables



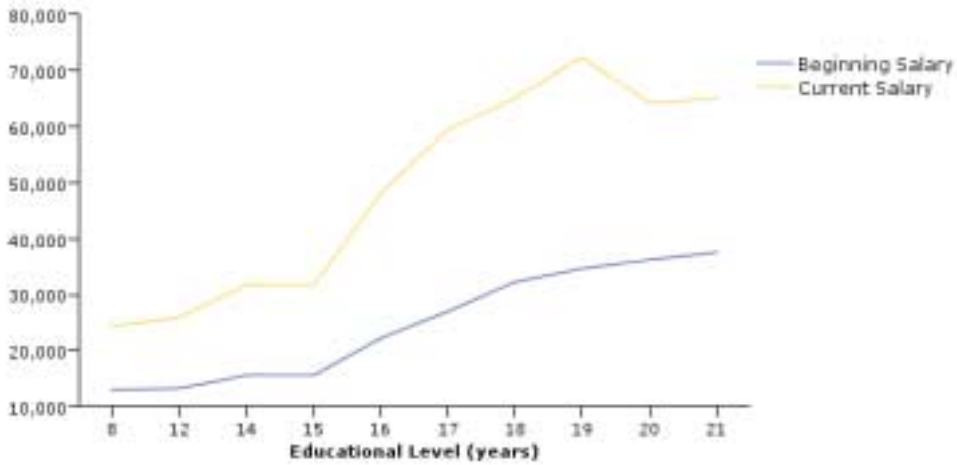
Grouping by Separate Variables

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.

Figure 3-145
GPL for grouping by separate variables

```
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 3-146
Grouping by separate variables



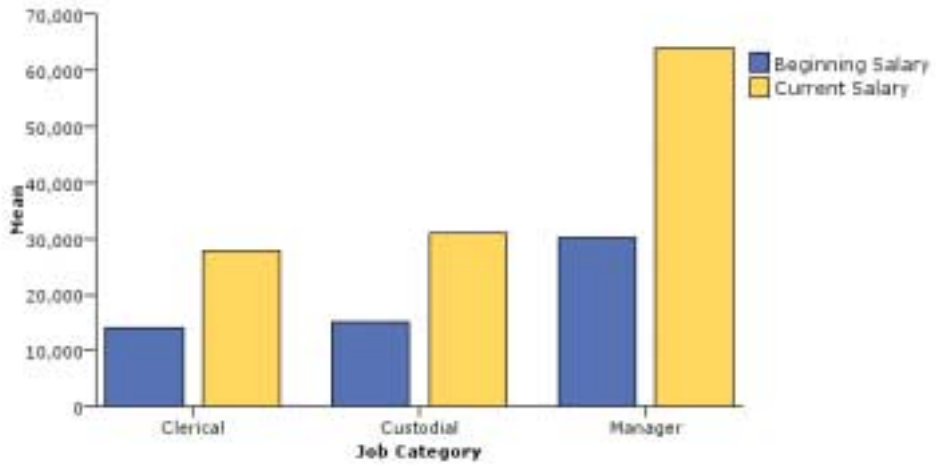
Clustering Separate Variables

This example demonstrates how you can cluster separate variables.

Figure 3-147
GPL for clustering separate variables

```
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 3-148
Clustering separate variables



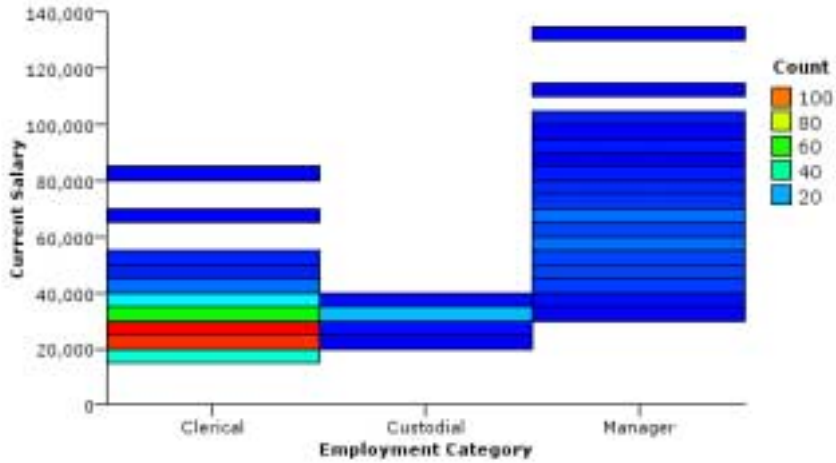
Binning over Categorical Values

This example demonstrates how you use binning to show the distribution of a continuous variable over categorical values.

Figure 3-149
GPL for binning over categorical values

```
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 3-150
Binning over categorical values



Categorical Heat Map

Figure 3-151
GPL for categorical heat map

```
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 3-152
Categorical heat map

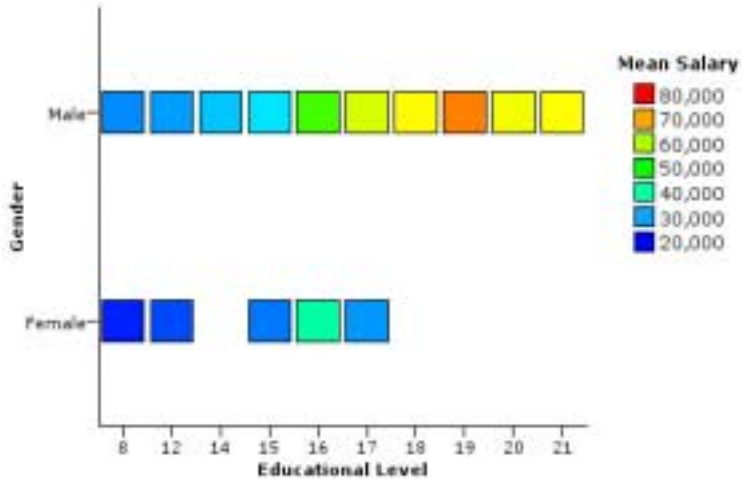
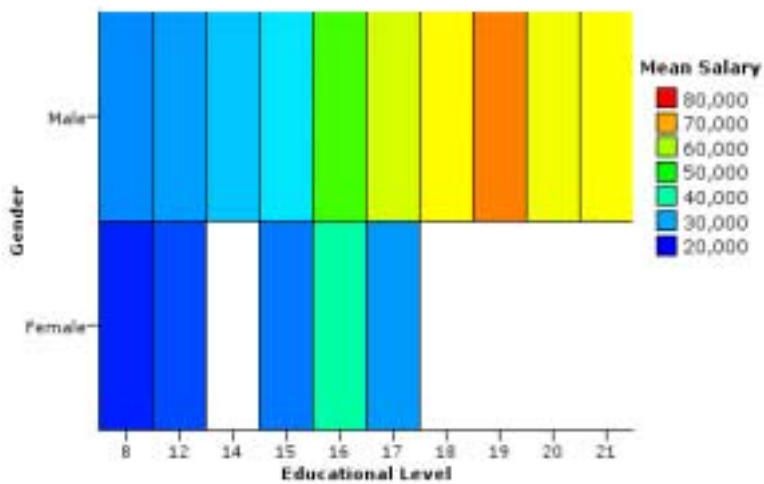


Figure 3-153
GPL for alternate categorical heat map

```
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 3-154
Alternate categorical heat map



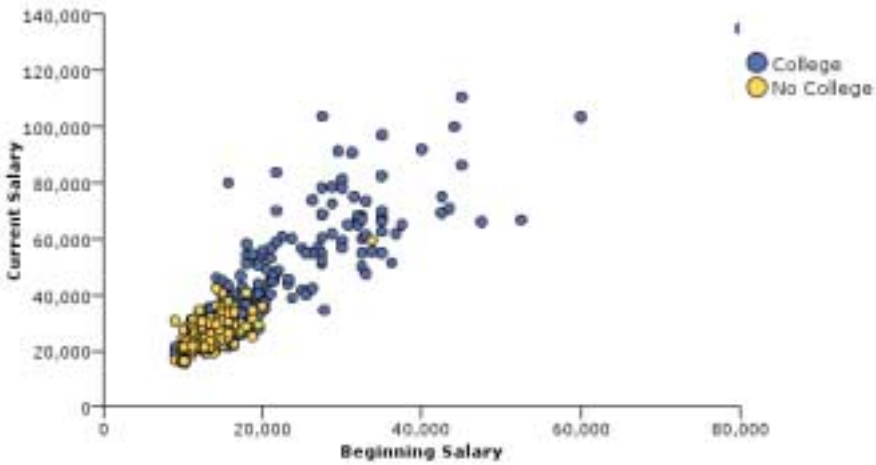
Creating Categories Using the eval Function

This example demonstrates how you can use the `eval` function to create categories based on an expression.

Figure 3-155
GPL for creating categories with the eval function

```
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 3-156
Creating categories with the eval function



Appendix
A

GPL 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
limegreenlinen	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.

Table A-1
Shape constants for interval elements

ibeam	line	square	

Table A-2
Shape constants for edge and point elements

arrow	bowtie	circle	cross
female	flower	ibeam	line
male	plus	pentagon	square
star			

Table A-3
Shape 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

tiny	small	medium	large
huge			

Pattern Constants

checkered	grid	grid2	grid3
grid4	grid5	mesh	mesh2
mesh3	mesh4	mesh5	pluses
pluses2	solid		

Bibliography

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

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