WORKING IN SGPLOT

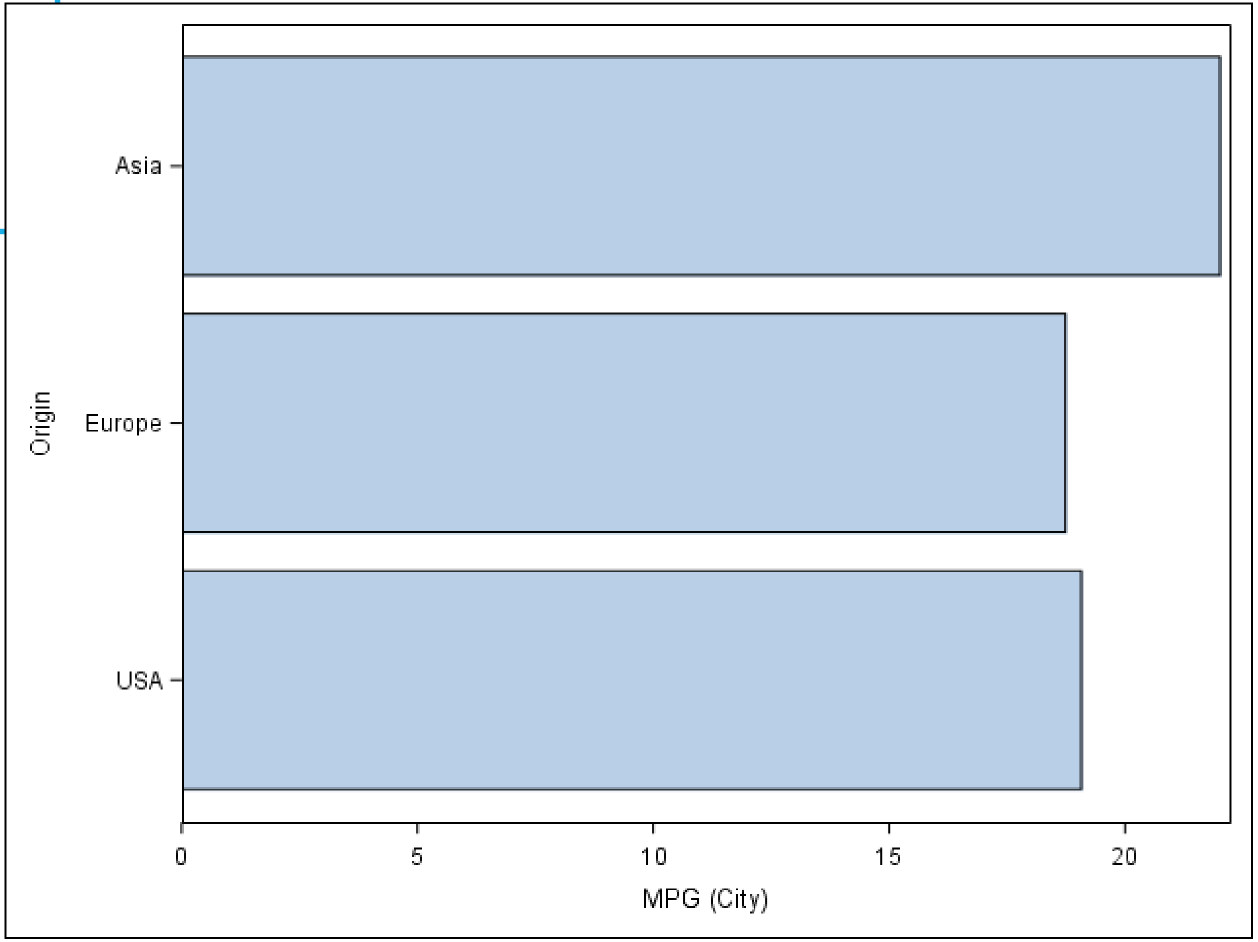
Understanding the General Logic of Attributes

Graphical Elements in SGPLOT

- All graphs generated by SGPLOT can be viewed as a collection of elements.
- Some of the nomenclature of these elements is the same or similar to that which was utilized in SAS/GRAPH.
  - Labels on axes, along with values at major tick marks.
  - Legends still have values for each category, but in SGPLOT we have a title instead of a label.
  - In scatterplots, and related graphs, we have markers—the keyword symbol is used to refer to their shape.
- Any of the elements can potentially be re-styled by altering their attributes.
  - In SGPLOT, graphical elements are divided into various types that have common attribute sets.

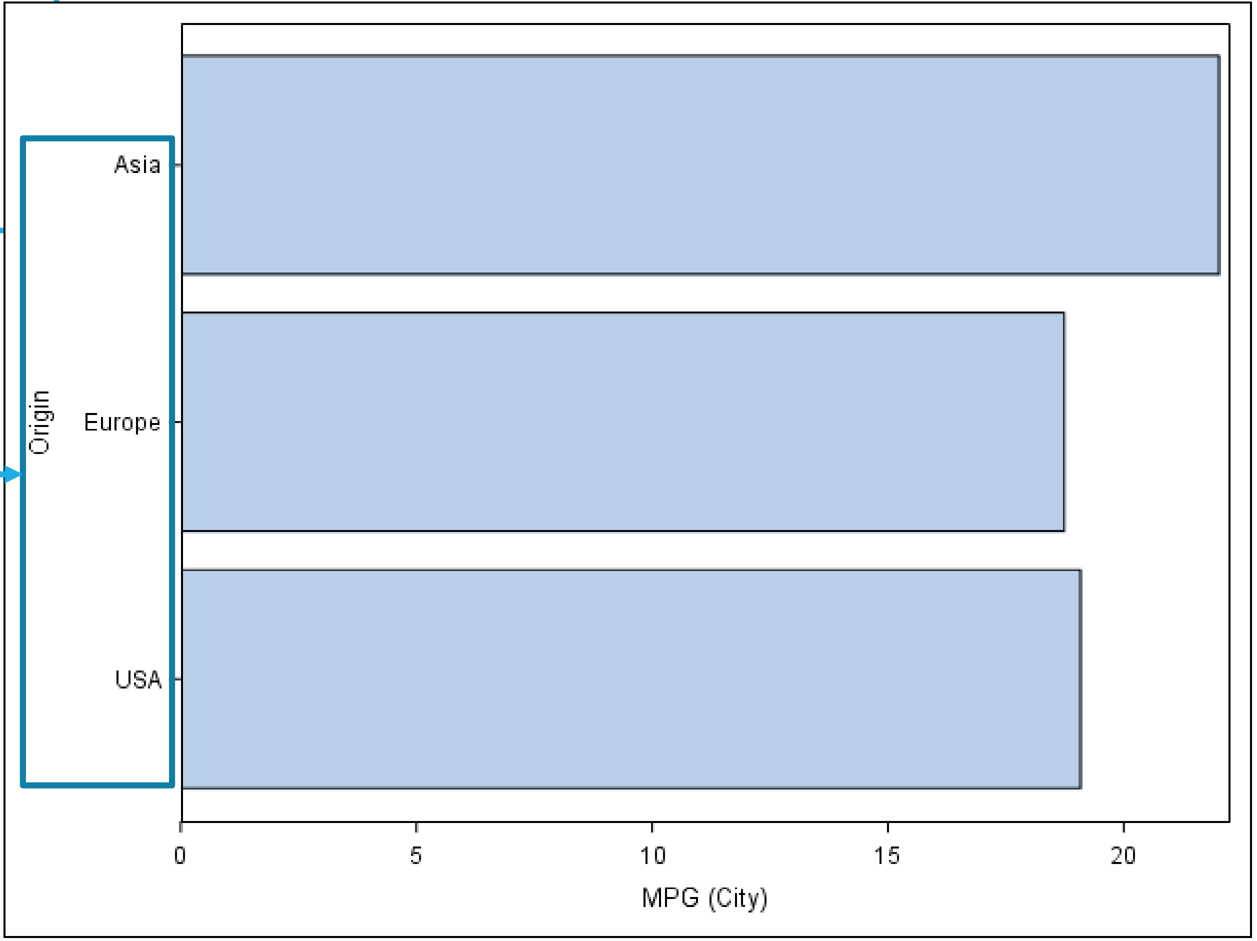
Two Simple Plots—Bar Chart

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
      hbar origin / response=mpg_city
            stat=mean;
run;
quit;
```



Two Simple Plots—Bar Chart

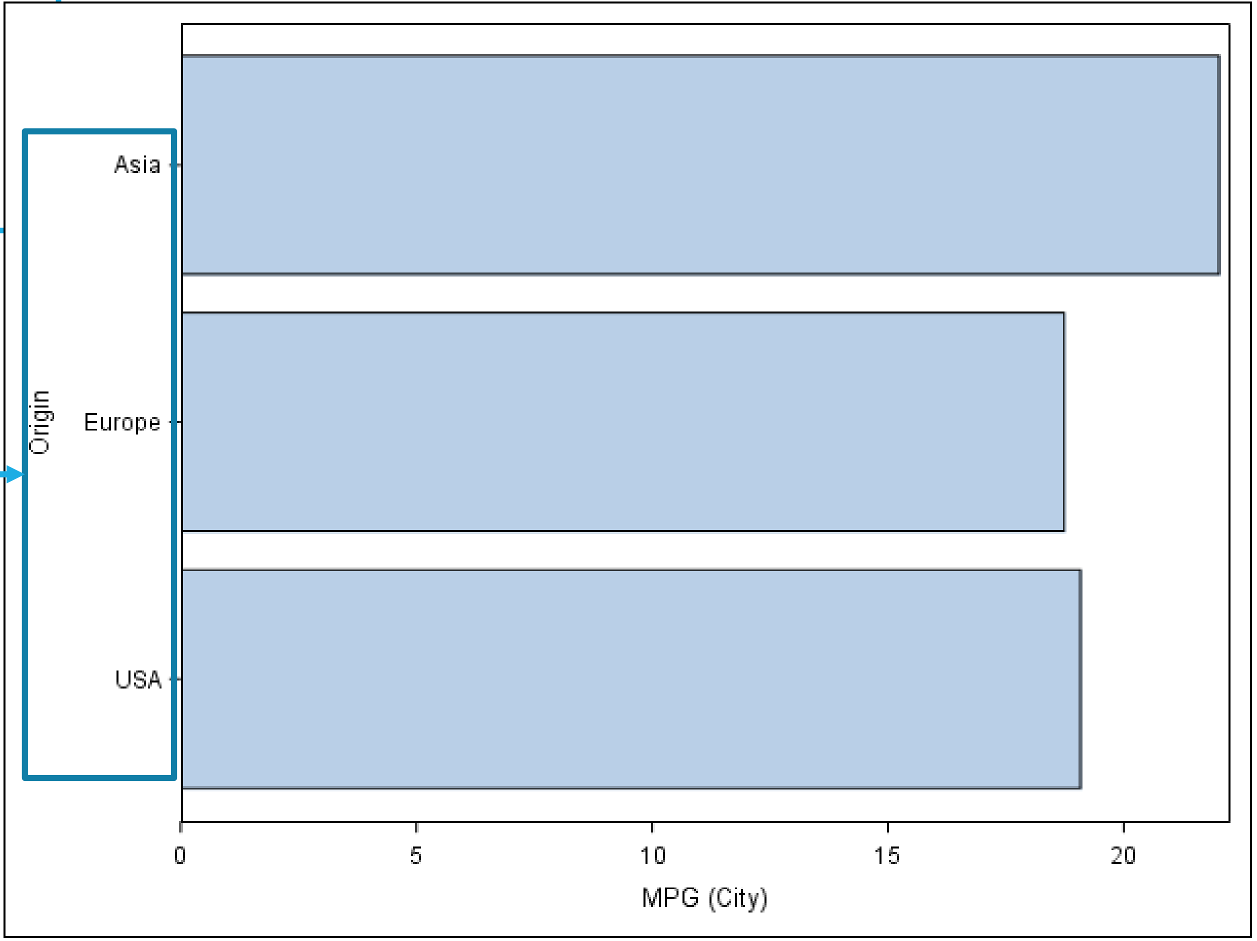
```
ods graphics / reset;
proc sgplot data=sashelp.cars;
        hbar origin / response=mpg_city
                stat=mean;
run;
quit;
```



Labels and values on any axis are text graphical elements. For text, 5 attributes can be set:

Two Simple Plots—Bar Chart

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
        hbar origin / response=mpg_city
                stat=mean;
run;
quit;
```



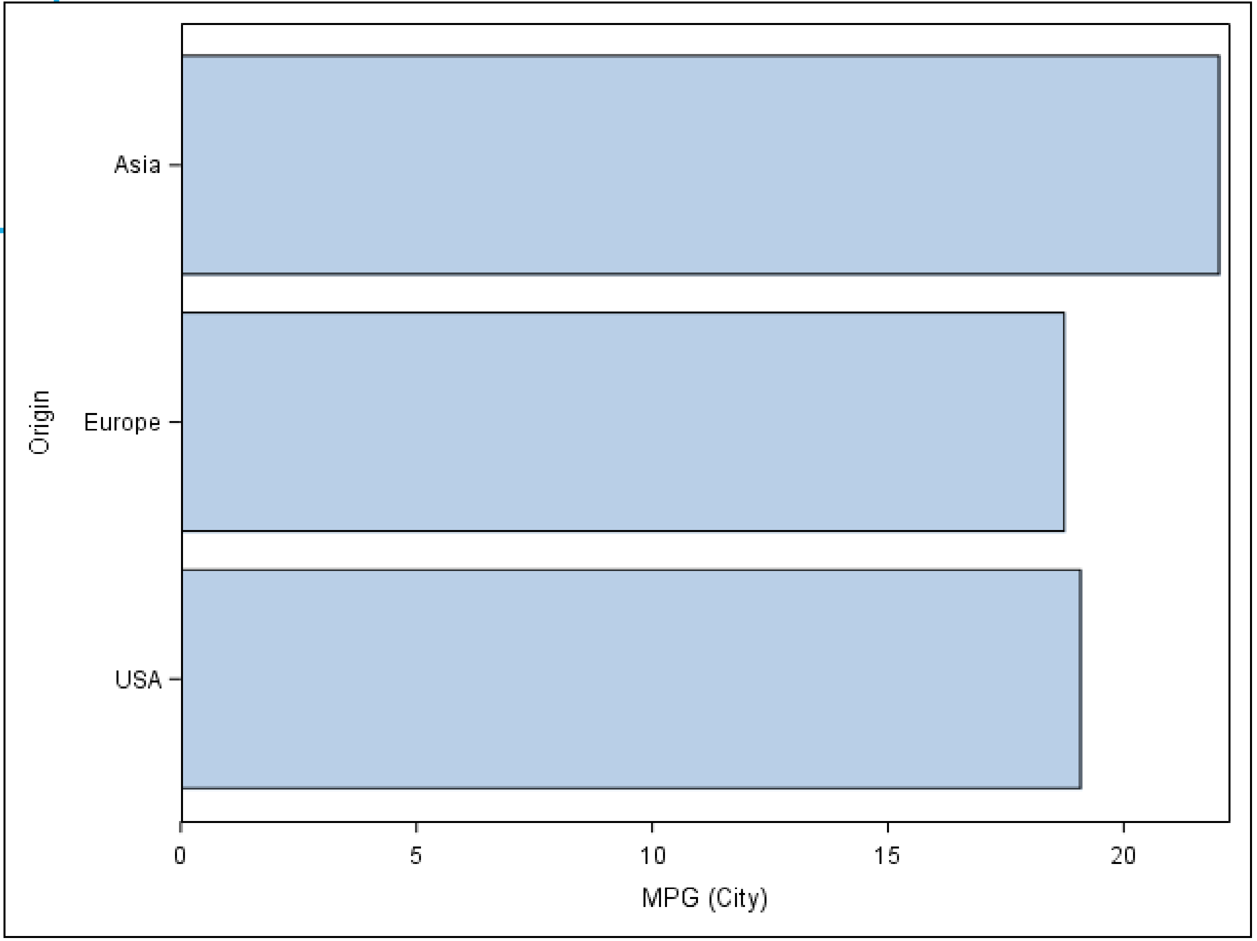
Labels and values on any axis are text elements. For text, 5 attributes can be set:

Font, size, color, style and weight

Two Simple Plots—Bar Chart

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
        hbar origin / response=mpg_city
                stat=mean;
run;
quit;
```

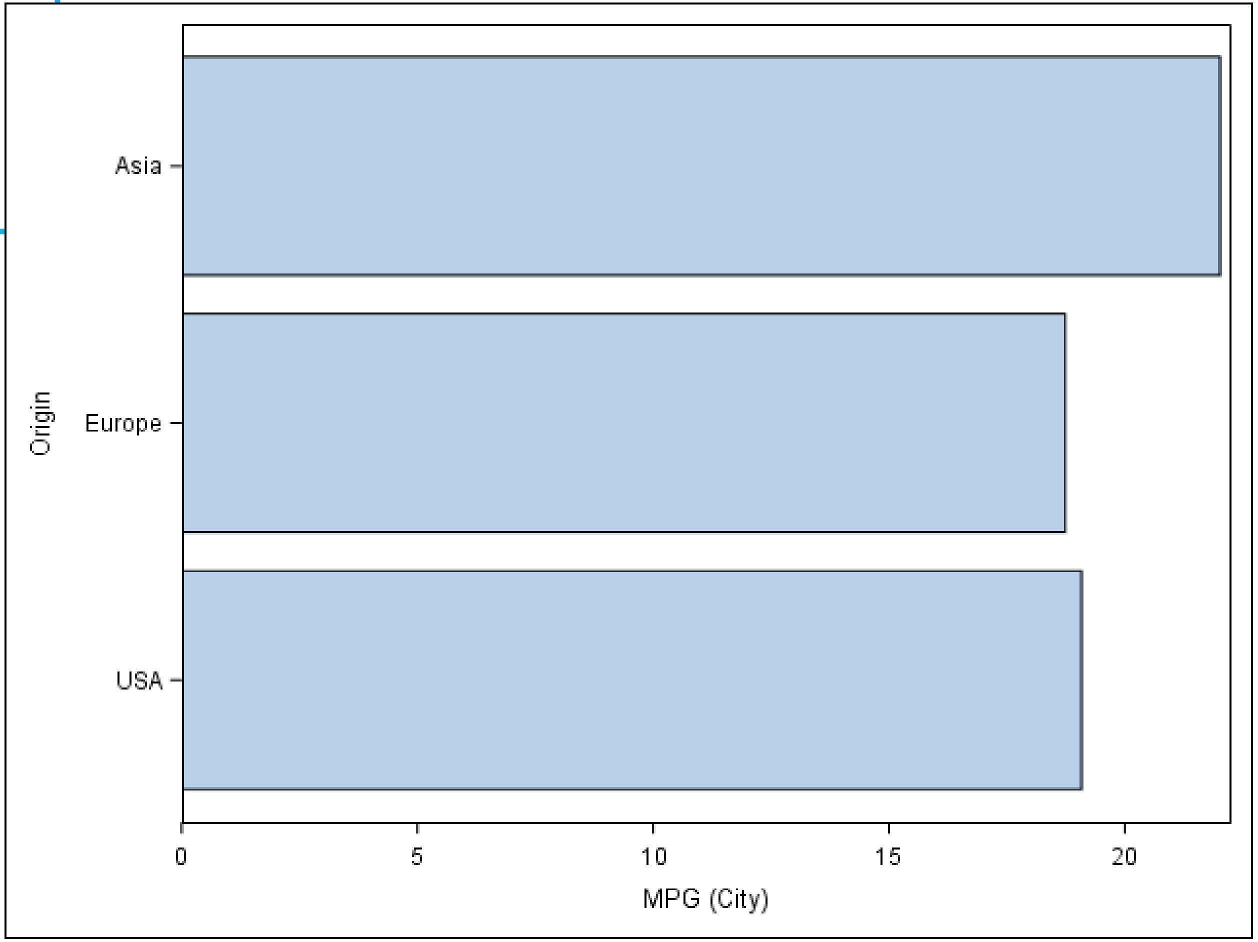
In their default form, bars have two elements—fill and outline. Fills and lines each have their own attribute sets.



Two Simple Plots—Bar Chart

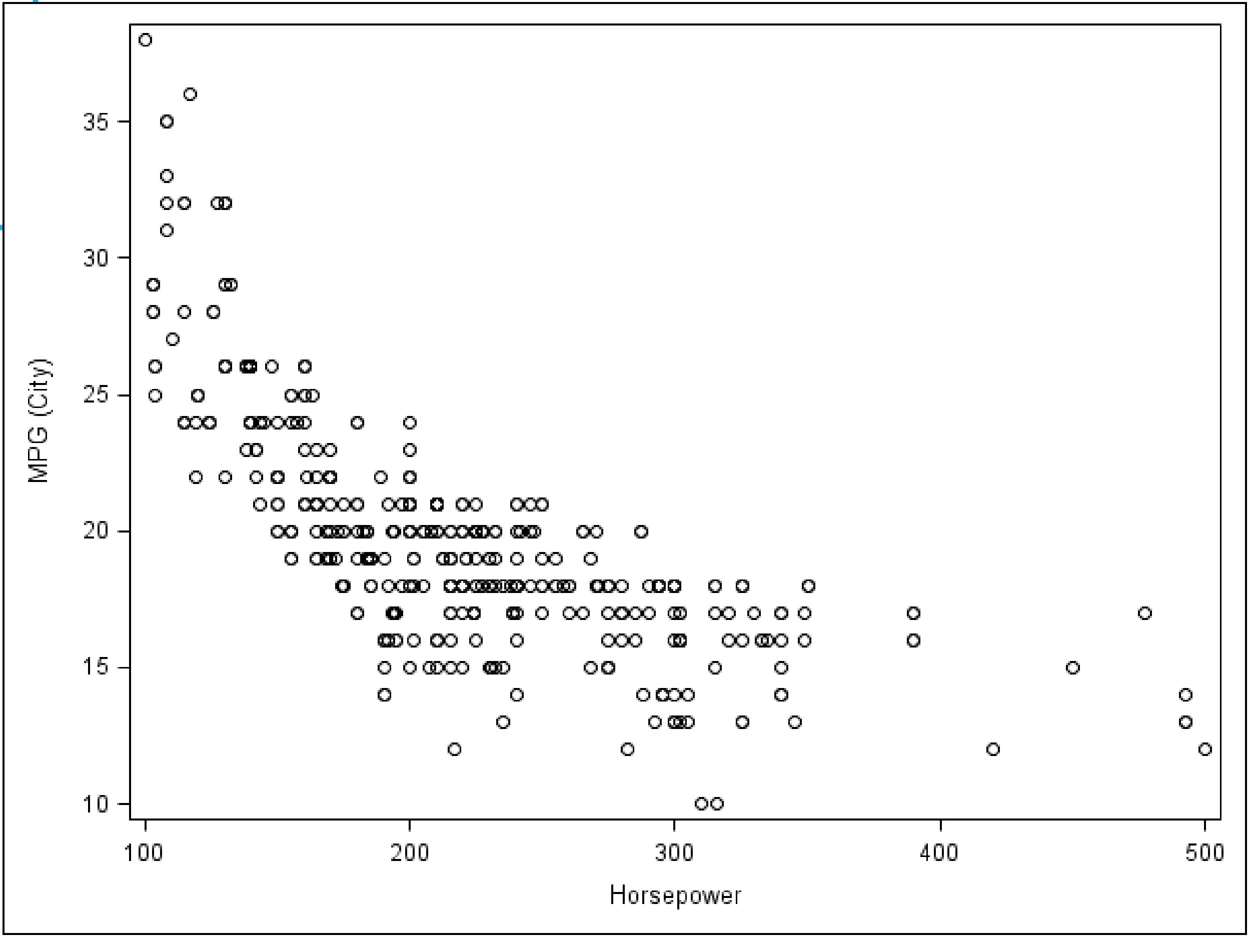
```
ods graphics / reset;
proc sgplot data=sashelp.cars;
       hbar origin / response=mpg_city
              stat=mean;
run;
quit;
```

Fill allows for color and transparency.
Line allows color, pattern and thickness.



Two Simple Plots—Scatterplot

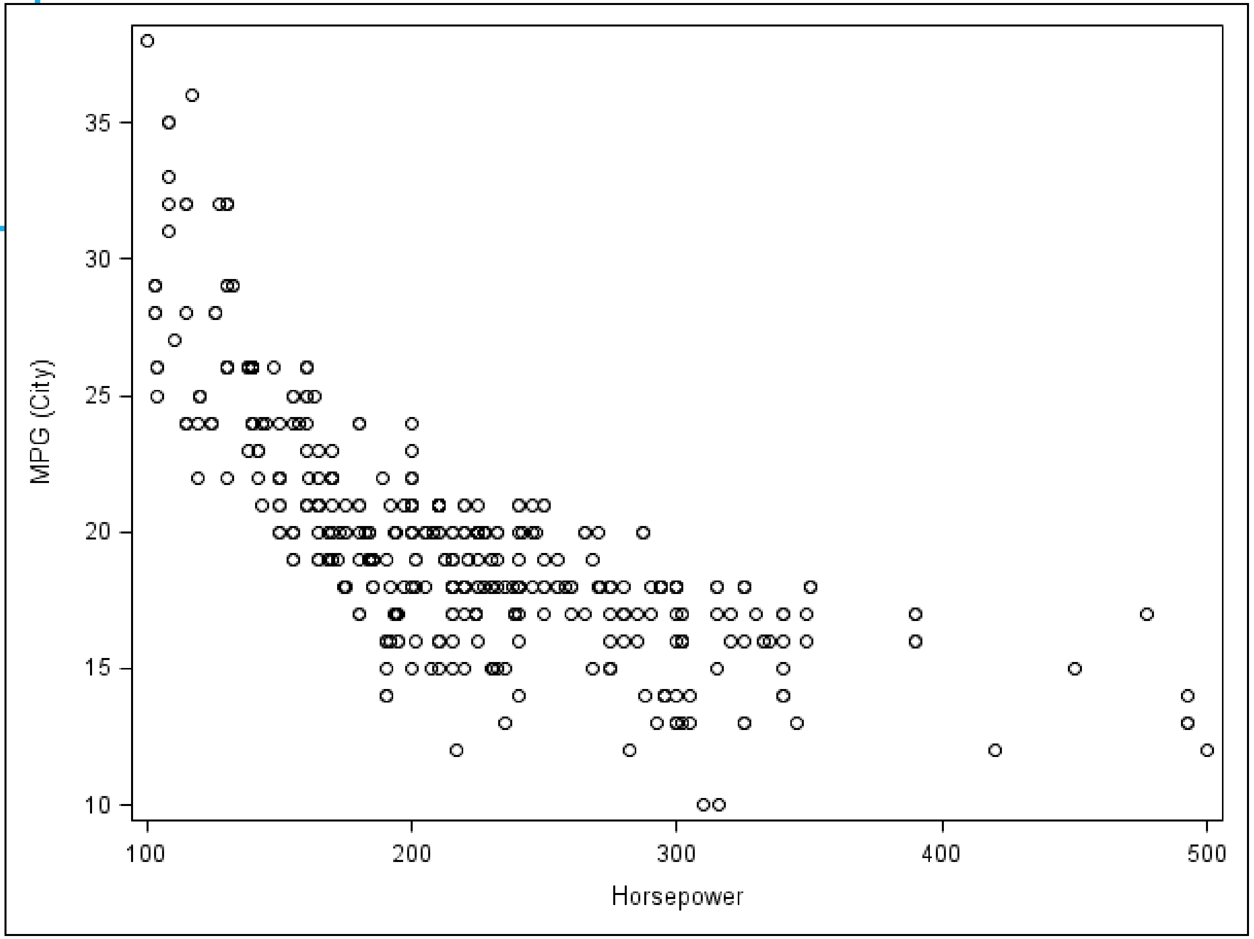
```
ods graphics / reset;
proc sgplot data=sashelp.cars;
       scatter x=horsepower y=mpg_city;
       where type ne 'Hybrid';
run;
quit;
```



Two Simple Plots—Scatterplot

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
       scatter x=horsepower y=mpg_city;
       where type ne 'Hybrid';
run;
quit;
```

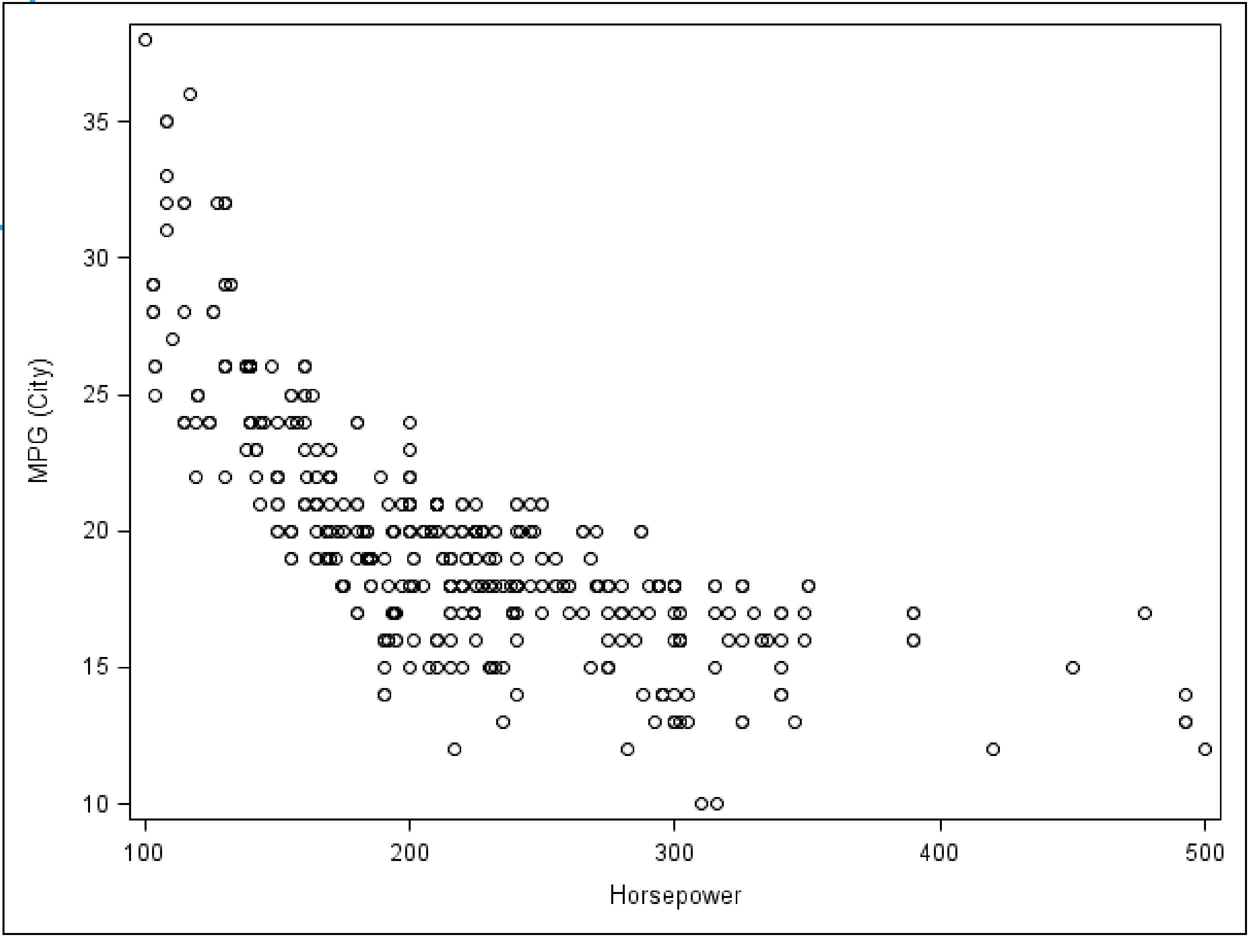
One element the bar graph does not have is the marker, which the scatterplot contains by default.



Two Simple Plots—Scatterplot

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
      scatter x=horsepower y=mpg_city;
      where type ne 'Hybrid';
run;
quit;
```

For markers, color, size and symbol can all be set.



The Fill Attribute

- We will start by modifying the bar fill in the first graph.

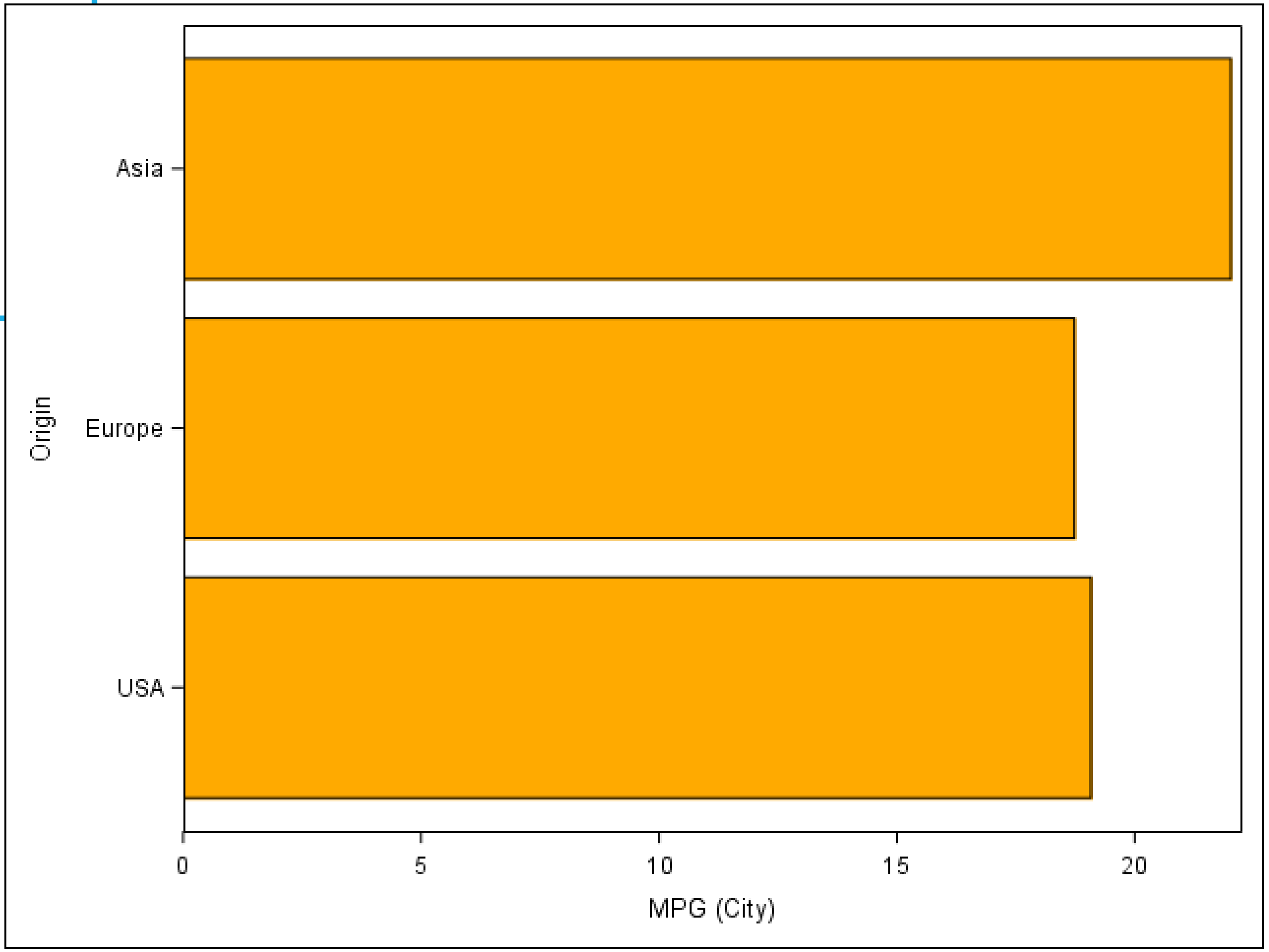
- Fill attributes available for modification are:
  - Color—in any of the SAS color models
  - Transparency—a proportion, from 0 to 1, with 0 being fully opaque

- Since the hbar statement generates the bars, these attributes can be set as an option in the hbar statement, in general:
  - The keyword is derived from the element name with the suffix ***attrs***
  - For the bar fill, we will use ***fillattrs=(***options***)***
  - It is also possible to assign a style element as part of this specification—beyond the scope of this lesson

The Fill Attribute

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
  hbar origin / response=mpg_city
    stat=mean
    fillattrs=(color=cxFFAA00);
run;
quit;
```

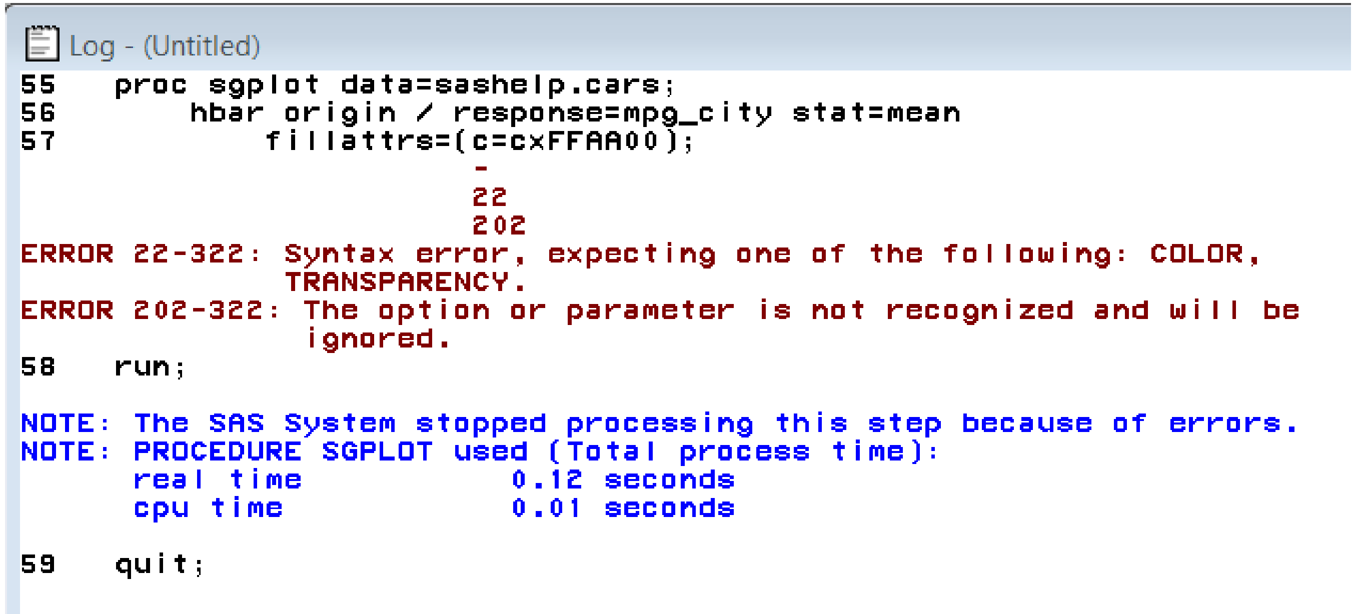
Add ***fillattrs*** to your list of hbar options and choose your favorite color.



The Fill Attribute

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
  hbar origin / response=mpg_city
    stat=mean
    fillattrs=(c=cxFFAA00);
run;
quit;
```

If you are used to SAS/GRAPH, common aliases do not work here.

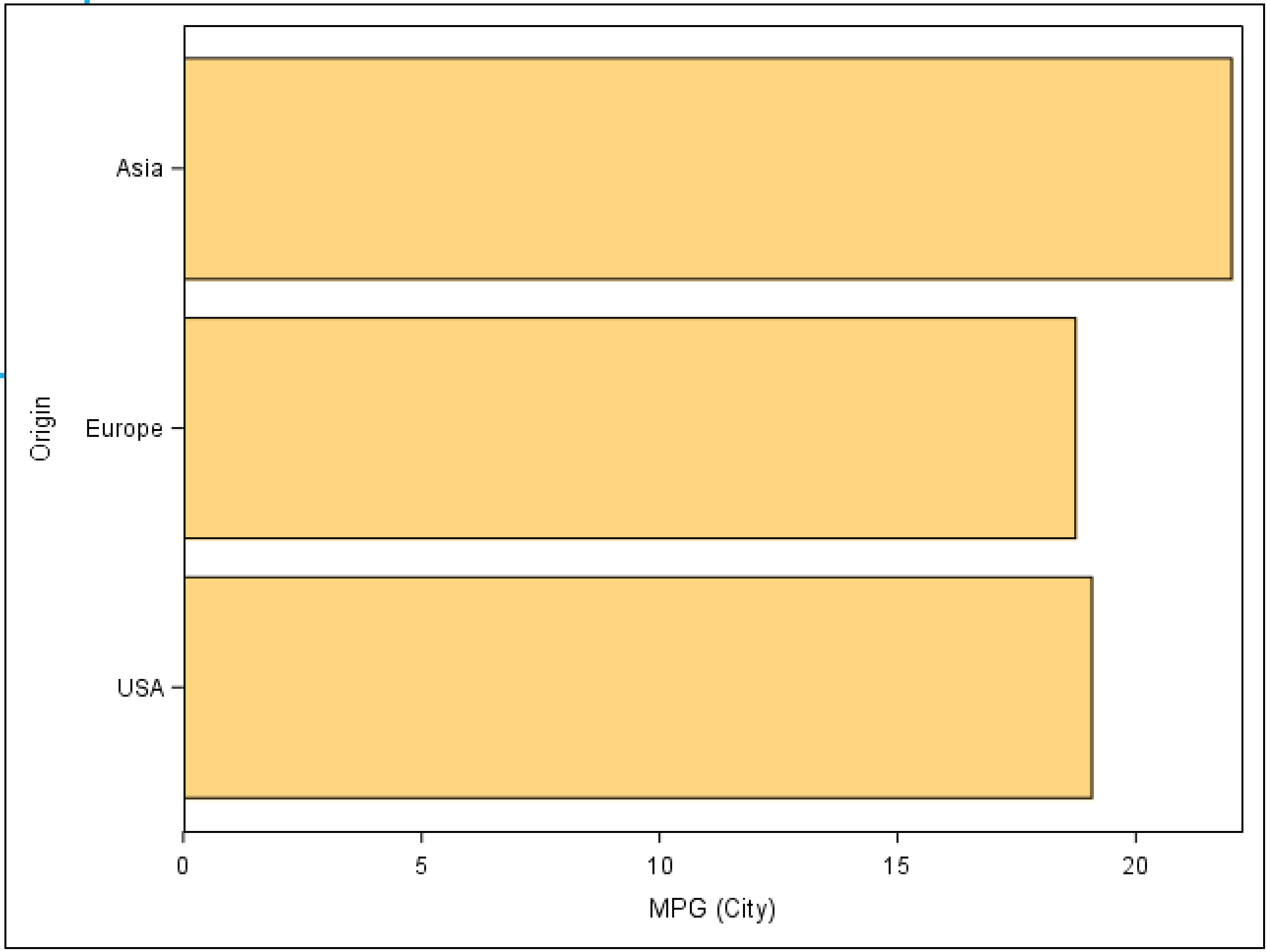


```
55   proc sgplot data=sashelp.cars;
56       hbar origin / response=mpg_city stat=mean
57           fillattrs=(c=cxFFAA00);
                        -
                        22
                        202
ERROR 22-322: Syntax error, expecting one of the following: COLOR,
              TRANSPARENCY.
ERROR 202-322: The option or parameter is not recognized and will be
               ignored.
58   run;

NOTE: The SAS System stopped processing this step because of errors.
NOTE: PROCEDURE SGPLOT used (Total process time):
      real time           0.12 seconds
      cpu time            0.01 seconds

59   quit;
```

The Fill Attribute

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
  hbar origin / response=mpg_city
    stat=mean
    fillattrs=(color=cxFFAA00
               transparency=0.5);
run;
quit;
```

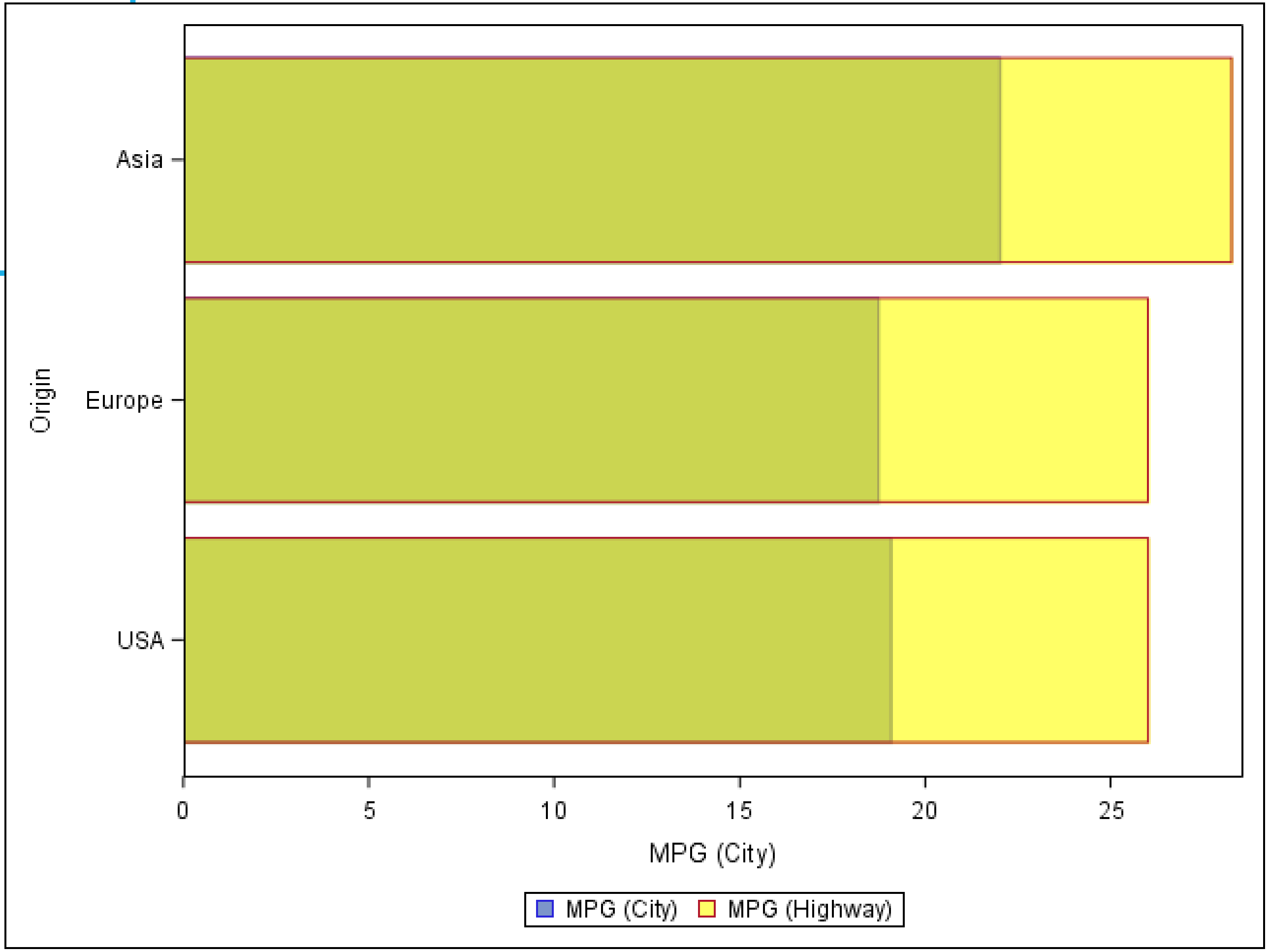
With no overlays of graphs, transparency amounts to little more than a lightening of the color.



The Fill Attribute

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   hbar origin / response=mpg_city stat=mean;
   hbar origin / response=mpg_highway stat=mean
       fillattrs=(transparency=0.4
                  color=yellow);
run;
quit;
```

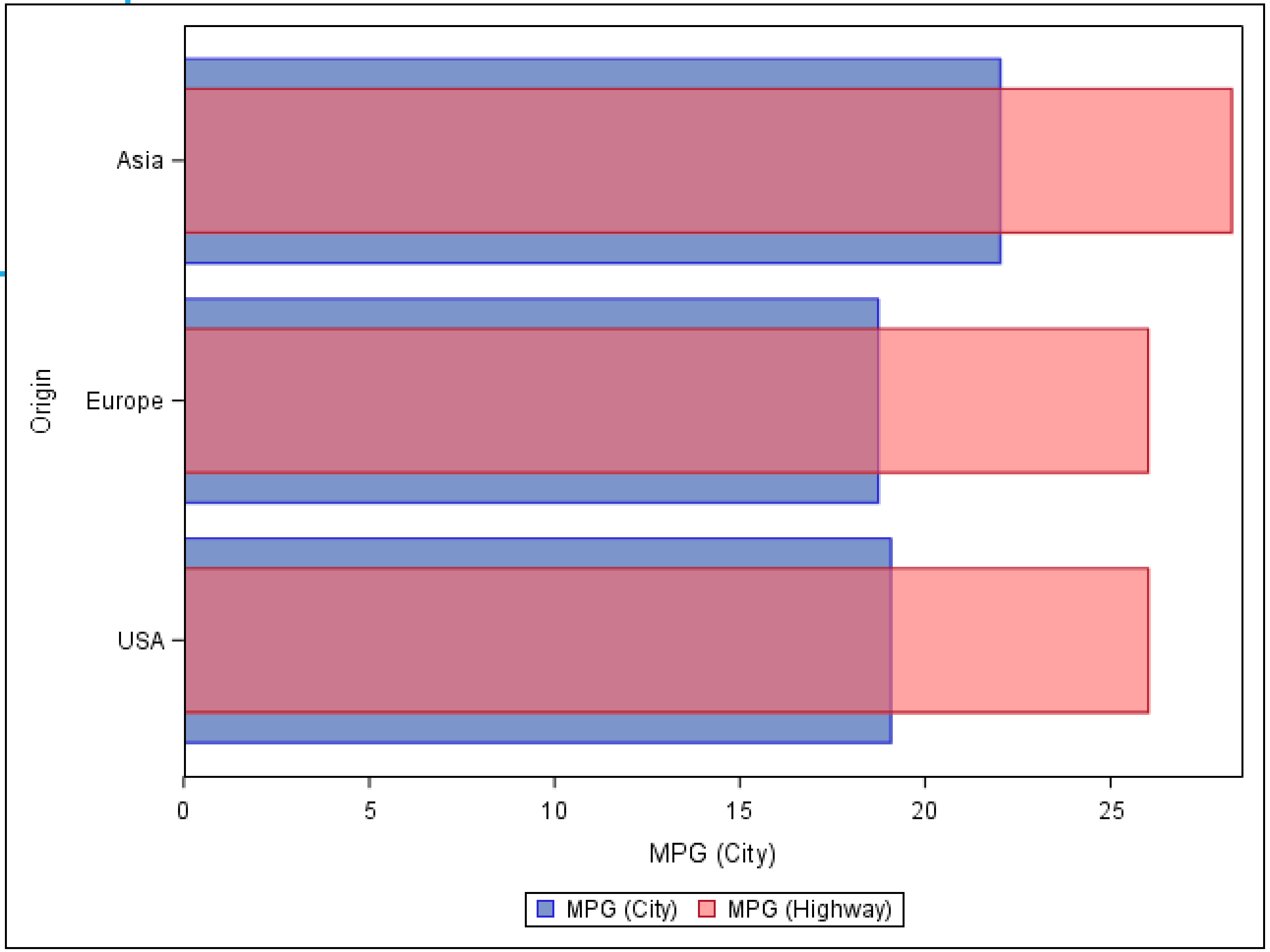
Here, yellow bars for highway MPG overlay the default blue bars for city. The transparency effect results in a green for the city bars.



The Fill Attribute

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   hbar origin / response=mpg_city stat=mean;
   hbar origin / response=mpg_highway stat=mean
     fillattrs=(transparency=0.4 color=cxFF6666)
     barwidth=0.6;
run;
quit;
```

Some care with colors and bar sizes can be helpful in these situations.



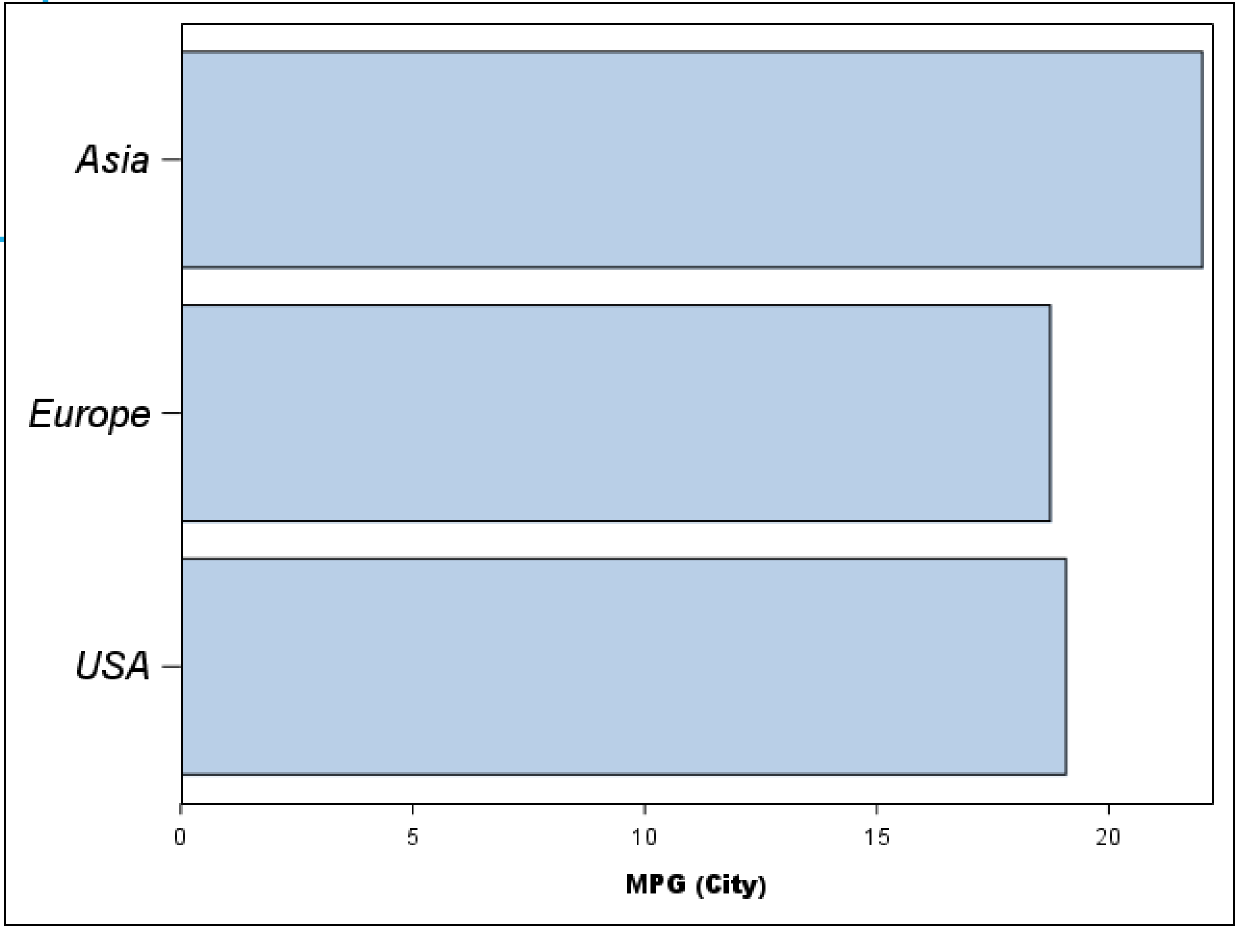
Text Attributes

- Returning to our simple bar graph, we will alter text styles.
- Text attributes available for modification are:
  - Color—in any of the SAS color models
  - Family—any font available in your session
  - Size—in various units: cm, mm, in, pct, pt, px
  - Style—normal or italic
  - Weight—normal or bold
- The hbar statement generates text only due to the axes:
  - The only text modifications we can make to the original graph will be in an ***xaxis*** or ***yaxis*** statement.
  - The keyword is still derived from the element name with the suffix ***attrs***
  - For the labels, we will use ***labelattrs=(***options***)***—for the values, we will use ***valueattrs=(***options***)***

Text Attributes

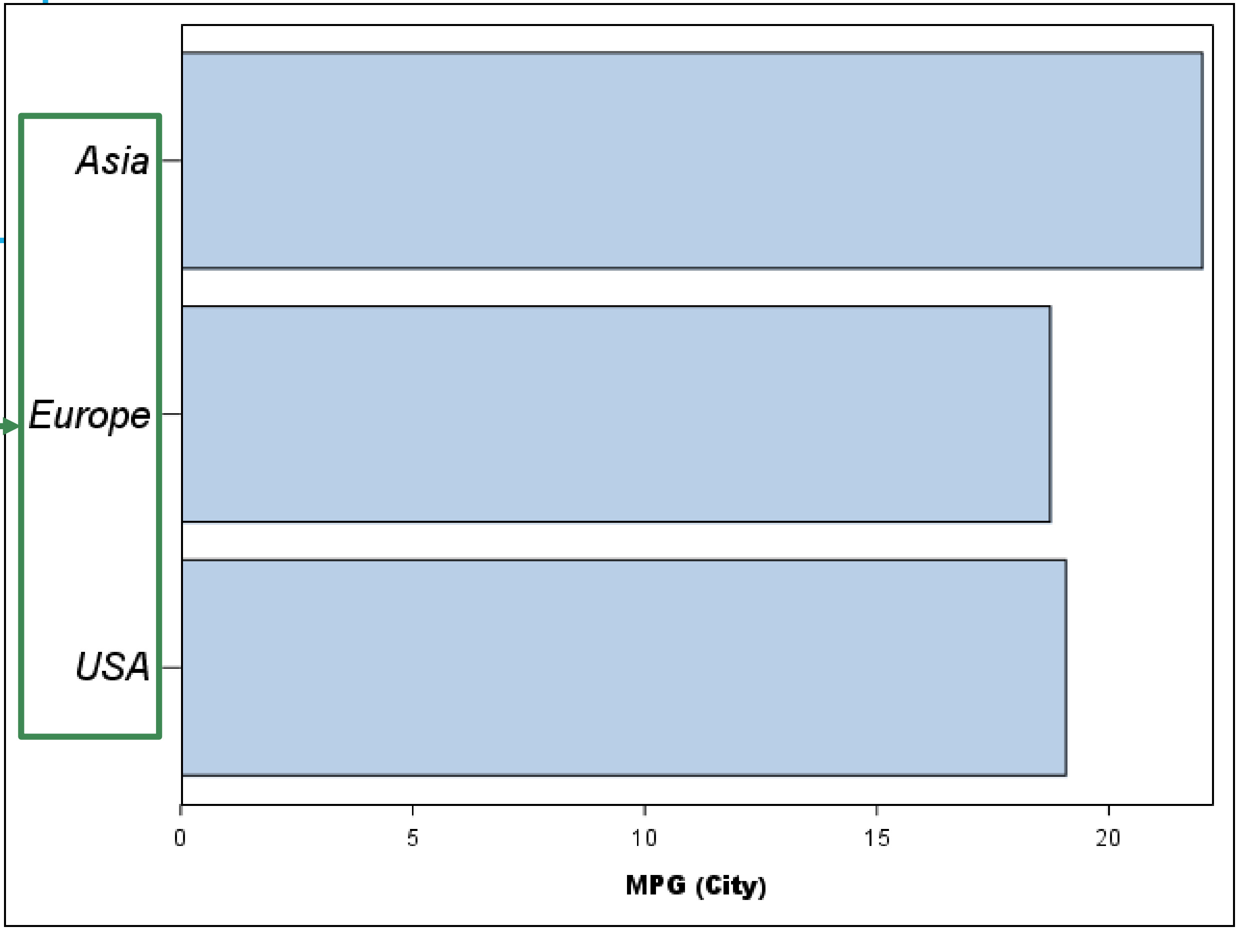
```
ods graphics / reset;
proc sgplot data=sashelp.cars;
  hbar origin / response=mpg_city stat=mean;
    yaxis display=(nolabel)
      valueattrs=(size=14pt style=italic);
    xaxis labelattrs=(family='Arial Black');
run;
quit;
```

So in each axis statement we have modified one of the text elements.



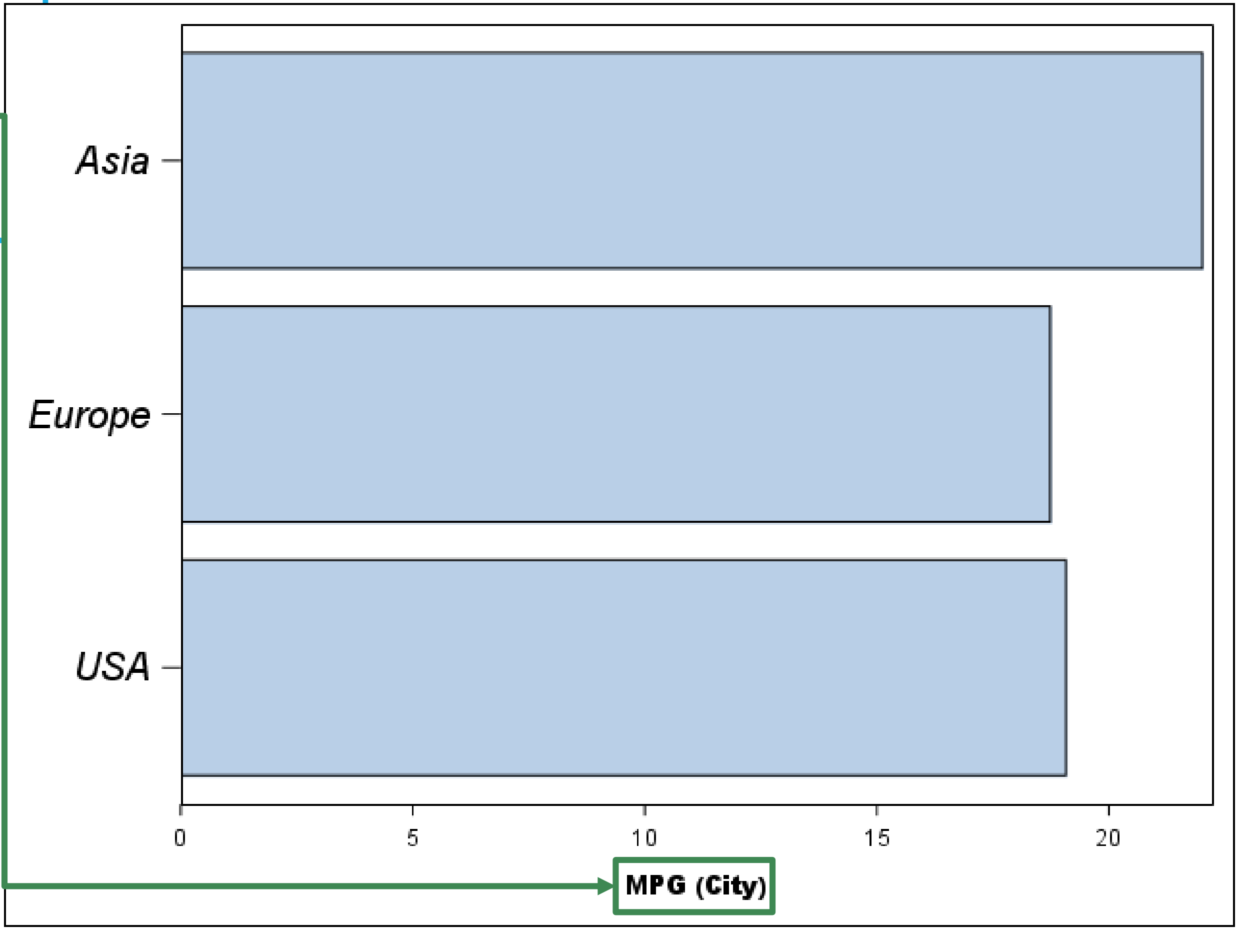
Text Attributes

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
  hbar origin / response=mpg_city stat=mean;
    yaxis display=(nolabel)
      valueattrs=(size=14pt style=italic);
    xaxis labelattrs=(family='Arial Black');
run;
quit;
```



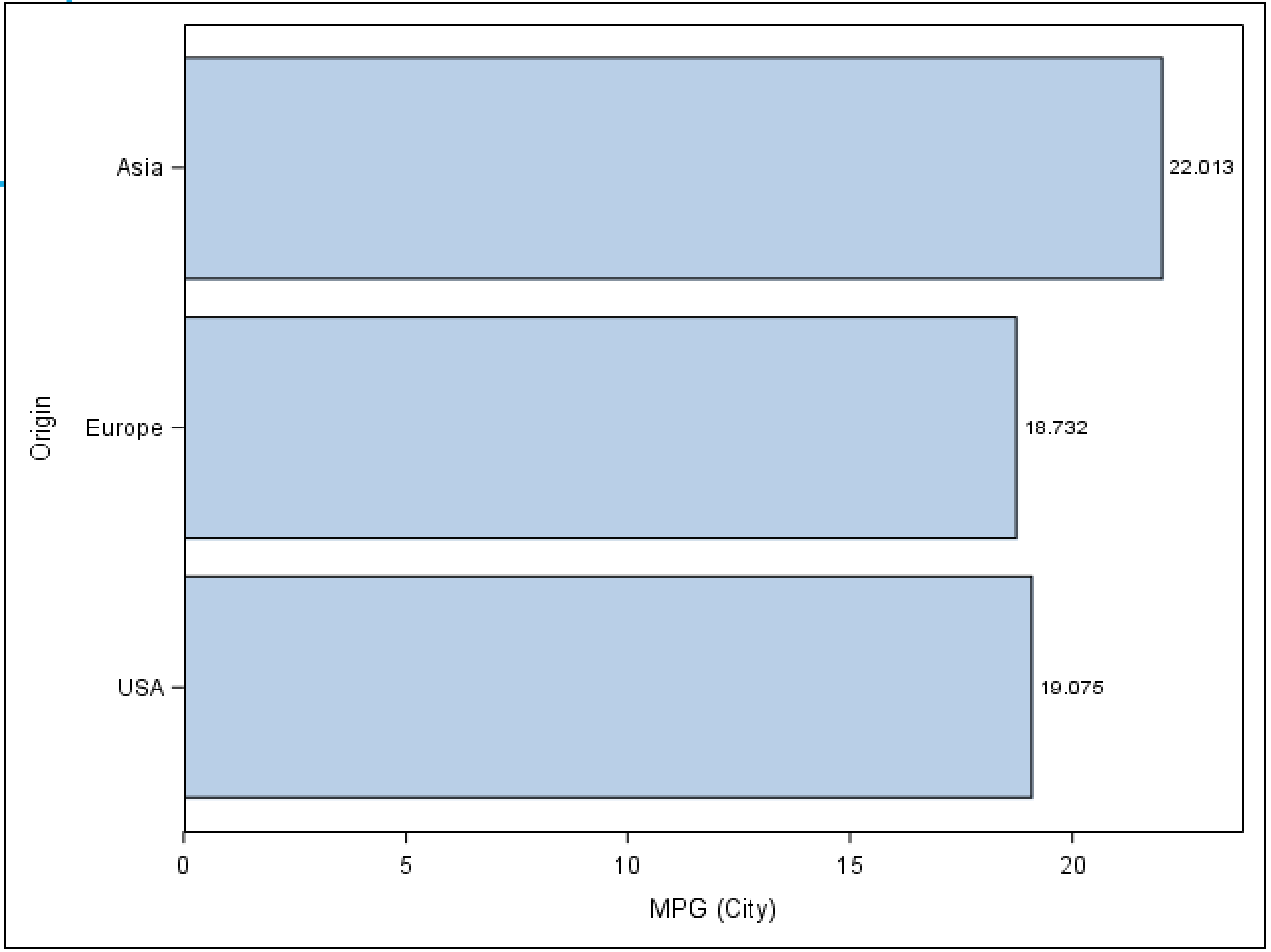
Text Attributes

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
  hbar origin / response=mpg_city stat=mean;
    yaxis display=(nolabel)
      valueattrs=(size=14pt style=italic);
    xaxis labelattrs=(family='Arial Black');
run;
quit;
```



Exercise

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   hbar origin / response=mpg_city stat=mean
      datalabel;
run;
quit;
```

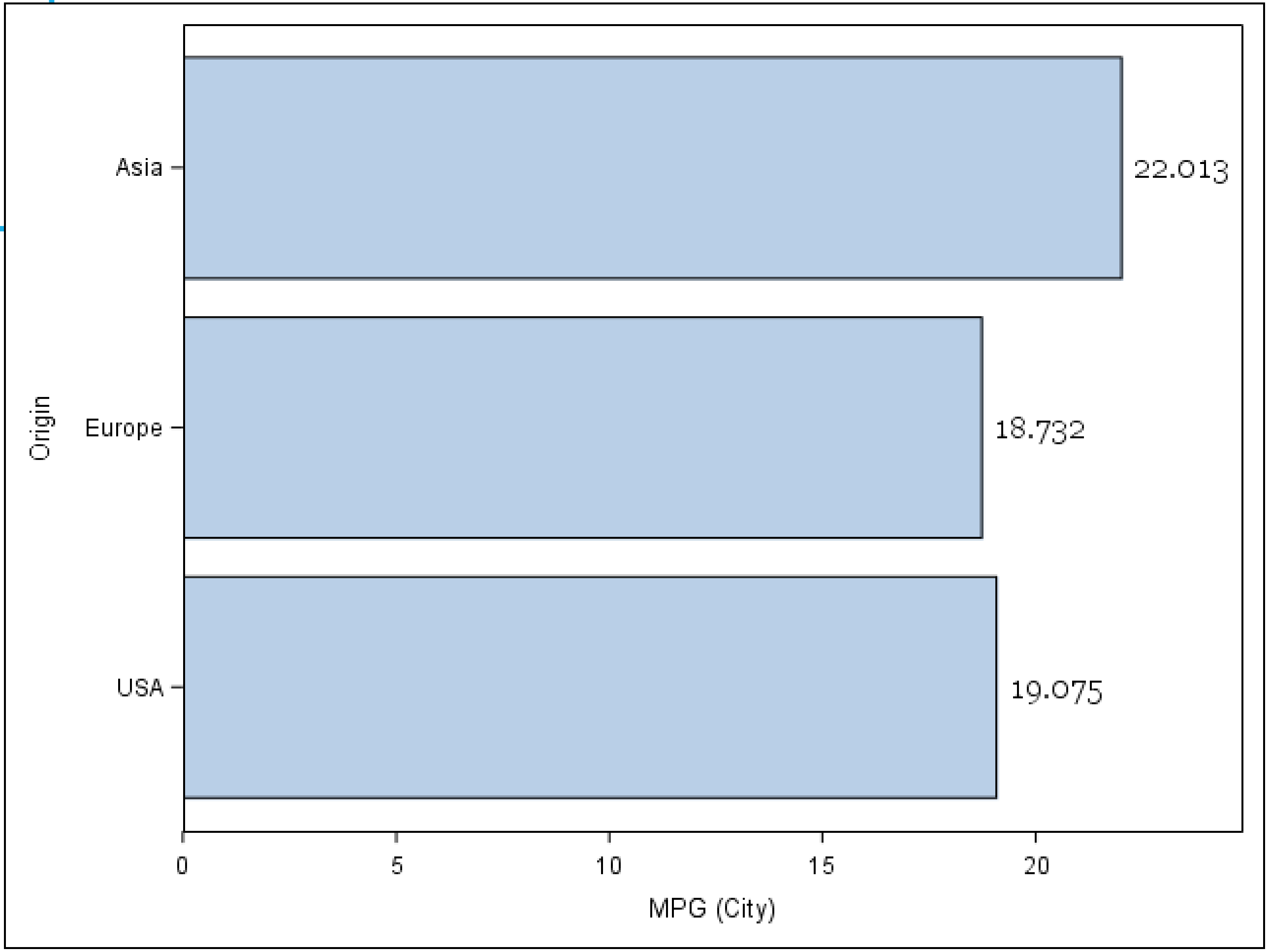


Of course, text may appear in the graph area for a bar graph, such as when the ***datalabel*** option is used.

Can you modify the attributes of the data labels?

Exercise

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   hbar origin / response=mpg_city stat=mean
      datalabel datalabelattrs=(family='Georgia'
                                size=12pt);
run;
quit;
```



Following the rules, the attribute keyword must be ***datalabelattrs*** (yes they can get long) and it must be an option in the graphing statement.

Any option that generates a graphic element can be reliably linked to its ***attrs*** keyword.

Line Attributes

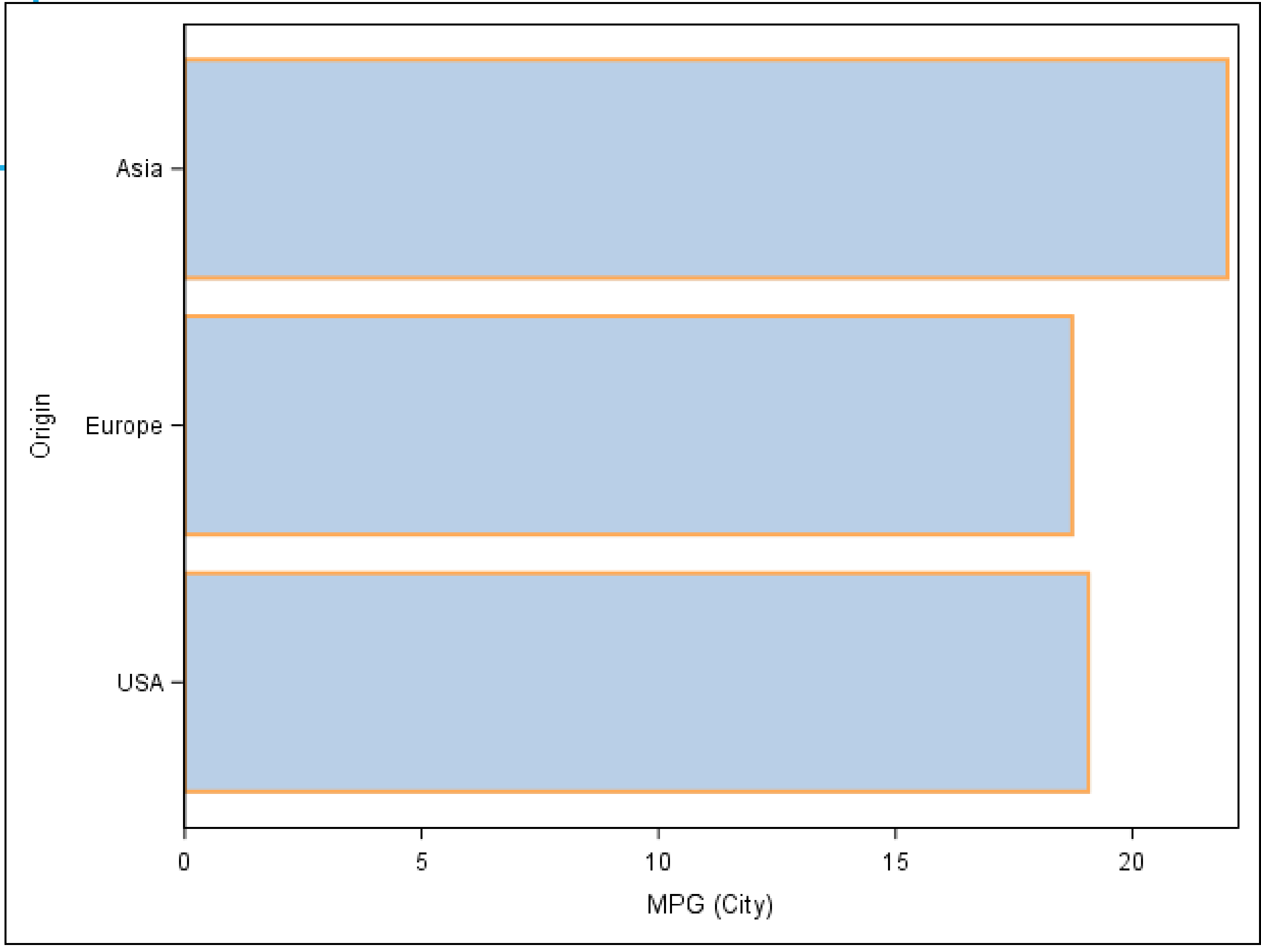
- Returning to our simple bar graph, we will alter the bar outlines.

- Line attributes available for modification are:
  - Color—in any of the SAS color models
  - Pattern—numbers 1 to 46 for various patterns (or names for named patterns)
  - Thickness—in various units: cm, mm, in, pct, pt, px

- Since the hbar statement generates the bars with outlines (by default), these attributes can be set as an option in the hbar statement :
  - The keyword is still derived from the element name with the suffix ***attrs***
  - So we will use ***outlineattrs=(***options***)***

Line Attributes

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   hbar origin / response=mpg_city stat=mean
      outlineattrs=(color=cxFFAA55 thickness=2pt);
run;
quit;
```



Knowing the names of default graph elements is helpful, as it gives a direct link to the ***attrs*** keyword.

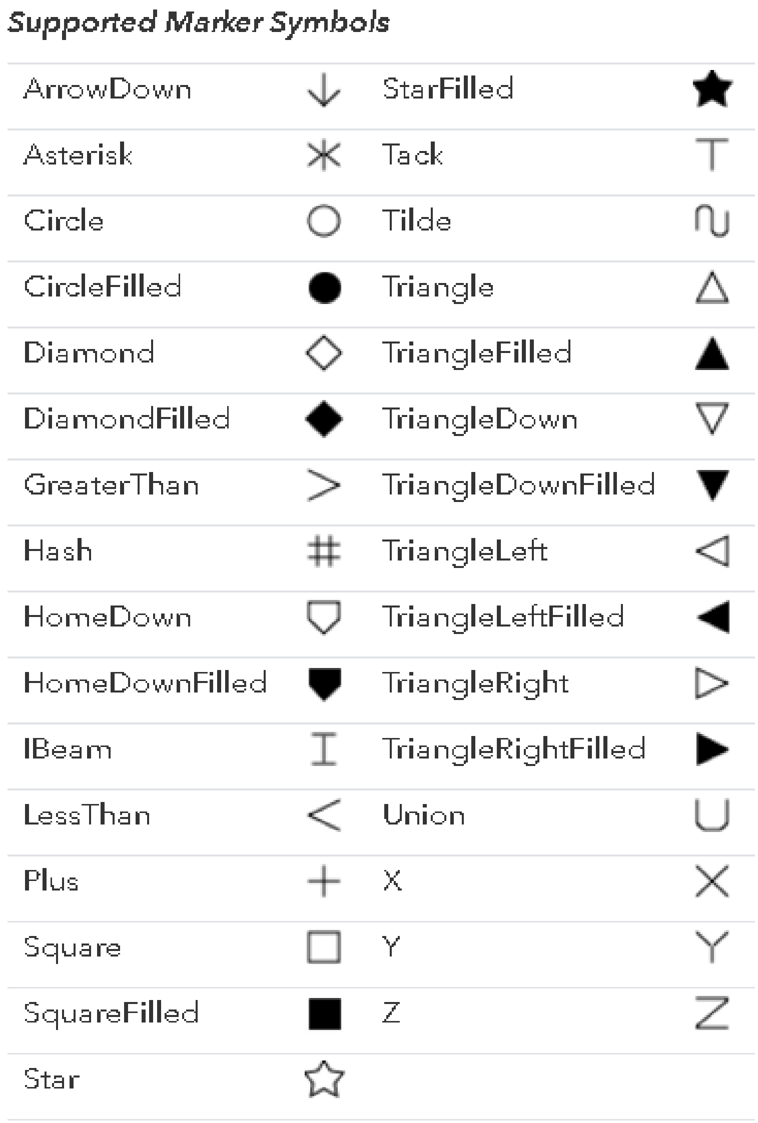
Marker Attributes

- The final type of graph element associated with attributes are markers—we will use the scatterplot to look at these.

- Marker attributes available for modification are:
  - Color—in any of the SAS color models
  - Size—in various units: cm, mm, in, pct, pt, px
  - Symbol—various shapes, see next slide for choices

- The scatter statement generates a marker at each data point:
  - The keyword is still derived from the element name with the suffix ***attrs***
  - So we will use ***markerattrs=(***options***)***—as an option in the scatter statement

Marker Symbols



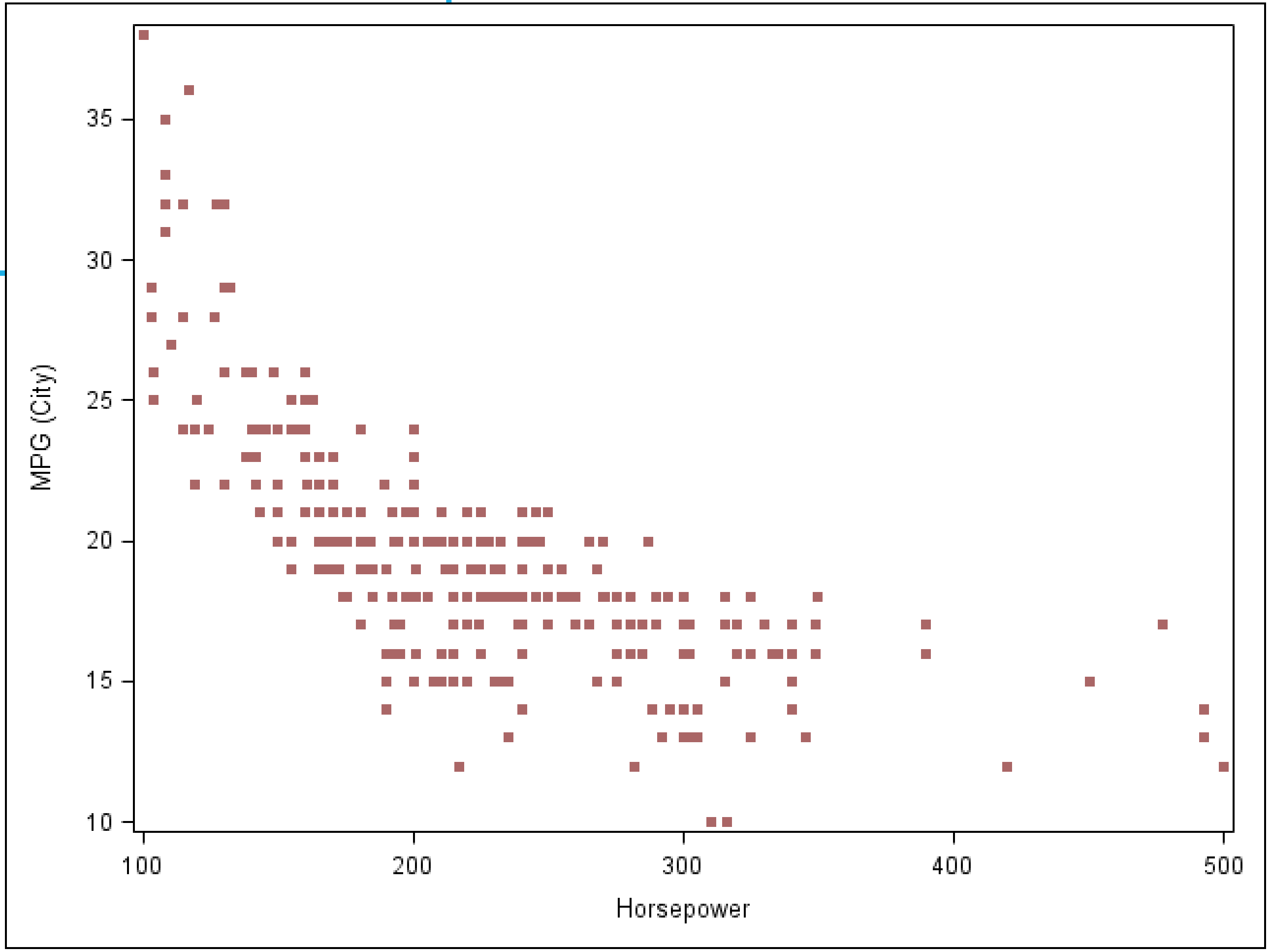
Supported Marker Symbols

ArrowDown	↓	StarFilled	★
Asterisk	✳	Tack	⊤
Circle	○	Tilde	∿
CircleFilled	●	Triangle	△
Diamond	◇	TriangleFilled	▲
DiamondFilled	◆	TriangleDown	▽
GreaterThan	>	TriangleDownFilled	▼
Hash	#	TriangleLeft	◁
HomeDown	⛉	TriangleLeftFilled	◀
HomeDownFilled	⛊	TriangleRight	▷
IBeam	I	TriangleRightFilled	▶
LessThan	<	Union	∪
Plus	+	X	×
Square	□	Y	Y
SquareFilled	■	Z	Z
Star	☆		

Marker Attributes

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
  scatter x=horsepower y=mpg_city/
    markerattrs=(symbol=squarefilled
                 color=cxAA6666 size=4pt);
  where type ne 'Hybrid';
run;
quit;
```

Whatever is chosen is applied to all markers.



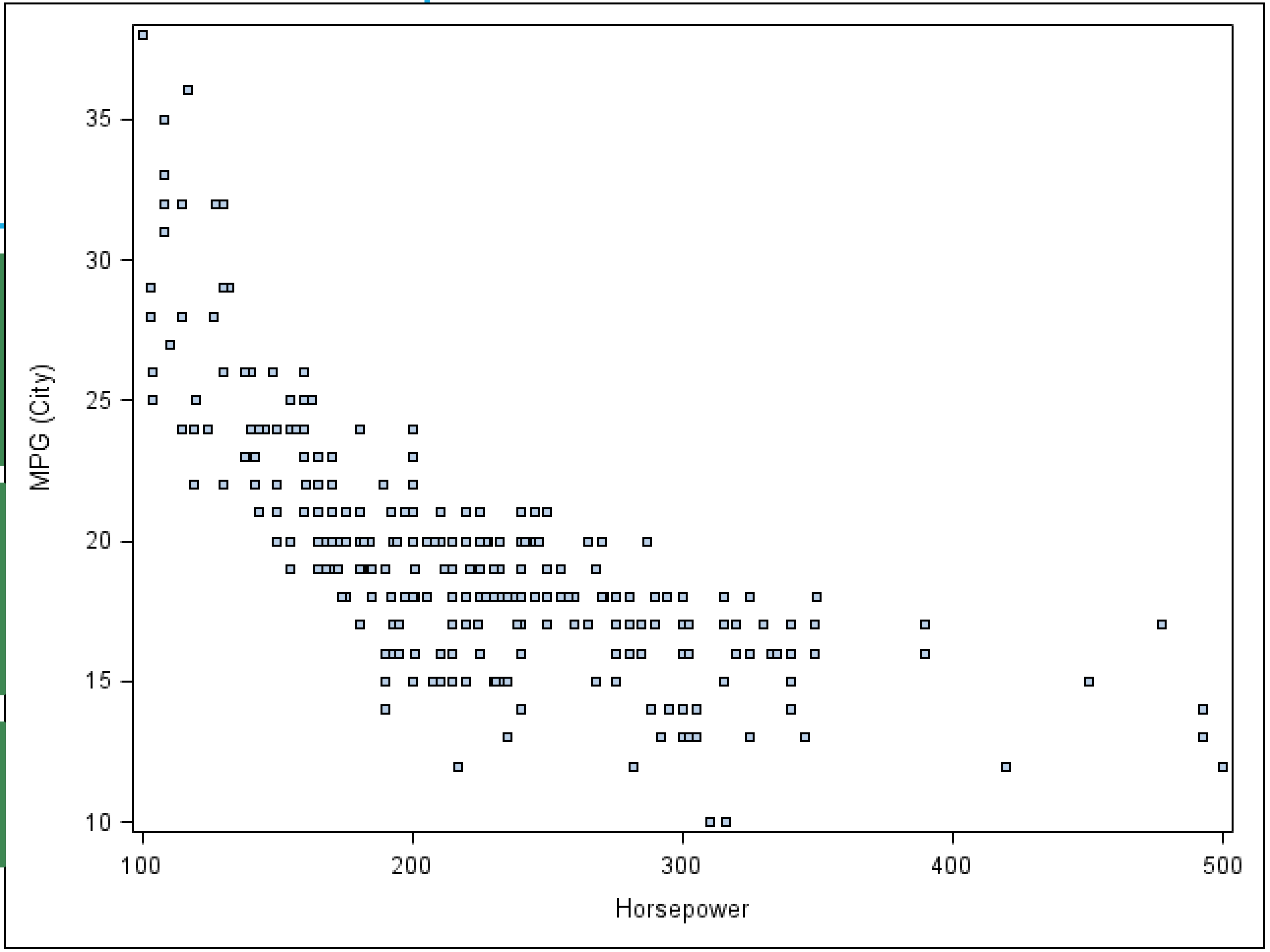
Marker Attributes—A Special Case

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
  scatter x=horsepower y=mpg_city/filledoutlinedmarkers
    markerattrs=(symbol=squarefilled
                 color=cxAA6666 size=4pt);
  where type ne 'Hybrid';
run;
quit;
```

The option ***filledoutlinedmarkers*** (yes these can be long) gives a peculiar result with our previous attributes.

The shape is correct (a filled symbol is required for ***filledoutlinedmarkers*** to work) and the size is also. However, neither the fill nor the outline use the red.

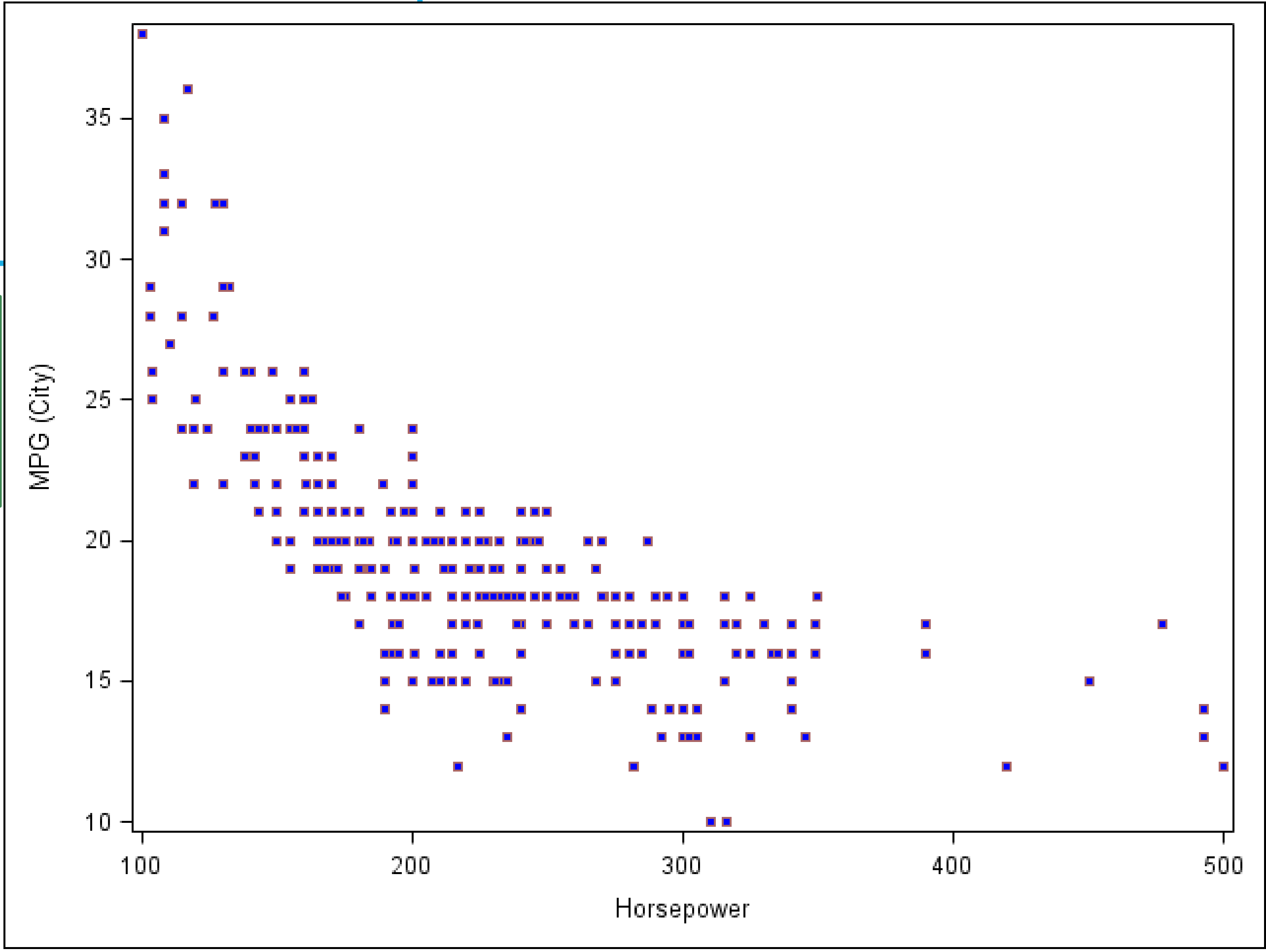
Can you figure out why and modify these to have a fill of a light blue and an outline in the red we used?



Marker Attributes—A Special Case

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
  scatter x=horsepower y=mpg_city/filledoutlinedmarkers
      markerattrs=(symbol=squarefilled size=4pt)
      markerfillattrs=(color=blue)
      markeroutlineattrs=(color=cxAA6666);
  where type ne 'Hybrid';
run;
quit;
```

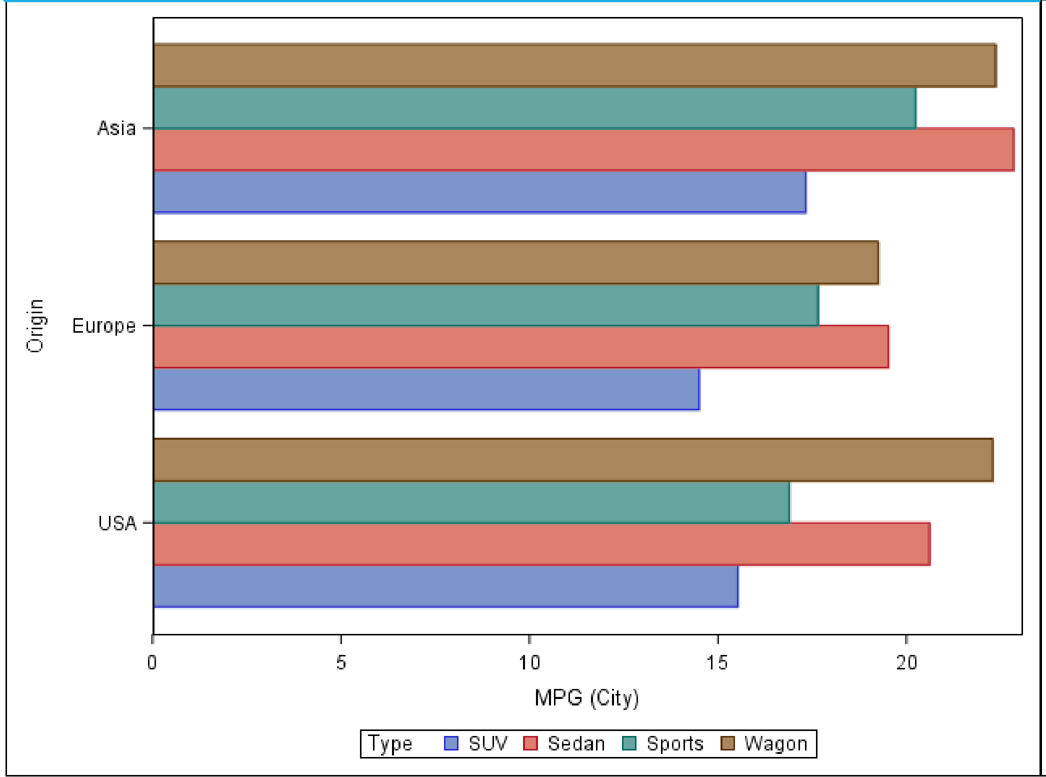
With ***filledoutlinedmarkers***, the marker fill and outline become separate elements. Realizing this, then it follows that each gets its own attrs keyword.

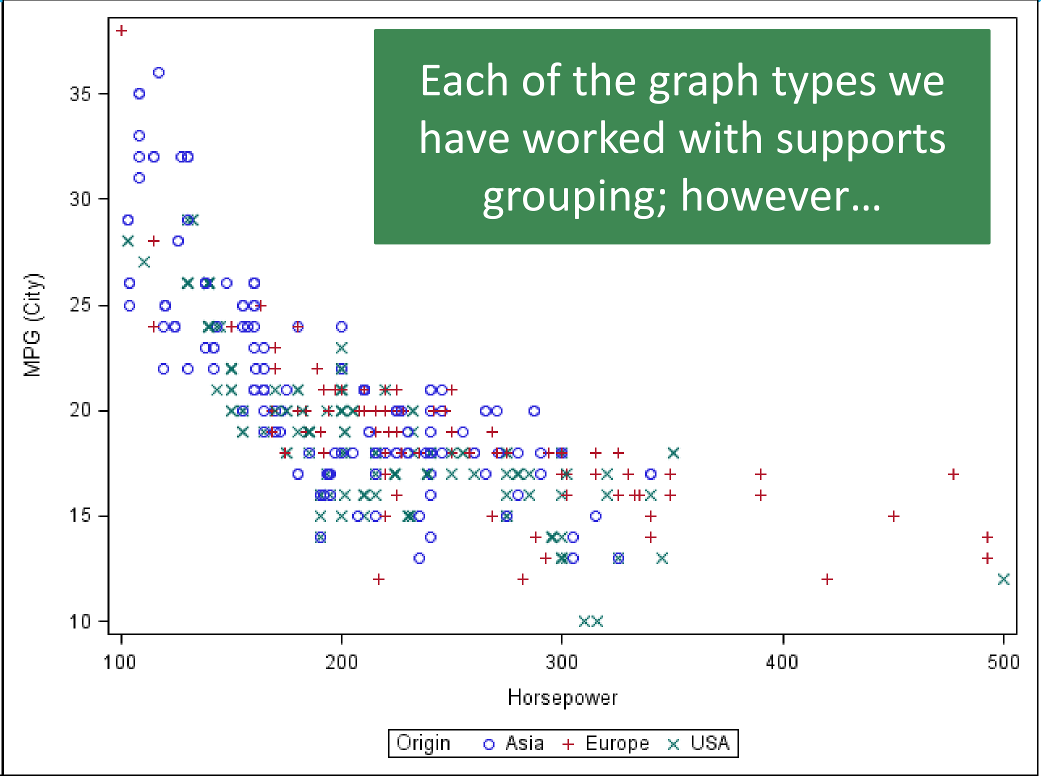


Groups

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   hbar origin / response=mpg_city stat=mean
      group=type groupdisplay=cluster;
   where type not in ('Truck','Hybrid');
run;
quit;
```

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   scatter x=horsepower y=mpg_city/
      group=origin;
   where type ne 'Hybrid';
run;
quit;
```



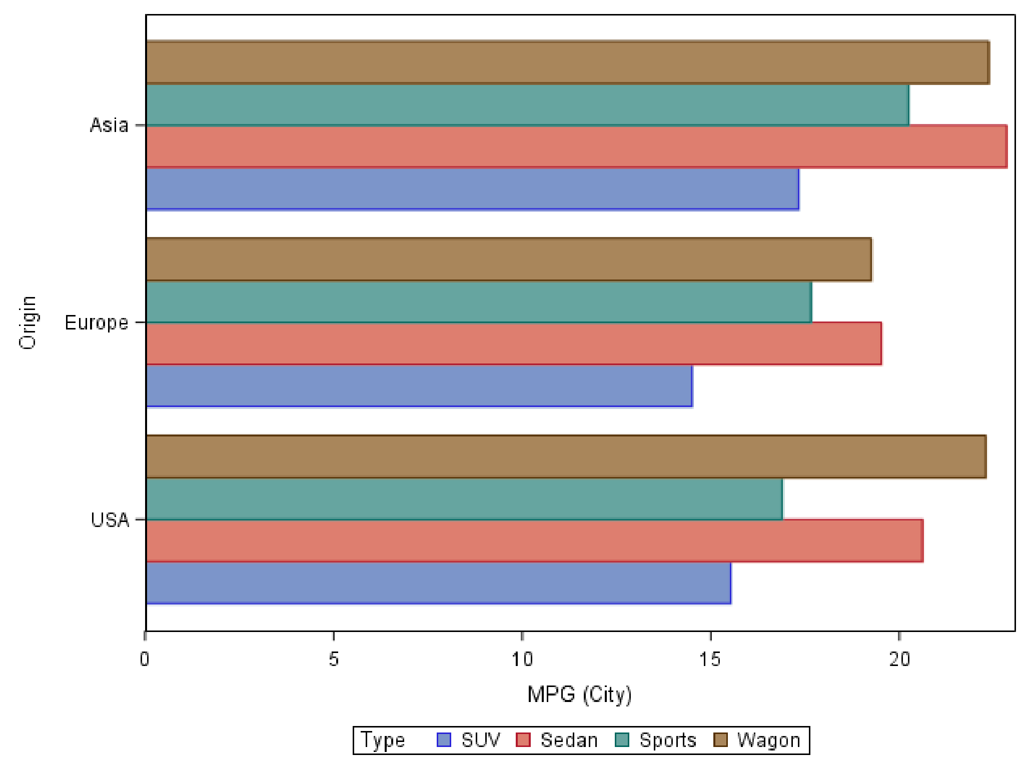


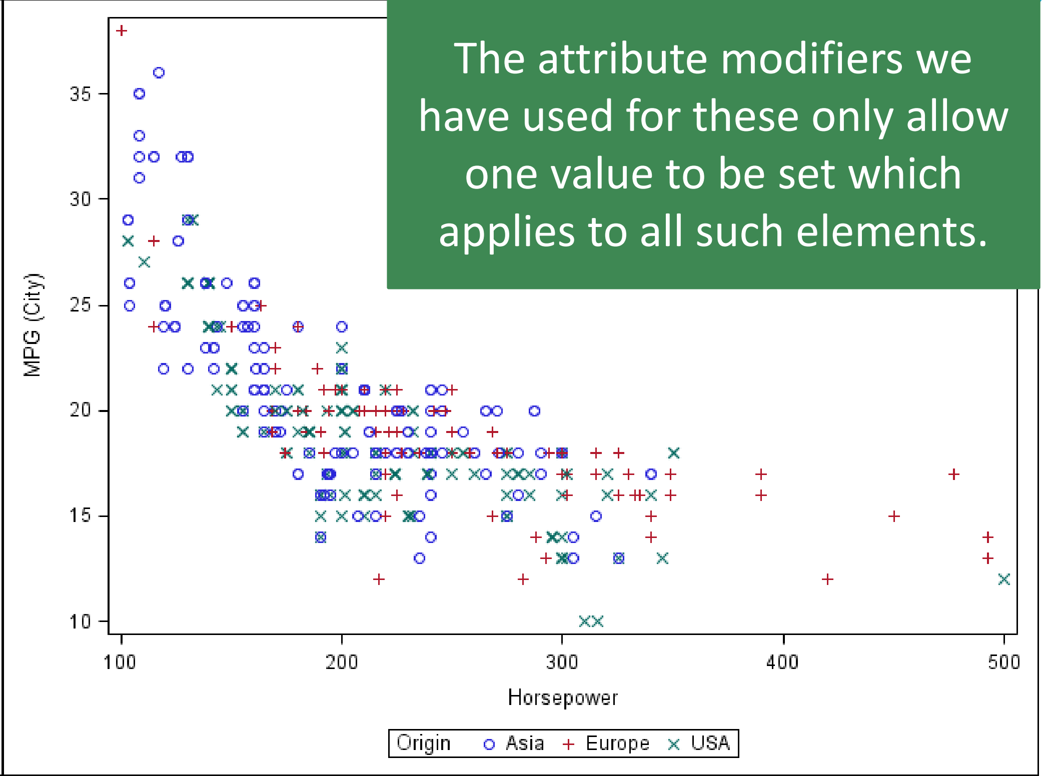
Each of the graph types we have worked with supports grouping; however…

Groups

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   hbar origin / response=mpg_city stat=mean
      group=type groupdisplay=cluster;
   where type not in ('Truck','Hybrid');
run;
quit;
```

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   scatter x=horsepower y=mpg_city/
      group=origin;
   where type ne 'Hybrid';
run;
quit;
```



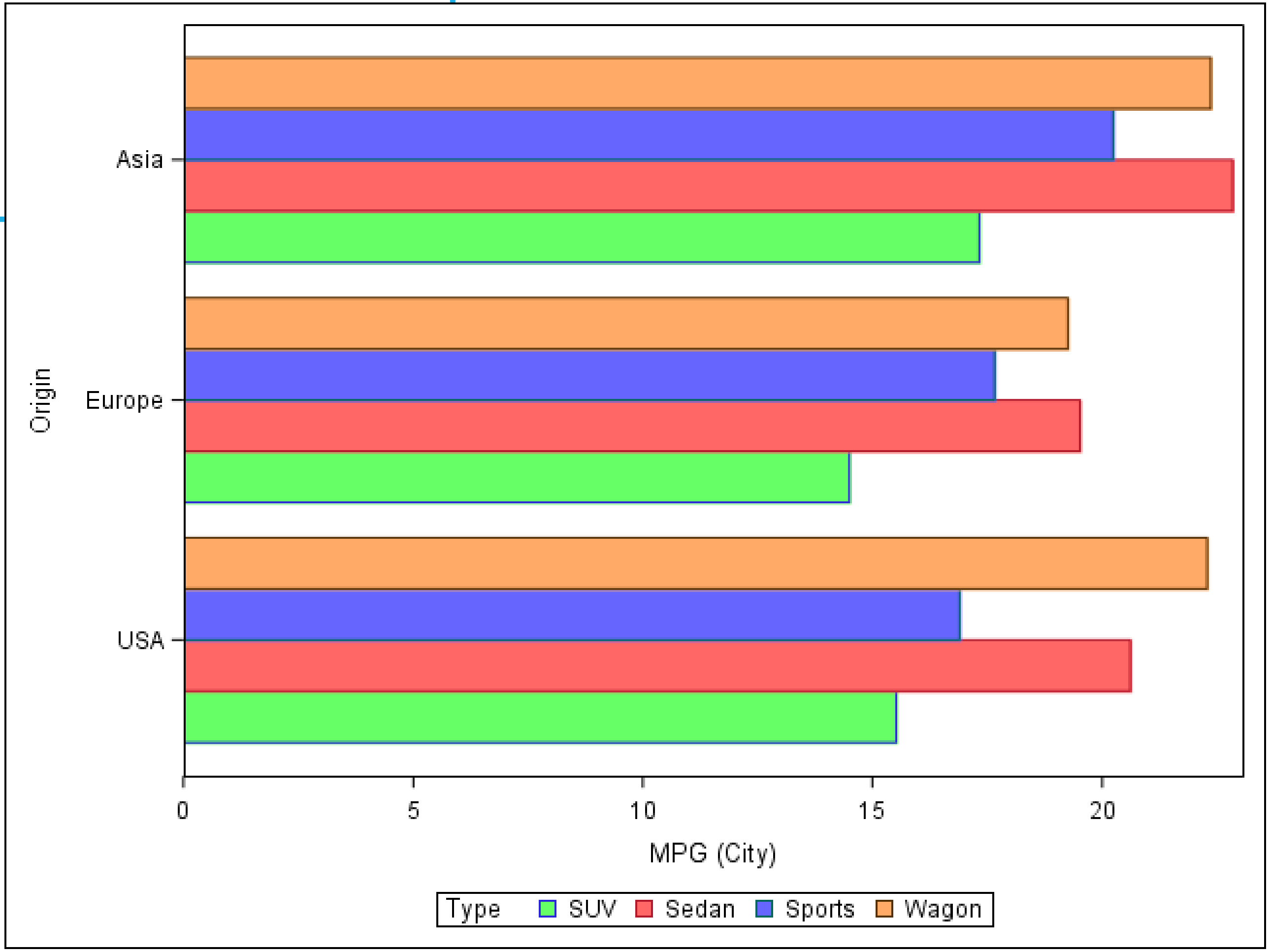


The attribute modifiers we have used for these only allow one value to be set which applies to all such elements.

styleattrs Statement

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   styleattrs datacolors=(cx66FF66 cxFF6666 cx6666FF cxFFAA66);
   hbar origin / response=mpg_city stat=mean
      group=type groupdisplay=cluster;
   where type not in ('Truck','Hybrid');
run;
quit;
```

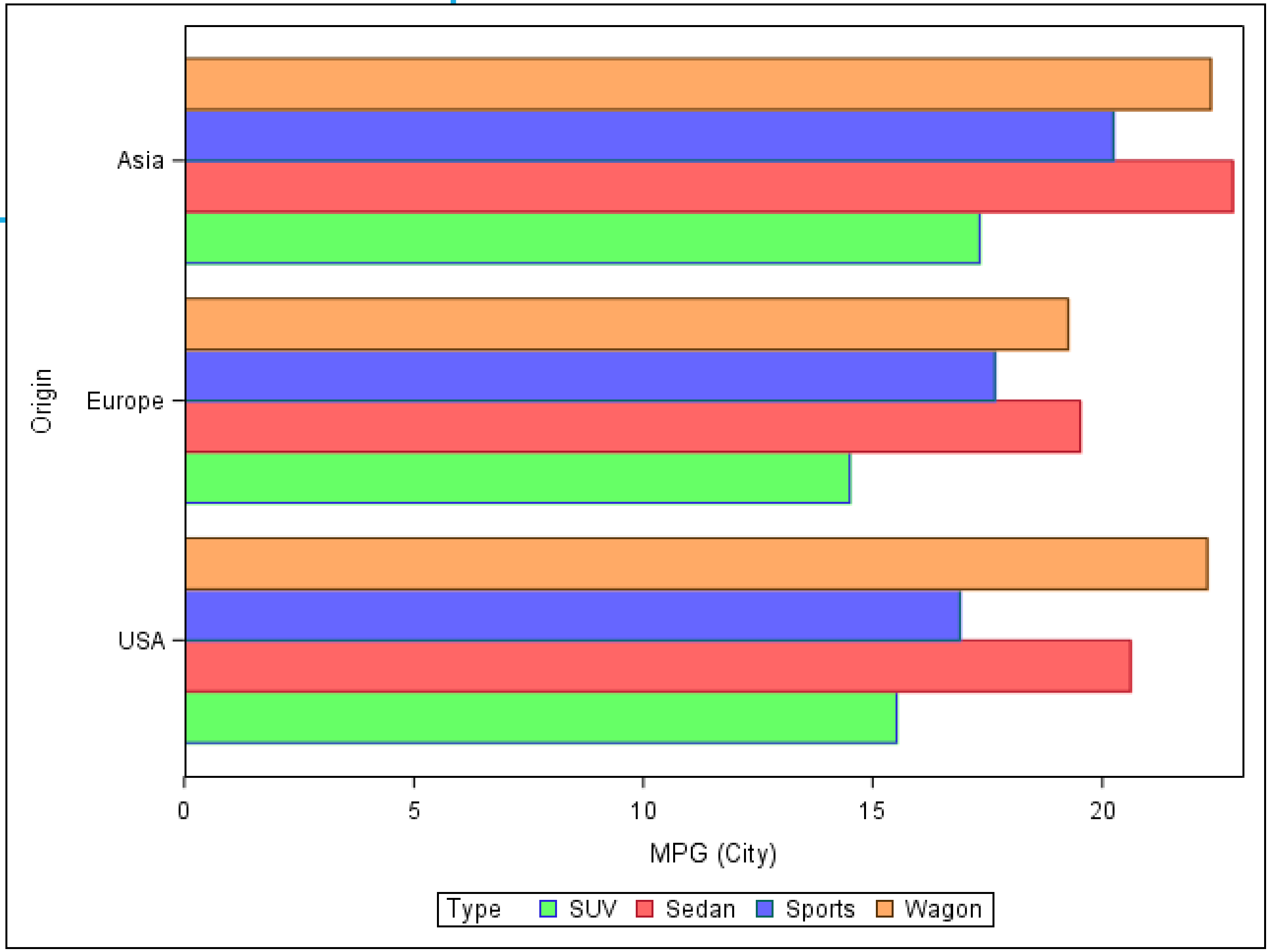
The ***styleattrs*** statement can be used to set lists of values to replace the default lists SAS cycles through.



styleattrs Statement

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   styleattrs datacolors=(cx66FF66 cxFF6666 cx6666FF cxFFAA66);
   hbar origin / response=mpg_city stat=mean
      group=type groupdisplay=cluster;
   where type not in ('Truck','Hybrid');
run;
quit;
```

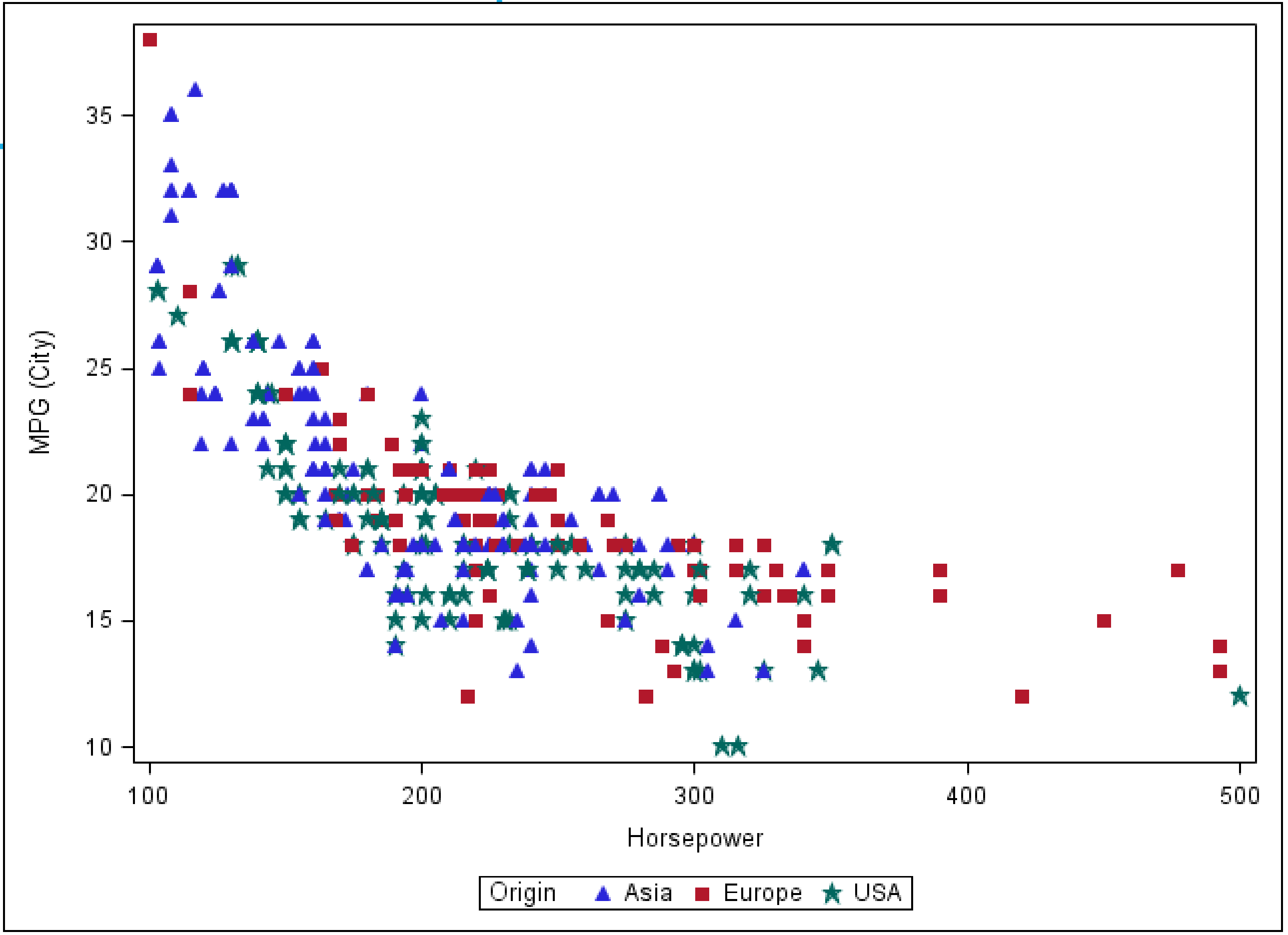
The ***datacolors*** option lets you set the list of fill colors.



styleattrs Statement

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   styleattrs datasymbols=(trianglefilled squarefilled starfilled);
   scatter x=horsepower y=mpg_city/group=origin;
   where type ne 'Hybrid';
run;
quit;
```

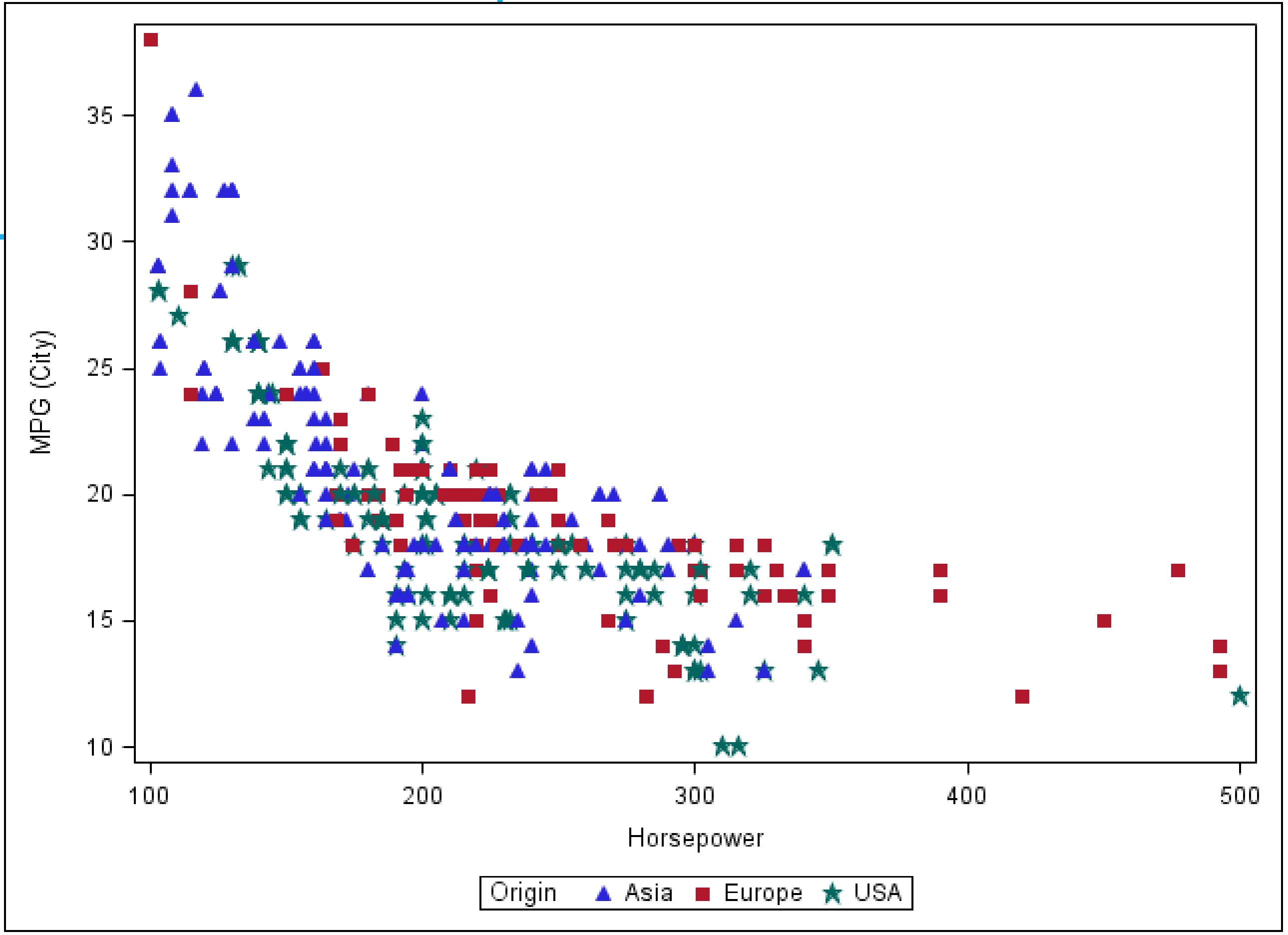
The ***datasymbols*** option lets you set the list of marker shapes.



styleattrs Statement

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   styleattrs datasymbols=(trianglefilled squarefilled starfilled)
      datacontrastcolors=(red green blue);
   scatter x=horsepower y=mpg_city/
      group=origin;
   where type ne 'Hybrid';
run;
quit;
```

The ***datacontrastcolors*** option lets you set the list of marker colors (and lines, if applicable).



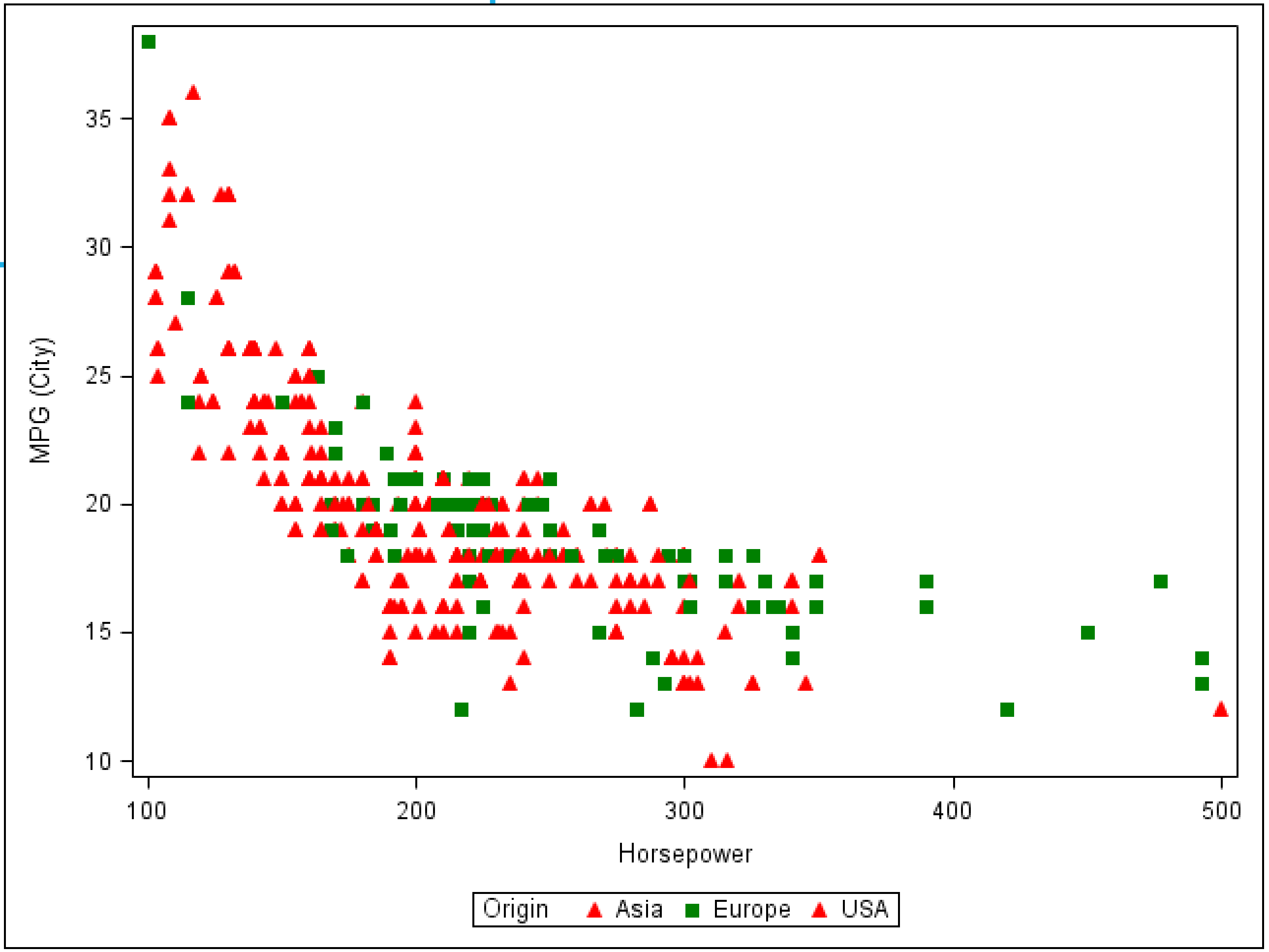
Styleattrs Statement

- Also includes:
  - ***datalinepatterns***—patterns for line elements
  - ***backcolor***—background color of the graph
  - ***wallcolor***—color for the plot wall
  - Maintenance release 3 and above for the color options

Symbol and Color Priority for Markers

```
ods graphics / reset;
proc sgplot data=sashelp.cars;
   styleattrs datasymbols=(trianglefilled squarefilled)
      datacontrastcolors=(red green);
   scatter x=horsepower y=mpg_city/
      group=origin;
   where type ne 'Hybrid';
run;
quit;
```

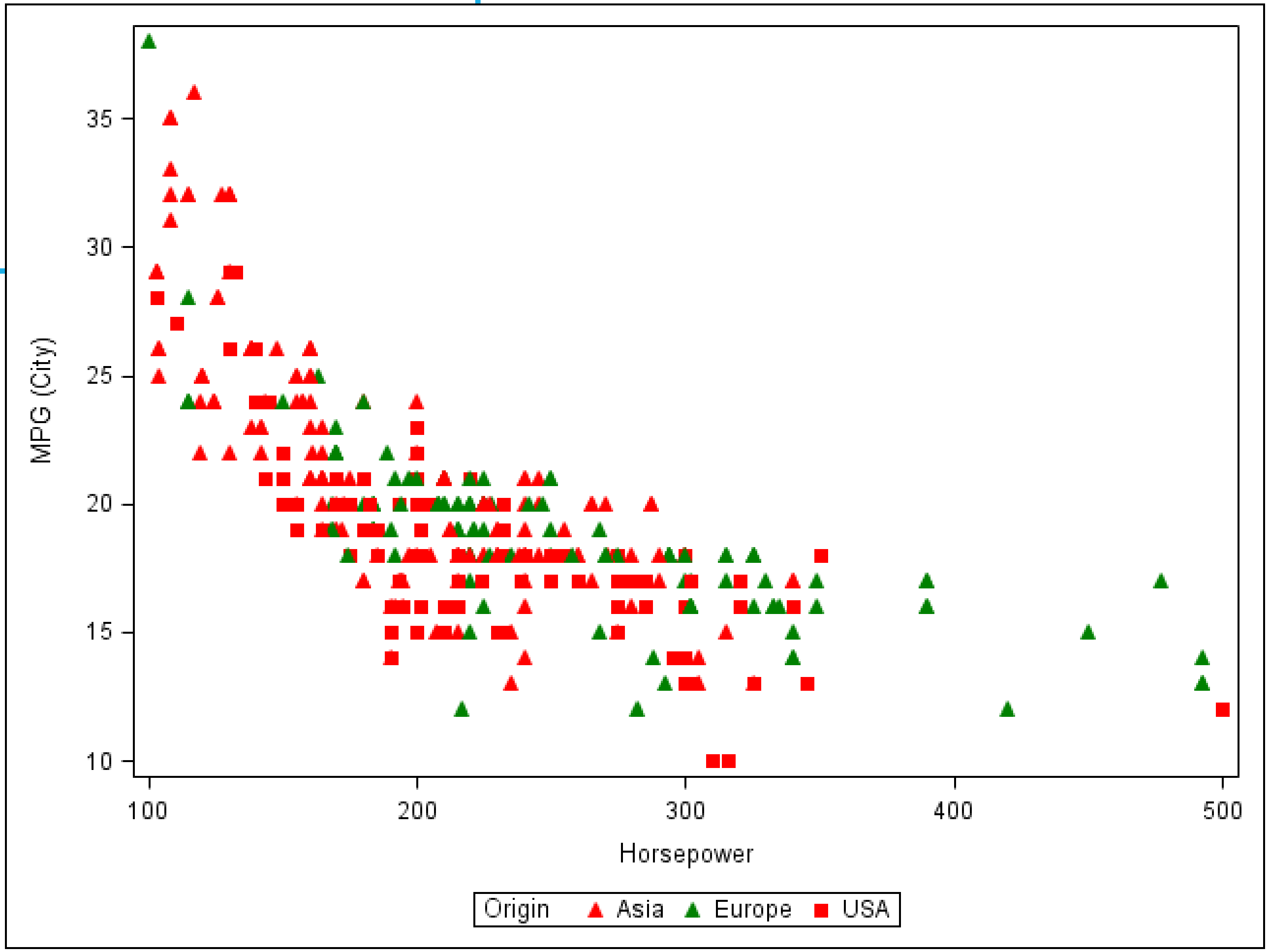
Because of the default behavior of changing color an symbol simultaneously, the four combinations that could be created from 2 colors and 2 shapes are not used effectively by default.



attrpriority Option in ODS Graphics

```
ods graphics / reset attrpriority=color;
proc sgplot data=sashelp.cars;
   styleattrs datasymbols=(trianglefilled squarefilled)
      datacontrastcolors=(red green);
   scatter x=horsepower y=mpg_city/
      group=origin;
   where type ne 'Hybrid';
run;
quit;
```

The default setting for ***attrpriority*** is none, which can be changed only to color. This causes SAS to cycle through colors prior to cycling through symbols.


MPG (City)
Horsepower
Origin
▲ Asia
▲ Europe
■ USA