

Paper 248-2013

## SAS® ODS Graphics Designer – The Next Step in Amazing Data Visualization

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### ABSTRACT

Admit it. You are swamped, overwhelmed, and desperate to find more efficient ways of doing things. But who has the time to learn something new? This poster won't be able to help for the majority of these issues. It will help you become a more effective and efficient data visualization expert, freeing up at least enough of your time to get a sandwich (and maybe even eat it). SAS® ODS Graphics Designer is highlighted, showing various examples with a generic step-by-step approach. Not as basic as Graph-N-Go and not nearly as complex as SAS® Enterprise Guide®, ODS Graphics Designer is a tool that appeals to both novice and expert users.

### INTRODUCTION

As part of my job at the Hospital for Sick Children, I am required to regularly generate a variety of high-quality graphs for a wide variety of users based on any number of variables, data types, and file types. I can certainly take the time to write new SAS® code, but often times the graphs are not just simple bar charts; they require colour-coding because of groups, or I need to add notes or marker labels to clarify what I'm showing. Having used SAS® now for about 2 years, my strengths are in PROC SQL and graphics. However, I often don't have the time to learn about an option that I have never used, or to figure out how to tweak my code to ensure I'm giving the user(s) what they require. I need something within SAS® that will allow me the flexibility to customise the graph(s) but at the same time allow me to maximise my efficiency; this is where ODS Graphics Designer comes into play. ODS Graphics Designer is more flexible and allows more complexities than Graph'n'Go, but is not nearly as complicated (and therefore less powerful) as JMP or Enterprise Guide.

Before going too much further, a word of caution, and one that I learned from personal experience. If you have password-protected libraries in your SAS® library collection, you will be unable to use the more complex graphs (Survival Analysis, etc.) as you will get an error message saying "Unable to locate library \_\_\_\_\_", even though the library and dataset are clearly available. If you are in this situation and require these graphs to be created, you will have to find an alternative way to connect to the database; I ended up having to use a PROC SQL pass-through query and pull data from each table separately. I am now able to use the full complement of graphs in the Designer. Briefly, the objectives of this paper can be broken up into the following categories: Types of Graphs available in ODS; Brief overview of the ODS Layout; How to build basic graphs; how to build advanced graphs; how to enhance graphs through colour and other features.

### GETTING INTO ODS GRAPHICS DESIGNER

Before getting into the graphs, I should mention how to open ODS. You can do this through TOOLS -> ODS Graphics Designer, or by running `%SGDESIGN;`.

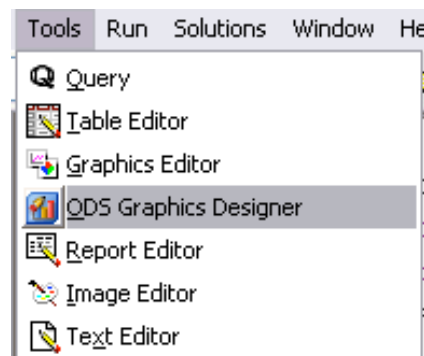


Figure 1. Accessing the ODS Graphics Designer

When using ODS Graphics Designer, you will notice that there are default datasets specified - to allow for easy reproducibility, I have used only these datasets in producing the graphs that follow. SAS®/GRAPH is not required; however, any customisations done in 9.3 3rd maintenance release must be imported if using a later version of SAS®. ODS does not support pre-9.2 SGD files.

## TYPES OF GRAPHS AVAILABLE IN ODS GRAPHICS DESIGNER

There are 37 different types of graphs available, in 6 different categories (Basic, Grouped, Analytical, Custom, Matrix, and Panels). Some of my favourites, and the ones I'll be focusing on in this paper, include Scatter Plot, Series Plot, Histograms, Vertical and Horizontal Box Plot, Vertical and Horizontal Bar Charts, Grouped Scatter Plot, Group Vertical / Horizontal Bar Charts, Survival Analysis, Regular Matrix, Data Lattice, and Combination Graphs. First I'll start off with the more basic graphs, and at the same time walking through some of the basic functionality of ODS.

## “GEOGRAPHY” OF THE DESIGNER

The interface for ODS Graphics Designer is very much in line with others that are within SAS® - easy enough to navigate, but chockfull of hidden treasures.

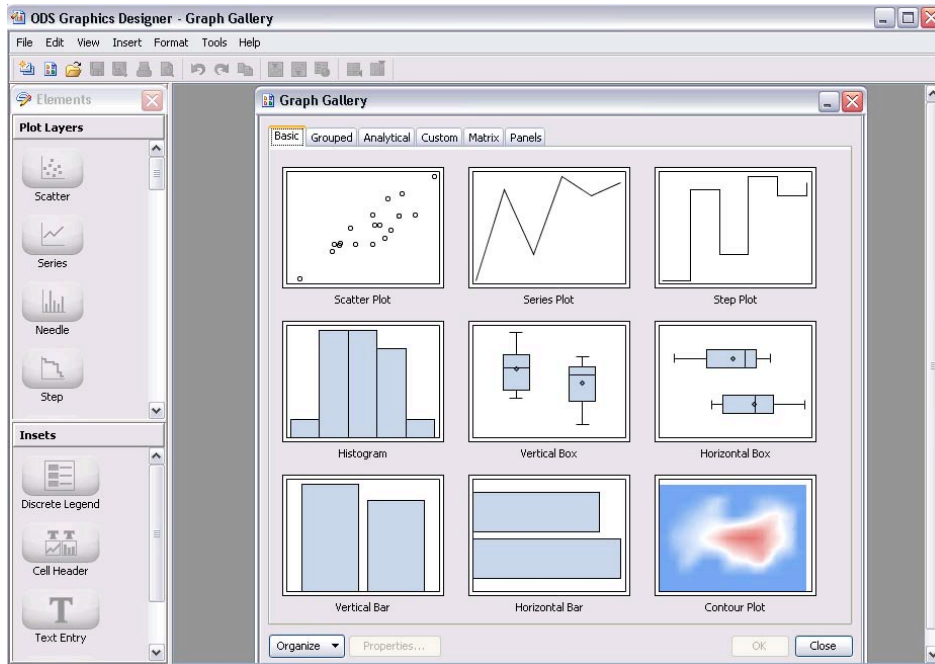


Figure 2a. The Overall Interface

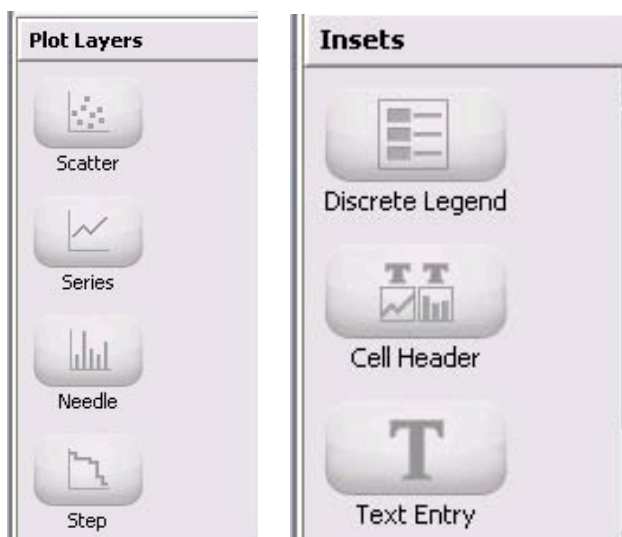
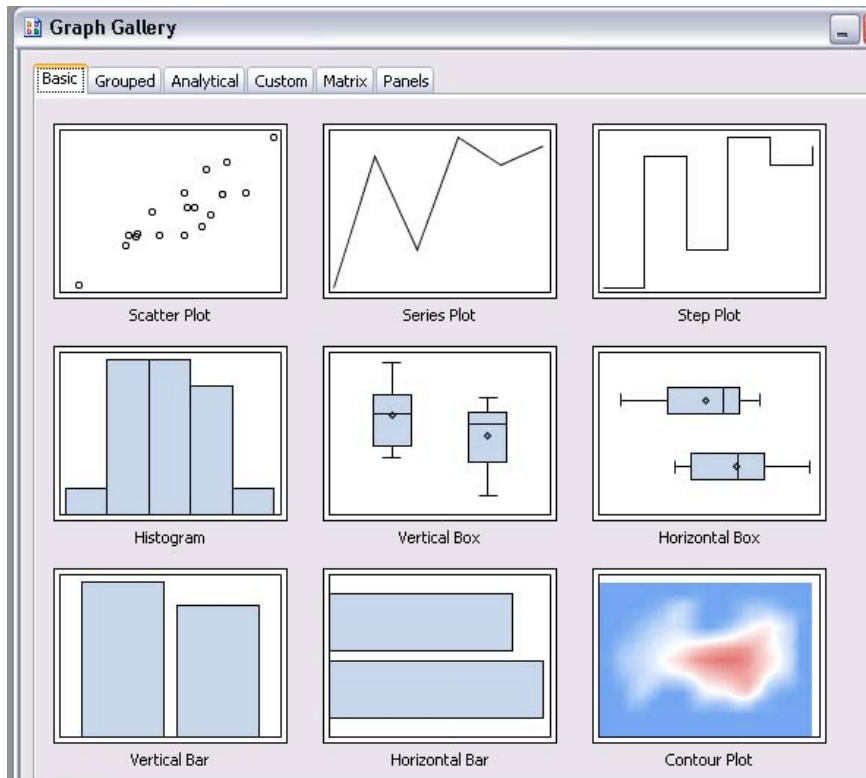


Figure 2b. The Plot Layers and Insets Sections (magnified)



**Figure 2c. The Graph Gallery**

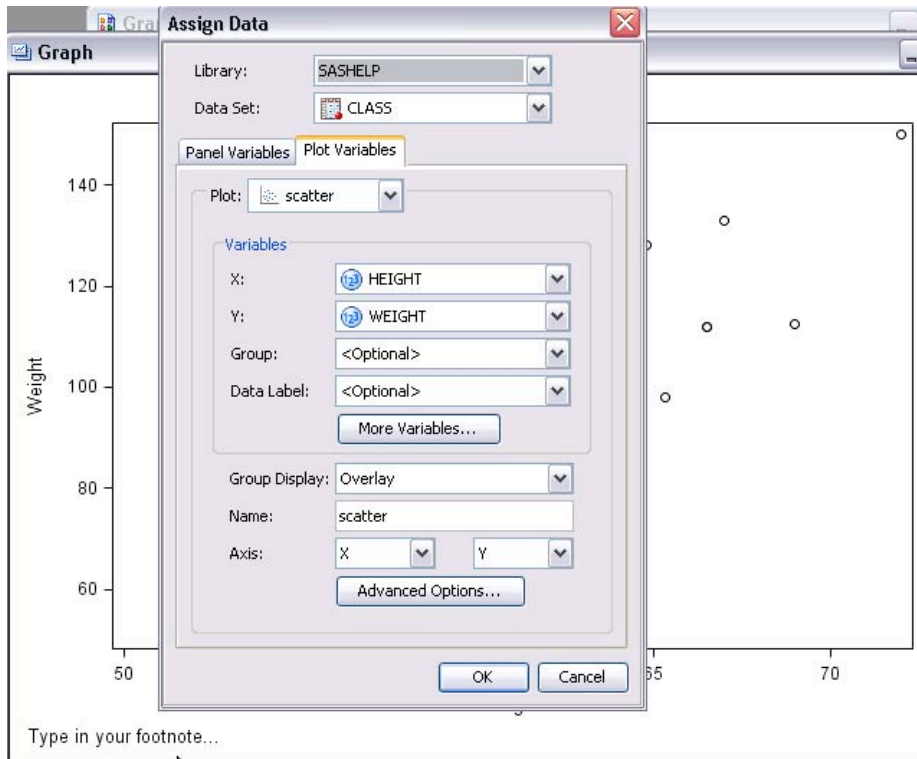
Figure 2a shows the overall interface; Figures 2b and c show the Plot Layers, Insets, and Graph Gallery respectively. The Plot Layers allow you to add different chart types to the output, reference lines, etc. The Insets are where you'll find Legends, Text boxes, and other additions to the graph. Finally, the Graph Gallery allows you to click on one of the graphs available and start the creation process. There are 6 tabs and almost 40 graphs that can be created through the Gallery, so more than likely the one that suits your needs will be there.

## BASIC GRAPHS

The four graphs highlighted in this section are the more standard types, and although all the graphs in Designer are easy to create, these ones are among the simplest to interpret, and can be easily enhanced by someone new to Data Visualisation. For people who are more comfortable with graphics, there are any number of features that can be added to make the graph more complex.

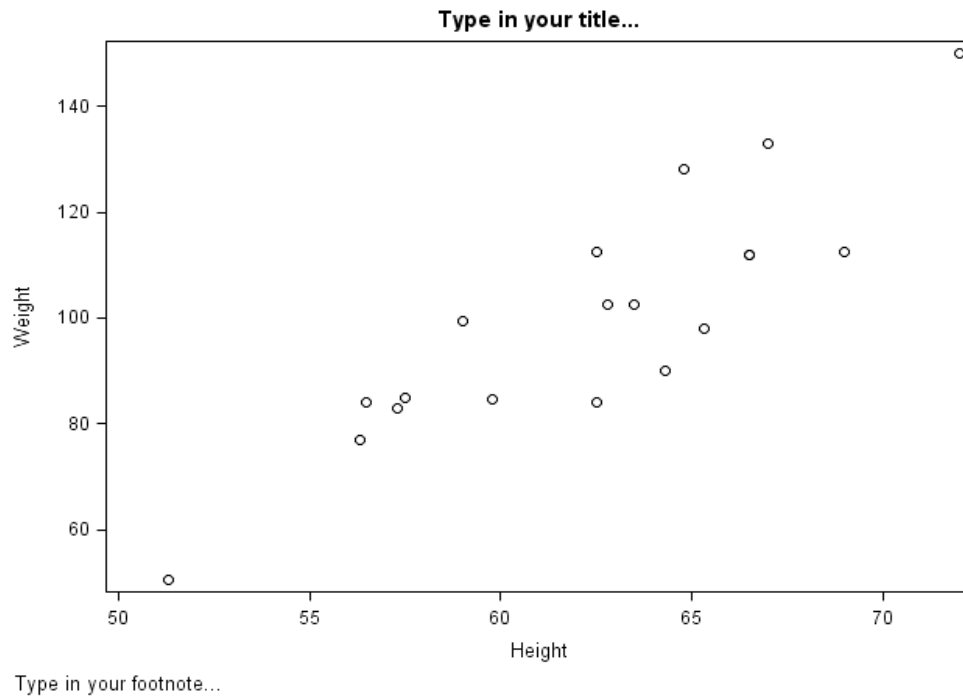
## SCATTER PLOTS

When you click on Scatter Plot in the Graph Gallery, you will get the dialog box below (Figure 3). As is obvious, some of the options are already filled out for you using the SASHELP.CLASS data set; this is a feature that proves very useful for new users, or people just wanting to see what that particular graph can do. The other functionality available throughout the Designer is that for the drop boxes you can only pick options that make sense from a graphics perspective (for example, you can't do SUM on text-based categorical data); however, you can still make selections that are not valid (for example, summing on ID Number). This is where understanding the data and your visualisation requirements are key; ODS Graphics Designer makes the creation of the graphs much easier, but it can't do the thinking for you.



**Figure 3. The Scatter Plot Dialog Box**

If the default graph options are used on the Class dataset, you get the output as shown in Figure 4; nothing terribly exciting, but it provides you with basic information about the Height and Weight variables; as with most graphs in Designer, this was done in less than 5 clicks of the mouse. The TITLE and FOOTNOTE can both be added in simply by clicking on those text-boxes, and will be discussed in the Enhancements section.



**Figure 4. The Scatter Plot Output**

## SERIES PLOTS

Series plots are one of the most misunderstood graph types; often people create series plots without having a solid understanding of the data, and therefore the plot is either illogical or convey the wrong message. With the Designer, SAS® has done a wonderful job of putting in logic that validates the dataset - if there are not any variables that make sense for that type of graph, the PLOT drop box will be red, as in Figure 5.



Figure 5. Warning of Illogical Plot for Data set

Having these checks and balances in place ensures that SAS® is at least leading you in the right direction; you can still make graphs that don't make sense (see Enhancements) but for Series Plots, this is definitely a feature that has proven useful.

As with the Scatter Plot, clicking on the Graph Gallery image for the Series Plot will open up a window that has already been pre-populated, or has drop boxes with limited options.

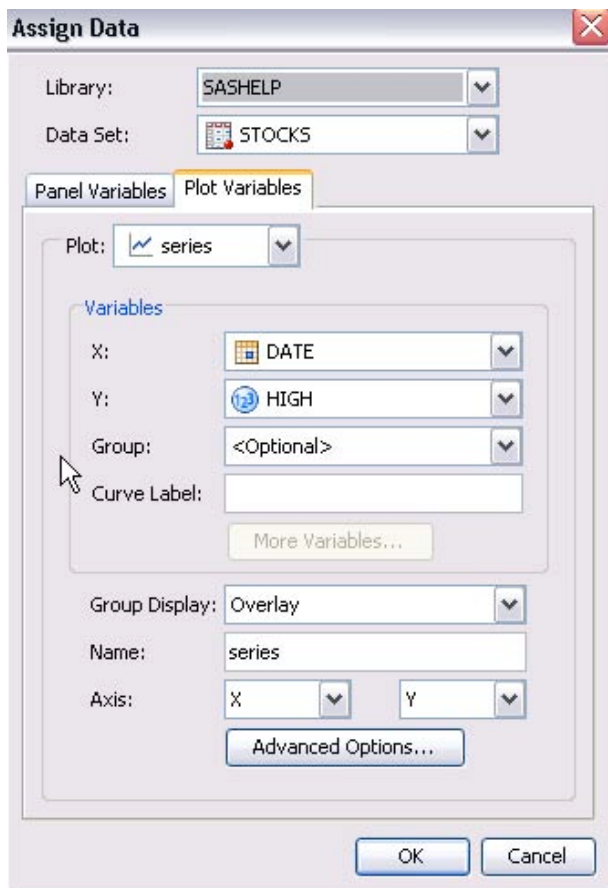
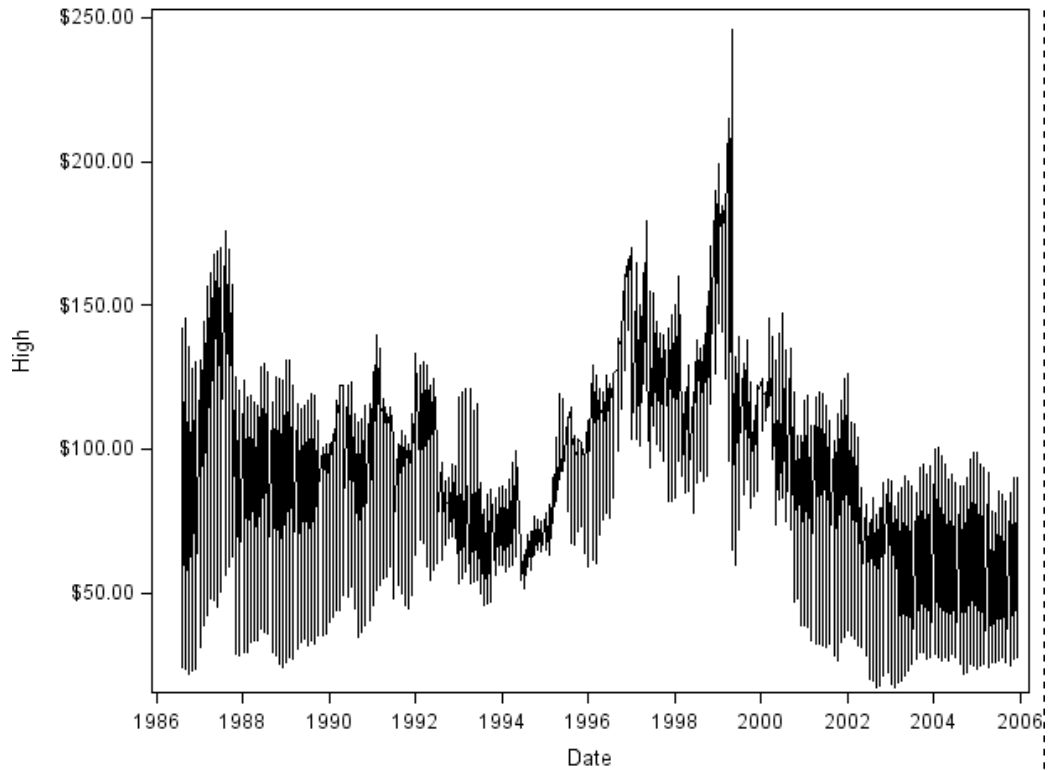


Figure 6. The Series Plot Dialog

Using the SASHELP.STOCKS dataset that was pre-selected, I see that my only option for the X Variable is "Date", and for the Y, I have High and Low (the only numeric values). I choose Date and High, and the once again, in less than 5 clicks of the mouse, I have the graph shown here:



**Figure 7. The Output Series Graph**

Unlike the Scatter Plot, I don't have the TITLE or FOOTNOTE textboxes - however they are easily enough added in by using the Text Entry option that I'll talk about in the Enhancements section.

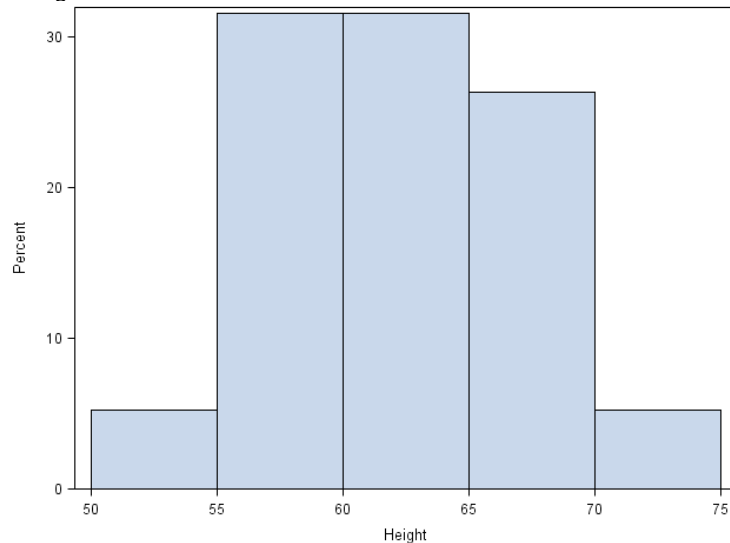
### **HISTOGRAMS**

Along with Scatter plots, Histograms are amongst the easiest to create. Again we're back to having the CLASS dataset, but this time only the X Variable is selected.



**Figure 8. Histogram Dialog**

Although very simplistic, this is another example of the ridiculously simple way to generate graphs in the Graphics Designer.

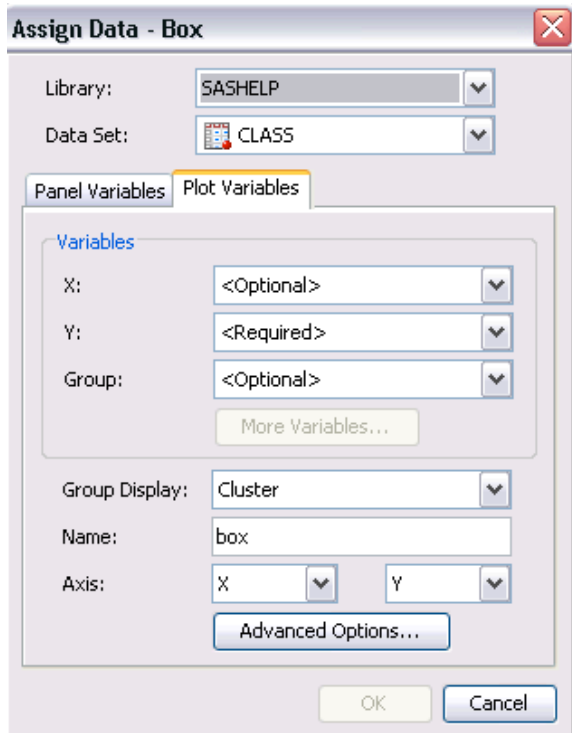


**Figure 9. Histogram Output**

One thing to be wary of is the upper limit of the bars extends slightly beyond the upper limit of the Y-axis. This can be tweaked in the Axis Settings, and you can set the Y- and X-axis to whatever minimum and maximum you see fit.

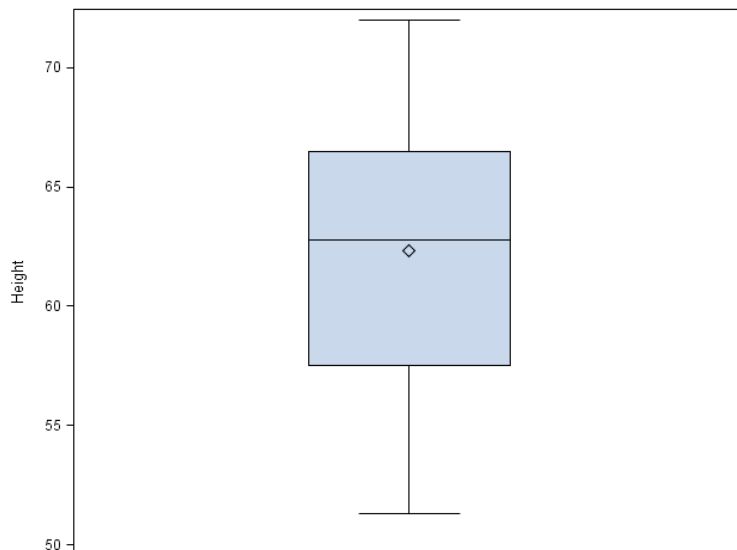
## BOX PLOTS

The last kind of basic graph to be discussed are Box Plots; unlike the other graphs in this section, which were both easy to create and understand, box plots require basic understanding to interpret the lines, rectangle(s) and diamond(s) that are included. However, because these can once again be created with minimum amount of effort, it was appropriate they be included here. One oddity compared to the other graphs in this section is that the X axis is optional, and the Y required. However, if one has experience and knowledge of box plots, this makes sense and can be utilised appropriately.



**Figure 10. Box Plots Dialog**

Once again having the CLASS dataset as the default, I decided to use Height as the Y variable, and to omit the X to produce just the one graph.



**Figure 11. Box Plot Output**

As with the Histogram, the Y axis does extend beyond the maximum for the axis, and this can once again be set manually in the Axis Properties menu.

Having reviewed some of the basic graphs, let's now take a look at some of the graphs that are a little more complex (both analytically and in setting up).



## ADVANCED GRAPHS

With the advanced graphs, you are able to accomplish fairly detailed outputs with slightly more time and effort than the basic graphs. However, as with all analytics, Effort and Understanding are two different concepts - it may be easy to create a graph that is completely illogical, or it may be complicated to create a graph that is precisely what is required. In ODS Graphics Designer, it makes it easy to create graphs but it is up to you to ensure they are accurate and fit the situation. The other issue that needs to be addressed is that these may not be suitable for publication; rather, quick preparation for meetings, a draft copy of a manuscript, or for testing data Designer is a very easy and efficient tool.

## SURVIVAL ANALYSES

In my experience, setting up and properly preparing data and the graphs for time-to-event analysis has been cumbersome, error-prone and given the various options in SAS® not the most efficient use of my time. I have to provide a word of caution here - as mentioned in the Introduction, if you have any password protected libraries, many of the advanced graphs cannot be created. The Survival ones are an example of this. You have to delete the library and find an alternative way to connect (I'm using Enterprise Guide and ODBC), but once you do, these graphs are a breeze.

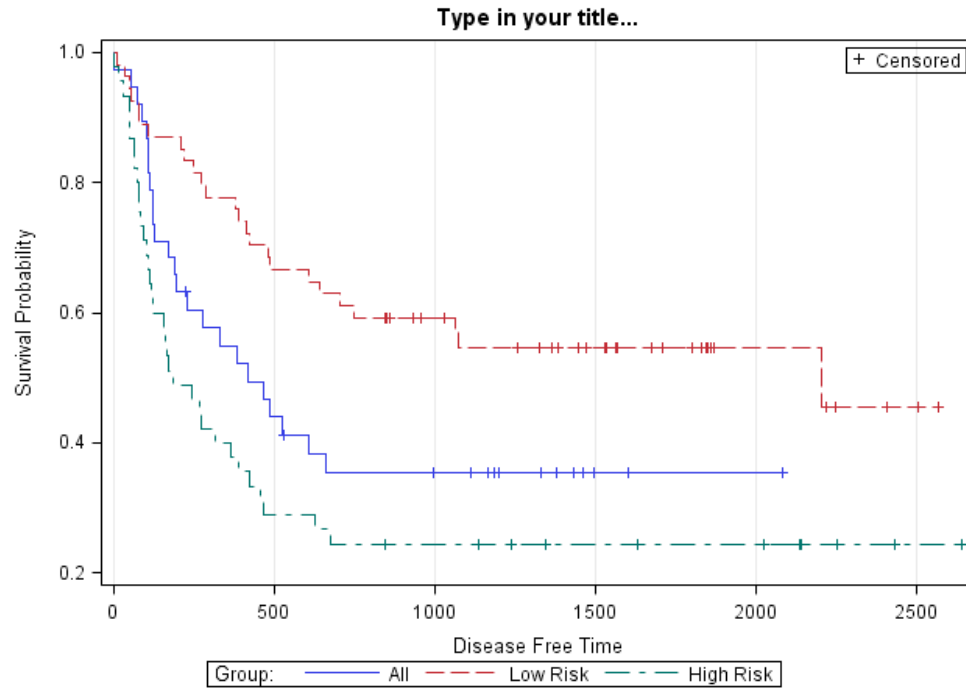
As with all the other graphs presented so far, clicking on the Survival Analysis graph will open up the dialog box as shown below.



**Figure 12. Survival Analysis Dialog**

Although seemingly no more complex than the other graphs, having to prepare the data for the X and Y variables may pose a problem. As well, having multiple variables that could be used in either case but that may not be actually valid can create graphs that may look right but are in fact useless.

Using the BONEMARROW dataset and the default options, the following graph was automatically created.



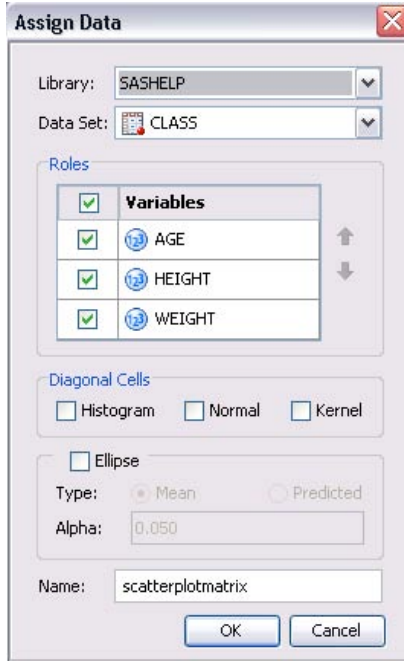
Type in your footnote...

### Figure 13. Survival Analysis Output

As with some of the graphs in the Basic section, the TITLE and FOOTNOTE can be edited by clicking on the textbox or by going into GRAPH PROPERTIES in the Context Menu.

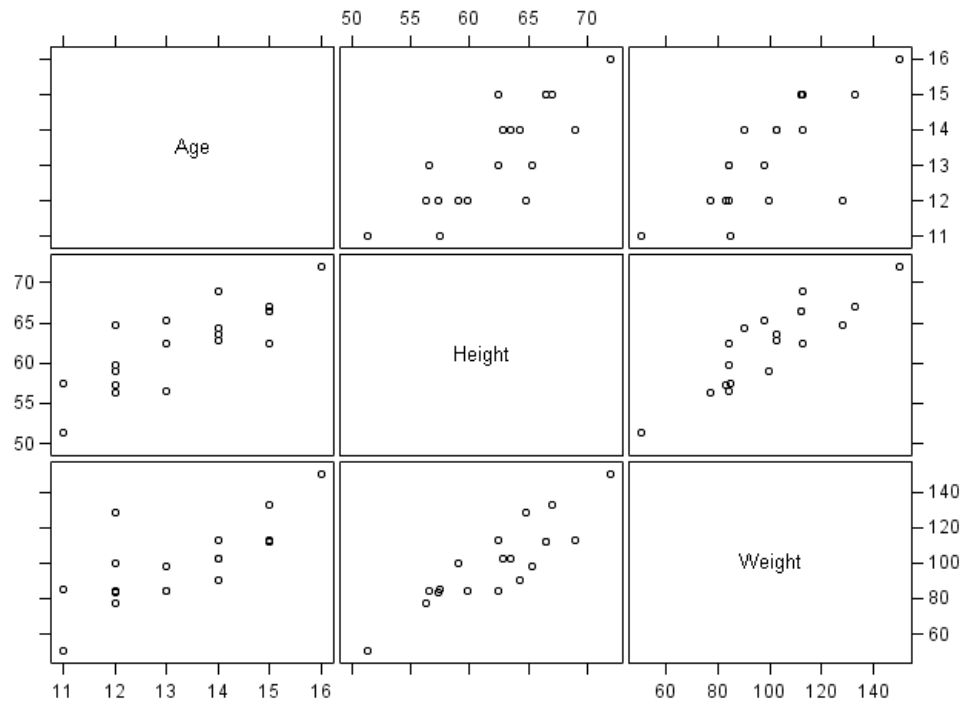
### REGULAR MATRIX

This is one of the graphs where things get a little tricky. Again I'm using the CLASS dataset, but the dialog is very different from what we've seen previously. In this graph you are able to specify roles for the variables, as well as creating diagonal cells with a Histogram, Normal distribution or a Kernel plot. With the simple click of the mouse, you can add an ellipse highlighting the mean or even predicted values, and specify your alpha.



**Figure 14. Regular Matrix Dialog**

Here is the basic matrix using the Age, Height and Weight variables.



**Figure 15. Regular Matrix Output**

## DATA LATTICE

Data Lattices are one of my favourite graph types, because you can add extra dimensions to your plots without having them become visually complicated or confusing.

The WORK.HEART data is used, and two of the variables are Smoke and Sex.

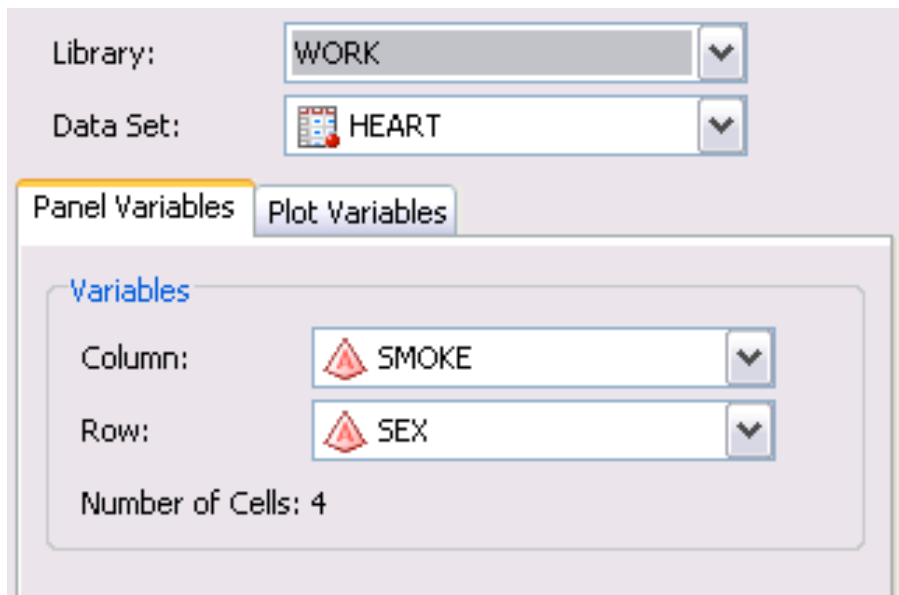
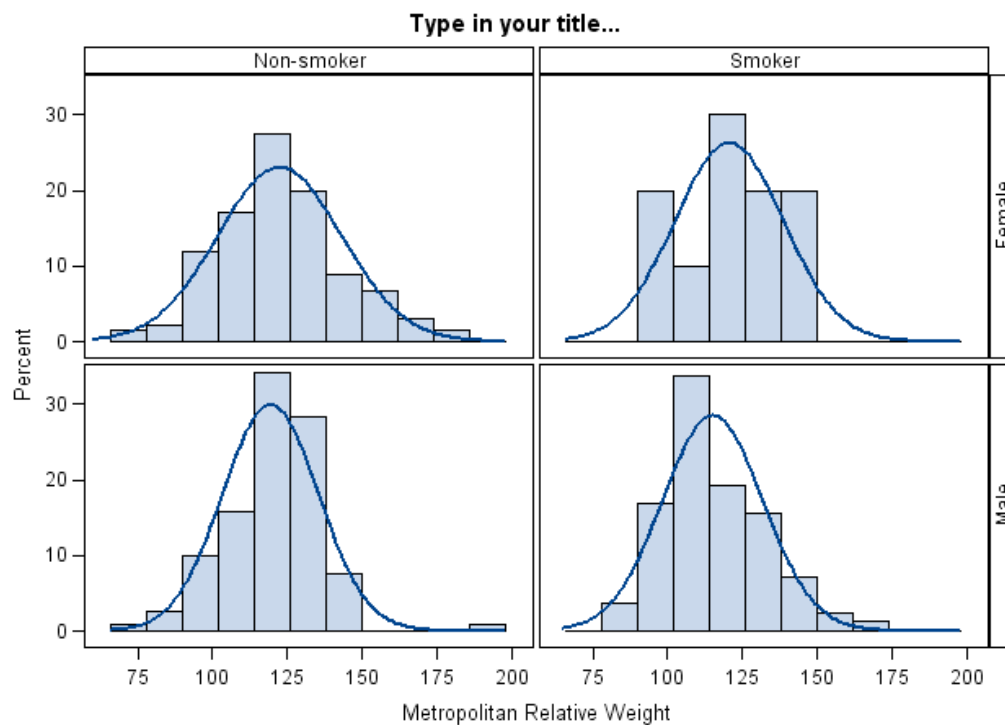


Figure 16. Data Lattice Dialog

Using these two I see that my output will have 4 cells, and when I click OK I get this output.



Type in your footnote...

Figure 17. Data Lattice Output

### OTHER TOTAL AWESOME (AND EASY!) GRAPHS YOU CAN CREATE

Using the same steps outlined above, there are some graphs that are just really cool and with the right kind of data and the right understanding of the requirements for visualisation, these graphs are a breeze.

#### BUTTERFLY

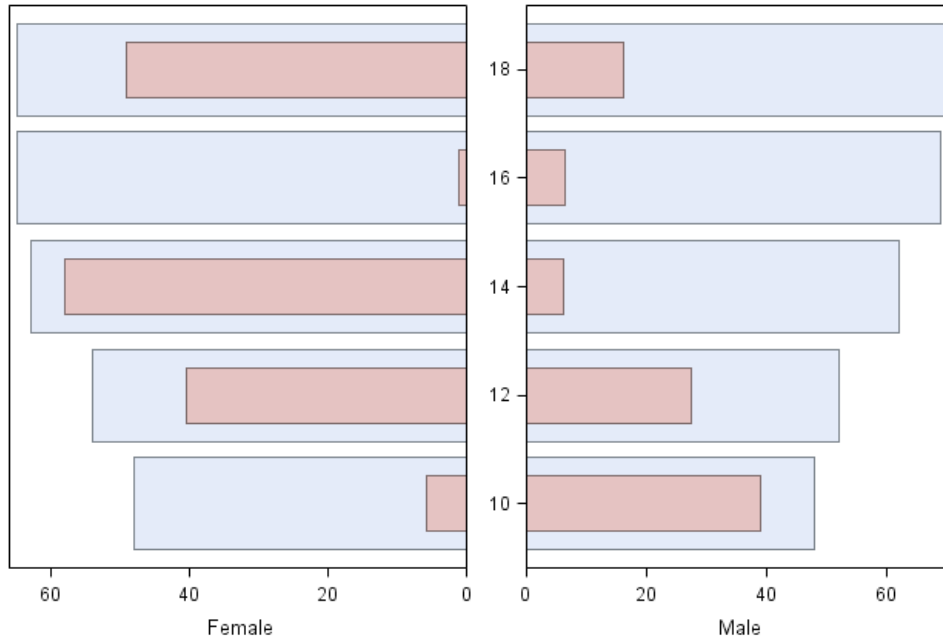


Figure 18. Butterfly Graph

#### MEANS

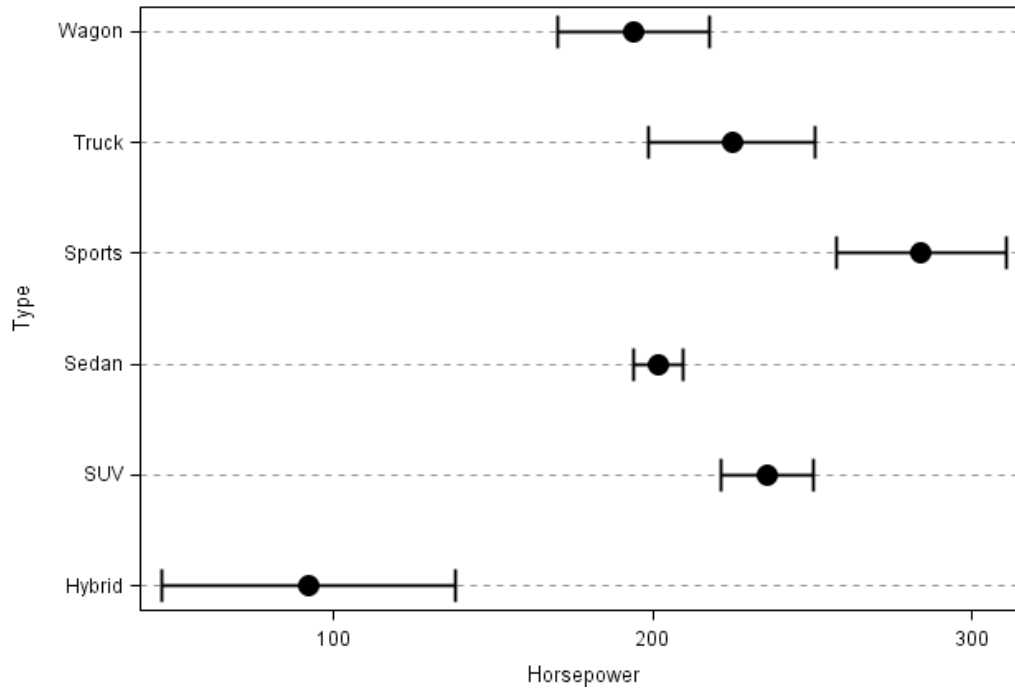
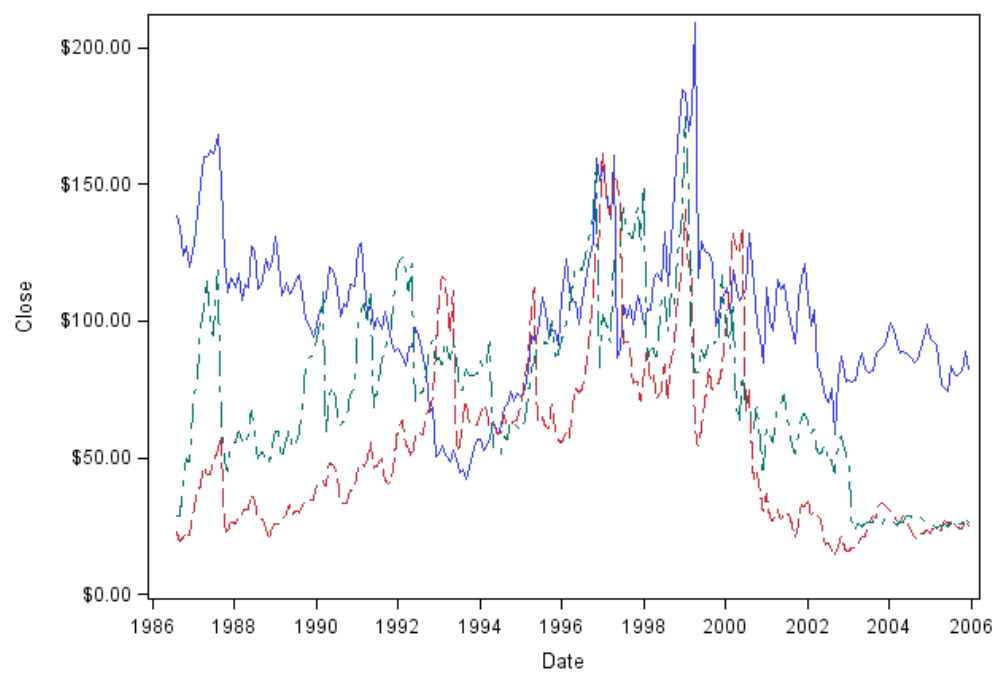
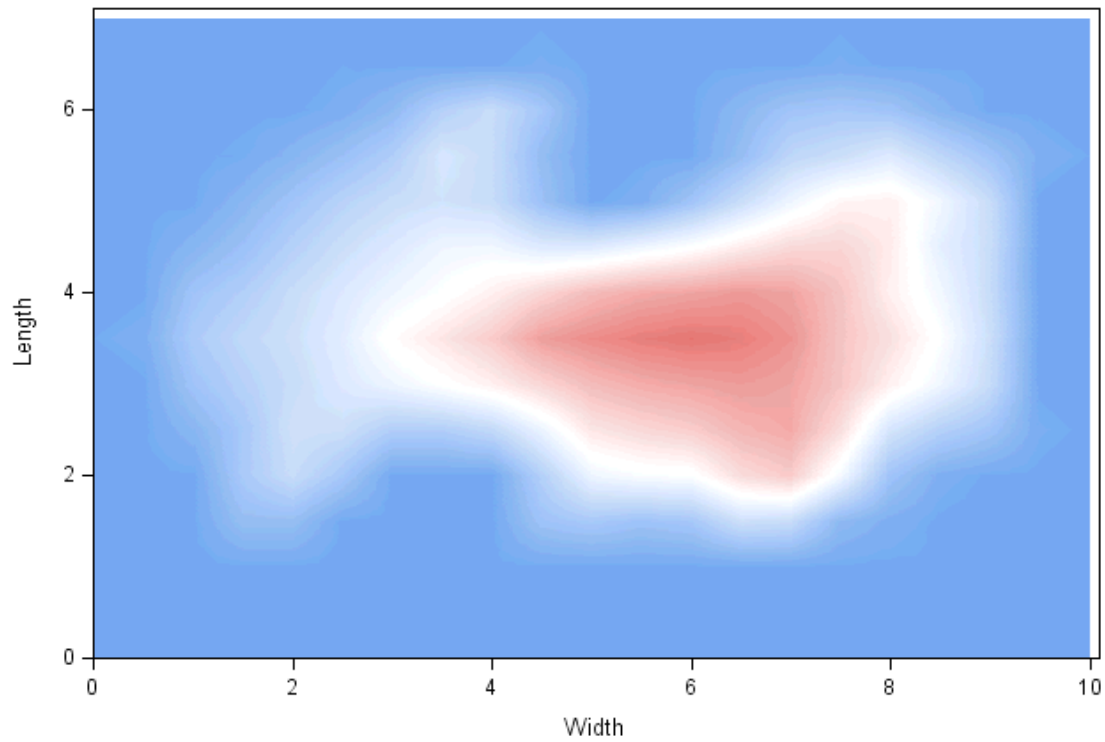


Figure 19. Means Graph

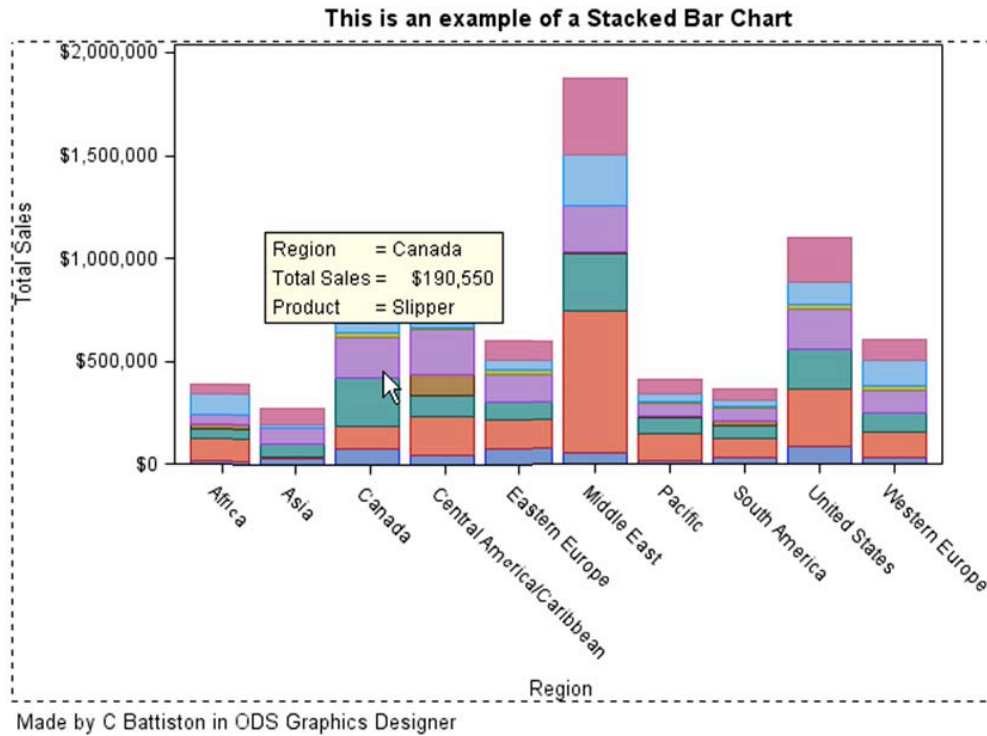
**GROUPED SERIES****Figure 20. Grouped Series Graph**

**CONTOUR PLOT****Figure 21. Contour Plot****ENHANCING YOUR GRAPHS**

Although enhancing graphs is really easy in ODS, there are some exceptions you should be aware of:

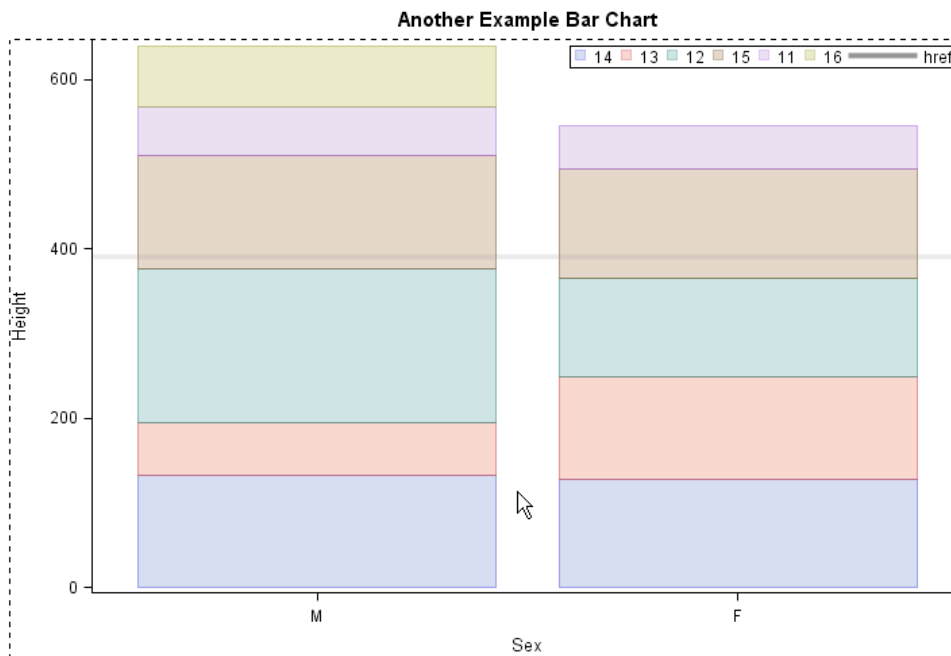
- cannot add plots to matrix graphs that you create from the Matrix tab of the graph gallery
- You cannot add rows and columns to graphs that you create from the Matrix or Panel tabs of the graph gallery

Having said that, here is an enhanced stacked bar chart, highlighting the fact that mouseovers are enabled (automatically!) and allow you to see the specific group variable / by variable and the statistic being plotted.



**Figure 22. An Example of an Enhanced Stacked Bar Chart**

As previously discussed, graphs can be created that are totally worthless and may cause severe and significant problems by being treated as if they were valid. Having said that, here is an example of a highly enhanced stacked bar chart showing the sum of the heights of boys versus girls in the CLASS dataset.



**Figure 23. Highly Enhanced (Yet Illogical) Graphic Output**



Enhancements to note include the slight transparency of the bars, the horizontal reference line at 390, and the legend on the top right corner. These are nowhere close to all the enhancements available, but was meant to showcase some of the more useful ones.

## OH WAIT! THERE'S A SURPRISE AS WELL!

If you go into the VIEW Menu, you'll see there's a Code item - clicking on that will actually open up an HTML page of the code used to generate your graphs, with all the options, text, reference lines, etc.! But wait, it's nothing like other SAS® code! Actually, it's using PROC TEMPLATE and the SG functions to create the graph(s). This code is now transferable to any other SAS® user and will ensure that as long as they have the data available, that the graph(s) will be identical. It's also a great way to learn about PROC TEMPLATE - putting the code into your base SAS® and playing around with it will allow you to see what the different options are and how they impact the output.

```

Code - Graph

proc template;
define statgraph sgdesign;
dynamic _SEX _HEIGHT _AGE;
begingraph / designwidth=729 designheight=504;
  entrytitle halign=center 'Another Example Bar Chart';
  layout lattice / rowdatarange=data columndatarange=data rowgutter=10 columngutter=10;
  layout overlay;
    barchart x=_SEX y=_HEIGHT / group=_AGE name='bar' datatransparency=0.6 clusterwidth=1.0;
    discretelegend 'bar' 'href' / opaque=false border=true halign=right valign=top displayclipped=true down=1
order=columnmajor location=inside;
    referenceline y=390.0 / name='href' yaxis=Y curvelabelposition=max lineattrs=(thickness=4);
  endlayout;
endlayout;
endgraph;
end;
run;

proc sgrender data=SASHELP.CLASS template=sgdesign;
dynamic _SEX="SEX" _HEIGHT="HEIGHT" _AGE="AGE";
run;

```

Figure 24. Code Automatically Generated

## CONCLUSION

ODS Graphics Designer is an effective, reliable and easy way to quickly produce graphs; although not final publication material, they are more than suitable for draft manuscripts, preliminary meetings, or data checks prior to further analysis.

The abundance of options, features and other "extras" that can be used were barely scratched in this paper. Because ODS Graphics Designer uses default data sets, you are able to go in and experiment with the various graph types without worrying about creating a dummy data set. ODS Graphics Designer is not as easy to use as Graph'n'Go, but with that added level of complexity comes a wider range of visualisations, better outputs, and brings us into the new version of SAS. As well, the PROC TEMPLATE and SG functions that are created in the background allow for easy reproducibility, learning new ways to generate graphs, and exploring these new features of the SAS®Language.

## REFERENCES

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- Mantage, S. 2012. "Quick Results with SAS®ODS Graphics Designer". Cary, NC: SAS®Institute Inc. Available at <http://support.sas.com/resources/papers/proceedings12/153-2012.pdf>
- Holland, P. 2010. "Using the ODS Graphics Designer to Create Your Own Templates". Cary, NC: SAS®Institute Inc. Available at <http://support.sas.com/resources/papers/proceedings10/034-2010.pdf>

## ACKNOWLEDGMENTS

Thanks go to Matt Malczewski and Laurent Josso for letting me “test drive” this as a presentation at a Toronto Area SAS® Society Meeting; also to Susan Slaughter for providing positive support on the material. Definite thanks go to Jennifer Waller and her co-chairs in their support and getting the job done!

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