

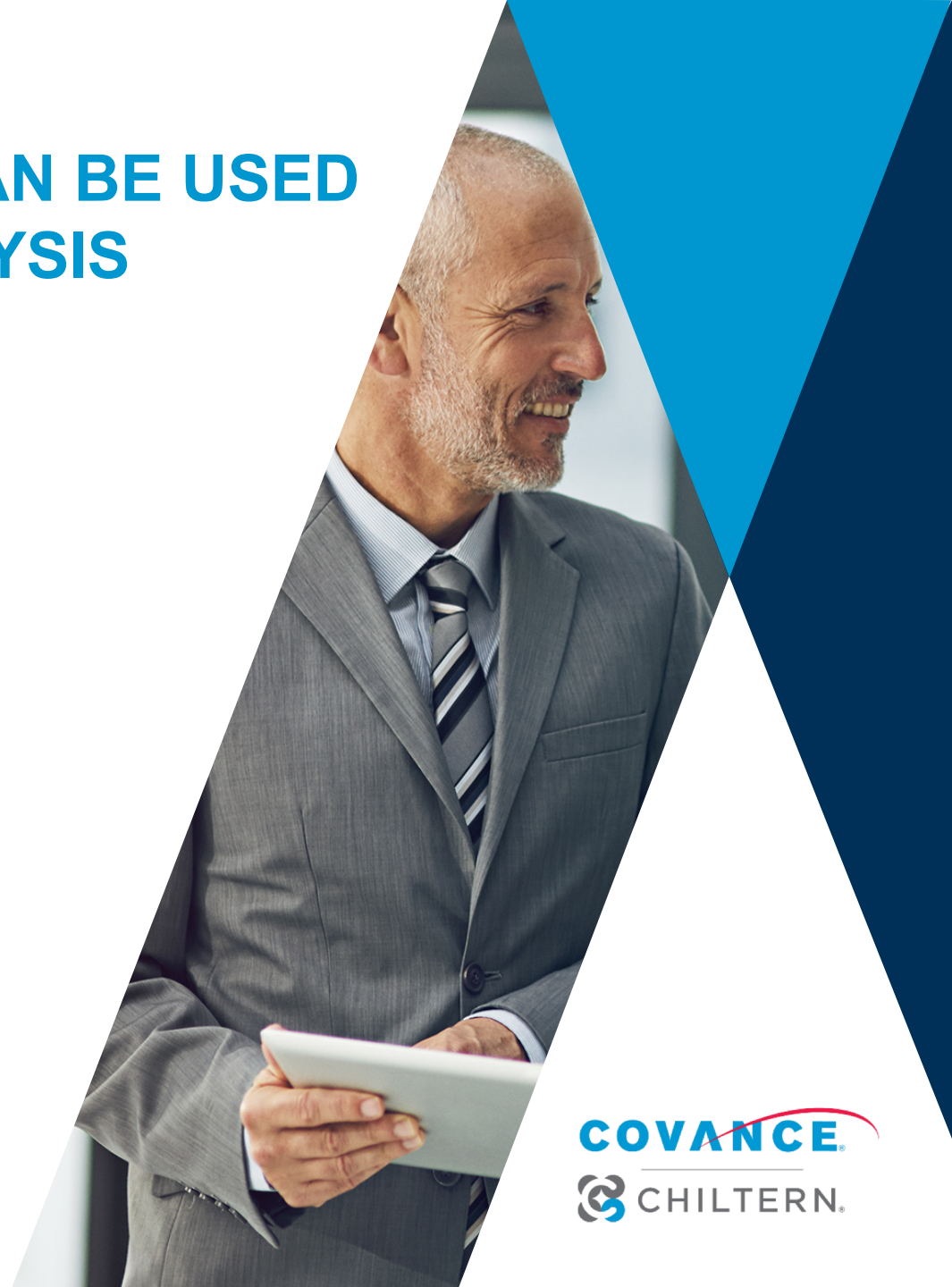
HOW ODS GRAPHICS INFRASTRUCTURE CAN BE USED IN STATISTICAL ANALYSIS

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Paper DV11

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Agenda

Topics Covered:

- ▶ Create Graphs Using ODS Graphics Designer
- ▶ Editing with ODS Graphics Editor
- ▶ SG Procedures and Graph Template Language (GTL) Examples
- ▶ Combine Graphs into a Single Document

Create Graphs Automatically from SAS Procedures

Minimal knowledge of SAS/Graph coding is required.

Simple plot from PROC FREQ using `/plots=freqplot` option

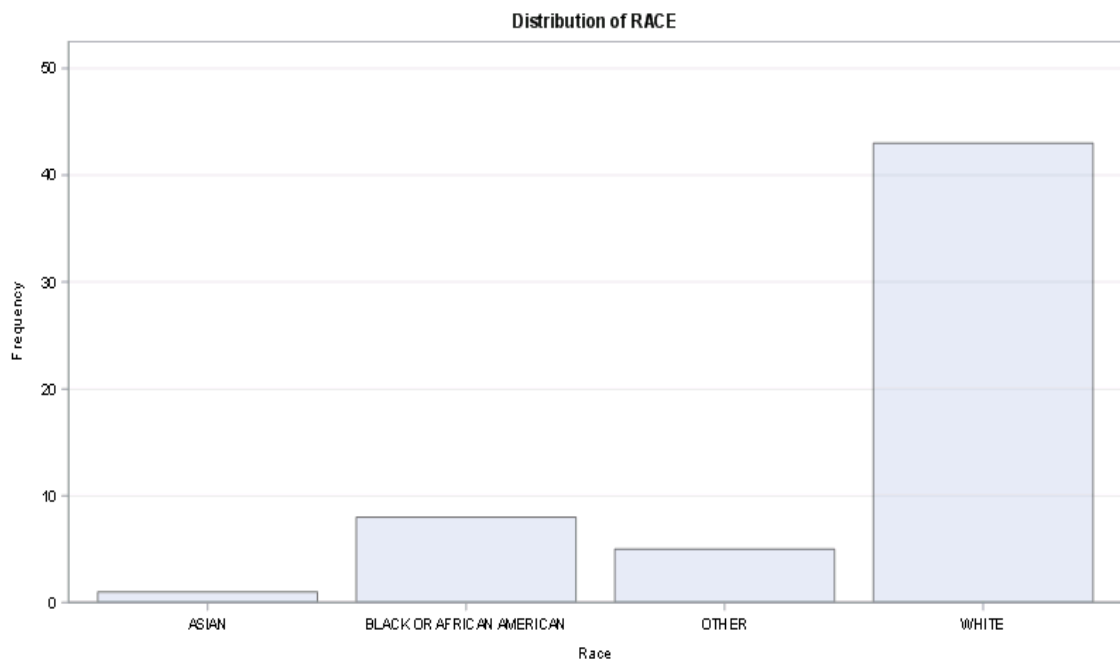


FIGURE 1: Code

```
ods graphics on;  
proc freq data=test.adsl;  
tables race/plots=freqplot;  
run;  
ods graphics off;
```

Create Graphs Automatically from SAS Procedures

Creating subgroup plots.

Using `freqplot/(twoway = grouphorizontal)` option.

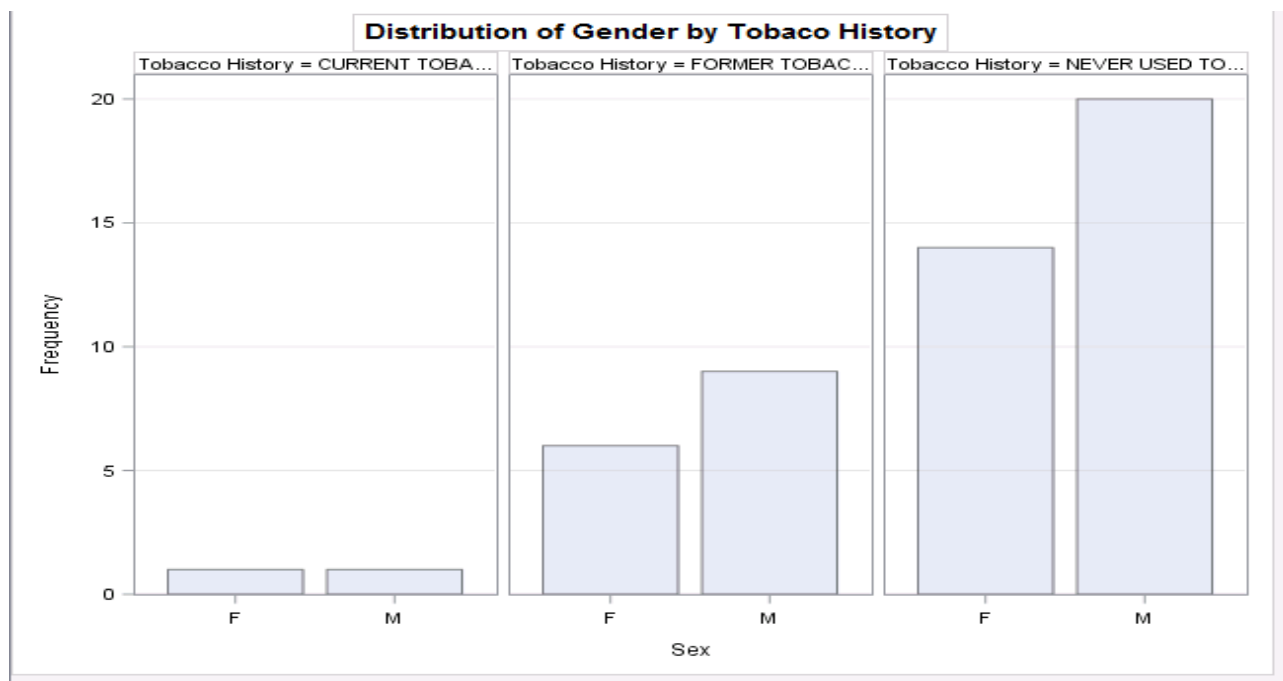
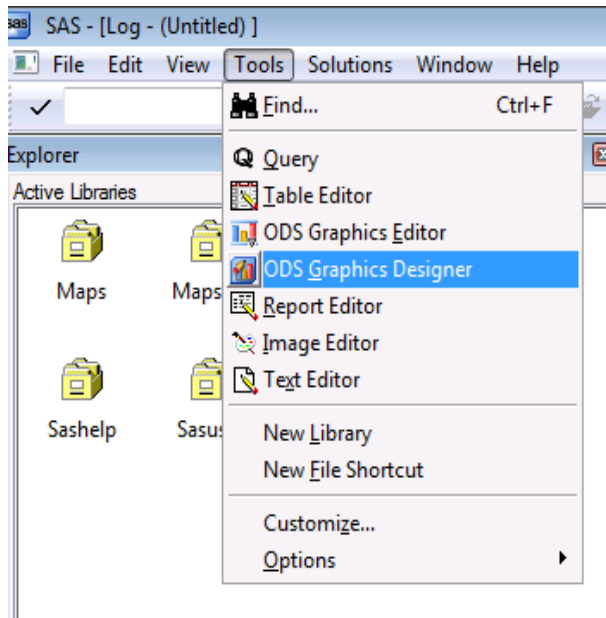


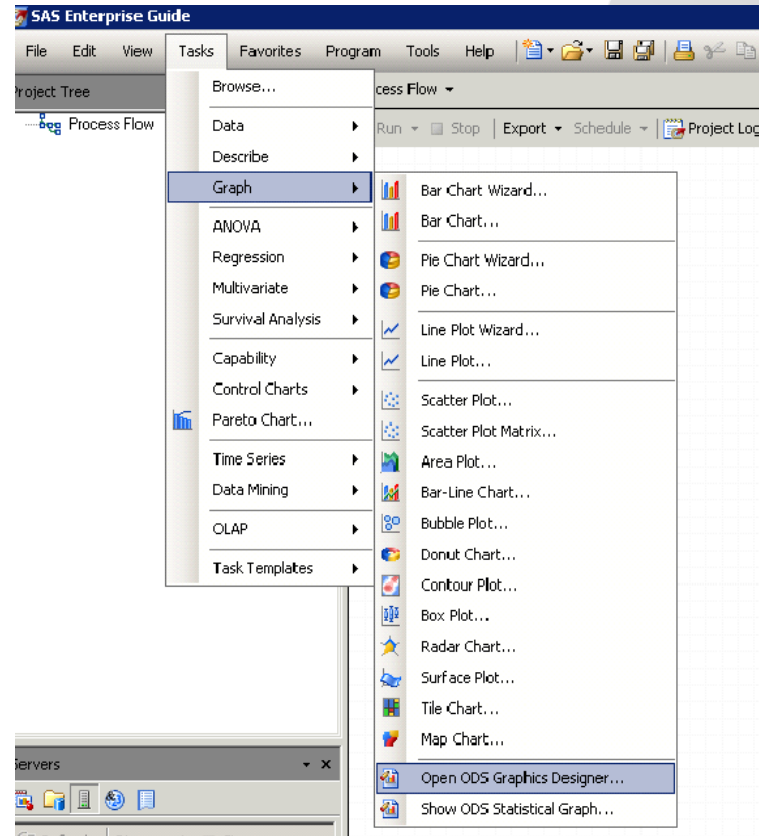
FIGURE 2: Code

```
ods graphics on;  
proc freq data = test.adsl;  
tables sex * SUNCFTOB /  
plots (only) = freqplot/(twoway =  
grouphorizontal);  
run;  
ods graphics off;
```

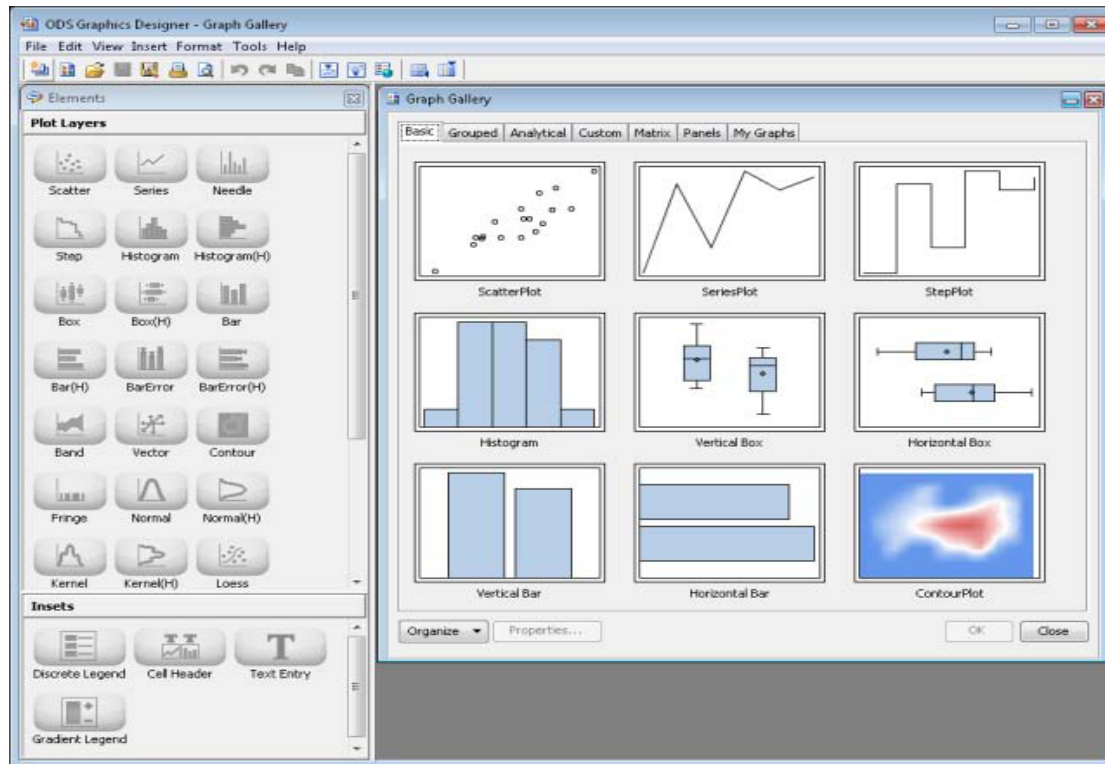
Create Graphs Using ODS Graphics Designer, an Interactive Application



Open ODS Graphics Designer using PC-SAS or Enterprise Guide



Create Graphs Using ODS Graphics Designer, an Interactive Application



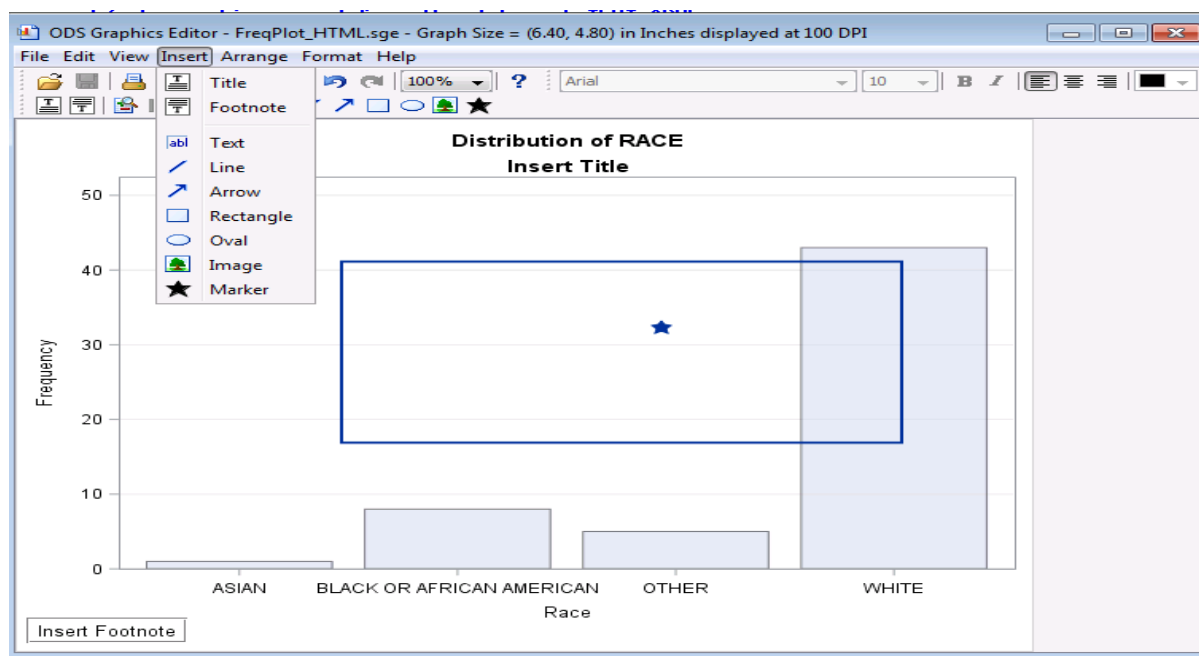
To invoke the ODS Graphics Designer

Submit in SAS Editor:
%sgdesign;

ODS Graphics Designer Interface

Edit Graphs Using ODS Graphics Editor

Start by adding the **SGE=ON** option in the ODS statement
Modify elements like titles, lines, and markers.

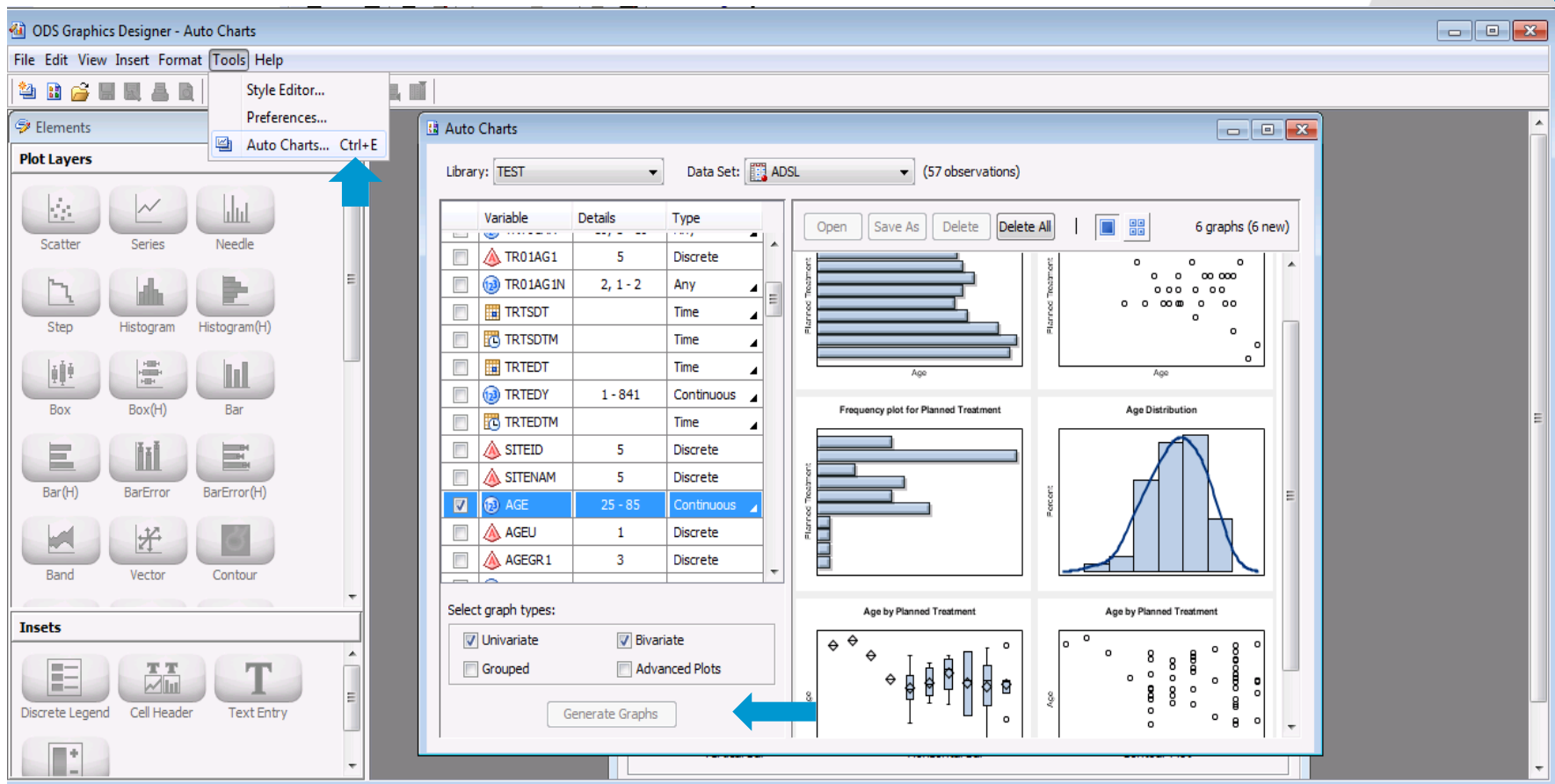


ods listing sge=on;

```
proc freq data=test.ads1;  
  tables race/plots=freqplot;  
run;
```

ODS Graphics Editor

Auto Charts



Auto Charts from ODS Graphic designer

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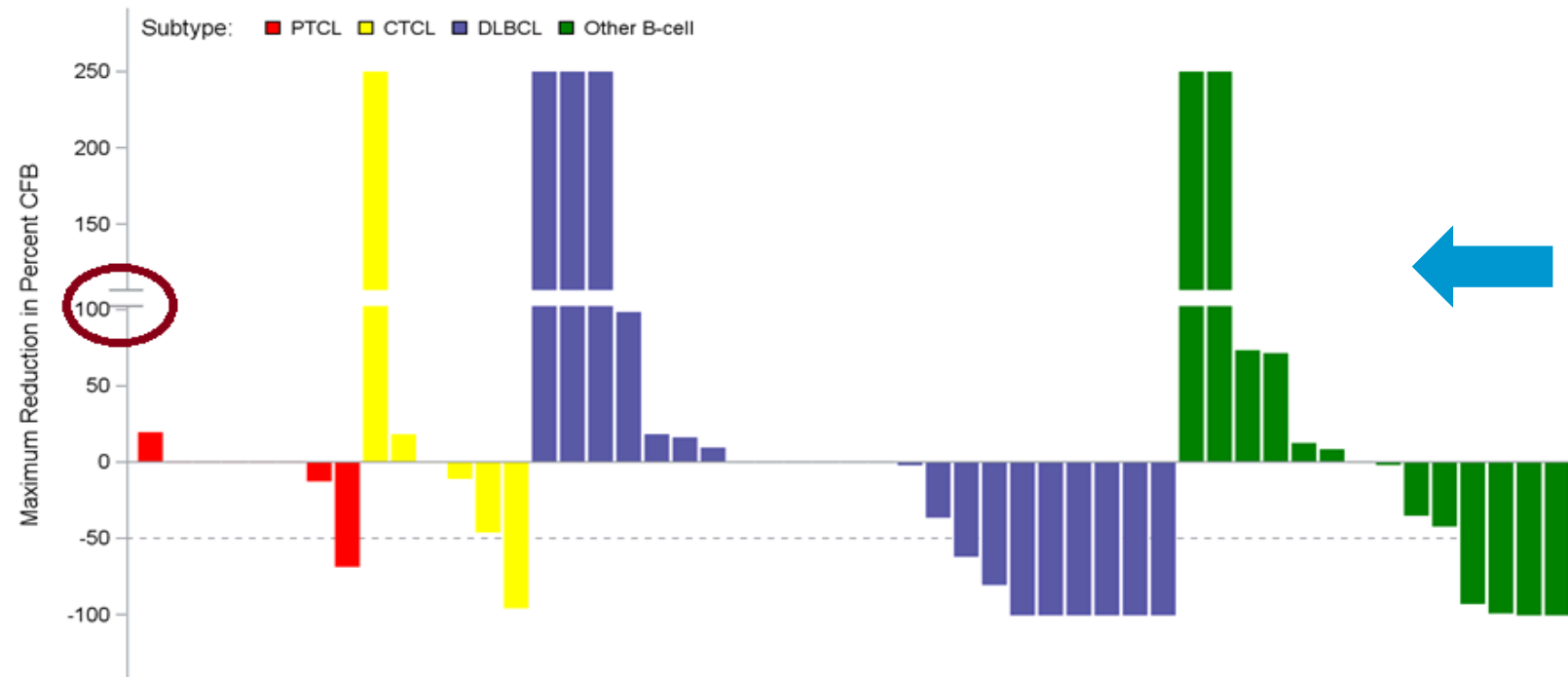
Public

Statistical Graphics (SG) Procedures: SGplot, SGPanel, and SGScatter

Scenario #1: Waterfall Plot with Break on Y-axis Indicating Disease Progression

- ▶ Display percent change from
- ▶ Indicate subtype
- ▶ Show a break at y-axis = 100% indicating Disease Progression (PD)
- ▶ Suppress x-axis labels

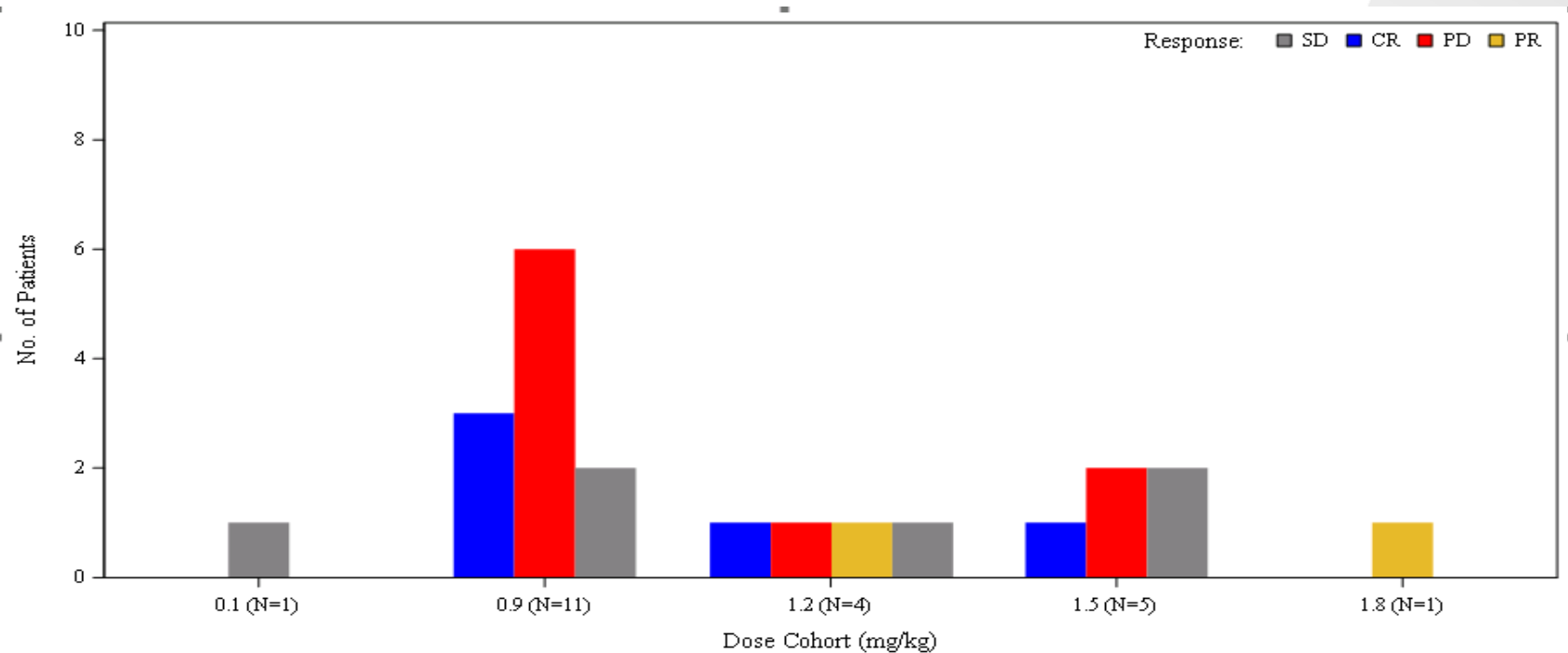
Scenario #1: Waterfall Plot with Break on Y-axis Indicating Disease Progression



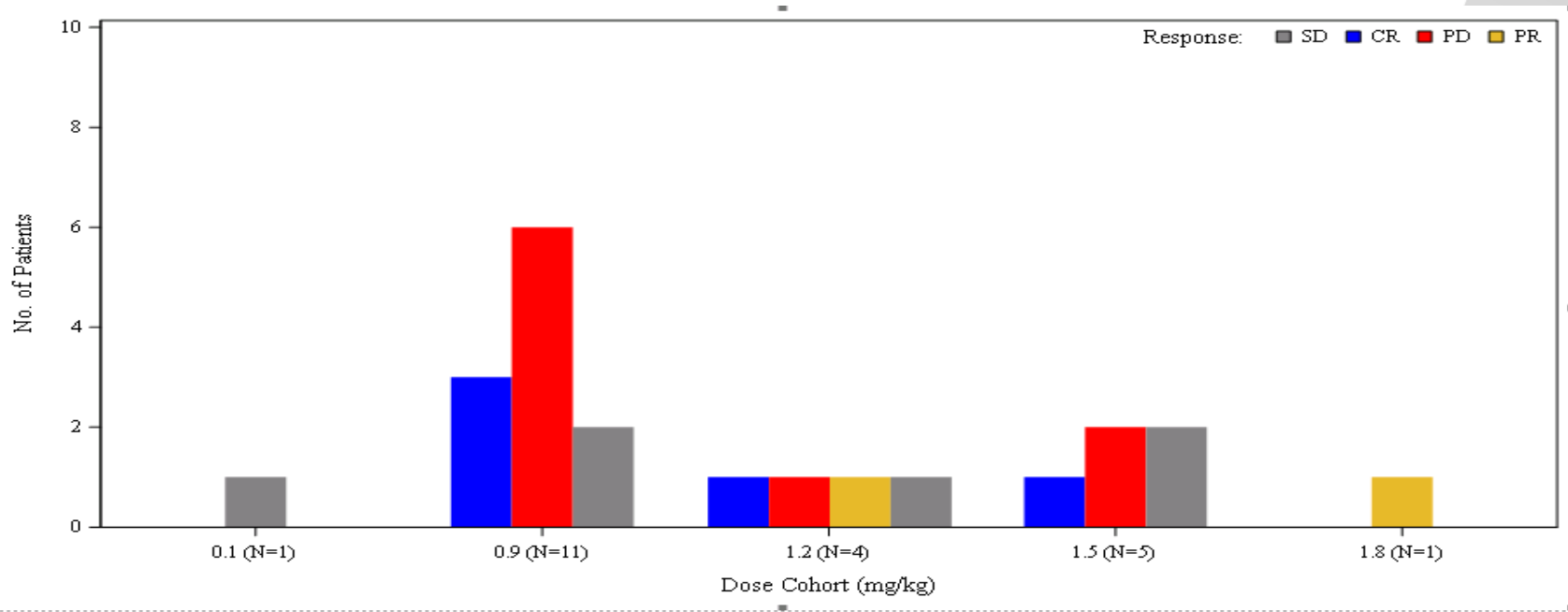
```
proc sgplot data=test pad=(bottom=8pct);
  styleattrs datacolors=(red yellow lib green) AXISBREAK=BRACKET axisextent=full ;
  refline -50 / axis=y lineattrs=(pattern=shortdash);
  vbar n / response=pcfb group=var nooutline name="sty" legendlabel="Subtype";
  yaxis ranges=(-100-100 110-250) values=(-100 to 250 by 50) valueshint offsetmin=0.1
    offsetmax=0.095;
  xaxis display=none ;
  keylegend "sty" / title="Subtype:" position = topleft location=inside noborder;
run;
```

Scenario #2: Cluster Groups Based on Response Types

- ▶ Best overall response by dose cohort
- ▶ Cluster bar showing number of patients by cohort and response
- ▶ Using SGPLOT options **response**, **group** and **groupdisplay**

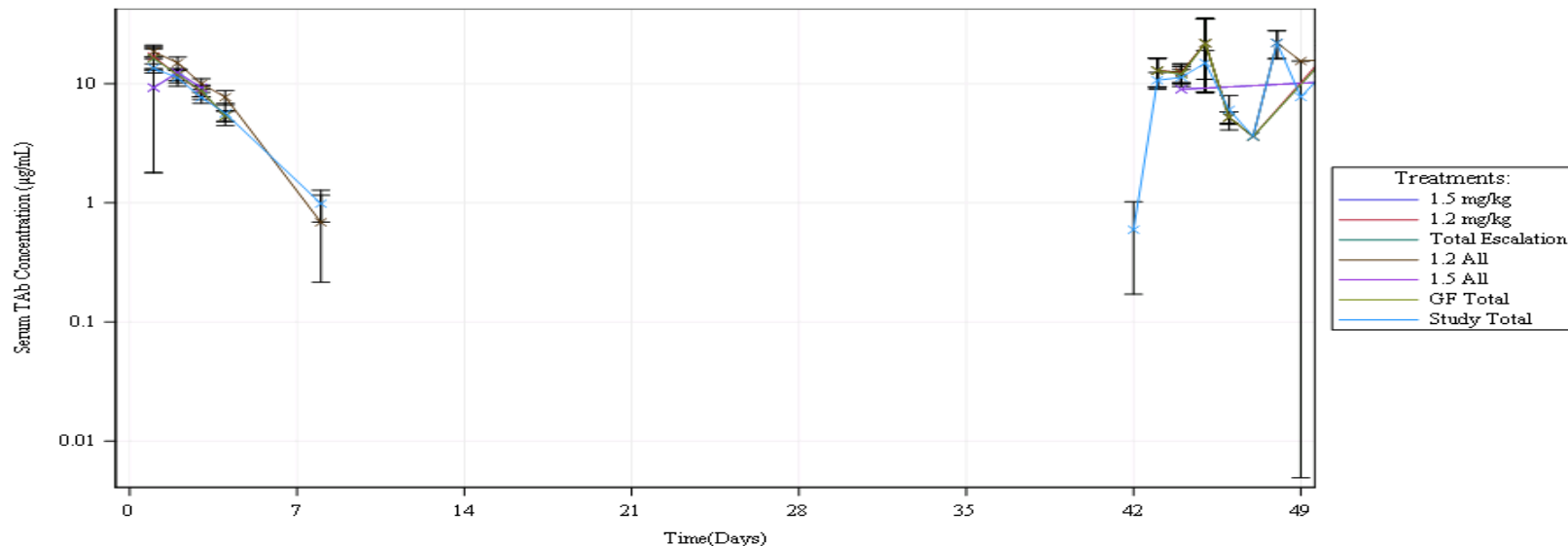


Scenario #2: Cluster Groups Based on Response Types



```
proc sgplot data=test ;
  styleattrs datacolors=(grey blue red BIOY) ;
  vbar trt / response=cntvar
  group=avalc groupdisplay=cluster stat=mean
  baselineattrs=(thickness=0) name="sty" legendlabel="Response" nooutline;
  yaxis values=(0 to 10 by 2);
  xaxis ;
  keylegend "sty" / title="Response:" position = topright location=inside noborder;
run;
```

Scenario #3: Suppressing Display of an Interpolated Line Connecting LLOQ Values



```
proc sgplot data=fin ;
```

```
axis grid values=(xval) label="Time(Days)" labelattrs=(size=9);
```

```
yaxis grid type = log label="&yax" labelattrs=(size=9);
```

```
scatter x=ady y=mean / group=trtp markerattrs=(symbol=x) yerrorlower=sel yerrorupper=seu  
errorbarattrs=(color=black);
```

```
series x=ady y=mean / group=trtp BREAK lineattrs=(pattern=solid) name="trtp"
```

```
legendlabel="Treatments";
```

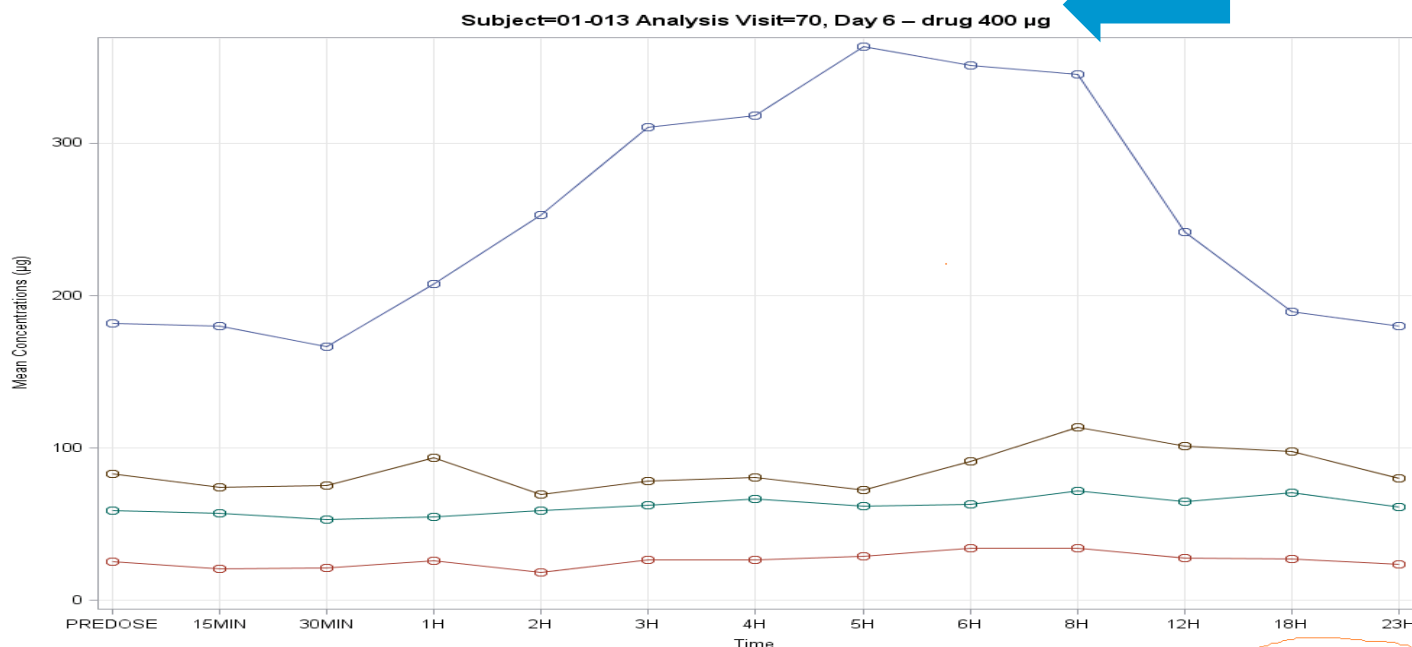
```
keylegend "trtp" / title="Treatments:" position = right location=outside border;
```

```
run;
```

Scenario #4: Maintaining a Dynamic X-axis on Multiple Plots with Varying Time Points

- ▶ Plasma concentration-time profile by treatment
- ▶ Plot visit and drug dose per subject
- ▶ Dynamic x-axis time points to account for missing time points **type=discrete**
- ▶ Dynamic page X of Y update with each subject, **#byval**

Scenario #4: Maintaining a Dynamic X-axis on Multiple Plots with Varying Time Points



Page 1 of 216

Title1 h=8pt j=c font="simplex" "Subject = #byval1 and Analysis Day = #byval3 ";

footnote3 j=r "Page #byval4 of &totpg";

proc sgplot data=fin noautolegend;

by usubjid avisitn avisit var;

format atptn tpt. ;

xaxis grid label="Time" type = discrete tickvalueformat = tpt. labelattrs=(size=9);

yaxis label="&yax" labelattrs=(size=9);

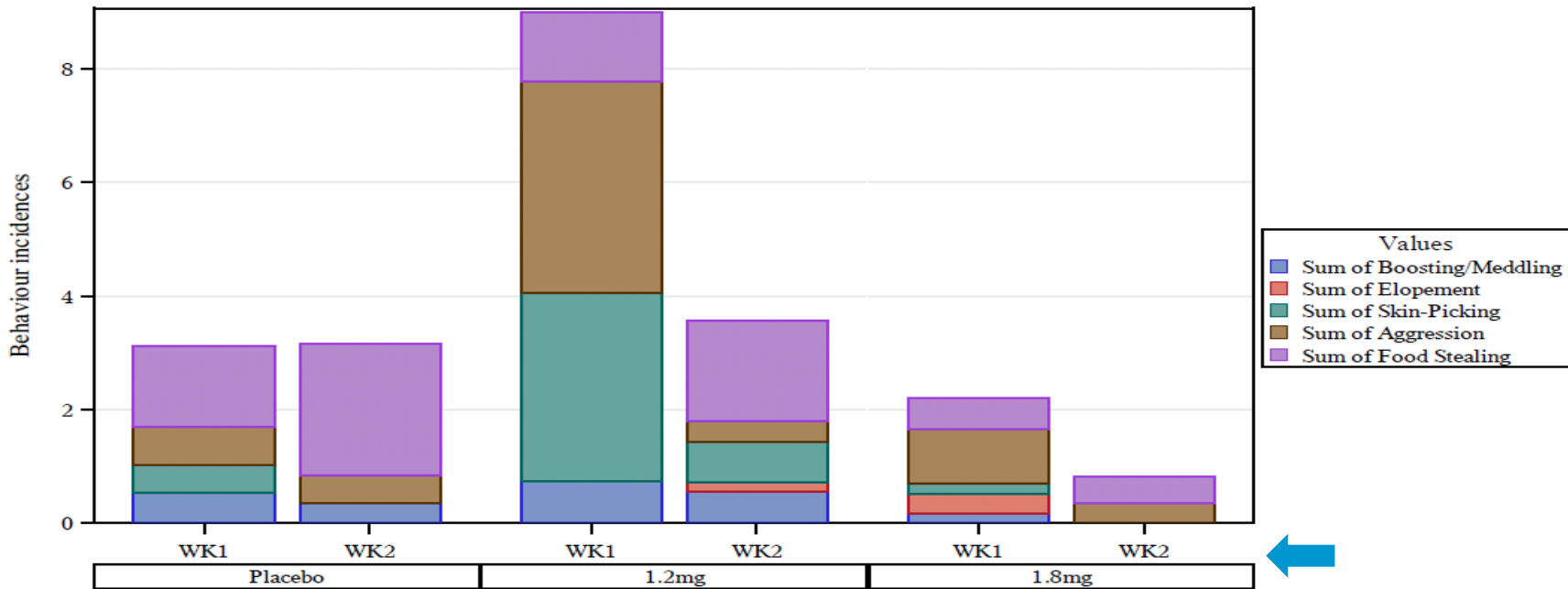
scatter x=atptn y=mean /group=paramcd markercharattrs = mark markerattrs=(size=9)

yerrorlower=sel yerrorupper=seu;

series x=atptn y=mean / group=paramcd lineattrs=(pattern=solid) ;

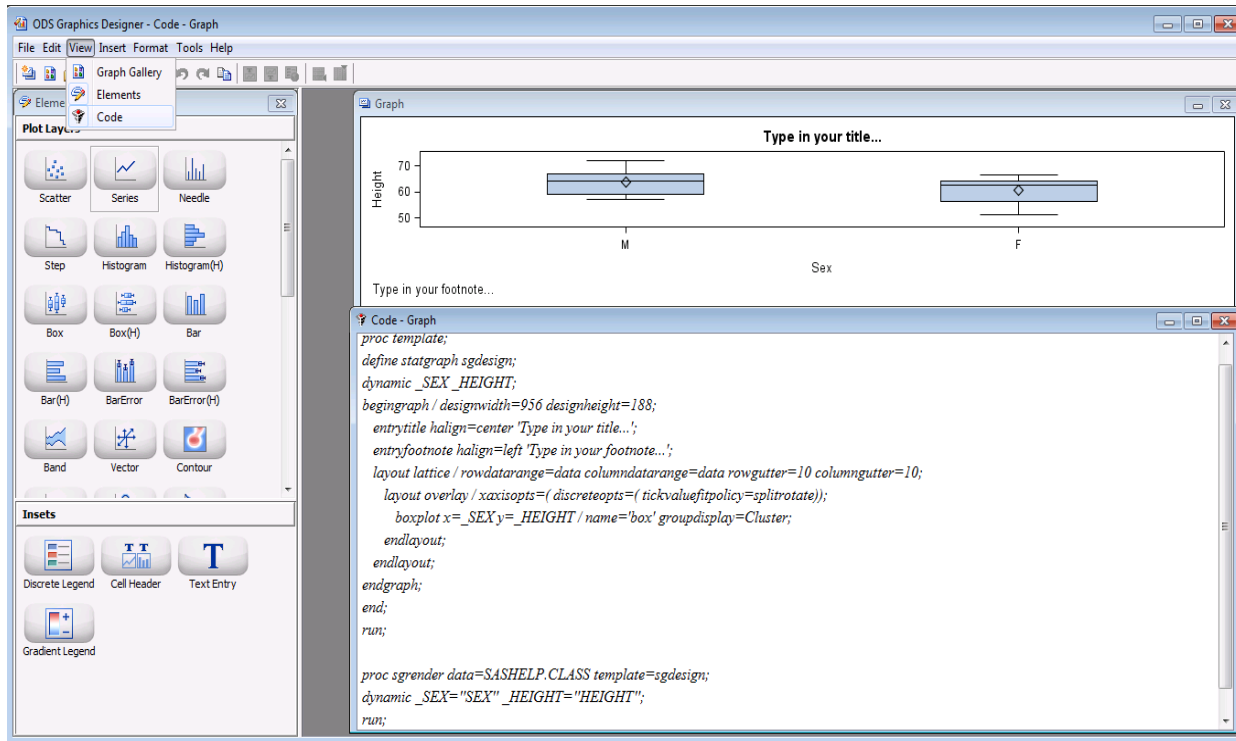
run;

Scenario #5: Combine Multiple Plots in the Same Panel of a Bar Chart



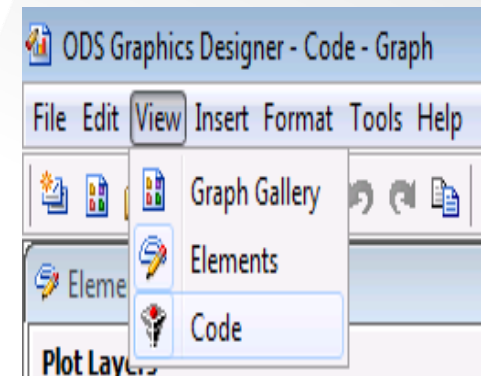
```
proc sgpanel data = figout_pl;
  format behavior $behav. avisitnum vstfmt. trtd trt.;
  panelby trtd / layout=columnlattice onepanel novarname noborder
    colheaderpos=bottom;
  vbar avisitnum / response=dgorres group=behavior grouporder=data;
  colaxis display=(nolabel) discreteorder=data;
  rowaxis grid;
  keylegend / across=1 position=right title="Values" ;
run;
```

Complex Graphs Using the Graph Template Language (GTL)



Access GTL Code used by ODS Graphics Designer

View → Code

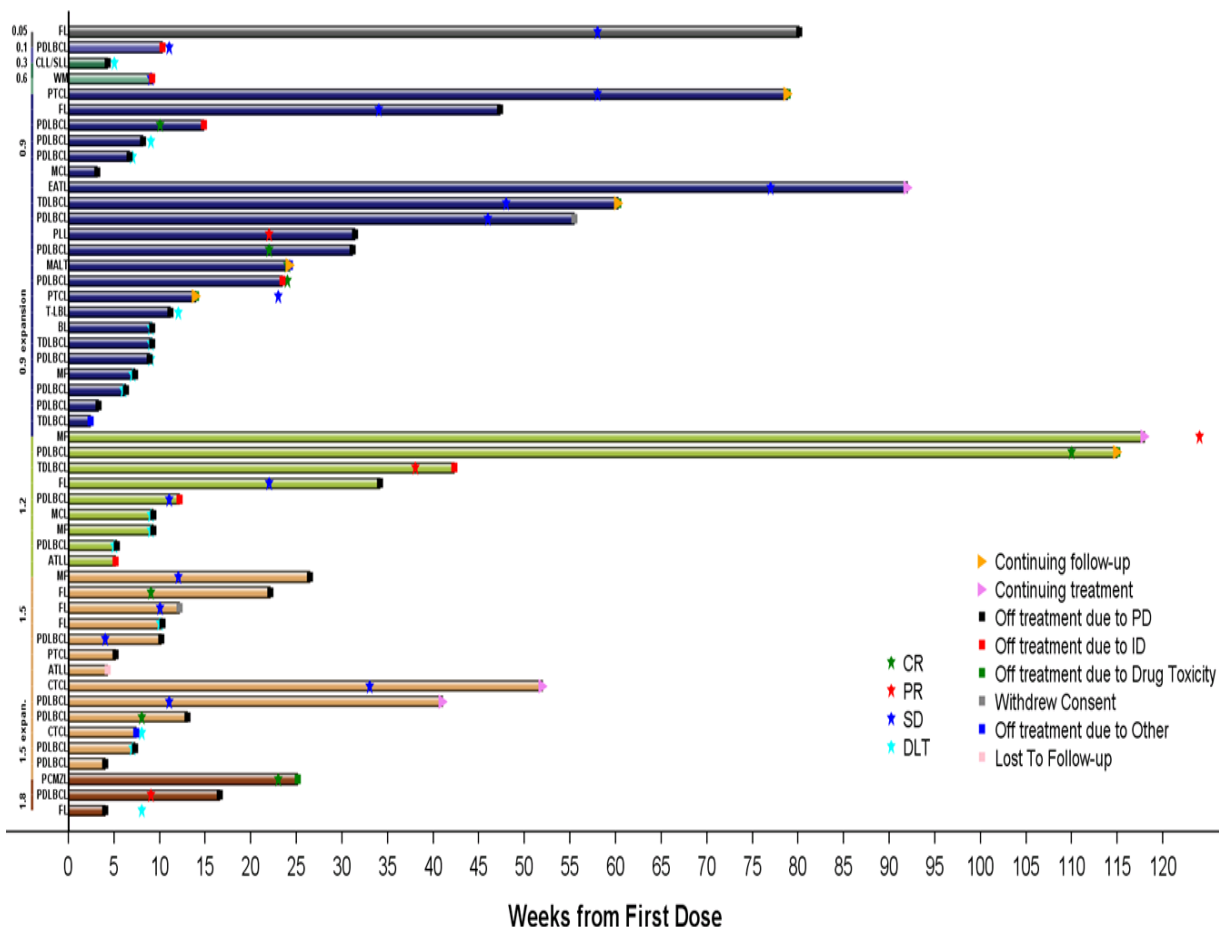


Example #1: Swimmer Plot (Patient Profile Graph) Using TEXTPLOT Facility

A plot that displays all this information for each subject:

- ▶ Duration of treatment
- ▶ Endpoints
- ▶ Dispositions
- ▶ Tumor Type
- ▶ Specialized Axis Legends

Example #1: Swimmer Plot (Patient Profile Graph) Using TEXTPLOT Facility



- Segmented multicolored vertical to the left of the y-axis
- Legend label orientation at -90 degrees more than one subject in the treatment group
- Legend label orientation at 0 degrees if there is only one subject in the treatment group

Swimmer plot with duration of treatment

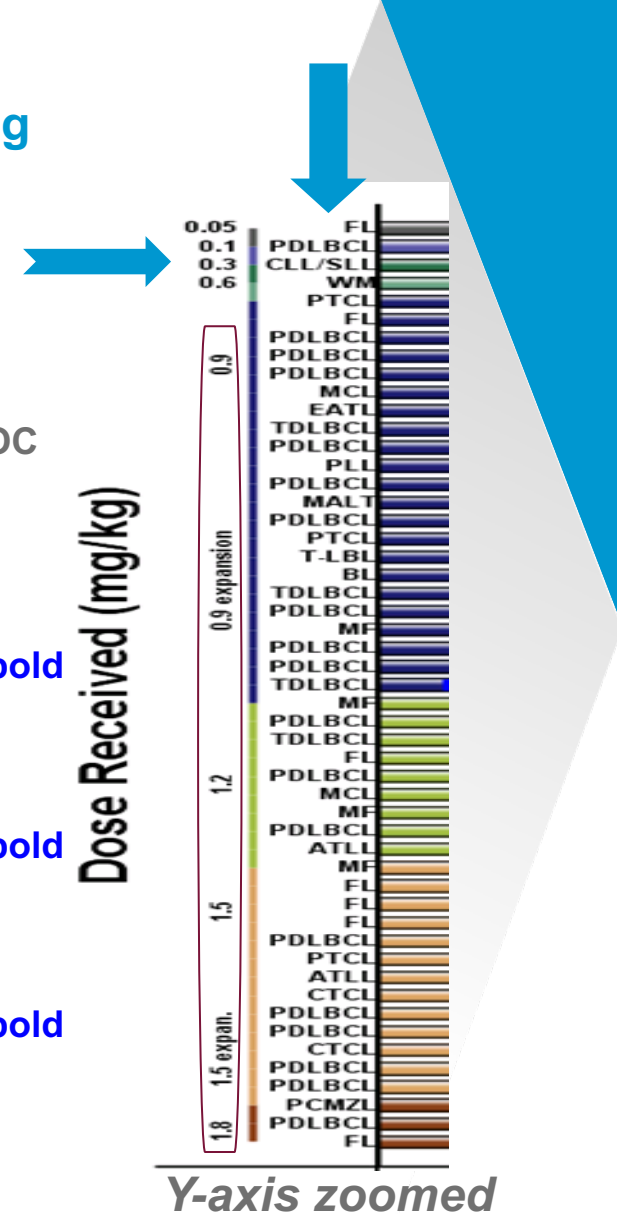
Example #1: Swimmer Plot (Patient Profile Graph) Using TEXTPLOT Facility

CODE SNIPPETS OF SIGNIFICANCE FOR THE SWIMMER PLOT IN PROC TEMPLATE

```
TEXTPLOT x=tp_x_0 y=yvar text=subtype /
          name="TP_1" textattrs=(color=black family="arial" weight=bold
          size=4) rotate=0 position=left;
```

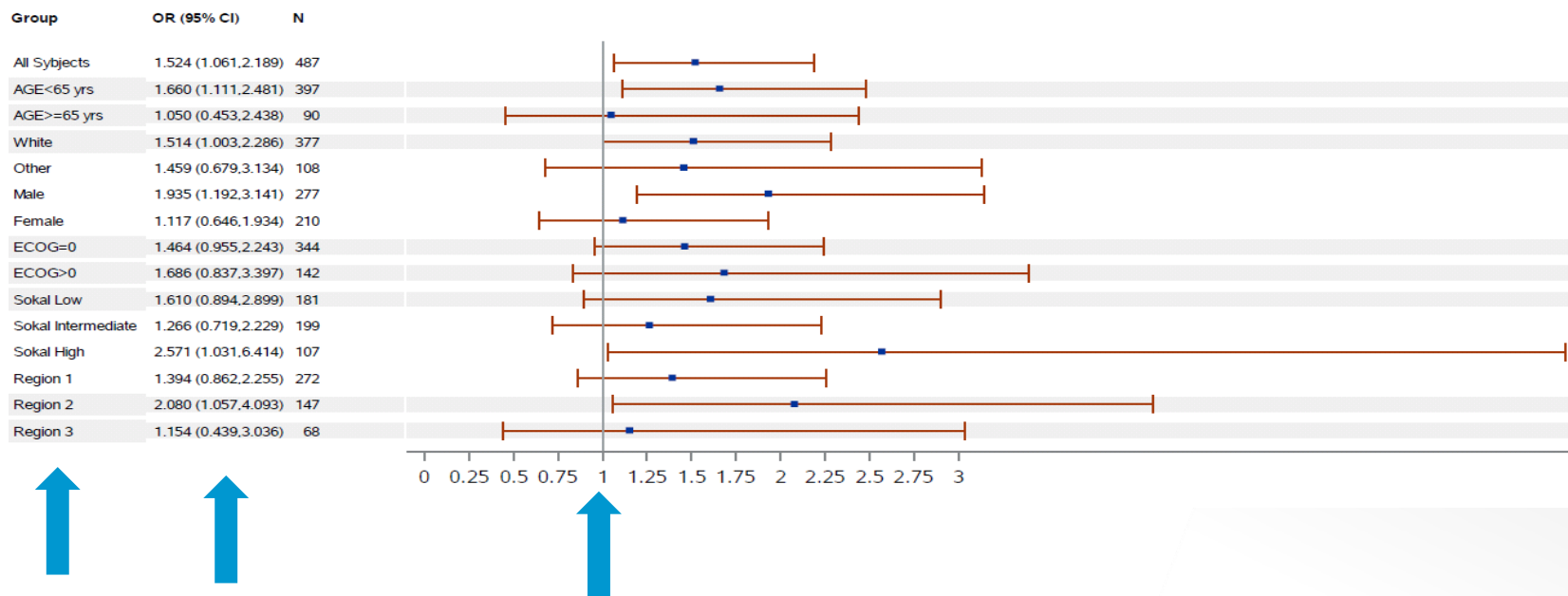
```
TEXTPLOT x=tp_x_neg90 y=yvar text=trtylab_90 /
name="TP_2" textattrs=(color=black family="arial" weight=bold
size=4) rotate=90 position=right;
```

```
TEXTPLOT x=tp_x_neg y=yvar text=trtylab_0 /
          name="TP_3" textattrs=(color=black family="arial" weight=bold
          size=4) rotate=0 position=left;
```



Example #2: Dynamically Changing Colors in Proc Template

Assigning different colors to various elements in a forest plot.



Elements of a graph like background color and reference line color can be altered.

Example #2: Dynamically Changing Colors in Proc Template

```
proc template;
  define statgraph Forest_HighLow/store=temp;
    dynamic _color _backgrcolor;
    begingraph;
    layout lattice / columns=4 columnweights=(0.06 0.06 0.05 0.50);
      entrytitle "Plot of Odds Ratio"/textattrs=(size=8) ;
      entrytitle halign=left " "/textattrs=(size=8) ;
      entrytitle halign=left " "/textattrs=(size=8) ;

/*--Column headers--*/
      sidebar / align=top;
        layout lattice / rows=2 columns=4 columnweights=(0.06 0.06 0.05 0.50)
          backgroundcolor=_backgrcolor opaque=true;
          entry textattrs=(size=7 weight=bold) halign=left "Group";
          entry textattrs=(size=7 weight=bold) halign=left "OR (95% CI)";
          entry textattrs=(size=7 weight=bold) halign=left "N";

        endlayout;
      endsidebar;

/*--First Covariates column*/
      layout overlay / walldisplay=none xaxisopts=(display=none)
        yaxisopts=(reverse=true display=none tickvalueattrs=(weight=bold));
        referenceline y=ref / lineattrs=(thickness=15 color=_color);
        axistable y=subgroup value=subgroup / textgroup=type display=(values);

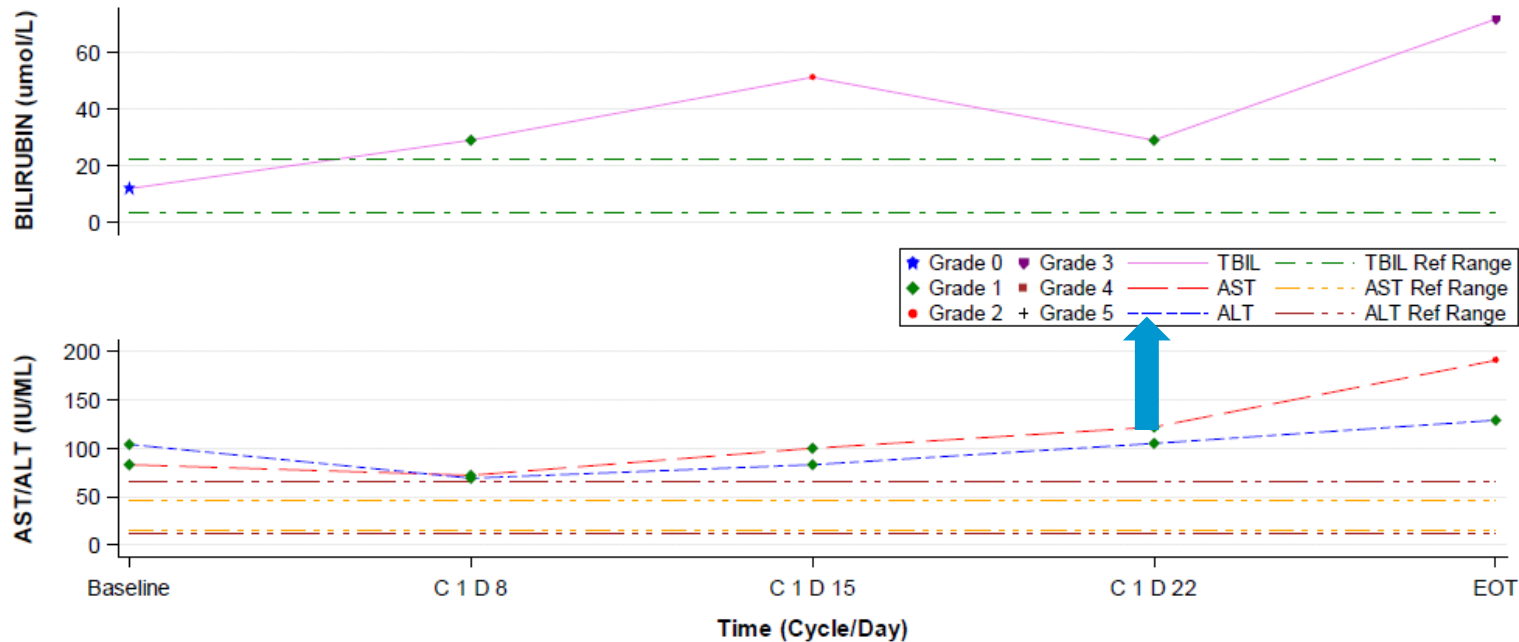
      endlayout;
      .....>>>>>>.;

    endlayout;
  endgraph;
end;
run;

proc sgrender data=Forest template=Forest_HighLow;
  dynamic _color='cxf0f0f0' __backgrcolor='white';
run;
```

Example #2: Interpolating a Common Legend on the X-axis for Comparing Multiple Plots

Subject Id: 01103



Same x-axis for each subject plotted on the same graph.

Create a lattice layout having 3 separate layout blocks in Proc Template.

Example #3: Interpolating a Common Legend on the X-axis for Comparing Multiple Plots

```
proc template;
define statgraph temp;
begingraph;
  layout lattice / rows = 2 rowdatarange=data columndatarange=data rowgutter=4px columngutter=2px
    rowweights=(75 30 100);

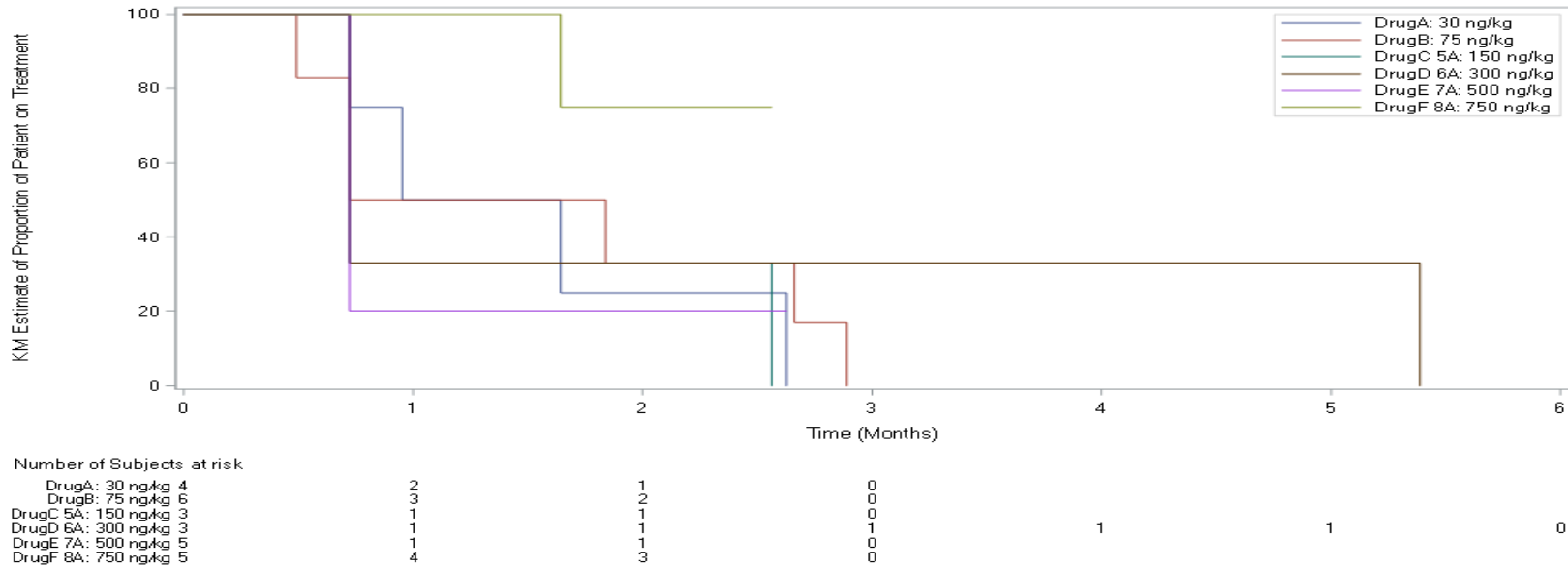
  /** TOTAL BILIRUBIN PLOT **/
  layout overlay / xaxisopts=(display=none) yaxisopts=( griddisplay=on label=('BILIRUBIN (umol/L)'))
    walldisplay=(FILL);
  Series plot of bilirubin.....;
  scatterplot of bilirubin.....;
  endlayout;

  /** COMMON LEGEND PLOT **/
  layout overlay;
  discretelegend " var" /
    border = true displayclipped = true across = 4 halign = right;
  endlayout;

  /** ALT/AST PLOT **/
  layout overlay / xaxisopts=(display=(line ticks tickvalues label) label=('Time (Cycle/Day)'))
    yaxisopts=( griddisplay=on label=('AST/ALT (IU/ML)')) walldisplay=(FILL);
  Series plot of ALT/AST.....;
  scatterplot ALT/AST.....;
  endlayout;
endlayout;
endgraph;
end; run;
```

Example #4: Displaying ATRISK Data in a Survival Plot without Using Annotation Facility

Figure
Kaplan-Meier Plot for Time on Treatment
Efficacy Evaluable population - Escalation Phase



Overlay the K-M Plot and At-Risk data

Display a zero for missing data in a time series the repeatedvalues=true

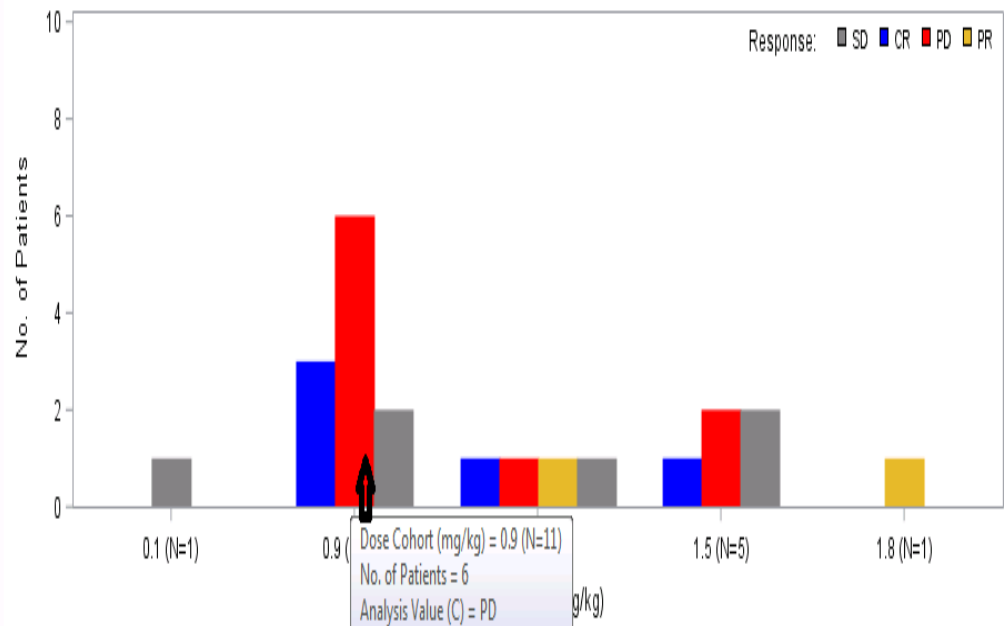
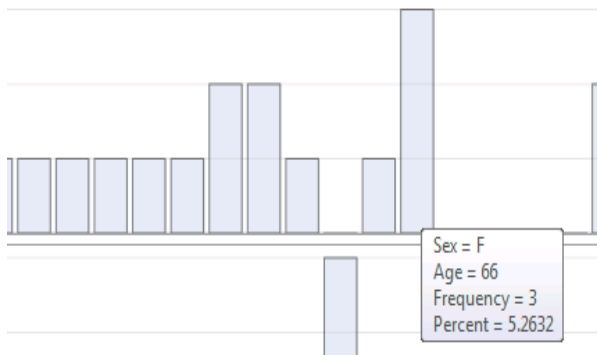
Example #4: Displaying ATRISK data in a Survival Plot without Using Annotation Facility

```
proc template;  
define statgraph xendesign;  
begingraph;  
  
layout lattice / rowdatarange=data columndatarange=union rowgutter=10 columngutter=10  
rowweights=(0.80 0.20) rows=2;  
layout overlay / xaxisopts=(label=('Time (Months)') linearopts=(tickvaluelist=(0 1 2 3 4 5 6 7  
8 9 10 11 12 13 14)))  
yaxisopts=( label("&yaxis") linearopts=(tickvaluesequence=(start=0 end=100 increment=20)));  
stepplot x=time y=survival / group = StratumNum name='step' connectorder=xaxis ;  
discretelegend 'step' 'scatter'/ opaque=false border=true halight=right valign=top displayclipped=true  
across=1 order=rowmajor location=inside ;  
endlayout;  
  
layout overlay / walldisplay=none xaxisopts=(display=none) ;  
entry halight=left "Number of Subjects at risk" / location=outside valign=top;  
blockplot x=tatrisk block=atrisk / display=(label values)  
class=stratumnum repeatedvalues=true valuehalight=start valueattrs=(size=8)  
labelattrs=(size=8);  
endlayout;  
  
endlayout;  
endgraph;  
end;  
run;
```

Adding Tooltips to Graphs for display in HTML

Informative descriptions when a mouse is hovered over certain areas of the graph

```
ods html body=' C:\Figures\fig.html'  
style=HTMLBlue;  
ods graphics on / imagemap=on;  
...  
... SAS Graph Statements  
...  
ods html close;
```



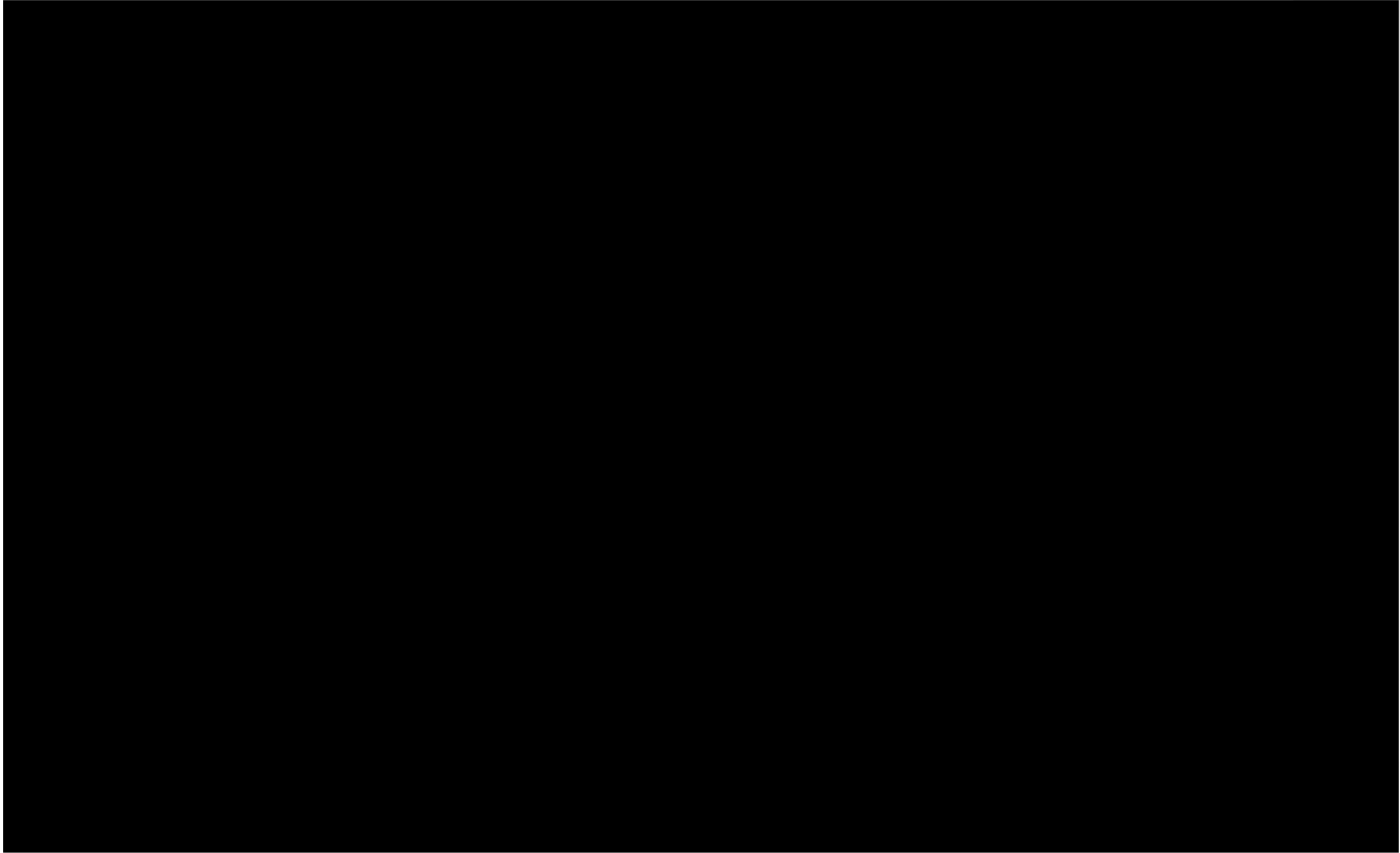
Combine Multiple Graphs into a Single ODS Output File

Combining individual plots from multiple locations or procedures into a single document with bookmarks.

```
/*Create individual graphs using  
ods document and close; */  
ods document name=test.KM1;  
.....  
    Graph  
    procedures/statements;  
.....  
ods document close;
```

```
ods pdf file="C:\Figures\Figures.pdf";  
/*Combine individual graphs using proc  
document; */  
proc document name=test.KM1;  
    replay;  
run;  
quit;  
  
proc document name=test.KM2;  
    replay;  
run;  
quit;  
ods pdf close;
```

ODS Graphic designer and Editor & Auto charts



Conclusion

ODS Graphics and Statistical procedures can produce graphical output together with tabular output. The examples above illustrate the power of ODS Graphics to create complex graphs without the need to learn how to write complex SAS/Graph code.

REFERENCES

SAS/STAT® 14.1 User's Guide Statistical Graphics Using ODS

Basic ODS Graphics Examples Warren F. Kuhfeld

Advanced ODS Graphics Examples Warren F. Kuhfeld

Kuhfeld, W. F. (2010). Statistical Graphics in SAS: An Introduction to the Graph Template Language and the

Statistical Graphics Procedures. Cary, NC: SAS Institute Inc.

Matange, S., and Heath, D. (2011). Statistical Graphics Procedures by Example: Effective Graphs Using

SAS. Cary, NC: SAS Institute Inc.

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CONTACT INFORMATION:

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