

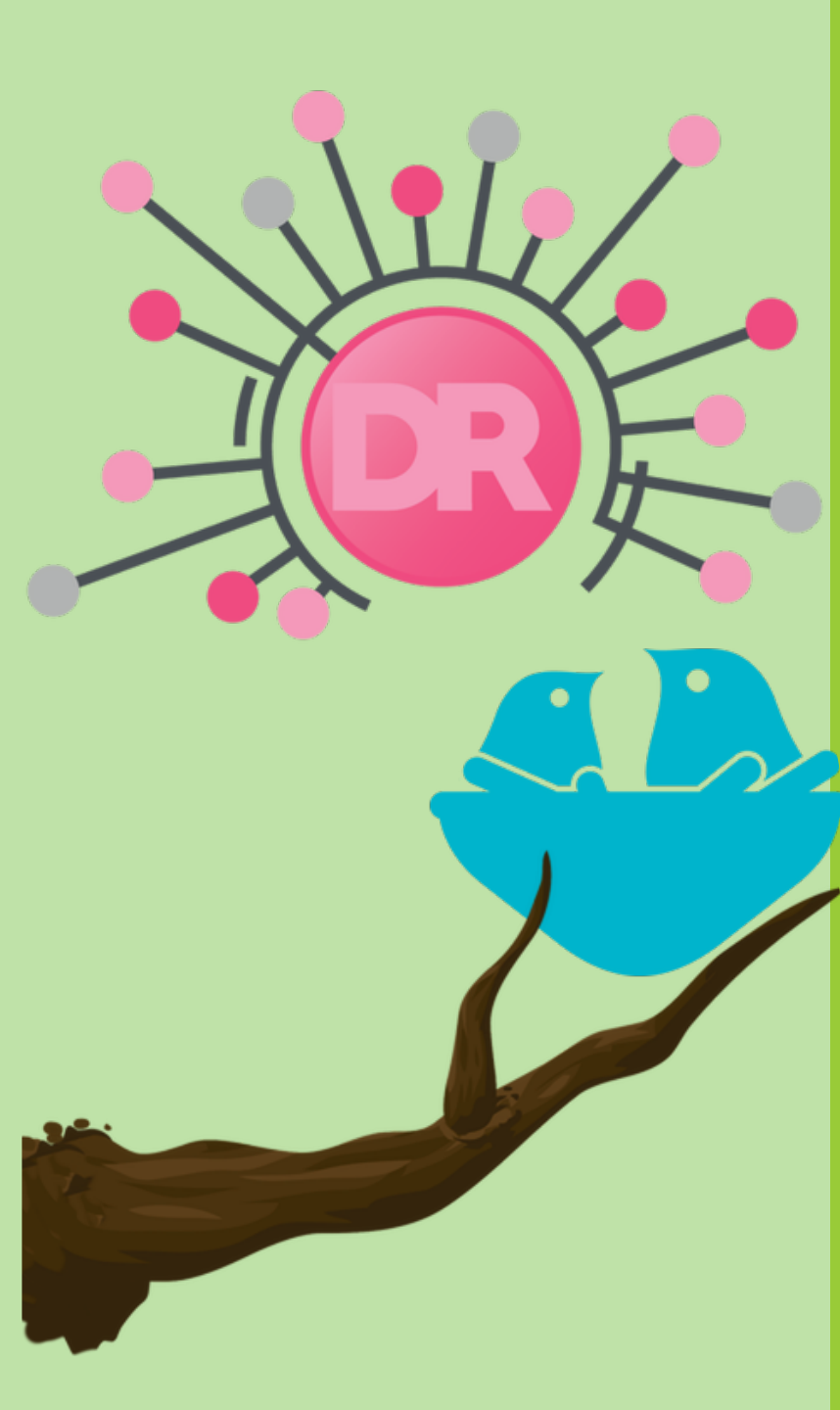
Complex Custom Clinical Graphs Step by Step with SAS® ODS Statistical Graphics

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Josh Horstman is an independent statistical programming consultant and trainer based in Indianapolis with 25 years of experience using SAS, primarily in the life sciences industry. Josh is a SAS Certified Advanced Programmer who loves coding and presenting at PharmaSUG and other industry conferences. Josh also enjoys travelling and hiking with his family and has been to 47 states and 27 national parks.

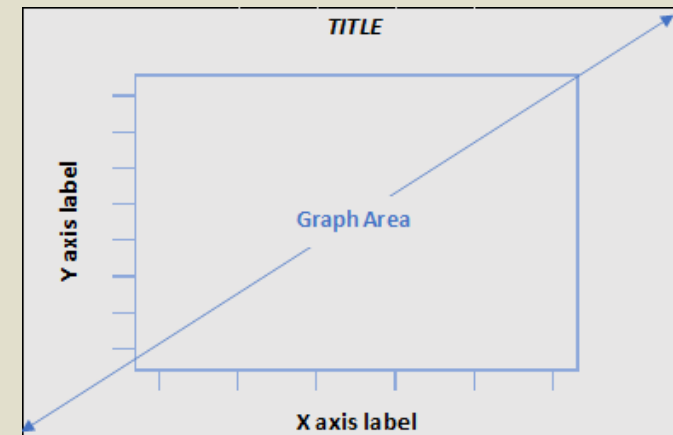
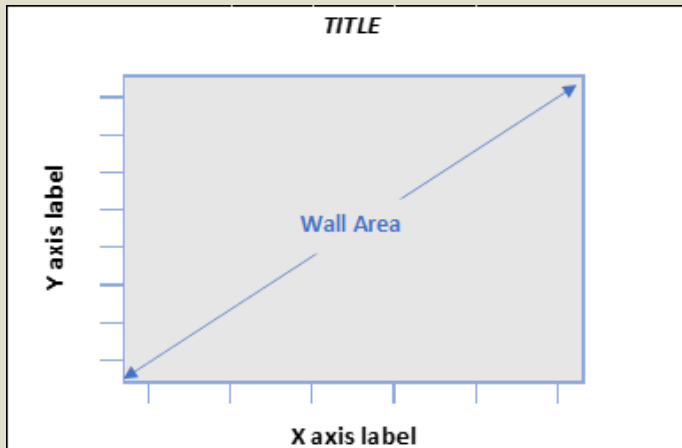
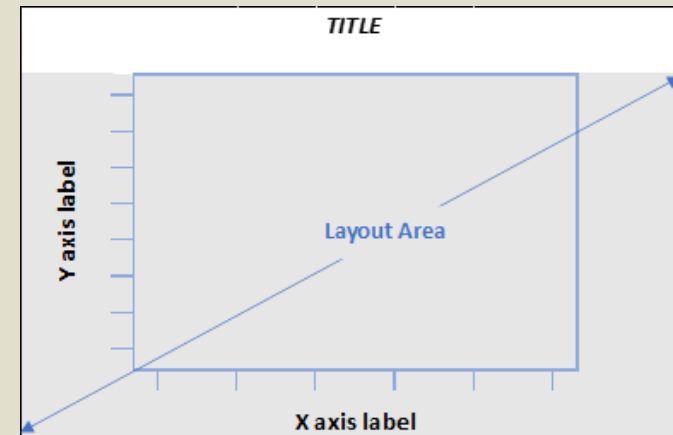
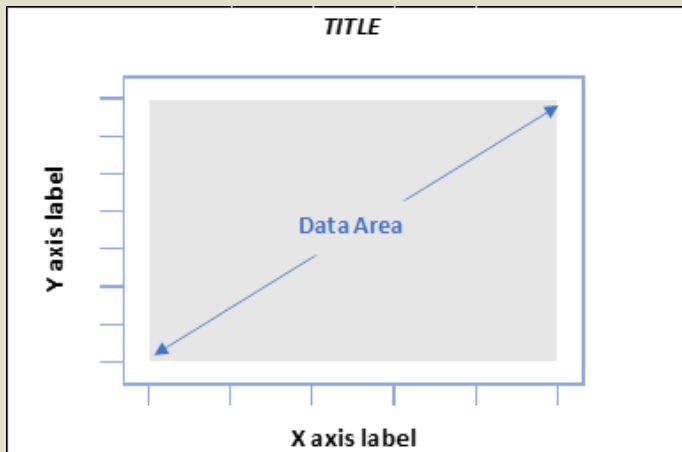
Agenda

- **Create a Basic Bar Chart**
 - SGPLOT
 - GTL
- **Add Titles and Footnotes to Graph Area**
 - SGPLOT
 - GTL
- **Embedding a Table Within a Graph**
 - SGPLOT
 - GTL
- **Adding a Table Outside the Graph**
 - SGPLOT
 - GTL

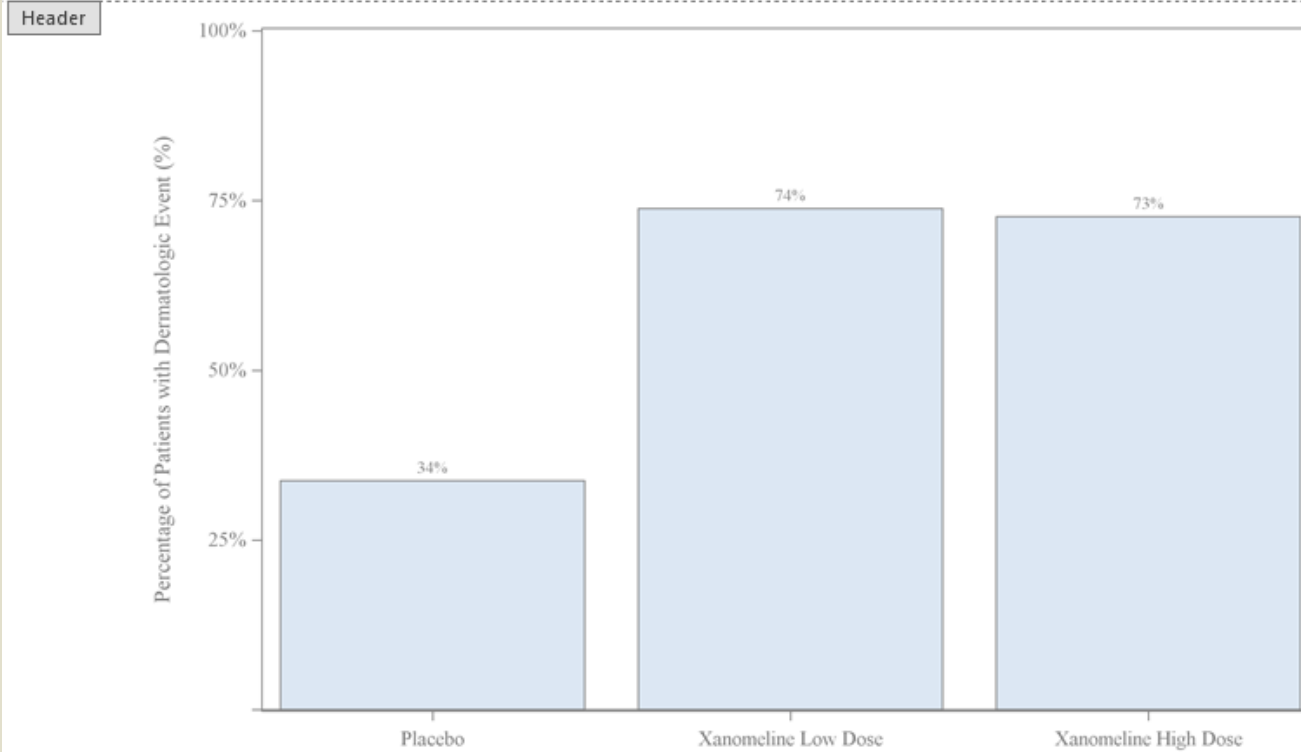


Creating a
Simple Bar Chart

Understanding Drawspace



Bar Chart by Treatment for Percent of Patients with Dermatologic Event - 1a



Bar Chart Component Only

Step 1: Creating a Simple Bar Chart

Using SGPLOT

```
title "Bar Chart by Treatment for Percent of Patients with Dermatologic Event - &fnmprt";  
footnote "SGPLOT - Bar Chart Component Only";
```

```
proc sgplot data = trtpct;  
  format TRTAN trt. pct_row pctfmt.;  
  xaxis type = discrete label = " ";  
  yaxis type = linear label = "Percentage of Patients with Dermatologic Event (%)"  
    values = (0 to 100 by 25);  
  vbar TRTAN / response = pct_row datalabel = pct_row;  
run;
```

Using GTL

```
title "Bar Chart by Treatment for Percent of Patients with Dermatologic Event - &fnmprt";
footnote "GTL - Bar Chart Component Only";
```

```
proc template;
```

```
  define statgraph recgrphb;
```

```
    begingraph / border = false;
```

```
    layout overlay / xaxisopts = (label = " " type = discrete)
```

```
      yaxisopts = (label = "Percentage of Patients with Dermatologic Event (%)"
```

```
        linearopts = (tickvaluesequence = (start = 0 end = 100 increment = 25)
```

```
          viewmax = 100));
```

```
    barchart x = TRTAN y = pct_row / orient = vertical barlabel = true;
```

```
    endlayout;
```

```
  endgraph;
```

```
end;
```

```
run;
```

Define the structure of the graph.

The template name is used when rendering the graph. This statement has a corresponding END.

Define statement has a corresponding END.

```
proc sgrender data = trtpct template = recgrphb;
```

```
  format TRTAN trt. pct_row pctfmt.;
```

```
run;
```

Using GTL

```
title "Bar Chart by Treatment for Percent of Patients with Dermatologic Event - &fnmprt";
footnote "GTL - Bar Chart Component Only";

proc template;
  define statgraph recgrphb;
    begingraph / border = false;
      layout overlay / xaxisopts = (label = " " type = discrete)
        yaxisopts = (label = "Percentage of Patients with Dermatologic Event (%)")
          linearopts = (tickvaluesequence = (start = 0 end = 100 increment = 25)
            viewmax = 100));
      barchart x = TRTAN y = pct_row / orient = vertical barlabel = true;
    endlayout;
  endgraph;
end;
run;

proc sgrender data = trtpct template = recgrphb;
  format TRTAN trt. pct_row pctfmt.;
run;
```

Each STATGRAPH has at most one BEGINGRAPH, which is the signal that indicates the various components of the custom template are specified within the block.

BEGINGRAPH has a corresponding ENDGRAPH, which signals the end of the graph template definition.

Using GTL

```
title "Bar Chart by Treatment for Percent of Patients with Dermatologic Event - &fnmprt";
footnote "GTL - Bar Chart Component Only";
```

```
proc template;
  define statgraph recrgrphb;
    begingraph / border = false;
      layout overlay / xaxisopts = (label = " " type = discrete)
        yaxisopts = (label = "Percentage of Patients with Dermatologic Event (%)")
          linearopts = (tickvaluesequence = (start = 0 end = 100 increment = 25)
            viewmax = 100));
      barchart x = TRTAN y = pct_row / orient = vertical barlabel = true;
    endlayout;
  endgraph;
end;
run;
```

LAYOUT allows you to specify the type of layout you want and assign the necessary options. Layouts can be nested depending on whether LATTICE, GRIDDED, DATAPANEL or DATALATTICE is used.

For each LAYOUT, you need to signal the end of the layout with ENDLAYOUT.

```
proc sgrender data = trtpct template = recrgrphb;
  format TRTAN trt. pct_row pctfmt.;
run;
```

Using GTL

```
title "Bar Chart by Treatment for Percent of Patients with Dermatologic Event - &fnmprt";
footnote "GTL - Bar Chart Component Only";

proc template;
  define statgraph recrgrphb;
    begingraph / border = false;
      layout overlay / xaxisopts = (label = " " type = discrete)
        yaxisopts = (label = "Percentage of Patients with Dermatologic Event (%)")
        linearopts = (tickvaluesequence = (start = 0 end = 100 increment = 25)
          viewmax = 100));
      barchart x = TRTAN y = pct_row / orient = vertical barlabel = true;
    endlayout;
  endgraph;
end;
run;

proc sgrender data = trtpct template = recrgrphb;
  format TRTAN trt. pct_row pctfmt.;
run;
```

Within the OVERLAY layout, the necessary plot statement is specified to build the bar chart. The options associated with the barchart specifies that the bars should be vertical rather than horizontal. In addition, each bar is to be labelled with the value. Since the bars are relatively wide and the label is small there is no concern for overlap of the values.

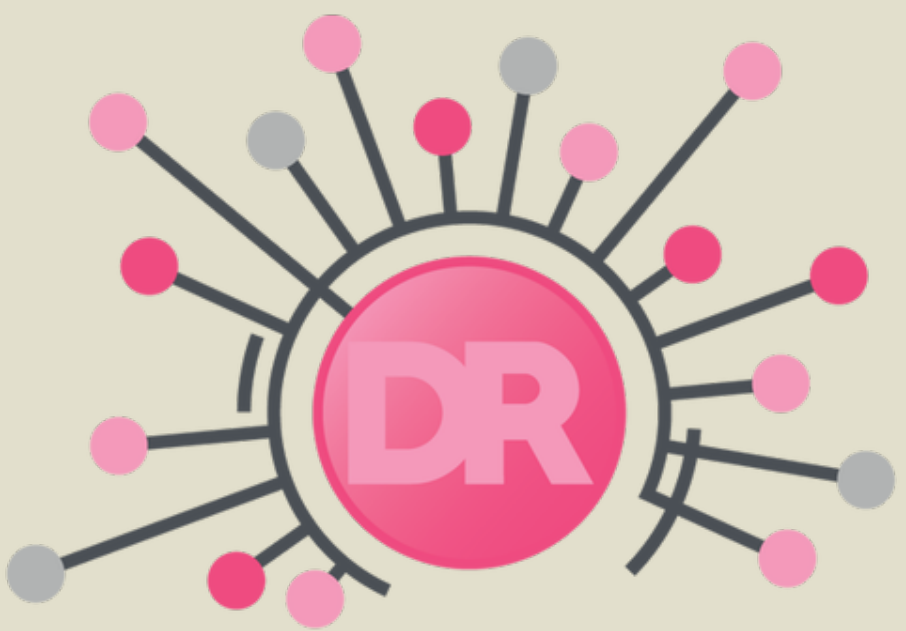
Using GTL

```
title "Bar Chart by Treatment for Percent of Patients with Dermatologic Event - &fnmprt";
footnote "GTL - Bar Chart Component Only";

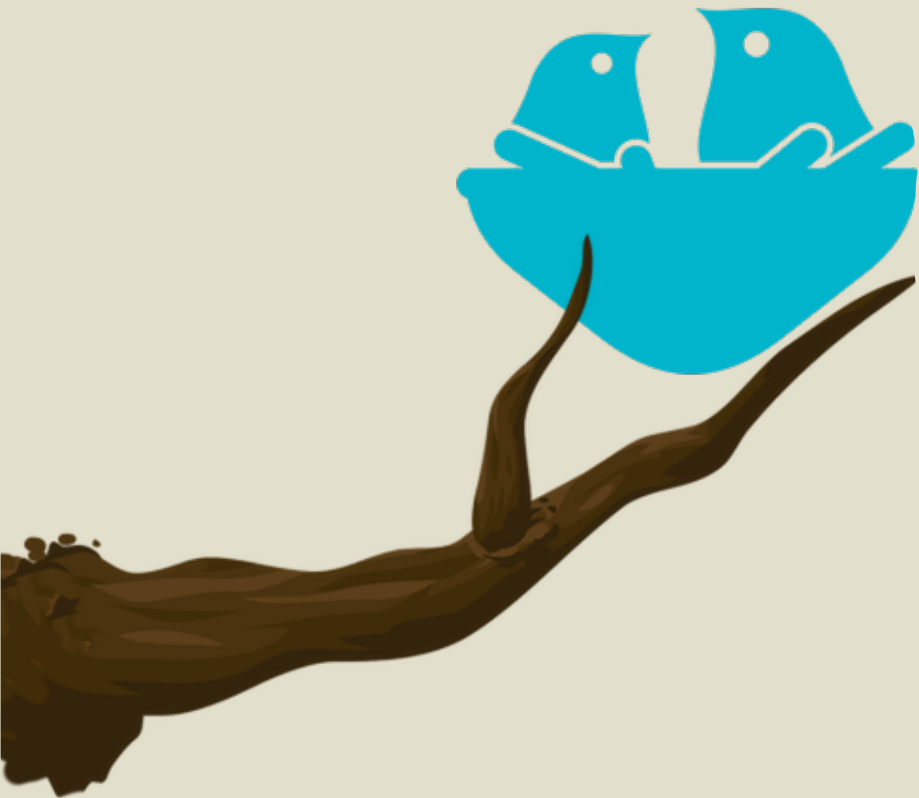
proc template;
  define statgraph recrgrphb;
    begingraph / border = false;
      layout overlay / xaxisopts = (label = " " type = discrete)
        yaxisopts = (label = "Percentage of Patients with Dermatologic Event (%)")
          linearopts = (tickvaluesequence = (start = 0 end = 100 increment = 25)
            viewmax = 100));
      barchart x = TRTAN y = pct_row / orient = vertical barlabel = true;
    endlayout;
  endgraph;
end;
run;

proc sgrender data = trtpct template = recrgrphb;
  format TRTAN trt. pct_row pctfmt.;
run;
```

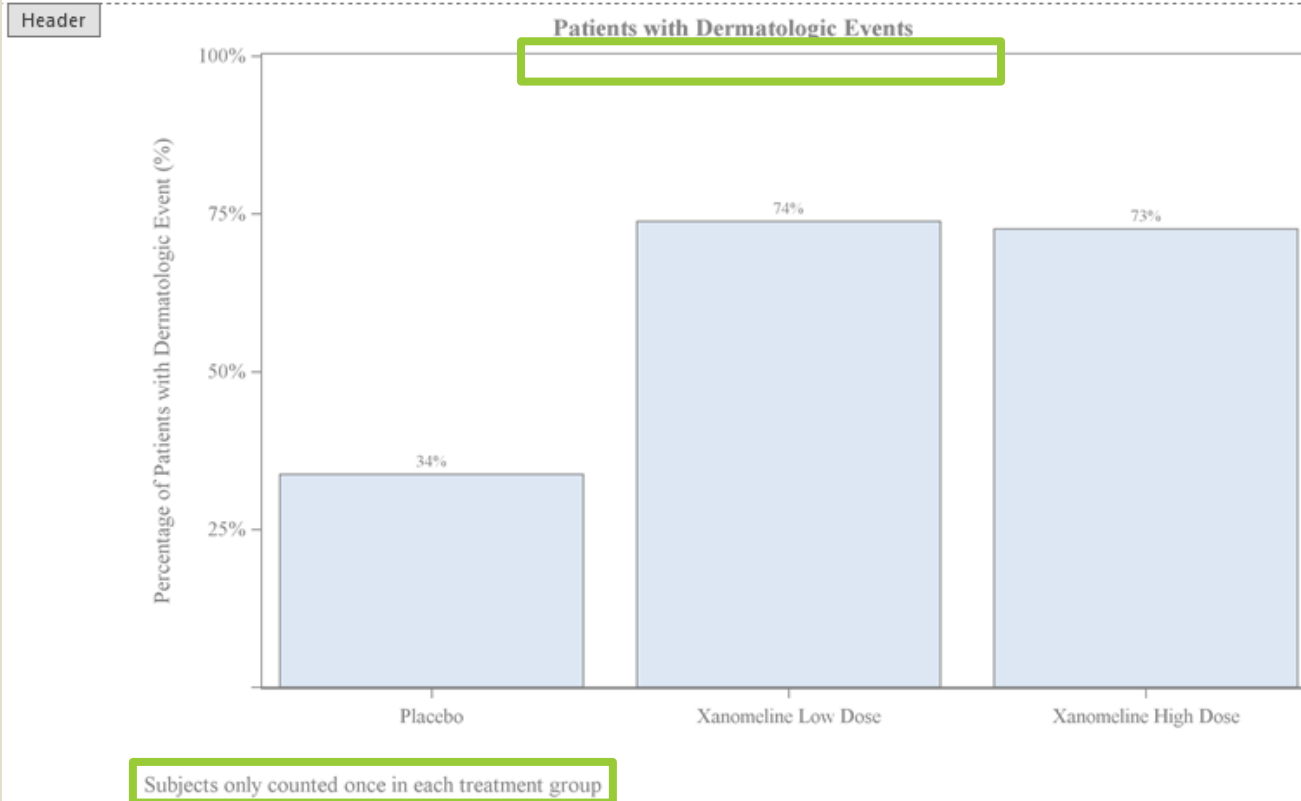
Using SGENDER you can specify the data that will be used with the template that was defined. Once the template is defined you can associate any data with it as long as the components (i.e., variables) defined in the template reside in the data set.



Titles and Footnotes in Graph Area



Bar Chart by Treatment for Percent of Patients with Dermatologic Event - 1b



Titles/Footnotes Inside and Outside Graph Area

Step 2: Titles and Footnotes in Graph Area

Using SGPLOT

Create Annotate Data Set

```
data insidetf;
  retain function 'text' drawspace 'graphpercent' width 100;
  length anchor $6 textstyleelement $17 label $51;
  input x1 y1 anchor $ textstyleelement $ label $ 32 - 82;
cards;
50 99 top      GraphTitleText      Patients with Dermatologic Events
20  1  bottom GraphFootnoteText Subjects only counted once in each treatment group.
;
run;
```

Using SGPLOT SGANNO

```
title "Bar Chart by Treatment for Percent of Patients with Dermatologic Event - &fnmprt";  
footnote "SGPLOT - Titles/Footnotes Inside and Outside Graph Area";
```

```
proc sgplot data = trtpct pad = (top = 5% bottom = 5%) sganno = insidetf;  
  format TRTAN trt. pct_row pctfmt.;  
  xaxis type = discrete label = " ";  
  yaxis type = linear label = "Percentage of Patients with Dermatologic Event (%)"  
    values = (0 to 100 by 25);  
  vbar TRTAN / response = pct_row  
    datalabel = pct_row;  
run;  
ods rtf close;  
ods pdf close;
```

Using GTL

```
title "Bar Chart by Treatment for Percent of Patients with Dermatologic Event - &fnmpert";
footnote "GTL - Titles/Footnotes Inside and Outside Graph Area";
```

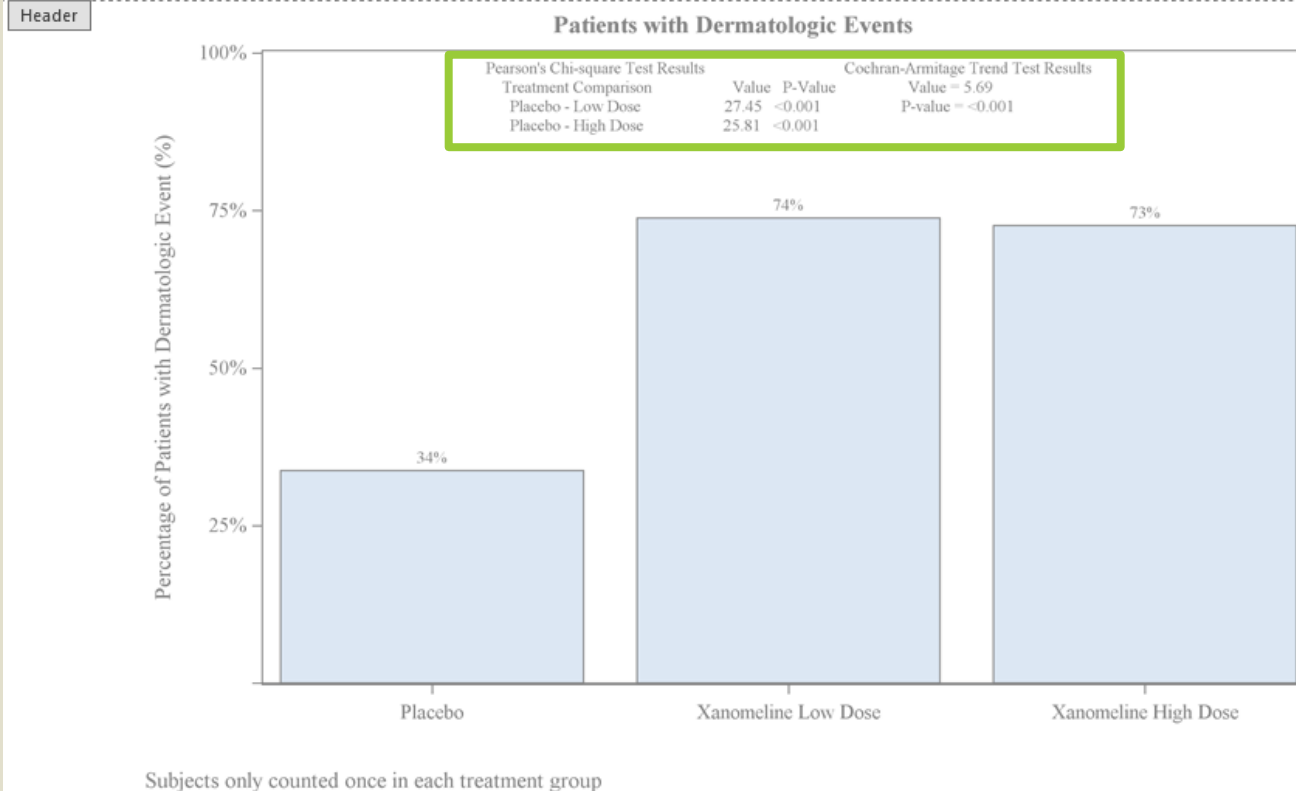
**Must be placed directly inside BEGINGRAPH block.
Displays a title above the wall area within the graph area**

```
proc template;
  define statgraph recrgrphb;
    begingraph / border = false;
      entrytitle "Patients with Dermatologic Events";
      entryfootnote halign = left "Subjects only counted once in each treatment group.";
      layout overlay / xaxisopts = (label = " " type = discrete)
        yaxisopts = (label = "Percentage of Patients with Dermatologic Event (%)")
          linearopts = (tickvaluesequence = (start = 0 end = 100 increment = 25)
            viewmax = 100));
      barchart x = TRTAN y = pct_row / orient = vertical
        barlabel = true;
    endlayout;
  endgraph;
end;
run;
```


Embedding a Table



Bar Chart by Treatment for Percent of Patients with Dermatologic Event - 1c



Footer

SGPLOT - Inset Table Component Using INSET

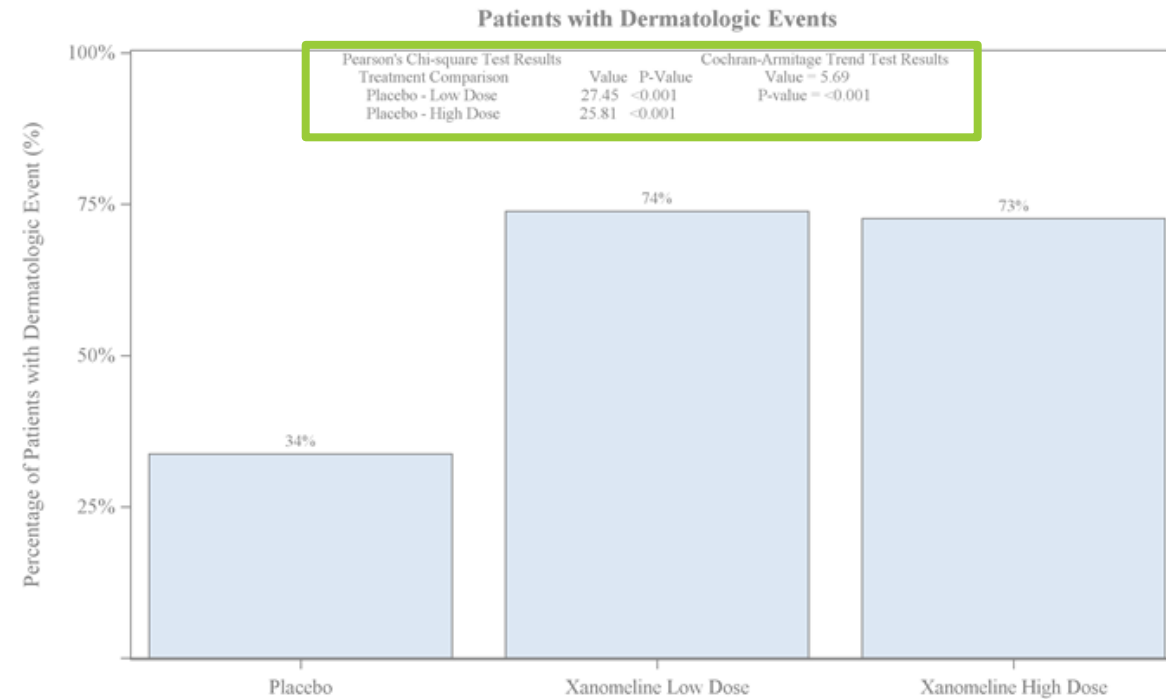
Step 3: Embedding a Table Using INSET

Using SGPLOT INSET

```
proc sgplot data = trtpct pad = (top = 5% bottom = 5%) sganno = insidetf;  
  format TRTAN trt. pct_row pctfmt.;  
  xaxis type = discrete label = " ";  
  yaxis type = linear label = "Percentage of Patients with Dermatologic Event (%)"  
    values = (0 to 100 by 25);  
  vbar TRTAN / response = pct_row  
    datalabel = pct_row;  
  
  inset "Pearson's Chi-square Test Results  
Cochran-Armitage Trend Test Results"  
    "      Treatment Comparison      Value    P-Value"  
Value = &cmstat"  
    "      Placebo - Low Dose      &valuechi054    &pchi054  
P-value = &cmpvalue"  
    "      Placebo - High Dose      &valuechi081    &pchi081"/  
  textattrs = (size = 8pt) position = top;  
  
run;  
ods rtf close;  
ods pdf close;
```

Bar Chart by Treatment for Percent of Patients with Dermatologic Event - 1c

Header



Subjects only counted once in each treatment group.

Footer

Inset Table Component Using DRAWTEXT

Step 3: Embedding a Table Using DRAWTEXT

Using GTL DRAWTEXT

```
proc template;  
  define statgraph recrgrphb;  
    begingraph / border = false;  
      entrytitle "Patients with Dermatologic Events";  
      entryfootnote halign = left "Subjects only counted once in each treatment group.";  
      layout overlay / xaxisopts = (label = " " type = discrete)  
        yaxisopts = (label = "Percentage of Patients with Dermatologic Event (%)"  
          linearopts = (tickvaluesequence = (start = 0 end = 100 increment = 25)  
            viewmax = 100));  
      barchart x = TRTAN y = pct_row / orient = vertical  
        barlabel = true;  
  
      /* drawtext statements */  
  
    endlayout;  
  endgraph;  
end;  
run;
```

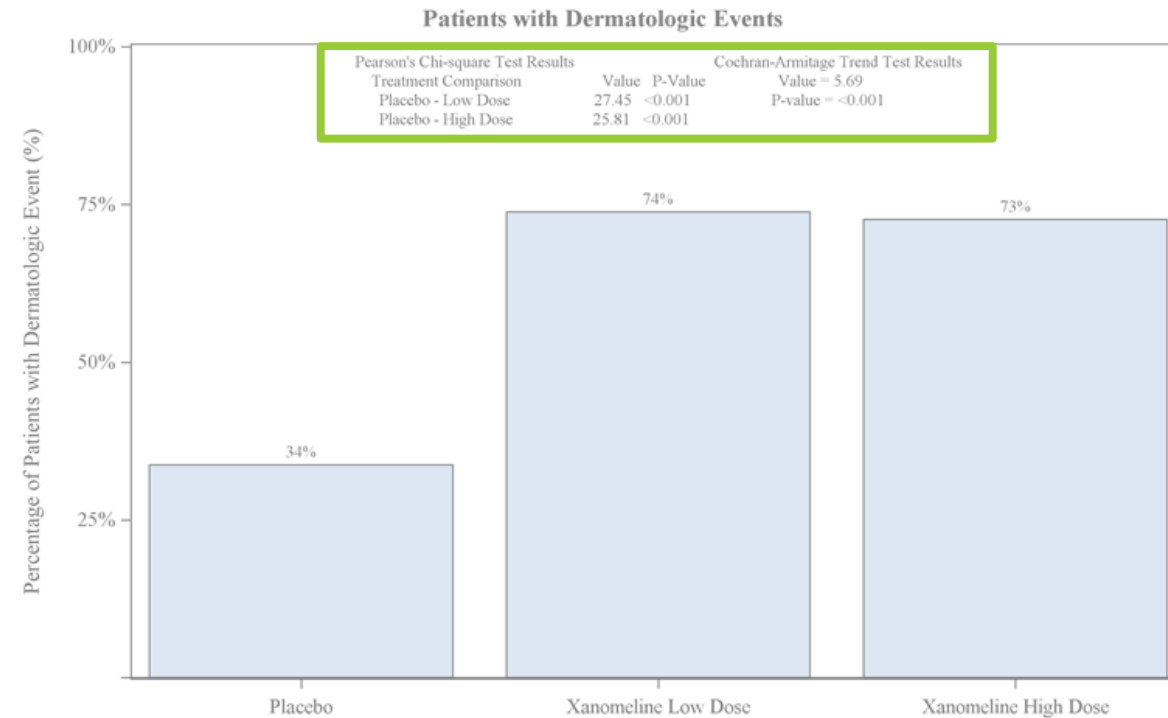
Using GTL DRAWTEXT

```
drawtext textattrs = (size = 8pt) "Pearson's Chi-square Test Results  
Cochran-Armitage Trend Test Results"  
    / x = 20 y = 99 width = 75 widthunit = percent  
    xspace = wallpercent yspace = datavalue anchor = left;  
  
drawtext textattrs = (size = 8pt) "    Treatment Comparison                Value    P-Value"  
Value = &cmstat"  
    / x = 20 y = 96 width = 75 widthunit = percent  
    xspace = wallpercent yspace = datavalue anchor = left;  
  
drawtext textattrs = (size = 8pt) "    Placebo - Low Dose                &valuechi054  
&pchi054                P-value = &cmpvalue"  
    / x = 20 y = 93 width = 75 widthunit = percent  
    xspace = wallpercent yspace = datavalue anchor = left;  
  
drawtext textattrs = (size = 8pt) "    Placebo - High Dose                &valuechi081    &pchi081"  
    / x = 20 y = 90 width = 75 widthunit = percent  
    xspace = wallpercent yspace = datavalue anchor = left;
```

Drawtext allows you to indicate exactly what you want displayed and where you want it displayed. You would need to specify the font size and the exact location in the graph of where the text is to be placed.

Bar Chart by Treatment for Percent of Patients with Dermatologic Event - 1c

Header



Subjects only counted once in each treatment group

Footer

SGPLOT - Inset Table Component Using INSET

Step 3: Embedding a Table Using GRIDDED

Using GTL GRIDDED Layout

```
proc template;  
  define statgraph recrqrbhb;  
    mvar valuechi054 pchi054 valuechi081 pchi081 cmstat cmpvalue;  
    begingraph / border = false;  
      entrytitle "Patients with Dermatologic Events";  
      entryfootnote halign = left "Subjects only counted once in each treatment group.";  
      layout overlay / xaxisopts = (label = " " type = discrete)  
        yaxisopts = (label = "Percentage of Patients with Dermatologic Event (%)")  
          linearopts = (tickvaluesequence = (start = 0 end = 100 increment = 25)  
            viewmax = 100));  
      barchart x = TRTAN y = pct_row / orient = vertical  
        barlabel = true;  
  
      /* GRIDDED layout */  
  
    endlayout;  
  endgraph;  
end;  
run;
```

Macro variables that are declared using MVAR will resolve to a string where macro variables declared with MVARN will convert to a numeric token. With MVAR(N) the macro variable is resolved at execution rather than a compile time.

Using GTL GRIDDED Layout

With GRIDDED layout you specify the number of columns or rows. Default is 1 if not specified.

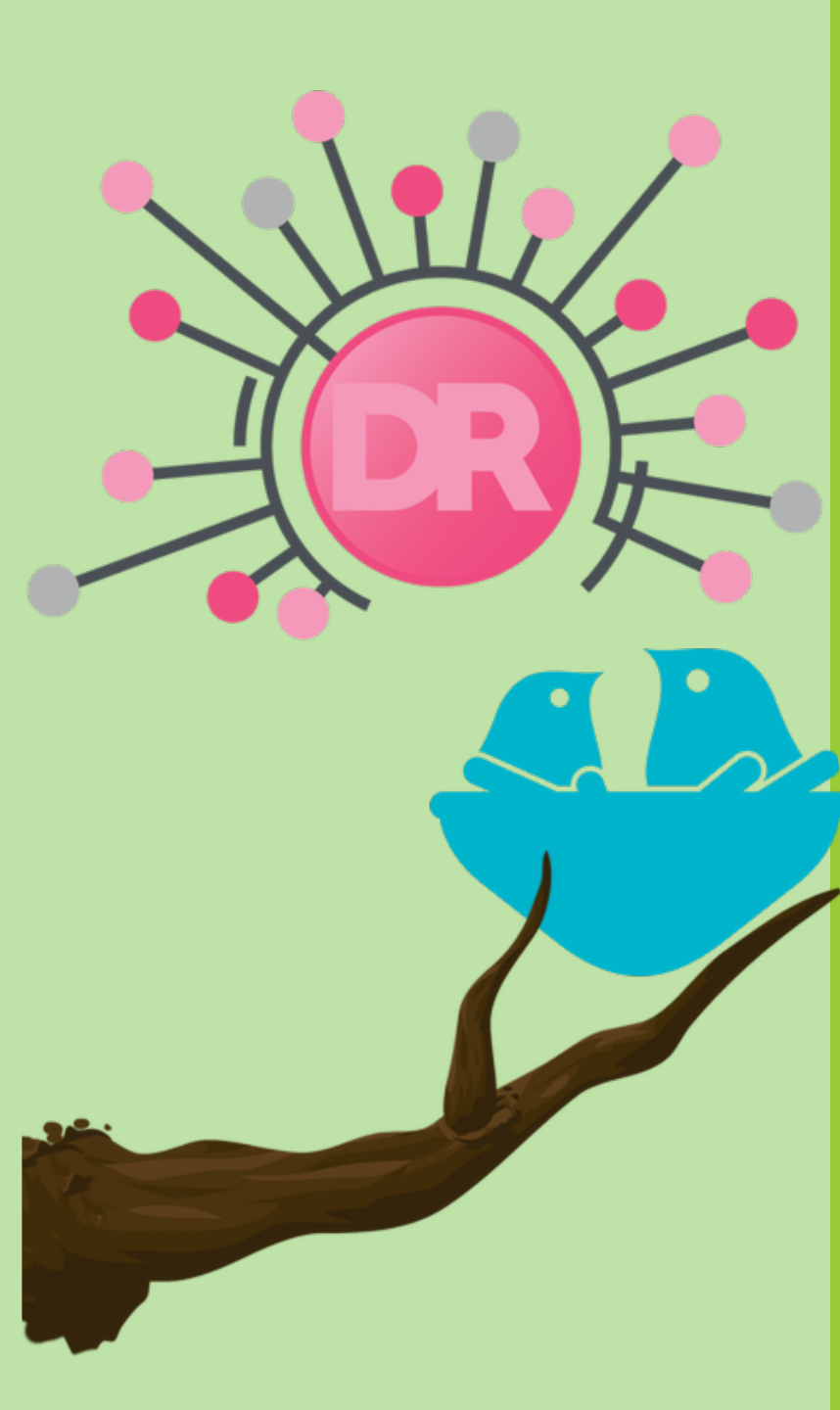
```
layout gridded / columns = 4
order = rowmajor
autoalign = (top);
entry "Pearson's Chi-square Test Results";
entry " ";
entry " ";
entry "Cochran-Armitage Trend Test Results";
entry "    Treatment Comparison";
entry "Value";
entry "P-value";
entry "    Value = " cmstat;
entry "    Placebo - Low Dose";
entry valuechi054;
entry pchi054;
entry "P-value = " cmpvalue;
entry "    Placebo - High Dose";
entry valuechi081;
entry pchi081;

endlayout;
```

Specify the order in which the grid is filled. ROWMAJOR fills each column before moving to next row.

If a specific cell in the table should be left null, then a blank entry line should be created.

Macro variables specified with MVAR(N) are referenced. Note they are referenced without & symbol.



Adding Table Outside of Graph

Bar Chart by Treatment for Percent of Patients with Dermatologic Event - 1e

Header

Patients with Dermatologic Events

Pearson's Chi-square Test Results

Treatment Comparison

Placebo - Low Dose

Placebo - High Dose

Value

27.45

25.81

P-value

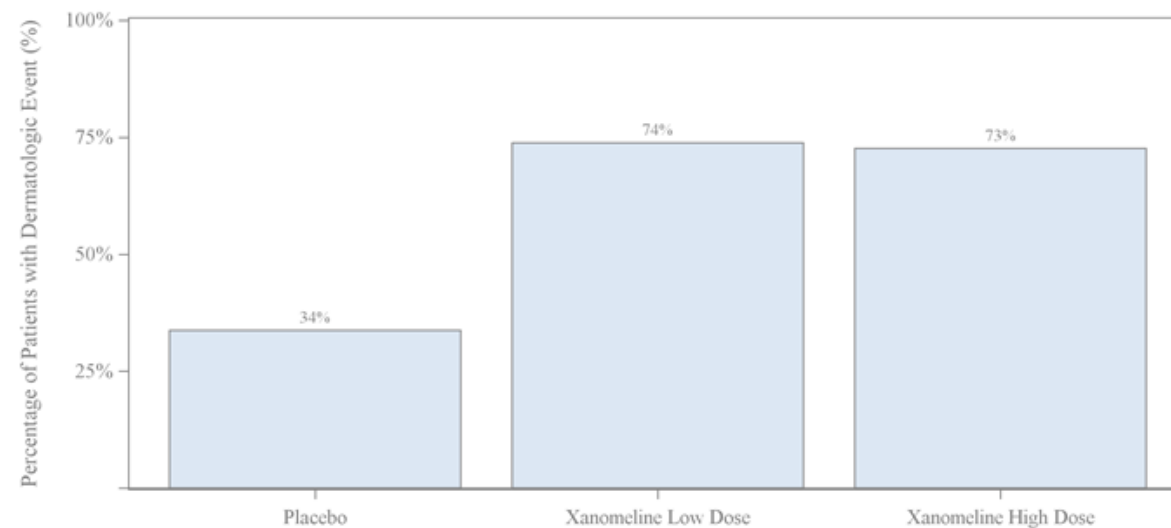
<0.001

<0.001

Cochran-Armitage Trend Test Results

Value = 5.69

P-value = <0.001



Subjects only counted once in each treatment group.

Footer

Inset Table Component Using GRIDDED

Step 4: Adding Table Outside Graph

Using GTL GRIDDED Layout with LATTICE

```
proc template;
  define statgraph recrgphb;
    mvar valuechi054 pchi054 valuechi081 pchi081 cmstat cmpvalue;
    begingraph / border = false;
      entrytitle "Patients with Dermatologic Events";
      entryfootnote halign = left "Subjects only counted once in each treatment group.";
      layout lattice / rows = 2 rowweights = (.2 .8);
      /* GRIDDED layout */

      layout overlay / xaxisopts = (label = " " type = discrete)
        yaxisopts = (label = "Percentage of Patients with Dermatologic Event (%)")
          linearopts = (tickvaluesequence = (start = 0 end = 100 increment = 25)
            viewmax = 100));
      barchart x = TRTAN y = pct_row / orient = vertical barlabel = true;
    endlayout;
  endlayout;
endgraph;
end;
run;
```

LATTICE allows you to split area into different sizes based on your needs. You can split into rows or columns or a combination of rows and columns.

Conclusion



What have we
learned?

SGPLOT vs. GTL

SGPLOT

Advantages:

- Simple syntax
- Ideal for simple graphs
- Inset table directly into graph

Disadvantages:

- Hard to embed titles and footnotes into graph
- Can't place a table outside of the graph

GTL

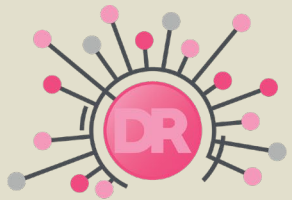
Advantages:

- Embed titles and footnotes into graph
- Ideal for complex graphs
- Different techniques to inset table directly into graph

Disadvantages:

- Complex syntax

Contact Information



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Nested Loop
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References and Recommended Reading

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https://documentation.sas.com/doc/en/pgmsascdc/9.4_3.5/grstatgraph/n0zp1mg0ard2dan17sohm8jb773n.htm

SAS Institute Inc. (2023, Jul 19). SGPLOT Procedure. Retrieved Dec 2023, from SAS® 9.4 and SAS® Viya® 3.5 Programming Documentation:

https://documentation.sas.com/doc/en/pgmsascdc/9.4_3.5/grstatproc/n0yjdd910dh59zn1toodgupaj4v9.htm

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<https://www.sas.com/content/dam/SAS/support/en/sas-global-forum-proceedings/2019/3170-2019.pdf>