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Fill Patterns to the Oncology Plots using SAS

Vikram Chanduri, Vita Data Sciences, Waltham, MA, USA
Mahesh Minnakanti, Vita Data Sciences, Waltham, MA, USA

ABSTRACT

In Oncology trials, it is very common to produce the plots with color coding based on grouping variables like Disease Responses using PROC SGPLOT. However, in some trials, there will be a requirement to use both fill patterns and color to distinguish between multiple group variables. Fill patterns can be applied to any plot using an option FILLPATTERN in SAS® v9.4M5 or later releases. However, there is no such option available in the previous versions of SAS. In this paper, we will present how one can generate the fill patterns and colors to the plots that are widely used in Oncology trials (e.g. Waterfall plots) using the power of PROC TEMPLATE and PROC SGPLOT in SAS versions before 9.4M5. We will also provide some examples of the plots that will help the end user in reviewing the results.

INTRODUCTION

It is very important in the Oncology trials to understand the change in the tumor diameter for each subject and Waterfall plot is the best way to visualize the change in tumor size for each subject. It is very common to produce the plots with color coding based on grouping variables like Disease Responses using SGPLOT procedure in SAS. However, based on the complexity of the trial, there will be a requirement to distinguish the plot based on multiple grouping variables. One way to represent the Waterfall plot when there are multiple grouping variables is to use fill patterns and colors.

FILLPATTERN option in SGPLOT procedure enables the display of fill patterns for the plot and FILLPATTERNATTRS option enables the fill color and pattern for the plot. But, the options FILLPATTERN and FILLPATTERNATTRS applies only to SAS® v9.4M5 or later releases. There are no such options available in the previous versions of SAS. In this paper, we will present how one can generate the fill patterns and colors to the plots using the power of PROC TEMPLATE and PROC SGPLOT in SAS versions before 9.4M5.

WATERFALL PLOT USING PROC SGPLOT

Waterfall plots are essentially a bar graph which represents the percentage or actual change of a tumor diameter from baseline and it will typically go from the worst value (greatest progression) to the best value (reduction of tumor). In this paper, we will present an example of a waterfall plot which consists of subjects having 3 types of cancer – Melanoma, Multiple Myeloma and Non-Small Cell Lung Cancer (NSCLC). The cancer types are identified by fill patterns and the disease responses are identified by colors.

SAS CODE FOR FILL PATTERNS:

Fill patterns help distinguish between different groups of data. Below is the PROC TEMPLATE code that generates fill patterns and colors to the waterfall plot. We have used FILLPATTERN style element attribute to add patterns to the bars generated with the SGPLOT procedure. Color attribute is used to specify the color of the bar based on the disease responses and CONTRASTCOLOR is used to specify the color of the pattern.

```
***PROC TEMPLATE code for Waterfall plots.
   Fill Patterns are defined using FILLPATTERN style element attribute**;

proc template;
   define style softrtf / store = SASUSER.TEMPLAT;
   parent = styles.printer;
       style GraphBar from GraphComponent /
          displayopts = "fillpattern";
       style GraphData1 from GraphData1 /
```

```
            fillpattern = "X5"
            color= red
            ContrastColor = white;
      style GraphData2 from GraphData2 /
            fillpattern = "R5"
            color= red
            ContrastColor = white;
      style GraphData3 from GraphData3 /
            fillpattern = "L5"
            color= red
            ContrastColor = white;
      style GraphData4 from GraphData4 /
            fillpattern = "L5"
            color= light blue
            ContrastColor = white;
      style GraphData5 from GraphData5 /
            fillpattern = "X5"
            color= light blue
            ContrastColor = white;
      style GraphData6 from GraphData6 /
            fillpattern = "R5"
            color= light blue
            ContrastColor = white;
      style GraphData7 from GraphData7 /
            fillpattern = "X5"
            color= green
            ContrastColor = white;
      style GraphData8 from GraphData8 /
            fillpattern = "X5"
            color= dark green
            ContrastColor = white;
      style GraphData9 from GraphData9 /
            fillpattern = "L5"
            color= dark green
            ContrastColor = white;
      end;
```

There may be cases where you may require many patterns and colors and the above code can be long. Below is the simplified code which counts the number of patterns and colors required, and then assigns the patterns and colors to the macro variables as shown in the SQL procedure below. 'R', 'L' and 'X' are the patterns used in this example. 'L' specifies left-slanting lines, 'R' specifies right-slanting lines, and 'X' specifies crosshatched lines. Density of the lines is specified by a number from 1 to 5. The number 1 produces the lightest shading and 5 produces the heaviest shading.

```
proc sql noprint;
  select count(distinct fingrp) into:numptrn trimmed from attr_ptrn ;
  select strip(fillpattern) into: pattr1 - :pattr&numptrn. from attr_ptrn;
  select strip(fillcolor) into: color1 - :color&numptrn. from attr_ptrn;
quit;

*** PROC TEMPLATE code for Waterfall plots **;
style GraphBar from GraphComponent /
   displayopts = "fillpattern";

       %do i=1 %to &numptrn.;
            style GraphData&i. from GraphData&i. /
                fillpattern = "&&pattr&i"
                color= &&color&i.
                ContrastColor = white;
       %end;
End;
```

fillcolor	ptmgrp	fillpattern	fingrp	Best_Response
red	Multiple Meloma	X1	Multiple Meloma - PD	Multiple Meloma - PD (N=10)
red	NSCLC	R1	NSCLC - PD	NSCLC - PD (N=9)
red	Melanoma	L1	Melanoma - PD	Melanoma - PD (N=10)
light blue	Melanoma	L1	Melanoma - SD	Melanoma - SD (N=9)
light blue	Multiple Meloma	X1	Multiple Meloma - SD	Multiple Meloma - SD (N=5)
light blue	NSCLC	R1	NSCLC - SD	NSCLC - SD (N=15)
green	Multiple Meloma	X1	Multiple Meloma - PR	Multiple Meloma - PR (N=1)
dark green	Multiple Meloma	X1	Multiple Meloma - CR	Multiple Meloma - CR (N=2)
dark green	Melanoma	L1	Melanoma - CR	Melanoma - CR (N=1)

Figure 1 Intermediate SAS Dataset - ATTR_PTRN

ATTR_PTRN is the intermediate dataset where we assign fill patterns and fill colors to the variables as shown in Fig. 1 below. The fill patterns and fill colors in the ATTR_PTRN dataset are assigned to the macro variables PATTR&i and COLOR&i.

SGPLOT PROCEDURE TO GENERATE WATERFALL CHART:

```
ods rtf file=<Path> style=softrtf nogtitle nogfootnote;

options replace formchar="|----|+|---+=|-/\<>*" missing=" ";
ods listing close;
ODS ESCAPECHAR ='~';

ods graphics on/ reset MAXLEGENDAREA=50 width=8in height=4in noborder;

proc Sgplot Data=wf_fin ;
vbar n /response=PCHG
        GROUP=Best_Response
        BARWIDTH=0.6
        dataskin=none name='c';

keylegend 'c' / location=outside position=bottom
title="Best Overall Response by Cancer Type:~n"  ;

refline 0.2 /axis=y
             legendlabel="20% increase"
             lineattrs=(color='orange' pattern=shortdash)
             name="d";
refline -0.3 /axis=y
             legendlabel="30% decrease"
             lineattrs=(color='black' pattern=shortdash)
             name="e" ;

keylegend 'd' 'e' / valueattrs=(size=9 )
                    location=inside
                    position=topright
                    down=10 noborder;

xaxis display=none;
Yaxis values=(-1 to -0.1 by 0.1   0 to 1 by 0.1)
valuesformat=percentn7.0 label="(%) Change";
run;

ods rtf close;
ods listing;
```

WATERFALL PLOT WITH FILL PATTERNS AND FILL COLORS:

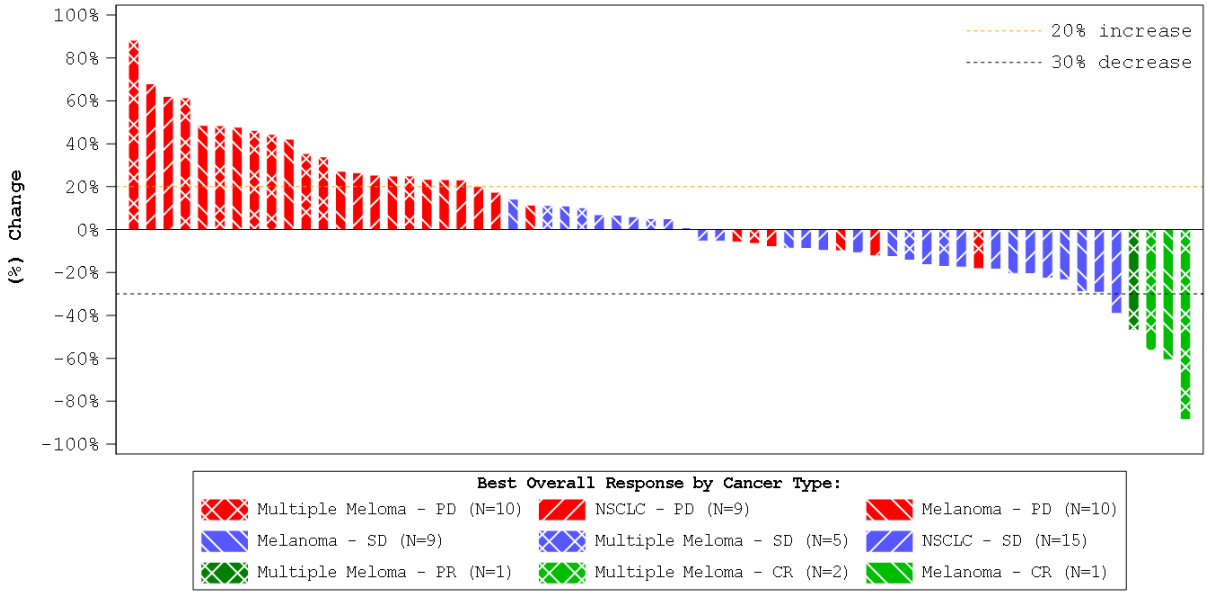

Figure 2 Waterfall plot with fill patterns and fill colors

PROC TEMPLATE and PROC SGPLOT code shown above are used to generate the above plot. The three cancer types are identified by Fill Patterns and the Disease responses are identified by Fill Color. Fill Pattern “X5” is assigned to Multiple Myeloma, “R5” is assigned to NSCLC and “L5” is assigned to Melanoma. Similarly, color red is assigned to PD (Progressive Disease), blue to SD (Stable Disease), green to PR (Partial Response), and dark green to CR (Complete Response).

CONCLUSION

The paper discussed how we can generate fill patterns and colors to the Waterfall plots by updating STYLE in TEMPLATE procedure using SAS versions before 9.4M5. In addition, the ability to create a centralized template and call it across logically related outputs will enable overall consistency in results.

REFERENCES

[1] Using Fill Patterns to Distinguish Categories of Data. (n.d.). Retrieved from http://support.sas.com/documentation/cdl/en/grstatproc/65235/HTML/default/viewer.htm#p0relmtk2s8ac9n13bnmicsgsmwu.htm

[2] Bar chart using fill patterns. (n.d.). Retrieved from http://support.sas.com/kb/45/663.html

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

Author Name: Vikram Chanduri
Company: Vita Data Sciences, a division of Softworld, Inc.
Address: 281 Winter St, Suite 100
City / Postcode: Waltham, MA - 02451
Work Phone: 781-833-0220
Email: vchanduri@vitadatasciences.com
Web: www.vitadatasciences.com

Author Name: Mahesh Minnakanti
Company: Vita Data Sciences, a division of Softworld, Inc.
Address: 281 Winter St, Suite 100
City / Postcode: Waltham, MA - 02451
Email: mminnakanti@vitadatasciences.com

Web: www.vitadatasciences.com