This paper will present several techniques to embed special characters and special symbols into SAS graphs. The special symbols can be Greek letters, mathematical symbols, subscription, superscription, underline and custom-designed symbols. The symbols can be created in the titles, footnotes, axis labels or on the graph area of a SAS graph. This presentation is prepared for an intermediate and advanced audience.

Key Words: Special Symbol, Special Character, SAS/Graph, NOTE-MOVE, Subscription, Superscription, Underline, Customized Font.

**Introduction:**

Very often, we need to create special characters or special symbols in a SAS output. If the SAS output is a listing or a table, it is not difficult to accomplish this. One simple practice is to map a special character to its Unicode and utilize SAS ODS to produce a RTF document. After that, the RTF file will automatically convert the Unicode into the corresponding special character or special symbol. There are several interesting papers discussing this SAS ODS/RTF technique [1, 2]. However, when the SAS output is a graph, for example a plot, a bar, or a pie chart etc., the SAS ODS/RTF method may not work. Alternative approaches are usually required.

In the following sections, we will demonstrate several tips to generate special symbols in a graph.

**Special Symbols:**

It is quite often that we need to use some special symbols, such as P-hat or X-bar in axis labels or in titles. To achieve this, we can utilize the SAS NOTE/MOVE function. An example to generate a P-hat in y-axis can be as following:

```plaintext
NOTE font=swiss move=(5,40)pct h=1.5  a=90 'P'  move=(-1, -1.4) "^" ;
```

This NOTE statement tells SAS to generate a ‘P’ at the (x, y) coordinate position (5, 40), then move back (-1, -1.4) unit and add a “^”. This will complete a P-hat in y-axis. A NOTE statement is usually employed together with another axis or title statement. At the end, we will present an integrated example of using NOTE statement and the techniques followed.

NOTE-MOVE statement is a very unique and useful statement. It can be used to perform some functions that can be done by SAS/Annotate, such as adding symbols or labels to a graph [3]. It can
also be utilized to draw underline or strikethrough as well as subscription and/or superscription \[4\]. The NOTE statement below will produce a $P_1$-hat symbol:

```
NOTE f=swiss m=(5,40)pct h=1.5 a=90 'P' m=(-1,-1.4) "^" m=(+1.5,-.5) h=.75 'l';
```

A statement like this:

```
footnote1 h=1 j=L " This is only an example." move=(-16,+0) "____" ;
```

will produce a footnote in a graph like this: **This is only an example.**

### Special Characters:

There are different methods to produce special characters, such as Greek letters or math symbols in a SAS graph. The usage of special graph fonts can be found from a SAS/Graph manual \[5\]. In the TITLE statement below, we use three different graph fonts to generate a graph title as: **SAS® Graph Example**

```
Title h=2 f=swissb "SAS" m=(+.5, +1) h=1.2 f=special "R"
   m=(+0, -1) h=2 f=swissb " Graph Example" m=(+1.5, +0) f=century "%sysfunc(byte(185))";
```

There are various fonts available in SAS system. SAS/Graph documents \[5\] have the list of all SAS fonts. To preview the fonts/symbols and its corresponding character codes, we can use the following code:

```
proc gfont name=greek nobuild height=4
   romcol=Blue romfont=swissb romht=3 showroman;
run; quit;
```

### Fonts Designed by User:

Occasionally, users may need some very unique symbols. Those symbols may not be provided by SAS Institution. In such situations, SAS procedure PROC GFONT can be used to build customized ‘fonts’ or symbols \[5, 6\]. A simple example of making a custom-designed font is shown below. This PROC GFONT will build a symbol of a circle with lower one-third filled with a specific color.

```
data myFont;
    input char $ seg x y lp $ ptype $ ;
datalines;
A 1 1 0 L V
A 1 0 0 L C
A 1 0 1 L V
A 1 . . L V
```

Integrated Example:

Finally, we will integrate the techniques introduced above to create a demonstration SAS graph. This sample code utilizes the four user-defined fonts (‘A’, ‘B’, ‘C’, ‘D’) built in the PROC GFONT illustration above. The output graph will be shown after the codes.

* 1) make-up a test dataset;
*** 3 time points, w/ 10 measures for each time point;
data test;
do t=1 to 3;
   do i=1 to 10; y=ranuni(0); age=ranuni(0)*100; output; end;
end;
run;
proc format;
   value tfmt 1="Q"  2="R"  3="QSR";
```sas
value AgeGrp 0-<25=1 25-<50=2 50-<75=3 75-100=4;
value $AgeLabl '1'='0-<25' '2'='25-<50' '3'='50-<75' '4'='75-100';
run;
data test;
set test;
AgeGrp=put(age,AgeGrp.);
run;

* 2) specify the axises and graph symbols;
goptions reset=all;
axis1 label=(h=1 pct ' ') value=(h=2 f=marker) offset=(5, 5) minor=none;
axis2 label=(a=90 h=7 pct ' ') minor=none;
axis3 label=none value=none major=none minor=none;
symbol1 v=none i=std2mj c=blue l=1; *** 2 std errors;
symbol2 v='A' f=myFonts h=.8 c=green;
symbol3 v='B' f=myFonts h=.8 c=blue;
symbol4 v='C' f=myFonts h=.8 c=purple;
symbol5 v='D' f=myFonts h=.8 c=black;
legend1 position=(center bottom outside) mode=protect
   label=('Age Group:' f=swissb) value=(f=swissb) offset=(0, -.8);

* 3) plot the graph;
proc gplot data=test;
plot y*t / haxis=axis1 vaxis=axis2;
plot2 y*t=AgeGrp / vaxis=axis3 legend=legend1;
format t tfmt3. AgeGrp $AgeLabl10.;
*** Y-axis: \( \hat{\beta}_i (\mu \pm 2\sigma) \);
*** Be sure to have the +/- in the m-vectors;
note f=swiss m=(5,40)pt h=1.5 a=90 'P' m=(-1,-1.4) '^' m=(+1.5,-.5) h=.75 '1'
   m=(-1.5, +.5) h=1.5 f=greek ' (m' f=math 'G' f=greek '2s' f=swiss ');
*** a title: SAS® Graph Example1;
title1 h=2 f=swissb "SAS" m=(+,.5, +1) h=1.2 f=special "R"
   m=(+0, -1) h=2 f=swissb " Graph Example" m=(+.5,+0) f=century
   "%sysfunc(byte(185))";
*** a footnote: This is only an example. ;
footnote1 h=1 j=L f=special " O" f=swiss " This is only an example." move=(-13,+0) "____" ;
footnote2 h=1 " ";
run; quit;
```
Conclusion:

Special characters and special symbols can be created on SAS graphs via various techniques. In addition to the fonts and symbols provided by SAS Institute, users can create self-designed symbols with PROC GFONT. With some enhanced fonts and selective symbols on a graph, SAS reports can be more customized and more self-explained.

References:


4. Lori D. Griffin; Graphing: Taking the Mystery out of Subscripts and Superscripts, SUGI 22, http://www2.sas.com/proceedings/sugi22/INFOVIS/PAPER172.PDF

5. SAS Manuals on SAS Graph Fonts; http://www2.stat.unibo.it/ManualiSas/gref/c06.pdf


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