

Leveraging Visualization Techniques to tell my data story: Survival Analysis Interpretation made easy through simple programming

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Abstract:

This presentation is targeted to focus on new and customizable key features of PROC LIFETEST with in SAS/STAT package from version SAS 9.2. Especially these features support in generating the survival plot with number of subjects at risk, multiple comparisons of survival curves, hall wellner confidence bands, individual vs group plots, panel plots and many more features, which can be easily be adopted in programming with no annotation techniques. The objective of this paper is to help support the end user to get acquainted to very simple options available at their disposal, to help alleviate their programming effort which is a daunting task. We will have many graphical presentation scenarios shared with the user, incorporating these techniques and options, which will make the programmer's and clinical analyst job simple and easy.

Introduction:

Survival analysis is generally defined as a set of methods for analyzing data where the outcome variable is the time until the occurrence of an event of interest. The event can be death, occurrence of a disease, marriage, divorce, etc. The time to event or survival time can be measured in days, weeks, years, etc. For example, if the event of interest is heart attack, then the survival time can be the time in years until a person develops a heart attack.

Observations are called censored when the information about their survival time is incomplete; the most commonly encountered form is right censoring. Suppose patients are followed in a study for 20 weeks. A patient who does not experience the event of interest for the duration of the study is said to be right censored. The survival time for this person is considered to be at least as long as the duration of the study. Another example of right censoring is when a person drops out of the study before the end of the study observation time and did not experience the event. This person's survival time is said to be censored, since we know that the event of interest did not happen while this person was under observation. Censoring is an important issue in survival analysis, representing a particular type of missing data.

For simple analyses, only the PROC LIFETEST and TIME statements are required. Consider a sample of survival data. Suppose that the time variable is t and the censoring variable is c with value 0 indicating censored observations. The following statement below used to generate figure 1, computes the product-limit estimate for the sample. You can use the STRATA statement to divide the data into various strata. A separate survivor function is then estimated for each stratum is produced.

This example highlights are referred from SAS support, illustrates new features of PROC LIFETEST for SAS 9.2, especially the survival plot with number of subjects at risk and multiple comparisons of survival curves.

Below is the snapshot of the data used for generating the plots:

	Group	Disease Free Time	Status
1	ALL	2081	0
2	ALL	1602	0
3	ALL	1496	0
4	ALL	1462	0
5	ALL	1433	0
6	ALL	1377	0
7	ALL	1330	0
8	ALL	996	0
9	ALL	226	0

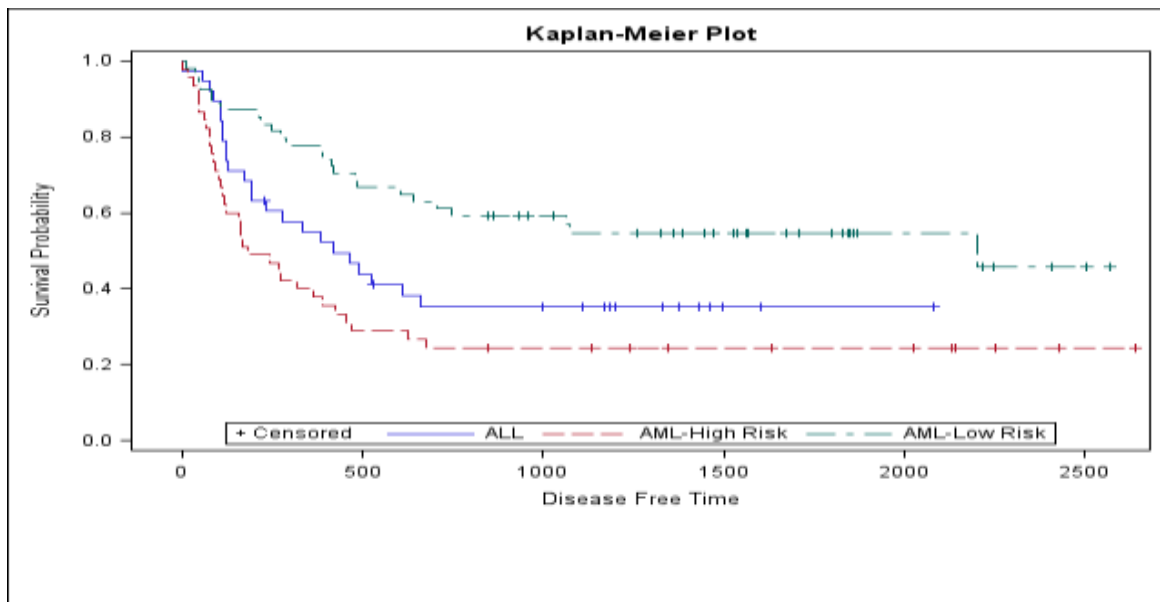
Use of various plot options to generate KM plots:

Various examples are been illustrated by using various plot options which are been incorporated new into this procedure. We will incorporate few of these options into the PROC LIFETEST to illustrate their functionality

The below code generates a default view of KM plots one for each of the patient groups defined in the as the strata. The output from the below code is been displayed in Figure 1.

```
ods graphics on;  
proc lifetest data=BMT ;  
time T * Status(0);  
strata Group;  
run;  
ods graphics off;
```

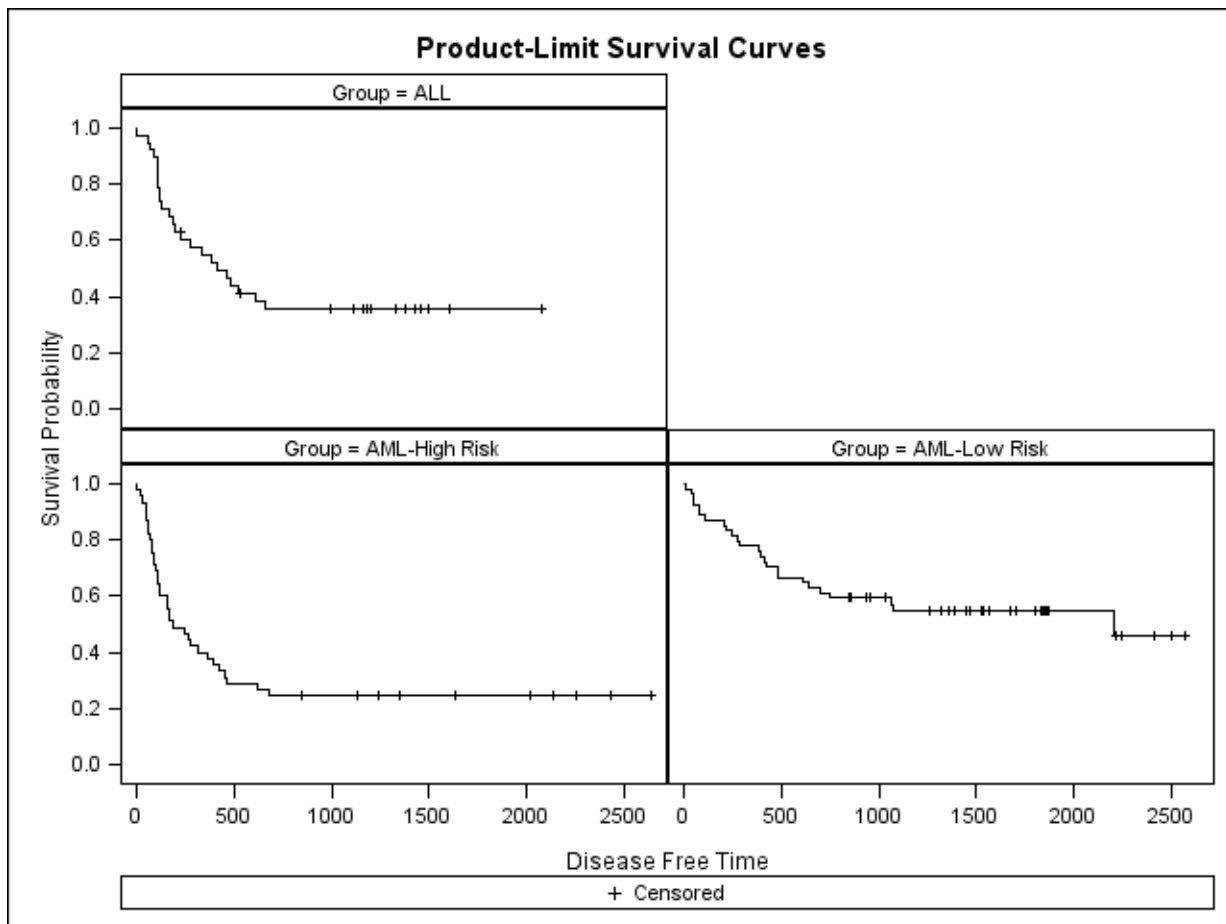
Figure 1: Default view of Kaplan Meier plot



The PLOTS= option enables to control some details of the graphs. STRATA= PANEL option allows to display the results in separate panels of each individual patient group defined in the dataset as highlighted. The output from the below code is been displayed in Figure 2.

```
ods graphics on;
proc lifetest data=BMT plots=survival(strata=panel);
time T * Status(0);
strata Group;
run;
ods graphics off;
```

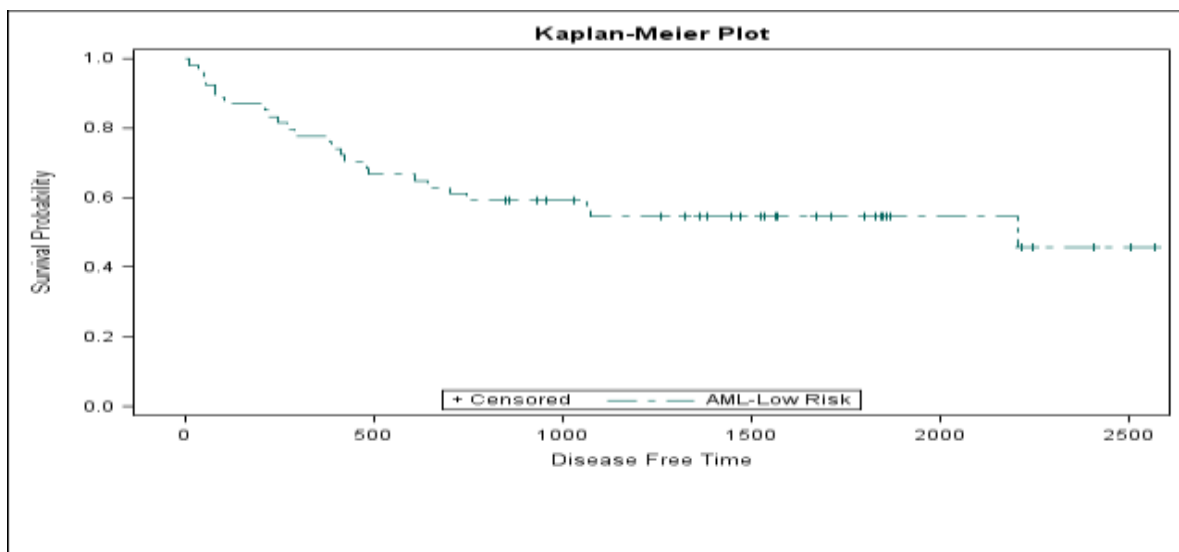
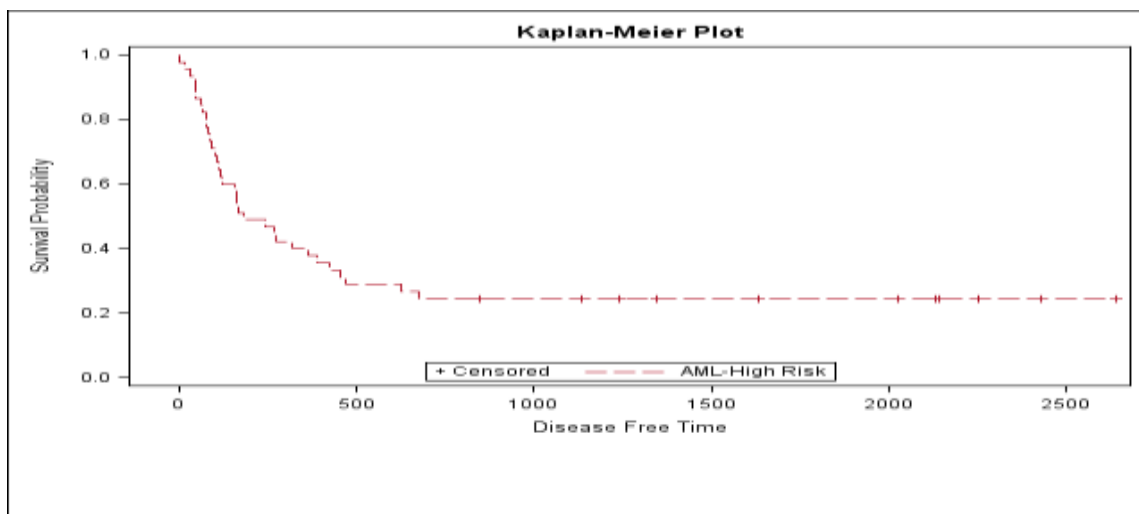
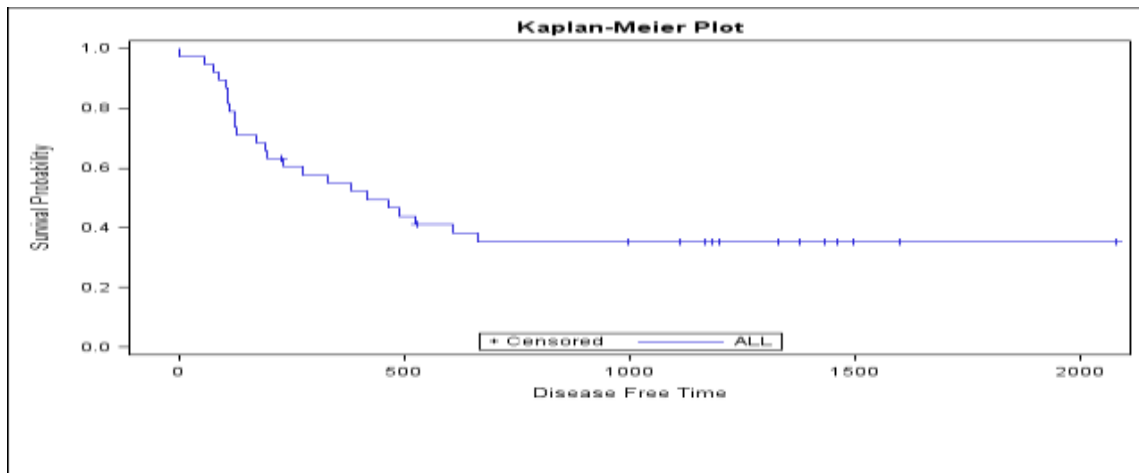
Figure 2: Kaplan Meier plot using STRATA= PANEL in the PLOTS= option



STRATA= UNPACKED option allows to display the results in separate plot of each patient group defined in the dataset as highlighted. The output from the below code is been displayed in Figure 3.

```
ods graphics on;
proc lifetest data=BMT plots=survival(strata=unpacked);
time T * Status(0);
strata Group;
run;
ods graphics off;
```

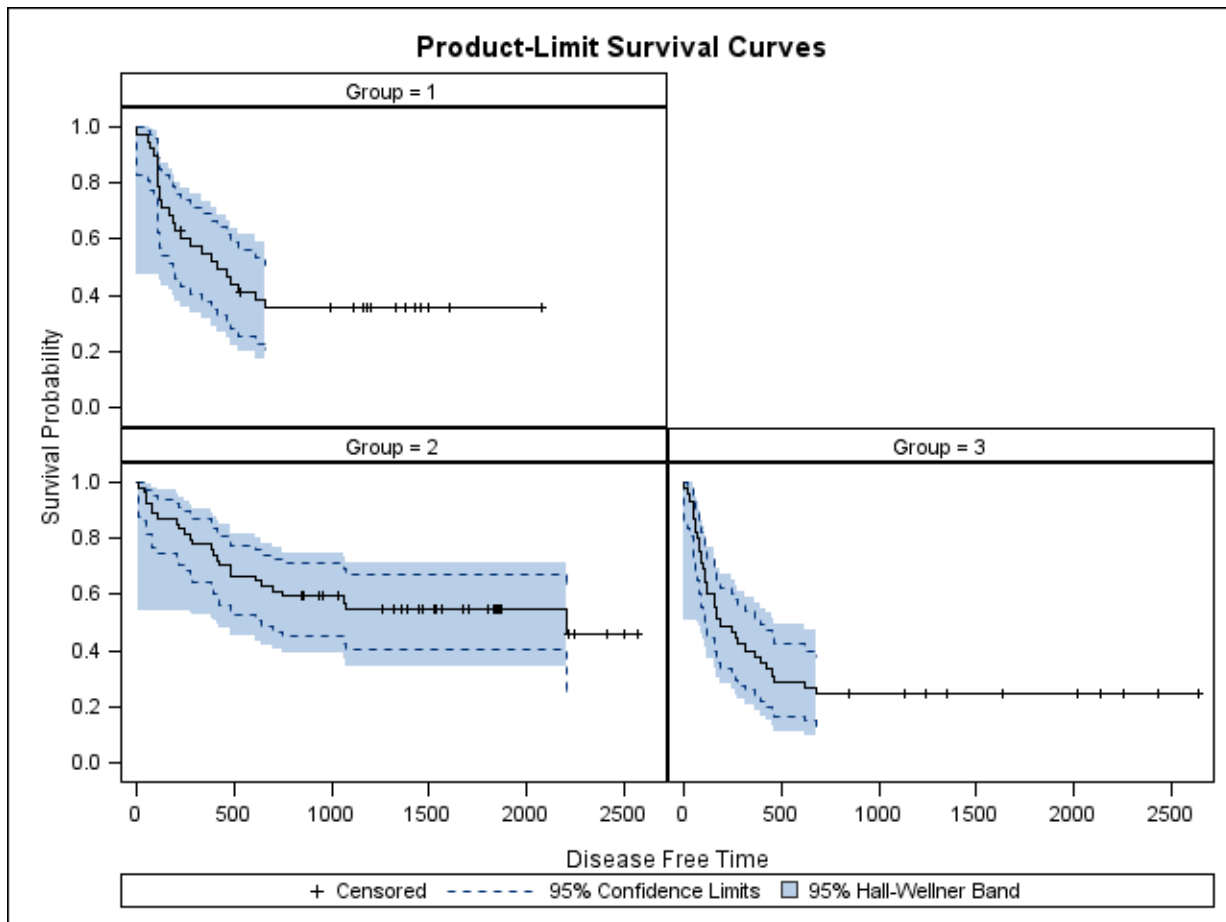
Figure 3: Kaplan Meier plot using STRATA=UNPACKED in the PLOTS= option



In the following statements, the PLOTS= specification requests that the survivor functions be displayed along with their point wise confidence limits (CL) and Hall-Wellner confidence bands (CB=HW). The STRATA= PANEL specification requests that the survival curves be displayed in a panel of three plots, one for each patient group. The output from the below code is been displayed in Figure 4.

```
ods graphics on;
proc lifetest data=BMT plots=survival(cl cb=hw strata=panel);
time T * Status(0);
strata Group;
run;
ods graphics off;
```

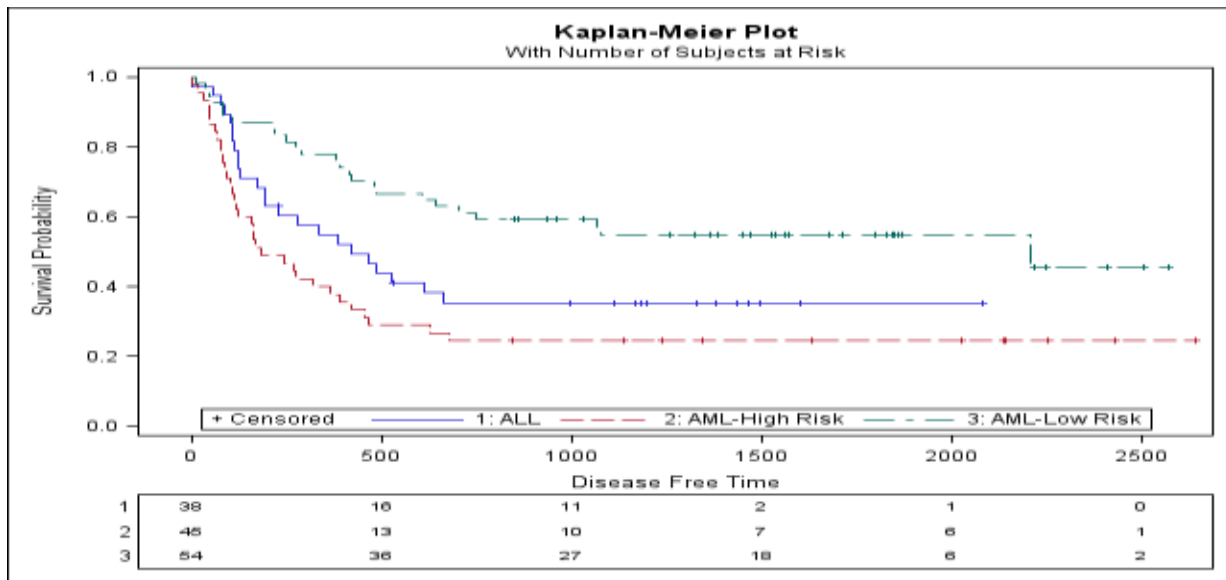
Figure 4: Kaplan Meier plot using STRATA= PANEL with CI and CB=HW in the PLOTS= option



In the following statements, the PLOTS= specification requests at risk subjects for each of the patients groups across the time duration. The output from the below code is been displayed in Figure 5.

```
ods graphics on;
proc lifetest data=BMT plots=survival(atrisk);
time T * Status(0);
strata Group;
run;
ods graphics off;
```

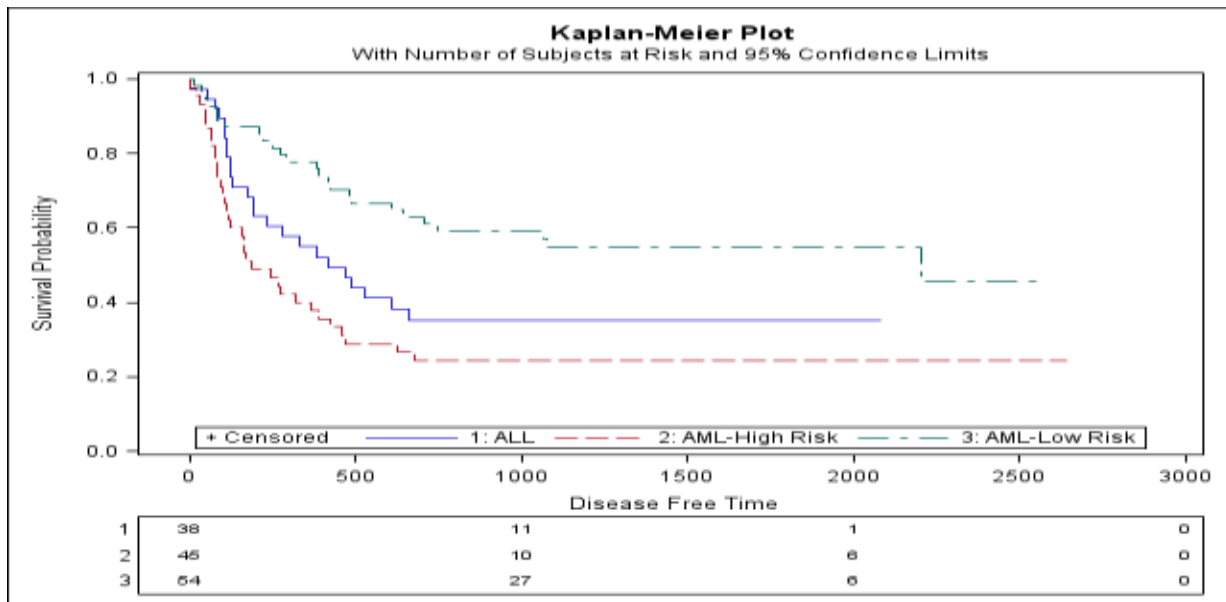
Figure 5: Kaplan Meier plot using ATRISK in the PLOTS= option



In the following statements, the PLOTS= specification requests no censored subjects be displayed for each of the patients groups across the time duration. The output from the below code is been displayed in Figure 6.

```
ods graphics on;
proc lifetest data=BMT1 plots=survival(nocensor atrisk);
time T * Status(0);
strata Group;
run;
ods graphics off;
```

Figure 6: Kaplan Meier plot using NOCENSOR in the PLOTS= option



Conclusion:

As illustrated there are many methods of presentation of data using plot options supported with in PROC LIFETEST survival plots. Will recommend the user to refer to the SAS support documentation page of this procedure to evolve their knowledge of many options and how they can apply to specific reporting needs. With the leverage of ODS Graphics statement made these survival plots easy to be reported.

References:

- SAS/STAT(R) 9.22 User's Guide: Enhanced Survival Plot and Multiple-Comparison Adjustments
- Warren F. Kuhfeld and Ying So "Creating and Customizing the Kaplan-Meier Survival Plot in PROC LIFETEST"

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