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Spotfire® Clinical Visualizations from SAS® and R®

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ABSTRACT

Data visualization is an innovative way to help our business decision-making process more intuitive and efficient. With this emphasis in mind, our project focuses on the interactive capabilities of the popular visualization tools: Spotfire®, SAS® and R. By using all these software together, we are able to create on-demand interactive visualizations including Kaplan Meier, waterfall, and forest plots to present subgroup efficacy analyses. Exploratory analyses can be viewed before they are formalized, therefore minimal adhoc TFLs are needed, which is cost saving.

INTRODUCTION

Spotfire® is a very powerful data analytics tool. Not only does Spotfire enable us to create various analyses using its robust visualization layout, it also is surprisingly user-friendly. Its intuitive user interface, potent visualization prowess, and quick subgroup filters make it an indispensable tool to the optimization of drug development. This visualization software is widely used to review clinical trial safety data.

Using the safety template in Spotfire, we can output the preassigned visualizations and graphs based on standard input datasets. Its intuitive user interface makes it easy to quickly analyze and visualize data. Additionally, we can share and distribute the interactive visualizations within and outside the organization through Spotfire Web Player, a web browser-based application that can be used inside a portal or a web site. These powerful features encourage collaboration, and increase interactivity and deployment of data visualization.

However, the safety template is not enough; we also need to conduct efficacy analyses, such as Kaplan Meier plots and forest plots. In the past, we could only present screenshots on the Kaplan Meier and forest plots in data review meetings. Such statistical tests and visualizations that Spotfire does not currently support can easily be done in SAS® and R®.

METHODS

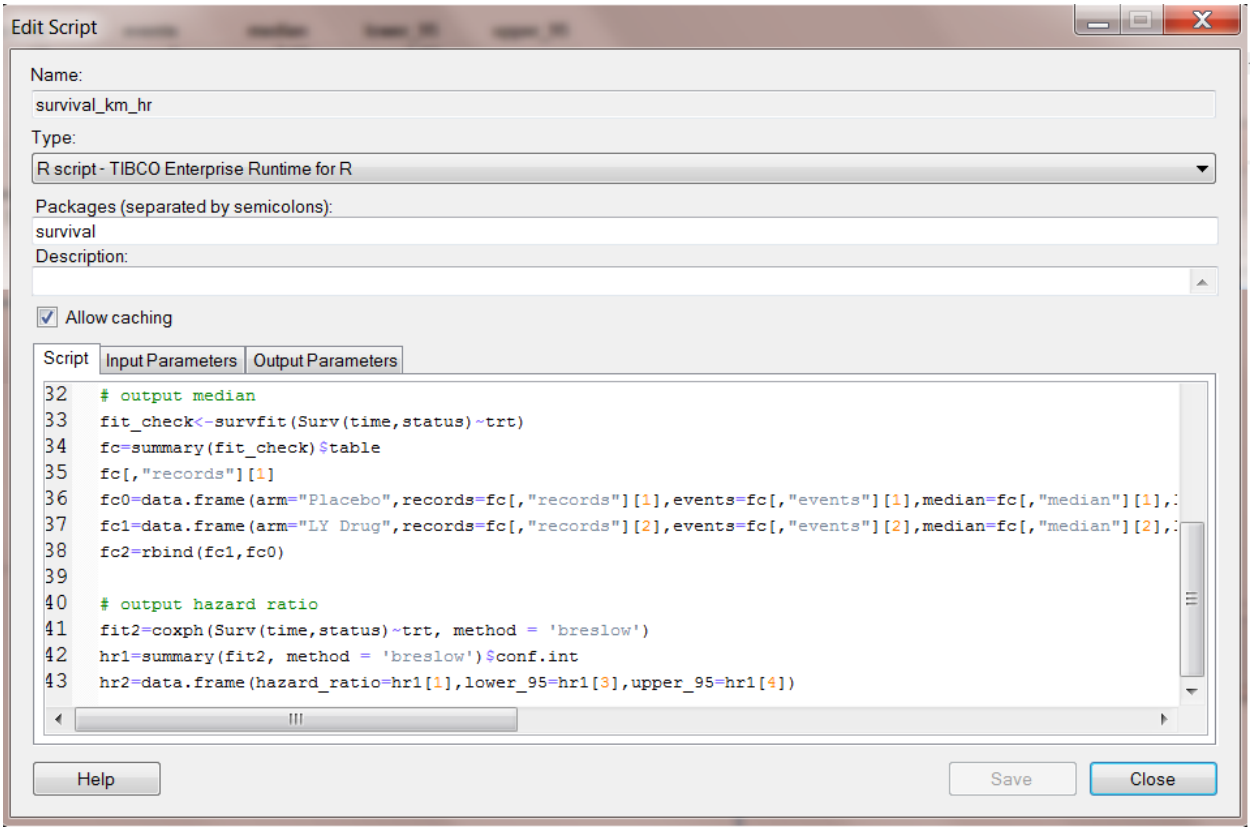
SAS datasets can be directly imported to Spotfire and linked with safety/efficacy datasets. That enables us to create visualizations such as forest plot based on the SAS generated datasets. In addition, Spotfire is equipped with TERR, Tibco Enterprise Runtime for R, which allows Spotfire to access and run the R application within its own interface. Using this feature, we are able to create Kaplan Meier plots, as well as a table of median survival time and hazard ratios. To do this, we first installed the necessary R packages in the TERR console. By registering the data function, we developed R code and generated datasets corresponding to the survival analyses we need. Finally, a Spotfire line plot is used to display the Kaplan Meier curves. By doing this, we are able to execute R scripts in Spotfire and create dynamic and interactive visualizations for subgroup analyses by utilizing Spotfire's filters.

EXAMPLES

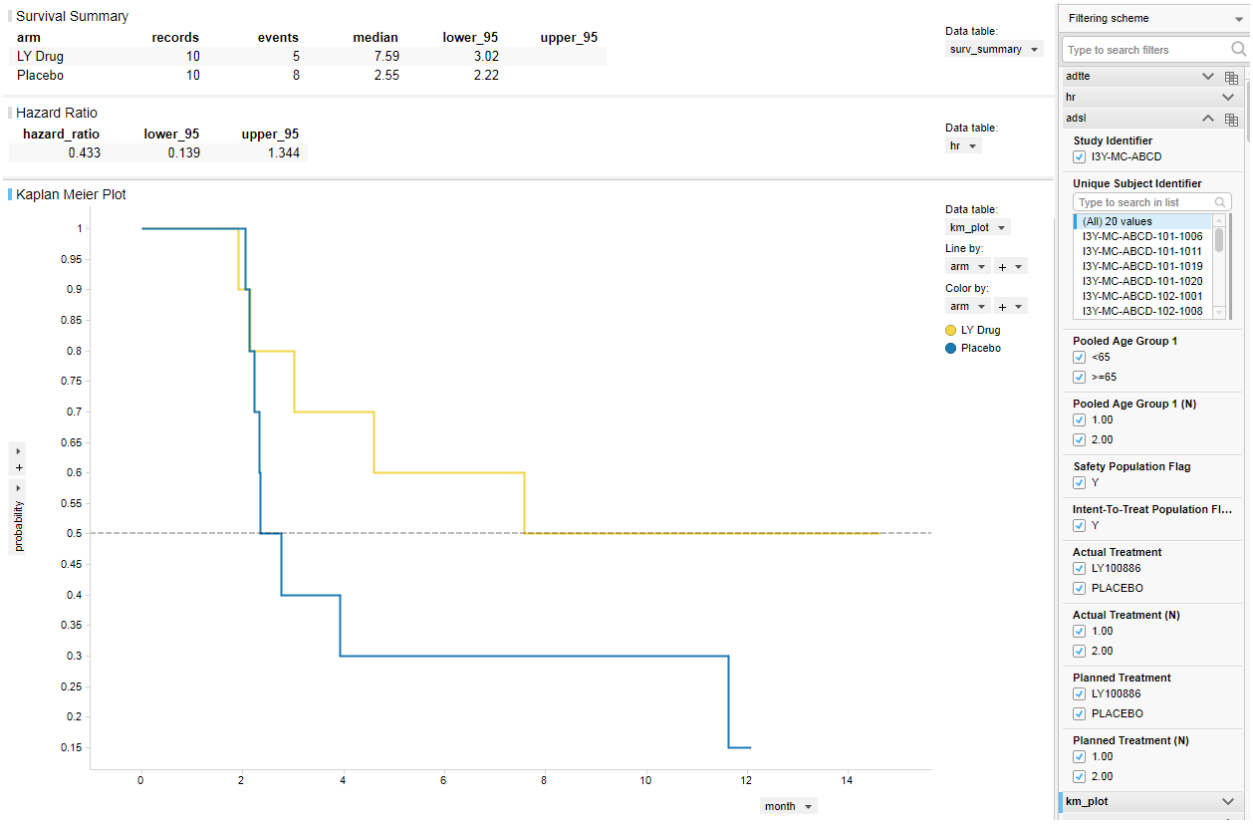
The following examples illustrate how to combine SAS/R with Spotfire to develop visualizations. All of the plots are created from fake data.

KAPLAN MEIER PLOT

Below is the window in Spotfire where we can insert R code. The output tables fc2 and hr2 are the tables we use to display the median, hazard ratio, and Kaplan Meier plots. Here is the plot. The filters on the right side can be selected to see any subgroups listed in the dataset.

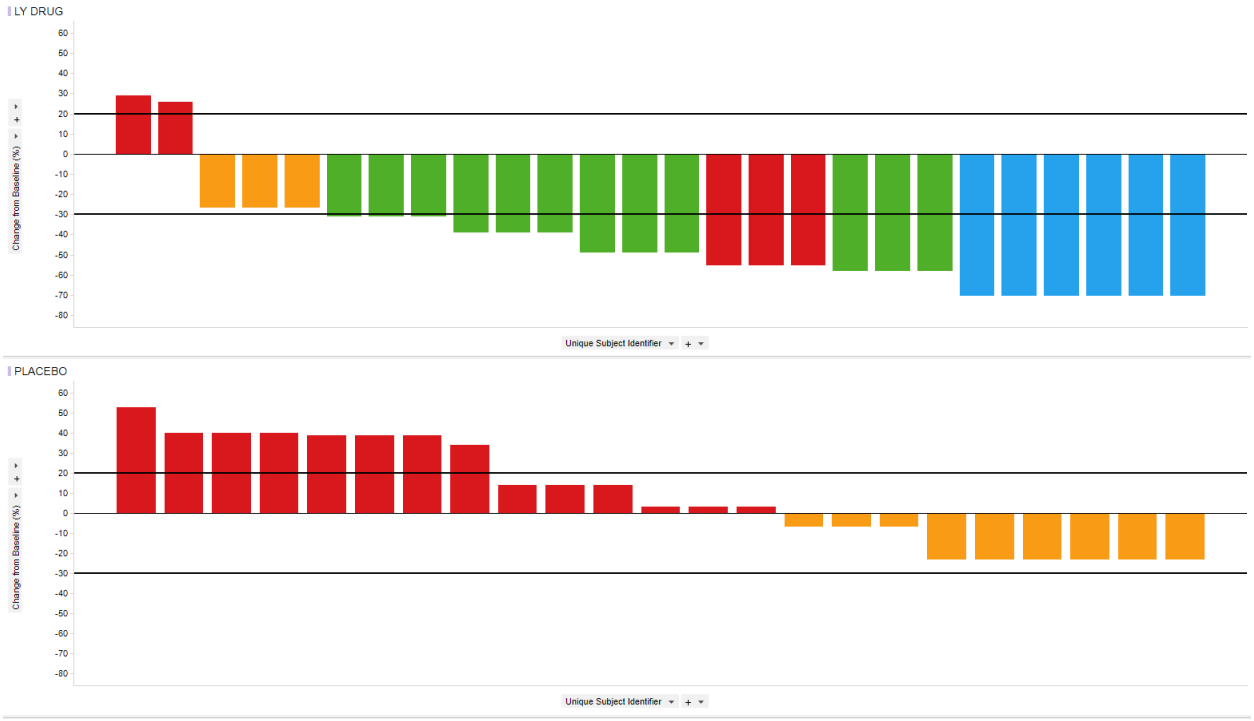


Here is the Kaplan Meier plot with filters.



WATERFALL PLOT

Below is the waterfall plot by starting from bar chart in Spotfire. We loaded ADTR that was programmed in SAS, selected best change from baseline (%) to be y-axis, and unique subject identifier to be x-aixs. Two reference lines are added to indicate tumors that decreased by 30% and grew by 20% or more.

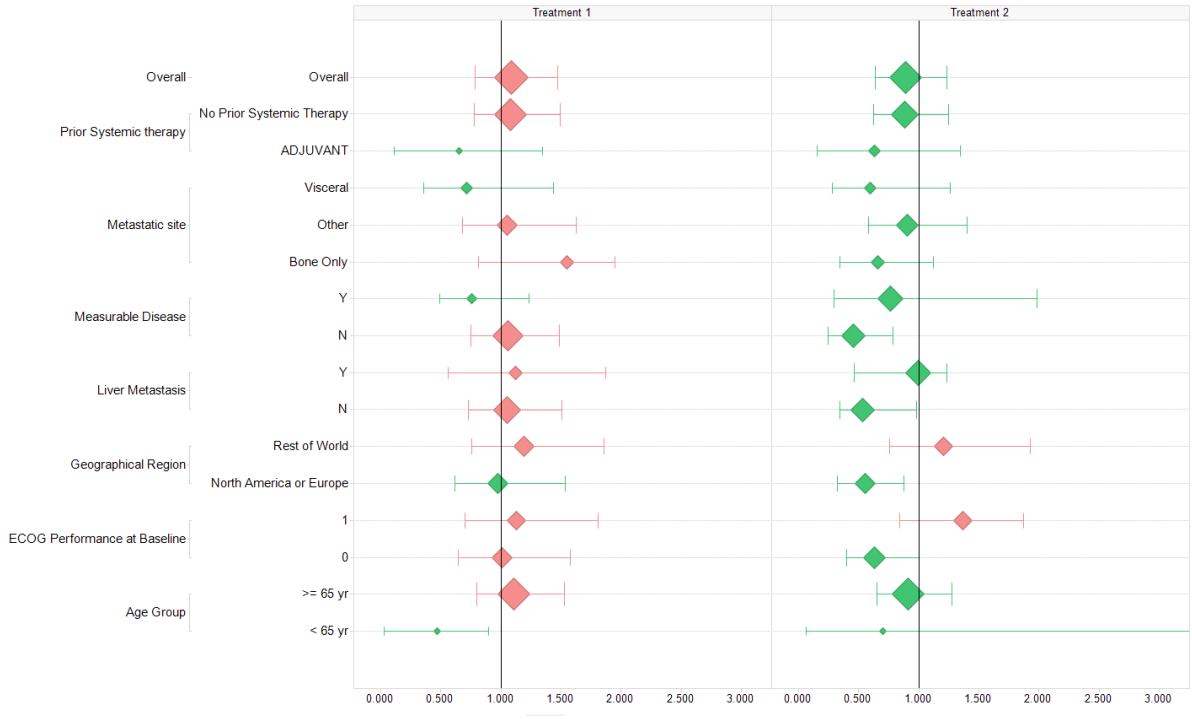


FOREST PLOT

In Oncology, forest plot is one of the most common plots in subgroup analyses. Hazard ratio on the subgroups of interest will be displayed with its confidence interval. We first used SAS to run the Cox proportional hazards models and created a dataset for the forest plot. Below is the example SAS code for one subgroup.

```
PROC PHREG DATA= subgrp1;
CLASS subgrp1;
MODEL AVAL*CNSR(1)=TRT| subgrp1 / ties=exact alpha=0.05 rl;
HAZARDRATIO 'H1' TRT;
ods listing close;
ods output
ParameterEstimates=subgrp1_Para
HAZARDRATIOs=subgrp1_haza
ModelANOVA=subgrp1_t3;
RUN;
ods listing;
```

Here is the output of the forest plot in Spotfire. If the hazard ratio is less than or equal to 1, the color is green; otherwise the color is red. By moving the mouse to each diamond, the number of patients and hazard ratio for that specific subgroup will be shown. By clicking on the diamond, other visualizations will only contain the patients in the selected subgroup from this forest plot.



CONCLUSION

Spotfire enables us to create on-demand interactive plots using templates, which can improve team engagement during data review meetings that leads to faster business decisions. SAS and R allow us to compute the relevant statistical tests to display alongside the visualizations. With this interactive visualization, we are able to minimize exploratory adhoc TFLs and save tremendous time and money.

REFERENCES

SAS/STAT® 14.3 User's Guide: The PHREG Procedure

Eisenhauer EA, Therasse P, Bogaerts J, et al: New response evaluation criteria in solid tumours: Revised RECIST guideline (version 1.1). Eur J Cancer 45:228-247, 2009

CONTACT INFORMATION

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