

## Role of SDAC in Clinical Trials

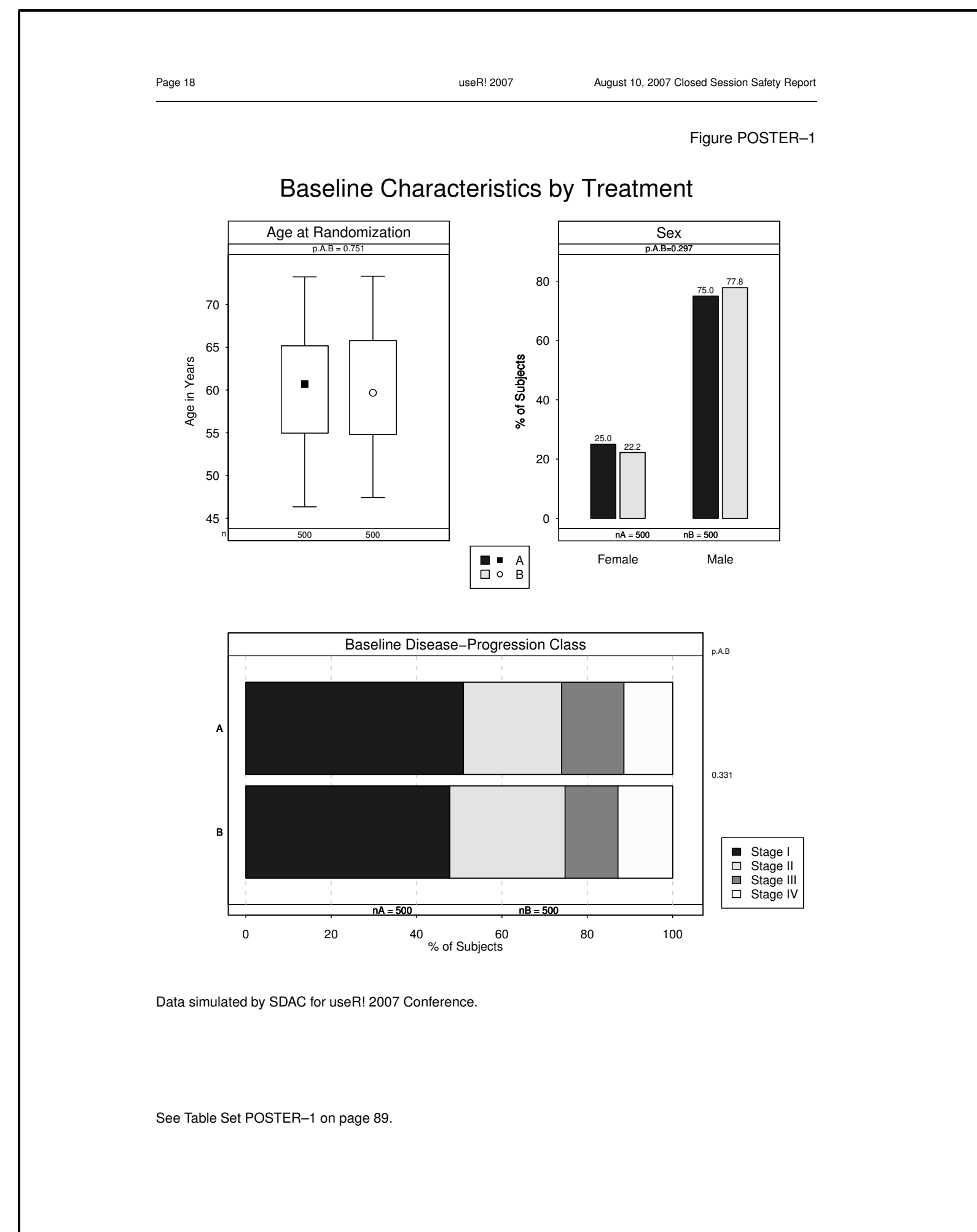
The Statistical Data Analysis Center (SDAC) at the University of Wisconsin performs interim analyses of evolving clinical trial data for review by independent data monitoring committees (DMCs). During the course of a clinical trial utilizing independent data monitoring, we produce reports for review by the group of experts making up the DMC—typically physicians with expertise in the research area of the clinical trial, and one or two statisticians.

Since a primary purpose of interim data monitoring is to ensure the safety of the subjects in the trial, these reports must necessarily present a large amount of information in a manner that facilitates rapid review. In contrast to the typical interim monitoring reports dominated by tables and listings, SDAC produces graphics-intensive reports with supporting tables and listings located after the main material.

The capabilities of R to produce high-quality customized graphics and integrate easily with other software tools enable us to produce interim monitoring reports with a high level of automation. We currently use and continue to develop an R package based on the traditional R `graphics` package, in conjunction with the SAS® System and freely available Unix tools such as L<sup>A</sup>T<sub>E</sub>X to produce our reports.

## Sample Report Page

The following panel shows a typical example of a page produced using the graphics output by our R package and included in a report with L<sup>A</sup>T<sub>E</sub>X.



## Data Processing

Clinical trial data are received by SDAC from the trial sponsor and other entities. Traditionally, SDAC has received data in the form of SAS datasets.

First, SAS and R are used to investigate data consistency and to create analysis datasets.

SDAC has developed a SAS macro, called IMPACT2, that takes as input an analysis dataset, and outputs a text file of summary statistics and variable documentation.

## The SLOTS Package

SLOTS (Simple PLOTting System) is an R package developed by SDAC to produce high-quality graphics for inclusion in clinical trial reports. Initially, SLOTS was designed to mimic the results of a previous package we developed using S-Plus; SLOTS has significantly expanded and improved upon our original effort.

## Role of SLOTS

Once data processing is complete, SLOTS is used to produce "pages" of graphical output.

- SLOTS uses the IMPACT2 output as its input.
- The output graphics are included by L<sup>A</sup>T<sub>E</sub>X in a page, complete with titles, captions, and cross-references.

## Example of a SLOTS Call

Since the concept of a "page" is central to how SDAC uses the SLOTS package, it was designed so that a single function call could produce multiple plots to be included on a single report page. Here is a typical SLOTS function call, which produced the page to the left:

```
splots(vars = list("AGE", "SEX", "DCLASS"),
       horz = list(FALSE, FALSE, TRUE),
       ylab = list("Age in Years", NULL, NULL),
       ttl = "Baseline Characteristics by Treatment",
       type = list(NULL, NULL, "sb")
)
```

Appropriate graphics for the variables AGE, SEX, and DCLASS will be produced based on the class of each variable. There are dozens of parameters available to users of the SLOTS package that can control almost every aspect of the plots produced.

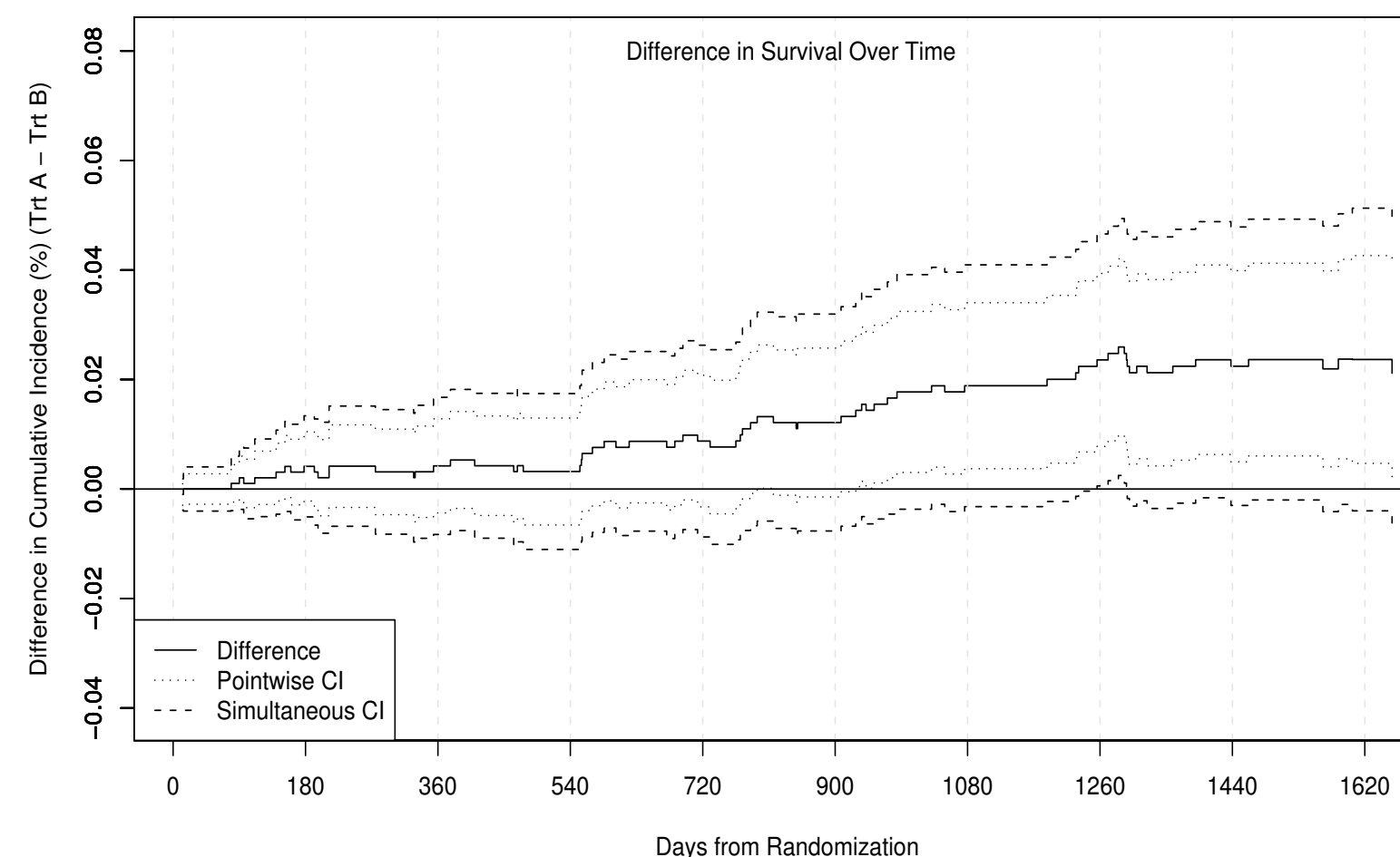
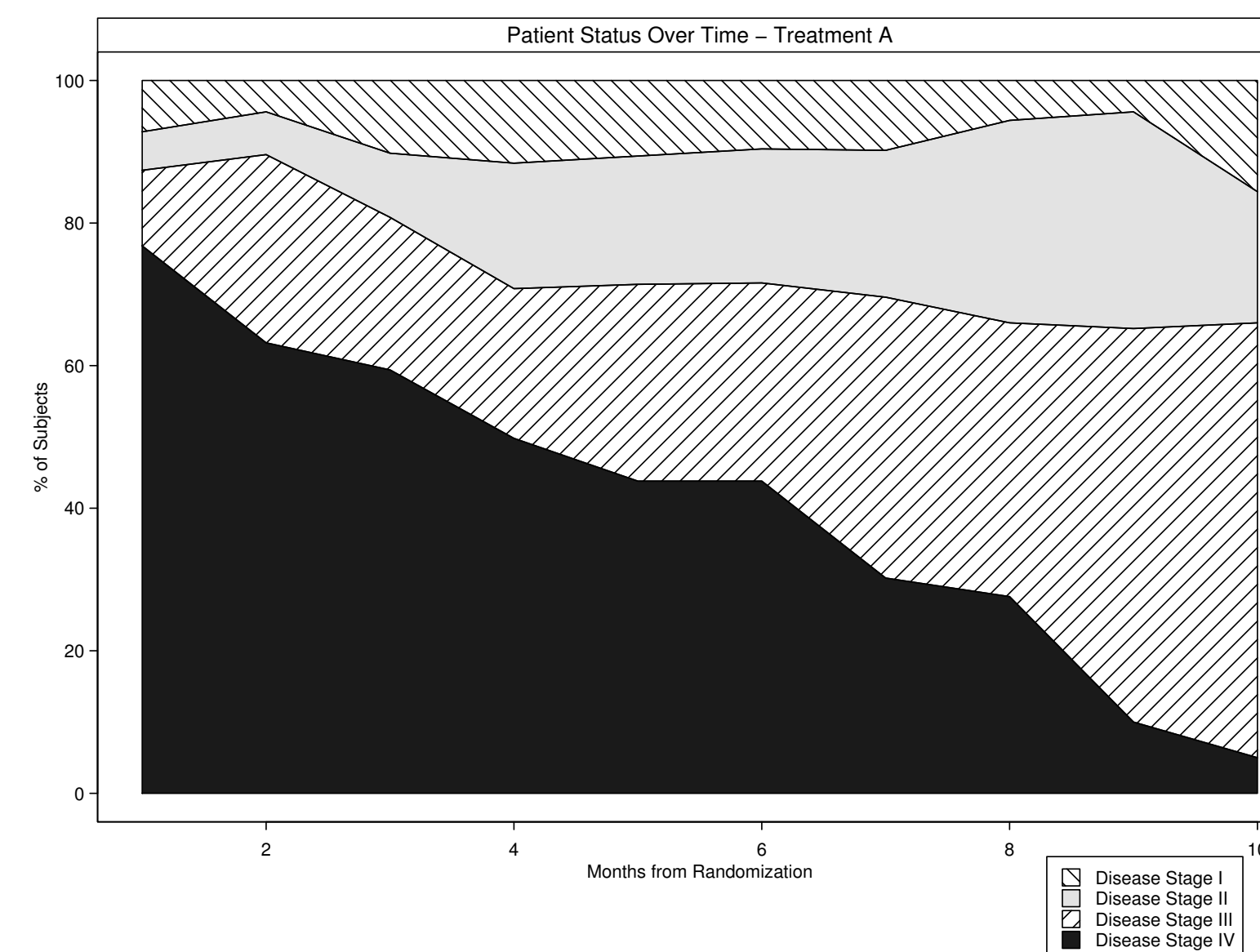
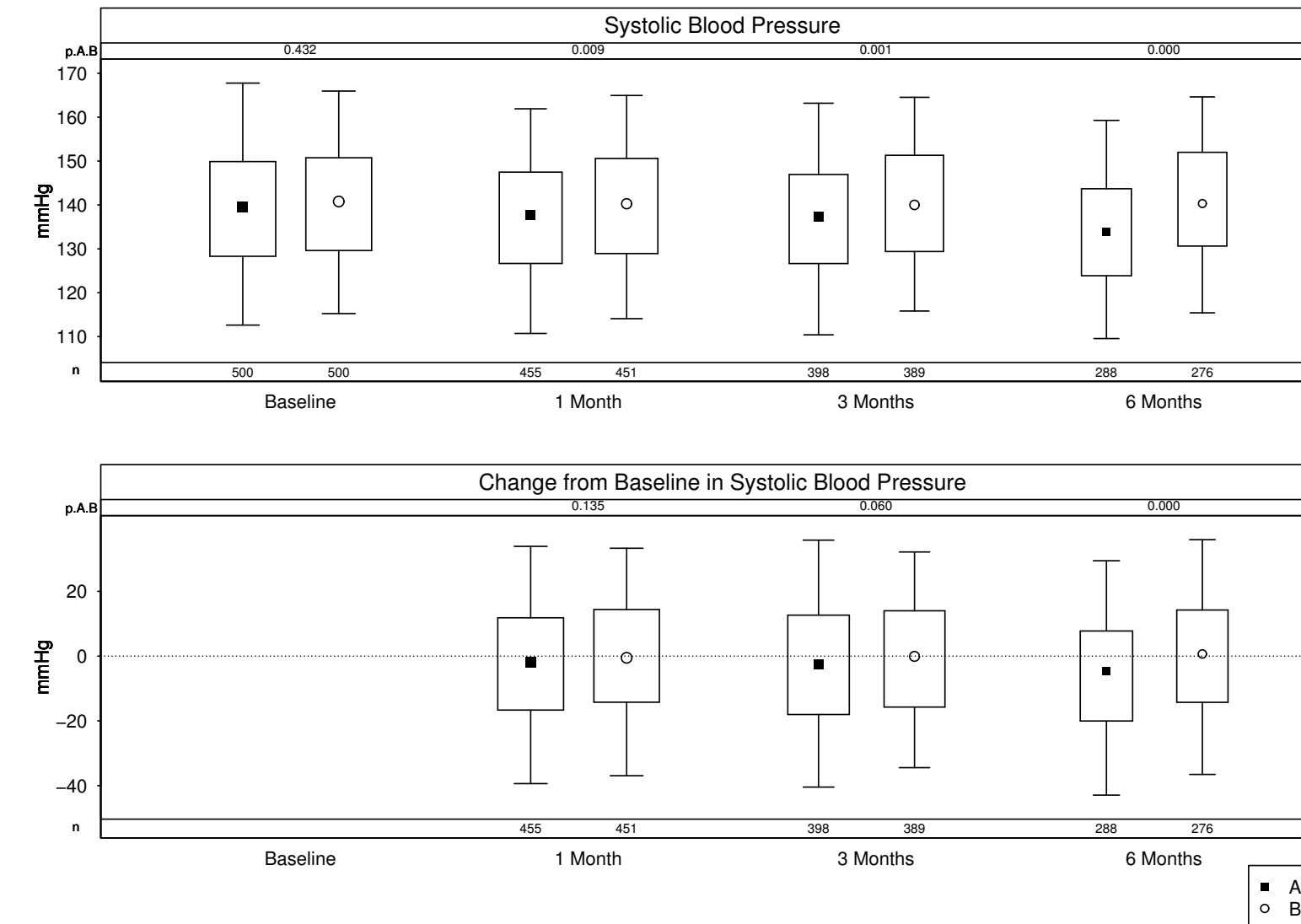
## Types of Graphics

SLOTS is used to create most graphics in our interim monitoring reports. Some of the plot types that can be produced include:

- Box Plots
- Bar Graphs
- Accrual Graphics
- Kaplan-Meier Curves
- Stacked Bar/Stacked Area Graphs

In addition to the output graphics, a backup table is produced for each type of plot. These backup tables are aggregated and included in the appendix of each report. The page numbers on the plots and backup tables are automatically cross-referenced by the report generating software.

## Sample Graphics Included in Reports



## Sample Backup Tables

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### Chapter 1

#### useR! 2007

#### 1 Baseline Measurements

Table Set POSTER-1

Baseline Characteristics by Treatment: Age at Randomization  
See Figure POSTER-1 on page 18.

Trt	Total Subj	Mean	Dev	Median	Q1	Q3	P5	P95	Contrast	p-
A	500	60.1	8.0	63.7	56.9	68.2	48.3	73.2	A,B	0.751
B	500	60.1	8.1	59.7	54.8	65.8	47.4	73.3		

Baseline Characteristics by Treatment: Sex  
See Figure POSTER-1 on page 18.

Trt	Total Subj	Female	Male	p-
A	500	125	375	0.297
B	500	111	389	

Baseline Characteristics by Treatment: Baseline Disease-Progression Class  
See Figure POSTER-1 on page 18.

Trt	Total Subj	Stage I	Stage II	Stage III	Stage IV	p-	
A	500	255	115	23.00	73	11.40	0.001
B	500	239	135	27.00	62	12.40	

## Future Work

SLOTS is currently stable and has been used to produce reports for many large, ongoing clinical trials. However, there are plans to improve and expand SLOTS, including:

- Modularizing the code so that new plot types can easily be added and maintenance and bug fixes are easier
- Converting SLOTS to the `grid` graphics system
- Enabling SLOTS to accept standardized analysis datasets as input, such as those described by CDISC, with the goal of making SLOTS available to the R and clinical trial communities

## References

- Freidman, L.M., Furberg, C.D., DeMets, D.L. (1998). *Fundamentals of Clinical Trials*. Springer-Verlag.
- The CDISC Analysis Dataset Modeling Team (2006). Analysis Data Model: Version 2.0. <http://www.cdisc.org/models/adam/v2.0/index.html>.

All figures are based on simulated data.

[http://www.biostat.wisc.edu/Clinical\\_Trials/sdacindex.htm](http://www.biostat.wisc.edu/Clinical_Trials/sdacindex.htm)