ST745, Spring 2016

Homework 3 Due: Thursday, 02/25/2016

1. You are given a small data sets on survival times of subjects in two groups: group 1: 2, 3+, 4, 4+ and group 2: 3, 5, 5+, 6, where + means a censored observation. Conduct the standard log-rank test (weight function = 1) **by hand** to compare the difference in the survival distribution. Which group has better survival?

2. Consider the kidney infection data from the textbook (Example 1.4 of Introduction Section). Do the following (you can do it using `SAS` or `R`):

   (a) Plot the Kaplan-Meier (KM) estimators of survival curves for the two catheter placement methods, respectively (in the same figure).

   (b) Perform the standard log-rank test, Gehan's Wilcoxon test and Peto-Prentice's Wilcoxon test to determine if there is any difference in survival between the two catheter placement methods. Which test is more powerful? Could you given some explanations on the power of these tests based on the KM plots obtained in (a)?

3. Consider the remission duration data for acute leukemia from the textbook (Example 1.2 of Introduction Section). Test the hypothesis that there is no difference in the times to relapse between the treated and control using a log-rank statistic stratified on remission status at randomization (do it using `SAS` or `R`).

4. An investigator asked you to help design a clinical trial for comparing a new treatment to the standard treatment for patients with some kind of cancer. Suppose the mean survival time of the standard treatment is 3 years and the new treatment is expected to extend the mean survival time to 5 years. For design purpose, let us assume the survival times for each treatment have exponential distribution. We would like to use the log-rank test for testing the survival difference at level $\alpha = 0.01$ and the investigator wants to have 90% power to detect the above difference. Assume equal number of patients will be allocated to each treatment. Do the following:

(a) What is the expected total number of deaths we have to observe in order for the log-rank test to have the desired power to detect the difference we expect?

(b) Suppose the study length is L (years) and the investigator wants to let the patients enter the study throughout **the first half** of the study. Assume that patients's entering times have the following density function $f_E(t) = 2(L/2 - t)/(L/2)^2$ if $t \in [0, L/2]$ and 0 otherwise. In addition, it is assumed that their failure times can be censored only at the end of the study, i.e. due to the limited follow-up. What is the relationship that the total sample size and the study length L have to satisfy?

(c) If on average there are 150 patients available each year. Find the study length L so that we have the above design characteristics.