

ST520, Fall 2011

Homework 7, due: Wednesday, 11/9/2011

1. (10 pts) The following table gives the survival time in days of rats implemented with brain cancer cells and then treated with two different treatments (trt 1 and trt 2).

Trt 1	Trt 2
26	31
28	32 ⁺
29	34
29 ⁺	35
30	36
30 ⁺	38
31	38 ⁺
31 ⁺	39
32	42 ⁺
35 ⁺	42 ⁺

⁺ right censored observation

- (a) Conduct the two-sample log-rank test by hand to compare the survival times for two treatments and check your result using `Proc Lifetest` in SAS.
2. (10 pts) The time (in months) to relapse data for 10 patients with bone marrow transplant are :8, 12, 16⁺, 17, 17⁺, 19⁺, 24, 30⁺, 31⁺, 32. Do the following by hand:
- (a) Construct the life-table estimates of the survival function $S(t)$ using following intervals: $[0, 10)$, $[10, 20)$, $[20, 30)$, $[30, 40)$. That is, estimate $S(10)$, $S(20)$, $S(30)$ and $S(40)$ using the life-table method (ignore the actual censoring times and treat all censoring to happen in those intervals), $S(t)$ is the true survival function.
- (b) Construct and plot the Kaplan-Meier estimate of $S(t)$.
3. (10 pts) During the design stage, we expect 200 patients per year will enter into a study to compare two treatments. Assume exponential distributions for the survival times of both treatments and assume the **median** survival time for treatment 2 is 2 year. We wish to detect with 90% power that treatment 1 has **median** survival time of 2.5 years using a two-sided log-rank test at 0.05 significance level. Suppose we will enroll patients for 6 years. How long should the study last?

(**Note:** You may plot the expected total number of deaths vs. the study length and roughly find the required study length by visualization or write a program to solve this problem).

4. (10 pts) In class, we indicated that the K dimensional vector for the log-rank test has one redundant element (since the sum is zero), and its variance matrix is singular. To construct the chi-squared log-rank test statistic (a quadratic form), we can pick up the elements for any $K-1$ groups from the vector and the corresponding sub-matrix from the variance matrix. Then the values of the quadratic forms should be the same. For the breast cancer example on slides 358-359, do the following:

- (a) Calculate the log-rank test statistic using the statistics from treatments 1 and 2.
- (b) Calculate the log-rank test statistic using the statistics from treatments 2 and 3.
- (c) Calculate the log-rank test statistic using the statistics from treatments 1 and 3.