

HW 4

February 18, 2025

For both of these exercises, feel free to use `survival`'s helper functions that we've encountered in prior homework sets.

1 Exercise 1

In the "Times to infection of Kidney Dialysis Patients" data described in Sec. 1.4 of the textbook (data can be downloaded from R package `KMsurv`, `data(kidney)`), 43 patients had a surgically placed catheter (Group 1) and 76 patients had a percutaneous placement of their catheter (Group 2).

1. Fit a Weibull model to patients with percutaneous placement (Group 2) using the `survreg` function.
 - (a) Find the maximum likelihood estimates of γ and α , and their standard errors where γ and α enter into the hazard function: $\lambda_i(t) = \gamma\alpha t^{\alpha-1}$. To find the standard errors, you'll need to use the estimated asymptotic variance covariance matrix returned by `survreg` as the `var` component of the fitted model and use the multivariate delta method to map from `survreg`'s parameterization of the Weibull back to the parameterization above.
 - (b) Test the hypothesis that the shape parameter α is equal to 1 using both the likelihood ratio test and the Wald test.
2. Fit a Weibull regression model to this data with a single covariate, Z , that indicates group membership.
 - (a) Find the maximum likelihood estimates of the regression coefficient of Z and its standard error. Provide an interpretation of the regression coefficient.
 - (b) Test the hypothesis of no effect of catheter placement on the time to infection using both likelihood ratio test and Wald test.

2 Exercise 2

Use the `aml` dataset from the `survival` package to do this exercise.

1. For two groups Nonmaintained and Maintained, make Kaplan-Meier plots of the survival curves with log – log confidence intervals for each group and overlay them on the same plot.
2. Now perform a log-rank test for treatment effect. Please provide your test statistic and a p-value. Does the treatment have an effect on the survival, based on log-rank test?
3. Now assume that the survival times for both groups follow exponential distribution:
 - $X_i \sim \text{Exponential}(\lambda)$ for the Nonmaintained group
 - $X_i \sim \text{Exponential}(\lambda e^\beta)$ for the Maintained group

Test the hypothesis of no treatment effect (i.e. $\beta = 0$) using composite Wald.

4. Discuss the assumptions underlying these two approaches, and the reasons for the discrepancy between two testing procedures.