

# HW 4

February 12, 2026

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  $\gamma$  and  $\alpha$ , and their standard errors where  $\gamma$  and  $\alpha$  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  $\alpha$  is equal to 1 using the composite versions of the likelihood ratio test, the Wald test, and the score 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 the 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.