PubH 7450 Homework 4 (Spring 2023)
Due date: TH on April 13, 2023

1. We have a censored survival time dataset for two groups (40 pts):
   Untreated: 20, 21, 23, 24+, 26+, 26+
   Radiated: 22, 24, 29+, 30+, 30+, 30+
   Create a dummy variable Z for the two groups.

   (a) Write down a PH model to compare the survival curves of the two groups. (5 pts)
   (b) Write down the partial likelihood for the model in (a) for the above data (15 pts).

   Suppose that we have another dataset:
   Untreated: 0, 50, 1000, 1100+, 1500+, 1500+
   Radiated: 100, 1100, 2000+, 3000+, 3000+, 3000+
   (c) Write down the partial likelihood for the model in (a) for this new dataset (15 pts).
   (d) If we use the same coding and fit the same PH model as in (b), explain why or why not the regression coefficient estimate and its variance estimate will remain the same as that in (b) (10 pts).

2. (35 pts) The "tongue" data in the "KMsurv" library (see also Sec 1.11), summarize a study that was conducted to test the effects of ploidy on the prognosis of patients with cancer of the tongue. Tissue samples were examined to determine if the tumor had a aneuploid or diploid DNA profile. Times to death for these two groups of patients are recorded in Table 1.6 of the KM-book. To analyze this data create a single indicator variable, Z, which reflects the type of tumor.

   (a) Find the p-value of a test of the hypothesis of no effect of ploidy on survival using the score test and the Breslow method of handling ties. (b) Find a 95% confidence interval for the relative risk of death of an individual with an aneuploid tumor as compared to an individual with a diploid tumor (5pts).
   (c) Repeat (a) using the likelihood test. Compare your answer to that of part a (10pts).
   (d) Repeat (a) using the Wald test. Compare your answer to those in parts a and c (10pts).
   (e) Estimate β and its standard error using the Breslow and Efron methods of handling ties and compare the estimates (10pts).

3. (40 pts) The "bnct" data in the "KMsurv" library (see also Exercise 7 of Chapter 7) contains data on three different treatments were administered to rats who had F98

glioma cells implanted into their brains. The data for the three groups of rats lists the death times (in days) in that exercise. Create two dummy variables,
$Z_1 = 1$ if animal is in the "radiation only" group, 0 otherwise;
$Z_2 = 1$ if animal is in the "radiation plus BPA" group, 0 otherwise.
Use the Breslow method of handling ties in the problems below.

(a) Estimate β_1 and β_2 and their respective standard errors (5pts).
(b) Find a 95% confidence interval for the relative risk of death of an animal radiated only compared to an untreated animal (5pts).
(c) Test the global hypothesis of no effect of either radiation or radiation plus BPA on survival. Perform the test using the Wald and likelihood ratio tests (10pts).
(d) Test the hypothesis that the effect a radiated only animal has on survival is the same as the effect of radiation plus BPA (i.e., Test $H_0 : \beta_1 = \beta_2$). (5pts).
(e) Find an estimate and a 95% confidence interval for the relative risk of death for a radiation plus BPA animal as compared to a radiated only animal (5pts).
(e) Test the hypothesis that any radiation given as a treatment (either radiation alone or with BPA) has a different effect on survival than no radiation. Use the likelihood ratio test (5pts).
(g) Repeat part (e) using a Wald test (5pts).

Note: Please include your computer programs and only relevant output; show major steps in your derivations or hand calculations.