Pharm 3011 - Fall 2019 - Assignment 4
Due Thursday, November 19, at the beginning of class.

1. The times until recurrence of headaches following treatment for ten subjects are listed below, with "+" indicating censored observations.

   2, 15+, 17, 18, 18+, 20+, 23, 25+, 30+, 31

   Calculate and plot the Kaplan Meier estimate of the survival curve.

2. The following table shows survival times (in weeks) for a control group (Group 0) and a Treatment group (Group 1):

Group 0	15	18	19	19	
Group 1	16+	18+	20+	23	24+

   Compare the two survival curves using the Cochran-Mantel-Haenszel test (also known as the log rank test).

   (a) State the hypotheses.

   (b) Calculate the test statistic, showing your work in a table similar to that on page 3 of the class notes. (Your table should have 4 rows, and the observed value of the test statistic should be approximately -2.52).

   (c) Determine the p-value as accurately as possible.

3. A Cox proportional hazards model for survival time of ovarian cancer patients was fit. Where $X = 1$ for a subject in the treatment group, and $X = 0$ for the control group, and AGE is the age of the subject in years, the model had estimated hazard function

$$h_{X,AGE}(t) = h_{0,0}(t)e^{-.8X+.2AGE}$$

   Also, it was determined that the baseline hazard at 20 months was $h_{0,0}(20) = .01$.

   (a) What is the hazard at 20 months for a 40 year old in the control group?

   (b) What is the hazard at 20 months for a 40 year old in the treatment group?

   (c) What is the ratio of the hazards at 20 months for a 40 year old in the treatment group relative to (over) a 40 year old in the control group.

   (d) What is the hazard ratio at 10 months for a patient aged 50 relative to (over) a patient aged 30 in the treatment group?

   (e) What is the hazard ratio at 15 months for a patient aged 50 relative to (over) a patient aged 30 in the treatment group?

4. A sample of size 10 was taken. The sample values were 1,2,3,4,5,6,7,8,9,10, giving a sample average $\bar{X} = 5.5$.

Imagine taking a bootstrap sample, meaning a sample of size 10 with replacement, from these data.

(a) What is the smallest possible mean of the bootstrap sample?

(b) What is the largest possible mean of the bootstrap sample?

(c) What is the probability that the value 10 does NOT occur in this bootstrap sample?