BIOS 845 Homework #1

Date assigned: 01/31/2018
Due Date: 02/12/2018 by 11:59 pm (Blackboard clock time);

Instructions:

1. To receive full credit, show all work. Please make your work legible.
2. Total points for this homework are 100.
3. Do not forget to write your name on the homework.
4. Insert page numbers on all pages and also total # of pages submitted.
5. Homework can be typed or hand-written. Provide SAS code wherever necessary.
6. Use the BLACKBOARD drop box to turn in the homework (preferably as pdf) or bring it to class on 01/12/2018.

Question # 1: **10 points**

a. Prove equation 2.4.3 from your textbook

b. Prove that equation 2.5.1 (memoryless property) holds true for an exponentially distributed random variable. Then using equation 2.4.1 show that $mrl(x) = 1/\lambda$

c. Show that another expression for $mrl(x)$ is given by

$$mrl(x) = \frac{\int_x^\infty uf(u)}{S(x)} du - x$$

d. Show that for a multiplicative hazard model,

$$S(x|Z) = [S_0(x)]^{G(\boldsymbol{\beta}'\boldsymbol{Z})}$$

Question # 2: **25 points**

a. Derive expressions for $E(X)$ and $Var(X)$ when X follows the following distributions:
{i} Weibull {ii} Gamma {iii} Lognormal {iv}Loglogistic

b. Derive the pdf of $Y = \ln(X)$ when X follows the following distributions:
{i} Exponential{ii} Weibull {iii} Lognormal {iv}Loglogistic

c. Solve the following Exercises from your textbook:
{i} Exercise 2.3 {ii} Exercise 2.5 {iii} Exercise 2.7

Question # 3: **20 points**

a. Solve Exercise 3.3 from your textbook

b. Solve Exercise 3.6 from your textbook

Question # 4: **30 points**

Researchers wish to explore the efficacy of triple-drug combinations of antiretroviral therapy for treatment of HIV-infected patients. Because of limitations on potency and the continuing emergence of drug resistance seen with the use of currently available antiretroviral agents in monotherapy and two-drug regimens, triple combination regimens should represent a more promising approach to maximize antiviral activity, maintain long-term efficacy, and reduce the incidence of drug resistance. Towards this end, investigators performed a randomized study comparing AZT + zalcitabine (ddC) versus AZT + zalcitabine (ddC) + saquinavir. The data, time from administration of treatment (in days) until the CD4 count reached a pre-specified level, is given below for the two groups:

AZT + zalcitabine (ddC):
4+, 6, 11, 12, 32, 35, 38+, 39, 45, 49, 75, 80, 84, 85, 87, 102, 180+

AZT + zalcitabine (ddC) + saquinivir:
2, 3, 4, 12, 22, 48, 51+, 56+, 80, 85, 90, 94+, 160, 171, 180, 180+, 238

a. For both groups separately, construct a data layout (similar to what was done in class) containing the unique, ordered event times, the number of events that occurred at those unique event times, the number of censored observations in the relevant interval, the number in the risk set at that time, and the Kaplan-Meier estimate of the survival curve at that time. What is the median survival time in the two groups? Will you be comfortable reporting the mean survival time in the two groups?

b. Use SAS to generate the Kaplan-Meier estimates you calculated in part [a] above.

c. For any one group, compute the Nelson Aalen estimates of the cumulative hazard function. Graphically compare $\widehat{H}(t)$ versus $\widetilde{H}(t)$ and comment on this comparison.

d. Use **PROC LIFETEST** to produce the Life-Table estimate of the survival function and to plot the life-table estimates of the hazard function based on interval widths of 60 days. What does this tell you about the hazard function for the two groups?

e. For any one group, use **PROC LIFETEST** to produce 95% confidence band using the various approaches you learned in class.

Question # 5: **15 points**

Solve Exercise 4.7 from your textbook.

Question # 6 (Bonus): **5 points**

Read proof of Greenwood's formula for variance (see pdf in folder titled 'Extra Reading'). Confirm that you fully understood the proof.

GOOD LUCK ☺☺