

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS
EXAMINATION FOR THE AWARD OF MASTER OF SCIENCE IN APPLIED
STATISTICS
MATH 856: SURVIVAL AND CLINICAL DATA ANALYSIS

STREAMS: M.Sc (Applied Statistics)

TIME: 3 HOURS

DAY/DATE : FRIDAY 8 /10/ 2021

8.30 AM – 11.30 AM

INSTRUCTIONS TO CANDIDATES:

- Answer any **THREE** Questions
- Don't write anything on this question paper

QUESTION ONE (20 MARKS)

In the study(Nahman et al, 1992) designed to assess the time to first exit site infection (in months) in patients with renal insufficiency, some patients utilized a surgically placed catheter (Group 1) and others utilized a percutaneous placement of their catheter (Group 2). Cutaneous exit site infection was defined as a painful cutaneous exit site and positive cultures or peritonitis, defined as a presence of clinical symptoms, elevated peritoneal dialytic fluid, elevated white blood cell count and positive peritoneal dialytic fluid cultures. The data appears in Table 1 below

Group 1: Surgically Placed Catheter											
Infection Times	1.5	3.5	4.5	4.5	5.5	26.5	18.5	23.5	15.5	16.5	11.5
Censored Observations	8.5	8.5	9.5	10.5							
	2.5	2.5	3.5	3.5	3.5	4.5	5.5	6.5	6.5	7.5	7.5
	7.5	7.5	8.5	9.5	10.5	11.5	12.5	12.5	13.5	14.5	14.5
	21.5	21.5	22.5	22.5	25.5	27.5					
Group 2: Percutaneous Placed Catheter											
Infection Times	0.5	0.5	0.5	0.5	0.5	0.5	2.5	2.5	3.5	6.5	15.5
Censored Observations	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.5
	1.5	1.5	1.5	2.5	2.5	2.5	2.5	2.5	3.5	3.5	3.5
	3.5	3.5	4.5	4.5	4.5	5.5	5.5	5.5	5.5	6.5	7.5
	7.5	7.5	8.5	8.5	9.5	9.5	10.5	10.5	10.5	11.5	11.5
	12.5	12.5	14.5	14.5	16.5	16.5	18.5	19.5	19.5	19.5	20.5
	22.5	24.5	25.5	26.5	26.5	28.5					

We are interested in testing if there is a difference in the time to cutaneous exit-site infection between patients whose catheter was placed surgically (Group 1) as compared to patients who had their catheters placed percutaneously (Group 2). Test whether this two methods are different using the log rank test at the survival times: (20 marks)

0.5 1.5 2.5 3.5 4.5 5.5 6.5 8.5 9.5 10.5 11.5 15.5 16.5 18.5 23.5 26.5

QUESTION TWO (20 MARKS)

(a) List the assumptions for the cox model [2 marks]

(b) The following data give survival time (in weeks) for n=15

1 1 1⁺ 1⁺ 1⁺ 2 2 2 2⁺ 2⁺ 3 3 3⁺ 4⁺ 5⁺

Where “+” denotes censored data. Complete the following Kaplan-meir table [8 marks]

t(j)	n _j	m _j	q _j	s(t)
0				
1				
2				
3				

(c) Suppose the data for age of the Percutaneous Placed Catheter group (**question one above**) was available. Write a program in R that exports the data into R, Fits the Cox ph hazard function with age as the regressor and finally plots the martingale residuals for age. [4 marks]

(a) The consideration for selection of study site is probably their ability to enroll patients and to complete the study within the planned time frame for a selected study Centre. Outline selection process for patients in such a study [6Marks]

QUESTION THREE (20 MARKS)

(a) Differentiate between inclusion criteria and exclusion criteria as used in clinical trials and give an example for each. [6 marks]

(b) The lifetime of light bulb follows on exponential distribution with a hazard rate at 0.001 failures per hour of use.

Required

- i. Find the mean lifetime of a randomly selected light bulb [2marks]
- ii. Find the median lifetime of a randomly selected light bulb [2marks]
- iii. What is the probability a light bulb will still function after 2000 hours of use?

[3 marks]

(c) A cox proportional hazard model fitted to the data with the R results in table below

Call
coxph(formular=surv(time,status) and age + gender, data=DATA)

	<i>coef</i>	<i>exp(coef)</i>	<i>se(coef)</i>	<i>z</i>	<i>p</i>
<i>age</i>	0.0124	1.012	0.0094	1.32	0.190
<i>gender</i>	-0.4972	0.608	0.1677	-2.96	0.003

likelihood ratio=18.8 on 3 df *p=0.0002999* *n=26*

Required

- i. Write the fitted model [2marks]
- ii. Comment on the significance of each regression coefficient and the overall model [3 marks]
- iii. Write a program in R that checks for violation of the assumption of proportional hazards of each of the covariates [4 marks]

QUESTION FOUR (20 MARKS)

The following are some hypothetical data on two groups, smokers and non-smokers, in a study that investigated survival (days) following a root canal.

Group	Day	Status
smokers	4	alive
smokers	7	dead
smokers	8	alive
nonsmoker	29	alive
smokers	29	dead
smokers	31	alive
nonsmoker	40	dead
smokers	65	dead
nonsmoker	69	dead
nonsmoker	78	alive
nonsmoker	79	alive
nonsmoker	106	dead
smokers	107	alive

nonsmoker	129	dead
smoker	130	alive
smokers	140	alive
smokers	142	alive
smokers	149	dead
smokers	158	alive
smoker	160	dead
nonsmoker	161	dead
smokers	162	alive
smoker	187	dead
smokers	188	alive
nonsmoker	197	dead
nonsmoker	204	alive
nonsmoker	208	alive
smoker	221	dead
nonsmoker	228	dead
nonsmoker	231	alive

Required

- i. Obtain the Kaplan-Meier estimates of survival, separately for smokers and non-smokers. [10 marks]
- ii. By hand, perform a log rank test of the null hypothesis of equal survival curves for smokers and non- smokers [10 marks]

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