MANICALAND STATE UNIVERSITY

OF

APPLIED SCIENCES

FACULTY OF APPLIED SCIENCES & TECHNOLOGY

DEPARTMENT OF APPLIED STATISTICS

MODULE: SURVIVAL MODELS

CODE: ASTA 424

SESSIONAL EXAMINATIONS

JUNE 2023

EXAMINER: MRS S MANDIZVIDZA

INSTRUCTIONS

1. Answer **All** in Section A.
2. Answer **three** questions in Section B.
3. Start a new question on a fresh page.
4. Total marks: 100.

Additional material(s)

- Statistical tables, Non-programmable electronic scientific calculator, List of formulae.

SECTION A [40 MARKS]

Answer **ALL** questions in this section

A 1

Define the following

(a) Censoring . (2)

(b) Survival functions. (2)

(c) Hazard rates. (2)

A 2

(a) State the assumptions underlying the Markov model of transfers between a finite number of states in continuous time (6)

(b) Derive the Maximum Likelihood Estimate for the transition intensities in models of transfers between states with piecewise constant transition intensities (5)

A 3

Define the following

(a) the actuarial functions $t^p x$ and $n^q x$. (4)

(b) curtate expectations of future lifetime, (2)

(c) probabilities of death (2)

(d) probabilities of survival (2)

A 4

Describe

(a) Types of censoring . (3)

(b) Types of truncation. (3)

A 5

(a) Describe the Binomial model of mortality. (2)

(b) derive a maximum likelihood estimator for the probability of death of a Binomial model of mortality. (5)

SECTION B [60 MARKS]

Answer any **THREE** questions in this section

B 6

(a) Describe the Cox model for proportional hazards (2)

(b) derive the partial likelihood estimate (8)

(c) Describe the two state model of a single decrement . (3)

(d) Describe the Poisson Models of mortality. (2)

(e) derive a maximum likelihood estimator for the probability of death of a Poisson Models of mortality. (5)

B 7

10 wombats in an infected community were followed over three years as show in the figure below.

Wombat	Infection Start Time	End Time	Survival time (months)	Died? (1=died)
A	Jan-19	Apr-20	15	1
B	Feb-19	Sep-21	31	0
C	Apr-19	Dec-20	20	1
D	Apr-19	May-21	25	1
E	Jun-19	Sep-20	15	1
F	Jun-19	Oct-19	4	1
G	Oct-19	Apr-20	6	1
H	Jan-20	Dec-20	11	1
I	Jan-20	Sep-21	20	0
J	Jan-21	Sep-21	8	0

Figure 1: Wombats

(a) Represent the information on a time line. (5)

(b) Calculate the survival rate and draw the Kaplan Meier Curve. (15)

B 8

(a) describe the methods of graduation (4)

(b) Describe the process of graduation by the using the three common methods (6)

(c) state the advantages and disadvantages of three common methods graduation . (6)

(d) State the principle of correspondence. (4)

B 9

A dental technician want to study the "survival time" of a filling in a tooth. Start time is that moment when a person gets a filling at the dentist's office and the end time, the event, is the moment when that filling breaks out. The time between these two events is the focus of the study. The groups would have each received different material for the fill. If we assume that time is measured in years, then for group one the first fill would have failed after two years, the second fill after 3 years and so on and so forth. as show in the figure below.

Group 1		Group 2	
time	Status	time	Status
2	1	2	1
3	1	2	1
$\boxed{5}$	$\boxed{0}$	4	1
7	1	4	1
7	1	6	1
8	1	8	1

Figure 2: Dental filling breaks out

(a) State the null and alternative hypothesis for the Logrank test of the above information (2)

(b) Carry out the log rank test to asses whether the Kaplan Meier survival curves from two subpopulations are significantly different. (18)