Australian National University

RESEARCH SCHOOL OF FINANCE, ACTUARIAL STUDIES AND APPLIED STATISTICS

Second Semester Mid-Semester Exam 2012

Survival Models / Biostatistics

(STAT3032/7042/8003)

Writing period: 1 Hour duration

Permitted materials: Calculators, lecture notes, dictionary

You must attempt to answer all questions.
All questions are to be completed in the script book provided.

Question 1 (5 marks)

The force of mortality for a particular population from birth (that is, $\lambda(t)$ is the hazard *t* years after birth) is assumed to take the following form:

$$\lambda(t) = (\theta - t)^{-1},$$

where, $0 \le t \le \theta$. Based on this form of the force of mortality, find an expression for ${}_tq_x$.

Question 2 (10 marks = 3+5+2)

The observed survival times (in years) of 7 patients after a heart transplant operation are provided below. Values denoted with "*" correspond to times of censoring, rather than times of death. The censoring is uninformative, right censoring.

1, 2, 3*, 4, 5*, 6, 7

a) Based on this data, what is the Kaplan-Meier estimate of the survival function at time 6.5? Your answer must include an estimate of the standard error.

b) Provide an estimate of the mean survival time after a heart transplant operation.

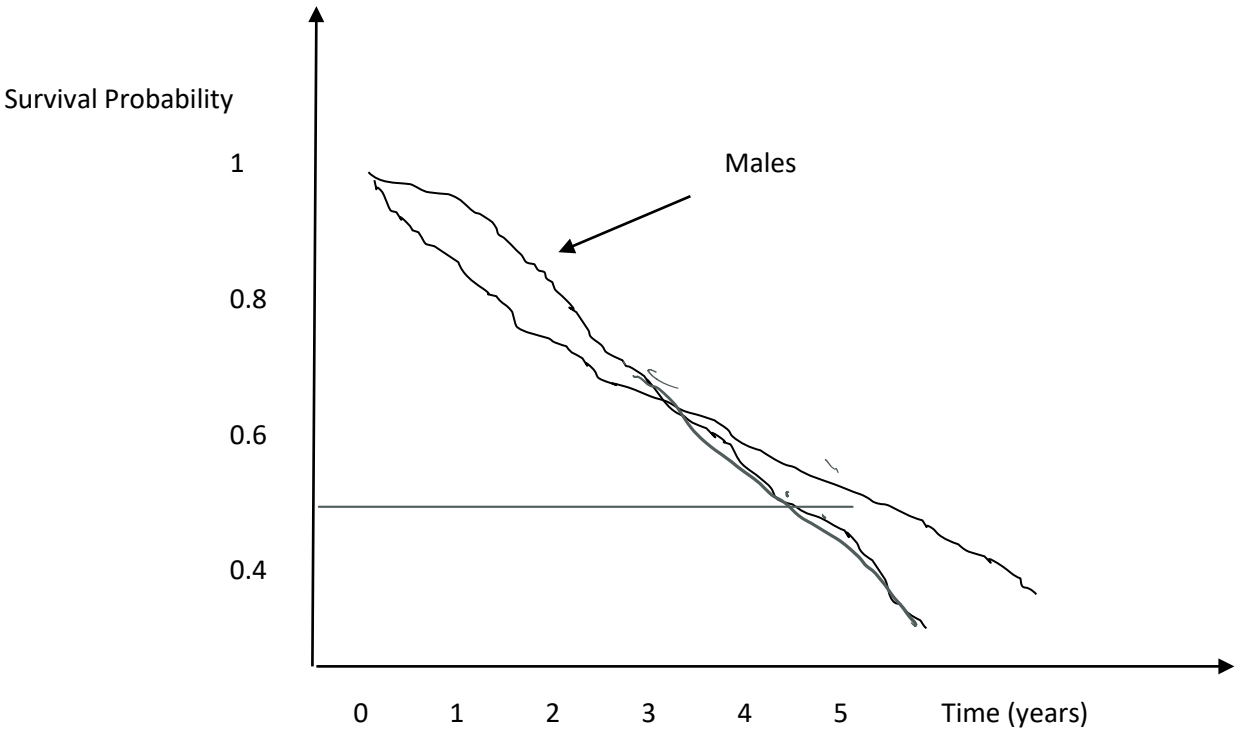
c) How does the Nelson-Aalen estimate of the survival function at time 6.5 compare to the Kaplan-Meier estimate at this time?

Question 3 (5 marks)

Based on a given set of data you have computed the maximum likelihood estimate of the parameter θ, denoted $\hat{\theta}$, to be 1.5. You have also computed an estimate of the standard error to be 2. Using this information compute an estimate of the variance of the quantity $\log(\hat{\theta})$. Also, provide an approximate 95% confidence interval for θ.

Question 4 (5 marks = 2 + 3)

The figure below contains (rough) plots of the estimated survival curves for males and females after a particular operation.



Based on this figure answer the following questions:

a) Provide a rough estimate of the median survival time for males.

b) Comment on any concerns you might have modeling this data using the Cox regression formulation of the hazard function given in class.