YASHWANTRAO CHAVAN MAHARASHTRA OPEN UNIVERSITY, NASIK

HOME ASSIGNMENT (2016-17)

V45 - BSAS 2015 CGPA Semester 4

Instructions for the Students :

1. All Questions are compulsory.
2. Write every question's answer on separate page.
3. Use of Scientific Calculator is allowed.
4. Use of Actuarial Tables is permissible.

S04041 (Stochastic Processes)

Q1 List the factors that should be considered when deciding whether a model is suitable for a particular application. [5]

Q2 An author is about to start writing a book that will contain 20 chapters. The author plans to write a new chapter each week. However, when he reviews his work at the end of each week, there is a probability of 0.25 (which is independent of the current state of the book) that he will not be happy with one of the chapters he has written. In this case, he will spend the following week rewriting that particular chapter instead of embarking on a new one. He may decide to rewrite any one chapter, including a new one he has just finished or one that he has previously rewritten.

Let X_k denote the number of chapters that the author is happy with at the end of week k, and define $X_0 = 0$.

i) Explain why X_k can be modeled as a Markov chain. (3)

ii) Calculate the probability that the author will complete the book in exactly 25 weeks. (2)

Q3 An investigation was carried out into the relationship between sickness and mortality in an historical population of working class men. The investigation used a three-state model with the states:

1 Healthy
2 Sick
3 Dead

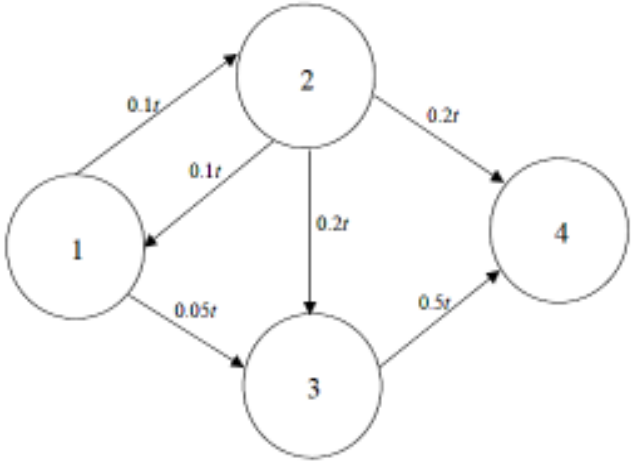
Let the probability that a person in state i at time x will be in state j at time x+t be ${}_tp_x^{ij}$.

Let the transition intensity at time x+t between any two states i and j be μ^{ij}_{x+t} .

(i) Draw a diagram showing the three states and the possible transitions between them. (2)

(ii) Write down the likelihood of the data in the investigation in terms of the transition rates and the waiting times in the Healthy and Sick states, under the assumption that the transition rates are constant. (3)

Q4 Consider the following time-inhomogeneous Markov jump process with transition rates as shown below:



i) Write down the generator matrix at time t. (2)

ii) Write down the Kolmogorov backward differential equations for $P_{33}(s, t)$ and $P_{13}(s,t)$. (3)

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S04042 (Survival Analysis)

Q1 i) A life office is conducting a study into the mortality of female lives ages 35, within 1 year of child-birth. The age is defined as age last birthday and the number of deaths and exposed to risk calculated accordingly. The below gives an extract of 5 lives.

	Date of birth	Date of child birth	Remarks
A	1.1.1980	1.11.2014	Died on 1st May 2015
B	1.2.1980	1.2.2015	Policy lapsed on 31st Jan 2015
C	1.4.1980	1.12.2014	Died on 1st July 2015
D	1.10.1981	1.1.2015	-
E	1.5.1979	1.1.2014	-

Calculate the exposure of each of the life for the above mortality analysis. (2)

ii) a) State the rate interval implied by the age definition above. (1)

b) If age were to be defined as age last birthday on the preceding 1 April, explain the difference in the rate interval implied by this definition and the definition in part ii (a). (2)

Q2 A pension scheme only allows retirement at exact age 65. An investigation of the mortality of the retired members of the scheme was carried out over the period 1 January 2005 to 31 December 2010.The following data were obtained:

Member	Date of retirement	Date of death (if occurred during the investigation period)
1	1 April 2002	30 April 2009
2	1 August 2004	-
3	1 February 2005	-
4	1 June 2006	31 August 2008
5	1 August 2006	31 December 2010
6	1 March 2008	-
7	1 May 2008	30 November 2010
8	1 January 2009	-

All months should be assumed to be of equal length.

Calculate the Kaplan-Meier (product-limit) estimate of the survival function $S_{65}(t)$ from these data. [5]

Q3 The following model for the force of mortality for a life insurance company's annuitants has been proposed:

$\mu(t,i) = (0.015 - 0.0001t).\exp[\alpha(x_i - 70) + \beta.y_i + \gamma.z_i]$

where $\mu(t, i)$ = force of mortality for the i^{th} life, in calendar year 2000 + t;

x_i = age of the i^{th} life;

$y_i = 1$ if the i^{th} life is a smoker, or $y_i = 0$ if a non-smoker;

$z_i = 1$ if the i^{th} life is male, or $z_i = 0$ if female;

α, β, γ are the parameters of the model.

The following data have been observed over the calendar year 2003:

Risk characteristics	No. of annuitants	Number dying
Male non-smoker, average age 65	800	6
Male smoker, average age 60	200	5
Female non-smoker, average age 70	450	2
Female smoker, average age 65	150	1

You can assume that the numbers of annuitants in each class remained constant throughout the investigation period, and that the average age for each class can be treated as representing the value of x_i for each individual in that class.

i) Explain why this model is a proportional hazards model. (2)

ii) Explain the importance of subdividing the data by age, sex and smoking status, and explain whether you think each of the parameters α, β and γ would be likely to be positive or negative. (3)

Q4 i) Describe three shortcomings of the χ^2 test for comparing crude estimates of mortality with a standard table and why they may occur. (3)

ii) For each of the three shortcomings you described in (i) name a test that would detect that shortcoming. (2)

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S04043 (Non Life Insurance - Principles, Products and Practices)

Q1 Describe in brief the structure and components of a General insurance Policy document. [5]

Q2 What is a non proportional reinsurance treaty? In which circumstances / situations is it found to be useful? [5]

Q3 In relation to claim payment, sometimes insurer is in a position to recover some amount from insured / others. Explain this statement. [5]

Q4 Write a short note on Surveyors / Loss adjusters, who play a very crucial role in the insurance industry. [5]

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