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**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE**

**UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE ACTUARIAL**

**1ST YEAR 2ND SEMESTER 2016/2017 ACADEMIC YEAR**

**REGULAR (MAIN)**

**COURSE CODE: SAC 102**

**COURSE TITLE: FUNDAMENTALS OF ACTUARIAL MATHEMATICS 1**

**EXAM VENUE: STREAM: (BSc. Actuarial)**

**DATE: EXAM SESSION:**

**TIME: 2.00 HOURS**

**Instructions:**

1. **Answer question 1 (Compulsory) and ANY other 2 questions**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

**QUESTION 1 [30 Marks]**

a)i.)Define the term central exposed to risk [2 marks]

ii)When is central exposed to risk equal to the initial exposed to risk [1 mark]

b)Explain the importance of dividing the data for mortality investigation into homogeneous classes [3 marks]

c).i.Describe what is meant by adverse selection in the context of a life insurance company’s underwriting process and give an example [2 marks]

ii).Explain with examples, 3 distinct types of selection in the membership of a pension scheme [6 marks]

d.Given  for 

(i) Find  and  and hence find  [4 marks]

(ii)Find  and then  and  [4 marks]

(iii)Calculate  assuming  to be constant between ages 40 and 41 [4 marks]

e) Explain the terms ‘’undergraduation ‘’ and ‘’overgraduation [4 marks]

**QUESTION 2 [20 Marks]**

a). Describe how occupation affects mortality and morbidity [4 marks]

b).Describe 3 casual factors that explain the differences in mortality and morbidity [3 marks]

c).Explain how an insurance company uses risk classification to control the profitability of its life insurance business [3 marks]

d)Briefly describe possible reasons why the mortality of one region of a country may differ from that of a country as a whole [6 marks]

e)Explain what is meant by the following terms and give an example of each [4 marks]

1. Temporary initial selection
2. Spurious selection

**QUESTION 3 [20 Marks]**

a).You are given the following statistics in respect to population of a town:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Males | | | Females | | |
| Age- band | population | Mortality rate | population | Mortality rate |  |
| 20-29 | 125,000 | 0.00356 | 100,000 | 0.00125 |
| 30-39 | 200,000 | 0.00689 | 250,000 | 0.00265 |
| 40-49 | 100,000 | 0.00989 | 200,000 | 0.00465 |
| 50-59 | 90,000 | 0.01233 | 150,000 | 0.00685 |

Calculate the directly standardized mortality rates for the female lives using the combined population(both male and female) as the standard population [6 marks]

b)You are given the following data which relate to an investigation of the mortality of people in a particular occupation

|  |  |  |
| --- | --- | --- |
| Age –range | Central exposed to risk | Observed deaths |
| 20-34 | 20,000 | 10 |
| 35-49 | 15,000 | 30 |
| 50-64 | 5,000 | 150 |

Find the crude death rate for the occupation [4 marks]

c)The following data has been from 2001 census extracted for a whole country with a developed economy and for two of its administrative regions [10 marks]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Region X |  | Region Y |  | Country |  |
| Age group | Popn.at June 30(000s) | Deaths in 2001 | Popn.at June 30(000s) | Deaths in 2001 | Popn.at June 30(000s) | Deaths in 2001 |
| 0-14 | 590 | 136 | 408 | 108 | 10200 | 2550 |
| 15-39 | 980 | 820 | 510 | 441 | 16800 | 13950 |
| 40-59 | 1050 | 5690 | 520 | 2816 | 12900 | 70950 |
| 60-79 | 870 | 42630 | 260 | 11980 | 8900 | 418300 |
| 80+ | 110 | 18920 | 36 | 6077 | 1200 | 204000 |
| total | 3600 | 68196 | 1734 | 21422 | 50000 | 709750 |

i.)Calculate the crude death rate for each region and for the whole country [3 marks]

ii.)calculate the standardized mortality rate for each region by reference to the country(standard) as a whole [6 marks]

iii).comment on your results [1 mark]

**QUESTION 4 [20 Marks]**

1. State the principle of correspondence as applied in mortality. [2 Marks]
2. A life office discovers that one of its potential policy holders was sub-standard in terms of mortality. Briefly explain four ways that as a company actuary you will advise them regarding this potential client. [6 Marks]
3. Briefly explain any two differences between initial exposed to risk and central exposed to risk. [2 Marks]
4. An investigation is being conducted on old lives in a large life .The investigation begins on 1st Jan 1991 and ends on 30th Nov 1992.You are given the following data in respect of 3 lives:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Date of birth | Date of exit from observation | Reason for exit |
| Life 1 | 1 July 1887 | 1 April 1992 | Death |
| Life 2 | 1 Oct 1896 | 31 Dec 1992 | Investigation ended |
| Life 3 | 1 April 1891 | 1 Oct 1991 | Death |

Calculate

i)The exact central exposed to risk at age 94 last birthday in respect of these 3 lives [5 marks]

ii)The initial exposed to risk at age 94 last birthday in respect of the 3 lives [5 marks]

(Assume that all months are of equal length)

**QUESTION 5 [20 Marks]**

1. In a certain population, the force of mortality is given by:

|  |  |
| --- | --- |
| *X* | *ux* |
|  | 0.01 |
|  | 0.015 |
|  | 0.025 |

Calculate the probability that a life aged exactly 61 will die between exact ages 82 and 90. [4 marks]

b). Given that  in the usual life table notation, determine  in terms of and hence show that  [5 marks]

c)State atleast 3 disadvantages of the following methods of graduation [6 marks]

i)Parametric(mathematical ) formula

ii)Graphical method

d).i)Define the term graduation [2 marks]

ii)State the aims of graduation [3 marks]