



THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

A. M. E. C. E. A

MAIN EXAMINATION

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AUGUST – DECEMBER 2018 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS AND ACTUARIAL SCIENCE

REGULAR PROGRAMME

ACS 101: FUNDAMENTALS OF ACTUARIAL MATHEMATICS I

Date: DECEMBER 2018

Duration: 2 Hours

INSTRUCTIONS: Answer Question ONE and any other TWO Questions

- Q1. a) Calculate $2.25 q 85.5$ using the method of Uniform Distribution of Deaths.
Basis: ELT15 (Males) **(4 marks)**
- b) Derive (to the nearest integer) the median of the complete future lifetime of a person aged 30 exact who is subject to the force of mortality shown below:

$$\mu_{30+t} = \begin{cases} 0.01 & \text{for } 0 < t \leq 10 \\ 0.02 & \text{for } 10 < t < 20 \\ 0.03 & \text{for } 20 \leq t \end{cases} \quad \text{(4 marks)}$$

- c) A population with limiting age 100 has the following survival function:

$${}_tP_0 = \left(1 - \frac{t}{100}\right)^{0.5} \text{ for } 0 \leq t \leq 100$$

Calculate the complete expectation of life at age 50. **(6 marks)**

- d) Explain why study fundamentals of actuarial mathematics at university levels. **(4 marks)**

- e) Calculate: $5|10 q[52]$
 Basis:
 Mortality: AM92 Select **(4 marks)**
- f) Define is what is force of mortality and give its mathematical formula **(5 marks)**
- g) What is a stationary population? **(3 marks)**

- Q2. a) A population is subject to the force of mortality $\mu_x = e^{0.0002x-1}$. Calculate the probability that a life now aged 20 exact:
- i) Survives to age 70 exact **(4 marks)**
- ii) Dies between ages 60 exact and 70 exact **(6 marks)**
- b) You are provided with the following extract from a life table:

x	l_x
50	99,813
51	97,702
52	95,046

Calculate $0.75p50.5$ using two different methods. **(10 marks)**

- Q3. For a certain group of pensioners, $q75 = 0.05$ and $q76 = 0.06$. Calculate the probability that a pensioner aged 75 exact will die between ages 75.5 and 76.5 assuming:
- a) A uniform distribution of deaths between consecutive birthdays **(10 marks)**
- b) A constant force of mortality between consecutive birthdays **(10 marks)**

- Q4. a) Calculate $1.75 p82.75$.
- i) Using the method of Uniform Distribution of Deaths **(6 marks)**
- ii) Using the method of Constant Force of Mortality. **(6 marks)**
- Basis:
 Mortality ELT15(Males)
- b) State and explain any four common laws of mortality **(8 marks)**

- Q5. a) In a special mortality table with a select period of one year, the following relationships are true for all ages:

$$0.5q_{[x]} = (0.25)q_x$$

$$0.5q_{[x]+0.5} = (0.45)q_x$$

Express $p[x]$ in terms of px .

(10 marks)

- b) Define and calculate the value of $5|_{10} q[40]+1$.
Basis: AM92 Select

(10 marks)

END