MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ACTUARIAL MATHEMATICS)

SAC 303: LIFE CONTIGENCIES

DATE: TIME:

INSTRUCTIONS: Answer question one and any other two questions

QUESTION ONE (COMPULSORY) (30 MARKS)

a)   Define the following notations.

   i. $_nq_x$.   (2 marks)

   ii. T_x.   (2 marks)

b)   Calculate:

   i. $_{12}p_{43}$ (3 marks)

   ii. $_{10|5}q_{55}$ (3 marks)

   iii. $\ddot{a}_{45:\overline{10|}}$ (5 marks)

c)   A parent who has just died left a bond in their will that provides a single payment of
£15,000 in 10 years' time. The payment of £15,000 will be shared equally between the
local cats' home and such of the parent's two sons (currently aged 25 and 30 exact) who
are then still alive. Calculate the expected present value of the share due to the cats'
home.
Basis:
Mortality AM92 Ultimate
Interest 3% per annum   (5 marks)

d) Examine the column of d_x shown in the English Life Table No. 15 (Males) in the Formulae and Tables for Examinations (Pages 68–69). Describe the key characteristics of this mortality table using the data to illustrate your points. (5 marks)

e) Show, using the random variable approach, that the expected present value of an annuity of 1 per annum payable annually in arrears to a life now aged x, deferred for n years is equal to: $a_x - a_{x:\overline{n}|}$. (5 marks)

QUESTION TWO (20 MARKS)

a) By considering a term assurance policy as a series of one year deferred term assurance policies, show that:

$$\overline{A}^1_{x:n|} = \frac{i}{\delta} A^1_{x:n|}$$

(10 marks)

b) 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. (6 marks)
   ii.   dies between ages 60 exact and 70 exact. (4 marks)

QUESTION THREE (20 MARKS)

Calculate the variance of the present value of benefits under an annuity payable to a life aged 35 exact. The annuity has payments of 1 per annum payable continuously for life.

Basis:

Mortality: µ = 0.02 throughout

Interest: δ = 0.05

QUESTION FOUR (20 MARKS)

A male life aged 52 exact and a female life aged 50 exact take out a whole life assurance policy. The policy pays a sum assured of £100,000 immediately on first death. Premiums are payable for a period of five years, monthly in advance.

Calculate the monthly premium payable.

Basis:

Mortality PMA92C20 (male life), PFA92C20 (female life)

Rate of interest 4% per annum

Expenses Nil

QUESTION FIVE (20 MARKS)

A term assurance contract for a life aged 50 exact for a term of 10 years provides a benefit of £10,000 payable at the end of the year of death. Calculate the expected present value and variance of benefits payable under this contract.

Basis:

Mortality: AM92 Select

Interest: 4% per annum