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KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATION, 2023/2024 ACADEMIC YEAR
FOURTH YEAR, SECOND SEMESTER EXAMINATION
FOR THE DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICS
KMA 420: ACTUARIAL SCIENCE III

Date:
Time:

INSTRUCTIONS TO CANDIDATES
ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS

QUESTION ONE (30 MARKS)

a) Explain what the following actuarial notations represent;
   i) T_x (1 Marks)
   ii) ${}_{n|m}q_x$ (2 Marks)

b) The following is an extract of ELT15 (Males) life table.

Age, x	l_x	d_x	q_x
60	96500	166	0.00172
61	96334	179	0.00186
62	96155	194	0.00201
63	95961	210	0.00219

From this table, calculate the probability that a life aged;
   i) 60 will survive to age 62 (2 Marks)
   ii) 61 will survive for the next 3 years (3 Marks)
   iii) 60 dies between age 62 and 64 (3 Marks)

c) A population is subject to a force of mortality $\mu_x = e^{0.0002t} - 1$
   Calculate the probability that a life aged 20 exact survives to age 70 exact. (4 Marks)

d) Calculate ${}_3P_{45.5}$ using the Uniform Distribution of Deaths assumption following the ELT15 (Females) table. (5 Marks)

e) With examples, explain the four types of assurance contracts. (6 Marks)

f) Calculate the standard deviation of a_{40} assuming AM92 mortality at 4% interest rate per annum. (4 Marks)

QUESTION TWO (20 MARKS)

a) Explain how education influences morbidity. (6 Marks)

b) Using commutation functions from AM92 mortality tables, calculate;
   i) $\ddot{a}_{40}$ (2 Marks)
   ii) $\ddot{a}_{¿¿}$ (3 Marks)

c) A 35-year old purchases policy cover with a term of 30 years. The premiums for the policy are payable annually in advance with each premium being KES 3200. Calculate the expected present value of the premiums paid given;
   Basis:
   Rate of interest 4% pa
   Mortality AM92
   Expenses Nil (4 Marks)

d) Calculate the expected present value for a contract with sum assured 50000 to life currently aged 40, and the benefit is payable at the end of year death if death occurs within the next 20 years. Based on AM92 mortality (4% interest p.a) and ELT15 (Females). (5 Marks)

QUESTION THREE (20 MARKS)

a) Outline the benefits that are usually provided by a pension scheme on retirement due to ill health. (3 Marks)

b) Using ELT15(Females) mortality tables,

i) Calculate the constant force of mortality applicable to a life aged between 67 and 68 exact. (3 Marks)

ii) Calculate the value of ${}_{0.5}q_{67.25}$ using the assumption of a constant force of mortality and the value derived in (i) above. (6 Marks)

c) A life aged 40 buys an endowment assurance contract with a sum assured of KES 25000, maturing after 25 years and paid at the end of year of death, if it occurs within the term. Calculate;

i) Expected present value of the benefit (4 Marks)

ii) Variance of the benefit (4 Marks)

Based on AM92 mortality at 4% interest p.a.

QUESTION FOUR (20 MARKS)

a) Consider the tables ELT15 (Females) and AM92 (interest at 4%), calculate;

i) $a_{50:\overline{2}|}$ (3 Marks)

ii) $A_{50:\overline{2}|}$ (3 Marks)

b) Given the following life table;

Age, x	$\mathbf{l_x}$	$\mathbf{d_x}$	$\mathbf{q_x}$
50	7896	76	0.00963
51			
52	7728		
53	7619	135	
54		189	

i) Complete the table above. (4 Marks)

Calculate;

ii) ${}_{2.5}P_{51.5}$ (based on CFM assumption) (3 Marks)

iii) ${}_{2|3}q_{50}$ (4 Marks)

c) Explain what is meant by the notation $P(T_{35}>40)$ and find its value using ELT15 (Females) table. (3 Marks)

QUESTION FIVE (20 MARKS)

a) A 20-year pure endowment with a benefit of Kshs 400000 is issued to a life aged exactly 40. Assuming interest rate to be 4% pa and AM92 mortality table applies, calculate the;

i) Expected present value of the benefits (4 Marks)

ii) Standard deviation of the benefits (4 Marks)

b) At the beginning of 2004, a life insurance company issued a number of 20-year "special" endowment assurance policies to male lives then aged 40 exact. Each policy provides a death benefit of £75,000 payable at the end of year of death and a maturity benefit of £150,000. Premiums on each policy are payable annually in advance for the term of the policy, ceasing on earlier death.

i) Calculate the annual gross premium for each policy using the following premium basis: (6 Marks)

Mortality	AM92 Select
Interest	4% per annum
Initial commission	25% of the first annual premium
Initial expenses	£400
Renewal expenses	£45 per annum at the start of the second and subsequent policy years

ii) Determine the gross premium reserve for each policy in force at the end of the eighth policy year and for each policy in force at the end of the ninth policy year, using the same basis as above. (6 Marks)