

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF
COMMERCE – INSURANCE OPTION

BCOM 347: INTRODUCTION TO ACTUARIAL SCIENCE

STREAMS: BCOM Y3S1

TIME: 2 HOURS

DAY/DATE: WEDNESDAY 07/07/2021

8.30 A.M. – 10.30 A.M.

INSTRUCTIONS:

- Answer question one and any other two questions

QUESTION ONE

- (a) Explain the following terms as used in actuarial science
- An actuary
 - Annuity in arrears
 - Annuity in advance
 - Life annuity (8 marks)
- (b) An investment promises dividends of Ksh. 45,000 payable in arrears for the next 10 years. Another similar investment promises Ksh, 14,560 also payable in arrears for the next 25 years. On which of the two options will an investor pay less to secure an annualized yield of 2% per annum? (6 marks)
- (c) Use standard notation to express the following probabilities.
- The probability of an employee age 30 surviving at age 40 (2 marks)
 - The probability that a workman aged 27 will live for 13 years but die in the next 5 years. (2 years)
- (d) A pure endowment policy with 12 years maturity is issued with a sum assured of sh. 250,000. Initial acquisition expenses are sh. 20,000. Other expenses are sh.200 on

payment of each premium and maintenance expense of 1% of the premium. The interest rate is assumed to be 5% per annum effective. The premium is an annuity due. Ignore mortality.

Required:

- (i) Explain the meaning of the term “pure endowment” as used in a policy document. (2 marks)
- (ii) Calculate premium payable after allowing for these expenses. (4 marks)
- (e) Complete the life table based on single decrement model (6 marks)

x	l_x	d_x	q_x
50	4,832,555	5,168	
51	4,121,927	5,363	
52			0.0017
53		5,929	

QUESTION TWO

- (a) In a certain population, you are given the following facts:
 - The probability that two independent lives, respectively aged 25 and 45, both survive 20 years 0.7.
 - The probability that a life aged 25 will survive 10 years is 0.9.

Find the probability that a life aged 25 will survive to age 65. (6 marks)

- (b) Supposing the survival probability function is given by $l_x = 0.1(100 - x)^{1/2}$ for $0 \leq x < 100$; Calculate the probability that
 - (i) A life aged 0 will die between exact age 19 and 36 (4 marks)
 - (ii) A life aged 36 will die before age 51 (4 marks)

- (c) The probability of an insurance claim on a particular insurance policy during the year follows a Poisson distribution whose probability density function $f(x) = p(X = x) =$

$$\frac{e^{-\lambda} \lambda^x}{x!}; x = 0, 1, 2, 3, \dots \text{ with } \lambda = 0.04. \text{ Calculate the probability that there will}$$

be:

- (i) No claim during the year of the policy (2 marks)
- (ii) Two or more claims (2 marks)

- (iii) At least one claim (2 marks)

QUESTION THREE

- (a) Determine the present value of a premium of Sh. 8000 per annum payable in advance for 10 years at an interest rate of 5% p.a. compounded quarterly. (5 marks)
- (b) A city market has five fire outbreaks in a span of 25 days. Assuming that the number of fire outbreaks per day follows distribution whose probability density function is given by

$$f(x) = p(X = x) = \frac{e^{-m} m^x}{x!}; x = 0,1,2,3, \dots \dots \dots \text{ find the probability that there will be}$$

three or more fire outbreaks in a day. (5 marks)

- (c) Compute the values of l_x , d_x , q_x and p_x to complete the table below (6 marks)

x	l_x	d_x	q_x	p_x
20	100,000	2,449		
21	97,551			0.99843
22		96	0.00099	
23	97,302		0.00069	
24		60		
25				

Hence compute and interpret the following:

- (i) $5q_{20}$ (2 marks)
- (ii) $4d_{20}$ (2 marks)

QUESTION FOUR

- (a) Discuss the role of an actuary in the insurance industry. (4 marks)
- (b) Calculate the nominal annual rate of interest assuming quarterly compounding equivalent to annual effective interest rate of 7.5% p.a. (3 marks)
- (c) You are given the following portion of a double decrement table. The table is based on the experience of a large organization. The cause for decrement are heart disease, accidents and other causes, symbolically represented by $d_x^{(1)}$ and $d_x^{(2)}$ and $d_x^{(3)}$ respectively (expressed to the nearest whole number).

x	$l_x^{(T)}$	$d_x^{(1)}$	$d_x^{(2)}$	$d_x^{(3)}$	$q_x^{(1)}$	$d_x^{(2)}$	$d_x^{(3)}$	$d_x^{(T)}$	$d_x^{(T)}$
50	??	5168	1157	4293					
51	4821927		1206	5162					
52	4810206	5618	1443	5960					
53		5929		6840	0.0625				0.99699
54	4782727					0.00045	0.00160		

Complete the table

(7 marks)

Hence compute the following from the table

(i) $2d_{51}^{(3)}$ (2 marks)

(ii) $3p_{50}^{(T)}$ (2 marks)

(iii) $2q_{51}^{(1)}$ (2 marks)