CHUKA   **UNIVERSITY**

UNIVERSITY EXAMINATIONS

SECOND YEAR EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE (ACTUARIAL SCIENCE)

ACMT 201: ACTUARIAL MATHEMATICS I

STREAMS: BSC   **TIME: 2 HOURS**

DAY/DATE: FRIDAY 13/12/2019   **8.30 A.M. – 10.30 A.M.**

INSTRUCTIONS:
- **Answer question ONE (compulsory) and any other TWO questions.**

QUESTION ONE (30 MARKS)

(a)   Consider mortality investigation over a period of three years from 1 January 2010 to 1 January 2013. List the data required per the exact calculation of central exposed to risk of lives aged x last birthday.   (4 marks)

(b)   Below are policyholders aged 40. Last birthday on 1 January for a local life office.

Calendar year	Policyholder aged 40 last birthday on 1 Jan
2010	5,200
2011	4,925
2012	4,615
2013	4,830
2014	4,111

Estimate E_{40}^{C} based on above information.   (5 marks)

(c)   State three reasons of graduating experience rates.   (3 marks)

(d)   Highlight six characteristics known from experience to have significant effect on mortality that a given observation data can be subdivided into.   (3 marks)

(e)   The graduated estimates should be also compared with other experiences to see if they behave as expected. Give three types of checks that would be considered. (3 marks)

(f)   Define risk classification.   (2 marks)

(g)   What is careful underwriting the context of life insurance?   (3 marks)

(h)   List four factors that could adversely affect the mortality of ghocyeless person in developed country.   (4 marks)

(i)   Highlight three desirable features of graduation.   (3 marks)

QUESTION TWO (20 MARKS)

(a)   State three factors that could lead to working with incomplete data when computing $E_X^{/C}$ (3 marks)

(b)   Consider a medical investigation that covered the period 1 January 2011 to 1 January 2012. Let $P_x(t)$ denotes the number of lives at time t aged x last birthday. Below data were recorded for each of x
       $dx =$ number of death aged x last birthday.
       Obtain an expression for the initial exposed based on above stating your assumptions.
                                                                                       (8 marks)

(c)   The following data was collected in a mortality investigation covering the period 1 January 2006 to 1 January 2009 in respect of three lives.

	Date of Birth	Date of Joining	Date of exit	Reasons for exit
Person A	1July 1956	08 March 2004	-	-
Person B	1 Sep 1958	01 Oct 2008	-	-
Person C	1 Oct 1956	01 January 2007	1 July 2007	Death

       Calculate the contribution of the above three lives to central exposed to risk and initial exposed to risk at age 50 last birthday.   (9 marks)

QUESTION THREE (20 MARKS)

(a)   A certain city in Africa had an investigation of the mortality of persons aged between 50 and 80 years who are known to be suffering from a certain disease. An actuary suggest that the crude estimates be graduated using the formula

$$U_{x+\frac{1}{2}} = \exp[C_0 + C_1\left(x + \frac{1}{2}\right) + C_2(x + \frac{1}{2})^2]$$

       (i)   Explain why this might be sensible formula to choose for this class of lives.
                                                                                       (6 marks)
       (ii)   Suggest two techniques which can be used to perform the graduation. (2 marks)

(b)   Which one of the three methods of graduation you think would be most appropriate in each of the following situation, giving reasons.

    (i)   Investigating the proportion of policyholder surrendering particular type of endowment policy at different duration for use in profit test calculation.

    (ii)   Investigating mortality rates in third world country as part of an international comparison study.

    (iii)   Investigating mortality rates over the last century in a small town to display in a historical exhibition at the town centenary celebration.   (12 marks)

QUESTION FOUR (20 MARKS)

(a)   Describe seven key principle factors contributing to variation in mortality. (14 marks)

(b)   Classify the possible source of selection that might influence risk levels in the following select group in the context indicated

    (i)   Mortality study based on nurses for population mortality.

    (ii)   People being interviewed in the street for market research.

    (iii)   Mortality study based on people earning over Ksh. 100,000 per annum for life insurance cover.   (6 marks)

QUESTION FIVE (20 MARKS)

(a)   Discuss the suitability of crude death rates the standardized mortality rates and standardized mortality ration for comparing the mortality at different time of the population of a given country.   (5 marks)

(b)   The below data gives a summary of mortality for one of occupational group and for country as whole.

Age group	Occupation Y Exposed to risk	Death	Whole Country Exposed to risk	Death
25 – 39	14,000	50	900,000	2,900
40 – 54	11,000	72	1,300,000	6,900
55 – 70	9,000	107	700,000	6,800
Total	34,000	229	2,900,000	16,600

Calculate the crude death rates, the standardized mortality rates and standardized mortality ratio for occupation Y.   (15 marks)