

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE

ACMT 404: MATHEMATICS OF DEMOGRAPHY AND GRADATION

STREAMS: BSC

TIME: 2 HOURS

DAY/DATE: MONDAY 16/12/2024

8.30 A.M – 10.30 A.M.

INSTRUCTIONS:

QUESTION ONE (30 MARKS)

- A. Give three definitions of demography (6 marks)
- B. Differentiate between De-facto and De-jure when it comes to the methods of enumeration used in Demography. (4 marks)
- C. The following data refers to some certain farmers and doctors between exact ages 60 and 65.

Farmers		Doctors		
$E_{65.5}^c$	$\Theta_{65.5}$	$E_{65.5}^c$	$\Theta_{65.5}$	
8,453	83	25,858	345	

Let the true central death rates of the two occupations between ages 60 and 65 be m_1 , and m_2 respectively. Find an approximate 95% confidence interval for $m_1 - m_2$. (6 marks)

- D. Suppose the sex ratio at birth in a given population was found to be 113:100, then assuming a sex ratio at birth of 105 male births to a 100 females, find the number of female births per 113 males. (3 marks)
- E. Explain the types of rate used in demography. (6 marks)
- F. List five sources of errors in fertility data. (5 marks)

QUESTION TWO (20 MARKS)

- A. Define population growth rate and deduce its formula. (4 marks)
- B. Explain the two simple models and patterns of population growth. (4 marks)
- C. List and explain four uses of pyramid scheme. (8 marks)

D. At a certain elderly age x , the following data have been recorded in a certain investigation.

i	d_i	b_i	d_i	
1	0.00	1.00	0	
2	0.25	1.00	0	
3	0.00	1.00	1	
4	0.25	0.75	1	

Calculate q_x , maximum likelihood estimator of q_x , assuming that deaths are uniformly distributed between ages x and $x+1$ **(4 marks)**

QUESTION THREE (20 MARKS)

A. Suppose that E_x lives in the present at age x , and are subject to the models of decrement d (mortality) and w (withdrawal) , Show that the actuarial estimate of the mortality rate at age x is

$$q_x^d = \frac{\theta_x^d}{E_x - \frac{1}{2\theta_x^w}} \quad (4 \text{ marks})$$

- B. Give two assumptions under which the chi-square –test work and explain three steps or procedures for the test of chi-square. **(10 marks)**
- C. A graduation covers 20 age groups and has resulted in 6 positive and 14 negative deviations. Carry out a signs test on these data. **(3 marks)**
- D. List three methods of collecting data. **(3 marks)**

QUESTION FOUR (20 MARKS)

- A. List and explain two advantages and three disadvantages of vital registration as a source of data. **(10 marks)**
- B. If the total number of births in a given population is 32,503 and we assume the sex ratio at birth to be 103 male births per 100 female births in that population. How many boys and girls are there in that population? **(5 marks)**
- C. Define crude death Rate (CDR) and state its two formulas. **(5 marks)**

QUESTION FIVE (20 MARKS)

- A. State the relationship between the crude death rate and age specific death rate. **(2 marks)**
- B. Elaborate the four phases that a logistic growth curve is divided into. **(8 marks)**
- C. List and explain three methods of graduation. **(6 marks)**
- D. The following table gives the exposed to E_{40} and the deaths θ_{40} for a certain male and female tuberculosis patients in Kenya.

	Exposed to risk	death
Males	221	68
Females	194	83

Test at 1% significance level, the hypothesis that the true rate of mortality at age 40 is the same for both sexes. **(4 marks)**
