



KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

INSTITUTION BASED PROGRAMME

DECEMBER SESSION EXAMINATION FOR THE DEGREE OF MASTER OF SCIENCE

SMA/SS/568: DEMOGRAPHIC METHOD

DATE: Thursday 3rd May, 2012

TIME: 9.00 a.m. – 12.00 p.m.

INSTRUCTIONS: Answer any *THREE* questions.

- Q1. (a) Define the term “parity progression ratio”. What does it measure? Show that the completed family size is given by
- $$a_0 + a_0a_1 + a_0a_1a_2 + \dots$$
- where a_i denotes the parity progression ratios. [4 marks]
- (b) Breast feeding is increasingly been encouraged to mothers as opposed to infant formula milk. Comment. [6 marks]
- (c) Distinguish the difference between “Morbidity” and “Mortality”. Considering Kenya as a Case Study compare the pattern of morbidity in developed and developing countries. [6 marks]
- (d) A population evolves over a long period of time according to the Leslie matrix

$$T = \begin{bmatrix} 0.5 & 1.4 & 0.35 \\ 0.8 & 0.0 & 0.0 \\ 0.0 & 0.70 & 0.0 \end{bmatrix}$$

Show that 1.4 is an eigen value of this matrix. If after a long period of growth the population has eventually reached 1,000,000. Calculate the numbers in each age band.

[9 marks]

Q2. (a) Life Table for Males USA 1978

Age x	Number of survivors l_x	Expected number of years lived after x e_x^0
0	100,000	73.30
20	97,051	51.43
40	93,045	33.19
60	78,213	17.10
80+	46,183	6.38

Source: US bureau of census.

Stating any assumption made, calculate the

- (i) male crude birth rate. [2 marks]
 - (ii) expected number of males who will die aged 60 – 80 out of 5,000 males now aged 40 – 60. [5 marks]
 - (iii) average age at death of those who die aged 40 – 60. [6 marks]
 - (iv) expectation of a life of a male reaching his 80th birthday. [2 marks]
 - (v) age specific death rate for males aged 20 – 39. [3 marks]
- (b) Prove the following inequality

$$\frac{M_x}{1 + M_x} \leq q_x \leq M_x \leq \frac{q_x}{1 - q_x} \quad [5 \text{ marks}]$$

where q_x and M_x have their usual meaning.

Q3. (a) Distinguish between a stable and a stationary population. [2 marks]

Given the Leslie matrix

$$T = \begin{bmatrix} 0.6 & 0.5 & 0 & 0 \\ 0.8 & 0 & 0 & 0 \\ 0 & 0.75 & 0 & 0 \\ 0 & 0 & 0.4 & 0.4 \end{bmatrix}$$

Show that the rate of natural increase for a population with this Leslie matrix is zero.

[5 marks]

- (b) A female population is divided into four age groups at time t. If $V(t)$ is a column vector whose elements are the number of women in successive age groups at time t, show that there exist a transition matrix T such that

$$T V(t) = V(t + 20)$$

where $T = \begin{bmatrix} f_1 & f_2 & 0 & 0 \\ p_1 & 0 & 0 & 0 \\ 0 & p_2 & 0 & 0 \\ 0 & 0 & p_3 & p_4 \end{bmatrix}$ [8 marks]

- (c) Prepare a projection of the number of Australian females in the year 2001.

Age	1961	1981
0-19	2041	2270
20 – 39	1485	1942
40 - 50	1211	1322
60+	575	1071

[8 marks]

Number of births 1961 – 1981 was 2,315,000 to women aged 20 – 39.

- Q4. (a) What is a life table? [1 mark]

A stationary population experiences mortality defined by the survivorship function

$$l(x) = 1 - \frac{x^3}{w^2} \quad 0 < x \leq w$$

- (i) Derive an expression for the instantaneous death rate $\mu(x)$ at age x . What is the value of $\mu(x)$ as x reaches the ultimate age w . [6 marks]
- (ii) Suppose the ultimate age $w = 110$. Calculate the instantaneous death rate at age 0 and age 1. Comment on the use of $l(x)$ in human populations. [7 marks]

- (b) The following is data of a certain unnamed country:

Age at death	Under 1 day	1 day – 6 days	7 days – 27 days	1 month – 3 months	3 months – 6 months	6 months – 12 months
Number of deaths	16199	8801	2912	4776	3758	3001

Calculate the separation factor. Using this factor

- (i) Compare the number of exogenous and endogenous deaths.
- (i) Identify whether the unnamed country is a developing or developed country. [9 marks]

- Q5. (a) List down the various indices used to measure Fertility. Which of these is the most commonly used. Give reasons. [6 marks]

- (b) Data on Fertility in Kenya.

Age Group	Age specific fertility rates (per 1,000)				
	Year				
	1978	1989	1993	1998	2003
15 - 19	168	152	110	111	114
20 – 24	342	314	257	248	243
25 – 29	357	303	241	218	231
30 – 34	293	255	197	188	196
35 – 39	239	183	154	109	123
40 – 44	145	99	70	51	55
45 - 49	59	35	50	16	15

Source: Demographic and Health Survey, Kenya 2003, using the above data.

- (i) Calculate the average number of children per woman in Kenya in the period 1978-2003.
- (ii) Comment on the trend of fertility in Kenya. Explain the reasons of the gradual increase in 2003.
- (iii) Estimate the gross reproduction rates and state which extra information you need to calculate Net reproduction rates. [13 marks]
- (c) What is mortality? Give reasons why mortality in developing countries is higher than in developed countries. [4 marks]

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