



MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING, APPLIED SCIENCES &
TECHNOLOGY

DEPARTMENT OF APPLIED STATISTICS

MODULE: DEMOGRAPHY

CODE: HAST 422

SESSIONAL EXAMINATIONS

APRIL 2023

DURATION: 3 HOURS

EXAMINER: MR J. MANYEMBA

INSTRUCTIONS

1. Answer **All** in Section A
2. Answer **Three** questions in Section B.
3. Start a new question on a fresh page
4. Total marks 100

Additional material(s): Non-programmable electronic scientific calculator,
Statistical Tables.

SECTION A [40 marks]

Answer **ALL** Questions being careful to number them A1 to A4.

A1. Contrast each of the following terms:

(a) Maternal mortality rate and Maternal Mortality Ratio, [4]

(b) Reproductivity and Fertility, [4]

A2. The population of Zimbabwe according to the 1992 national census was as in the table below.

Age Group	Male Population	Female Population	Total Population
0-4	788 963	795 728	1 584 691
5-9	821 319	832 469	1 653 788
10-14	724 905	731 846	1 456 751
15-19	615 728	632 510	1 248 238
20-24	466 837	523 060	989 897
25-29	335 713	376 495	712 208
30-34	280 066	326 299	606 365
35-39	229 360	259 555	488 915
40-44	174 266	189 509	363 774
45-49	145 437	143 441	288 878
50-54	133 261	147 339	280 600
55-59	94 713	86 729	181 442
60-64	95 510	84 213	179 723
65-69	51 202	50 902	102 104
70-74	58 279	62 479	120 758
75+	67 978	86 437	154 415
TOTAL	5 083 537	5 329 011	10 412 548

Using the data in the table above, calculate the

(a) Dependence Ratio, [3]

(b) Child-Woman Ratio, [3]

(c) Sex-Ratio for children, and [3]

(d) Sex-Ratio for the aged, i.e. from 65 years and above. [3]

(e) Give one reason for the differences in the Sex-Ratio in (c) and (d) above. [3]

A3. (a) Contrast the terms NRR and GRR . [3]

(b) Prove that $NRR \leq GRR$. [4]

A4. State any two types of census and briefly explain what is involved in each of the methods. Also state the advantages and disadvantages of each method. [10]

SECTION B [60 marks]

Answer any **THREE** Questions being careful to number them B5 to B8.

- B5.** (a) The population of Zimbabwe in 2002 was 11.1 million and in 2012 was 13.1 million.
- (i) Assuming that the population growth follows a geometric pattern, estimate the population size for the year 2016. [6]
 - (ii) State two advantages and two disadvantages of the geometric model. [4]
- (b) Briefly describe each of the given models for estimating the population size and clearly outlining the strength and weaknesses of each model ,
- (i) linear interpolation model, [3]
 - (ii) logistic model, and [3]
 - (iii) component model. [4]
- B6.** The following data gives information on the fertility and survival rates for females in a certain country. The sex ratio at birth is 98 females to 100 males.

Age-group	f_x (daughters)	${}_5L_x/{}_5L_0$
15-19	0.095	0.919
20-24	0.152	0.901
25-29	0.161	0.878
30-34	0.110	0.769
35-39	0.103	0.732
40-44	0.085	0.706
45-49	0.045	0.006

Calculate the following:

- (a) the mean age at child bearing, [3]
- (b) the median age at child bearing, [3]
- (c) Gross Reproductive Rate, [2]
- (d) Total Fertility Rate, [2]
- (e) Net Reproductive Rate, [3]
- (f) Mean length of a generation, and [3]
- (g) intrinsic rate of increase using Coale's approximation. [4]

B7. (a) Given that the force of mortality μ_x is defined as $\mu_x = -\frac{1}{l_x} \frac{dl_x}{dx}$, show that

$$(i) \quad l_x = \int_0^{w-x} \mu_{x+t} \cdot l_{x-t} dt \quad [3]$$

$$(ii) \quad d_x = \int_0^1 \mu_{x+t} \cdot l_{x+t} dt \quad [3]$$

$$(iii) \quad {}_nq_x = \int_0^n \mu_{x+t} \cdot t p_x dt \quad [4]$$

(b) Suppose that the probability of having k sons follows the distribution,

$$p_k = (0.2473)(0.4718)^{k-1}, \quad p_0 = 0.5318$$

Determine the probability of extinction of the male line. [10]

B8. The hypothetical replacement rates per annum of electric poles (i.e. the probability at the beginning of the year that a pole will in the next 12 months be in such a state that it must be replaced) are given in the table below:

Year	Replacement rate
1	0.1
2	0.2
3	0.3
4	0.4
5	0.5
6	0.6
7	0.7
8	0.8
9	0.9
10	1.0

(a) Five hundred new poles have just been erected. Draw up a life table showing l_x , p_x , q_x , d_x , L_x , T_x and e_x^0 . [10]

(b) What is the probability that a pole erected three years ago will last at least three more years? [2]

(c) If it is the policy of the authority to paint poles as soon as they have been standing for five years, how much would it cost them a year at \$15 a pole to get a contractor to do the job? [4]

(d) A firm supplies 200 poles per year is thinking of guaranteeing its poles for 2 years. If the cost of replacement is \$35 per pole, what is the expected cost per annum of the guarantee? [4]

END OF EXAMINATION PAPER