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**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

**UNIVERSITY EXAMINATIONS  
2021 / 2022 ACADEMIC YEAR**

**SECOND YEAR SECOND SEMESTER REGULAR EXAMINATIONS FOR THE  
DEGREE OF BACHELOR OF SCIENCE IN APPLIED STATISTICS WITH  
INFORMATION TECHNOLOGY & BACHELOR OF SCIENCE IN MATHEMATICS  
WITH ECONOMICS**

**COURSE CODE: STA 246**

**COURSE TITLE: STATISTICAL DEMOGRAPHY**

**DATE: 26<sup>TH</sup> APRIL, 2022**

**TIME: 12 P.M – 2 P.M**

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**INSTRUCTIONS:**

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**INSTRUCTIONS TO CANDIDATES**

This paper consists of FIVE Questions.  
Answer question 1 (compulsory) and any other TWO questions .

Time: 2 hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over

**QUESTION ONE (30 MKS)**

- a. State and explain 5 determinants of Fertility. (10 marks)
- b. Using the life tables for Brazil 1950 (table 1 &2), given at the back of this question paper, estimate the following measures stating clearly any assumptions you are making.
  - i. In 1946, there were 338558 female births, estimate the number of girls aged last birthday on 31/12/1951 (6 marks)
  - ii. A couple aged (both) 25 years have male twins. What is the probability that one parent or both will die before either of the sons in the next 10 years. (9 marks)
- c. Define infant mortality hence, use the data given below to calculate the infant mortality rate by product formula.

1959	1960
11186	11865
5116	5263

181740 births in 1959

186476 births in 1960

(5 marks)

**QUESTION TWO (20 MKS)**

- a. Distinguish between the following terms
  - i. Fertility and fecundity (2 marks)
  - ii. Census survey and sample survey (2 marks)
  - iii. Stationary population and stable population (2 marks)
  - iv. Immigration and Emigration (2 marks)
- b. Using the table below, calculate the crude death rate and the age specific death rates for England and Wales. (6 marks)

ENGLAND AND WALES 1971	Ages	0-1	1-4	5-14	15-24	25-44	45-64	65-74	75+
	Population in (000')	380.1	1530.7	3776.7	3493.5	5873.6	6089.6	2417.2	1534.2
	5747	980	892	1432	1643	44028	64007	155368	278887

- c. State and explain 6 factors that affect mortality. (6 marks)

**QUESTION THREE (20MKS)**

- a.
  - i. What is a life table? (1 mark)
  - ii. State and explain 5 uses of a life table. (5 marks)

b. Life table for males in USAn(1978)

Age in years	Survivors to exact age	Person years lived above age x
X	lx	Tx
0	100,000	7,330,600
20	97,051	4,991,021
40	93,045	3,088,262
60	78,213	1,337,299
80	46,183	294,850

From the above life table, calculate;

- i. The crude birth rate (3 marks)
- ii. Of 5,000 men now aged 20 the expected number who will die aged 60-80 (3 marks)
- iii. The average age at death of those males who die aged 40-60 (5 marks)
- iv. The expectations of life for a male reaching his 80<sup>th</sup> birthday (3 marks)

**QUESTION FOUR (20 MKS)**

- a. Distinguish between the following terms; (6 marks)
  - i. Age specific fertility rate and Total fertility rate
  - ii. Crude birth rate and General fertility rate
  - iii. Gross reproductive rate and Net reproductive rate
  
- b. Show that the average family size can be expressed as  $a_0 + a_0a_1 + a_0a_1a_2 + \dots$  where parity progression ratio  $a_i$  is as follows;  $a_i = \frac{\text{no. of women with } (i+1)^{\text{th}} \text{ or more children}}{\text{no. of women with } i^{\text{th}} \text{ or more children}}$  (4 marks)
  
- c. A maternity hospital delivers 10 newborn babies per week, 30% of them leave the hospital within a week, 10% of the remaining one week babies leave the hospital before they are two weeks old, 20% leave before they are three weeks old, 40% of the remaining before they are four weeks old and 70% of the remaining before they are five weeks old and the remainder before they are six weeks old.
  - i. How many cots are needed? (7 marks)
  - ii. At any one time, what is the average stay in the hospital? (3 marks)

**QUESTION FIVE (20 MKS)**

- a. State 4 assumptions used in population projection. (4 marks)
- b. Using the data below, prepare a projection of the number of females in the year 2029, given that the number of live births between the years 1989-2009 was 41410. (16 marks)

Age group	0 – 19	20 – 39	40+
1989	36670	30540	29168
2009	40241	35321	34321

**BRAZIL 1950 HYPOTHETICAL DATA**  
**TABLE 1 (MALE LIFE TABLE)**

x	$nq_x$	$l_x$	$nd_x$	$nL_x$	$nm_x$	$T_x$	$e^0_x$	x
0	0.176589	100000			0.199680			0
1	0.095046	82341	7826	307545	0.025447			1
5	0.26729	74515	1992	367596	0.005418	3718609	49.904	5
10	0.019711	72523	1430	359044	0.003981	3351013	46.206	10
15	0.028098	71094	1998	350749		2991970	42.805	15
20	0.039718	69096	2744	338807		2641221	38.225	20
25	0.043638		2895	324611		2302414	34.700	25
30	0.050079	63457	3178	307478	0.010268	1977804	31.168	30
35	0.059282	60279	3573	292661	0.012210	1668325	27.677	35
40	0.073137	56705	4147	273392	0.015170	1375664	24.260	40
45	0.089425	52558	4700		0.018699	1102272	20.973	45
50		47858	5635	225567	0.024900	850923	17.780	50
55		42223	6446	195400	0.032990	625356	14.811	55
60	0.211066	35777	7551	160345	0.047094	429956	12.018	60
65	0.285906	28226	8070	121020	0.066682	269611	9.552	65
70	0.390500	20156	7871	80767	0.097451	148590	7.372	70
75	0.525958	12285	6461	44468	0.145306	67824	5.521	75
80	0.688975	5824	4012	18118	0.221449	23356	4.011	80
85+	1.000000	1811	1811	5238	0.345824	5238	2.892	85+

**TABLE 2 (FEMALE LIFE TABLE)**

x	$nq_x$	$l_x$	$nd_x$	$nL_x$	$nm_x$	$T_x$	$e^0_x$	x
0	0.149948	100000	14995	90468	0.165747	4413308	44.133	0
1	0.94095	85005	7999	318000	0.025153	4322839	50.854	1
5	0.027503	77007	2118	379738	0.005577	4004839	52.006	5
10	0.021743	74889	1628		0.004396	3625101	48.407	10
15	0.299274	73260	2145	381153	0.005938	3254722	44.427	15
20	0.037216	71116	2647	349115	0.007581	2893570	40.688	20
25	0.042055	68469		335245	0.008589	2544455	37.162	25
30	0.047540	65590		320243	0.009737	2209209	33.682	30
35	0.053022	62472	3312	304153	0.010891	1888966	30.237	35
40	0.058905	59159	3485	287176	0.012135	1544812	26.789	40
45	0.067393	55674	3752	269233	0.013936	1297637	23.308	45
50	0.089431	51922	4643	248380	0.018695	1028403	19.809	50
55	0.117598	47279	5560	223016	0.024930	780023	16.498	55
60	0.171275	41719	7145	191287	0.37354	557007	13.351	60
65	0.238011		8229	152695	0.053891	365720	10.578	65
70	0.344072			109067	0.083109	213025	8.086	70
75	0.477467	17280	8251	65118	0.126704	103958	6.016	75
80	0.655076	9029	5915	29290	0.201947	38840	4.301	80
85+	1.000000	3112	3114	9550	0.326131	9550	3.066	85+