

MACHAKOS UNIVERSITY

University Examination 2017/2018

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FOURTH YEAR SECOND SEMESTER

STA 400: DEMOGRAPHY AND VITAL STATISTICS

INSTRUCTIONS: Answer Questions ONE and any other TWO questions

QUESTION ONE (30 MARKS)

- a) Define the following terms [4 Marks]
- i) Fecundability
 - ii) Fertility
 - iii) Nuptiality
 - iv) Demography
- b) Define vital statistics and state 4 uses of vital statistics [5 Marks]
- c) Distinguish between stationary population and stable population [4 Marks]
- d) Describe three techniques of adjusting Infant Mortality Rate [3 Marks]
- e) Using age distribution data for a West African country (1960), determine the extent of heaping on Digit '0' and '5', Digit '0' only and Digit '5' only. [5 Marks]

Age	Population	Age	Population
23	38687	25	77141
24	51289	30	110379
26-29	201450	35	64091
31-34	132136	40	81515
36-39	134140	45	44654
41-44	84422	50	52024
46-49	77102	55	14024
51-54	44751	60	38377
56-59	45283		
60	38377		
61	4779		

- f) Fill in the blanks in the life table below [5 Marks]

Age x	l_x	d_x	p_x	q_x	L_x	T_x	e_x
4	95,000	500	?	?	?	4,850,300	?
5	?	400	?	?	?	?	?

- g) Describe the advantages and disadvantages of graduating a set of observed mortality rates using a parametric formula. [4 Marks]

QUESTION TWO (20 MARKS)

The following table gives the population of a country for some given year with estimated number of births based on a special vital statistics inquiry conducted in the country. Compute: [20 Marks]

- i) CBR
- ii) GFR
- iii) TFR
- iv) GRR
- v) NRR
- vi) CDR for Males
- vii) CDR for Females
- viii) CDR for Total Population

Age	Males		Females		Births		Survival Rates
	Population	Deaths	Population	Deaths	Males	Females	
0 to 4	442,532	18,623	434,980	17,308	-	-	0
5 to 9	419,042	1,809	416,736	1,709	-	-	0
10 to 14	393,543	984	384,616	1,638	-	-	0
15 to 19	308,269	1,233	314,056	1,329	3,578	3,343	0.914
20 to 24	257,852	1,289	269,340	1,481	7,293	6,690	0.899
25 to 29	230,629	1,776	236,187	1,677	6,775	6,361	0.844
30 to 34	204,188	1,633	203,477	1,465	4,233	4,187	0.868
35 to 39	182,270	1,588	176,534	1,289	2,999	2,685	0.852
40 to 44	162,509	1,967	145,037	1,233	593	725	0.834
45 to 49	128,784	2,138	122,946	1,352	129	125	0.819
50 to 54	102,971	1,905	96,589	1,188	-	-	0
55 to 59	80,717	2,478	78,311	1,605	-	-	0
60 to 64	58,899	3,099	58,142	1,980	-	-	0

65 to 69	37,797	2,428	39,099	2,468	-	-	0
70 & Above	45,099	5,981	48,866	7,175	-	-	0

QUESTION THREE (20 MARKS)

- a) Two stable populations embody the same fertility schedule but different mortality schedules. In both populations, 20% of women between exact age 45 to 55 bear a female child annually. No child bearing occurs outside their span. In population A, there is no mortality until age 100 where all who reach that age perish. In population B, 1% of each cohort dies within each jusingle year of age with no survivors beyond age 100.

i) Compute GRR, NRR and r for each population. [3 Marks]

ii) Determine the birth rate and the death rate of each. [3 Marks]

- b) The values of l_x , viz, the number of persons living at age x are given below

x	102	103	104	105	106	107	108
l_x	97	59	32	25	6	2	0

Compute the remaining entries of the life table for $x > 102$

[6 Marks]

- c) Calculate General Fertility Rate, Specific Fertility Rates, Total Fertility Rate and Gross Reproduction Rate from the following data given that out of 9.00 births, the number of females is 4,300 [8 Marks]

Age-group (years)	16-20	21-25	25-30	31-35	36-40	41-45	46-50
No. of Women	25	24	20	16	15	12	8
No. of Live Births	1140	3000	2740	1360	600	150	10

QUESTION FOUR (20 MARKS)

Give the an abridged Life table below

An Abridged Life Table						
Age Interval	${}_nQ_x$	l_x	${}_nd_x$	L_x	T_x	e
00-01	0.02592	100000	2592	97408	6892855	68.93
1-5	0.0042	97408	409	387996	6795447	69.76

5-10	0.00232	96999	225	483869	6407451	66.06
10-15	0.00201	96774	195	482897	5923582	61.21
15-20	0.00443	96579	428	480757	5440686	56.33
20-25	0.00611	96151	587	477820	4959928	51.58
25-30	0.00632	95564	604	474800	4482108	46.90
30-35	0.00654	94960	621	471695	4007308	42.20
35-40	0.01098	94339	1036	466516	3535613	37.48
40-45	0.01765	93303	1647	458282	3069097	32.89
45-50	0.02765	91656	2534	445610	2610815	28.48
50-55	0.04387	89122	3910	426061	2165205	24.29
55-60	0.05987	85212	5102	400553	1739144	20.41
60-65	0.09654	80111	7734	361884	1338591	16.71
65-70	0.13654	72377	9882	312472	976707	13.49
70-75	0.18765	62494	11727	253837	664235	10.63
75-80	0.25439	50767	12915	189263	410399	8.08
80-85	0.37887	37853	14341	117557	221135	5.84
85-90	0.47898	23511	11261	61250	103578	4.41
90-95	0.57908	12250	7094	25781	42329	3.46
95+	1	5156	5156	16548	16548	3.21

- i) 5-year Survival Rate [3 Marks]
- ii) calculate a rate to survive women ages 25–29 into the next 5-year age cohort (30–34) [5 Marks]
- iii) Surviving the youngest age cohort [3 Marks]
- iv) Surviving the oldest age cohort [3 Marks]
- v) Develop a 10-year survival rate to determine how many women ages 50–54 are expected to live to be 60–64 years of age. [6 Marks]

QUESTION FIVE (20 MARKS)

- a) Calculate the cohort probability of infant death for Kenya in (1990) given below

[4 Marks]

Year	Birth Cohort	Births	Deaths	Infant Deaths
1989	1989	4,040,958	39,655	33,645
1990	1989	--		5,861
1990	1990	4,158,212	38,351	32,490
1991	1990	--		5,657
1991	1991	4,110,907	36,766	31,109

Obtain from the life table

- i) The probability that one aged 20 will live for 5 years more [3 Marks]
- ii) The probability that one aged 20 will die in their 30th year of age [3 Marks]
- b) Starting with 10,000 persons of age, construct a mortality table upto age 30, using the following values of (q_x) mortality rates. [10 Marks]

x	20	21	22	23	24	25	26	27	28	29	30
q_x	0.0127	0.0132	0.0137	0.0142	0.0147	0.0153	0.0159	0.0166	0.0174	0.0183	0.0193