KISII UNIVERSITY
UNIVERSITY EXAMINATIONS
FOURTH YEAR EXAMINATION FOR THE AWARD OF THE DEGREE OF BACHELOR OF SCIENCE IN ACTUARIAL SCIENCE
FIRST SEMESTER 2022/2023
[SEPTEMBER-DECEMBER, 2022]

BACS 410: MATHEMATICS FOR DEMOGRAPHY

STREAM: Y4S1   **TIME: 2 HOURS**

DAY: THURSDAY, 3:00 – 5:00 PM   **DATE: 15/12/2022**

INSTRUCTIONS
1. *Do not write anything on this question paper.*
2. *Answer question ONE and any other TWO questions in Section B.*

SECTION A (30 MARKS)

QUESTION ONE (30 MARKS)

a) Define Vital Statistics and state 4 uses of vital statistics   (5marks)
b) What is your understanding of the term formal demography?   (2marks)
c) Explain the three major categories of fetal deaths recommended by WHO.
                                                                                (3marks)
d) Explain the two methods used in demography to correct age errors in the data collected by demographers.   (2marks)
e) Explain the meaning of the rates of mortality usually denoted q_x and m_x and the relationship between them.   (3marks)
f) The following table represents data collected from a sample selected from a population. the demographer believes that these data contain some irregularities. use the method of carrier-farrag graduation method to either approve or disapprove his fears.   (10marks)

Age group	Enumerated Population Quinary
5-9	736169
10-14	573723
15-19	425970
20-24	338311
25-29	352284

30-34	305756
35-39	259617
40-44	199129
45-49	170264
50-54	149483
55-59	98073
60-64	99448
65-69	62115
70-74	54992
75-79	28013
80-84	26746
85+	34041

g) Calculate the indirectly standardized crude death rates for populations one and two by using standard population. (5marks)

Age group	Population 1		Population		Standard population	
	rate	proportion	Rate	proportion	Rate	proportion
1	30	0.8	32	0.3	20	0.6
2	15	0.2	16	0.7	35	0.4

SECTION B
QUESTION TWO (20 MARKS)

(a) List any five factors that contribute to increase of maternal mortality in developing countries as discussed by WHO. (5marks)

(b) You are given the following data extracted from a survey done by InfoTrack in 2014 .use the Myers blended index to assess the quality of this collected age data. (10marks)

Digit	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-9
0	386	417	307	190	89	50	50	40	10
1	133	93	90	89	35	33	33	10	2
2	341	227	100	40	25	15	15	6	4
3	223	160	90	46	22	8	8	5	1
4	201	138	50	38	10	8	8	5	3
5	298	238	201	154	65	25	25	2	3
6	198	105	70	49	18	12	12	6	4
7	166	86	50	45	9	5	5	4	2
8	255	100	90	40	10	5	5	5	2
9	132	85	40	20	6	2	2	2	2

(c) Compare the smoothness of rates in graduation (A) and (B) over range of ages 40-45 years. (5marks)

	A	B
X	q_x^0	q_x^0
40	0.001056	0.000867
41	0.001167	0.001018
42	0.001290	0.001215

43	0.001426		0.001494				
44	0.001576		0.001701				
45	0.001742		0.001945				

QUESTION THREE (20 MARKS)

(a) 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:

Ages	males		Females		Births		Survival rates
	population	deaths	Population	Deaths	males	Female	
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	128	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

i.   CBR , GFR ,TFR ,GRR   (4marks)

ii.   NRR , CDR for Males ,CDR for Females, CDR for Total Population. (6marks)

(b) Describe the 3 methods of obtaining vital statistics   (3marks)

(c) Discuss any two major errors in age data   (2marks)

(d) Define

   i.   Stationary Population   (2marks)

   ii.   Stable Population   (3marks)

QUESTION FOUR (20MARKS)

(a) The following represents data extracted from current survey conducted in central Kenya. Use the united nation age sex accuracy index to assess the age sex reporting of these data given below   (10marks)

Age Group	Male population	Female population
0-4	2376	2350
5-9	1983	1972
10-14	1628	1614
15-19	1277	1265
20-24	997	986
25-29	807	779
30-34	661	644
35-39	551	533
40-44	394	378
45-49	267	278
50-54	194	228
55-59	161	200
60-64	136	163
65-69	103	123
70-74	75	79
75-79	62	59

(b) Starting with 10,000 persons of age, construct a mortality table up to age 30, using the following values of (q_x) mortality rates.   (6marks)

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

Obtain from the life table
   i.   the probability that one aged 20 will live for 5 years more.   (2marks)
   ii.   the probability that one aged 20 will die in their 30th year of age. (2marks)

QUESTION FIVE (20 MARKS)

(a) Define over graduation and under graduation.   (4marks)

(b) What are the aims of graduation?   (4marks)

(c) Describe two important observations on suitability of graduation. (4marks)

(d) Describe three possible shortcomings in a graduation which the chi squared test cannot detect, and state a test which can be used to detect each one.   (4marks)

(e) Describe the advantages and disadvantages of graduating a set of observed mortality rates using a parametric formula.   (4marks)