বিদ্যাসাগর বিশ্ববিদ্যালয়
VIDYASAGAR UNIVERSITY

Question Paper

B.Sc. Honours Examinations 2020
(Under CBCS Pattern)
Semester - III
Subject: STATISTICS
Paper: C6T & C6P
(Demography and Vital Statistics)

Full Marks : 60
Time : 3 Hours

Candiates are required to give their answer in their own words as far as practicable.
The figures in the margin indicate full marks.

THEORY

Attempt any ***two*** questions from the following : 2×20=40

1. (a) What is Malthusian population theory? Discuss its applicability in present time.

   (b) What are coverage error and content error in demographic data?

   (c) What is age heaping? How Mayer's index is used to get a measure of age-heaping. Suggest one modification of Mayer's index. 6+5+9=20

2. (a) Why mortality rates are important as demographic measure?

   (b) What is the life table stationary population? How the life table stationary population of India can be used to compare mortality situation Assam and Odisha?

   (c) Show that the CDR for the life table stationary population, except for the multiplier 1000 equals $1/e_0^0$ where e_0^0 is the life expectancy at birth.

   (d) Discuss the importance infant mortality rate as a measure of public health. Discuss one modification of IMR to overcome its drawback of not being probability rate.

3+6+3+8=20

3. (a) Let $p(x;\ n)$ be the probability of survival for n years in a life table stationary population. Show that if the force of mortality over the age interval $(x, x+n)$ is increased by a factor *k*, then new probability of survival $p^*(x;\ n) = \left[p(x;\ n)\right]^k$.

   (b) If $p(x;\ n) = \dfrac{x}{x+n}$, find force of mortality $\mu(x)$ at age *x*.

   (c) Find the expression for survival curve $l(x)$ when $\mu(x) = A \log_e x$.

   (d) By starting from a suitable functional form for survival curve $l(x)$, derive

$$L(x) = \frac{l(x) - l(x+1)}{\ln l(x) - \ln l(x+1)},$$

   $L(x)$ being the age distribution of the life table stationary population.

   (e) In a life table calculated by linear method show that

$$L(x) = \frac{l(x)}{1 + \frac{1}{2} m(x)}$$

   where $m(x)$ is the age specific death rate for life table stationary population.

4×5=20

4. (a) What is population projection?

   (b) Derive expression for logistic curve for population projection. Show that this curve is elongated S shaped.

   (c) Why this curve does not fit to Indian population growth? Suggest an modification of logistic curve for Indian population.

   (d) Let $P(t) = P(0)e^{rt}$ be curve for population projection. Find an expression for the time required for the population to double in size. If $r = 0.02$ how long it will take for the population to double. 1+10+3+6=20

PRACTICAL

Attempt any ***one*** question from the following : 1×20=20

1. A part of the life table is given here with most of entries missing. On the basis of the available figures, complete the life table

Age x	$l(x)$	$d(x)$	$1000q(x)$	$L(x)$	$T(x)$	$e^0(x)$
10	90,102		0.62			
11			0.66			
12			0.72			
13			0.80			
14			0.90			
15			1.00			
16			1.12			
17			1.23			
18			1.33			
19			1.40		4,842,446	

Interpret all the functions of the life table

Hence determine the probability

(a) that a child of age 10 will live at least 5 more years

(b) that two children aged 10 and 11 will each live at least 5 years more

(c) that two children aged 10 and 11, at least one will die within 9 years

(d) obtain force of mortality $\mu(x)$ for $x = 10, 11, \ldots 19$ assuming linearity of $l(x)$ in the age interval $(x, x+1)$. Plot $\mu(x)$. 8+2+2+2+6=20

2. (a) In the second and third columns of the following table are given the ASDR for Kerala and West Bengal for the year 1993. The figures in the fourth column give the estimated age distribution of the Indian population for the same year

Age (years l.b.d.)	ASDR for Kerala	ASDR for West Bengal	Percentage in estimated population
0 – 4	3.4	17.0	12.8
5 – 9	0.1	1.5	12.1
10 – 14	0.3	0.9	11.2
15 – 19	0.8	1.7	10.5
20 – 24	0.9	2.3	9.7
25 – 29	1.1	1.7	8.2
30 – 34	1.7	2.4	6.9
35 – 39	1.7	2.3	6.2
40 – 44	2.4	4.0	5.0
45 – 49	4.1	4.8	4.4
50 – 54	7.4	10.1	3.6
55 – 59	12.2	16.9	3.0
60 – 64	21.6	24.6	2.4
65 – 69	27.3	40.5	1.8
70 +	85.5	79.4	2.2
All ages	6.0	7.4	100.0

Compute the standardised death rates for Kerala and West Bengal taking the all India population as standard.

(b) With the help of the following data relating to New Zealand,1958, determine crude death rate and age specific death rates, separately for males and females

Age	Population(000) Male	Population(000) Female	Number of male deaths	Number of female deaths
0	29.8	28.5	807	609
1 – 4	109.3	104.9	192	138
5 – 9	126.1	120.7	88	65
10 – 19	198.2	189.7	182	82
20 – 29	150.8	142.7	247	117
30 – 39	156.9	151.0	284	203
40 – 49	139.5	138.3	565	425
50 – 59	110	106.7	1230	746
60 – 69	70.1	80.9	2083	1464
70 – 79	45.4	54.5	3308	2650
80 –	13.7	18.1	2195	2621

10+10=20

5. For the following values $l(x)$ of a life table fit a Makeham's curve. Also fit a Gompertz curve to the data and find the fitted values

x	$l(x)$
43	79737
44	78842
45	77918
46	76964
47	75978
48	74957
49	73896
50	72795
51	71651
52	70458
53	69215
54	67919

10+10=20