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PGIIIS-1574 B-18

M.A./M.Sc. III Semester (CBCS)Degree Examination

STATISTICS

(Practical) Based on HCT 3.1

Paper - HCP 3.1

(New)

Time : 2 Hours **Maximum Marks : 30**

Instructions to Candidates:

1) *Answer any two questions.*

2) *All questins carry equal marks.*

1. Consider a Markov chain with the following transition probability matrix.

$$P = \begin{matrix} & \begin{matrix} 0 & 1 & 2 \end{matrix} \\ \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} & \begin{pmatrix} 0 & 1 & 0 \\ ½ & 0 & ½ \\ 0 & 1 & 0 \end{pmatrix} \end{matrix}$$

Show that the Markov chain is irreducible, periodic with period 2 and the states of the Markov chain are persistent non null.

2. There are two food stores A&B in a certain area. An investigation of the performance of customers reveals that, with probability 0.15 a customer of the store A one week would go over to store B next week and with probability 0.10 a customer of store B would go over to store A. Initially 60% of people buy from store A and 40% from store B.

   i) What do you expect to be the percentage of purchases in the two stores after 4 weeks? After sufficiently long time?

   ii) What is the expected duration of a customer remaining with the same store for A&B?

3. Consider a Markov chain, on states (B,E,H), has transition probability matrix.

$$P = \begin{array}{c} \\ B \\ E \\ H \end{array} \begin{array}{c} \begin{array}{ccc} B & E & H \end{array} \\ \begin{pmatrix} 1/3 & 1/3 & 1/3 \\ 1/4 & 1/2 & 1/4 \\ 1/6 & 1/3 & 1/2 \end{pmatrix} \end{array}$$

Obtain stationary distribution.

4. Mr. X has exactly 3 children who independently of each other have equal probability 0.5 of being a boy or girl the same pattern continues in the male descendants of Mr. X

i) What is the probability that the male descendants eventually become extinct?

ii) What is the rate of increase of male population?

ii) If there is probability 0.2 of death for a boy .025 for a girl, find the survival rate for male and female.

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PGIIIS-1572 B-18

M.A./M.Sc. III Semester (CBCS) Degree Examination

STATISTICS

Stochastic Processes

Paper - HCT 3.1

Time : 3 Hours **Maximum Marks : 80**

Instructions to Candidates:

Answer any six questions from **Part-A** and any five questions from **Part-B.**

Part - A

(6×5=30)

1. Define Maskov process, stationary process and Gaussian process.

2. Define Markov chain and show that the sequence $X_n = \sum_{i=1}^{n} y_i$ where y_i's are i.i.d random variable is a Markov chain.

3. Define persistent state, transient state and absorbing state.

4. Show that for a Poisson process $\{N(t), t \geq 0\}$ as $t \to \infty$, $\frac{N(t)}{t}$ is an estimate of the mean rate λ.

5. Explain briefly compound poisson process.

6. Discuss Delayed and equilibrium renewal process.

7. Obtain the distribution of first passage time to a fined point of a winner process.

8. Explain branching process with an example.

Part - B

(10×5=50)

9. State and prove chapman kolmogorov equation for obtaining higher step transition probabilities.

10. Show that if state k is either transient or persistent null then for every state j $P_{jk}^{(n)} \to \frac{F_{jk}}{\mu_{kk}}$

and if state K is a periodic, persistent non-null then $^{(n)}P_{jk} \to \frac{F_{jk}}{\mu_{kk}}$ $as\ n \to \infty$.

11. Under the assumptions of poisson process, obtain the distribution of Poisson process with parameter λt.

12. Obtain the distribution function of Yule-Furry process.

13. a) Derive the kolmogorov forward equation of birth and death process.
 b) Show that the probability of ultimate extinction of birth and death process is 1 when $\mu > \lambda$.

14. State and prove elementary ren ewal theorem.

15. Show that for a renewal reward process $\{x_n, y_n\}$, $n = 1,2,....$if E(x) = E(x_n) and E(y) = E(y_n) are finite than $\frac{y(t)}{t} \to \frac{E(y)}{F(x)}$ as $t \to \infty$ with probability one.

16. For a branching process $\{x_n, n \geq 0\}$ with E(x_1) = m and V(x_1) = σ2 show that

$$V(x_n) = \begin{cases} m^{n-1}(m^n - 1) & \text{if } m \neq 1 \\ n\sigma 2 & \text{if } m = 1 \end{cases}$$

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PGIIIS-1576 B-18

M.A./M.Sc. III Semester (CBCS) Degree Examination

STATISTICS

Based on SCT 3.1(a)

Paper - SCP 3.1 (Practical)

(New)

Time : 2 Hours **Maximum Marks : 30**

Instructions to Candidates:

1) *Answer any two questions.*
2) *All questions carry equal marks.*

1. Compute UN index for the following data.

Age	Population		Age	Population		Age	Population	
	M	F		M	F		M	F
0	331785	325365	25	465218	446573	50	365480	349711
1	185669	174101	26	115620	112567	51	11250	10440
2	365214	347846	27	89456	89364	52	45890	42403
3	327896	328229	28	204530	185491	53	14560	13280
4	351256	339014	29	31025	29781	54	12546	10574
5	394562	373438	30	521026	500031	55	18640	186210
6	395420	382955	31	27654	24516	56	17890	17101
7	298560	255327	32	162451	137722	57	13250	11058
8	465261	437329	33	50125	45595	58	285040	27467
9	186542	192459	34	36452	32286	59	5620	4740
10	485672	459536	35	475620	453543	60	278951	260170
11	180215	161094	36	60125	58581	61	5562	5011
12	386580	386354	37	36452	332324	62	23456	22954

Age	Population		Age	Population		Age	Population	
	M	F		M	F		M	F
13	235890	208917	38	91025	88214	63	6540	6820
14	245621	215402	39	16897	15923	64	7521	6909
15	332546	310588	40	457890	416307	65	124500	118797
16	258791	226749	41	14562	12719	66	7152	6018
17	134256	124189	42	75620	66712	67	5210	4793
18	354680	330316	43	23456	22314	68	11254	9933
19	86759	85710	44	17890	15482	69	1891	1969
20	425560	386144	45	375689	266071			
21	89650	82106	46	25689	25754			
22	250120	239467	47	26789	25156			
23	100562	99159	48	58920	52572			
24	120125	78473	49	9012	8989			

2. a) Compute Cause specific death rate and Cause specific death ratio to the following data:

Major Cause Groups	No. of Deaths
Senility	102574
Coughs	126786
Diseases of Circulatory	35659
Causes Peculiar to infancy	60751
Accidents and Injuries	30376
Other clear symptoms	22012
Fever	32136
Digestive disorders	18489
Disorders of central nervous system	9685
Child birth and pregnancy	6164

Total Population is : 44005990

b) Compute CBR, GFR, ASFR and TFR for the following data. Assuming that sex ratio at birth is 1.05, compute GRR.

Age Group	Female Population	No. of Births
15-19	1593505	46474
20-24	1602390	339237
25-29	1390614	175342
30-34	1127005	53027
35-39	967062	14554
40-44	783424	3408
45-49	644214	461

Total Population is : 29098518

3. Using Brass P/F ratio technique, compute TFR for the following data of Bangladesh (1974) given the coefficients for interpolation between cumulative fertility rates to estimate parity equivalents.

Age Group	No. of women	Children ever born	ASFR (i) F (i)	i	a(i)	b(i)	c(i)
15-19	3014706	116091	0.1063	1	2.531	0.188	0.0024
20-24	3653155	4901382	0.2296	2	3.321	0.754	0.0161
25-29	2607009	9085852	0.2154	3	3.265	0.627	0.0145
30-34	3015663	9910256	0.1825	4	3.442	0.563	0.0029
35-39	1771680	10340601	0.1339	5	3.518	0.763	0.0006
40-44	1479575	9164329	0.0844	6	3.862	0.481	0.0001
45-49	1135129	6905673	0.0336	7	3.828	0.016	0.0002

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PGIIIS-1577 B-18

M.A./M.Sc. III Semester (CBCS) Degree Examination

STATISTICS

Demography

Paper - SCT 3.1(a)

(New)

Time : 3 Hours **Maximum Marks : 80**

Instructions to Candidates:

Answer any six questions from Part-A and any five questions from Part-B.

Part - A

(6×5=30)

1. Explain Whipple's Index of identifying digit preference in age reporting.

2. Derive chandrasekharan and Deming formula to check completeness of registration data.

3. Define infant mortality rate (IMR) and explain the use of Lexis chart in calculating IMR.

4. Define GRR and NRR. Explain how they are connected to population growth.

5. Define period and cohort life tables. Derive an algebraic expression relating q_x to the force of mortality μ_x

6. Differentiate between CDR and ASDR and establish the relation between them.

7. Define migration mention its types? Explain the factors responsible for migration.

8. Explain stationary and stable population models.

(9)

Part - B

(5×10=50)

9. Define census and discuss its silent features.

10. a) What is Child women ratio? What are its uses?

    b) What is TFR? Distinguish between current and cohort fertility rates.

11. Define TFR, GFR and CBR establish the relationship between them.

12. Explain the columns of life table and their inter relationship.

13. Derive Reed and Merrels' formula for the construction of abridged life table from Greville's formula.

14. State the needs for population projection. Explain the use of Leslie's matrix in population projection.

15. Describe one of the demographic methods of estimation of future population.

16. Derive fundamental equation of Lotka's stable population model.

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PGIIIS-1575 B-18

M.A./M.Sc. III Semester (CBCS) Degree Examination

STATISTICS

Based on HCT 3.2

Paper - HCP 3.2 (Practical)

(New)

Time : 2 Hours **Maximum Marks : 30**

Instructions to Candidates:

1) *Answer any two questions.*
2) *All questins carry equal marks.*

1. Suppose that an experiment is studying the effect of three different formulation of an explosive mixture used in the manufacture of dynamite, on the observed explosive strength. Four batches of raw material used formed the blocks. The data are given below:

	Formulations		
Batches (Blocks)	F1	F2	F3
1	27	24	25
2	44	40	35
3	33	--	46
4	40	26	25

i) State the linear model to analyze the above data.

ii) Estimate the missing value such that the error sum of squares is minimized and carry out the analysis of the data.

iii) Estimate the standard error of the difference between sample mean of (a) F1 and F2 and (b) F1 and F3.

2. The following table gives the plan and yield of a 2^3 factorial experiment involving 3 factors N,P & K in blocks of four plots each.

Replication I		Replication II	
Block 1	Block 2	Block 1	Block 2
(1) 54	k 98	(1) 122	p 156
pk 90	p 182	k 65	nk 210
nk 188	n 65	npk 145	pk 143
np 136	npk 201	np 88	n 187

i) State the model with the assumptions.

ii) Identify the confounded interactions.

iii) Test for the relevant hypothesis and draw appropriate conclusions.

3. Three different formulations of an industrial glue are being tested. The tensile strength of the glue when it is applied to join parts is also related to the application thickness. Four observations on strength (y) to Ibs and the thickness (x) in 0.01 inches are obtained for each formulation. The data are given below:

Glue formulation					
1		2		3	
x	y	x	y	x	y
46.5	13	48.7	12	46.3	15
45.9	14	49.0	10	47.1	14
49.8	12	50.1	11	48.9	11
46.1	12	48.5	12	48.2	11

i) State the model with assumptions.

ii) Test the significance of linear regression of y on x.

iii) Analyze the data using analysis of covariance.

iv) Compute the adjusted treatment means.

v) Estimate the standard error of the difference between adjusted means of treatment 1 and treatment 2.

4. A paper manufacture wants to study the effect of two factors, pulp preparation methods and cooking temperatures for the pulp, on the tensile strength of the paper. Three different pulp preparation methods and four different cooking temperatures are considered. The design used is a split plot design with two replicates each divided into three main plots to which the three pulp preparation methods are applied randomly and each main plot is divided into four subplots to which different temperatures are allotted in a random manner. Analyze the data.

	Replication I			Replication II		
Pulp Preparation Methods	1	2	3	1	2	3
Temp						
200	30	34	29	28	31	31
225	35	41	26	32	36	30
250	37	38	33	40	42	32
275	36	42	36	41	40	40

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PGIIIS-1573 B-18

M.A./M.Sc. IIISemester (CBCS) Degree Examination

STATISTICS

Design and Analysis of Experiments

Paper - HCT 3.2

Time : 3 Hours **Maximum Marks : 80**

Instructions to Candidates:

Answer any six questions from Part-A and any five questions from Part-B.

Part - A

(6×5=30)

1. Define C-matrix of block design and show that it is a singular matrix.

2. Let y_1, y_2, y_3 be independent random variables with common variance σ^2 and $E(y_1) = \theta_1 + 2\theta_2$. $E(y_2) = \theta_1 + \theta_3$ and $E(y_3) = \theta_2 + \theta_3$. Obtain the BLUE of $\theta_1 - \theta_2$.

3. Describe a latin square design (LSD). Set up the ANOVA table for this design.

4. Describe a BIBD. Show that it is a non-orthogonal design.

5. Discuss Yate's technique to find the sum of squares of various effects in a 2 factorial experiments.

6. Discuss confounding and its importance in factorial experiments.

7. Define one-way random effects model. In what way it differs from on-way fixed effects model?

8. What is analysis of covariance? When is it used?

Part - B

(5×10=50)

9. a) In a Gauss-Markov model, derive a necessary and sufficient condition for the linear parametric function to be estimable.

   b) Given the model $E(y_1)=\theta_1-\theta_2+\theta_3$, $E(y_2)=\theta_2+\theta_3$, $E(y_3)=\theta_1-3\theta-\theta_3$ and $E(y_4)=\theta_1-2\theta_2$ examine the estimability of $\theta_1+2\theta_3$.

10. State and prove Gauss-Markov Theorem.

11. Discuss the statistical analysis of a LSD with one missing observation.

12. State and establish the parametric relation of a BIBD.

13. Explain total confounding in factorial experiments. Discuss the analysis of a totally confounded z^3 factorial experiments.

14. a) Give, the layout of a z^4 factorial experiment arranged in 2 incomplete block to confound ABC and ACD.

    b) Give an example for a random effects model. Evaluate the expected value of error sum of squares in a one-way random effects model.

15. State the one-way analysis of covariance model. Derive a test statistic for testing the equality of treatment effects in this model.

16. Describe a split plot design with an example. Discuss the analysis of this design with main plot treatments arranged in an RBD.
