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PGIS-1070 B-18

M.A./M.Sc. I Semester Degree Examination

STATISTICS

(Practical Based on SCT 1.1(a))

Paper -SCP 1.1(a)

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

Instructions to Candidates:

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

(2×15=30)

1. The following data table gives measurements on a particular critical groove dimension. Due to high volume of keys processed per hour, the sampling frequency is chosen to be 05 keys, every 20 minutes.

Sub groups	Measurements				
01	61	81	76	76	44
02	88	83	76	74	59
03	80	80	94	75	70
04	67	76	64	71	88
05	87	84	88	94	86
06	71	52	72	88	52
07	78	89	87	65	68
08	87	94	86	73	71
09	74	81	86	83	87
10	81	65	75	89	97

a) Establish statistical control of this process using $\bar{x}$ and R charts and also construct control charts for these.

b) Find the upper and lower natural tolerance limits.

c) The upper and lower specification limits for the dimension are 100 and 60 respectively.

Assuming that dimension is normally distributed, find the percentage of non-conforming keys produced by this process.

2. The number of non-conformities observed in the final inspection of disk-drive assemblies have been tabulated below. Does the process appear to be in control?

Day:	1	2	3	4	5	6	7	8	9	10
NO. of. assemblies inspected:	2	4	2	1	3	4	2	4	3	1
Non Conformities:	10	30	18	10	20	24	15	26	21	08

3. The single specification limit U for elongation of certain yarn fiber is 6.86 milligram. Construct the sampling plan for unknown σ for given $P_1=0.025$, $P_2=0.06$, $\alpha=0.06$, $\beta=0.15$. Deduce whether to accept or reject the lot if the sample of required size has mean $=6.54$ and standard deviation $=0.3528$. Also draw the 0.C- curve.

4. Suppose 20 items from an exponential distribution are put on life test and observed for 150 hours. During this period, 15 items failed with the following life times measured in hours:

3, 19, 23, 26, 27, 37, 38, 41, 45, 58, 84, 90, 99, 109, 138. Test the hypothesis

$H_0: \mu=65$ against $H_1: \mu>65$ at 5% level of significance.

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PGIS-1066 B-18

M.A./M.Sc. I Semester Degree Examination

STATISTICS

(Statistical Process Control and Reliability Analysis)

Paper -SCT 1.1(a)

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

Instructions to Candidates:

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

PART -A

(6×5=30)

1. Write about analysis of patterns on control charts.
2. Explain process capability and ARL.
3. Define the following terms:
   i) Producer's risk ii) Consumer's risk iii) ATI
   iv) ASN v) AOQ
4. Briefly explain chain sampling plans.
5. Define failure rate. Show that exponential distribution has constant failure rate.
6. Define two parameter weibull distribution. Obtain its hazard function.
7. What is censored sampling? Distinguish between its various types.
8. Define renewal function with usual notations, prove that

$$M(t) = \int_0^t [1 + M(t-x)].dF(x)$$

PART -B

(5×10=50)

9. Discuss the construction and operation of $\bar{x}$ and S charts.
10. a) Discuss the construction of control charts for number of nonconformities.
    b) Explain the construction of moving average control charts. **(5+5)**
11. a) Describe sequential sampling plan for attributes.
    b) What is the need for chain sampling plans? Obtain an expression for the O.C. function of a chain sampling plan. **(5+5)**

12. Derive a single limit known sigma sampling plan by variables based on normal approximation.

13. a) Define survival function and hazard function. Establish the relationship between them.

b) Define DFR distributions. Show that Pare to distribution is DFR. (5+5)

14. a) Distinguish between MTTF and MTBF.

b) Obtain the distribution of number of renewals in the interval (o, t). (5+5)

15. Find MLE and UMVUE of reliability function for exponential distribution under type II censoring with replacement.

16. Find the reliability of

i) Series

ii) Parallel system of k independent components. When life time of each component follows exponential distribution.

PGIS-1063 B-18

M.Sc. I Semester Degree Examination

STATISTICS

(Linear Algebra)

Paper - HCT 1.1

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

Instructions to Candidates:

Answer any Six questions from Part-A and Five questions from Part-B.

Part-A

(6×5=30)

1. Decide the nature of $X_1 = (1,2,3,3)$, $X_2 = (-1,0,4,5)$ and $X_3 = (0,1,3,4)$.
2. Define subspace, and show that $s = \{(xy); y = mx\}$ is a subspace, where m is a real number.
3. Let M_1 and M_2 be any two subspaces having the null vector, as the only common vector then show that, $\dim(M_1 \cup M_2) = \dim(M_1) + \dim(M_2)$.
4. Define the following:
   a) Idempotent matrix
   b) Skew symmetric matrix
   c) Adjoint matrix.
5. Prove that the characteristic roots of Hermition matrix are real.
6. Let A and B any two square matrices of order nxn, then prove that $R(AB) \geq R(A) + R(B) - n$.
7. For which value of λ, no two values of a,b,c are equal. Are the following equations consistent when
   1. $a+b+c \neq 0$
   2. $a+b+c = 0$

   $x + ay + a^3z = a^4 + \lambda a^2$

   $x + by + b^3z = b^4 + \lambda b^2$

   $x + cy + c^3z = c^4 + \lambda c^2$
8. Let $X^{\|}AX$ be any quadratic form and $R(A) = r$ then show that $X^{\|}AX$ is positive definite iff there exists a non singular matrix p and $p'Ap = I_n$.

Part-B

(5×10=50)

9. Obtain the orthogonal vector using the following independent vectors.

$$\begin{bmatrix}1\\0\\0\end{bmatrix}\begin{bmatrix}1\\1\\0\end{bmatrix}\begin{bmatrix}1\\1\\1\end{bmatrix}$$

10. a) Obtain the basis of the subspace spanned by $X_1, X_2, X_3 \,\&\, X_4$ where $X_1 = [1 \;\; 2 \;\; 3], X_2 = [2 \;\; 3 \;\; 4], X_3 = [3 \;\; 4 \;\; 5]$ and $X_4 = [4 \;\; 5 \;\; 6]$.

b) Show that the number of members in the basis of a subspace is invariant. (5+5)

11. a) Find the inverse of the matrix, where A is as follows.

$$A = \begin{bmatrix}1 & 1 & 1\\1 & 2 & 1\\1 & 2 & 0\end{bmatrix}$$

b) Let $A_{n\times n}$ be any square matrix then show that $R(A) = n$ iff $|A| \neq 0$. (5+5)

12. Find rank of A and obtain 2 non singular matrices P&Q such that A reduces to its normal form, where A is

$$A = \begin{bmatrix}1 & 2 & 3 & 4\\2 & 3 & 4 & 5\\3 & 5 & 7 & 9\end{bmatrix}_{3\times 3}$$

13. Find a g^{-1} of $A = \begin{bmatrix}1 & 1 & 1\\1 & 0 & -1\end{bmatrix}_{2\times 3}$

14. Define homogeneous equations. Let $R(A) = r$ then show that their exist $(n-r)$ linearly independent solution of $Ax = 0$.

15. Solve the following equations by using Frame's method.

$x + 2y = 3;\; 3x - y + 2z = 1;\; 2x - 2y + 3z = 2;$ and $x - y + z = -1$.

16. a) Show that the characteristic vectors corresponding to distinct characteristic roots of a unitary matrix are orthogonal.

b) Obtain an orthogonal matrix P, such that $pAp = diag(\lambda_1, \lambda_2, \lambda_3)$. Obtain $\lambda_1, \lambda_2, \lambda_3$ the characteristic roots of A, where A is,

$$A = \begin{bmatrix}1 & 2 & 3\\2 & 4 & 6\\3 & 6 & 9\end{bmatrix}$$

(5+5)

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PGIS 1067 B-18

M.Sc. I Semester (CBCS) Degree Examination

STATISTICS

(Programming in C and Simulation)

Paper -HCP 1.1 (Practical)

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

Instructions to Candidates:

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

(2×15=30)

1. a) Write a computer program using 'for' loop to compute and print the sum of fifth powers of first 100 natural numbers.

b) Write a program to compute and print the regression lines and correlation coefficient.

2. Write a program to compute and print standard deviation and coefficient of variation.

3. Explain structure. Discuss its declaration and initialization, with examples.

4. a) Define unions. Explain its declaration and initialization.

b) Define Pointer. Explain its declaration and initialization of Pointers.

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PGIS-1068 B-18

M.A/M.Sc. I Semester Degree Examination

STATISTICS

(Statistical Oriented R Programming)

Paper - HCP 1.2 (Practical)

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

Instructions to Candidates:

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

1. a) Explain data accessing in R.

   b) Discuss about various data structures in R.

   c) Write a note on R Graphics facilities. **(5+5+5)**

2. a) Write R commands to evaluate the following:

   i) Given $X \sim P(\lambda), \lambda = 3$, calculate $P(X = 5)$.

   ii) $P(X \geq 3)$ if $X \sim b(n, p)$ with $n = 7$ and $P = 0{,}4$.

   iii) $R_f X \sim N(\mu, \sigma^2)$, $\mu = 8$, $\sigma^2 = 25$, find the constants a and b such that $p(a \leq X \leq b)$

   b) Explain how user defined functions are created in R. Illustrate with examples.

   c) Illustrate with examples the words, NA and NAN's in R. **(6+6+3)**

3. a) Write R program to fit Binomial distribution.

   b) Write R commands to generate the following diagrams/graphs.

   i) Pie chart

   ii) Bar diagram

   iii) Histogram

   c) Briefly explain about any three functions in R that Provide basic statistical tests.

(6+3+6)

4. Write short notes on any **three** of the following:

a) Data management in R.

b) Control statements in R.

c) Built-in functions in R.

d) Correlation analysis using R.

(3×5=15)

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PGIS- 1064 B-18

M.A/M.Sc. I Semester Degree Examination

STATISTICS

(Probability Theory)

Paper - HCT 1.2

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

Instructions to Candidates:

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

PART-A

(6×5=30)

1. Define $\lim A_n, \underline{\lim} A_n \, and \, \overline{\lim} A_n$.

2. Define Borel field and monotone field.

3. State an axiomatic definition of probability. Show that $A_n \to A \Rightarrow P(A_n) \to P(A)$.

4. Define measurable function, Borel function and simple function.

5. Define expectation. If Ex and Ey exists show that x is integrable if and only if $|X|$ is integrable.

6. Define convergence of a random variable, convergence in distribution and convergence in r^{th} mean.

7. Show that if $X_n \xrightarrow{P} X \Rightarrow X_n - X_m \xrightarrow{P} 0$ as n, m $\to \infty$.

8. Define characteristic function. Obtain characteristic function of gamma distribution.

PART-B

(5×10=50)

9. a) Show that a filed is closed under finite unions. Coressely, any class closed under complimentation and finite unions is a field.

   b) If A is a class of subsets of Ω and is a σ field, then show that the class A of all sets whose inverse images belong to A is also a σ - field. (5+5)

10. a) Define random variable, single random variable and economic definition of random variable.

b) If X is a random variable defined on (Ω, A) and a and b are constants. Then show that ax+b is also a random variable. **(5+5)**

11. a) Define conditional measure and conditing measure.

b) If for events A_1, A_2, A_3, $P(A_1A_2A_3) = P(A_1^c A_2^c A_3^c)$ then show that

$$P(A_1A_2A_3) = \frac{1}{2}[1 - P(A_1) - P(A_2) - P(A_3) + P(A_1A_2) + P(A_1A_3) + P(A_2A_3)]$$ **(5+5)**

12. If X and Y are non- negative random variable then prove the following.

a) $E(X+Y) = EX + EY$

b) $If X \geq 0 a's \Rightarrow EX \geq 0$

c) $If X \geq Y a's \Rightarrow EX \geq EY$ **(5+2+3)**

13. State and prove Holdess in equality.

14. Prove that If $X_n \xrightarrow{r} X \Rightarrow E|X_n|^r \to E|X|^r$

15. State and prove inversion formula of a characteristic function.

16. State and prove Lindberg and Levy form of CLT.

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PGIS-1065 B-18

M.Sc. I Semester Degree Examination

STATISTICS

(Estimation Theory)

Paper - HCT 1.3

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

Instructions to Candidates:

1. *Answer any SIX questions from Part A and FIVE from PART B*

Part-A

(6×5=30)

1. Define
   a) Consistent estimator
   b) Sufficient Estimator
   c) Completeness

2. If T_n is consistant estimator of $g(\theta)$ and $\underset{n\to\infty}{Lim}\, a_n = 1$ and $\underset{n\to\infty}{Lim}\, b_n = 0$ then show that $a_nT_n + b_n$ is also consistant estimator of $g(\theta)$.

3. State and prove sufficient conditions for consistency.

4. Let $X \to N(\mu,\sigma^2)$ then obtain sufficient statistics for μ if σ^2 is known.

5. State Cramer Rao Regularity conditions.

6. Write short note on method of moments.

7. Define UMA and UMAU of confidence sets.

8. Let $x_1, x_2 ...... x_n \to N(\mu,\sigma^2)$ where σ is unknown and we seek a $1-\alpha$ level confidence interval for μ.

Part-B

(5×10=50)

9. a) State the Factorisation theorem on sufficiency for a discrete case.

   b) Verify whether $T = x_1 + 2x_2$ is sufficient for λ. If $x_1, x_2 \sim p(\lambda)$ and are iid r.v's.

(5+5)

10. Let $X \sim G(\alpha, p)$. Find sufficient statistics for

i) α if P is Unknown

ii) P if α is Unknown

iii) (α ,p) both are Unknown. **(10)**

11. a) Show that MVB estimator is Unique.

b) Obtain MVB estimator for μ in normal population $N(\mu, \sigma^2)$, where σ^2 is known. **(5+5)**

12. If $X \sim N(\mu, \sigma^2)$ Find the MLE of (μ, σ^2). **(10)**

13. a) State and prove Rao Blackwell theorem.

b) Let $X \sim p(\lambda)$. Find UMVDE of $e^{-\lambda}\lambda^k / K!$. **(5+5)**

14. Let $p\{X = x\} = \begin{cases} \theta/4 & if \quad x = 0 \\ \theta/3 & if \quad x = 1 \\ 1 - \frac{7\theta}{12} & if \quad x = 2 \end{cases}$ where $0 < \theta < 12/7$. ObtainMLE of θ. **(10)**

15. Let $X_1, X_2 .....X_n$ be iid $N(\mu, \sigma^2)$ r.v, suppose that μ is known them find a confidence interval for 'σ^2'. **(10)**

16. a) Let $X_1, X_2 .....X_n$ be a sample form $N(\mu, \sigma^2)$ whose both μ and σ^2 are unknown $H_0 : \mu = \mu_0$ against $H_1 : \mu \geq \mu_0$

b) Write short note on shortcut length confidence interval. **(5+5)**

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PGIS-1069 B-18

M.Sc. I Semester (CBCS) Degree Examination

STATISTICS

(Based on HCT 1.1 and HCP 1.3)

Paper - HCP 1.3

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

Instructions to Candidates:

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

(2×15=30)

1. Given the matrix

$$A = \begin{bmatrix} 0.25 & 0.5 & 0.25 \\ 0.32 & 0.28 & 0.4 \\ 0.26 & 0.34 & 0.4 \end{bmatrix}$$

Find: i. $A^{-1}|\lambda I - A|$

ii. Adj $|\lambda I - A|$

2. Following is a random sample of size 5 from the Cauchy distribution with the median α. Find the MLE of α up to two places of decimals. Also find an estimate of standard error of the estimator. Five observations are as follows

-10.2, 15.4, 0.5, -8.5, 12.5.

3. A chemical compound containing 12.5% of iron is given to two techniques A&B for chemical analysis. A made 15 determinations & B made 10 determinations of percentage of iron. The results are as follows.

(2)

	12.46	11.89	12.76	11.95	12.77
A:	12.43	12.12	11.86	12.24	12.28
	12.77	12.33	12.56	12.65	12.12
B:	12.05	12.22	12.45	11.97	12.21
	12.33	12.45	12.39	12.37	12.65

Assuming that the above two sets of observations are form normal distribution with equal variance. Construct 95% confidence interval for $\mu_{A-}\mu_{B}$.

4. The following data gives the yield of brown seeds from squares cells of 57ft × 57ft. Construct 95% confidence interval for mean yield if $\sigma = 9$, the data is as follows

116, 160, 114, 112, 110, 110, 116, 90, 96, 88, 114, 112, 92, 94, 92, 86, 100, 86, 86, 110.

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