ADS – 3/17
Statistics

Time : 3 hours

Full Marks : 300

The figures in the right-hand margin indicate marks.

*Answer any **five** questions.*

1. (a) Define discrete and continuous variables with examples. If a coin is tossed 4 times, find the distribution of getting heads 0, 1, 2, 3 and 4 times. 15

   (b) Discuss normal curve and find the characteristic function and show that it is symmetrical. A frequency function in the range $(-3, 3)$ is defined by :

$$y = \frac{1}{16}(3+x)^2, \quad -3 < x \leq -1$$

$$= \frac{1}{16}\left(6-2x^2\right), \quad -1 \leq x \leq 1$$

$$= \frac{1}{16}(3-x)^2, \quad 1 < x \leq 3$$

   Find the standard deviation. 25

(c) Express Birth and Death process and find mean is Poisson process. 20

2. (a) Explain correlation coefficient, its range and show that $r^2_{xy} = b_{yx} \cdot b_{xy}$. If $2x + 4y = 6$ and $3x + 6y = 9$. Then find the value of r_{xy}. 15

(b) Discuss attribute, coefficient of association, serial correlation and correlogram and where they are used. Analyse the following : 20

	Colour		
	White	Red	Green
Ball 1	6	3	2
2	4	5	3
3	3	4	2

(c) (i) Describe the variation in Time series. 5

(ii) Explain the concepts multiple correlation coefficient with the help of examples. In usual notations show that the necessary and sufficient condition for coincidence of the three regression planes for a **trivariate** distribution is $r_{12}^2 + r_{13}^2 + r_{23}^2 - 2r_{12}\,r_{13}\,r_{23} = 1$. 20

3. (a) Describe Census and Sample Surveys. Explain the role of a National Sample Survey Organization. 10

(b) Explain Simple Random Sampling and Stratified Random Sampling with proportional and optimum allocation. Show that optimum allocation gives better result than proportional allocation. 20

(c) Explain three principles of design of experiments. Latin square design is better than randomized block, prove it. For three treatments A, B, C the layout is as follows. Analyse the data : 30

C_4	A_3	B_2
A_2	B_4	C_1
B_3	C_4	A_2

4. (a) Describe the life table, abridge life table with its properties. 15

(b) Explain the total fertility rate, gross and net reproduction rate, standardised death rates with suitable examples. 20

(c) (i) Explain logistic curve fitting. Find the curve for the following data : 15

x	y
1	9
2	24
3	47
4	78

(ii) Population census in India held in the preceding year. Discuss. 10

5. (a) (i) Discuss Δ and E operators and find f(7) for the followings data : 8

x	f(x)
4	3.11
5	2.96
6	2.85
7	—
8	2.70

(ii) Describe Lagrange's formula with remainder term. Prove that: 12

$$\frac{^{n-1}C_2}{1}+\frac{^{n-1}C_3}{2}+\frac{^{n-1}C_4}{3}+\ldots\ldots\ldots+\frac{(-1)^{n-1}(n-1)}{(n-1)}C_{n-1}=$$

$$1+\frac{1}{2}+\frac{1}{3}+\ldots\ldots\ldots+\frac{1}{n-1}$$

(b) (i) Discuss Euler-Maclaurin Summation formula and find the sum $1^3+2^3+\ldots\ldots\ldots+n^3$. 15

(ii) Find f(4) from f(0) = 0, f(1) + f(2) = 10, f(3) + f(4) + f(5) = 65. 10

(c) Discuss Simpson's $\frac{1}{3}$rd, $\frac{2}{3}$rd formula for integration and differential rule. By Weddles rule find $\int_1^2 \frac{dx}{x}$. 15

6. (a) (i) Describe the Computer system, Main memory, Byte, Input / Output devices. 20

(ii) Discuss the types and function of operating system and logical data elements. 15

(b) (i) Discuss software packages and word processing and spreadsheets. 15

(ii) Discuss the Analysis of Algorithm and Data Structure. 10

7. (a) (i) Explain Multivariate normal, distribution and discuss its properties. 15

(ii) Differentiate Hotelling's T^2 and Mahalanobis D^2 statistics. 15

(b) (i) Explain cluster analysis or discriminant analysis with its applications. 15

(ii) Describe Simplex method and duality or Assignment problems. 15

8. (a) Discuss one way or two ways classified data. Explain its assumption and analysis of variance table and where these are used. 15

(b) Principle of experimentation and their advantages. Analyse the following : 15

Replications					
	I	A_4	B_3	C_2	D_1
	II	B_3	C_2	D_4	A_1
	III	C_3	D_2	A_1	B_4

(c) (i) Explain recovery of interblock information. Discuss BIBD and its application. How the construction of balanced incomplete design can be discussed ? 20

(ii) Discuss 2^3 factorial design. 10

9. (a) (i) Discuss Rao-Blackwell theorem and complete sufficiency. 10

(ii) Explain the method of estimation and explain properties of estimators. 10

(b) (i) Express the level of significance, confidence interval. Obtain 95% confidence interval of σ^2 in $N(\mu, \sigma^2)$. 20

(ii) Define loss function and risk function, prior and posterior distribution. Explain Bayes estimator and give one example where it is not admissible. 20

10. (a) (i) Explain simple and composite hypothesis, power of the test, unbiased test, similar region. 10

(ii) Describe Likelihood ratio test and obtain the test statistics H_0: $\sigma_1^2 = \sigma_2^2$ against $H_1 > \sigma_1^2 > \sigma_2^2$ from $N(\mu_1, \sigma_1^2)$ and $N(\mu_2, \sigma_2^2)$. Whether the test statistics is unbiased ? 20

(b) (i) Describe Median test or Mann-Whitney U test. If :

Sample 1	Sample 2
26	23
27	28
31	26
26	24
19	22
21	19
20	
25	
30	

is given, find combine median and suggest the method to test it. 15

(ii) Explain Kolmogorov-Smirnov test and suggest its application. 15