

Time : 3 hours

Full Marks : 200

Instructions :

- (1) Answer **all** questions following the directions.
 (2) The figures in the right-hand margin indicate full marks for the questions.

1. (a) State and prove Bayes theorem.
 (b) n different objects 1, 2, 3, ..., n are distributed at random in n places marked 1, 2, 3, ..., n . Find the probability that none of the objects occupies the place corresponding its number.
 (c) Derive normal distribution as a limiting case of binomial distribution.
 (d) Of a large group of men, 5% are less than 60 inches in height and 40% are between 60 and 65 inches. Assuming a normal distribution, find the mean height and standard deviation [$P(0 < Z < 1.645) = 0.45$].
 (e) What do you mean by joint probability distribution function? What are the properties of joint probability distribution?
 (f) State and prove Bernoulli's law of large numbers. 8×6=48
2. (a) Show that the correlation coefficient is independent of change of origin and scale.
 (b) What do you mean by regression coefficient? Show that

$$R_{1.23}^2 = \frac{r_{12}^2 + r_{13}^2 - 2r_{12}r_{13}r_{23}}{1 - r_{23}^2}$$

- (c) Who developed the method of least squares? Explain the principle used in the method of least squares of fitting of a mathematical curve $y = f(x)$ to a set of numerical data, viz., $(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)$ on (x, y) . Find the normal equations for fitting of the mathematical curve

$$y = a + bx + cx^2 + dx^3$$

to the data on (x, y) mentioned above.

- (d) Distinguish between the following :
- (i) Small sample and Large sample
 - (ii) Parameter and Statistic
 - (iii) Correlation and Regression
- (e) What are the applications of chi-squared test? What are the conditions for validity of chi-squared test? 7×5=35
3. (a) Write the procedure for test of significance.
- (b) What are the properties of maximum likelihood estimator?
- (c) Discuss the errors in statistics.
- (d) Which criteria should be followed by a best linear unbiased estimator? Explain in brief. 5×4=20
4. Explain the following : 6×7=42
- (a) Sign test
 - (b) Wald-Wolfowitz runs test
 - (c) Runs test for randomness
 - (d) Median test
 - (e) Wilcoxon-Mann-Whitney test
 - (f) Walla's sequential probability ratio test
 - (g) ASN function
5. Define the following : 1×10=10
- (a) Mutually exclusive events
 - (b) Random variable
 - (c) Type I error
 - (d) Standard error
 - (e) Coefficient of variation
 - (f) Mathematical expectation
 - (g) p.m.f.
 - (h) Degrees of freedom
 - (i) Experimental error
 - (j) Power of a test

6. Answer the following :

3×6=18

- (a) Why are non-sampling errors occurred?
- (b) What is simple random sampling?
- (c) What is the difference between census and sample survey?
- (d) Prove that in simple random sampling without replacement (SRSWOR), sample mean is an unbiased estimate of population mean.
- (e) Describe a situation where we can use cluster sampling successfully.
- (f) Discuss the advantages of systematic sampling over simple random and stratified sampling.

7. (a) What is the objective of analysis of covariance? Describe a situation where it works.

(b) What principles of design of experiment are used in a randomised blocks design (RBD)? Give the layout of an RBD by explaining the procedure of allotment.

3+3=6

8. Describe the following :

3+3=6

- (a) Monte Carlo methods
- (b) Sensitivity analysis

9. Explain the following :

3+4=7

- (a) Individual replacement policies
- (b) Markov chain

10. (a) The following Table No. 1 is the outcome of a factorial experiment conducted in a randomized block design to investigate gain in weight of both sexes due to protein supplement in diet :

Table No. 1

Protein level (%) (P)	Sexes (S)	Block				
		1	2	3	4	5
10	Male	1.05	1.2	1.29	0.96	1.1
	Female	0.95	1.18	1.2	0.85	0.99
20	Male	1.25	1.34	1.2	1.3	1.32
	Female	0.85	1.16	1.1	1	1.1

Give the arrangement of data set to transfer it to a spreadsheet of SPSS window.