STATISTICS

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.
- **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

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

(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.

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8×6=48

- (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 :
 - (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 :

- (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

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1×10=10

6×7=42

6. Answer the following :

- (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 :
 - (a) Monte Carlo methods
 - (b) Sensitivity analysis
- 9. Explain the following :
 - (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 :

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	

Table No. 1

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

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[P.T.O.

3+3=6

3+4=7

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(b) The following Table No. 2 gives the result of the above example (Table No. 1). Interpret the result :

Table No.-2

Dependent Variable : Weight gain

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	·333(a)	7	·048	5.980	·004
Intercept	25.066	1	25.066	3149.275	·000
Block	·135	4	·034	4.227	·023
Р	·036	1	·036	4.539	·055
S	·133	1	·133	16.691	·002
P*s	·030	1	.030	3.725	·078
Error	.096	12	·008	100 N	
Total	25.494	20	20 ×		
Corrected Total	·429	19	9 K.		

R squared = $\cdot777$ (Adjusted R squared = $\cdot647$)

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4+4=8

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