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6 SEM TDC STSH (CBCS) C 13

2024

(May)

STATISTICS

(Core)

Paper : C-13

(Design of Experiments)

Full Marks : 50

Pass Marks : 20

Time : 2 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer from the following : 1×5=5

(a) Replication in an experiment means

- (i) the number of blocks
- (ii) total number of treatments
- (iii) the number of times a treatment occurs in an experiment
- (iv) None of the above

(2)

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- (b) In a randomized block design with 4 blocks and 5 treatments having one missing value, the error degrees of freedom will be

- (i) 12 (ii) 11
(iii) 10 (iv) 9

- (c) A Latin square design is a

- (i) one-restrictional design
(ii) two-restrictional design
(iii) three-restrictional design
(iv) non-restrictional design

- (d) A BIBD is said to be symmetrical if the number of blocks =

- (i) number of factors
(ii) number of treatments
(iii) number of levels
(iv) number of degrees of freedom

- (e) An experiment having several factors with equal number of levels is known as

- (i) complex treatment
(ii) symmetrical factorial experiment
(iii) asymmetrical experiment
(iv) All of the above

24P/843

(Continued)

(3)

2. Answer the following in brief :

2×7=14

- (a) What are the requirements of a good experimental design?
(b) Define an experimental unit.
(c) What are the drawbacks of RBD?
(d) Why should not the number of treatments tested in LSD be less than three?
(e) Explain what is meant by main effects and interactions in factorial experiment.
(f) When do you call the partial confounding as balanced and unbalanced confounding?
(g) What are the limitations of confounding?

3. (a) Give the statistical model and hypothesis to be tested in an RBD. Also obtain the relative efficiency of an RBD over CRD.

4+5=9

Or

- (b) What is missing plot technique? When and how is it used in design of experiment? Discuss how a missing observation of RBD is estimated and the analysis of an RBD involving one missing plot.

3+6=9

24P/843

(Turn Over)

(4)

4. (a) (i) Define a balanced incomplete block design (BIBD). State the important relations among the parameters of a BIBD. $3+2=5$

(ii) If N is the incidence matrix of a symmetric BIBD, then prove that

$$(NN')(NN') = (r+\lambda)N'N + k^2\lambda E_v$$

where E_v is a square matrix of order v with all elements equal to 1. 4

Or

- (b) When does a balanced incomplete block design (BIBD) become resolvable? Explain with an example. For a resolvable BIBD with parameters v, b, r, k, λ prove that $b \geq v + r - 1$. $3+2+4=9$

5. Answer any one question :

- (a) (i) State the advantages of factorial experiment over a simple experiment. Give complete statistical analysis of 2^3 designs. $2+7=9$

(ii) What is a treatment contrast? When are two such contrasts said to be orthogonal? $2+2=4$

(5)

Or

- (b) (i) In a partially confounded 2^3 -factorial experiment, the control blocks of two replications are as given below :

1.	(1)	a	bc	abc
2.	(1)	b	ac	abc

Identify the confounded effects and write down the other blocks of the replications. $2+2=4$

- (ii) Give the analysis of a 2^3 -factorial experiment with 4 replications in which the three-factor interaction is confounded with block effects. 9

- (c) (i) What are fractional replication and factors at two levels? 4

- (ii) Write a short note on one-half fraction of 2^3 -factorial experiments. 9

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6 SEM TDC STSH (CBCS) C 14

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(May)

STATISTICS

(Core)

Paper : C-14

**(Multivariate Analysis
and Non-Parametric Methods)**

Full Marks : 50

Pass Marks : 20

Time : 2 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer from the following alternatives :

1×5=5

(a) If (X, Y) are bivariate $N(0, 0, 1, 1, \rho)$, then the variables $(x + y)$ and $(x - y)$ are

(i) correlated with $\rho = \frac{1}{2}$

(ii) independently distributed

(iii) negatively correlated

(iv) None of the above

(2)

(b) The quantity $(x-\mu)' \Sigma^{-1} (x-\mu)$ involved in multivariate normal density function represents

- (i) multivariate normal density
- (ii) dispersion matrix
- (iii) exponential series
- (iv) Mahalanobis squared distance

(c) The partial correlation coefficient $r_{13.2}$ is called

- (i) first-order partial correlation
- (ii) zero-order partial correlation
- (iii) second-order partial correlation
- (iv) None of the above

(d) Principal component analysis is meant for

- (i) reducing the number of observed variables
- (ii) increasing the number of variables
- (iii) reducing the correlation between variables
- (iv) reducing the variance among variables

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(Continued)

(3)

(e) Kolmogorov-Smirnov test is useful as

- (i) a test of goodness of fit
- (ii) a test of identicalness of two populations
- (iii) a measure of confidence band
- (iv) All of the above

2. Answer the following questions in brief :

2×5=10

- (a) State the properties of random vector.
- (b) Define partial correlation coefficient with examples.
- (c) How to obtain discriminant scores?
- (d) Distinguish between non-parametric methods and distribution-free methods.
- (e) What do you mean by empirical distribution function?

3. (a) State the properties of bivariate normal distribution.

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(Turn Over)

(4)

Let the joint p.d.f. of X and Y be

$$f(x, y) = \frac{1}{2\pi\sigma_1\sigma_2\sqrt{1-\rho^2}} \exp\left\{-\frac{1}{2(1-\rho^2)}\left[\frac{(x-\mu_1)^2}{\sigma_1^2} - 2\rho\frac{(x-\mu_1)}{\sigma_1}\frac{(y-\mu_2)}{\sigma_2} + \frac{(y-\mu_2)^2}{\sigma_2^2}\right]\right\}$$

where

$$-\infty < x < \infty, -\infty < y < \infty, -1 < \rho < 1.$$

Find—

(i) the marginal distribution of X ;

(ii) $P(3 < y < 8 | X = 7)$ given that $\mu_1 = 3$,
 $\mu_2 = 1$, $\sigma_1^2 = 16$, $\sigma_2^2 = 25$, $\rho = 0.6$.

$$2+3+2=7$$

Or

(b) How do you express and organize multivariate data?

Let

$$X = \begin{bmatrix} 10 & 100 \\ 12 & 110 \\ 11 & 105 \end{bmatrix}$$

Calculate the mean vector and variance-covariance matrix.

$$3+4=7$$

24P/844

(Continued)

(5)

4. (a) (i) Define multivariate normal distribution. If $X \sim N_p(\mu, \Sigma)$, then show that the components of X will be jointly independent if and only if the covariance of X_j and X_k ($j \neq k = 1, 2, \dots, p$) is zero. 2+6=8

(ii) Define Wishart distribution and its properties. 3

Or

(b) (i) Clarify the concept of Hotelling's T^2 distribution. 4

(ii) Discuss the properties of multiple correlation coefficient. Show that the relationship between regression coefficient and partial regression coefficient is

$$1 - R_{1.23}^2 = (1 - r_{12}^2)(1 - r_{13.2}^2) \quad 3+4=7$$

5. (a) What does discriminant analysis signify? What are the assumptions underlying discriminant analysis? Usually, what test statistics are involved in discriminant analysis technique? 2+3+2=7

24P/844

(Turn Over)

Or

(b) How is principal component analysis used for dimensionality reduction? What are the major uses of principal component analysis? What is the purpose of factor analysis? $2+3+2=7$

6. (a) What do you mean by empirical distribution function? Define run in a sequence of symbols. Explicate Mann-Whitney U-test for testing the identicalness of two populations. $2+2+6=10$

Or

(b) Write some applications of Kolmogorov-Smirnov test. How to resolve the problem of zero differences in sign test? Discuss the Kruskal-Wallis method of analysis for one-way classification of data. $2+2+6=10$

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