

Ph. D. IN STATISTICS
(PHDSTAT)
Term-End Examination
December, 2024
RST-004 : ADVANCES IN STATISTICS

Time : 3 Hours

Maximum Marks : 100

Note : (i) *Question No. 1 is compulsory.*

(ii) *Attempt any **four** questions from question no. 2 to 7.*

(iii) *Non-programmable/Scientific calculator is allowed.*

(iv) *Symbols have their usual meanings.*

1. (a) State whether the following statements are True or False. Give reasons in support of your answer : 5×2=10

(i) In a regression model :

$$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + C$$

If $H_0 : B_1 = 0$ and $H_0 : B_3 = 0$ are rejected whereas $H_0 : B_2 = 0$ is not rejected, then the variable X_2 will remain in the model.

- (ii) In regression analysis, if R^2 is 0.9717 for a given data of 12 values on Y as dependent variable and X_1 and X_2 as independent variables, then adjusted R^2 will be 0.7454.
- (iii) A prior is said to be improper prior if posterior distribution belongs to the same family of the prior distribution.
- (iv) Inversion method of sampling is used when cumulative distribution function exists.
- (v) If there are 3 regressor variables and 10 pair of observations, then degrees of freedom for residuals will be 12.
- (b) Explain the significance of residual analysis. 10
2. Let $X_1, X_2, \dots, X_n$ be a random sample taken from normal distribution with mean μ and variance 1. If prior distribution of μ is normal with mean θ and variance 1, then find :
- (i) posterior distribution of μ ,

- (ii) Bayes estimate of μ under SELF and LINEX loss functions. 20
3. (a) Describe Jeffrey's prior. Let $X_1, X_2, \dots, X_n$ be a random sample from exponential distribution with mean θ . Construct Jeffrey's prior. 10
- (b) Explain loss function. Define the following : 5+5
- (i) Squared error loss function
- (ii) Entropy loss function
4. Explain Metropolis-Hastings method of generating sample. Also write its algorithm. 20
5. (a) Differentiate between the forward and backward selection methods. 8
- (b) Describe residual and normal probability plots. 8
- (c) Describe conjugate priors. 4
6. A company believes that the number of salespersons employed is a good predictor of sales. The following table exhibits sales (in thousand

rupees) and number of salespersons employed for different years : 20

Sales	No. of Salespersons
12	10
13	15
11	12
15	18
18	21
18	22
14	19
13	15

- (i) Draw the scatter diagram of the data.
- (ii) Fit a regression line.
- (iii) Test whether no. of salespersons has any significant effect on the sale at 5% level of significance.
- (iv) Construct 95% confidence interval for the slope.

It is given that :

$$t_{(6),0.05} = 1.943; \quad t_{(6),0.025} = 2.447; \quad t_{(7),0.05} = 1.895;$$

$$t_{(7),0.025} = 2.365$$

7. Explain in brief Bayesian approach. Also obtain the posterior distribution of θ in $\exp(\theta)$ when the prior distribution of θ is gamma (α, β) . 20

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