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MSTE-004

**POST GRADUATE DIPLOMA IN
APPLIED STATISTICS (PGDAST)**

Term-End Examination

December, 2024

MSTE-004 : BIOSTATISTICS—II

Time : 3 Hours

Maximum Marks : 50

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

(ii) *Attempt any **four** questions from the remaining question nos. 2 to 7.*

(iii) *Use of scientific calculator (non-programmable) is allowed.*

(iv) *Use of Formulae and Statistical Tables Booklet for PGDAST is allowed.*

(v) *Symbols have their usual meanings.*

1. State whether the following statements are True or False. Give reasons in support of your answers :

$$5 \times 2 = 10$$

- (a) A blood test for which sensitivity and specificity were 96% and 98%, respectively, was applied to diagnose bacterial infection for which prevalence was 5.25%. If a patient tested negative, the probability of not having a bacterial infection will be 0.998.
- (b) A multiple regression model with 3 regressor variables was fitted on 15 observations, the following values were given :

$$SS_{\text{Res}} = 15 \text{ and } SS_{\text{T}} = 500.$$

Then the value of adjusted R^2 will be 0.9618.

- (c) The regression coefficients for a probit model to study the relationship between occurrence of a disease and ages of patients are :

$$\hat{\beta}_0 = 0.05 \text{ and } \hat{\beta}_1 = 0.012 .$$

Then the probability of occurrence of disease for a person of age 45 years is 0.7224.

- (d) The survival function is the probability of surviving an individual less than a specified time t .
- (e) The degrees of freedom for applying Chi-square test for trend on a (2×7) contingency table will be 6.
2. (a) The following table represents the data of a case-control study related to breathing problem and chemical exposure conducted on 150 pairs of workers in case of matched pairs design :

		No Breathing Problem	
		Exposed	Unexposed
Breathing Problem	Exposed	23	35
	Unexposed	27	65

Compute the odds ratio and test its significance at 5% level of significance. 5

- (b) Write a short note on the Receiver Operating Characteristic (ROC) curve. 5
3. For studying the effect of duration of daily walk (in minutes) and age (in years) on the Random

Blood Sugar (RBS) (in mg/dL), of 10 diabetic patients were recorded and presented in the following table : 10

S. No.	RBS	Duration of Walk	Age
1	302	55	33
2	328	50	36
3	390	51	43
4	364	52	40
5	407	53	45
6	374	55	41
7	390	51	43
8	307	45	34
9	264	60	29
10	282	51	42

- (i) Fit a multiple regression model to the data.
 - (ii) Compute the standardised residuals.
4. (a) Explain the Hosmer-Lameshow test for the logistic models. 4

- (b) For a multiple logistic model, the values of maximum log-likelihood of the saturated model, fitted model and null model are -62.95 , -63.99 and -68.59 , respectively.

Test the significance of the fitted multiple logistic model at 5% level of significance using (i) deviance D_F and (ii) statistic G .
(Given that : $n = 5$ and $k = 2$). 6

5. (a) If the survival time of a bacteria follows the probability density function given as :

$$f(t) = \frac{1}{\theta} e^{-\frac{t}{\theta}}; \quad \theta > 0, \quad t \geq 0$$

Find the survival and hazard functions.

- (b) Explain the Poisson regression model with examples for count data as well as rate data. 5

6. A group of patients were randomised for receiving standard, say 1 and new treatments, say 2 for a particular disease. The survival data

of those patients who were followed for 72 days are given as follows :

Patient No.	Survival Time (in days)	Outcome	Treatment
1	2	Died	2
2	4	Died	2
3	5	Died	2
4	6	Unknown	1
5	9	Died	2
6	9	Unknown	2
7	12	Died	2
8	12	Died	1
9	15	Unknown	2
10	15	Unknown	1
11	22	Died	2
12	30	Died	1
13	37	Died	1
14	55	Died	1
15	72	Survived	1

Test whether there is a significant difference between the survival times of the patients under standard and new treatments at 5% level of significance.

7. (a) Describe the assumptions of multiple linear regression model. 5
- (b) In a public health study, the data on infant mortality and maternal fitness level are given as follows :

Fitness level	Status of Infant Mortality	
	Died	Survived
Fit	7	24
Unfit	37	32

Test whether the new borns' survival depend upon mothers' fitness level at 5% level of significance using Yates' corrected Chi-square test. 5

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