

2022

COMMERCE

Paper : CC-103

[Statistics for Business Decisions (STAT)]

Full Marks : 40

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

Module - I

Answer *any two* questions.

1. (a) A small town has one fire engine and one ambulance available for emergencies. The probability that the fire engine is available when needed is 0.95 and that the ambulance is available on call is 0.85. In the event of an injury resulting from fire in a building, find the probability that
- (i) both fire engine and ambulance will be available
  - (ii) at least one of these will be available
  - (iii) exactly one of these will be available.
- (b) An editor of a publishing company calculates that it requires 10 months on an average to complete the publication process from manuscript to finished books with s.d. of 2 months. He believes that the distribution of publication time follows normal. Handling 1000 books this year, in this process how many books will be able to complete within a year?
- (c) A random sample of 8 students is taken from a population having 40 students without replacement and their marks are as follows : 47, 25, 32, 43, 37, 45, 26 and 39. Estimate the average marks and obtain its estimated standard error. 3+3+4
2. (a) A binomial random variable X has mean 6 and variance 2. Find the probability that  $6 \leq X \leq 8$ .
- (b) The life (in hours) of an electronic device follows Exponential Distribution with mean 1000 hours. What is the probability that the device will fail after 2000 hours of its operation?
- (c) In a town, 90 accidents took place in a span of 30 days. Assuming that the number of accidents per day follows the Poisson distribution, find the probability that
- (i) there will be at most 3 accidents on a day
  - (ii) there will be at least 3 accidents on a day. 3+3+4

Please Turn Over

3. (a) Suppose there is a chance for a newly constructed house to collapse whether the design is faulty or not. The chance that the design is faulty is 0.05. The chance that the house collapses, if the design is faulty, is 0.95 and otherwise it is 0.25. It is seen that the house collapsed. What is the probability that it is due to faulty design?
- (b) Distinguish between Parameter and Statistic with illustration.
- (c) If  $x_1, x_2, \dots, x_n$  be a random sample drawn from a population with variance  $\sigma^2$ , then show that

the unbiased estimator of  $\sigma^2$  is  $\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$  4+2+4

4. (a) If  $(X, Y)$  be a pair of discrete random variable with the joint distribution as follows :

X \ Y	1	3	5
2	$\frac{6}{30}$	$\frac{4}{30}$	$\frac{2}{30}$
4	$\frac{1}{30}$	$\frac{3}{30}$	$\frac{3}{30}$
6	$\frac{3}{30}$	$\frac{4}{30}$	$\frac{4}{30}$

- (i) Obtain marginal distribution of  $X$  and  $Y$ .
- (ii) Compute  $P[2X + Y > 10]$  and  $P[Y = 5/X = 2]$ .
- (iii) Compute correlation coefficient between  $X$  and  $Y$ .
- (iv) Are  $X$  and  $Y$  independent?
- (b) Briefly describe the process of Stratified Sampling and Multistage Sampling. (1+2+2+1)+4

### Module - II

Answer *any two* questions.

5. (a) Women entrepreneurs are becoming popular in the business world. To form an opinion about the definition of success from a women entrepreneur's perspective, an international study conducted by an international business research agency offered them optional choices such as sales revenues/profit, achievement/ challenges, happiness/self-fulfilment, organisational growth/promotion etc. It seemed from the study that a significantly higher proportion of women entrepreneurs in the \$10 to \$50 million annual sales revenue opted for sales revenue/profit as a definition of their success than those belonging to the below \$10 million sales revenue category.

Motivated by the international study, a reputed Indian business research agency wanted to know the relevance of this opinion from the perspective of Asian women entrepreneurs. For this purpose, the women are divided into two groups according to the reported sales revenue of their businesses for the financial year 2021-22. Out of 100 women entrepreneurs with annual sales revenue less than \$10 million, 24 believed sales revenues/profit as a definition of success. However, out of 95 women entrepreneurs with annual sales revenue between \$10 to \$50 million, 39 cited sales revenues/

profit as a definition of success. Do you think that there is a significant difference between the two groups, which define success as equivalent to sales revenue/profit? Test at 1% level of significance.

- (b) What is normal equation in multiple regression analysis? Define range for multiple correlation coefficient and the value when it is a perfect linear relationship. State any four general problems due to deviation from assumptions of multiple linear regression analysis. 4+(2+2+2)

6. (a) The Commissioner of Income Tax Department of the eastern region believes that refund claims in IT Return (ITR) filed are more quickly when IT Returns are verified electronically than when IT Returns are verified by signing ITR-V physically and sending them to Central Processing Centre (CPC). Looking at ITR claiming refunds, a random sample of 13 ITR verified electronically had an average refund of ₹ 958 and a standard deviation of ₹ 619. The average refund on a random sample of 17 ITR verified physically by signing ITR-V was ₹ 563 and a standard deviation of ₹ 378. Does this information support the Commissioner's belief? Test at 1% level of significance.
- (b)  $x_1, x_2, x_3$  are three variates measured from their mean with  $n = 10$ .

$$\sum x_1^2 = 90, \sum x_2^2 = 160, \sum x_3^2 = 40, \sum x_1 x_2 = 60, \sum x_1 x_3 = 40 \text{ and } \sum x_2 x_3 = 60$$

Calculate partial correlation coefficient  $r_{12.3}$  and  $r_{13.2}$ . Compute multiple correlation coefficient and interpret the result. 6+(2+2)

7. (a) Using the method of exponential smoothing, find forecasts for the following sales data on 9th day taking initial forecast as 150 and smoothing coefficient  $\alpha = 0.2$ .

DAY	1	2	3	4	5	6	7	8
Sales ('000 units)	160	180	132	173	145	201	165	177

- (b) A luxury furniture company manufactures ergonomically designed sofa, bed, lounge etc. To keep the cover of the furniture stain resistant, it wants to know whether there are differences in stain resistance among the four chemicals used to treat three different fabrics. The following table shows the yields on resistance to stain (a low value indicates a good result).

Chemicals	Fabrics			Total
	Acrylic	Vinyl	Olefin	
$C_1$	8	12	11	31
$C_2$	14	16	13	43
$C_3$	7	10	12	29
$C_4$	12	14	13	39
<b>Total</b>	41	52	49	142

- (i) Is there any evidence to conclude that there is a difference in mean resistance among the four chemicals used in fabrics?

Please Turn Over

(ii) Is there any difference in the mean resistance among the fabrics used in the furniture?

Test at 5% level of significance.

4+6

8. (a) The management of Planox Multiplex Theatre chain wants to know the impact of types of movie on the sale of snack items sold in various movie theatres located in different metro cities. The management wants to estimate the quantity of snacks to buy for its snacks counters located at each theatre. It collected a random sample of 600 people who watched the movies in the multiplex. The summarised data is shown below :

<i>Types of Movie</i>	<i>Snacks</i>	<i>No Snacks</i>
Action	50	75
Comedy	125	175
Romantic	90	30
Thriller	45	10

Test at 5% level of significance to know whether types of movie have any relationship with snack purchases.

- (b) Define Mean Absolute Deviation (MAD) for forecasting financial data.
- (c) With which component of a time series would you mainly associate each of the following?
- Strike in a factory interrupting production for 15 days
  - Increase in sales in a departmental store on Diwali
  - An era of prosperity
  - Fall in death rate due to advances in medical sciences.

4+2+4

**Table Values :**

[Given that,  $\Phi(1.5) = 0.9331$ ,  $\Phi(1.0) = 0.8413$ ,  $\Phi(2.0) = 0.9772$ ,

$Z_{0.025} = 1.960$ ,  $Z_{0.05} = 1.645$ ,  $\chi_{0.05,3}^2 = 7.815$ ,  $\chi_{0.05,4}^2 = 9.488$ ,

$t_{0.01,23} = 2.500$ ,  $t_{0.01,25} = 2.485$ ,  $t_{0.005,19} = 2.861$ ,  $t_{0.005,20} = 2.845$ ,

$F_{0.05,3,6} = 4.757$ ,  $F_{0.05,2,6} = 5.143$ ,  $F_{0.05,3,2} = 19.164$ ,

$Z_{0.01} = 2.326$ ,  $Z_{0.005} = 2.576$

$t_{0.01,28} = 2.467$ ,  $t_{0.01,29} = 2.462$ ,  $t_{0.01,30} = 2.457$

$F_{0.05,3,6} = 4.76$ ,  $F_{0.05,2,6} = 5.14$ ,  $F_{0.05,3,7} = 4.35$

$\chi_{0.05,3}^2 = 7.815$ ,  $\chi_{0.05,5}^2 = 11.070$ ,  $\chi_{0.05,6}^2 = 12.592$ ,  $e = 2.7183$ ]