

No. of Printed Pages : 7

**MST-016**

**M. SC. (APPLIED STATISTICS)  
(MSCAST)**

**Term-End Examination**

**June, 2024**

**MST-016 : STATISTICAL INFERENCE**

*Time : 3 Hours*

*Maximum Marks : 50*

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

(ii) *Attempt any **four** questions from the remaining question no. 2 to 6.*

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

(iv) *Symbols have their usual meanings.*

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

5×2=10

(a) If sample size of a survey has increased by 50%, then the standard error will also increase by 50%.

**P. T. O.**

- (b) If probability density function of a Chi-square distribution is :

$$f(\chi^2) = \frac{1}{96} e^{-\frac{\chi^2}{2}} (\chi^2)^3; \quad 0 < \chi^2 < \infty$$

then the degrees of freedom of the distribution will be 8.

- (c) If variance of a normal population is known and sample size is small, then we use the  $t$ -test for testing the hypothesis about population mean.
- (d) A consistent estimator is always unbiased estimator.
- (e) A sample of 200 persons is chosen at random from a colony. Out of these, 20% are found to be smokers, then 95% confidence interval for the proportion of smokers in the colony will be [0.172, 0.228].
2. An online retailer claims that 90% of all orders are shipped within 24 hours of being received. A consumer group placed 250 orders of different

sizes and at different times of a day. Out of these orders, 210 were shipped within 24 hours, then :

- (i) Compute the sample proportion of the items shipped within 24 hours.
  - (ii) Check whether the sample size can be regarded as large enough to assume that the sampling distribution of sample proportion of the items shipped within 24 hours is normal. Assume that the retailers claim is valid.
  - (iii) Find the mean and variance of the sampling distribution of sample proportion of items shipped within 24 hours.
  - (iv) Find the probability that the sample proportion computed from a sample size 250 will be within 5 percent point of the true population proportion.
3. If magnitude of earthquake (on the Richter scale) recorded in a region follows gamma distribution with parameters  $a$  and  $b$  whose pdf is given as follows :

$$f(x) = \frac{a^b}{\Gamma(b)} e^{-ax} x^{b-1}; x > 0, a, b > 0$$

then obtain sufficient estimator for :

- (i) parameter  $b$  when  $a$  is known.
  - (ii) parameter  $a$  when  $b$  is known.
  - (ii) parameters  $a$  and  $b$  when both are unknown.
4. If the number of weekly accident occurring on a mile stretch of a particular road follows a Poisson distribution with parameter  $\lambda$  whose pdf is given as follows :

$$p(X = x) = \frac{e^{-\lambda} \lambda^x}{x!}$$

$x = 0, 1, 2, \dots; \lambda > 0$ . Find :

- (i) the maximum likelihood estimator of  $\lambda$ .
- (ii) If the following data are observed :

No. of Accidents	Frequency
0	10
1	12
2	12
3	9
4	5
5	3
6	1

then find the maximum likelihood estimate of  $\lambda$  on the basis of the given data. 10

5. A random sample of 12 home internet users were selected from a colony by an internet marketing manager and their monthly internet wage (in hours) was identified for March of last year (Period 1) and again for March of current year (Period 2). The data, together in the matched- pair are given as follows : 10

<b>Subscriber</b>	<b>Period 1</b>	<b>Period 2</b>
A	70	72
B	85	84
C	64	68
D	83	88
E	68	68
F	91	95
G	65	64
H	78	76
I	96	102
J	92	94
K	86	89
L	73	75

The internet marketing manager is interested to know whether the internet usage is increasing or not. Conduct a hypothesis test.

- (i) Which test will be used to test the hypothesis and why ? (Assume that the difference of the monthly internet usage of both periods follows normal distribution.)
  - (ii) Write the assumptions of the suitable test.
  - (iii) Apply the test at 5% level of significance.
  - (iv) Also, write the conclusion.
6. (a) Describe mean square error and consistency. 4
- (b) The variance of a certain dimension of articles produced by a machine is 7.2 over a long period of time. A random sample of 20 articles was collected and the variance was computed as 8. Is it justifiable to conclude that the variability has increased at 5% level of significance ? Assume that the measurement of dimension of articles is normally distributed. 6

### Table Values

(Some Values for use, if required)

Z-Value	<i>t</i> -Value	Chi-square values
$Z_{0.005} = 2.58$	$t_{(11),0.05} = -1.796$	$\chi_{(19),0.05}^2 = 30.14$
$Z_{0.025} = 1.96$	$t_{(12),0.05} = -1.78$	$\chi_{(20),0.05}^2 = 31.41$
$Z_{0.05} = 1.645$		
P [Z < 2.63] = 0.9943		
P [Z < -2.63] = 0.0043		