

114

2015

## STATISTICS – GENERAL

## Second Paper

Full Marks – 100

*The figures in the margin indicate full marks**Candidates are required to give their answers in their own words as far as practicable*

SET – 1

## Group – A

Answer **Question No. 1** and **any three** questions from the rest1. Answer **any four** of the following questions :

2×4

- (a) Distinguish between a 'parameter' and a 'statistic'.
- (b) Define minimum variance unbiased estimator.
- (c) What do you mean by power of a test ?
- (d) If two independent random variables  $X$  and  $Y$  follow normal distributions with means 2 and 3 and standard deviations 3 and 4, respectively, what is the distribution of  $X + Y$ ?
- (e) What is interval estimation ?
- (f) Distinguish between an upper-tail test and a both-tail test.
- (g) Define consistency of an estimator.
- (h) Write down the pdf of an F distribution with degrees of freedom 6 and 10.

2. (a) Distinguish between :

- (i) Null hypothesis and alternative hypothesis
  - (ii) Type I error and Type II error
- (b) Suppose  $(x_1, x_2, \dots, x_n)$  is a random sample from a normal distribution with mean  $\mu$  and standard deviation  $\sigma$ . How do you test :
- (i)  $H_0 : \mu = \mu_0$  against alternative  $H_1 : \mu \neq \mu_0$  and
  - (ii)  $H_0 : \sigma = \sigma_0$  against alternative  $H_1 : \sigma \neq \sigma_0$

where both  $\mu$  and  $\sigma$  are unknown.

3+3+4+4

[Turn Over]

3. (a) Suppose  $(x_1, x_2, \dots, x_n)$  is a random sample from a Bernoulli distribution with parameter  $p$ . Show that (i)  $\frac{T(T-1)}{n(n-1)}$  is an unbiased estimator of

$$p^2 \quad \text{(ii) } \frac{T(n-T)}{n(n-1)} \text{ is an unbiased estimator of } p(1-p) \text{ where } T = \sum_{i=1}^n x_i.$$

(b) Suppose  $X$  and  $Y$  are independently distributed Poisson random variables with mean  $m_1$  and  $m_2$ , respectively. Obtain the distribution of

(i)  $X+Y$ , (ii)  $X|X+Y$ . 4+4+3+3

4. What is maximum likelihood estimation? Suppose  $(x_1, x_2, \dots, x_n)$  is a random sample from  $N(\mu, \sigma^2)$ , where both  $\mu$  and  $\sigma$  are unknown. Obtain the maximum likelihood estimates of  $\mu$  and  $\sigma^2$ . Are the estimators unbiased? Also show that method of moments estimation gives identical estimates of the parameters. 2+5+4+3

5. Define Pearsonian  $\chi^2$  statistic.

How do you use this statistic to test :

(i) independence of two population classified according to two characters A and B.

(ii) homogeneity of several similarly classified populations. 2+(6+6)

6. (a) Suppose  $(x_1, x_2, \dots, x_n)$  is a random sample from Poisson distribution with parameter  $m$  and  $T_1 = \sum_{i=1}^n \frac{x_i}{n}$ ,  $T_2 = \frac{2x_1 + \sum_{i=2}^n x_i}{n+1}$ . Which of the above estimators of  $m$  would you prefer? Explain.

(b) Derive the mean and variance of  $\chi^2$  distribution with  $n$  degrees of freedom. (7+3)+4

7. Write notes on **any two** of the following : 7×2

(a) F distribution

(b) Method of moments estimation

(c) Properties of maximum likelihood estimator.

### Group – B

Answer **Question No. 8** and **any three** questions from the rest

8. Answer **any four** of the following questions : 2×4

(a) Write down the meaning of  $L_x$  in a complete life table.

(b) "TFR is a hypothetical figure" — Justify.

- (c) What is rational sub-groups in control chart technique ?
- (d) Define Average Sample Number in the context of statistical quality control.
- (e) Interpret the comment — “The wholesale price index number for India is 185.3 during 2014-15 with 2009-10 as the base period.
- (f) Define weighted aggregative price index.
- (g) Write down a suitable model for economic time series data with all its relevant components.
- (h) What is seasonal fluctuation in a time series data ?
9. Define GRR. What is the rationale behind the consideration of ‘female birth’ and ‘reproduction rate’ for computation of population growth ? What are the disadvantages in GRR ? Define NRR and state two disadvantages of NRR as a measure of population growth. Interpret the situation that NRR for a certain country is 0.88. 2+4+2+(2+2)+2
10. (a) Define operation characteristic and average amount of total inspection with respect to a single sampling inspection plan. 5
- (b) How do you examine whether the process is in control with respect to the mean ? Discuss both the situations when underlying parameters specified and not specified. 9
11. (a) Show that Laspeyre’s and Paasche’s index numbers can be considered as weighted averages of price relatives. 5
- (b) What is Time Reversal Test ? Test whether the weighted arithmetic mean and weighted geometric mean of the price relatives satisfy the Time Reversal Test. 3+(3+3)
12. Discuss the moving average method for determining the trend in a time series data. Explain the procedure to fit a linear trend to time series data. 8+6
13. (a) Describe the different columns of a complete life table. 9
- (b) Briefly discuss the demerits of the moving average method for determining trend. What do you mean by cyclical fluctuations present in a time series data ? 3+2
14. Write notes on **any two** of the following : 7×2
- (a) Determination of seasonal fluctuations by Ratio to trend method.
- (b) Construction of control chart for number of defectives.
- (c) Cost of Living Index.
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