

**2 0 1 5**

**STATISTICS**

*Full Marks : 100*

*Time : 3 hours*

*The figures in the margin indicate full marks for the questions*

*General Instructions :*

- (i) Write all the answers in the Answer Script.
- (ii) Attempt Part—A Objective Questions serially.
- (iii) Attempt all parts of a question together at one place.
- (iv) Regular and private candidates are to attempt Part—A Objective and Part—B Descriptive only.
- (v) Elementary School Teacher candidates are to attempt Part—A Objective and Part—C Descriptive only.

( PART : A—OBJECTIVE )

( Marks : 50 )

SECTION—I

( Marks : 20 )

**1.** Choose and write the correct answer :  $1 \times 10 = 10$

(a) If  $X$  is a random variable with its mean  $\bar{X}$ , the expression  $E(X - \bar{X})^2$  represents

- (i) variance of  $X$
- (ii) mean of  $X$
- (iii) standard deviation of  $X$
- (iv) None of the above

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(b) Which of the following is not true?

(i)  $E(aX) = aE(X)$

(ii)  $E(aX) = XE(a)$

(iii)  $E(a) = a$

(iv)  $E(aX + bY) = aE(X) + bE(Y)$

(c) If  $n = 48$ ,  $p = \frac{3}{4}$  and  $q = \frac{1}{4}$ , then the variance of binomial distribution is

(i) 9

(ii) 3

(iii) 36

(iv) 0

(d) The maximum height of the normal curve lies at the point

(i)

(ii)

(iii) 2

(iv) None of the above

(e) The geometric mean of Laspeyres' and Paasche's price indices is also known as

- (i) Dorbish-Bowley price index
- (ii) Fisher's price index
- (iii) Marshall-Edgeworth price index
- (iv) None of the above

(f) Base period for an index number should be

- (i) a year only
- (ii) a normal period
- (iii) a period at distant past
- (iv) None of the above

(g) The sales of a departmental store on Christmas and Diwali are associated with the component of

- (i) trend
- (ii) seasonal variation
- (iii) cyclical variation
- (iv) irregular variation

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(h) Time series consists of

(i) one component

(ii) two components

(iii) three components

(iv) four components

(i) In simple random sampling with replacement, the same sampling unit may be included in the sample

(i) only once

(ii) more than once

(iii) only twice

(iv) None of the above

(j) A sample consists of

(i) all units of the population

(ii) 50% units of the population

(iii) 5% units of the population

(iv) any fraction of the population

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2. Fill the blanks :

$\frac{1}{2} \times 10 = 5$

- (a) If  $E(X) = 4$ , then  $E(5X) = \text{---}$ .
- (b) For binomial distribution, mean is  $\text{---}$  than variance.
- (c) If  $X \sim N(\mu, \sigma^2)$ , the standard normal variate is distributed as  $\text{---}$ .
- (d) The number of parameters involved in Poisson distribution is  $\text{---}$ .
- (e) Laspeyres' price index number is also known as  $\text{---}$ .
- (f) Index numbers are expressed in  $\text{---}$ .
- (g) A time series is a set of values arranged in  $\text{---}$  order.
- (h) The component representing the long-term fluctuations of a time series is called  $\text{---}$ .
- (i) Stratified sampling is not preferred when the population is  $\text{---}$ .
- (j) If all the units of a population are surveyed, it is called  $\text{---}$ .

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3. Write whether the following statements are *True* or *False* :  $\frac{1}{2} \times 10 = 5$

(a)  $E(XY) = E(X) E(Y)$ , where  $X$  and  $Y$  are random variables which are not independent.

(b) The expected value of a constant is the constant itself.

(c)  $\sum_{r=0}^n {}^n C_r p^r (1-p)^{n-r} = 1$ .

(d) Normal distribution is a unimodal.

(e) An index number is not a pure number.

(f) The general tendency of the data either to increase or decrease over a long period of time is called secular trend.

(g) The index number is called economic barometer.

(h) The expression  $n/N$  is known as sampling fraction.

(i) Seasonal variation, cyclical variation and irregular variation—all are short-term fluctuations.

(j) In simple random sampling, sampling is a biased estimate of the population mean.

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SECTION—II

( Marks : 30 )

4. Answer the following questions : 3×10=30

(a) The random variable  $X$  has the following distribution :

$X$	:	-1	0	1
$P(X)$	:	0.5	0.3	0.2

Find the variance of  $X$ .

(b) Show that  $V(aX) = a^2V(X)$ .

(c) Find the mean of the Poisson distribution.

(d) Write down the properties of normal distribution.

(e) Define cost of living index number. State its uses.

(f) What are the limitations of index number?

(g) Distinguish between seasonal variation and cyclical variation.

(h) Describe the models of a time series.

(i) Distinguish between sample survey and complete census.

(j) Define stratified random sampling.

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( PART : B—DESCRIPTIVE )

( For Regular and Private candidates only and not for  
Teacher candidates )

( Marks : 50 )

Answer **four** questions, taking at least **one** from each Group

GROUP—A

5. (a) Define (i) mathematical expectation, (ii) discrete random variable and (iii) continuous random variable. Show that  $E(aX + b) = aE(X) + b$ . 3+3=6

(b) Mention the three conditions under which binomial distribution tends to Poisson distribution.

The mean of a binomial distribution is 20 and standard deviation is 4. Calculate  $n$ ,  $p$  and  $q$ .

$$3+3\frac{1}{2}=6\frac{1}{2}$$

6. (a) Find the mean and variance of binomial distribution. 3+3\frac{1}{2}=6\frac{1}{2}

(b) For a Poisson distribution, compute—

(i)  $P(2)$  when  $\lambda = 1$ ;

(ii)  $P(3)$  when  $\lambda = \frac{1}{2}$ .

[Given,  $e^{0.5} = 0.607$ ]

$$1\frac{1}{2}+1\frac{1}{2}=3$$

(c) If a random variable  $X$  follows Poisson distribution such that  $P(X = 1) = P(X = 2)$ . Find the mean of the distribution. 3



GROUP—B

7. (a) Show that Fisher's index number satisfies both time and factor reversal test. 6
- (b) Construct index number of prices from the following data using Paasche's and Laspeyres' index methods : 6½

<i>Commodities</i>	<i>2001 Price</i>	<i>2001 Quantity</i>	<i>2005 Price</i>	<i>2005 Quantity</i>
A	5	10	6	5
B	4	14	5	10
C	2	8	4	6
D	2	19	2	13

8. (a) Define time series. Describe the method of moving average for measurement of trend. 2+4=6
- (b) Construct a cost of living index number from the following data and interpret your result : 6½

<i>Article</i>	<i>Indices on 1990</i>	<i>Expenditure</i>
Food	550	46%
Clothing	215	10%
Fuel and Lighting	220	7%
House Rent	150	12%
Miscellaneous	275	25%

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GROUP—C

9. (a) Write a note on the difference between census and sample survey. 6

(b) Show that

$$V(\bar{x}) \text{ SRSWOR} = \frac{\sigma^2}{n} \left( \frac{N-n}{N} \right)$$

where  $\bar{x}$  and  $\sigma^2$  have usual meanings. 6½

10. (a) Suppose 4 units of a population are  $X_1 = 2$ ,  $X_2 = 4$ ,  $X_3 = 6$  and  $X_4 = 8$ . Draw all possible samples of size 2 without replacement and calculate their mean. Show that  $E(\bar{X}) = \bar{X}$ . Also, find the variance of the estimate of the population mean in case of—

(i) SRSWR of size 2;

(ii) SRSWOR of size 2.  $2+3\frac{1}{2}+3=8\frac{1}{2}$

(b) Write notes on SRSWR and SRSWOR with example.  $2+2=4$

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( PART : C—DESCRIPTIVE )

( For Elementary School Teacher candidates only )

( Marks : 50 )

11. Fill in the blanks : 1×20=20

- (a) If  $x$  and  $y$  are random variables, then  $E(x + y)$  equals —.
- (b) If  $x$  is a random variable, then mean of  $x$  is —.
- (c) If  $x = 29$ , then  $E(x)$  equals —.
- (d) If  $\bar{x}$  is the mean of a random variable  $x$ , then  $E(x - \bar{x})$  —.
- (e) If  $x$  and  $y$  are independent random variables, then  $E(xy)$  —.
- (f) If  $n$  be the number of trials in a binomial distribution with probability of success  $P$ , then mean of the distribution is —.
- (g) In case of Poisson distribution, the mean and the variance are —.
- (h) Index numbers help in studying — and tendencies.
- (i) In the selection of the base period while constructing the index numbers, base year should be a — year.

- (j) Index numbers are employed to study changes in the — level.
- (k) In time-series analysis, the free-hand method can represent both linear and — trends.
- (l) If trend is absent in the data, then the seasonal indices are computed by the method of — averages.
- (m) Fisher's index number is also called — index number.
- (n) The formula error arises because of the choice of a particular — in the construction of an index number.
- (o) Simple random sampling is also called — selection method.
- (p) In sampling distribution, a finite population of 5 units samples of size 2 can be selected in — ways.
- (q) In case of SRSWOR,  $E(\bar{x})$  is equal to —.
- (r) The positive square root of the sampling variance is called —.
- (s) In sample survey, a group of individuals is called —.
- (t) SRSWR represents simple random sampling with —.

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GROUP—A

12. Define (a) mathematical expectation, (b) discrete random variable and (c) continuous random variable. Show that  $E(ax + b) = aE(x) + b$ . 3+3=6
13. (a) For a Poisson distribution, compute—  
(i)  $P(2)$  when  $\lambda = 1$ ;  
(ii)  $P(3)$  when  $\lambda = \frac{1}{2}$ .  
[Given,  $e^{0.5} = 0.607$ ]  $1\frac{1}{2} + 1\frac{1}{2} = 3$
- (b) Find the mean of binomial distribution. 3

GROUP—B

14. Show that Fisher's index number satisfies both time and factor reversal test. 6
15. Define time series. Describe the method of moving average for measurement of trend. 2+4=6

GROUP—C

16. Write a note on the difference between census and sample survey. 6

**OR**

17. Write notes on SRSWR and SRSWOR with example. 6

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