3 (Sem–3/CBCS) STA HC 1

2024

STATISTICS

(Honours Core)

Paper : STA–HC–3016

(Sampling Distributions)

Full Marks : 60

Time : Three hours

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

1. Answer the following questions as directed : 1×7=7

   (a) Define parameter.

   (b) The probability of type I error is called _____. *(Fill in the blank)*

(c) The value of test statistic which separates the critical region and the acceptance region is called the

(Choose the correct option)

(i) critical value

(ii) test value

(iii) probability value

(iv) None of the above

(d) The square of a standard normal variate is called *(Choose the correct option)*

(i) Chi-square variate with n d.f.

(ii) t variate

(iii) Chi-square variate with 1 d.f.

(iv) F variate

(e) Write the cumulative distribution function of smallest order statistic.

(f) The null hypothesis is the hypothesis which is tested for possible rejection under the assumption that is true.

(Write True ***or*** *False)*

(g) The ratio of a standard normal variate to the square root of an independent Chi-square variate divided by its degree of freedom. *(Choose the correct option)*

(i) Student's t

(ii) Fisher's t

(iii) F statistic

(iv) Z-test

2. Answer the following questions : 2×4=8

(a) Define sampling distribution of a statistic.

(b) Distinguish between type I and type II error.

(c) Write *two* applications of F statistic.

(d) Write *two* assumptions for student's t-test.

3. Answer ***any three*** questions from the following : 5×3=15

(a) Discuss the application of F-test in testing homogeneity of two variances.

(b) Find the cumulative distribution function of $X(n)$.

(c) Discuss different large sample tests.

(d) State and prove additive property of a Chi-square variate.

(e) If a statistic t follows student's t-distribution with n d.f., then prove that t^2 follows Snedecor's F-distribution with $(1, n)$ d.f.

Answer either 4. *(a)* **or** 4. *(b)*

4. *(a)* Explain the following with illustrations :

(i) Order statistic 2

(ii) One-tailed and two-tailed test 4

(iii) Standard error 2

(iv) p-value approach 2

(b) Let $X_1, X_2, \ldots, X_n$ be a random sample from a population with continuous density. Show that $Y_1 = \min(X_1, X_2, \ldots, X_n)$ is exponential with parameter $n\lambda$ if and only if X_i is exponential with parameter λ. 10

Answer either 5. *(a)* **or** 5. *(b)*

5. *(a)* Derive the p.d.f. of Chi-square distribution. 10

(b) In a random and large sample, prove that

$$\chi^2 = \sum_{i=1}^{k} \left[\frac{(n_i - np_i)^2}{np_i} \right]$$

follows a Chi-square distribution appropriately with $(k-1)$ degrees of freedom, when n_i is the observed frequency and np_i is the corresponding expected frequency of the i^{th} class $(i = 1, 2, \ldots, k)$, $\sum_{i=1}^{k} n_i = n$. 10

Answer either 6. *(a)* **or** 6. *(b)*

6. *(a)* Let X_1 and X_2 be a random sample of size 2 from $N(0, 1)$ and Y_1 and Y_2 be a random sample of size 2 from $N(1, 1)$ and let Y_i's be independent of X_i's. Find the distribution of the following :

(i) $\dfrac{(X_1 + X_2)^2}{(X_2 - X_1)^2}$

(ii) $\dfrac{(Y_1 + Y_2 - 2)^2}{(X_2 - X_1)^2}$ 10

(b) State and prove the relation between t, F and χ^2 distribution. 10

3 (Sem–3/CBCS) STA HC 2

2024

STATISTICS

(Honours Core)

Paper : STA–HC–3026

(Sampling and Indian Official Statistics)

Full Marks : 60

Time : Three hours

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

1. Answer the following questions as directed : 1×7=7

   (a) Probability of drawing an unit in each selection remain same in

   (i) SRSWOR

   (ii) SRSWR

   (iii) Both *(i)* and *(ii)*

   (iv) None of the above

   (Choose the correct answer)

(b) With usual notations, the estimate of the variance of $\bar{y}_{st}$ under proportional allocation is _____. *(Fill in the blank)*

(symbols have their usual meaning)

(c) Subsampling is also known as two-stage sampling. *(Write True* ***or*** *False)*

(d) The sample is regarded as a subset of

(i) Data

(ii) Set

(iii) Distribution

(iv) Population

(Choose the correct answer)

(e) Increasing the sample size has the following effect upon the sampling error.

(i) It increases the sampling error.

(ii) It reduces the sampling error.

(iii) No effect on the sampling error.

(iv) None of the above

(Choose the correct answer)

(f) Error in the survey other than sampling error is known as _____.

(Fill in the blank)

(g) If the number of units in the population is limited, it is called finite population.
(State True ***or*** *False)*

2. Answer the following questions in brief : 2×4=8

(a) Mention *two* drawbacks of systematic sampling.

(b) When does one should go for stratification in sample surveys ?

(c) How does sample survey differ from complete census ?

(d) What are the basic principle of sample survey ?

3. Answer ***any three*** : 5×3=15

(a) Obtain the variance of the estimate of population mean under SRSWOR.

(b) Explain the procedure of selecting a random sample of size 2 using cumulative total method of PPSWR with the help of an example.

(c) In what situations the cluster sampling is preferred ? Comment on the efficiency of cluster sampling as compared to the simple random sampling.

(d) Mention the practical difficulties that may face in allocation of sample size in case of stratified random sampling.

(e) Describe the method of collection of official statistics in India.

4. Answer ***any three*** of the following questions : 10×3=30

(a) Write short notes on :

(i) Origin and function of Central Statistical Organisations (CSO) and its publications 5

(ii) National Sample Survey Office (NSSO) 5

(b) Explain the principal steps involved in the planning and execution of a sample survey.

(c) Explain ratio estimator and regression estimator in detail. When is regression estimator prefered over ratio estimator ?

(d) Show that

$$V(\bar{y}_n)_{wor} \geq V(\bar{y}_{st})_{prop} \geq V(\bar{y}_{st})_N$$

where the notations have their usual meaning.

(e) Prove that in simple random sampling the sample mean is the best linear unbiased estimate (BLUE) of the population mean. What is margin of errors in the estimate ?