

2021

STATISTICS — HONOURS

Paper : CC-8

(Survey Sampling & Indian official Statistics)

Full Marks : 50

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

Answer **any five** questions from question nos. **1 to 8**,
any two from question nos. **9 to 11**, and
any three from question nos. **12 to 16**.

1. If the group of all the students of the Statistics Department of your college be treated as a population, explain the meanings of population size and sampling units. 2
2. Form the sample spaces in case of systematic sampling with $N = 5$ and the sampling interval $k = 2, 3$. 2
3. The sample mean of a study variable differs from the corresponding population mean. State, with justification, which type of error it is. 2
4. To estimate the population total of a variable y , if the population is divided into two strata, stating the meanings of the notations, suggest an estimator of the population total. 2
5. What is the probability that two one-digit numbers read from a random-number series differ? 2
6. Explain, with examples, the ideas of consumption goods and capital goods in connection with national income. 2
7. Mention the fields covered in a publication of the Central Statistical Office. 2
8. Explain the statement, "partial complete enumeration is adopted in cluster sampling". 2
9. If a population is stratified, and n_h units are selected by SRSWOR from the h^{th} stratum of size N_h , show that the estimator \hat{P} , given by

$$\hat{P} = \sum_{h=1}^L W_h p_h$$

is unbiased for the population proportion P ,

and that

$$V(\hat{P}) = \sum_{h=1}^L W_h^2 \frac{1-f_h}{n_h} \frac{N_h P_h (1-P_h)}{N_h - 1},$$

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where $W_h = \frac{N_h}{N}$, $f_h = \frac{n_h}{N_h}$, and p_h and P_h are, respectively, the sample proportion and the population proportion in the h^{th} stratum. 2+3

10. Consider an artificial population such that the value Y_i of the study variable y corresponding to the unit numbered i , is directly proportional to the number i , $i = 1, 2, \dots, N$. Discuss the ratio estimation of \bar{Y} , where i plays the role of the auxiliary variable. Hence make an appropriate comment. 5
11. Stating the names of the different Statistical Offices, give an idea of the Statistical System in India. 5
12. (a) How are the official data flow in the Statistical Offices in India?
 (b) Make a comparison between a complete enumeration and a sample survey. Also state real-life cases where complete enumeration must be adopted. 5+5
13. (a) A population is segregated into two strata of sizes N_1 and N_2 units. Random samples of sizes n_1 and n_2 are to be drawn with replacement from the two strata to estimate the population mean. For a given total sample size, derive the best choice of n_1 and n_2 .
 (b) In case of estimating the population mean of a study variable y , obtain an estimator of the gain (defined by sampling variance of estimator minus that of the other) due to stratification over simple random sampling, on the basis of random data on a study variable y . 5+5
14. In a population of size N , the variate value of one of the units is known to be y_1 . An SRSWOR of size n is selected from the remaining $(N - 1)$ units and the sample mean \bar{y}_n' is used in the estimator T_1 , given by $T_1 = y_1 + (N - 1) \bar{y}_n'$. Show that both T_1 and T , given by $T = N\bar{y}_n$ based on an SRSWOR of size n taken from the entire population are unbiased for the population total, and that T_1 has a smaller variance than T . 2+2+6
15. (a) Describe how you would use the information on an auxiliary variable x correlated with the study variable y to improve the simple unbiased estimate of the total of y -values in simple random sampling without replacement.
 (b) Show that for a hypothetical population where the values of the population units have a linear trend, systematic sampling is more efficient than simple random sampling. 5+5
16. In case of two-stage sampling using simple random without replacement sampling at both the stages, obtain an unbiased estimator of the population total where the first-stage units are of equal size. Show that the variance of the estimator depends on both the between-mean-square and the within-mean-square of the first-stage values of the study variable. 5+5
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