

2020

STATISTICS — HONOURS

Sixth Paper

(Group – B)

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.*

Unit - I

[Time Series Analysis]

(Marks : 25)

Answer *any one* question from *question nos. 1 to 4* and *any one* from *question nos. 5 to 8*.

1. State the additive model and the product model, both involving all the relevant components in connection with the time-series analysis. If the monthly rainfall (in mm) is observed over years in Kolkata, clearly specify the measuring units of all the components of each model. 10
2. Describe how you will fit an exponential curve to a time-series data. Clearly specify the cases when, if required, the number of observations is odd and it is even. 10
3. What is moving average method? How does the *Slutsky-Yule Effect* arise in this context? 10
4. Write a short note on exponential smoothing method. 10
5. (a) Kolkata has shown no appreciable change in the total annual rainfall over the years. Using two different ways of elimination of trend from the data, discuss how you will estimate the seasonal component of rainfall in Kolkata on the basis of the last five years' monthly data. 15
6. Discuss if seasonal pattern changes in a time-series. 15
7. (a) When is a time-series said to be stationary?
(b) Write down a moving average process of order 2 (MA(2)) and check whether this process is stationary. 15
8. (a) Define the autocorrelation function. Derive the autocorrelation function of a MA(2) process.
(b) What is a correlogram? Discuss how the correlogram of a MA(2) process would look like and sketch it. 15

Please Turn Over

Unit - II
[Sample Survey]
(Marks : 25)

Answer **any one** question from **question nos. 9 to 12** and **any one** from **question nos. 13 to 16**.

9. Describe (i) systematic sampling and (ii) two-stage sampling with suitable examples. 10
10. Suppose that the ratio of the sizes (numbers of units) of the two strata is d and the ratio of the standard deviations of the two strata is λ . In simple random with replacement sampling from within strata for estimating the population total, if the sampling variances are v_e when administratively convenient equal

allocation is used and v_o when the optimum allocation is used, show that $\frac{v_e - v_o}{v_o} = \left(\frac{1 - \lambda d}{1 + \lambda d} \right)^2$. 10

11. For systematic sampling, show that the variance of the sample mean can be expressed as

$$\frac{\sigma^2}{n} [1 + (n-1)\rho_c],$$

where σ^2 is the population variance and ρ_c is the correlation coefficient between pairs of sample values in the same sample of fixed size n . 10

12. Obtain an estimator of the population proportion of individuals having some specific habit by the Warner's Randomised Response Technique and hence find the corresponding sampling variance. 10
13. In case of simple random sampling without replacement (SRSWOR) of n_h units from N_h units of the h th stratum, show that an estimator \hat{P} of the population proportion P (of a characteristic "C"), given by

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

where L is the total number of strata, $W_h = \frac{N_h}{N}$, $f_h = \frac{n_h}{N_h}$ and p_h and P_h are respectively the sample proportion and population proportion in the h th stratum. 15

14. Show that $\hat{V}(\hat{P})$, given by $\hat{V}(\hat{P}) = \sum_{h=1}^L W_h^2 (1-f_h) \frac{p_h(1-p_h)}{n_h - 1}$ is unbiased for the sampling

variance $V(\hat{P})$ in question no. 13 above. 15

15. Explain the *Regression-Method of Estimation* of the population mean of a study variable on the basis of samples drawn by simple random sampling without replacement and derive an approximate variance function of the estimator. 15
16. Show that for a hypothetical population where the values of the population units have a linear trend in their serial numbers, systematic sampling is more efficient than simple random sampling. 15