2017
STATISTICS – PAPER-II

BM- (O) ST-II/17

Time Allowed : 3 Hours

Full Marks : 200

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be written either in <u>English</u> or in <u>Bengali</u> but all answers must be in one and the same language.

Group-A
Answer <u>any ten</u> questions

1. (a) Justify the following statement : "Application of a k-point simple moving average process on a time series is equivalent to fitting straight lines to successive k values by method of least squares and finding the mid-values of the fitted lines".

   (b) Discuss the variate difference method for determination of the degree of a polynomial trend equation.

   (c) Describe how '3σ limits' and 'probability limits' are used in setting limits on control charts.

   (d) If you are provided with means and ranges of some manufactured items at regular intervals of time, how do you utilize them to comment on the state of control of the manufacturing process ?

   (e) Explain clearly what do you mean by a stable and a stationary population.

   (f) Given (y_i, x_i), respectively the cumulative income and cumulative population proportions for $i = 1, 2, ..., m$ with $y_{i-1} < y_i$ and $x_{i-1} < x_i, \forall i = 1, 2, ..., m$ while $y_0 = x_0 = 0$ and $y_m = x_m = 1$, find the approximate lorenz area.

   (g) Distinguish between GDP and GNP.

   (h) Discuss the limitations of crude Death Rate for comparing the mortality situations of two communities. How can the limitation be overcome ?

   (i) Explain briefly the principles of Holt-Winters forecasting procedure.

   (j) The lower specification limit for the length of an iron screw is given to a producer. Explain how one can accept or reject a lot of such screws on the assumption that length distribution is normal.

   (k) Derive the AOQ and ATI functions for a double sampling inspection plan by attribute. You may use suitable approximate expressions.

   (l) A series of yearly data show no cyclical fluctuations. Assuming an additive model, describe how you can fit an exponential curve to the data.

   (m) A study on global warming conducted in India is based on the maximum temperature during summer (March – June), monsoon (July – October) and winter (November – February) for the last 100 years. Suggest a method of analysing the data.

   (n) Discuss the situation under which Logistic curve can be used for population forecasting.

P.T.O.

(o) Describe the activities of NSSD.

10×10

Group-B

Answer any five questions.

2. (a) What is population growth ?

   (b) Define reproduction rates and explain how far these rates may be looked upon as indices of population growth.

   (c) What is meant by saying that NRR for a country is 1.5 ? Show that for any community NRR<GRR.

   (d) Explain the nature of growth when NRR=1.   3+8+6+3

3. (a) What is an abridged life table ?

   (b) Derive the relations between different functions of a complete life table.

   (c) Given a complete life table with

   $$l_x = (100-x)/190, \quad 5 \leqslant x \leqslant 100,$$ find the probability that a person of age 30 will live upto age 80.

   6+8+6

4.   Consider the model

   $$x_t = \rho x_{t-1} + \epsilon_t$$

   Where ϵ_t are independently distributed with $E(\epsilon_t)=0$ and $V(\epsilon_t) = \sigma^2$ $\forall t$.

   (a) Find the auto correlation function for this model. If the condition $|\rho| < 1$ necessary to derive the function ? If not, when is this condition required ?

   (b) Describe two different methods of estimating the parameter ρ

   12+8

5. (a) Explain the theoretical basis of control charts.

   (b) The lengths of the diagonal (L) of screens of a particular television brand should not be less than L_0 cms. Assuming that $L \sim N(\mu, \sigma^2)$,

   i) Establish the relationship between the proportion of defectives and the process parameters (μ, σ^2).

   ii) Set up a control chart for number of defectives when sample sizes vary. Also comment on the control limits.
   6+(5+9)

6.   A time series $\left\{ x_t \right\}$ is represented by an AR(2) process

   $$x_t = \alpha_1 x_{t-1} + \alpha_2 x_{t-1} + \epsilon_t$$

   where α_1, α_2 are constants and ϵ_t are independently distributed with $E(\epsilon_t)=0$ and $V(\epsilon_t) = \sigma^2 \forall t$.

   (a) Derive the Yule-Walker equations for auto-correlation of the process.

   (b) How will you use these equations to plot the coorelogram when α_1 and α_2 are given ?

(c) From an observed time series how will you estimate the coefficients α_1 and α_2 of the AR(2) process ?

6+6+8

7. (a) Discuss the different types of errors associated with the construction of index numbers.

(b) Why is Laspeyres' formula said to have an upward bias and Paasche's formula a downward bias ?

(c) In constructing an index number it was decided to choose only those items whose marketed quantity have remained approximately the same over the base and current periods. What effect will it have on the different types of errors and the biases in Laspeyres' and Paasche's formulae ?

7+5+8

8. (a) Distinguish between income, expenditure and production approaches of computing national income.

(b) Describe briefly how national income is computed in the agricultural sector.

(c) Why is Pareto distribution preferred as an income distribution ?

8+8+4

9. (a) Derive the control charts for the number of defectives for (i) standard given and (ii) standard not given.

(b) Comment on the following : The larger the subgroup size, the greater is the sensitivity of $\bar{x}$ - chart to detect shifts in process average.

(c) Discuss various non-random patterns of points in a control chart.

6+6+8

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