2020

STATISTICS — GENERAL

Paper : DSE-A-1

(Econometrics)

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.

Day 1

1. Answer ***any ten*** questions : 1×10

(a) Give an example of trivariate data relevant to Econometrics where one variable is qualitative.

(b) Give an example of a structural econometric model.

(c) Write down the name of a test for detecting heteroscedasticity.

(d) As incomes grow, people have more choices about their savings behaviour. Write down a suitable linear regression model of savings on income clearly stating the assumptions.

(e) State a use of Durbin–Watson d-statistic.

(f) State a reason for correlation between regressor and the error term.

State with reason whether the following statements (g to o) are true, false, or uncertain :

(g) In cases of high multicollinearity, it is not possible to assess the individual significance of one or more partial regression coefficients.

(h) High pair-wise correlations do not suggest that there is high multicollinearity.

(i) Multicollinearity is harmless if the objective of the analysis is prediction only.

(j) In the presence of heteroscedasticity, the ordinary least squares estimator of the regression coefficient in a two-variable linear regression model is biased.

(k) The first-difference transformation to eliminate autocorrelation assumes that the coefficient of autocorrelation ρ is -1.

(l) Often, the exclusion of an important variable from a regression model is a source of autocorrelation.

(m) In the presence of autocorrelation, the ordinary least squares estimator of the regression coefficient in a two-variable linear regression model is unbiased.

(n) A generalized least squares estimate is an ordinary least squares estimate obtained from the transformed variables that satisfy the standard assumptions of ordinary least squares method.

(o) Suppose a variable Z is a candidate instrument for a stochastic regressor X. To be a valid instrument, Z must satisfy the criteria that X and Z are uncorrelated.

2. Answer ***any four*** questions : 5×4

(a) What is an econometric regression model? Justify the insertion of the stochastic error term in an econometric regression model with an example(s).

(b) Write a short note on *dummy variables* with example(s) from Econometrics.

(c) Discuss the remedial method of pooling cross-sectional and time series data to address the problem of multicollinearity.

(d) What do you mean by heteroscedasticity? Discuss the graphical method of detecting heteroscedasticity.

(e) "The problem of heteroscedasticity is likely to be more common in cross section data than in time series data"— explain with examples.

(f) What do you mean by autocorrelation? Discuss a method for detecting autocorrelation.

3. Answer ***any two*** questions :

(a) Explain the concept of multicollinearity. Show that in cases of high multicollinearity, the ordinary least squares estimators of the regression coefficients have large variances and covariances; you may consider a three-variable linear regression model. State some other practical consequences of multicollinearity. 2+5+3

(b) Consider the two-variable linear regression model $Y_i = \alpha + \beta x_i + U_i, i = 1(1)n$. Assume, however, that the classical homoscedasticity assumption is violated. For the first m observations, the variance of the error terms $Var(U_i) = 1$ and for the remaining $(n - m)$ observations $Var(U_i) = 4$. How would you estimate α and β by the method of generalized least squares? What problems arise if you estimate β by the ordinary least squares method? 7+3

(c) Suppose in the regression model $Y_i = \alpha + \beta x_i + U_i$, $i = 1(1)n$ the error term $U_t = \rho U_{t-1} + \varepsilon_t$, where $|\rho| < 1$ and ε_t are uncorrelated and with $E(\varepsilon_t) = 0$ and $Var(\varepsilon_t) = \sigma_\varepsilon^2$ Mention a consequence if the ordinary least squares method is used in estimation of the parameters α and β. Suggest an appropriate method to estimate the model parameters when ρ is unknown. 3+7

2020

STATISTICS — GENERAL

Paper : DSE-A-2

(Operations Research)

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.

Day 1

1. Answer ***any ten*** questions from the following : 1×10

(a) Define feasible solution.

(b) Dual simplex method always gives degenerate solution. [Write True / False]

(c) Name various phases of operations research.

(d) Who introduced the simplex algorithm?

(e) A feasible solution to an L.P.P. must satisfy all the constraints simultaneously. [Write True / False]

(f) What do you mean by artificial variable?

(g) Hungarian method is used to solve _____ problems. [Fill in the blank]

(h) An L.P.P. may have infinite solutions. [Write True / False]

(i) Graphical method can be applied when the number of variables is _____. [Fill in the blank]

(j) North-East Corner rule is used in transportation problem. [Write True / False]

(k) Write an area of application of OR.

(l) Assignment is a special type of transportation problem. [Write True / False]

(m) In Charne's M method, M assumes

(i) small positive value

(ii) large positive value

(iii) large negative value.

[Choose the right answer]

(n) A basic feasible solution is always unique. [Write True / False]

(o) Matrix minima method gives optimum solution to a transportation problem. [Write True/False]

2. Answer ***any four*** questions from the following : 5×4

(a) An agricultural farm has 180 tons of nitrogen fertilizers, 250 tons of phosphate and 220 tons of potash. It is able to sell 3 : 3 : 4 mixtures of these substances at a profit of ₹ 15 per ton and 1 : 2 : 1 mixtures at a profit of ₹ 12 per ton respectively. Formulate an L.P.P. problem to show how many tons of these two mixtures should be prepared to obtain the maximum profit.

(b) Define basic feasible solution. When does a basic feasible solution become degenerate? — Explain using an example.

(c) For the following equations, find the basic solution with x_3 as the non-basic variable :

$$x_1 + 4x_2 - x_3 = 3$$
$$5x_1 + 2x_2 + 3x_3 = 4$$

(d) Show that the set of all convex combinations of a finite number of points is a convex set.

(e) What do you mean by dual problem in the context of L.P.P.? Discuss economic interpretation of duality.

(f) Prove that a transportation problem always has a feasible solution.

3. Answer ***any two*** questions.

(a) (i) Discuss different properties of L.P. model.

(ii) Graphically solve the following L.P.P. :

maximize : $Z = 10x_1 + 15x_2$

subject to : $x_1 + x_2 \geq 2$

$3x_1 + 2x_2 \leq 6z$

$x_1, x_2 \geq 0.$ 5+5

(b) (i) Write the first tableau to solve the following L.P.P. using simplex :

maximize : $Z = 2x_1 + 3x_2 + x_3$

subject to : $-3x_1 + 2x_2 + 3x_3 = 8$

$-3x_1 + 4x_2 + 2x_3 = 7$

$x_1, x_2, x_3 \geq 0.$

(ii) Discuss the formulation of a transportation problem as an L.P.P. 6+4

(c) (i) Formulate the dual problem of the following L.P.P. :

maximize : $Z = 2x_1 + 5x_2 + 6x_3$

subject to : $5x_1 + 6x_2 - x_3 \leq 3$

$-2x_1 + x_2 + 4x_3 \leq 4$

$x_1 - 5x_2 + 3x_3 \leq 1$

$-3x_1 - 3x_2 + 7x_3 \leq 6$

$x_1, x_2, x_3 \geq 0.$

(ii) Find the optimal assignment to find the minimum cost for the following cost matrix : 4+6

	1	2	3	4
1	1	4	6	3
2	9	7	10	9
3	4	5	11	7
4	8	7	8	5