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14 (ECO-2) 2036

2023

ECONOMICS

Paper : ECO-2036

(Quantitative Tools)

Full Marks : 50+30=80

Time : Three hours

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

PART-A

(Marks : 50)

1. Answer the following : 4×3=12

(a) If the investment function for an economy is given by

$$I(t) = sk^{\frac{1}{2}}(\alpha t + \beta)$$

where, K is stock of capital, s is mps, α and β are constants. Find the function for the stock of capital.

Contd.

- (b) Write the significance of co-state variable in the optimal control theory. Why is the co-state variable negatively associated with respect to the state variable in the H function? $2+2=4$
- (c) State the applications of the linear programming technique in economic analysis.

2. Answer **any three** from the following :

$$8 \times 3 = 24$$

- (a) (i) If C is the total cost of output x , it is given that marginal cost always equals to average cost. Show that average cost is constant. 3
- (ii) If the growth of an economy is given by the equation $\frac{dy}{dt} + 2ty = t$, where, y is national income and t is time. Find the equation for the national income of the economy if $y(0) = y_0$ 5

(b) Maximise $\int_0^{20} -\frac{1}{2}u^2 dt$

subject to $y' = u$, $y(0) = 10$, $y(20) = 0$

- (c) State the assumptions of linear programming technique. Explain how linear programming technique can be used to determine the least cost purchases of a consumer subject to fulfillment of minimum required nutritional levels from consumption.

3+5=8

- (d) X and Y are picking cards at random from a well-shuffled pack of playing cards. If both of them pick cards of the same colour, then Y pays X Rs. 2. If both of them pick cards of different colours, then X pays Y Rs. 2.

- (i) Find the pay-off matrix of player X . 3

- (ii) Solve the game and find optimal pay-off of player X . 5

(e) Two firms have two strategies each : to charge either a 'high price' or a 'low price' for a product produced by them. Both firms receive higher per unit profit if both of them charge 'high price'. However, if one of the firms charges 'high price' while the other firm charges 'low price', then the firm charging 'high price' has a reduction in its per unit profit but the firm charging 'low price' enjoys increase in its per unit profit. Charging 'low price' brings them lower per unit profits.

(i) Discuss the above situation as a prisoner's dilemma game. 5

(ii) Find the Nash equilibrium in the game and justify it. 3

3. Answer **any one** from the following :

$$14 \times 1 = 14$$

- (a) (i) Suppose that consumer demand depends upon the price trend according to the equation

$$q = 20 - p - 4 \frac{dp}{dt} + \frac{d^2 p}{dt^2}$$

If the supply function is $q^s(p) = -4 + 4p$, determine the price $p(t)$, given that $p(0) = 5$ and $p'(0) = 4$. Also check the stability of $p(t)$. 9

- (ii) Explain Harrod's model of growth. 5

- (b) Distinguish between well-behaved and ill-behaved linear programming problems. Why are artificial variables with M coefficients used in Big-M method? 400 students are planning to go for a holiday trip. They approached a travel agency who can provide 10 buses of 50 seats each and 8 buses of 40 seats, but only has 9 drivers available. The rental cost for a big bus is Rs. 800 and that for a small bus is Rs. 600. Formulate a linear programming problem and find how many buses of each type the students should hire to minimise transportation costs. $2+2+10=14$

PART-B

(Marks : 30)

1. Answer the following questions : $4 \times 2 = 8$

(a) Explain briefly the method of moments used for estimating population parameters.

(b) The means of two large samples of sizes 1000 and 2000 are 67.5 and 68.0 respectively. Test the equality of means of the two populations each with a standard deviation of 2.5.

2. Answer **any two** of the following questions :

$11 \times 2 = 22$

(a) Discuss the conditions under which sampling is likely to be a desirable and/or necessary method of collecting information about the population. Elaborate on the concept of sampling distribution of a statistic and its standard error with suitable example.

$4 + 7 = 11$

- (b) (i) In hypothesis testing, what are the null and alternative hypotheses? How is the critical region related to the stated hypothesis? Explain.

$$2+3=5$$

- (ii) Eight students were given a test in statistics, and after one month's coaching, they were given another test of similar nature. The following table gives the increase in their marks in the second test over the first :

Roll No. Increase in mark

1	2
2	-2
3	6
4	-8
5	12
6	5
7	-7
8	2

Do the marks indicate that the students have gained from the coaching? 6

(c) (i) Discuss the χ^2 test as used for hypothesis testing. 4

(ii) An experiment was conducted to test the effectiveness of a new drug. The results of the experiment are given below :

Details	Cured	Condition worsened	No effect	Total
Treated with the drug	200	40	60	300
Not treated with the drug	120	30	50	200
Total	320	70	110	500

Use χ^2 test and comment on the effectiveness of the drug. 7