

UNIVERSITY OF COLOMBO

FACULTY OF ARTS

SECOND YEAR EXAMINATION IN ARTS (ECONOMICS) -2017

END OF THE SECOND SEMESTER

ECN: 2223: QUANTITATIVE TECHNIQUES

TIME ALLOWED: TWO (02) HOURS

Question paper has two sections. (Section A and Section B) **Select at least one (01) question from each section and answer four (04) Questions.**

Section A

1.

a. List the steps of the problem solving process and identify the relationship between problems solving and decision making process. (10 Marks)

b. Assume that a firm has developed a following mathematical model to identify demand for its product at various prices.

$$D = 800 - 10P$$

D = Demand for product

P = Price, where $20 < P < 70$

i. How many units can the firm sell at the Rs.20.0 per unit price? At the Rs.70.00 per-unit price? (5 Marks)

ii. Develop a mathematical model for the total revenue (TR). (4 Marks)

iii. The firm's management will only consider following price alternatives of Rs.30.00, Rs.40.00 and Rs.50.00. Using your model from part (ii) determine the price level at which the total revenue is maximized.

(6Marks)

2. A firm produces two type of goods (Regular(R) and Daily special (DS)) using three type of materials. Firm management has developed following linear programming model to identify the number of units produce from each product to maximize its profit.

$$\text{Max } 40R + 30DS$$

$$\text{S.t. } 0.4R + 0.5DS \leq 20 \quad \text{Material 1}$$

$$0.2DS \leq 5 \quad \text{Material 2}$$

$$0.6R + 0.3DS \leq 21 \quad \text{Material 3}$$

$$R, DS \geq 0$$

- i. Is it possible to solve above linear program using graphical method? Give reasons for your answer. (3 Marks)
- ii. Plot the each constraint in separate diagrams and shade the feasible regions of each constraint. (6 Marks)
- iii. Plot all constraints in one diagram and shade the feasible region. (2 Marks)
- iv. How many extreme points are in the feasible region? Mark all extreme points in the feasible. (4 Marks)
- v. Find the optimal solution and maximum profit. (6 Marks)
- vi. Due to change of market conditions. Profit contribution of regular goods per unit decreases from 40 to 30. Mark the new optimal solution in the diagram. Find the new optimal solution and maximum profit. (4 Marks)

3. Use the simplex algorithm to solve the following linear program

$$Z=4X_1+6 X_2$$

S.t

$$-1X_1+1X_2 \leq 11 \quad \text{Material 1}$$

$$1X_1+1X_2 \leq 27 \quad \text{Material 2}$$

$$2X_1+5X_2 \leq 90 \quad \text{Material 3}$$

- i. Convert above inequalities to equations. (3 Marks)
- ii. Express the constraint equations in matrix form. (3 Marks)
- iii. Create an initial simplex table. (3 Marks)
- iv. What are the first basic solutions? Why the first basic solution are not optimal solution for the above problem? (3 Marks)
- v. What is the first pivot element of the problem? (3 Marks)
- vi. What is the criterion that you use to identify the optimal solution? (3 Marks)
- vii. Find the optimal solution and the value of the objective function. (3 Marks)
- viii. What are the shadow prices of each material? (2 Marks)
- ix. How much the value of objective function would change as a result of one unit increase in the material? (2 Marks)

Section B

4. A company has three different plants. The production shipped to three warehouses. The transportation cost, capacity of plants and demand at each warehouse are shown in the following table.

Plant	Warehouse			Plant Capacity
	W1	W2	W3	
P1	20	16	24	300
P2	10	10	8	500
P3	12	18	10	100
Warehouse demand	200	400	300	

- i. Present the above problem using network representation method.

(10 Marks)
 - ii. Develop a linear programming model for above problem.

(10Marks)
 - iii. Suppose that the entries in the table represent profit per unit produce at plan i and sold to warehouse j . How does the linear model change from that in part ii?

(5 Marks)
- 5.
- i. What is the main different between deterministic inventory model and probabilistic inventory models? Give an example for each model

(6 Marks)
 - ii. A firm produces CFL bulbs which has constant annual demand. The demand for bulbs is 12,000 per year. Assume that the ordering cost is \$25.00 per order. A cost of one bulb is \$2.50 and annual holding cost is 20% of the value of inventory. A firm operates 250 working days per year and lead time is 5 days. The total annual inventory cost of firm.
 1. Derive an equation for holding cost, equation for ordering cost and equation for total annual inventory cost.

(4 Marks)
 2. Find the annual order quantity (EQO) which minimizes total inventory cost.

(5 Marks)
 3. What is the optimal reorder point?

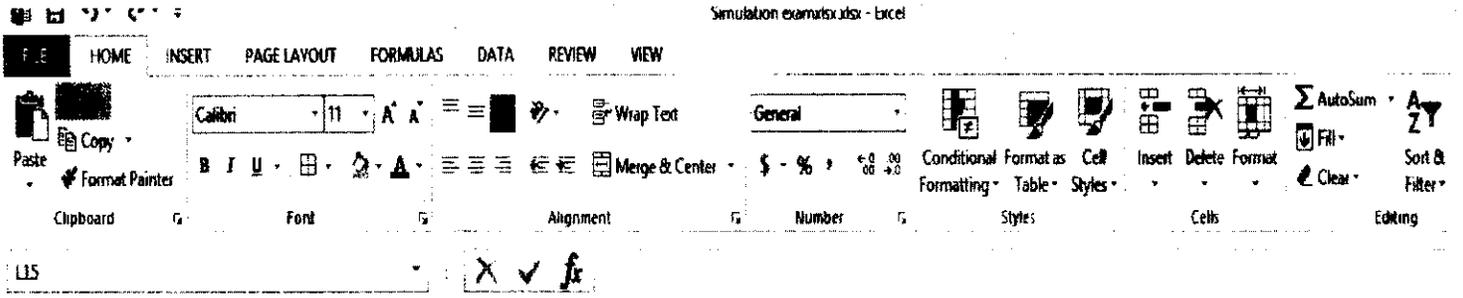
(4 Marks)
 4. How many orders does firm place per year?

(2 Marks)

5. How frequently does firm place an order? (2 Marks)
6. Calculate the total annual inventory cost. (2 Marks)
6. RSM is an Air conditioner service firm. Four technicians (W1, W2, W3, and W4) are working in the RSM. Firm has four (J1, J2, J3, and J4) jobs to complete in this month. Firm wants to assign job to each technicians. The matrix below shows the cost of assigning a certain worker to a certain job. The objective is to minimize the total cost of the assignment.

	<i>J1</i>	<i>J2</i>	<i>J3</i>	<i>J4</i>
<i>W1</i>	82	83	69	92
<i>W2</i>	77	37	49	92
<i>W3</i>	11	69	5	86
<i>W4</i>	8	9	98	23

- i. Present above problem using network representation method. (10 Marks)
- ii. How should assign workers for jobs to minimize the cost of the firm? (Hint ; use Hungarian Method) (10 Marks)
- iii. What is total cost of firm? (5 Marks)
- 7.
- i. Simulation will always give the best (best meaning maximum profit, etc.) solution to a problem. Do you agree with this statement? Give reasons for your answer. (8 Marks)
- ii. The management of MDL Manufacturing Company is considering the introduction of a new product. The fixed cost to being the production of product is Rs.30000.00. The variable cost for the product is uniformly distributed between Rs16.00 and Rs.24.00 per unit. The product will sell for Rs.50.00 per unit. Demand for the product is best described by a normal probability distribution with a mean of 1200 standard deviation of 300 units.
- The simulation model has been developed using Microsoft spreadsheet for above problem and summary of the data is presented below. Answer the questions based on the information in the spreadsheet.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	MDL Manufacturing Company													
2	Selling Price per Unit	50.00					Profit	Number of trials						
3	Fixed Cost	30000.00					Less than -10000	30.00						
4							-9999 to -5000	51.00						
5	Variable Cost (Uniform Distribution)		Demand (Normal Distribution)				-4999 to 0	9.00	Variable Cost=(\$B\$6+RAND())*((\$B\$7-\$B\$6))					
6	Smallest Value	16.00	Mean	1200			1 to 4999	114.00	Demand =NORMINV(RAND(),\$F\$6,\$F\$7)					
7	Largest value	24.00	SD	300			5000 to 9999	30.00	Profit=,=(\$B\$2-B12)*C12-\$B\$3					
8							Above 10000	66.00						
9	Simulation trials						Total number of trials	300.00						
10														
11	Trial	Variable Cost	Demand	Profit				Profit						
12	1	22.28	1133.60	1425.23			Mean	5865.328						
13	2	21.52	1370.66	9041.70			Median	6019.918						
14	3	19.95	1191.24	5792.64			Standard Deviation	9906.044						
15	4	20.09	972.40	-916.13			Minimum	-21026.357						
16	5	18.19	506.56	-13886.80			Maximum	38850.824						
17	6	19.35	1541.33	17243.68										
18	7	22.94	1415.02	8286.70										
19	8	16.96	1070.20	019										
20	9	21.12	820	13488.35										
21	10	821	809.89	-4707.19										
22														

- Fill in the blanks for trial numbers 8, 9 and 10. The blank sells have been highlighted. Write down your answer referring to the sell reference number. (9 Marks)
- What is the probability the project will result in a profit? (5 Marks)
- Assume that MDL Manufacturer is risk averter, what is your recommendation concerning the introduction of the product. (3 Marks)
