

UNIVERSITY OF COLOMBO, SRI LANKA

FACULTY OF ARTS

FOURTH YEAR EXAMINATION IN ARTS (ONSITE – ECONOMICS) – 2021/2022

END OF FIRST SEMESTER

ECN 4182: QUANTITATIVE TECHNIQUES

The paper consists of 03 (three) parts and 07 (seven) questions.

Attempt 03 (three) questions in total, selecting 01 (one) question from each part.

Students are **allowed** to use calculators.

Time duration: 2 hours only

PART I

Question 01 is compulsory

Question No. 01 [40 Marks]

1. State whether the following statements are True or False. Provide a **very brief** justification.
[04 Marks for each]
 - a) The value of one additional unit of an input in a dynamic programming model is the shadow price.
 - b) The stage transformation mechanism in dynamic programming fails to identify which state one reaches at the next stage for a given decision.
 - c) The graphical method can be used to solve linear programming problems that involve two or more decision variables.
 - d) The pivot row is selected based on the smallest displacement ratio.
2. Compare and contrast between the applicability and importance of using the method of simulation and factor analysis. Use examples to support your answer. [08 Marks]
3. Explain the special cases in linear programming using examples of graphs where applicable. [08 Marks]
4. Compare and contrast between the sensitivity analysis in linear programming models against the deterministic dynamic programming approach. [08 Marks]

PART II

Attempt 01 (one) question from this section

Question No. 02 [30 Marks]

An emerging automobile company in a small island nation explores the feasibility of introducing three models of electric vehicles. All models have been tested and has received the preliminary approvals from relevant authorities to be released to the market. However, these prototype models are to be improved for efficiency under the supervision of three skilled teams of engineers so that the models can then be released to the domestic market as soon as possible. The table below provides the estimated number of years it will take to release each vehicle to the market. Vehicles cannot be released unless it is supervised by at least one of the proposed teams of technicians.

Table for Question No. 02

Teams of Technicians	Estimated number of years to release the model		
	Model 1	Model 2	Model 3
0	≥ 10	≥ 10	≥ 10
1	6	6	7
2	5	5	4
3	3	5	2

1. Draw the network to the above problem. [10 Marks]
2. Identify the following with respect to the above problem. [02 Marks each]
 - a) Objective
 - b) Stages
 - c) States
3. Solve the above problem using the tabular method in dynamic programming. [10 Marks]
4. Interpret your findings. [04 Marks]

Question No. 03 [30 Marks]

A developing country suffering from a serious foreign exchange crisis coupled by a socio-economic downturn has reached a phase of debt defaulting to its creditors. Thus, the country has decided to explore the possibilities of avoiding a default by going into a debt restructuring plan with the creditors.

However, according to the estimations made under present circumstances, the probability that the respective creditors (C1, C2 and C3) would not facilitate debt restructuring is 0.60, 0.40 and 0.20 respectively.

Thereby, three creditors were invited to have discussions with two teams from the said country with economic and legal expertise. The table below provides the estimated probability that the creditors would successfully agree to facilitate a restructuring process after discussions are held with 0, 1, or 2 teams put together by the country.

Table for Question No. 03

Teams of Expertise	Probability of success of the discussions		
	Creditor 1	Creditor 2	Creditor 3
0	0.40	0.60	0.80
1	0.20	0.40	0.50
2	0.15	0.20	0.30

1. Draw the network to the above problem. [10 Marks]
2. Identify the following with respect to the above problem. [02 Marks each]
 - a) Objective
 - b) Stages
 - c) States
3. Solve the above problem using the tabular method in dynamic programming. [10 Marks]
4. Interpret your findings. [04 Marks]

Question No. 04 [30 Marks]

A researcher intends to identify the domestic tourists' perception towards the satisfaction gained from a selected tourists' destination under the sub-objectives of investigating the relevance of 5A's concept (accommodation, amenities, attractions, accessibility, and activities) on domestic tourists' satisfaction and discovering the influence from them. A sample of 485 observations were collected using a structured questionnaire designed to collect information regarding domestic tourists' intention towards the 5A's using five-point Likert scale questions.

1. Propose a technique that this researcher could use to analyze the above collected data and justify your proposal. [04 Marks]

2. Identify the stages of the operational methodology proposed in part 1. above, to meet each of the following objectives: [02 Marks for each]
- to identify the major factors that influence the domestic tourists' satisfaction in the selected destination.
 - to confirm the identified major factors from part 2. b) above.
 - to identify the relationships between the identified factors in the model.
3. Define any 05 (five) of the following terms. [04 Marks for each]
- Latent variables
 - KMO Value
 - Factor Loadings
 - Communalities
 - Bartlett's Test
 - Scree Plot

PART III

Attempt 01 (one) question from this section

Question No. 05 [30 Marks]

With the growing interest and demand for organic foods, a popular fast foods restaurant is testing the feasibility of introducing two organic lunch meals to keep its sales stable while attracting more customers. Meal 1 is expected to contribute to a profit margin of Rs. 300 while meal 2 will contribute by Rs. 200. Meal 1 takes 6 hours of processing (including harvest collecting) and 4 hours of preparation (meal preparation and packaging). Meal 2 takes 3 hours of processing and 6 hours of preparation. Both meals include 5 chefs each and it has been recorded that 50 chefs are available for this purpose. It is estimated that 54 hours are available for processing and 48 hours for preparation.

- Formulate the problem and identify the objective and constraints involved in this problem. [05 Marks]
- Solve the problem using the graphical solution. [10 Marks]
- Solve the problem using the simplex method. [10 Marks]
- Interpret your findings. [05 Marks]

Question No. 06 [30 Marks]

A leading hotel chain is planning to incorporate a safari experience to its international tourists arriving in a location near two world renowned national parks. Safari to park 1 requires 2 hours of a trained tour guide, 5-hour trip experience within the park and 8 hotel staff members for meal preparation, trip planning and accompanying the guests to the park. Safari to park 2 requires 6 hours of a trained tour guide, 3-hour trip experience within the park and only 2 hotel staff members. The hotel has estimated the availability of 36 hours of trained tour guides, 30 hours of total trip experience and 40 hotel staff members for this project. A trip arranged to Park 1 is estimated to net the hotel \$40 while a trip to Park 2 is estimated to net the hotel \$50.

1. Formulate the problem and identify the objective and constraints involved in this problem. [05 Marks]
2. Solve the problem using the graphical solution. [10 Marks]
3. Solve the problem using the simplex method. [10 Marks]
4. Interpret your findings. [05 Marks]

Question No. 07 [30 Marks]

A branch manager of a multinational company wants to find a good, low-cost inventory policy for one product: rooftop solar panels. S/He identifies that the inventory policy would be affected by the order quantities, reorder points, daily demand and lead time to receive a reordered product. His past experience shows that the daily demand has a relatively low fluctuation over a period of 300 days. He also noticed that when an order is placed to receive the product from the warehouse, there is a delivery lag of one to three days. Taking these experiences into consideration, the manager decides to use Monte Carlo Simulation to check the status of an identified inventory policy to simulate an order quantity of 10 with a reorder point of 5. The entire process is simulated for a 10-day period as given in the table below.

1. List two other types of simulation methods other than the one used by the Manager. [02 Marks]
2. Identify the controllable and uncontrollable inputs in the above problem. [04 Marks]

Table for Question No. 07

Policy: order quantity = 10 units & reorder point = 5 units									
Day	Units received	Beginning inventory	Random number	Demand	Ending Inventory	Lost sales	Order	Random Number	Lead time
1	..	10	06	1	9	0	No	..	..
2	0	9	63	3	6	0	No	..	..
3	0	6	57	3	3	0	Yes	02	1
4	0	3	94	5	0	2	No	..	..
5	10	10	52	3	7	0	No	..	..
6	0	7	69	3	4	0	Yes	33	2
7	0	4	32	2	2	0	No	..	..
8	0	2	30	2	0	0	No	..	..
9	10	10	48	3	7	0	No	..	..
10	0	7	88	4	3	0	Yes	14	1

3. Considering the 10-day period simulated above to answer the following questions.
- When does the inventory drop below the reorder point for the first time? [01 Marks]
 - How long did it take to receive the order after the inventory dropped below the reorder point for the first time during this 10-day period? [01 Marks]
 - What is the average ending inventory per day? [02 Marks]
 - How much is the average lost sales per day? [02 Marks]
 - On average, how many orders were placed per day? [02 Marks]
4. Assume that during a calendar year, the said branch is open for 200 days. The manager estimates the cost of placing each order to be Rs. 10 (lakhs equivalent Rs. one million), cost of holding a solar panel in stock to be Rs. 6 (lakhs equivalent Rs. six million) per panel per year and cost of a shortage to be Rs. 8 (lakhs equivalent Rs. eight million). Calculate the following:
- Daily order cost [03 Marks]
 - Daily holding cost [03 Marks]
 - Daily shortage cost [03 Marks]
 - Total daily inventory cost [03 Marks]
5. How can you help the branch manager identify the best inventory policy for the branch? Provide suggestions with valid reasoning. [04 Marks]
