

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

SBA2104

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF STATISTICS AND OPERATIONS RESEARCH

SBA2104: FINANCIAL OPERATIONS RESEARCH

DECEMBER 2024: EXAMINATION

Time : 3 hours

Candidates should attempt **ALL** questions from **Section A** (40 marks) and **ANY THREE** questions from **Section B** (20 marks each).

SECTION A

Answer ALL questions in this section [40 Marks]

- A1.** As a financial operations consultant, your client, a large-scale manufacturing company, has been facing increased costs due to inefficient inventory management.
- (a) Explain the six steps involved in applying an Operations Research (OR) approach to optimize inventory levels and reduce overall costs. [9]
 - (b) Describe any three optimization algorithms commonly used in financial modeling for cost reduction. [6]
 - (c) Discuss the importance of Linear Programming (LP) models in real-world applications. [5]
- A2.** A startup is considering two investment options: Project Alpha (high risk, 20% return) and Project Beta (low risk, 10% return). With a budget of \$1 million, they aim to maximize returns while controlling risk. Project Alpha has a risk factor of 0.7 per dollar, and Project Beta has a risk factor of 0.3. The combined risk must stay below 0.5 per dollar invested, and at least \$200,000 must be allocated to each project for diversification.
- (a) Formulate a model to determine the optimal allocation of a budget to maximize returns. [12]
 - (b) Determine an optimal investment mix that maximizes returns while satisfying all constraints. Include a graph to illustrate the feasible region and identify the optimal solution. [8]

SECTION B

Answer any **THREE** questions in this section [60 Marks]

- B3.** A restaurant chain is planning to expand into a new city and is evaluating three potential locations (downtown, suburban and rural). Due to uncertain demand, management has developed the following payoff matrix based on three demand levels: low, medium and high.

Table 1: Payoff Matrix (\$)

Location	Low Demand	Medium Demand	High Demand
Downtown	100	400	800
Suburban	200	500	700
Rural	300	300	600

- (a) Using the Maximin, Maximax, and Minimax Regret criteria, determine which location the restaurant chain should choose. [15]
- (b) Calculate the Expected Monetary Value (EMV) for each location and recommend a decision strategy. [5]
- B4.** A farmer is deciding between growing rice or sugarcane. The probabilities for weather conditions (good, average, and bad) are 0.2, 0.5, and 0.3, respectively. The estimated profits (in \$1000) for each scenario are as follows.

Table 2: Estimated Profits (in \$1000)

Crop	Good	Average	Bad
Rice	80	50	-20
Sugarcane	100	40	-30

- (a) Draw a decision tree to illustrate the farmer's options. [8]
- (b) Using the decision tree, recommend which crop the farmer should invest in. [5]
- (c) Calculate the Expected Value of Perfect Information (EVPI) for the decision. [7]

- B5.** A company needs to allocate its product from two warehouses (W1, W2) to three retail stores (S1, S2, S3). The transportation costs per unit, along with supply and demand quantities shown in the table below.

Table 3: Transportation Costs

From/To (\$)	S1	S2	S3	Supply
W1	10	15	20	30
W2	12	18	25	40
Demand	20	30	20	

- (a) Formulate a linear programming model to minimize the transportation costs. [8]
- (b) Use the following methods to find an initial basic feasible solution.
- (i) North West Corner Method. [4]
- (ii) Minimum Cost Method. [4]
- (iii) Vogel's Approximation Method. [4]
- B6.** An investor is considering investing in one of three businesses: a tech startup, a retail store, or a restaurant. The expected profits (in thousands of dollars) under good and bad economic conditions are shown below.

Table 4: Expected Profits (in \$1000)

Business	Good Conditions (0.7)	Bad Conditions (0.3)
Tech Startup	150	-50
Retail Store	100	20
Restaurant	80	60

- (a) Calculate the Expected Monetary Value (EMV) for each business and suggest a suitable investment strategy. [5]
- (b) Determine the Expected Monetary Value with Perfect Information. (EMVPI). [5]
- (c) Write a Python function to represent the above data using a DataFrame and calculate the EMV. [7]
- (d) Calculate the Expected Value of Perfect Information (EVPI). [3]

END OF QUESTION PAPER