**Operations Research**

**Jun 2025 Examination**

**PLEASE NOTE: This assignment is application based, you have to apply what you have learnt in this subject into real life scenario. You will find most of the information through internet search and the remaining from your common sense. None of the answers appear directly in the textbook chapters but are based on the content in the chapter**

**Q1. A company supplies goods from three factories (A, B, C) to four warehouses (D1, D2, D3, D4). The supply capacities, demand requirements, and transportation costs (in Rs. per unit) are given below:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Factory** | **D1** | **D2** | **D3** | **D4** | **Supply** |
| **A** | **5** | **3** | **7** | **6** | **30** |
| **B** | **4** | **6** | **5** | **8** | **50** |
| **C** | **7** | **4** | **6** | **5** | **20** |
| **Demand** | **20** | **35** | **25** | **20** | **100** |

**Briefly explain the transportation problem and the significance of finding an Initial Basic Feasible Solution (IBFS). Calculate the IBFS using: Northwest Corner Method, Least Cost Method and Vogel’s Approximation Method (VAM). Lastly compare the total transportation costs obtained from all three methods and identify the most efficient one. (10 Marks)**

**Ans 1.**

**Introduction**

Transportation problems are a special class of linear programming problems concerned with transporting goods from multiple origins (like factories) to multiple destinations (like warehouses), such that the total transportation cost is minimized while meeting supply and demand constraints. Solving such problems efficiently ensures cost optimization in logistics and operations. One of the primary steps in solving a transportation problem is to find an Initial Basic Feasible Solution (IBFS). IBFS satisfies all supply and demand constraints without necessarily minimizing the cost. It serves as the foundation for reaching an optimal solution using advanced methods. In this answer, we apply three popular methods to calculate IBFS—Northwest Corner Method, Least Cost Method, and Vogel’s Approximation Method—and

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**Q2. FreshBake Co. supplies bread from three bakeries (B1, B2, B3) to four retail stores (S1, S2, S3, S4). The daily supply capacities (in trays), demand requirements (in trays), and transportation costs (in Rs. per tray) are given below:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bakery** | **S1** | **S2** | **S3** | **S4** | **Supply** |
| **B1** | **5** | **4** | **7** | **6** | **35** |
| **B2** | **3** | **6** | **5** | **4** | **50** |
| **B3** | **7** | **4** | **3** | **5** | **15** |
| **Demand** | **20** | **25** | **30** | **25** | **100** |

**Explain the transportation problem and justify why Vogel’s Approximation Method (VAM) is preferred for finding an Initial Basic Feasible Solution (IBFS). Find the IBFS using Vogel’s Approximation Method (VAM). Use the Stepping Stone Method to derive the optimal solution from the VAM-based IBFS. Lastly compare the total costs of the IBFS and the optimal solution. (10 Marks)**

**Ans 2.**

**Introduction**

A transportation problem is a special type of linear programming problem that focuses on transporting goods from multiple sources (such as factories or bakeries) to multiple destinations (like warehouses or retail stores) at the minimum cost. The goal is to determine the optimal quantity to be transported from each source to each destination so that the total transportation cost is minimized, while simultaneously meeting all the supply and demand constraints. In this case, FreshBake Co. must deliver trays of bread from three bakeries (B1, B2, B3) to four stores (S1, S2, S3, S4).

The transportation problem is a fundamental topic in Operations Research that focuses on determining the most efficient way to distribute products from various supply points, such as

**Q3A. TechMach Industries is a leading manufacturing company specializing in heavy-duty industrial machinery. The company operates multiple production lines, each relying on critical equipment for smooth operations. However, equipment failures and deterioration over time have led to production downtime, increased maintenan costs, and efficiency losses.**

**To optimize costs and operational performance, the company must decide when to replace its equipment. TechMach faces two distinct types of equipment replacement challenges:**

**Part A: Equipment That Fails Completely – Some machines experience sudden and unpredictable failures, leading to urgent replacements.**

**Part B: Equipment That Deteriorates Over Time – Other machines gradually lose efficiency, increasing repair costs and downtime until they become uneconomical to maintain.**

**Discuss the replacement strategies for equipment that fails completely. Using a case- based approach, analyze how TechMach should decide between individual replacement (replacing each unit as it fails) and group replacement (replacing multiple units at scheduled intervals) to minimize costs and disruptions. (5 Marks)**

**Ans 3a.**

**Introduction**

TechMach Industries relies heavily on machinery that operates under intense workloads. Some of these machines are prone to sudden and complete failures, causing unplanned downtime, higher emergency repair costs, and disruption of production schedules. To manage such events and ensure smooth operations, TechMach must implement effective replacement strategies. These strategies should focus on minimizing total costs while maintaining equipment availability. The two key approaches under consideration are **individual replacement** and

**Q3B. Discuss the replacement strategies for equipment that deteriorates over time. Using a case-based approach, analyze how TechMach should decide between repairing aging machines versus replacing them with new equipment, considering factors like increasing maintenance costs, efficiency loss, and depreciation. (5 Marks)**

**Ans 3b.**

**Introduction**

TechMach Industries operates complex machines that gradually wear out and become less efficient over time. As these machines age, they require frequent repairs, consume more energy, and eventually become too costly to maintain. This deterioration leads to productivity losses, higher operational expenses, and increasing breakdown risks. To ensure long-term efficiency and cost savings, TechMach must evaluate the best time to retire old equipment and