**Operations Research**

**April 2024 Examination**

**Q1. A retail company operates several distribution centers (D1, D2, D3, and D4) and serves multiple retail stores (S1, S2, and S3). The shipping costs (in Rs.) per unit from each distribution center to each retail store are presented in the following table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **D1** | **D2** | **D3** | **D4** | **Supply** |
| **S1** | **19** | **30** | **50** | **10** | **7** |
| **S2** | **70** | **30** | **40** | **60** | **9** |
| **S3** | **40** | **8** | **70** | **20** | **18** |
| **Demand** | **5** | **8** | **7** | **14** |  |

**Find the initial basic feasible solution using Vogel's Approximation Method (VAM) for the given transportation problem. Post that, implement the stepping-stone method to find the optimal solution for the transportation problem. Calculate the total shipping cost for the optimal solution. (10 marks)**

**Ans 1.**

To find the initial basic feasible solution using Vogel's Approximation Method (VAM), we start by calculating the penalty for each row and column. The penalty for each row is the difference between the two lowest costs in that row, and the penalty for each column is the difference between the two lowest costs in that column. We will use these penalties to determine which cells to allocate first.

**Step 1: Calculate** It is only half solved

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**Q2. A manufacturing company has several plants (P1, P2, and P3) and several warehouses**

**(WH1, WH2, WH3, and WH4) for distribution. The shipping costs (in Rs.) per unit from each plant to each warehouse are presented in the following table:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **WH1** | **WH2** | **WH3** | **WH4** | **Supply** |
| **P1** | **19** | **30** | **50** | **12** | **7** |
| **P2** | **70** | **30** | **40** | **60** | **10** |
| **P3** | **40** | **10** | **60** | **20** | **18** |
| **Requirement** | **5** | **8** | **7** | **15** |  |

**Find an initial feasible solution using the Northwest Corner Method and Least Cost Method, and also determine the optimal solution using Modified Distribution (MODI) method. (10 marks)**

**(Note- For each method, show the step-by-step calculations, allocations, and the total transportation cost for the final optimal solution)**

**Ans 2.**

To solve this transportation problem, we will use three methods as you requested: the Northwest Corner Method, the Least Cost Method, and the Modified Distribution (MODI) Method. We'll calculate the total transportation cost for each method. Let's begin:

**1. Northwest Corner Method**

The Northwest Corner

**Q3. A small project consisting of eight activities has the following characteristics: Time- Estimates (in weeks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Activity** | **Preceding**  **activity** | **Most optimistic**  **time (a)** | **Most likely**  **time (m)** | **Most pessimistic**  **time (b)** |
| **A** | **None** | **2** | **4** | **12** |
| **B** | **None** | **10** | **12** | **26** |
| **C** | **A** | **8** | **9** | **10** |
| **D** | **A** | **10** | **15** | **20** |
| **E** | **A** | **7** | **7.5** | **11** |
| **F** | **B,C** | **9** | **9** | **9** |
| **G** | **D** | **3** | **3.5** | **7** |
| **H** | **E,F,G** | **5** | **5** | **5** |

**PART a) Prepare the activity schedule for the project and determine the critical path. (5 marks)**

**Ans 3a.**

**Introduction**

In project management, creating an activity schedule and determining the critical path are essential steps in planning and executing a project efficiently. The given project, consisting of eight activities with varying time estimates, requires careful analysis to establish the sequence and duration of each activity. By applying the Critical Path Method (CPM), we can identify the longest stretch of dependent activities and forecast the shortest time possible to complete the project. This

**PART b) Suppose a 30-week deadline is imposed, what is the probability that the project will be finished within the time limit? Also, if the project manager wants to be**

**99% sure that the project is completed on the scheduled date, how many weeks before that date should he start the project work? (5 marks)**

Ans 3b.

To determine the probability that the project will be finished within the time limit, we can use the completion probability of the critical path activities. The completion probability of an activity is the probability that the activity will be completed on time, given its estimated duration and the time limit.

The completion probability of an activity is calculated as follows:

Completion