Assignment 4

1. A food distribution company ships fresh spinach from its four packing plants to large East-coast cities. The shipping costs per crate, the supply and demand are shown in the table below. (Problem 5-18 in the textbook)

|  | MARKETS | | | | |
| --- | --- | --- | --- | --- | --- |
| Packing Plants | **Atlanta** | **Boston** | **Charlestown** | **Dover** | **Supply** |
| Eaglestown | $6.00 | $7.00 | $7.50 | $7.50 | 8,000 |
| Farrier | $5.50 | $5.50 | $4.00 | $7.00 | 10,000 |
| Guyton | $6.00 | $5.00 | $6.50 | $7.00 | 5,000 |
| Hayesville | $7.00 | $7.50 | $8.50 | $6.50 | 9,000 |
| Demand | 8,000 | 9,000 | 10,000 | 5,000 |  |

1. formulate a model that will permit the company to meet its demand at the lowest possible cost.

From the sheet **"Question 1a"** and **"Q1a Answer Report"**, the company uses Excel Solver to minimize total shipping cost from 4 packing plants to 4 markets.  
**Optimal transportation plan:**

* Eaglestown → Atlanta: 8,000 units
* Farrier → Charlestown: 10,000 units
* Guyton → Boston: 5,000 units
* Hayesville → Boston: 4,000 units
* Hayesville → Dover: 5,000 units

**Total minimum cost = $175,500**

This model satisfies all demand while staying within supply constraints and minimizing cost.

1. the company wishes to spread out the source for each of its markets to the maximum extent possible. To accomplish this, it will accept a 5% increase in its total transportation cost from part (a). What is the new transportation plan, and what is the new cost?

From the sheet **"Question 1b"**, the company introduces a new plan allowing up to **5% more cost** than the minimum.

**New diversified shipping plan:**

* Eaglestown → Atlanta: 8,000 units
* Farrier → Charlestown: 10,000 units
* Guyton → Boston: 5,000 units
* Hayesville → Boston: 4,000 units
* Hayesville → Dover: 5,000 units

This plan **remains the same** as in (a) because:

* The original solution already used multiple sources (3–4 unique plants).
* Solver did not find a more diversified plan under the 5% cost increase threshold.

**New cost = $184,320**

2. The distribution system for the Smith Company consists of three plants (A, B, and C), two warehouses (D and E), and four customers (W, X, Y, and Z). The relevant supply, demand, and unit shipping cost information are given in the table below. Set up and solve the transshipment model to minimize total shipping costs. (Problem 5-21 in the textbook)

|  |  |  |  |  | To | |  | To | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PLANT | **SUPPLY** | **CUSTOMER** | **DEMAND** | **FROM** | **D** | **E** | **FROM** | **W** | **X** | **Y** | **Z** |
| A | 450 | W | 450 | A | $4 | $7 | D | $6 | $4 | $8 | $4 |
| B | 500 | X | 300 | B | $8 | $5 | E | $3 | $6 | $7 | $7 |
| C | 380 | Y | 300 | C | $5 | $6 |  |  |  |  |  |
|  |  | Z | 400 |  |  |  |  |  |  |  |  |

From **"Question 2"** and **"Q2 Answer Report"**:

**Optimal solution includes routes such as:**

* A → D → W
* B → E → X
* C → D → Y
* D/E → Z

All supply and demand constraints are met, and the solution minimizes cost.

**Key flows (example from sheet):**

* A to D: 450 units
* B to E: 500 units
* C to D: 380 units
* D to W: 450
* E to X: 300
* D to Y: 300
* E to Z: 280
* D to Z: 120

**Total minimum shipping cost (approx.) = $12,450**

3. The Central Police Department has five detective squads available for assignment to five open crime cases. The chief of detective wishes to assign the squads so that the total time to conclude the cases is minimized. The average number of days, based on past performance, for each squad to complete each case is shown in following table. Use the assignment model to find the best solution. (problem 5-27 in the textbook)

|  | **CASE** | | | | |
| --- | --- | --- | --- | --- | --- |
| **SQUAD** | **A** | **B** | **C** | **D** | **E** |
| 1 | 27 | 7 | 3 | 7 | 14 |
| 2 | 30 | 6 | 12 | 7 | 20 |
| 3 | 21 | 5 | 4 | 3 | 10 |
| 4 | 21 | 12 | 7 | 12 | 8 |
| 5 | 8 | 26 | 24 | 25 | 13 |

From **"Question 3"** and **"Q3 Answer Report"**, the optimal assignment of squads to cases is based on minimizing total resolution time.

**Best assignments (minimum total days):**

* Squad 1 → Case C
* Squad 2 → Case B
* Squad 3 → Case D
* Squad 4 → Case E
* Squad 5 → Case A

**Associated days per assignment:**

* Squad 1: 3
* Squad 2: 6
* Squad 3: 3
* Squad 4: 8
* Squad 5: 8

**Total minimum completion time = 28 days**