

# Strategic Inventory and Distribution Planning for EcoHaven Co. - 623

Iman Khajepour

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## 1 Introduction

**EcoHaven Co.** operates a network of warehouses and stores managing three key products. The company aims to increase profit by minimizing costs related to inventory management, shipping, ordering, and buying. A daily plan is required for 2 weeks (14 days) to meet product demand in stores while minimizing total costs and satisfying constraints on storage and transportation.

The three products are:

- **Fresh Organic Milk**
- **Fresh Salmon**
- **Organic Strawberries**

Each product occupies a different unit of space in the warehouse and store inventories:

- **Fresh Organic Milk:** 2 units of space.
- **Fresh Salmon:** 1.5 units of space.
- **Organic Strawberries:** 1 unit of space.

## 2 Warehouses and Stores

EcoHaven Co. operates 3 warehouses and 5 stores in the region, where the warehouses hold inventory before distributing goods to the stores to meet daily product demand. Each warehouse and store has its own inventory space capacity, detailed below.

- Warehouse 1: 5500 units of space
- Warehouse 2: 6500 units of space
- Warehouse 3: 7200 units of space
- Store 1: 850 units of space
- Store 2: 600 units of space
- Store 3: 700 units of space
- Store 4: 1050 units of space
- Store 5: 1350 units of space

### 3 Costs Breakdown

EcoHaven Co. incurs several costs in the distribution process, including costs for order replenishment, shipping, and storage. These costs need to be managed effectively to minimize overall expenses.

#### 3.1 Order and Buying Costs

Each time the inventory in a warehouse needs to be restocked, EcoHaven Co. incurs the following costs:

- **Fixed order cost** of \$2500 per order, which is independent of the number of products ordered.
- A **variable buying cost** based on the quantity of products ordered, with higher costs typically incurred on weekends. The buying costs are provided in a table for each product, by day.

\* It is important to note that orders placed on a given day are delivered to the warehouse the **next day**.

#### 3.2 Shipping Costs

Shipping products from the warehouses to the stores also incurs various costs. These costs are composed of:

- Shipping incurs a **fixed** cost of \$800 per shipment from warehouse  $i$  to store  $j$ , regardless of the number or type of products shipped.
- A **variable** cost based on the route from the warehouse to the store, influenced by distance and time, which remains the same for all products and days (as the company relies on its own trucks and inventory for daily shipments).

\* It is important to note that the shipment from the warehouse  $i$  to the store  $j$  on a given day is delivered on the **same day**.

The shipping costs (in \$ per unit of product) between the warehouses and stores are provided in the table below:

	Store 1	Store 2	Store 3	Store 4	Store 5
Warehouse 1	1.0	0.8	1.2	2.0	1.6
Warehouse 2	1.4	0.8	1.4	1.0	2.2
Warehouse 3	1.0	1.6	1.8	2.4	1.2

Table 1: Shipping Costs from Warehouses to Stores (in \$ per unit of product)

#### 3.3 Storage Costs

Storage costs depend on the type of product being stored and the duration it stays in the warehouse or stores. Due to the maintenance methods used in the warehouses, the cost of inventory per unit of product is lower in warehouses than in stores. The costs are as follows:

- Inventory cost in warehouses per unit of product:
  - Fresh Organic Milk: **\$0.1**/unit of product
  - Fresh Salmon: **\$0.25**/unit of product
  - Organic Strawberries: **\$0.15**/unit of product
- Inventory cost in stores per unit of product:

- Fresh Organic Milk: **\$1.25**/unit of product
- Fresh Salmon: **\$2.25**/unit of product
- Organic Strawberries: **\$1.75**/unit of product

## 4 Demand

Meeting daily demand at each store is essential for maintaining customer satisfaction. The company cannot afford to lose demand, as it may lead to lost sales and unhappy customers. EcoHaven must efficiently manage the flow of products to each store to ensure all demand is satisfied.

\* The daily demand for each product at each store  $j$  is provided in the **Demand**  $j$ .csv file.

## 5 Goal

Considering that there are 550 units of milk (gallon containers), 350 units of salmon packs, and 750 units of strawberry boxes in each warehouse, with the inventory of all stores being empty on day 0, the goal is to model and solve this problem in Python using GurobiPy. The aim is to determine the daily plan for EcoHaven Co. over a 14-day period, helping them run their warehouses and stores efficiently to minimize the total cost.