**Scheduling Sports Equipment Production**

# Problem

# Brendamore Sports needs to plan the production and inventory management of footballs and soccer balls over the next six months. The goal is to meet the monthly demand while considering production and inventory constraints.

# 2 Data

* ***Current Inventory****:*
  + *Footballs: 7,000*
  + *Soccer Balls: 5,000*
* ***Production Capacity per Month****: 32,000 balls (combined footballs and soccer balls)*
* ***Inventory Capacity****: 20,000 balls (combined footballs and soccer balls)*
* ***Ending Inventory Requirement (End of Month 6)****:*
  + *Footballs: 3,000*
  + *Soccer Balls: 3,000*
* ***Monthly Demand Forecasts, Production Costs, and Holding Costs****:*
* **Table**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Month** | **Football Demand** | **Football Production Cost** | **Football Holding Cost** | **Soccer Ball Demand** | **Soccer Ball Production Cost** | **Soccer Ball Holding Cost** |
| 1 | 15,000 | $13.80 | $0.69 | 10,000 | $10.85 | $0.54 |
| 2 | 25,000 | $13.90 | $0.70 | 15,000 | $10.55 | $0.53 |
| 3 | 20,000 | $12.95 | $0.65 | 10,000 | $10.50 | $0.53 |
| 4 | 5,000 | $12.60 | $0.63 | 5,000 | $10.50 | $0.53 |
| 5 | 2,500 | $12.55 | $0.63 | 5,000 | $10.55 | $0.53 |
| 6 | 5,000 | $12.70 | $0.64 | 7,500 | $10.00 | $0.50 |

# Objective

# Decide the number of footballs and soccer balls to produce and store in each month

# so that the total production and inventory holding costs over the six-month period are minimized

# subject to the following constraints:

# • The demand for each product in each month must be met through production or inventory.

# • The total production in any month cannot exceed the production capacity.

# • The total inventory at the end of each month cannot exceed the storage capacity.

# • Initial inventory levels are given, and required inventory levels at the end of the planning horizon must be achieved.

# Decision Variables

* : Number of footballs produced in month t
* Number of soccer balls produced in month t
* : Inventory of footballs at the end of month t
* : Inventory of soccer balls at the end of month t

# Constraints:

1. **Production Capacity**: Maximum of 32,000 balls per month.
2. **Inventory Capacity**: Maximum of 20,000 balls at the end of each month.
3. **Initial Inventory**: 7,000 footballs and 5,000 soccer balls.
4. **Ending Inventory Requirement**: 3,000 footballs and 3,000 soccer balls at the end of month 6.

# Algebraic Formulation

**Objective Function**: Minimize the total cost, which includes production and holding costs:

s.t.

**Constraints**:

1. **Production Capacity**:
2. **Inventory Capacity**:
3. **Inventory Balance:**

**And**

1. **Initial Inventory**:
2. **Ending Inventory Requirement**:
3. **Non-negativity**:

# Implementation:

Please See the attached drive link which contains the Google Colab file, for the implementation and solution of the model using Python, AMPL, with the solution.

<https://colab.research.google.com/drive/1OjcVpBgoXTg8Tsd_FpA5_g1cd9oNOurd?usp=sharing>

# Result:

The optimal solution involves:

**Producing:** 16,000 of Football in Month 1 17,000 of Football in Month 2 20,000 of Football in Month 3 5,000 of Football in Month 4 2,500 of Football in Month 5 8,000 of Football in Month 6 5,000 of Soccer in Month 1 15,000 of Soccer in Month 2 10,000 of Soccer in Month 3 5,000 of Soccer in Month 4 5,000 of Soccer in Month 5 10,500 of Soccer in Month 6

**Inventory Levels:** 8,000 of Football at the end of Month 1 0 of Football at the end of Month 2 0 of Football at the end of Month 3 0 of Football at the end of Month 4 0 of Football at the end of Month 5 3,000 of Football at the end of Month 6 0 of Soccer at the end of Month 1 0 of Soccer at the end of Month 2 0 of Soccer at the end of Month 3 0 of Soccer at the end of Month 4 0 of Soccer at the end of Month 5 3,000 of Soccer at the end of Month 6

This arrangement results in a total cost of **$1,448,750.**

# AI Training: (copilot)

<https://chatgpt.com/share/66fe198a-e8c8-8009-971d-7396ed84c812>

<https://chatgpt.com/share/66fe19c0-b03c-8009-9949-a27136606a19>