# Lab 02 - Order Quantities When Demand is Approximately Level

Huehn-Brown Products in St. Petersburg offers the following discount schedule for its 4-by-8-foot sheets of quality plywood.

| ORDER | UNIT COST |
|---|---|
| 9 sheets or less | $18.00 |
| 10 to 50 sheets | $17.50 |
| More than 50 sheets | $17.25 |

Home Sweet Home Company sources its plywood from Huehn-Brown, facing an ordering cost of $45 per order, a carrying cost rate of 20% per year, and an annual demand of 100 sheets. To determine the most cost-effective purchasing strategy, it is essential to analyze the impact of different order quantities under the supplier's discount schedule. The following sections outline the development of a computer program that reads input data from an Excel sheet and visualizes the total replenishment cost as a function of order quantity, guiding the selection of the optimal order policy.

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# Assignment: Economic Order Quantity (EOQ) with Price Breaks

## Objective

Develop a program that determines the **cost-minimizing order quantity** under a vendor's **quantity discount schedule**.
Your task is to:

1. Read input data from a spreadsheet.
2. Compute feasible EOQs by price tier.
3. Evaluate **total annual replenishment cost** for each feasible order quantity.
4. Identify and report the optimal order policy.
5. Plot the **Total Annual Cost vs. Order Quantity** curve.

Base case parameters:

- Ordering cost = $45
- Carrying-cost rate = 20% per year
- Annual demand = 100 units

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# 1) Program Requirements

## Inputs

From the spreadsheet, your program must read:

- **Global parameters:**
  - Annual demand (D) (units/year)
  - Ordering cost (K) ($/order)
  - Carrying-cost rate (i) (fraction/year)
  - Optional: Lead time (L) (days) and working days/year
- **Discount schedule (All-Units price breaks):**

| min_qty | max_qty | unit_price |
|---|---|---|
| 1 | 49 | 120.00 |
| 50 | 99 | 115.00 |
| 100 | ∞ | 110.00 |

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### Core Calculations

1. **EOQ per tier:**

$$Q_k^* = \sqrt{\frac{2\,D\,K}{i\,c_k}}$$

   If ($Q_k^*$) is below the tier minimum, replace it with that minimum.

2. **Total Annual Cost (TAC):**

$$\mathrm{TAC}(Q) = Dc(Q) + \frac{D}{Q}K + \frac{Q}{2}, i, c(Q)$$

   where ($c(Q)$) is the price for the tier containing ($Q$).
3. **Evaluation:**
   Calculate TAC for each candidate ($Q_k^*$) and for every tier boundary.
   Choose the ($Q$) that gives the **lowest TAC**.
4. **Visualization:**
   Generate a **cost curve** showing TAC vs. ($Q$), with vertical lines marking the price breaks.

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### Outputs

- **Candidates Table**: shows each tier, unit price, candidate ($Q_k^*$), feasibility, and TAC.
- **Cost Curve Plot**: Total Annual Cost vs. Order Quantity.
- **Recommendation Paragraph**: identify the optimal ($Q$), tier, and minimum TAC.

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## 2) Example Input Data

**Sheet "config"**

| parameter | value |
|---|---|
| D | 100 |
| K | 45 |
| i | 0.20 |

**Sheet "discounts"**

| min_qty | max_qty | unit_price |
|---|---|---|
| 1 | 49 | 120 |
| 50 | 99 | 115 |
| 100 | ∞ | 110 |

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## 3) Expected Output

**A. Candidates Table**

**Tier Price ($) Nominal EOQ Feasible? Evaluated Q TAC ($)**

**B. Cost Curve Plot**

- X-axis: Order Quantity (Q)
- Y-axis: Total Annual Cost
- Mark the minimum cost and price-break lines

**C. Recommendation**
State the best (Q), its price tier, and total cost, and briefly explain why this policy is optimal.

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## 4) Discussion Questions

1. How much cost savings (in $ and %) does the optimal discounted policy achieve compared to the no-discount case?
2. If the carrying-cost rate increases to 25%, does the optimal (Q) change? Why?
3. Find the minimum demand (D) that makes a move to the next price tier worthwhile.
4. Summarize the managerial lesson: when do price breaks justify larger lots?

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## 5) Deliverables

- **Program Script** that reads the spreadsheet, performs EOQ calculations, and plots TAC vs. (Q).
- **Input Spreadsheet** (config and discounts sheets).
- **Candidates Table and Cost Curve** (exported or embedded).
- **Short Report (2–3 pages)** including:
    - Objective and method
    - Results and plots
    - Recommendation and answers to discussion questions

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## 6) Evaluation Criteria

| Criterion | Description | Weight |
|---|---|---|
| Calculation accuracy | Feasibility check, EOQ per tier, and correct TAC evaluation | 35 % |
| Graph clarity | Readable cost curve with tier markers | 15 % |
| Explanation quality | Clear, well-reasoned recommendation | 20 % |
| Code structure | Readable logic and comments | 20 % |
| Presentation | Professional tables and report format | 10 % |

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## Bonus Challenge (Optional)

- Extend the program to handle **Incremental discounts** as well as All-Units.
- Produce a **heatmap** showing optimal (Q) for various values of (D) and (i).
- Incorporate a **Reorder Point** calculation if lead time (L) and daily demand are known.

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