Problem: Minimize Motorola's total purchase and administrative cost for buying 8 products from 5 suppliers given list price, discount and quantity

Solution: Build a linear integer model to minimize the total purchase and administrative cost under the given constraints on suppliers and products

Inputs: in blue in spreadsheet,

- For each product the list price and required quantity
- For each product, supplier the discount percentage
- For each supplier, $5,000 as the admin cost of setup for Motorola

Objective function: Min (**Total Purchase and Admin cost**) **=**

$$\min_{i\in(1\ldots8),\ j\in(1\ldots5)} (\sum(Xij * (Pi * (1 - Dij) * Qi)) + \sum(Yj * Cj))$$, where

- X_{ij} – Quantity of product i supplied by supplier j
- P_i – List price ($) of product i
- Q_i – Quantity required (demand) of product i
- D_{ij} – Discount (%) offered on product i by supplier j
- Y_j – Binary variable to decide whether supplier j is selected or not ∈ (0,1)
- C_j – Fixed administrative cost ($) of setting up supplier j for Motorola ∈ (5000)
- **i** ∈ **(1…8)** for the 8 products
- **j** ∈ **(1…5)** for the 5 suppliers

Decision variables:

- X_{ij} – Quantity of product i supplied by supplier j
- Y_j – Binary variable to decide whether supplier j is selected or not

Constraints:

1. X_{ij} **<= 0.8*** Q_i**,** a supplier cannot supply more than 80% of any products required quantity
2. $\sum_j$ **Xij >=** Q_i **for all i,** quantity supplied by all suppliers must meet demand for each product
- X_{ij} **<=** Y_j *** M**, where **M** ∈ **(797)**
    - To ensure that product i is supplied by supplier j only when it is selected, which forces the model to incur the fixed administrative cost of setting up supplier j
    - **M – maximum quantity required among all products**
        - It could be any large no like 1,000 or 10,000, etc, but the result is the same
        - Smaller value will give sub-optimal result
3. X_{ij} ∈ **int,** only integer quantities must be supplied by each supplier
4. X_{ij} **>= 0,** non-negativity constraint
5. Y_j ∈ **(0,1),** as it is a binary decision variable
6. $\sum_j$ **Yj >= 2,** we need at least 2 suppliers for each product as no supplier can supply more than 80% of each product quantity required

Result:

- Motorola's **minimum total purchase and administrative cost** is **$ 243,550.52**