Problem: Automobile manufacturer to meet next 2 months demand and avg mileage of 23 mpg for trucks and cars by minimising the cost given production and available steel constraints

Solution: Find **maximum no of units of trucks and cars** that should be produced to meet the **monthly demand and mileage requirements** with **minimum production cost for the company**

Inputs: in blue in spreadsheet

- **For each month**
  - Maximum total available production for vehicles (trucks + cars)
  - **Demand for trucks and cars**
  - Maximum steel available in ton's
  - $ Cost/ ton for steel
  - $ Holding cost/vehicle
- Starting inventory for trucks and cars
- Mileage in mpg for trucks and cars
- **Average mileage required 23 mpg**

Objective function = **Min ($ Total Cost) =** $\min_{i \in (1,2)} \sum Yi + Zi$**,** where

- **Y_i** – $ Total cost of steel used per month
- **Z_i** – $ Total inventory holding cost per month
- **i** ∈ **(1,2)** for the two months
- **Y_i = (SC_i * TSU_i),** where
  - **SC** – $ Steel cost / ton for month i, ∈ (700,800)
  - **TSU** – Total Steel Used in month i
  - **TSU_i =** $\sum_{i \in (1,2),\ j \in (trucks,cars)} (Xij * SUPVj)$
    - **X_{ij} - units of vehicle j to be produced for month i**
    - **SUPV** – Steel Used Per Vehicle j in ton's, ∈ (2,1)
    - j ∈ (trucks, cars)
- **Z_i = HC_i * EI_i**, where
  - **HC** – $ Holding Cost/vehicle for ending inventory for month i, ∈ (200,200)
  - **EI** – Ending Inventory for month i
  - **EI_i = IAP_i – D_i**
    - **IAP** – Inventory After Production for month i
    - **D – Demand for month i**
  - **IAP_i = X_i + OI_i**
    - **X** – Total vehicles (trucks + cars) produced in month i
    - **OI** – Opening Inventory for month i **=** starting inventory or EI_{i-1}

Decision variable: **X_{ij}** – units of vehicle j to be produced for month i. j ∈ (trucks, cars), i ∈ (1,2)

Constraints:

1. $\sum_{i \in (1,2),\ j \in (trucks,cars)}$ **Xij <= $MTAV_i$**
   - $MTAV_i$ = Maximum Total Available Vehicle production for month i ∈ (1000, 1000)

2. **X_{ij}** must be integer values
3. **$IAP_{ij} >= D_{ij}$**
    - IAP_{ij} = Inventory After Production for vehicle j in month i
    - D_{ij} = Demand for vehicle j in month i
4. **$EI_{ij} >= 0$**
    - Ending Inventory for vehicle j in month i, should be >= 0 to ensure we meet demand for each vehicle in each month
5. **$TSU_i <= MSA_i$**
    - MSA_i – Monthly Steel Available to purchase in month i
6. $\sum_{i\in(1,2),\ j\in(trucks,cars)} (Xij * VMj) >= \sum_{i\in(1,2),\ j\in(trucks,cars)} (Xij * AVMR)$
    - Total vehicle mileage per month >= total minimum vehicle mileage per month
    - **VM_j** – Vehicle Mileage in mpg for vehicle j ∈ (15, 35)
    - **AVMR** – Average Vehicle Mileage Required = 23 mpg

Result:

- The automobile manufacturer should **produce (400, 600) and (200, 300) units of (trucks, cars)** to **meet month (1,2) demand** and **average mileage requirement of 23 mpg** with **minimum Cost** = **$1,560,000**

Problem: Use SolverTable to do sensitivity analysis on **Total Cost** by **varying** the **minimum avg mileage requirement** of 23 mpg from 20 to 30 in 0.5 increments. What happens when it is greater than 27 mpg

Solution: Vary **avg mileage required as input** (in increments of 0.5 from 20 to 30) and see the results by observing **output cells of X_{ij} and Minimum Total Cost in SolverTable**

Result:

- The results of sensitivity analysis are in STS_2 sheet. It shows that by varying avg mileage,
- There is **no impact on Total Cost from 20 to 27 mpg** as avg mileage
    - It stays constant at $1,560,000, as total vehicles produced is constant at 1,500
    - So, there is no sensitivity to cost from 20 - 27 mpg
- **From 27.5 – 29.0 mpg mileage, the Total Cost of production keeps increasing**
    - As total vehicles produced start increasing beyond 1,500, to meet minimum monthly mileage requirement
- **From 29.5 – 30.0 mpg mileage**, there is **no feasible solution** as it **most likely exceeds** the Total Maximum Available Vehicle production for both months (2000)