Problem: Find the distribution plan for Westvaco's paper mill in Wickliffe, Kentucky that creates a least-cost assignment of truckloads to carriers within the necessary requirements

Solution: Minimize the total cost of distribution from Wickliffe to different destinations by meeting trips(truckloads) and intermediate stop requirements

Inputs: in blue in spreadsheet,
For each destination

- No of trips (truckloads) required
- No of intermediate stops required
- Distance (miles) travelled per trip
- Cost ($/miles) per Carrier
- Some destinations are not served by some carriers, set as 0 and highlighted in red
- Total 32 trips are required for distributing last night's production

For each carrier

- Minimum truckload charge
- Intermediate stop-off charge
- Available trips(pulls)
- Minimum trips(commitment) required

Objective function: Min (**Total Transportation Cost**) = $\min_{i \in (1 \ldots 12),\ j \in (1 \ldots 6)} \sum Xij * Cij$, where

- Minimize the total transportation cost ($) to destination i by carrier j
- $\mathbf{X_{ij}}$ – No of trips to destination i by carrier j
- $\mathbf{C_{ij}}$ – Total Cost ($) to destination i by carrier j per trip
- **i** ∈ **(1…12)** for the 12 destinations
- **j** ∈ **(1…6)** for the 6 carriers
- $\mathbf{C_{ij} = min\ [(CC_{ij} * D_i + SC_j * S_i), MC_j]}$, where
    - Total cost per trip is the minimum of Carrier Cost based on destination distance and no of stops or the carrier's minimum truckload charge
    - This has been calculated in a separate table based on the input data
    - $\mathbf{CC_{ij}}$ – Carrier Cost in miles/$ to destination i by carrier j
    - $\mathbf{D_i}$ – Distance in miles for each trip to destination i
    - $\mathbf{SC_j}$ – Intermediate stop-off charge for carrier j
    - $\mathbf{S_i}$ – No of stops for destination i trip
    - $\mathbf{MC_j}$ – Minimum truckload charge for carrier j for each trip

Decision variable: $\mathbf{X_{ij}}$ – No of trips to destination i by carrier j
Constraints:

1. $\mathbf{\sum_i Xij <= ATC_j}$ **for all j,** where
    - $\mathbf{ATC_i}$ – Available trips(pulls) for each carrier j

2. $\sum_i$ **Xij >= MTC$_j$ for all j,** where
    - **MTC$_j$** – Minimum trips(commitment) for each carrier j
3. $\sum_j$ **Xij >= T$_i$ for all i,** where
    - **T$_i$** – No of trips required to be made to destination i
4. **X$_{ij}$** ∈ **int,** must be integer to ensure 1 full trip/carrier
5. $\sum_{i,j}$ **Xij <= 0,** where
    - **i,j** ∈ {(1,1),(2,1),(3,1),(5,1),(6,1),(8,1),(9,1),(10,1),(12,1),(9,3),(5,4),(9,5),(5,6),(9,6)}
    - Total of all trips that are not served by carrier j to destination i should be 0, to ensure that they are not part of the distribution plan

Result:

- **The least-cost distribution plan** from Wickliffe to different destinations is given with **minimum total cost** of **$ 22,394.38**
- The results are given in **Case5.1** sheet