Using Excel Solver in Spreadsheet with an Example

FRUIT EXAMPLE:

There are 3 people Jack, Alice, and Robbie who wants to divide the fruits that they have (shown on Table 1). Each of them wants to have 25kg fruit individually. At least how much each individual wants from each fruit type is shown on Table 3. Wastes come with penalty costs (Table 2). Do the distribution with minimum penalty.

Closed model:

Table 1: Amount of fruit in total. (kg)

1 (apple)	2 (banana)	3 (pear)	4 (melon)
10	15	30	35

Table 2: Waste penalty costs ($/kg)

1 (apple)	2 (banana)	3 (pear)	4 (melon)
6	2	5	3

Table 3: person j wants from fruit i (kg)

Customer	1 (apple)	2 (banana)	3 (pear)	4 (melon)
1 (Jack)	5	6	5	0
2 (Alice)	2	2	10	5
3 (Robbie)	1	3	11	5

Following is the closed form model of the problem.

Indices: i = indices of the fruits. i={1,2,3,4} $\begin{Bmatrix} 1 = apple \\ 2 = banana \\ 3 = pear \\ 4 = melon \end{Bmatrix}$

j = indices of the people. j={1,2,3} $\begin{Bmatrix} 1 = Jack \\ 2 = Alice \\ 3 = Robbie \end{Bmatrix}$

Parameters:

Capacity: c(i) = how much i type of fruit do we have from table 1.

Penalty: p(i)= penalty of type i fruit waste table 2.

Limit: l(i,j)=how much person j wants from fruit i table 3.

Decision Variables:

x(i,j)= how much from fruit type i is sent to customer j.

Objective Function:

$$\min \sum_i p(i) * (c(i) - \sum_j x(i,j))$$

Constraints:

1. $\sum_j x(i,j) \leq c(i)$ $for\ \forall i.$ (To not exceed the total amount of each fruit)
2. $x(i,j) \geq l(i,j)$ $for\ \forall i\ and\ \forall j.$ (To meet the customer demand)
3. $\sum_i x(i,j) = 25$ $for\ \forall j.$ (Each individual wants 25 kg in total)
4. $x(i,j) \geq 0$ $for\ \forall i\ and\ \forall j.\ (Sign\ restriction)$

Step 1: First write the indices and parameters. Then certify the location of decision variables and left those places empty.

INDICES
i = indices of the fruits.
j = indices of the people.

PARAMETERS

Capacity: c(i) = how much i type of fruit do we have.

1(apple)	2(banana)	3(pear)	4(melon)
10	15	30	35

Penalty: p(i)= penalty of type i fruit waste.

1(apple)	2(banana)	3(pear)	4(melon)
6	2	5	3

Limit: l(i,j)=how much person j wants from fruit i

Customer	1(apple)	2(banana)	3(pear)	4(melon)
1 (Jack)	5	6	5	0
2 (Alice)	2	2	10	5
3 (Robbie)	1	3	11	5

DECISION VARIABLES

x(i,j)= how much from fruit type i is sent to customer j.

Customer	1(apple)	2(banana)	3(pear)	4(melon)
1 (Jack)				
2 (Alice)				
3 (Robbie)				

Step 2: Put the objective function equation to a cell as a linear function of parameter and decision variable cells.

OBJECTIVE FUNCTION

$$\min \sum_i p(i) * (c(i) - \sum_j x(i,j))$$

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=SUM(B14*(B10-SUM(H7:H9)),C14*(C10-SUM(I7:I9)),D14*(D10-SUM(J7:J9)),E14*(E10-SUM(K7:K9)))
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Step 3: For the constraints write the left hand side functions to one cell and right hand side values to

another. To make it easier to understand also write the sign in the middle. No need to write the sign constraint those can be specified on the solver modelling part.

CONSTRAINTS

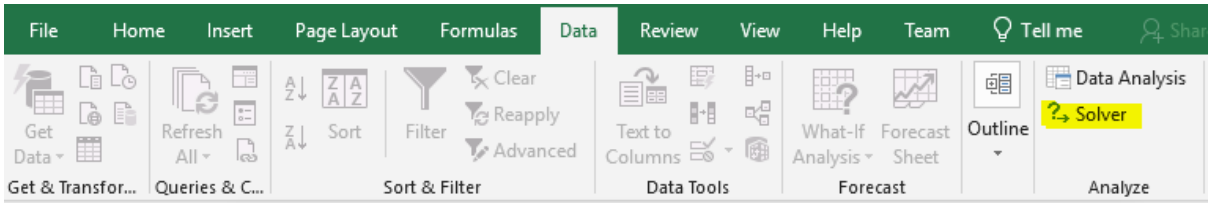
1- $\sum_j x(i,j) \leq c(i)$ $for\ \forall i$

0	≤	10
0	≤	15
0	≤	30
0	≤	35

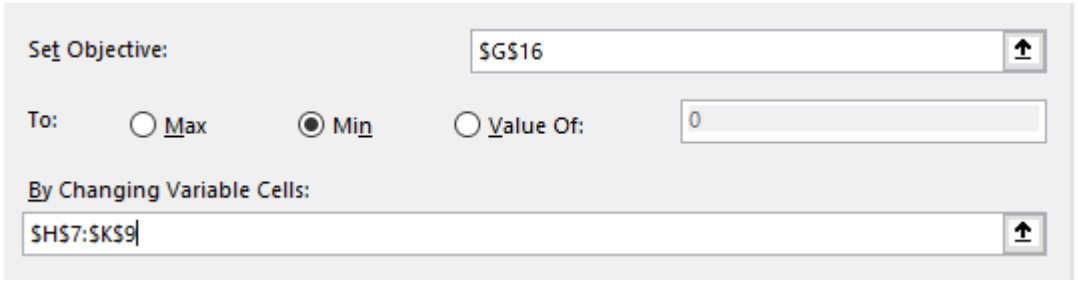
2- $x(i,j) \geq l(i,j)$ $for\ \forall i\ and\ \forall j.$

0	≥	5
0	≥	2
0	≥	1
0	≥	6
0	≥	2
0	≥	3
0	≥	5

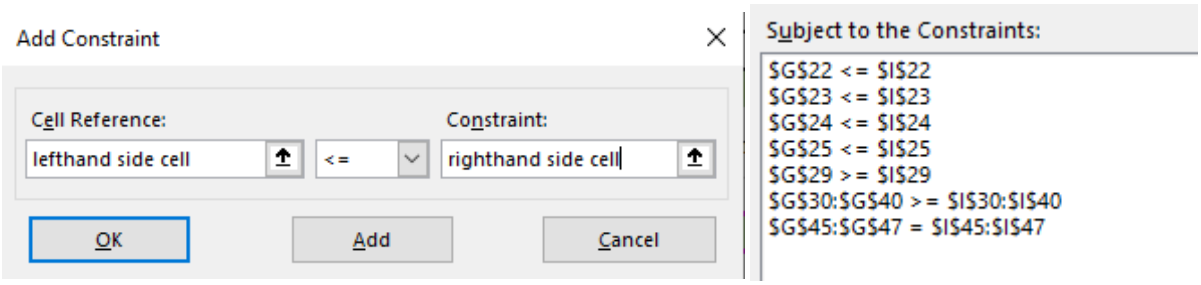
Step 4: Click to “Solver” from “Analyze” under ‘Data’.



Step 5: As we introduced everything before fill the set objective with objective function cell, whether objective is to minimise or maximise, variable cells (decision variable cells that left empty).



Step 6: For constraints fill the following. You can do it for each constraint or if the sign is the same by choosing a range.



Step 7: Hit the Solve button. Choose the reports you want to see and hit OK.