

Assignment Problem (AP)

What is assignment problem?

Assignment problem relates to problem where the objective is to assign a no. of jobs to an equal no. of persons so that the time is minimum or the cost is minimum or profit is maximum

Model of a assignment problem

		Jobs		
		I	II	III
Persons	A	8	19	7
	B	13	17	11
	C	21	3	18

Steps in solving assignment problem

- ▶ Check whether given assignment problem is balanced
- ▶ Subtract the lowest element in each row from every element of that row
- ▶ Subtract the lowest element in each column from every element of that column
- ▶ Check for '0' assignment

STEP 1: Check for balanced matrix

8	19	7
13	17	11
21	3	18

No of Rows : 3

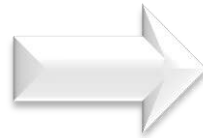
No of Columns : 3

$$3=3$$

Hence matrix is balanced

STEP 2: Row subtraction

8	19	7
13	17	11
21	3	18



1	12	0
2	6	0
18	0	15

Note : Nos. marked in red are min in the row

STEP 3: Column subtraction

1	12	0
2	6	0
18	0	15



0	12	0
1	6	0
17	0	15

Note : Nos. marked in red are min in the Column

STEP 4: Zero Assignment

0	12	0
1	6	0
17	0	15



0	12	0
1	6	0
17	0	15

Matrix after column subtraction



Important

Condition for '0' assignment

- ▶ If any row or column has more than one zero then zero assignment is not possible
- ▶ Only one assignment can be done in row and column
- ▶ After assigning zero in a particular row strike off all other zeros if any in the column of assigned zero and vice versa
- ▶ After finishing row assignment if all the rows are not assigned start column assignment



If all the rows have '0' assignment then the solution is reached or else proceed with **Hungarian method**



In case where zero assignment is not possible by row wise and column wise **Arbitrary assignment** can be done

Hungarian method

- ▶ Tick mark the rows which do not have '0' assignment
- ▶ Tick mark the columns which has a striked zero
- ▶ Check whether any assigned zero is there in that particular column
- ▶ If there is assigned zero then tick mark that corresponding row
- ▶ Again check if there is any striked zero in that particular row

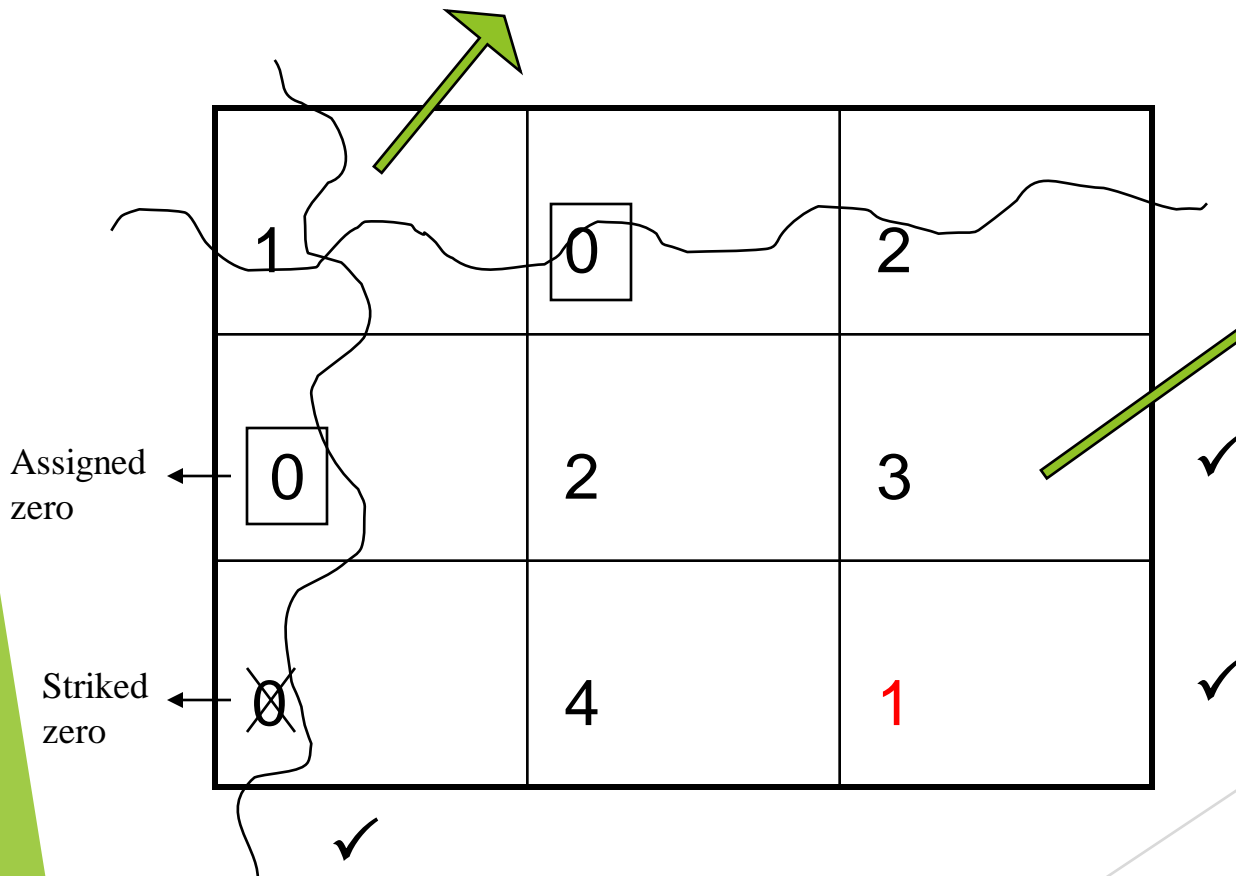
Hungarian method

- ▶ If there is struck zero then follow the same procedure again
- ▶ **Draw lines thru UNMARKED ROWS AND MARKED COLUMNS**
- ▶ Find 'k' as minimum element among the free cells (cells thru which no lines are passing)
- ▶ Add 'k' at the intersection of two lines
- ▶ Subtract 'k' from free cells
- ▶ Do not make any change to the cells thru which only single line is passing

Hungarian method

1+1 since value
Is covered by
both lines

3-1 since
Value is not
covered
By any lines and
1 being the min value
in the matrix



2	0	2
0	1	2
0	3	0

Types of Assignment problem

1. **Maximisation problem**
2. **Unbalanced problem or non square matrix**
3. **Alternative solutions (when arbitrary assignment is done)**
4. **Restricted assignment**

Note: In the cases of maximisation and unbalanced problem same methods to be adopted which is used in the transportation problem

Alternate solutions

- ▶ An assignment problem may have more than one solution
- ▶ In such case both solutions should be obtained

Arbitrary assignment

5	0	35	5	30
15	5	0	30	10
0	5	0	0	30
0	0	5	0	0
15	5	5	10	0

Note : Red boxes shows arbitrary assignment

Restricted assignment

	A	B	C
I	3	4	7
II	7	8	—
III	1	3	6

Restricted assignment (No assignment is possible in this cell)

Solving Restricted assignment

3	4	7
7	8	—
1	3	6



0	1	4
0	1	—
0	2	5

Matrix before Row subtraction

Matrix after Row subtraction

Note : Column subtraction may be performed same way