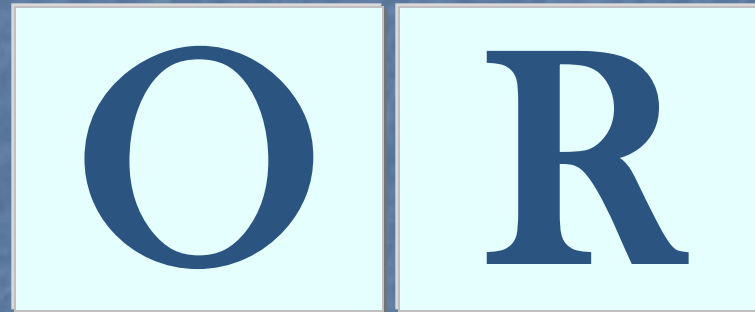


OPERATIONS RESEARCH



ASSIGNMENT PROBLEMS

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ASSIGNMENT PROBLEMS

- The *assignment problem* refers to the class of LP problems that involve determining the most efficient assignment of resources to tasks
- The objective is most often to minimize total costs or total time to perform the tasks at hand
- One important characteristic of assignment problems is that only one job or worker can be assigned to one machine or project
- An assignment problem can be viewed as a transportation problem in which the capacity from each source is 1 and the demand at each destination is 1

GENERAL FORMAT OF ASSIGNMENT PROBLEM

Let m be the number of jobs as well as the operators, and t_{ij} be the processing time of the job i if it is assigned to the operator j . Here the objective is to assign the jobs to the operators such that the total processing time is minimized.

		Operators					
Job		1	2	...	j	...	m
	1	t_{11}	t_{12}		t_{1j}		t_{1m}
	2						
	.						
	i	t_{i1}			t_{ij}		t_{im}
	.						
	m	t_{m1}	t_{m2}		t_{mj}		t_{mm}

■ Examples of assignment problem

Row entity	Column entity	Cell entity
jobs	operators	Processing time
Programmer	program	Processing time
operators	machine	Processing time
Drivers	Routes	Travel time
Teachers	Subjects	Students pass percentage

Assignment problem as a zero-one (Binary) programming problem

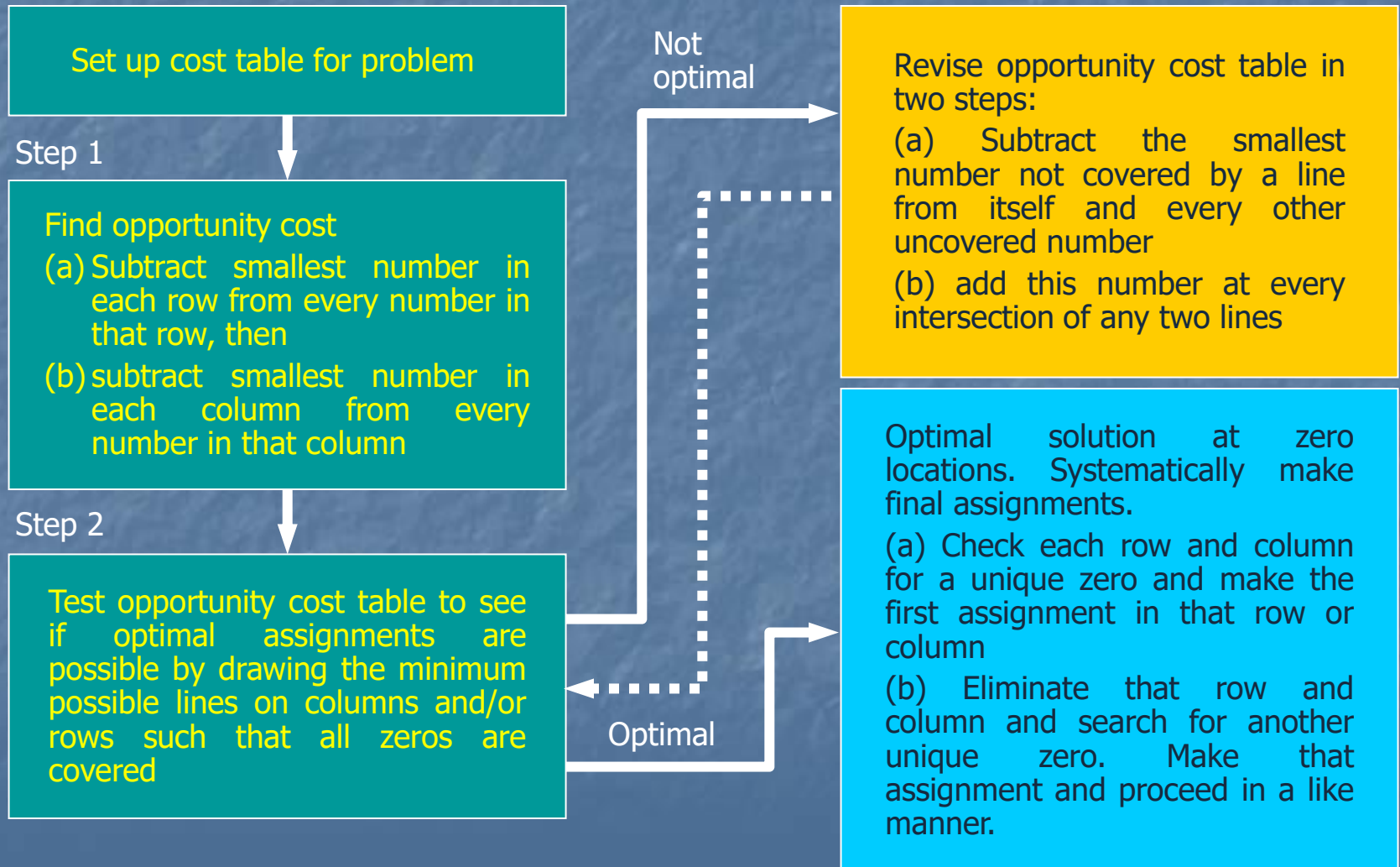
- Min $Z = c_{11}x_{11} + \dots + c_{ij}x_{ij} + \dots + c_{mm}x_{mm}$
- Subject to

$$\begin{aligned}
 x_{11} + \dots + x_{1m} &= 1 \\
 x_{21} + \dots + x_{2m} &= 1 \\
 &\dots\dots\dots \\
 x_{m1} + \dots + x_{mm} &= 1 \\
 x_{11} + \dots + x_{m1} &= 1 \\
 x_{12} + \dots + x_{m2} &= 1 \\
 &\dots\dots\dots \\
 x_{1m} + \dots + x_{mm} &= 1
 \end{aligned}$$

$x_{ij} = 0 \text{ or } 1 \text{ for } i=1,2,\dots,m \text{ and } j=1,2,\dots,m.$

$$\begin{aligned}
 \text{Min } Z &= \sum_{i=1}^m \sum_{j=1}^m C_{ij} X_{ij} \\
 \sum_{j=1}^m X_{ij} &= 1 \text{ for } i = 1, \dots, m \\
 \sum_{i=1}^m X_{ij} &= 1 \text{ for } j = 1, \dots, m
 \end{aligned}$$

THE HUNGARIAN METHOD (FLOOD'S TECHNIQUE)



SPECIAL CASES IN ASSIGNMENT PROBLEMS

- Unbalanced Problem
- Maximum Case
- Multiple Alternative Solution
- Prohibited Assignment

ASSIGNMENT PROBLEMS USING EXCEL SOLVER

The Fix-It Shop has three rush projects to repair. They have three repair persons with different talents and abilities. The owner has estimates of wage costs for each worker for each project. The owner's objective is to assign the three project to the workers in a way that will result in the lowest cost to the shop. Each project will be assigned exclusively to one worker.

Estimated project repair costs for the Fix-It shop assignment problem

PERSON	PROJECT		
	1	2	3
Adams	\$11	\$14	\$6
Brown	8	10	11
Cooper	9	12	7

ASSIGNMENT PROBLEMS USING EXCEL SOLVER

	A	B
1	Fix-It Shop Assignment	
2		
3	Assignment	
4	Enter the assignment costs	
5	SOLVER, SOLVE on the menu	
6	If SOLVER is not a menu option	
7	INS. If SOLVER is not an add-in	
8	Data	
9	COSTS	Project 1
10	Adams	11 14 6
11	Brown	8 10 11
12	Cooper	9 12 7
13		
14	Assignments	
15	Shipments	=B9 =C9 =D9 Row Total
16	=A10	1 0 0 =SUM(B16:D16)
17	=A11	0 1 0 =SUM(B17:D17)
18	=A12	0 0 1 =SUM(B18:D18)
19	Column Total	=SUM(B16:B18) =SUM(C16:C18) =SUM(D16:D18) =SUM(B19:D19)
20		
21	Total Cost	=SUMPRODUCT(B10:D12,B16:D18)
22		

Solver Parameters

Set Target Cell:

Equal To: ☐ Max ☒ Min ☐ Value of:

By Changing Cells:

Subject to the Constraints:

Options

Change

Reset All

Help

Our target cell is the total cost cell (B21), which we wish to minimize by changing the assignment cells.

These guarantee that each project is assigned exactly one employee (3 constraints).

These guarantee that each employee is assigned exactly one project (3 constraints).

Enter the name and assignment codes.

Solver will place the assignments in these cells.

The total assignments for each person and project are calculated here.

The total cost is created here by multiplying the assignment costs in the data table by the assignments in the assignment table using the SUMPRODUCT function.

ASSIGNMENT PROBLEMS USING EXCEL SOLVER

	A	B	C
1	Fix-It Shop Assignment		
2			
3	Assignment		
4	Enter the assignment costs in the table below.		
5	SOLVE on the menu bar at the top of the window.		
6	If SOLVER is not a menu option in the Tools menu then go to TOOLS, ADD-INS. If SOLVER is not an addin option then reinstall Excel.		
7			
8	Data		
9	COSTS	Project 1	Project 2
10	Adams	11	14
11	Brown	8	10
12	Cooper	9	12
13			
14	Assignments		
15	Shipments	Project 1	Project 2
16	Adams	0	0
17	Brown	0	1
18	Cooper	1	0
19	Column Total	1	1
20			
21	Total Cost	25	
22			

Solver Results

Solver found a solution. All constraints and optimality conditions are satisfied.

☒ Keep Solver Solution
☐ Restore Original Values

Reports

☐ Answer
☐ Sensitivity
☐ Limits

It is important to check the statement made by the Solver. In this case, it says that Solver found a solution. In other problems, this may not be the case. For some problems, there may be no feasible solution, and for others, more iterations may be required.

Solver has filled in the assignments with 1s.

QUESTIONS

