Unbalanced Assignment Problems

- Often the number of people or objects to be assigned does not equal the number of tasks or clients or machines listed in the columns, and the problem is *unbalanced.*
- When this occurs, and there are more rows than columns, simply add a *dummy column* or task.
- If the number of tasks exceeds the number of people available, we add a *dummy row*.
- Since the dummy task or person is nonexistent, we enter zeros in its row or column as the cost or time estimate.

Unbalanced Assignment Problems

- Suppose the Fix-It Shop has another worker available.
- The shop owner still has the same basic problem of assigning workers to projects, but the problem now needs a dummy column to balance the four workers and three projects.

Table 9.29

	PROJECT			
PERSON	1	2	3	DUMMY
Adams	$11	$14	$6	$0
Brown	8	10	11	0
Cooper	9	12	7	0
Davis	10	13	8	0

Unbalanced

- One of the four workers, you should realize, will be assigned to the dummy project; in other words, the worker will not really be assigned any of the tasks.

	PROJECT			
PERSON	1	2	3	DUMMY
Adams	$3	$4	$0	$0
Brown	0	0	5	0
Cooper	1	2	1	0
Davis	2	3	2	0

	PROJECT			
PERSON	1	2	3	DUMMY
Adams	$3	$4	$0	$0
Brown	0	0	5	0
Cooper	1	2	1	0
Davis	2	3	2	0

PERSON	PROJECT			
	1	2	3	DUMMY
Adams	$3	$4	$0	$0
Brown	0	0	5	0
Cooper	1	2	1	0
Davis	2	3	2	0

PERSON	PROJECT			
	1	2	3	DUMMY
Adams	$3	$4	$0	$1
Brown	0	0	5	1
Cooper	0	1	0	0
Davis	1	2	1	0

PERSON	PROJECT			
	1	2	3	DUMMY
Adams	$3	$4	$0	$1
Brown	0	0	5	1
Cooper	0	1	0	0
Davis	1	2	1	0

Maximization Assignment Problems

- Some assignment problems are phrased in terms of maximizing the payoff, profit, or effectiveness of an assignment instead of minimizing costs.
- It is easy to obtain an equivalent minimization problem by converting all numbers in the table to opportunity costs.
- This is brought about by subtracting every number in the original payoff table from the largest single number in that table.
- Transformed entries represent opportunity costs.
- Once the optimal assignment has been found, the total payoff is found by adding the original payoffs of those cells that are in the optimal assignment.

Maximization Assignment Problems

- The British navy wishes to assign four ships to patrol four sectors of the North Sea.
- Ships are rated for their probable efficiency in each sector.
- The commander wants to determine patrol assignments producing the greatest overall efficiencies.

Maximization Assignment Problems

Efficiencies of British Ships in Patrol Sectors

SHIP	SECTOR			
	A	*B*	*C*	*D*
1	20	60	50	55
2	60	30	80	75
3	80	100	90	80
4	65	80	75	70

Table 9.30

Maximization Assignment Problems

Opportunity Costs of British Ships

	SECTOR			
SHIP	*A*	*B*	*C*	*D*
1	80	40	50	45
2	40	70	20	25
3	20	0	10	20
4	35	20	25	30

Table 9.31

Maximization Assignment Problems

- Convert the maximization efficiency table into a minimizing opportunity cost table by subtracting each rating from 100, the largest rating in the whole table.
- The smallest number in each row is subtracted from every number in that row and the smallest number in each column is subtracted from every number in that column.
- The minimum number of lines needed to cover the zeros in the table is four, so this represents an optimal solution.

Maximization Assignment Problems

Row Opportunity Costs for the British Navy Problem

SHIP	SECTOR			
	A	*B*	*C*	*D*
1	40	0	10	5
2	20	50	0	5
3	20	0	10	20
4	15	0	5	10

Table 9.32

Maximization Assignment Problems

Total Opportunity Costs for the British Navy Problem

	SECTOR			
SHIP	*A*	*B*	*C*	*D*
1	25	0	10	0
2	5	50	0	0
3	5	0	10	15
4	0	0	5	5

Table 9.33

Maximization Assignment Problems

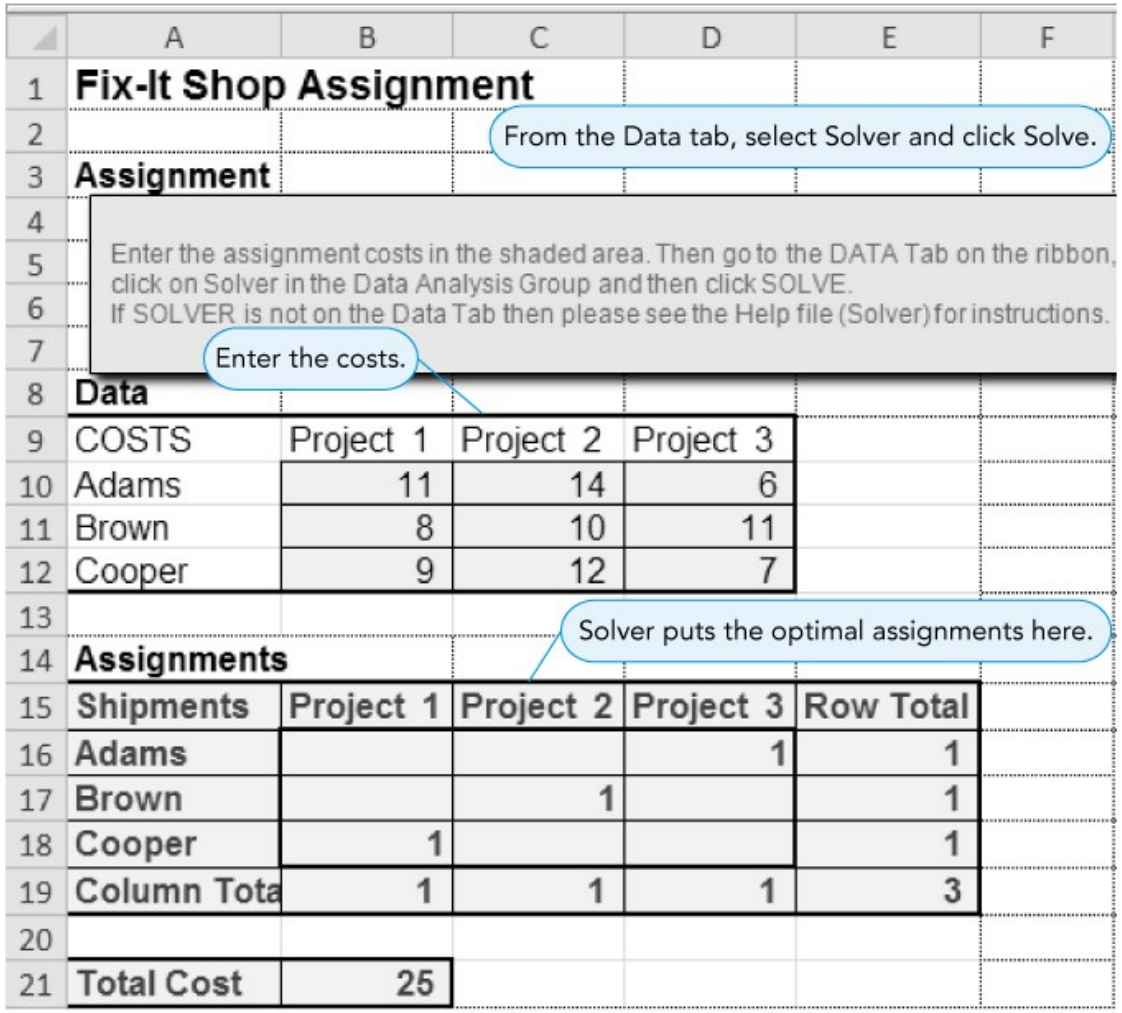
SHIP	SECTOR			
	A	*B*	*C*	*D*
1	25	0	10	0
2	5	5	0	0
3	5	0	10	15
4	0	0	5	5

Maximization Assignment Problems

The overall efficiency

ASSIGNMENT	EFFICIENCY
Ship 1 to sector *D*	**55**
Ship 2 to sector *C*	**80**
Ship 3 to sector *B*	**100**
Ship 4 to sector *A*	**65**
Total efficiency	**300**

Excel QM Solution for Fix-It Shop Assignment Problem



Fix-It Shop Assignment

From the Data tab, select Solver and click Solve.

Assignment

Enter the assignment costs in the shaded area. Then go to the DATA Tab on the ribbon, click on Solver in the Data Analysis Group and then click SOLVE.
If SOLVER is not on the Data Tab then please see the Help file (Solver) for instructions.

Enter the costs.

Data

COSTS	Project 1	Project 2	Project 3
Adams	11	14	6
Brown	8	10	11
Cooper	9	12	7

Solver puts the optimal assignments here.

Assignments

Shipments	Project 1	Project 2	Project 3	Row Total
Adams			1	1
Brown		1		1
Cooper	1			1
Column Tota	1	1	1	3

Total Cost	25

Program 9.5