(Touché Young) Touché Young has eight auditors. Each can work up to 160 hours during the next month, during which time six projects must be completed. The hours required for each project and the amounts each auditor can be billed for each project are given in the file **P05_49.xlsx**. Note that more than one auditor can work on a given project, in which case their hours add to the total for the project. Determine how to maximize total billings during the next month.

Auditor data

Amount billed per hour

Auditor\Project	1	2	3	4	5	6
1	$160	$130	$130	$190	$160	$150
2	$170	$140	$170	$160	$160	$180
3	$130	$170	$160	$170	$160	$160
4	$180	$190	$130	$190	$170	$190
5	$130	$140	$170	$130	$130	$170
6	$140	$160	$170	$150	$150	$170
7	$150	$180	$140	$130	$140	$140
8	$150	$170	$190	$160	$120	$140

Project	1	2	3	4	5	6
Hours required	180	200	200	170	150	190

WinstonAlbright_6e_ P05_49.xlsx

Discussion: -

This is like the earlier problems and our objective is to increase profit for Touché Young's. We must make sure that associate does not work more than 160 hours and assign auditors to projects in such a way that they can complete the project. Total billed amount is sum-product of the hourly billing amount and hours worked by each auditor to each project. So, we can go for Number of hours auditor worked on each project as our decision variable.

Mathematical Model: -

Parameters (Inputs):

$i \in 1,2,..8$ $\quad (i: Index\ for\ auditors)$
$j \in 1,2,..6$ $\quad (j: Index\ for\ projects)$
A_{ij} : $Hourly\ billing\ amount\ of\ \ auditor\ i\ working\ for\ project\ j$
D_j : $Hours\ required\ to\ complete\ project\ j$
M : $Maximum\ hours\ each\ auditor\ can\ work\ ; M = 160$

Decision Variables:
x_{ij} : $Number\ of\ hours\ auditor\ i\ worked\ on\ project\ j$

Objective:

$$Maximize\ total\ profit = \sum_{j=1}^{6}\sum_{i=1}^{8}(x_{ij} * A_{ij})$$

Constraints:

$$\sum_{j=1}^{6} x_{ij} \leq M \ ; \quad for\ i\ \epsilon\{1,2,..8\} \qquad (1)\ Auditors\ working\ hours\ constraint$$

$$\sum_{i=1}^{8} x_{ij} \geq D_j \ ; \quad for\ j\ \epsilon\{1,2,..6\} \qquad (2)\ Hours\ required\ to\ complete\ each\ project$$

Our model will not go for any negative decision values as it is maximization problem, so no need to define non-negative constraint in the model.

Excel Implementation: Please find the attached spreadsheet for solution.

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Auditor data

Amount billed per hour

Auditor\Project	1	2	3	4	5	6
1	$160	$130	$130	$190	$160	$150
2	$170	$140	$170	$160	$160	$180
3	$130	$170	$160	$170	$160	$160
4	$180	$190	$130	$190	$170	$190
5	$130	$140	$170	$130	$130	$170
6	$140	$160	$170	$150	$150	$170
7	$150	$180	$140	$130	$140	$140
8	$150	$170	$190	$160	$120	$140

Project	1	2	3	4	5	6
Hours required	180	200	200	170	150	190

Inputs
Decision variables
Calculated Variables
Constraints
Objective

Total Revenue 227100

Auditor\Project	1	2	3	4	5	6			
1	0	0	0	160	0	0	160	<=	160
2	160	0	0	0	0	0	160	<=	160
3	0	10	0	0	150	0	160	<=	160
4	20	30	0	10	0	100	160	<=	160
5	0	0	0	0	0	160	160	<=	160
6	0	0	40	0	0	120	160	<=	160
7	0	160	0	0	0	0	160	<=	160
8	0	0	160	0	0	0	160	<=	160

	1	2	3	4	5	6
>=	180	200	200	170	150	380