I pledge on my honor that I have not given or received any unauthorized assistance on this

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Date: 10/12/2022

Topic name -

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Date: October 12, 2022

W&A Chapter - 6

Question No – Q04 Q18 & Q 28

Page no – 305, 318, 335

**Management Overview**

**Problem Statement:**

HWK 6: Ch 6: Integer programming

**Data Sources:**

Capital Budgeting: 4E#4=3E#3; use data in P06\_04.xlx

 Solve the following modifications of the capital budgeting model in Figure 6.4. (Solve each part independently of the others.)

**Model Approach**: Optimization Models with Integer Variables

**Solution & Sensitivity Analysis:**

Basic optimal solution for Tatham problem statement -

The optimal solution in for Tatham can obtain a maximum NPV of **$57,500** by selecting investments 1, 4, and 5. These three investments consume total of **$18,000** equal to the available budget. Hence can be considered as optimal solution.

1. **Suppose that at most two of projects 1 through 5 can be selected.**

**Solution –** We add a constraint where the sum of 0-1 variables for the investments is less than or equal to 2.   
As mentioned in the solution sheet as - Total investments and Minimum investment level.   
This gives us optimal solution of selecting investments 4 and 5 with total NPV of $41,500.   
The two investments consume total of $13000 of the total budget of $18000 that is $5000 less than available. But there are no other choices that would fit in with the rest of available amount left.

Hence optimal solution results in **Total NPV of - $53,500** by selection of **4&5 investment plans.**

1. **Suppose that if investment 1 is selected, then investment 3 must also be selected.**

**Solution** – Given the condition we add a constraint to say that Variable for investment 1 >= variable for investment 3.   
This constraint rules out the possibility that is not allowed where investment 3 is selected but investment 1 is not.  
The optimal solution for this constraint is **Total NPV - $56,000** where investments of **1,2,3 and 5** are selected.

With maximum utilization **of $18,000 Budget.**

1. Suppose that at least one of investments 6 and 7 must be selected.

**Solution** – Here we added a constraint that sum of Investments made for 6 and 7 should be greater than equal to 1. The optimal solution to this is **Total NPV - $55,500** where investment **for 6, 4,2 and 1** are selected with complete utilization of allotted **budget of $18000**.

1. Suppose that investment 2 can be selected only if both investments 1 and 3 are selected.

**Solution** – The optimal solution with above constraint is - **Total NPV $57,500** where investment **for 1,4 and 5** are considered. And with the total amount investment of **$18,000** out of total budget $**18000** allotted.   
Hence $1000 are still left out of the total budget with the given case.

**2. Problem Statement:**

Capital budgeting;

1. The optimal solution to the Dorian production model appears to be sensitive to the model inputs. For each of the following inputs, create a one-way Solver Table that captures all changing cells and the target cell as outputs. You can choose the ranges of these inputs to make the results interesting. Comment on your results.
   1. The steel available
   2. The labor hours available
   3. The unit profit contribution of large mini vans
   4. The minimum production level(currently 200) of large minivans
   5. The minimum production level(currently 1000) of compact cars

**Data Sources:**

4E#18=3E#17; use data in P06\_18.xlx

**Model Approach**: Optimization Models with Integer Variables

**Solution & Sensitivity Analysis:**

Management Report –

1. The steel available – Currently, 6500 tons of steel is available. With the sensitivity analysis report, the profits are increasing from over 1000 tons and reaches higher range as it goes on increasing till 10000. There is a slight decrease observed at 600-7000 but picks up as we further increase the steel capacity. Hence increasing steel capacity will help in tangent increase the Profits for the company
2. The Labor hours available- Currently 650000 labor hours are available if we check with the sensitivity analysis report, It is clearly seen that the Units of Production increase as we increase on labor capacity for the production. The sensitivity of Profit vs labor hours increase over time.
3. The unit profit contribution of large mini vans - STS\_3 – it clearly states that the Units\_produced to the unit profit contributions of Large minivans has a steep rise after $7000 which increases over to $8000 which further stays stable. Hence, it will be best to keep the unit profit contribution within the range of $7000-$8000 for maximum profits
4. The minimum production level(currently 200) of large minivans -- Dorian must produce minimum of 200 type of large minivans the minimum they should produce is however 472.72~ 473 units which will be optimal way to maximize the profit. It looks like a flat sensitivity analysis for Large mini van production profit.
5. The minimum production level(currently 1000) of compact cars – the numbers of 1s in the row 13 indicates Dorian should have minimum 1 lot of compact cars produced. i.e. (1000) minimum number of compact cars. These are profitable vehicle types and are evidently not as profitable as large minivans. Although the sensitivity analysis reports suggest after certain amount of production level of up to 1200 the company should stop or will face loss.

The company should make as many of these as it can, after producing the compact cars and midsize minivans, until it runs out of labor hours.

**3. Problem Statement:**

1. In the United Copiers service center model, we assumed that the potential locations of service centers are the same as existing customer locations. Change the model so that the customer locations are the ones given, but the only potential service center locations are in Memphis, Houston, Cleveland, Buffalo, Minneapolis, St. Louis, and Kansas City. You can look up the distances from these cities to the customer cities in a reference book (or on the Web), or you can make up approximate distances. Use Solver to find the optimal solution.

**Data Sources:**

Dorian; 4E#28=3E#28 United Copiers; use data in use data in P06\_28.xlx

**Model Approach**: Optimization Models with Integer Variables

**Solution & Sensitivity Analysis:**

**Solution** – The optimal solution is **6926.206** of Total distance( in 1000 miles) of travelled annually to customers for maximum number of annual trips to customers at different locations of the cities mentioned.It indicates that United Copiers should locate 11 service centers in 2, 5 6 i.e. Houston, Minneapolis and St. Louis having number of service centers of 2,4,5 respetively. The total distance travelled annually is over 6.9 million miles.

Sensitivity Analysis

This is straightforward with SolverTable, the cell Max\_centers as single input cell varies from 1 to 11 in increments of 1, and tracking the binary values in row 19 and target cell. The service centers are typically located in Service center 2,5,and 6 i.e. Houston, St. Louis and Kansas City.