**Case Study #1: Outsourcing Heart Valves**

Hayward Care, a large healthcare organization, outsources a variety of supplies to efficiently maintain its healthcare processes in the organization’s hospitals and outpatient services. One of such supplies is heart valves used in heart operations. Different heart surgeries require valves of different sizes – small, medium, and large. Hayward Care outsources valves from three quality suppliers (wholesale distributors). The cost per valve, which does not depend on the valve size, and proportion of valves of various sizes purchased from each supplier are given in the table below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Suppliers* | *Cost per valve* | *Proportion of Small Valves* | *Proportion of Medium Valves* | *Proportion of Large Valves* |
| Supplier 1 | $280 | 0.40 | 0.40 | 0.20 |
| Supplier 2 | $200 | 0.30 | 0.35 | 0.35 |
| Supplier 3 | $180 | 0.20 | 0.20 | 0.60 |

Each month, Hayward Care places an order with each supplier. At least 300 small, 300 medium, and 400 large valves must be purchased each month. Because of the limited availability of the those valves, at most 500 valves per month can be purchased from each supplier.

Hayward Care is interested to understand how many heart valves need to be acquired from each supplier to minimize the total monthly cost of the organization’s valve purchases.

Questions.

1. Develop an LP model formulation that addresses the issue of minimizing the monthly cost of purchasing heart valves. Briefly explain the model’s decision variables, objective function, and constraints.

1. Based on the LP model formulation, develop a spreadsheet model, and apply Excel Solver to determine the optimal solution of purchasing the needed heart valves. Present and briefly explain your solution.
2. Use a Solver Sensitivity Report from this optimal model in question 2 to explain the following:
   1. if Hayward Care would like to negotiate a higher availability of valves to purchase (above 500), which supplier(s) and why they would need to negotiate it with, and what would be the effect on the optimal cost?
   2. What should be the cost per valve from Supplier 1 in order to increase the optimal number of vales purchased from this supplier? Provide the new optimal solution in this case.
3. Hayward Care would like to purchase more from Supplier 3, which has the lowest cost per valve. For example, they would like to purchase at least 350 valves from Supplier 3. Revise the model in a new spreadsheet by adding this constraint, and identify the optimal solution for the revised model. Compare this optimal solution with the optimal solution in question 2, and briefly explain your results.
4. For the revised model in question 4, apply SolverTable to investigate the effect on the total cost of changing the number of valves purchased from Supplier 3 from 250 to 350 units with an increment of 10 units. Present and briefly explain your results.