

## 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:

<i>Suppliers</i>	<i>Cost per valve</i>	<i>Proportion of Small Valves</i>	<i>Proportion of Medium Valves</i>	<i>Proportion of Large Valves</i>
Supplier 1	\$260	0.30	0.40	0.30
Supplier 2	\$180	0.35	0.35	0.30
Supplier 3	\$150	0.25	0.25	0.50

Each month, Hayward Care places an order with each supplier. At least 400 small, 300 medium, and 500 large valves must be purchased each month. Because of the limited availability of those valves, at most 600 valves per month can be purchased from each supplier. Due to contractual obligations with Supplier 1, Hayward Care needs to purchase at least 300 valves from this 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.
2. 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.
3. Use a Solver Sensitivity Report from the optimal model in question 2 to explain the following:
  - a. What should be the cost per valve from Supplier 3 in order to increase the optimal number of valves purchased from this supplier? Present and briefly explain your results.
  - b. if Hayward Care would like to decrease the maximum purchase from Supplier 1 to 450 units (currently, it is 600 units), how would this decrease affect/change the optimal solution? Present and briefly explain your results.
4. Hayward Care would like to purchase more from Supplier 2, which is the best quality supplier but has the second highest cost per valve. For example, they would like to purchase at least 530 valves from Supplier 2. Present a mathematical formulation of this constraint. Revise the spreadsheet model in question 2 by adding this constraint, identify and present the optimal solution for the

revised model. Compare this optimal solution with the optimal solution in question 2 and briefly explain your results.

5. For the revised model in question 4, apply SolverTable to investigate the effect on the optimal total cost of changing the minimum number of valves purchased from Supplier 1 from 200 to 400 units (currently it is 300 units) with an increment of 10 units. Present and briefly explain your results.