**Case Study #3: Pricing and Production at Blue Ridge Hot Tubs**

Howie Jones, owner of Blue Ridge Hot Tubs, is facing a new problem. Although sale of the two hot tubs manufactured by his company, Agua-Spa and Hydro-Luxe, have been brisk, the company is not earning the level of profits that Howie wants to achieve. The current price of the Aqua-Spa unit is $1,399, and $1,489 for Hydro-Luxe. Having established a reputation for high quality and reliability, Howie believes he can increase profits by increasing the prices of the hot tubs. However, he is concerned that a price increase might have a detrimental effect on demand, so Howie has engaged a marketing research firm to estimate the level of demand for Aqua-Spa and Hydro-Luxe at various prices. To analyze possible relationships between the price and market demand, Howie Jones collected information on the monthly product prices and respective demands for each hot tub in the last two years. See the data below. In any case scenario, and based on competitor prices, Howie wants the price for his hot tubs not to exceed $1,400.

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| --- | --- | --- | --- | --- | --- | --- |
| ***Demand and Price for Aqua Spa*** | | |  | ***Price and Demand for Hydro Luxe*** | | |
| ***Period*** | ***Price*** | ***Demand*** |  | ***Period*** | ***Price*** | ***Demand*** |
| **1** | **$1,100** | **120** |  | **1** | **$1,280** | **133** |
| **2** | **$1,250** | **90** |  | **2** | **$1,290** | **129** |
| **3** | **$1,180** | **106** |  | **3** | **$1,210** | **143** |
| **4** | **$1,290** | **79** |  | **4** | **$1,190** | **152** |
| **5** | **$1,290** | **91** |  | **5** | **$1,250** | **136** |
| **6** | **$1,190** | **97** |  | **6** | **$1,299** | **125** |
| **7** | **$1,010** | **138** |  | **7** | **$1,149** | **144** |
| **8** | **$899** | **146** |  | **8** | **$1,149** | **153** |
| **9** | **$1,095** | **122** |  | **9** | **$1,145** | **154** |
| **10** | **$1,095** | **110** |  | **10** | **$1,195** | **148** |
| **11** | **$999** | **140** |  | **11** | **$1,195** | **141** |
| **12** | **$989** | **126** |  | **12** | **$1,210** | **137** |
| **13** | **$1,115** | **117** |  | **13** | **$1,315** | **126** |
| **14** | **$990** | **142** |  | **14** | **$1,190** | **146** |
| **15** | **$890** | **143** |  | **15** | **$1,199** | **147** |
| **16** | **$1,090** | **110** |  | **16** | **$1,210** | **148** |
| **17** | **$1,190** | **105** |  | **17** | **$1,230** | **139** |
| **18** | **$1,250** | **89** |  | **18** | **$1,250** | **134** |
| **19** | **$1,140** | **113** |  | **19** | **$1,199** | **144** |
| **20** | **$1,019** | **128** |  | **20** | **$1,149** | **155** |
| **21** | **$999** | **139** |  | **21** | **$1,199** | **145** |
| **22** | **$912** | **142** |  | **22** | **$1,112** | **154** |
| **23** | **$1,020** | **136** |  | **23** | **$1,109** | **158** |
| **24** | **$1,115** | **110** |  | **24** | **$1,115** | **159** |

Howie determined that the costs of manufacturing Aqua-Spa and Hydro-Luxe are $540 and $640 per unit, respectively. Ideally, he wants to produce enough hot tubs to meet demand exactly and carry no inventory of hot tubs. Each Aqua-Spa requires 1 pump, 4 hours of labor, and 10 feet of tubing materials; each Hydro-Luxe requires 1 pump, 6 hours of labor, and 16 feet of tubing materials. Howie’s suppliers have committed to supplying him with 200 pumps and 2,700 feet of tubing. Also, 1,600 hours of labor are available for production. Howie wants to determine how much to charge for each type of hot tub to maximize the total monthly profit.

Questions.

1. Based on the historical information on prices and demand, identify using regression analysis a linear demand function for each hut tub. Present and briefly describe these linear functions.
2. Using the linear demand functions from question 1, formulate an NLP model that identifies the optimal prices of Aqua-Spa and Hydro-Luxe hot tubs that would maximize the total profit for next month. (Hint: the number of units produced for each spa should be equal to the respective demand).
3. Develop a spreadsheet model in Excel and solve the model using Excel Solver. Present the optimal solution and briefly explain it.
4. What will be the projected profit increase (or loss) by switching from the current hut tub prices and current production to the optimal prices identified in question 2. Present and briefly explain. Consider the current production (demand) equal to 65 units of Aqua-Spa and 98 units of Hydro-Luxe. (Hint: For the case of the current prices and current production units, you don’t need to identify the demand/production of Aqua-Spa and Hydro-Luxe using the demand function equation).
5. For optimal results in question 3, use SolverTable to analyze how changes in the maximum number of pumps (take the range between 10 and 300 units with an increment of 10) affect the optimal price for each hot tub, the number of units produced, and the maximum total profit. Present and briefly explain your results.
6. For the optimal model in question 3, use SolverTable to provide a single one- or two-way sensitivity analysis of your choice for one or several hot tub resource limitations, i.e., pump, tubing, and labor, and also maximum tub price. Present and briefly explain your results.