

Problem 3: Hotel La Quinta Motor Inns (LQM)

LQM is a middle-sized hotel chain that is considering expanding to more locations. LQM used data on 75 existing inn locations to build a linear regression model to predict “Profitability”, computed at the operating margin, or earnings before interest and taxes divided by total revenue. They tried many independent variables and came up with the final model

$$\begin{aligned} \text{Profitability} = & 39.05 - (5.41 \times \text{State Population per Inn}) + (5.86 \times \text{Price of the Inn}) \\ & - (3.09 \times \text{Square Root of the Median Income in the area}) \\ & + (1.75 \times \text{College Students in the Area}) \end{aligned}$$

All independent variables are significant and were normalized to have mean zero and standard deviation 1.

1. According to the regression equation given above, which variable positively affect Profitability? Which variable negatively affect Profitability? Does this intuitively make sense? Why?

2. Using this regression equation, LQM created a spreadsheet model to predict profitability. LQM collected data for several locations in California, which is provided in the excel spreadsheet on Canvas “LQM”. Using this spreadsheet, compute the profitability for each hotel. Which one has the highest profitability? Which one has the lowest profitability?

3. LQM has a budget of \$10 million to spend on hotels. Suppose we used a “greedy” approach where we selected the most profitable hotels until we ran out of budget. So we would start by the most profitable, and then if we had enough budget left, we would buy the hotel we predict to be the second most profitable, and so on.

a. Describe what we would do with this approach, i.e., which hotels would we purchase?

b. What would our total predicted profitability be? (This is the sum of the predicted profitability of all hotels we purchase.)

c. If we are trying to maximize our total predicted profitability, is this a good approach? How about if we were trying to maximize the average predicted profitability of the hotels we select? How about if we had a budget of \$20 million instead of \$10 million?

4. Now, build an optimization model to select hotels given the \$10 million budget.

a. Write out the optimization problem. Make sure to detail the decision variables, the objective function and the constraints.

b. What is the optimal solution? Give the values of the decision variables and the optimal objective function value.

c. Does the optimal solution make sense intuitively? How does it compare to the greedy solution?

5. LQM thinks that buying too many hotels in one city is probably not a good idea and would prefer to diversify across as many cities as possible. Add constraint(s) to your model to limit the number of hotels purchased in any city to at most 2.

a. What are the constraints that you need to add to the model? Intuitively, do you expect the new optimal objective function value to be larger, smaller or the same as before?

b. Write the new optimization model.

c. Solve the new model. Give the values of the decision variables and the optimal objective function value. How does this compare to the previous solution?

6. In one paragraph (no more than 300 words), describe how you would present your results to LQM. Do you have any recommendations for them to improve the regression model? How about to improve the optimization model?