**ALY6050 80478 Intro to Enterprise Analytics SEC 09 Spring 2023 CPS**

**Module 5 Assignment — Using Linear Programming Models to maximize profits REPORT**

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**Using Linear Programming Models to maximize profits**

**Assignment Introduction:**

In today's data-driven business environment, companies are leveraging mathematical models to optimize various aspects of their operations and maximize profits. One such powerful tool is Linear Programming (LP). This report presents the application of LP to assist in decision-making for a hypothetical company. The main objective is to identify the optimal inventory levels of different products that yield the maximum monthly net profit, subject to budget and space constraints and marketing decisions. We also aim to understand how changes in the budget and warehouse space could affect the net monthly profit.

**Step 1: Linear Programming Formulation**

Let's denote the decision variables as follows:

1. **PW** - Number of Pressure Washers
2. **LM** - Number of Lawn Mowers
3. **G** - Number of Generators
4. **WP** - Number of Water Pump cases (each case contains 5 water pumps)

The objective function represents the total profit which needs to be maximized:

The constraints are given by the problem:

1. Budget constraint:
2. Space constraint:
   * Note that all measures are in square feet, and we are assuming each shelf can only hold one level of products.
3. Marketing department decisions:

**Step 2: Set up the linear programming formulation in an Excel workbook or R**

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We've solved the LP problem and obtained the optimal (maximum) monthly net profit, which is $137,134.

**Step 3: Use the Excel Solver or R to solve the problem and generate a sensitivity report.**

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The optimal solution obtained suggests that the company should keep the following amounts of each product in the inventory:

* Pressure washers: 0.0000
* Lawn Mowers: 201.7682
* Generators: 0.0000
* Cases of Water Pumps: 113.4946

The optimal monthly profit will be $137,134.

**Step 4: Describe the optimal solutions obtained in the Word document**

The optimal solution obtained indicates that the company should focus more on the products that yield higher profit. We also identified that one of the products has an optimal inventory level of zero, meaning that it does not contribute to the maximization of the profit.

**Step 5: Use the Solver sensitivity report to determine the smallest selling price**

Using the sensitivity report, we found the smallest selling price for the item with an optimal value of zero that would change this value to a non-zero value. This price should be considered as the lower limit when setting the selling price for this item.

**Step 6: How much should the company expect its net**

**monthly profit**

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* The **increase\_in\_profit\_per\_dollar\_invested** is approximately 0.91. This means that for every additional dollar invested in the budget, the company could expect an increase in profit of about $0.91. So, it seems to be a good investment.
* The **increase\_in\_profit\_per\_sqft\_added** is approximately 6.84. This means that for every additional square foot of warehouse space, the company could expect an increase in profit of about $6.84. This would be a worthwhile investment if the cost of the additional space is less than this amount.

We found that for every additional dollar invested in the budget, the company could expect an increase in profit of about $0.91. Therefore, it is recommended to allocate additional money to the purchasing budget, especially if the company's goal is to maximize profit.

**Step 7: Recommend that the company should rent a**

**smaller or a larger warehouse**

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For every additional square foot of warehouse space, the company could expect an increase in profit of about $6.84. Therefore, renting a larger warehouse would be beneficial if the cost of the additional space is less than this amount. However, for each square foot of warehouse space removed, the company's profit could decrease by about $7.60. Therefore, renting a smaller warehouse would not be beneficial.

**Conclusion:**

Through our comprehensive analysis using linear programming, we identified the optimal product mix that maximizes the monthly net profit. We discovered that by increasing the budget or the warehouse space, the company could significantly boost its profits. However, a reduction in warehouse space could adversely impact the profitability. Therefore, the company should consider increasing its budget and securing more warehouse space, if cost-effective. By adopting this data-driven approach, the company can make more informed decisions and significantly enhance its profitability. The analysis and recommendations provided in this report demonstrate the powerful role that linear programming can play in facilitating strategic business decisions.