Logo

Description automatically generated

**ALY 6050: Enterprise Analytics**

***Project: Using Linear Programming Models to maximize profits***

**Submitted to: Prof. Roy, Wada**

**Submitted by: Abhinav Jain**

**Date: 06/26/2022**

**INTRODUCTION**

“In this analysis report, we are trying to fix the issue regarding the distribution of the hardware for the company Northern hardware company. To open a new distribution center in the southeast for pressure washer which has a cost of $335, whereas has other items like Go-kart which cost $380, Generator which cost $420, and the water pumps which has the cost of $127 these are the few products which have high demand.

A northern hardware company raised a project to study a plan to launch a new unit for distribution. Mainly these facilities will be provided to the local dealers of that area who are dealing with major product pressure washers, go-karts, generators, and water pumps.

On the other hand, the company budget of $175000 was expected to set up a new distribution center in the southeast with a few products at the initial level. The company has launched a selling price list for the items they are going to keep in the new distribution center. The list of the product are as follows Pressure washer’s selling price are $505.99, however, the company wants to sell Go-kart for $735.99, and they put generator prices at $710.99, and water pump prices at $272.99 whereas the revenue of the products will be in dollars.

If we look at the budget only that provides you the idea about the space company has a concern to get the availability of the space in that region so that the cost will be low inventory cost for the few items. The requirement for the warehouse as we required 82 shelves, which has the size of each shelf should be 30ft long and 5 ft wide. Looking at the storage space for the pressure washer they need 5 ft by 5 ft pallets, however, Go-Kart needs 8 ft by 5 ft pallet, whereas if we look at water pumps required 5 ft by 5 ft for the four cases of water pumps.

Looking at the marketing strategy of the company, the marketing department has allocated 30% of the inventory to pressure washers and go-karts, on the other hand, the sales for the generators will be at least twice of the water pumps.

In this report to do the analysis, we are implementing a linear programming model to maximize the net profit of the company in Excel.

**ANALYSIS AND INTERPRETATION**

**Introduction**

The corporation is concerned to find the space available in that area so that the cost will be cheap inventory cost for the few products if we simply look at the budget since it gives you an idea about the space. The number of shelves needed for the warehouse was 82, and each one had to be 30 feet long and 5 feet broad. While Go-Kart requires an 8 ft by 5 ft pallet for storage, pressure washers require 5 ft by 5 ft pallets, while water pumps demand 5 ft by 5 ft for each of the four cases of water pumps.

The marketing division of the business examined its marketing plan.

***Part – I***

|  |
| --- |
| **PART I** |
| **Mathematical Formulation Z = 171X1 + 356X2 + 291X3 + 146X4** |
| ***Maximize Z = P1 X1 + ….*** |
| ***Subject to:*** |
| ***\_Budget: (335 X1+ 380 X2 + 420 X3 + 127 X4 ≤ 175,000)*** |
| ***\_Space: (25 X1 + 40 X2 +25 X3 + 1.25 X4 ≤ 12,300)*** |
| ***\_Requirement 1: (- 0.7X1 - 0.7X2 + 0.3X3 + 0.3X4 ≤ 0)*** |
| ***or,*** |
| ***\_Requirement 2: X3 ≥ 2X4 or, 2X4-X3 ≤ 0*** |
| ***or,*** |
| ***\_Non-negativity: X1 , X2 , X3 , X4* ≥ 0** |

***PART II***

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PART II** | ***Pressure Washers X1*** | ***Go-Karts X2*** | ***Generators X3*** | ***Water Pumps X4*** | ***Objective Z (Total profit)*** |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| **Profits:** | 0 | 155.17 | 237.76 | 118.88 | 511.81 |  |  |  |  |
| **Price:** | 171 | 356 | 291 | 146 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| **\_Constraints:** | ***X1*** | ***X2*** | ***X3*** | ***X4*** | ***LHS*** | ***Ineq*** | ***RHS*** | ***Slack*** | ***Remark*** |
| ***\_Cost/Budget*** | 335 | 380 | 420 | 127 | 26702.5 | <= | 175000 | 0 | Unused Budget |
| ***\_Warehouse Space*** | 25 | 40 | 25 | 6.25 | 12893.8 | <= | 12300 | 0 | Unused Space |
| ***\_Requirement 1*** | -0.70 | -0.70 | 0.30 | 0.30 | -1.63 | <= | 0 | 2.00 |  |
| ***\_Requirement 2*** | 0.00 | 0.00 | -1.00 | 2.00 | 0 | <= | 0 | 0 |  |

***Part III***

**Sensitivity Analysis:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sensitivity Report** | | | | | | |
| **\_** | **\_\_** | **Final** | **Reduced** | **Objective** | **Allowable** | **Allowable3** |
| **Cell** | **Sell Cost** | **Value** | **Cost** | **Coefficient** | **Increase** | **Decrease** |
| $D$3 | Pressure Washers X1 | 0.0000 | -110.07 | 170 | 110.1 | 1.000E+30 |
| $E$3 | Go-Karts X2 | 155.18 | 0 | 360 | 205.9 | 76.74 |
| $F$3 | Generators X3 | 237.77 | 0 | 291 | 98.2 | 131.88 |
| $G$3 | Water Pumps X4 | 118.88 | 0 | 143 | 196.4 | 89.13 |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **\_** | **\_** | **Final** | **Shadow** | **Constraint** | **Allowable** | **Allowable3** |
| **Cell** | **Name** | **Value** | **Price** | **R.H. Side** | **Increase** | **Decrease** |
| $H$8 | Requirement for the 2nd Constraint LHS | 0 | 33.68613717 | 0 | 974.1201949 | 27.91666667 |
| $H$9 | Budgets Constraint for LHS | 175000 | 0.557684683 | 170000 | 428.8 | 56225 |
| $H$10 | Spaces Constraints for the LHS | 12300 | 3.841416678 | 12300 | 6078.378378 | 30.94688222 |
| $H$11 | Requirement for the 1st Constraint LHS | -1.629179331 | 0.0000000000 | 0.000000 | 1.000E+30 | 1.629179331 |

It demonstrates how variations in particular variables affect the solution parameter. It looks into how a change in input variables affects result variables. The predicted circulation for a commercial technology, its selling unit price, and its variable cost per unit will be used as input variables for sensitivity analysis in this Excel file. The sensitivity analysis outcome variable, which may be found in column B of the profit and loss projection, is the percentage of operating margin. This is the figure we want to verify and improve. We're attempting to determine how stimuli-responsive it is.

Microsoft Excel is used to complete the job. One business in the state's southern and northern regions wants to grow into the southeast.

***Part IV***

Optimal Monthly Profit

|  |  |
| --- | --- |
| **PART IV** | |
| ***\_LP Optimal Solution:*** |  |
| ***\_Optimal Monthly Profit:*** | ***$ -*** |
| **\_Pressure Washers X1** | **0** |
| **\_Go-Karts X2** | **155.2** |
| **\_Generators X3** | **237.8** |

***Part V***

In terms of pressure washers, 0 is the ideal setting. According to careful analysis, it is appropriate to raise the price of such a product by around $110.07. As a result, production should be as profitable as possible.

Spending $169.99 plus $110.07, or a total of $280.06, would alter those zeros.

Every pressure washer's sale price needs to be at least $499.99+$110.07=$610.06 to be considered profitable, using the "0" figure as an example.

***Part VI***

According to Section VI, the shadow price for the sensitive pricing analysis is 0.55 whenever it is taken into consideration.

Maximum price increases and reductions were 428.8 and 56225, respectively. Accordingly, the optimal range for the present budget is between 113,775 and 170,428 dollars. According to the statistical vulnerability analysis, they must increase the price by $428.8, bringing the total cost to $170,428.

***Part VII***

**Suggest that the business hires a smaller or larger warehouse.**

According to sensitive analysis, its acceptable increase is 6078.4 ft2 and its shadow price for the associated limits is $3.84. The shadow price of the storage limitation is $3.84. Accordingly, the enormous earnings will rise by $3.84 for every additional square foot (over 12,300 and up to 6078.4). As a result, the institution would have to increase its accessible storage space by 6078.4 square feet. The whole profit will thus rise by (6078.4)(3.84)=$23,350.11, or a factor of 684%.

In other words, the ideal warehouse would have a floor space of 18,278.40 ft2. The monthly profitability is anticipated to increase by $23,350.11 as a result of this larger facility.”