ALY-6050 Module Five Project

Project: Using Linear Programming Models to maximize profits

The submission of this project will consist of two attachments:

1. A text document that is prepared according to the APA standards of formatting – this refers to the page numbers and spacing. In the document, explain the experiments and their respective conclusions, and additional information as indicated in each problem. Your report should be submitted as a pdf titled as follows:
   ALY6050_MOD5_Project_LastName.pdf
2. You should complete this project as an R script (.R) and submit your script named as follows: ALY6050_MOD5_Project_Lastname.R

Alternatively, feel free to submit everything as a single .pdf output of a R Notebook (see lesson 1-0 for details).

Problem:

A northern hardware company is studying a plan to open a new distribution center in the southeast. The company plans to rent a warehouse and an adjacent office and distribute its main products to the local dealers. The company has decided to initially start with four of its main products: Pressure washers, Go karts, Generators, and Water pumps. The table below describes how much each of the products will cost the company (including transportation costs):

Item	Cost (in Dollars)
Pressure washer	330
Go-kart	370
Generator	410
(Case of 5 Water Pumps)	635

Table 1: Costs of products in dollars

The company has set aside a purchasing monthly budget of $170,000 for the new location. The selling prices (per unit) for each item are given in the table below:

Item	Selling Price (in Dollars)
Pressure washer	499.99
Go-kart	729.99
Generator	700.99
Water pump	269.99

Table 2: Revenues of products in dollars

Other than the budget, another of the company's concerns is the available space in the warehouse. The warehouse has 82 shelves, and each shelf is 30 ft long and 5 ft wide. Pressure washers and generators each are stored on 5 ft by 5 ft pallets whereas each Go Kart is stored on an 8 ft by 5 ft pallet. Furthermore, a 5 ft by 5 ft pallet is used to store four cases of water pumps

To promote its brand products, the company's marketing department has decided to allocate at least 30% of its inventory to pressure washers and Go Karts and sell at least twice as many generators as water pumps.

Perform a monthly analysis using a linear programming model to maximize the company's net profit.

1. In your submission, include the mathematical formulation of the problem.

2. Set up the linear programming formulation in R.
3. Use R to solve the problem, and generate a sensitivity report.
4. Describe the optimal solutions obtained in your results. These will consist of the inventory level for all four products and the optimal monthly profit.
5. One of the decision variables has an optimal value of zero. Use the sensitivity report to determine the smallest selling price for that item so that this optimal zero solution value changes to a non-zero value.
6. Explain whether, in addition to the $170,000 allocated to the purchasing budget during the first month, the company should allocate additional money. If yes, how much additional investment do you recommend, and how much should the company expect its net monthly profit to increase as a consequence of this increase?
7. Explain whether you recommend that the company should rent a smaller or a larger warehouse. In any case, indicate the ideal size of your recommended warehouse in square feet, and indicate how much this change in the size of the warehouse will contribute to the monthly profit.

Requirements

- Please do *not* include a cover letter, table-of-contents, lengthy introduction, or references in your report.
- *Do* make every effort to communicate clearly and concisely.
- Clearly indicate which part of your report corresponds to each part of the assignment.
- *No screenshots!* Please submit a PDF of an R notebook with results included (see Lesson 1-0 for instructions) or export your plots to .png and load those into your document at a sufficient resolution to be clearly visible.
- Use base (or at least common-place) R packages only. Your script should be able to run without requiring additional libraries.
- Emailed submissions are not accepted. Give yourself enough time to ensure your file is properly rendered and uploaded as instructed.

Grading rubric

Category Score	Characteristics
A Range *Excellent* **90–100 points**	• Accurate completion of 90%–100% of all R requirements. Code is well formatted and easily readable. • Complete presentation and analysis of key results. Contains all required tables, and visualizations. Provides a precise description of the analytical concepts and theories used in the analysis.
B Range *Good* **80–90 points**	• Accurate completion of two parts of the project. Code is poorly formatted or difficult to read. • At most one major required component missing. Report shows gaps in reasoning or conclusions not supported by the data. Missing one of the required elements (introduction, conclusion, etc.); occasional grammar or spelling errors. Imprecise.
C Range *Satisfactory* **70–80 points**	• Completion of only a single part of the project. Major deficiencies in readability. • Report missing major required elements; evidence for recommendations is unclear or inaccurate; lack of organization. • Missing more than one of the required elements; frequent grammatical and spelling mistakes.
F Range *Unsatisfactory* **0–70 points**	• Accurate completion of fewer than 70% of all requirements. Disorganized and incomplete code. • Report content mostly missing. • Missing most required elements; major formatting or grammatical errors.