

CS 325 Project 3: Linear Programming

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Problem 1

Part A

Determine the number of refrigerators to be shipped from plants to warehouses, and then warehouses to retailers to minimize the cost.

- i. Formulate the problem as a linear program with an objective function and all constraints.
- ii. Determine the optimal solution for the linear program using any software you want. Include a copy of the code/file in the report.
- iii. What are the optimal shipping routes and minimum cost?

Part B

Due to old infrastructure, Warehouse 2 is going to close, eliminating all of the associated routes. What is the optimal solution for this modified model? Is it feasible to ship all the refrigerators to either Warehouse 1 or 3 and then to the retailers without using Warehouse 2? Why or why not?

Part C

Instead of closing Warehouse 2, management has decided to keep a portion of it open but limit shipments to 100 refrigerators per week. Is this feasible? If so, what is the optimal solution when Warehouse 2 is limited to 100 refrigerators?

Part D

Formulate a generalized linear programming model for the transshipment problem. Give the objective function and constraints as mathematical formulas.

Problem 2

Part A

Determine the combination of ingredients that minimizes calories but meets all nutritional requirements.

- i. Formulate the problem as a linear program with an objective function and all constraints.
- ii. Determine the optimal solution for the linear program using any software you want. Include a copy of the code/file in the report.
- iii. What is the cost of the low calorie salad?

Part B

Veronica realizes that it is also important to minimize the cost associated with the new salad. Unfortunately some of the ingredients can be expensive. Determine the combination of ingredients that minimizes cost.

- i. Formulate the problem as a linear program with an objective function and all constraints.
- ii. Determine the optimal solution for the linear program using any software you want. Include a copy of the code/file in the report.
- iii. How many calories are in the low cost salad?

Part C

Compare the results from part A and B. Veronicas goal is to create a Very Veggie Salad that is both low calorie and low cost. She would like to sell the salad for \$5.00 and still have a profit of at least \$3.00. However if she can advertise that the salad has under 250 calories then she may be able to sell more.

- i. Suggest some possible ways that she select a combination of ingredients that is near optimal for both objectives. This is a type of multi-objective optimization.
- ii. What combination of ingredient would you suggest and what is the associated cost and calorie.
- iii. Note: There is not one right answer. Discuss how you derived your solution.

Problem 3

- a) What are the lengths of the shortest paths from vertex a to all other vertices?
- b) If a vertex z is added to the graph for which there is no path from vertex a to vertex z , what will be the result when you attempt to find the lengths of shortest paths as in part a).
- c) What are the lengths of the shortest paths from each vertex to vertex m ? How can you solve this problem with just one linear program?
- d) Suppose that all paths must pass through vertex i . How can you calculate the length of the shortest path from any vertex x to vertex y that pass through vertex i (for all $x, y \in V$)? Calculate the lengths of these paths for the given graph. (Note: for some vertices x and y , it may be impossible to pass through vertex i).