ISE 4623/5023: Deterministic Systems Models / Systems Optimization

University of Oklahoma
College of Engineering
School of Industrial and Systems Engineering
Fall 2021

Individual Assignment 3 (100 points)

Name: **Student ID:**

Note: Be explicit in the procedures of each point (i.e., show all the steps and calculations made)

Problem 1 - (25 points)

Seeds Inc. is a company that produces and exports bags of corn seeds. For this purpose, the company has a production plant in the state of Oklahoma, in which the company processes corn of two varieties: Hard and Serrated. To make the seed bags, the plant uses three resources: water, electricity, and gas. The following table provides the basic data of the problem:

Resource	Hard (units of resources per bag of seeds)	Serrated (units of raw resources per bag of seeds)	Maximum monthly availability (units of Liters, kWh, and cm^3, respectively)
Water	100.05	60.75	810.50
Electricity	5.50	10.25	655.80
Gas	75.30	24.84	520.75

Profit per seed bag	$275.75	$120.50

In this way, Seeds Inc. produces bags of seeds for both varieties of corn that it processes (i.e., hard corn seeds and serrated corn seeds). Given that Seeds Inc. is so famous and respected, the demand for her seed bags is always very high, so they always sell all the seed bags they produce, and they can produce fractional numbers of seed bags (i.e., 7.22 bag of hard corn seed bags). You want to determine the production plan that retrieves the greatest profit to Seeds Inc. To do this, first you decide to formulate this problem as an LP model. In particular:

a. (5 points) Write the previous problem in its standard form.

b. (5 points) How many basic solutions does this problem have? How many basic feasible solutions does this problem have? Explain your answer in detail.

c. (15 points) Solve this problem using the Simplex algorithm. Show each iteration clearly (indicating the values of all the variables, reduced costs, and the objective function associated with each iteration) until optimality is achieved. How do you know you have converged to the optimal solution?

Problem 2 (75 points)

Andes Inc. is an oil company that has a refinery on the Texas coast. The refinery processes crude oil from Saudi Arabia and Venezuela, producing gasoline, diesel, and lubricants. The two crude oils differ in their chemical composition, which is why they produce different amounts of each product. A barrel of crude from Saudi Arabia produces 0.3 barrels of gasoline, 0.4 barrels of diesel, and 0.2 barrels of lubricants. On the other hand, a barrel from Venezuela produces 0.4 barrels of gasoline, 0.2 barrels of diesel, and 0.3 barrels of lubricants. The remaining 10% of the crude is lost in the refining process.

Crudes also differ in price and availability. Andes Inc. can buy up to 9,000 barrels per day from Saudi Arabia at a price of $20 per barrel. You can buy from Venezuela up to 6,000 barrels per day at a price of $ 15 per barrel.

The contracts established by Andes Inc. forces them to produce 2,000 barrels per day of gasoline, 1,500 barrels per day of diesel, and 500 barrels per day of lubricants.

You want to determine the supply plan for the crude oil that results in the least cost for Andes Inc. To do this, first you decide to formulate this problem as an LP model. In particular:

a. (15 points) Suppose that the number of barrels bought from both Saudi Arabia and Venezuela are exactly 9,000 and 6,000, respectively. However, this solution is not optimal. Find the basic solution associated with these values and use it (as an initial feasible solution) in the Simplex Algorithm to find the optimal solution to the problem.

b. (25 points) Find an initial basic solution using the big M initialization method.

c. (25 points) Find an initial basic solution using the two-phase initialization method.

d. (10 points) Starting from one of the initial basic solutions found in either b) or c), solve this problem using the Simplex algorithm. Indicate the values of all the variables and the objective function associated with the optimal solution.