Jacobs University
Fall 2021

October 4, 2021

Operations Research

Homework 5

Due on October 11, 2021

Note: Your homework must be submitted via moodle (see the link on the class website) on the due day BEFORE THE TUTORIAL.

Problem 1 [10 points]

(Note: This is a variation of Exercise 6.8-8 from HL.) David, LaDeana, and Lydia are the sole partners and workers in a company which produces fine clocks. David and LaDeana each are available to work a maximum of 40 hours per week at the company, while Lydia is available to work a maximum of 20 hours per week. The company makes two different types of clocks: a grand-father clock and a wall clock. To make a clock, David (a mechanical engineer) assembles the inside mechanical parts of the clock while LaDeana (a woodworker) produces the handcarved wood casings. Lydia is responsible for taking orders and shipping the clocks. The amount of time required for each of these tasks is shown below.

	Time Required	
Task	**Grandfather Clock**	**Wall Clock**
Assemble clock mechanism	6 hours	4 hours
Carve wood casing	8 hours	4 hours
Shipping	3 hours	3 hours

Each grandfather clock built and shipped yields a profit of \$300 while each wall clock yields a profit of \$200.

(a) Formulate and solve the problem in Pyomo, and ask Pyomo to compute shadow prices (dual variables) for each activity. Please submit (a printout of) your Ipython notebook showing code and output.

(b) Occasionally, someone stops by asking for help with restoring antique clocks. How much should David charge per hour for mechanical repairs and how much should LaDeana charge per hour for wood restoration assuming that they do not wish to add more working hours and also do not wish to reduce company profit if one of them is taking on a repair job?

Problem 2 [10 points]

(Note: This is a variation of Exercise 8.1-2 from HL.) The Childfair Company has three plants producing child push chairs that are to be shipped to four distribution centers.

Plants 1, 2, and 3 produce 12, 17, and 11 shipments per month, respectively. Each distribution center needs to receive 10 shipments per month. The distance from each plant to the respective distribution centers is given below:

	Distribution Center			
	1	**2**	**3**	**4**
Plant 1	800 miles	1 300 miles	400 miles	700 miles
Plant 2	1 100 miles	1 400 miles	600 miles	1 000 miles
Plant 3	600 miles	1 200 miles	800 miles	900 miles

The freight cost for each shipment is \$100 plus 50 cents per mile. The objective is minimizing the total cost of transportation.

(a) Formulate and solve the problem in Pyomo.

(b) Now suppose that demand in the area served by Center 1 goes up to 15 shipments per month. Production cannot be increased on short notice, so some or all of the distribution centers will be under-supplied. Modify your Pyomo code to determine the total number of shipments to arrive at each of the centers if the objective is still to minimize the overall cost of transportation.

Submit a commented (printout of your) Ipython notebook showing code and output for each.