Operations Research

Homework 5

Due on October 11, 2023

Note: Your homework must be submitted via moodle (see the link on the class website) on the due day BEFORE THE TUTORIAL, i.e., before 20:45.

Problem 1 [10 points]

Let us revisit the WYNDOR company problem: *Maximize*

$$Z = 3\,x_1 + 5\,x_2$$

subject to

$$x_1 \le 4\,,$$
$$2x_2 \le 12\,,$$
$$3\,x_1 + 2\,x_2 \le 18\,,$$
$$x_1, x_2 \ge 0\,.$$

(a) Use the simplex method (by hand, on paper) to solve this LP problem. (Convert it to standard form first.)

(b) What are the binding constraints, what are the non-binding constraints?

(c) From your solution in (a), compute the shadow prices y_1 and y_2 of resources 1 and 2.

Problem 2 [10 points]

Reconsider Problem 1 from Homework Sheet 1: *Minimize*

$$Z = 8\,x_1 + 12\,x_2$$

subject to

$$5\,x_1 + 2\,x_2 \ge 20\,,$$
$$4\,x_1 + 3\,x_2 \ge 24\,,$$
$$x_2 \ge 2\,,$$
$$x_1, x_2 \ge 0\,.$$

(a) Write a Pyomo program to solve this LP problem.

(b) Pyomo can return the values of slack variables via the the `lslack()` and `uslack()` attributes on each constraint.

Re-run your code, call `lslack()` and `uslack()` on each constraint, and explain the numbers which are returned.

(c) Pyomo can return the dual variables as shown in class. Compute the dual variables. What do you notice in relation to the values of the slack variables from part (a)?

(d) Write out the dual of this problem explicitly and solve it in Pyomo. Compare to your result from part (b).

(e) Give an interpretation of the meaning of all parameters and decision variables in the primal and dual problem. (E.g., in terms of unit profit, capacities, capacity requirement per unit, shadow prices, and number of units produced. Note that these are just suggestions; it is certainly possible to give alternative interpretations from completely different problem domains.)