Linear Optimization (Spring 2023): Homework 9

- The total points (given in parentheses) add up to 190. You will be graded for 180 points (with the possibility of getting up to 10 points as extra credit).
- BT-ILO stands for the text (Bertsimas and Tsitsiklis: Introduction to Linear Optimization).
- **You must email your submission as a folder to kbala@wsu.edu**. Include the **PDF file with answers to proof problems** as well as all **files for the AMPL problems** in this folder.
- **Your folder name should identify you in the following manner. If you are Millard Anderson, you should name your submission folder MillardAnderson_Hw9. If you want to add more bits to the title, e.g., Math464, you could name it MillardAnderson_Math464_Hw9, for instance. Start the folder name with MillardAnderson; and NOT "Millard Anderson" or "Mill_Anderson"...**
- Name your **PDF file** as **MillardAnderson_Hw9.pdf**.
- **Begin the SUBJECT of your email submission with the same `FirstnameLastname`, e.g., "MillardAnderson Hw9 submission".**
- **This homework is due by 4:59 PM on Friday, April 7**.

1. (50) Consider the following simplex tableau:

		x_1	x_2	x_3	x_4	x_5	x_6	x_7
	0	-10	57	9	24	0	0	0
$x_5 =$	0	$1/2$	$-11/2$	$-5/2$	9	1	0	0
$x_6 =$	0	$1/2$	$-3/2$	$-1/2$	1	0	1	0
$x_7 =$	1	1	0	0	0	0	0	1

Apply the simplex tableau method with the default pivoting rules:

- the non-basic variable with the most negative reduced cost enters; and
- in case of ties for the leaving variable, the basic variable with the smallest index (involved in the tie) leaves.

Demonstrate that the simplex method cycles.

Now apply the simplex method with

(a) lexicographic pivoting rule, and

(b) Bland's rule (smallest index pivoting rule),

and demonstrate that the simplex method does not cycle in either case.

2. (35) Consider the following simplex tableau:

		x_1	x_2	x_3	x_4	x_5	x_6
	2	-2	-3	1	12	0	0
$x_5 =$	0	-2	-9	1	9	1	0
$x_6 =$	0	$1/3$	1	$-1/3$	-2	0	1

   Apply the simplex tableau method with the following rules:

   - the non-basic variable with the most negative reduced cost enters; and
   - in case of ties for the leaving variable, choose the row that is *higher up* in the tableau as the pivot row (even if the basic variable in that row has a larger subscript or index).

   Demonstrate that the simplex method cycles. Now apply the simplex method with Bland's rule (smallest index pivoting rule), and demonstrate that the simplex method does not cycle.

3. (30) BT-ILO Problem 3.18 (c),(d),(e) from page 133.

4. (35) Write AMPL model and data files for the LP formulation of the inventory scheduling Problem 1.10 (BT-ILO page 35–36, discussed in Lecture 5). The data is available on the course web page in the file InventoryData.txt. Assume that you do not want to have any inventory left at the end of twelve months. Solve the LP in AMPL, and record the optimal solution and the optimal objective function value. Submit model and data files, as well as the output from the AMPL run.

5. (40) Write AMPL model and data files for the LP formulation of the school assignment Problem 1.9 (BT-ILO page 35, discussed in Homework 2). The data is available on the course web page in three files: Capacities.txt, Distances.txt, and Populations.txt. Solve the LP in AMPL, and record the optimal solution and objective function **in easily readable formats**. Submit model and data files, as well as the output from the AMPL run.