ORIE 5380, CS 5727: Optimization Methods
Homework Assignment 5

Due October 5, 12:00 pm

Please submit a single PDF document formatted to print and show all your work clearly.
Feel free to scan and submit handwritten work. Do not spend too much time on
wordprocessing your answers.

Question 1
Consider the linear program

$$\begin{aligned}
\max \quad & -2\,x_1 + 2\,x_2 - x_3 + 3\,x_4 \\
\text{st} \quad & -3\,x_1 + x_2 + 4\,x_3 + x_4 \le 0 \\
& 3\,x_1 - x_2 - 3\,x_3 - 2\,x_4 \le 3 \\
& x_1, x_2, x_3, x_4 \ge 0
\end{aligned}$$

Use the simplex method to check whether this linear program is unbounded or has alternative
optimal solutions. If the problem has alternative optimal solutions, then state two possible
optimal solutions.

Question 2
Consider the linear program

$$\begin{aligned}
\max \quad & 5\,x_1 + 7\,x_2 - 12\,x_3 - 10\,x_4 \\
\text{st} \quad & 2\,x_1 - 2\,x_2 - 3\,x_3 - 2\,x_4 \le 6 \\
& 2\,x_1 + 5\,x_2 - 4\,x_3 - 4\,x_4 \le 3 \\
& x_1, x_2, x_3, x_4 \ge 0
\end{aligned}$$

Use the simplex method to check whether this linear program is unbounded or has alternative
optimal solutions. If the problem has alternative optimal solutions, then state two possible
optimal solutions.

Question 3
Consider the linear program

$$\begin{aligned}
\max \quad & -x_1 + 4\,x_2 + 4\,x_3 - x_4 \\
\text{st} \quad & -x_1 - 2\,x_2 + 4\,x_3 + 2\,x_4 \le 1 \\
& 2\,x_2 + 2\,x_3 \le 3 \\
& x_1, x_2, x_3, x_4 \ge 0
\end{aligned}$$

Use the simplex method to check whether this linear program is unbounded or has alternative
optimal solutions. If the problem has alternative optimal solutions, then state two possible
optimal solutions.

(There is one more question on the next page.)

Question 4

Consider the linear program

$$\begin{aligned}
\max \quad & -4\,x_1 + 19\,x_2 + 5\,x_3 \\
\text{st} \quad & 6\,x_2 - x_3 \le 4 \\
& -2\,x_1 + 3\,x_2 + 3\,x_3 \le 3 \\
& x_1, x_2, x_3 \ge 0
\end{aligned}$$

Use the simplex method to check whether this linear program is unbounded or has alternative optimal solutions. If the problem has alternative optimal solutions, then state two possible optimal solutions.