

Homework 4

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October 13, 2016

1: Consider the linear program (LP) $\min c^T x$ such that $Ax = b, x \geq 0$ where

$$A = \begin{bmatrix} -6 & -5 & 25 & 3 & -85 & 4 & 30 \\ 24 & -2 & 28 & 6 & -55 & 1 & -9 \\ 9 & -5 & 11 & 2 & -55 & -1 & 19 \end{bmatrix}, \quad b = \begin{bmatrix} 62 \\ 62 \\ 3 \end{bmatrix}, \quad c = [23 \quad 1 \quad -16 \quad -1 \quad 52 \quad -6 \quad -12]^T$$

Solve this problem using the Simplex Method, starting from the basis consisting of A 's columns 1, 3, 6.

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1 M = [1 -23 -1 16 1 -52 6 12 0;
2 0 -6 -5 25 3 -85 4 30 62;
3 0 24 -2 28 6 -55 1 -9 62;
4 0 9 -5 11 2 -55 -1 19 3];
5 % swap columns 3 and 7 in M (correspond to columns 2 and 6 in A)
6 M(:, [3, 7])=M(:, [7, 3]);
7 A=rref(M)
8
9 A =
10
11 <<<<<<< HEAD
12      1          0          0          0          4/9          -13/9
13          0          7/9         -130/9         -569/9          1/9          35/9
14          0          4/9         -28/9          13/9          2/9          205/9
15          0          0          -137/9         134/9          1/9          -55/9
16          0          -5/9          26/9           4/9
17 =====
18      1.0000          0          0          0      0.4444      -1.4444      0.7778      -14.4444
19          -63.2222
20      0      1.0000          0          0      0.1111      3.8889      0.4444      -3.1111
21          1.4444
22      0          0      1.0000          0      0.2222      22.7778      2.8889      -15.2222
23          14.8889
24      0          0          0      1.0000      0.1111      -6.1111      -0.5556      2.8889
25          0.4444
26 >>>>>>> f5d31343c2616764d3e6e7032cdf1a02353f09fc
27
28 % use column 7 since it is largest positive number
29 % pivot on row 2 since ratio (13/9)/(4/9) is smallest, positive
30 % swap columns 2 and 7
31 A(:, [2, 7])=A(:, [7, 2]);
32 B=rref(A)
33
34 B =
35
36      1.0000          0          0          0      0.2500      -8.2500      -1.7500      -9.0000
37          -65.7500
38      0      1.0000          0          0      0.2500      8.7500      2.2500      -7.0000
39          3.2500
40      0          0      1.0000          0     -0.5000      -2.5000      -6.5000      5.0000
41          5.5000
42      0          0          0      1.0000      0.2500      -1.2500      1.2500      -1.0000
43          2.2500

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36 % use column 5 since it is largest positive number
37 % pivot on row 4 since ratio (9/4)/(1/4) is smallest, positive
38 % swap columns 4 and 5
39 B(:,[4, 5])=B(:,[5, 4]);
40 C=rref(B)
41
42 C =
43
44      1      0      0      0     -1     -7     -3     -8    -68
45      0      1      0      0     -1     10      1     -6      1
46      0      0      1      0      2     -5     -4      3     10
47      0      0      0      1      4     -5      5     -4      9
48
49 % minimum is -68.
50 diary off

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2: Consider the linear program (LP) $\min c^T x$ such that $Ax = b, x \geq 0$ where

$$A = \begin{bmatrix} 8 & -226 & -33 & 10 & 9 & 49 & -1 \\ 9 & -199 & -51 & 10 & 3 & 25 & -25 \\ 2 & 24 & 45 & -6 & 3 & -45 & -15 \end{bmatrix}, \quad b = \begin{bmatrix} 107 \\ 55 \\ 25 \end{bmatrix}, \quad c = [-4 \quad 63 \quad 7 \quad -2 \quad -2 \quad 0 \quad 21]^T$$

Solve this problem using the Simplex Method, starting from the basis consisting of A 's columns 1, 3, 4.

3: Consider the linear program (LP) $\min c^T x$ such that $Ax = b, x \geq 0$ where

$$A = \begin{bmatrix} 7 & 7 & 45 & -1 & 3 & -53 & -68 \\ 9 & -5 & 27 & -115 & 7 & -129 & 42 \\ 5 & -3 & 63 & -96 & 10 & -109 & 86 \end{bmatrix}, \quad b = \begin{bmatrix} 26 \\ 18 \\ 34 \end{bmatrix}, \quad c = [1 \quad 7 \quad -37 \quad 94 \quad -9 \quad 76 \quad -146]^T$$

- Solve this problem using the Simplex Method, starting from the basis consisting of A 's columns 1, 2, 5.
- Solve this problem using the Simplex Method, starting from the basis consisting of A 's columns 1, 2, 7. Comment on the difference in outcome between this part b and the previous part a.
- Solve this problem using the Simplex Method, starting from the basis consisting of A 's columns 1, 3, 6. Observe how the objective function changes through this particular Simplex Method implementation, and comment on an anomaly.