Rexam 2017

Exercise 1

Consider the following optimization problem:

$$\text{Maximize:} \quad f(x) = 6x_1 + 5x_2$$

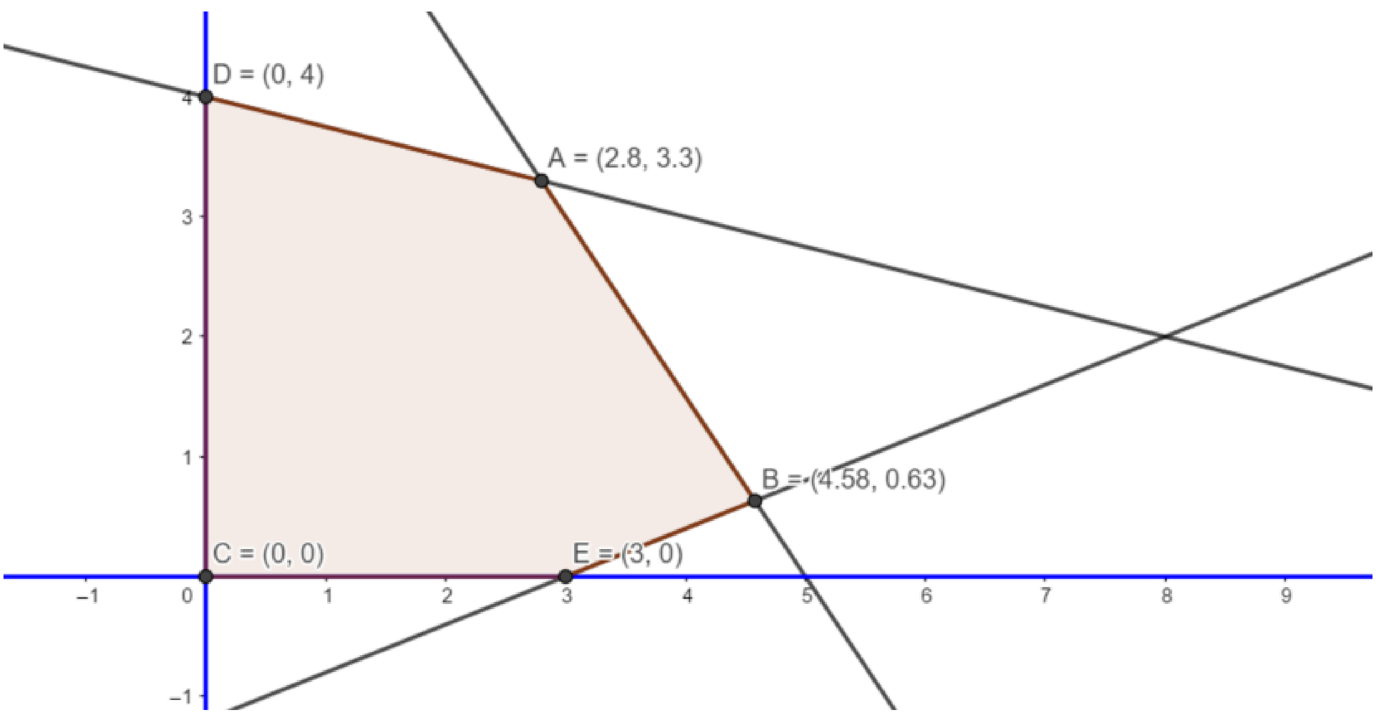
$$\text{Subject to:} \quad x_1 + 4x_2 \leq 16; \qquad \text{(i)}$$

$$6x_1 + 4x_2 \leq 30; \qquad \text{(ii)}$$

$$2x_1 - 5x_2 \leq 6; \qquad \text{(iii)}$$

$$\text{and} \quad x_1 \geq 0; x_2 \geq 0;$$

a) Sketch the feasible set in 2 dimensions.



Point A : (2.8, 3.3), Point B : (4.58,0.63), Point C : (0,0), Point D : (0,4) ,Point E : (3,0)

Objective function results

$f(x) = 6x_1 + 5x_2$

Inputing the different solutions to maximize the objective function:

```
F_A = 6*2.8 + 5*3.3
```

```
F_A = 33.3000
```

```
F_B = 6*4.58 + 5*0.63
```

```
F_B = 30.6300
```

```
F_C = 6*0 + 5*0
```

```
F_C = 0
```

```
F_D = 6*0 + 5*4
```

```
F_D = 20
```

```
F_E = 6*3 + 5*0
```

```
F_E = 18
```

```

fprintf("Our maxpoint is B[8,2] with the following value: %.2f", F_A )
```

```
Our maxpoint is B[8,2] with the following value: 33.30
```

The solution for the max of the objective function is $x_1 = 8$, $x_2 = 2$, $\max = 58$

b) Write out the simplex tableaux for the problem and show the first step needed to bring in a new variable into the solution (e.g. argue what column and row to choose, and what elementary operations are needed for the first reductions). Find the maximum for f on the feasible set (you may use MatLab).

```
% Simplex tuable for the problem
% Step change inquality to equality by adding slacks var
%    x1    x2,    s1    s2   s3     M      B
A = [1,     4,    1,    0,    0,    0,    16;
     6,     4,    0,    1,    0,    0,    30;
     2,    -5,    0,    0,    1,    0,    6;
     -6,   -5,    0,    0,    0,    1,    0]
```

```
A = 4×7
     1     4     1     0     0     0    16
     6     4     0     1     0     0    30
     2    -5     0     0     1     0     6
    -6    -5     0     0     0     1     0
```

```
% Step two, find most negative --> they are equal -- we take x1
% Step three a positive ratio than is smallets
```

```
% B/entry  for all entries
% 16/1 = 16  |   30/6 = 5    |    6/2 = 3     --> pivot x1 at row3

% Row operations to finish pivot collum

% R4 + 3R3
A(4,:) =  3*A(3,:) + A(4,:);

% R2- 3R3
A(2,:) = 3*A(3,:)-A(2,:);

% R1 - 1/2*R3
A(1,:) = A(1,:)-1/2 * A(3,:);

% R3 * 1/2
A(3,:) = 1/2 * A(3,:)
```

```
A = 4×7
         0    6.5000    1.0000         0   -0.5000         0   13.0000
         0  -19.0000         0   -1.0000    3.0000         0  -12.0000
    1.0000   -2.5000         0         0    0.5000         0    3.0000
         0  -20.0000         0         0    3.0000    1.0000   18.0000
```

```
x1 = optimvar('x1');
x2 = optimvar('x2');
prob = optimproblem('Objective',6*x1 +5*x2,'ObjectiveSense','max');
prob.Constraints.c1 = x1 +4*x2 <= 16;
prob.Constraints.c2 = 6*x1 + 4*x2 <= 30;
prob.Constraints.c3 = 2*x1-5*x2 <= 6;
prob.Constraints.c4 = x1 >= 0;
prob.Constraints.c5 = x2 >= 0;

problem = prob2struct(prob);1
```

```
ans = 1
```

```
[sol,fval,exitflag,output] = linprog(problem);
```

```
Optimal solution found.
```

```
sol
```

```
sol = 2×1
    2.8000
    3.3000
```