OR – 1st Semester Mid Term (11/11/2017) **Resolution topics**

1. a) The augmented form, multiplying the last constraint by (-1):

$$Max\ Z$$

$$\text{s.t.:} \begin{cases} Z - 2\,x_1 - 4\,x_2 = 0 \\ 2x_1 + x_2 + x_3 = 20 \\ x_1 + 2x_2 + x_4 = 18 \\ -x_1 + 2x_2 + x_5 = 0 \\ x_1, \dots, x_5 \geq 0 \end{cases}$$

E C: $\text{Mín}\{-2;\ -4\} = -4 \rightarrow x_2$; LC: $\text{Mín}\left\{\frac{20}{1}; \frac{18}{2}; \frac{0}{2}\right\} = 0 \rightarrow x_5$

	Z	x_1	x_2	x_3	x_4	x_5	TI
Z	1	-2	-4	0	0	0	0
x_3	0	2	1	1	0	0	20
x_4	0	1	2	0	1	0	18
x_5	0	-1	2	0	0	1	0
Z	1	-4	0	0	0	2	0
x_3	0	5/2	0	1	0	-1/2	20
x_4	0	2	0	0	1	-1	18
x_2	0	-1/2	1	0	0	1/2	0

1. b) Solution: $\mathbf{x} = (0, 0, 20, 18, 0)$. Basic feasible solution non optimal (x_1 coefficient in the Z row is negative).

1. c) Dual:

$$Min\ W = 20\,y_1 + 18\,y_2$$

$$\text{s.t.:} \begin{cases} 2y_1 + y_2 + y_3 \geq 2 \\ y_1 + 2y_2 - 2y_3 \geq 4 \\ y_1, y_2 \geq 0,\ \ y_3 \leq 0 \end{cases}$$

2) It occurs when the problem is infeasible, i.e., when the feasible region is the empty set.

3. a) Let x_j – the quantity (participation units) to acquire of fund $j = A, B, C$

$$Max\ Z = 0{,}09 \times 1{,}2\ x_A + 0{,}08 \times 1{,}8 x_B + 0{,}06 \times 1{,}9 x_C = 0{,}108\ x_A + 0{,}144 x_B + 0{,}114 x_C$$

s.t.:

$$\begin{cases} x_C \geq 110 & \text{rule 1} \\ 1{,}8x_B \geq 400 & \text{rule 2} \\ 1{,}2x_A + 1{,}8x_B + 1{,}9x_C \leq 1200 & \text{budget constraint} \\ x_A, x_B, x_C \geq 0 \end{cases}$$

3. b) $\mathbf{x} = (492.5;\ 222.2;\ 110;\ 0;\ 0;\ 0)$. Should be acquired 492.5; 222.2 and 110 participation units from funds A, B and C, respectively. All slack variables are zero, meaning that the minimum amount required from fund C is acquired (rule 1); the minimum is also acquired of fund C (rule 2), and the whole budget is invested in funds.

3. c) $y_3 = 0.09$ – each m.u. extra of budget will improve the total return by 0.09, or each reduction of one m.u. will decrease the total return by 0.09, while the optimal basis is kept.