

Exam test – Operation Research

1. **(5 points)** Mrs. Vokurka has two children which have a lot of hobbies. Both children would like to visit as many summer camps as is possible. Her daughter would like to visit: scout camp – in duration of 21 days and at the price of 3500 CzK; sport camp – 7 days, 4500 CzK, English camp – 7 days, 5000 CzK and Sokolem camp – 14 days, 2500 CzK. Her son would like to visit following camps: scout camp – in duration of 21 days and at the price of 3500 CzK; sport camp – 7 days, 4500 CzK, fishing camp – 10 days, 3000 CzK and Football camp – 14 days, 5000 CzK.

Unfortunately, Mrs. Vokurka has not enough money for all of these activities. She can put maximally 18 000 CzK into these activities. She wants for each children at least one camp. She does not want both of them to go to the sport camp (maximally one of them). Which camps should Ms. Vokurka to choose for her children if she wants to maximize the number of days which her children spend on the camps and she has only limited budged (as was mentioned above)?

Write down the model for Linear optimization with all constrains. Explain the variables meaning.

2. **(5 points)** Use a graphical solution to solve the following problem. Highlight the set of feasible solutions, all basic feasible solutions and (all) optimal solution(s).

		x_1	x_2
$\max x_1 + 2x_2$	1st cond.		
s. t. $2x_1 + 2x_2 \geq 4$,			
$3x_1 + 2x_2 \leq 6$,	2nd cond.		
$x_2 - 2x_1 \geq 0$,			
$x_1, x_2 \geq 0$.	3rd cond.		

3. **(3 points)** Use Gantt diagram to identify the number of workers which are necessary to finish the project in time.

activity	prec.	number of workers	duration
a		5	1
b		3	3
c	b	2	10
d	a	4	5
e	a,b	3	2
f	c,d	5	4

4. **7 points (3 + 4 points)** The animal feed supplier has five warehouses. Each of these warehouses has two inputs (monthly cost, number of employees) and one output (monthly returns) as is given in the following table. Use DEA to decide which of these units are effective and which are not. First use a graphical way of solution, then write down a linear optimization model and explain the variable meaning.

	employees	cost	return
S1	8	6	100
S2	6	5	50
S3	9	12	150
S4	5	10	50
S5	6	8	100