Written Exam for the B.Sc. or M.Sc. in Economics winter 2014-15

Operations Research

Elective Course

January 19th, 2015

(3-hour open book exam)

You may write your exam paper in Danish or in English.

This exam question consists of 4 pages in total, including this one

Part 1

Consider the following Initial and Optimal Simplex tableaus

Initial Simplex tableau:

z	x_1	x_2	x_3	x_4	s_1	e_2	e_3	RHS
0	1	1	1	1	1	0	0	40
0	2	1	-1	-1	0	-1	0	10
0	0	-1	0	1	0	0	-1	10
1	-1/2	-3	-1	-4	0	0	0	0

Optimal Simplex tableau:

z	x_1	x_2	x_3	x_4	s_1	e_2	e_3	RHS
0	0	1	3/4	0	1/2	1/4	3/4	10
0	1	0	-1/2	0	0	-1/2	-1/2	10
0	0	0	3/4	1	1/2	1/4	-1/4	20
1	0	0	4	0	7/2	3/2	1	115

Question 1.1: State the optimal solution and solution value in the Optimal Simplex tableau.

Question 1.2: Suggest a LP problem which could have been the one solved by Simplex above.

Question 1.3: How much can the objective function coefficient to x_1 deviate without changing the optimal solution?

Question 1.4: Formulate the dual LP to the LP found in question 1.2 and give the optimal solution.

Part 2

Consider a MILP with integer constraints on all decision variables and integer coefficients in all constraints and right hand sides. During the Simplex iterations, the following constraint appears in the tableau:

$$5.1\ x_1 - 3.3\ x_2 + 1\ x_3 - 3.9\ s_1 + 0.5\ s_2 = 42.2$$

Question 2.1: Formulate a cutting plane which can be added to the Simplex tableau

Question 2.2: If instead a Branch & Bound algorithm was underway, which constraints would now be added?

Part 3

3 regional warehouses are supplying 5 shopping centers with batches of firewood. The maximum quantities that can be sold from the 5 shopping centers are 100, 200, 300, 200 and 100 batches, respectively. The maximum delivery from the 3 warehouses is 300, 400 and 400 batches, respectively. The production and handling costs at the warehouses are 10, 7 and 7 per batch, respectively, and batches are sold at the shopping centers for a price of 20, 19, 17, 16 and 20 per batch, respectively. The unit transportation cost from warehouse (i) to shopping center (j), c_{ij}, is defined as $c_{ij} = M + (i - j)$ per batch, where M is a positive constant which can be assumed to be between 5 and 8.

Question 3.1: Formulate a balanced Transportation model to maximize the profit.

Question 3.2: Find an initial basic feasible solution using Vogel's method

Question 3.3: What would happen if M increases to 18?