CAIRO UNIVERISITY
FACULTY OF SCIENCE
MATHEMATICS DEPARTMENT

Exam Midterm Math 493 (Operations research) 4^{th}year

Time: 45 Mints **Date: 10-11-2022**

Answer the following questions:

Question (1)

a) Solve the following (LP) problem by using two-phase technique

$$\text{Maximize} \quad Z = x_1 + x_2 + 4$$
$$\text{Subject to} \quad -x_1 + 3x_2 \leq 9 \;;\; x_1 + x_2 \geq 5;\; 3x_1 - x_2 \leq 9$$
$$x_1, x_2 \geq 0$$

b) The following table represents a minimize (LP) in standard form:

	x_1	x_2	x_3	x_4	x_5	*solution*
z-eqn.	0	B	E	0	0	3
	1	C	1	0	0	A
	0	D	-1	1	0	2
	0	-1	1	0	1	4

Give conditions on the parameters A, B, C, D, and E so that:

i) The table is in optimal form b, e ≤ 0

ii) The table is in unbounded form b < 0 c, d ≤ 0

iii) The table is in feasible form (2) c ≥ 0 a < 0

Question (2)

a) Prove that a (LP) problem in standard form has a finite optimal solution it has an extreme optimal point.

b) Consider the following (LP) problem:

$$\text{Minimize} \quad Z = -x_1 - x_2$$
$$\text{Subject to} \quad -x_1 + x_2 \leq 2 \;;\; -x_1 + x_2 \geq -2; \quad X(-)$$
$$0 \leq x_1 \leq 4 \;;\; 0 \leq x_2 \leq 4.$$

Solve the (LP) problem graphically and find its dual problem.

****** *Best wishes*******

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Math 493 (Operations research) 4^{th}years | Time allowed: 45 min

First midterm Exam | Date: 1-12-2022

Answer the following questions:

Question (1)

a) Solve the following (ILP) problem by apply Gomory's cutting plane method

$$\text{Minimize} \quad Z = x_1 - 2x_2$$
$$\text{Subject to} \quad 2x_1 + x_2 \leq 5$$
$$-4x_1 + 4x_2 \leq 5$$

$x_1, x_2 \geq 0$

$$x_1, x_2 \geq 0 \text{ And } x_2 \text{ integer}$$

The optimal continuous solution for given (ILP) problem is given by the table:

Basis	X_1	X_2	X_3	X_4	Solution
Z	0	0	-1/3	-5/12	-15/4
X_1	1	0	1/3	-1/12	5/4
X_2	0	1	1/3	1/6	5/2 $2+\frac{1}{2}$

b) Find the dual problem to the problem in (a) after change $x_1, x_2 \geq 0$ and x_2 integer to $x_1, x_2 \geq 0$

c) Solve the problem in (b) graphically and specify (S, θ, θ_x, θ_μ, z^*, x^*)

Question (2)

Select (True) or (False) and correct the wrong answer for the following statements:

a. The dual simplex method solves any (LP) problem. ×
b. The feasible region of (ILP) problem is convex set. × discrete
c. The variables in (ILP) problem are non-negative and integers. ✓
d. A point $x \in S$ is degenerate if the number of constraints active at x is equal the dimension of the feasible region S ✓
e. To solve maximize (LP) problem by M- technique we add $M \sum_{i=1}^{k} R_i$ to objective function. ✗
f. To solve (LP) problem by two-phase Method the objective function in phase (II) is a function of basic variable. ✗ ×

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