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Catchup exam of Operational research

Duration: 1h Session:May 2021

EXERCISE 1:(2 + 2 + 2 + 2 = 8 Marks)

1. Using the simplex procedure, solve the following linear program on the right.

$$\begin{array}{ll} \text{maximize} & -x_1 + x_2 \\ \text{subject to} & x_1 - x_2 \leqslant 2 \\ & x_1 + x_2 \leqslant 6 \\ & x_1 \geqslant 0, \quad x_2 \geqslant 0. \end{array}$$

2. Draw a graphical representation of the problem (question 1) in x1, x2 space and indicate with an arrow, the path of the simplex steps.
3. Consider the constraint set in *E2* defined in terms of the inequalities, in the right. Draw the feasible set according to the constraint set.

$$\begin{array}{l} x_1 + \frac{8}{3}x_2 \leqslant 4 \\ x_1 + x_2 \leqslant 2 \\ 2x_1 \leqslant 3 \\ x_1 \geqslant 0, \quad x_2 \geqslant 0. \end{array}$$

4. Is the feasible set of question 3, convex? If yes list the extreme points, else justify your answer

EXERCISE 2:(1 + 2 + 2 + 2 = 7 Marks)

Let us consider the following tableau produced by an iteration of the simplex method using the vector interpretation and solving the linear program *minimize* c^Tx *subject to* $Ax=b$ *and* $x \geq 0$; *where* x is an *n*-dimensional column vector, $c^T$is an *n*-dimensional row vector, A is an $m \times n$ matrix, and b is an *m*-dimensional column vector. The vector inequality $x \geq 0$ means that each component of x is nonnegative. Based on the tableau, answer to the questions below

a_1	a_2	a_3	$\cdots$	a_m	a_{m+1}	a_{m+2}	$\cdots$	a_n	b
1	0	0	$\cdots$	0	$\bar{a}_{1(m+1)}$	$\bar{a}_{1(m+2)}$	$\cdots$	$\bar{a}_{1n}$	$\bar{a}_{10}$
0	1	0	$\cdots$	0	$\bar{a}_{2(m+1)}$	$\bar{a}_{2(m+2)}$	$\cdots$	.	$\bar{a}_{20}$
0	0	1	$\cdots$	.	.	.		.	.
.	.	.		.	.	.		.	.
.	.	.		.	.	.		.	.
.	.	.		.	.	.		.	.
0	0	0	$\cdots$	1	$\bar{a}_{m(m+1)}$	$\bar{a}_{m(m+2)}$	$\cdots$	$\bar{a}_{mn}$	$\bar{a}_{m0}$

1. Is the tableau in canonical form?
2. List the a_j belonging to the basis
3. What is the current value of the solution vector x
4. Write the vector a_{m+2}as linear combination of basic vectors of question2

EXERCISE 3:(5 Marks)

Solve the following linear program

$$\begin{array}{ll} \text{minimize} & -2x_1 + 4x_2 + 7x_3 + x_4 + 5x_5 \\ \text{subject to} & -x_1 + x_2 + 2x_3 + x_4 + 2x_5 = 7 \\ & -x_1 + 2x_2 + 3x_3 + x_4 + x_5 = 6 \\ & -x_1 + x_2 + x_3 + 2x_4 + x_5 = 4 \\ & x_2 \geqslant 0, \; x_3 \geqslant 0, \; x_4 \geqslant 0, \; x_5 \geqslant 0. \end{array}$$

Good Luck