Operations Research
Lab Session

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Outline

1. Homework 4 illustration

Problem 3

Non-basic variable

c_1	c_2	0	0	0	0	10
4	a_1	1	0	a_2	0	b
-1	-5	0	1	-1	0	2
a_3	-3	0	0	-4	1	3

Basic variable

Problem 3(a)

c_1	c_2	0	0	0	0	10
4	a_1	1	0	a_2	0	b
-1	-5	0	1	-1	0	2
a_3	-3	0	0	-4	1	3

tableau optimal => (1) find a solution (2) find multiple solutions

$$c_1 \geq 0, c_2 \geq 0$$

Problem 3(b)

c_1	c_2	0	0	0	0	10
4	a_1	1	0	a_2	0	b
-1	-5	0	1	-1	0	2
a_3	-3	0	0	-4	1	3

unbounded => has entering variable, has no leaving variable

$c_2 < 0$ $\qquad\qquad$ $a_1 \leq 0$

Problem 3(c)

c_1	c_2	0	0	0	0	10
4	a_1	1	0	a_2	0	b
-1	-5	0	1	-1	0	2
a_3	-3	0	0	-4	1	3

current bfs degenerate => RHS has 0

RHS has 0 => m+1 variable value are 0 => m bfs in same point (0, 0 ,0, 2, 0, 3) choose 3 zero as non-basis variable

Problem 3(c)

LP is degenerated

-1	2	0
1	-1	2
2	-3	4

Same ratio of leaving variable

Problem 3(d)

c_1	c_2	0	0	0	0	10
4	a_1	1	0	a_2	0	b
-1	-5	0	1	-1	0	2
a_3	-3	0	0	-4	1	3

Enter x_1 and leave x_6 $\quad \dfrac{b}{4} \geq \dfrac{3}{a_3}$

Problem 3(e) modified

c_1	c_2	0	0	0	10
4	a_1	1	0	0	b
-1	-5	0	1	0	2
a_3	-3	0	0	1	3

$b > 0$, multiple solutions

solution => c_1, c_2 non-negative $c_1 \geq 0, c_2 \geq 0$

multiple solutions => c_1, c_2 at least one is 0 $c_1 c_2 = 0$

Problem 3(e)

c_1	c_2	0	0	0	0	10
4	a_1	1	0	a_2	0	b
-1	-5	0	1	-1	0	2
a_3	-3	0	0	-4	1	3

$c_1 \geq 0, c_2 \geq 0$

Problem 3(f) modified

c_1	c_2	0	0	0	10
4	a_1	1	0	0	b
-1	-5	0	1	0	2
a_3	-3	0	0	1	3

$b = 0$, multiple solutions

When $c_1 = 0$ (degenerate has same solution!) => $\quad c_1 \geq 0$

When $c_2 = 0$, $a_1 > 0$ (degenerate) => $c_2 = 0$, $a_1 \leq 0$

Problem 3(f)

c_1	c_2	0	0	$\boxed{0}$	0	10
4	a_1	1	0	$\boxed{a_2}$	0	b
-1	-5	0	1	-1	0	2
a_3	-3	0	0	-4	1	3

$a_2 \leq 0,\ c_1 \geq 0, c_2 \geq 0$ => multiple solutions