

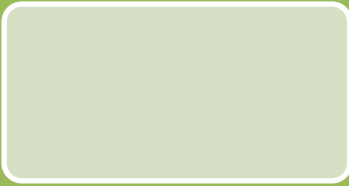
Teori Pengambilan Keputusan

Week 3

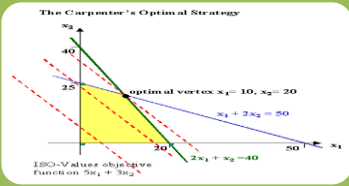
Linear Programming

Simplex Method - Maximize

Outlines



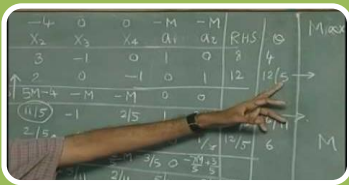
Linear Programming Model – Problem Formulation



Linear Programming Model – Graphic Solution



Linear Programming Model – Simplex Method (Maximize)



Linear Programming Model – Simplex Method (Minimize and Non-Standard)

Linear Programming Problems

Standard Maximization

Objective:
Maximize

Constraints: ALL
with \leq

Standard simplex

Standard Minimization

Objective:
Minimize

Constraints: All
with \geq

Dual

Non-Standard

Objective:
Max or Min

Constraints: Mixed,
can be \leq , \geq or $=$

Two Phase

STANDARD MAXIMIZATION PROBLEM

Flair Furniture Company

- Objective function:

$$\text{Maximize profit (P)} = \$70T + \$50C$$

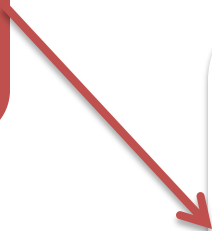
- Constraints:

$$4T + 3C \leq 240$$

$$2T + 1C \leq 100$$

$$T \geq 0$$

$$C \geq 0$$



Introduce slack variables into constraints to obtain equality (equations)

Slack Variables

All the inequality transformed into equality by adding slack variables to each of the inequality.

$$\begin{array}{l} 4T + 3C \leq 240 \\ 2T + 1C \leq 100 \end{array} \quad \longrightarrow \quad \begin{array}{l} 4T + 3C + S_1 = 240 \\ 2T + 1C + S_2 = 100 \end{array}$$

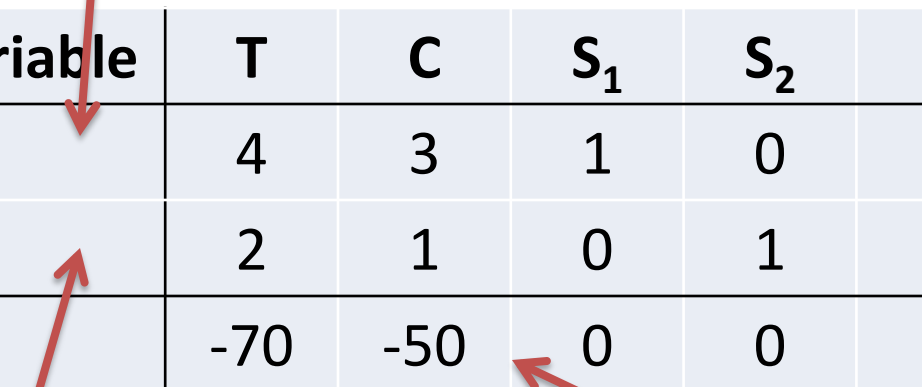
Move the objective function to the left hand side of the equation

$$P = \$70T + \$50C \quad \longrightarrow \quad -70T - 50C + P = 0$$

First Simplex Tableau

$$4T + 3C + S_1 = 240 \rightarrow \text{row 1}$$

Basic Variable	T	C	S ₁	S ₂	P	RHS
S ₁	4	3	1	0	0	240
S ₂	2	1	0	1	0	100
P	-70	-50	0	0	1	0



$$2T + 1C + S_2 = 100 \rightarrow \text{row 2}$$

$$-70T - 50C + P = 0 \rightarrow \text{row 3}$$

Simplex Tableau

Change the pivot number to 1 and other number in the same column to 0

Pivot Number

Basic Variable	T	C	S ₁	S ₂	P	RHS	
S ₁	4	3	1	0	0	240	= 240/4 = 60
S ₂	2	1	0	1	0	100	= 100/2 = 50
P	-70	-50	0	0	1	0	

Most negative, therefore variable T enter the solution mix

Smallest result of the ratio, therefore variable S₂ leave the solution mix.

Second Simplex Tableau

Basic Var.	T	C	S ₁	S ₂	P	RHS
S ₁	4	3	1	0	0	240
S ₂	2	1	0	1	0	100
P	-70	-50	0	0	1	0



Basic Variable	T	C	S ₁	S ₂	P	RHS
S ₁						
T						
P						

S₂ leaving the solution mix, while T enter it

Second Simplex Tableau

Basic Var.	T	C	S ₁	S ₂	P	RHS
S ₁	4	3	1	0	0	240
S ₂	2	1	0	1	0	100
P	-70	-50	0	0	1	0



The value in pivot number need to be changed into 1

Basic Variable	T	C	S ₁	S ₂	P	RHS
S ₁						
T	1					
P						

Second Simplex Tableau

Basic Var.	T	C	S ₁	S ₂	P	RHS
S ₁	4	3	1	0	0	240
S ₂	2	1	0	1	0	100
P	-70	-50	0	0	1	0

Therefore, all number in row 2 need to be divided by 2



The value in pivot number need to be changed into 1

Basic Variable	T	C	S ₁	S ₂	P	RHS
S ₁						
T	1					
P						

Second Simplex Tableau

Basic Var.	T	C	S ₁	S ₂	P	RHS
S ₁	4	3	1	0	0	240
S ₂	2	1	0	1	0	100
P	-70	-50	0	0	1	0

= 100 : 2
= 50



variable	T	C	S ₁	S ₂	P	RHS
S ₁						
T	1	1/2		1/2	0	50
P						

= 2 : 2
= 1

= 1 : 2
= 1/2

Second Simplex Tableau

Basic Var.	T	C	S ₁	S ₂	P	RHS
S ₁	4	3	1	0	0	240
S ₂	2	1	0	1	0	100
P	-70	-50	0	0	1	0



Other numbers in the pivot column need to be changed into 0

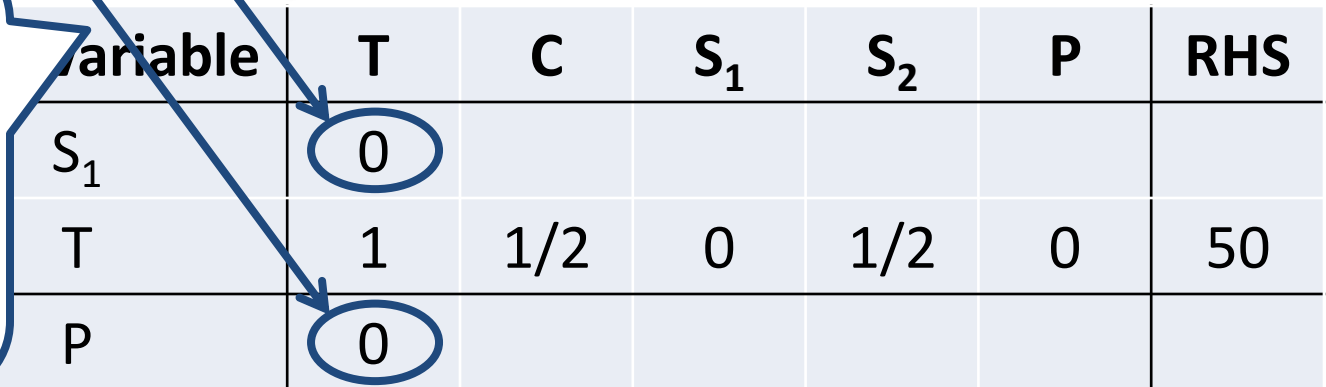
Variable	T	C	S ₁	S ₂	P	RHS
S ₁	0					
T	1	1/2	0	1/2	0	50
P	0					

Second Simplex Tableau

Basic Var.	T	C	S ₁	S ₂	P	RHS
S ₁	4	3	1	0	0	240
S ₂	2	1	0	1	0	100
P	-70	-50	0	0	1	0

Use elimination procedure using **row 2** to obtain that number (0)

Other numbers in the pivot column need to be changed into 0



Variable	T	C	S ₁	S ₂	P	RHS
S ₁	0					
T	1	1/2	0	1/2	0	50
P	0					

Second Simplex Tableau

• S_1 :

4	3	1	0	0		240
<u>2</u>	<u>1</u>	<u>0</u>	<u>1</u>	<u>0</u>		<u>100 (x2)</u>
4	3	1	0	0		240
<u>4</u>	<u>2</u>	<u>0</u>	<u>2</u>	<u>0</u>		<u>200 -</u>
0	1	1	-2	0		40

Second Simplex Tableau

Basic Var.	T	C	S ₁	S ₂	P	RHS
S ₁	4	3	1	0	0	240
S ₂	2	1	0	1	0	100
P	-70	-50	0	0	1	0



Basic Variable	T	C	S ₁	S ₂	P	RHS
S ₁	0	1	1	-2	0	40
T	1	1/2	0	1/2	0	50
	0					

Do the same calculation for the rest of row 3

Second Simplex Tableau

- P:

-70	-50	0	0	1		0
<u>2</u>	<u>1</u>	<u>0</u>	<u>1</u>	<u>0</u>		<u>100</u> (x35)
-70	-50	0	0	1		0
<u>70</u>	<u>35</u>	<u>0</u>	<u>35</u>	<u>0</u>		<u>3500</u> +
0	-15	0	35	1		3500

Second Simplex Tableau

Basic Var.	T	C	S ₁	S ₂	P	RHS
S ₁	4	3	1	0	0	240
S ₂	2	1	0	1	0	100
P	-70	-50	0	0	1	0



Basic Variable	T	C	S ₁	S ₂	P	RHS
S ₁	0	1	1	-2	0	40
T	1	1/2	0	1/2	0	50
P	0	-15	0	35	1	3500

Second Simplex Tableau

Basic Var.	T	C	S ₁	S ₂	P	RHS	
S ₁	4	3	1	0	0	240	= Row 2 * (-2) + Row 1
S ₂	2	1	0	1	0	100	= Row 2 / 2
P	-70	-50	0	0	1	0	= Row 2 * (35) + Row 3



Basic Variable	T	C	S ₁	S ₂	P	RHS
S ₁	0	1	1	-2	0	40
T	1	1/2	0	1/2	0	50
P	0	-15	0	35	1	3500

Row P still contain negative value

Second Simplex Tableau

Change the pivot number to 1 and other number in the same column to 0

Pivot Number

Basic Variable	T	C	S ₁	S ₂	P	RHS
S ₁	0	1	1	-2	0	40
T	1	1/2	0	1/2	0	50
P	0	-15	0	35	1	3500

$$40/1 = 40$$

$$50/(1/2) = 100$$

Most negative, therefore variable C enter the solution mix

Smallest result of the ratio, therefore variable S₁ leave the solution mix

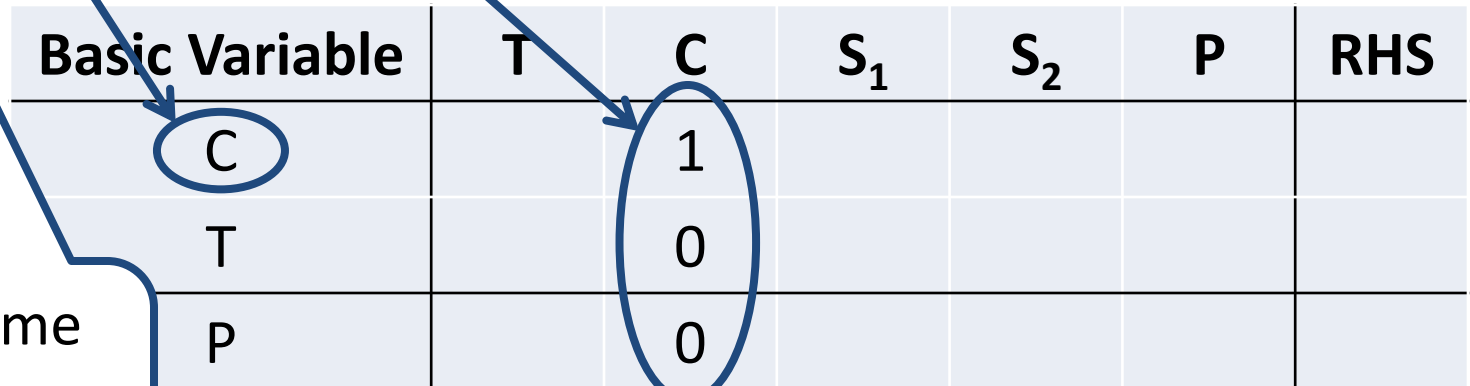
Third Simplex Tableau

Basic Var.	T	C	S ₁	S ₂	P	RHS
S ₁	0	1	1	-2	0	40
T	1	1/2	0	1/2	0	50
P	0	-15	0	35	1	3500

= Row 1

= Row 1 * (-1/2) + Row 2

= Row 1 * 15 + Row 3



Basic Variable	T	C	S ₁	S ₂	P	RHS
C		1				
T		0				
P		0				

Use the same procedure as before

Third Simplex Tableau

Basic Var.	T	C	S ₁	S ₂	P	RHS	
S ₁	0	1	1	-2	0	40	= Row 1
T	1	1/2	0	1/2	0	50	= Row 1 * (-1/2) + Row 2
P	0	-15	0	35	1	3500	= Row 1 * 15 + Row 3



Basic Variable	T	C	S ₁	S ₂	P	RHS
C	0	1	1	-2	0	40
T	1	0	-1/2	3/2	0	30
P	0	0	15	5	1	4100

Third Simplex Tableau

Basic Var.	T	C	S ₁	S ₂	P	RHS	
S ₁	0	1	1	-2	0	40	= Row 1
T	1	1/2	0	1/2	0	50	= Row 1 * (-1/2) + Row 2
P	0	-15	0	35	1	3500	= Row 1 * 15 + Row 3



Note that all the values in row 3 now don't have negative numbers

Variable	T	C	S ₁	S ₂	P	RHS
C	0	1	1	-2	0	40
T	1	0	-1/2	3/2	0	30
P	0	0	15	5	1	4100

THEREFORE, OPTIMAL!!

Optimal Solution

C (Chairs) = 40
T (Tables) = 30

Basic Variable	T	C	S ₁	S ₂	P	RHS
C	0	1	1	-2	0	40
T	1	0	-1/2	3/2	0	30
P	0	0	15	5	1	4100

P (Profit) = 4100

EXERCISE

M7-20

Coba selesaikan permasalahan berikut dengan menggunakan metode grafik. Kemudian cobalah selesaikan masalah tersebut dengan menggunakan metode simpleks. Tunjukkan titik sudut yang anda dapatkan untuk setiap iterasi simpleks.

$$\text{Maks. profit} = \$3X_1 + \$5X_2$$

$$\text{Hambatan} \quad X_2 \leq 6$$

$$3X_1 + 2X_2 \leq 18$$

$$X_1, X_2 \geq 0$$

M7-24

Selesaikan masalah berikut dengan menggunakan metode simpleks. Kondisi apakah yang membuat solusi optimal sulit dicapai?

$$\text{Maks. profit} = 6X_1 + 3X_2$$

$$\text{Hambatan } 2X_1 - 2X_2 \leq 2$$

$$-X_1 + X_2 \leq 1$$

$$X_1, X_2 \geq 0$$

THANK YOU