University of Technology

Building and Construction Eng Depart

Subject: Planning & management system

Branch: Construction Engineering and Management

Class: 3rd   Time: 3 hours

Examiner: Dr. Ibraheem Abid Mohammed   Date: /5/2015

Note: Answer only four questions

Q1//: Max $Z = X_1 + 3X_2$

s.to

$$x_1 + x_2 \le 6$$

$$x_1 \ge 3$$

$$x_2 \ge 3$$

$$2x_1 + 3x_2 \ge 3$$

$$X_1, x_2 \ge 0$$

1- Determine feasible region graphically.

2- Determine all redundant constraints.

3- Construct the duel of the problem.

Q2// A: Min $Z = 4X_1 + X_2$

S. to

$$3x_1 + x_2 = 3$$

$$4x_1 + 3x_2 \ge 6$$

$$x_1 + 2x_2 \le 3$$

$$X_1, x_2 \ge 0$$

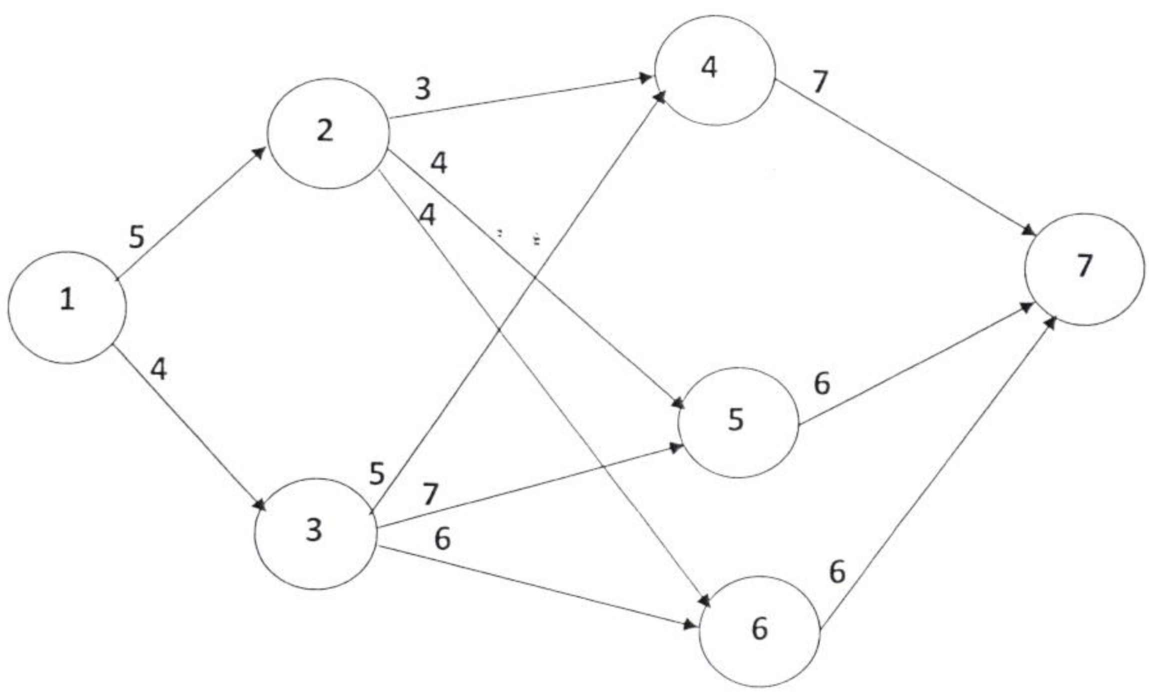
by using BIG.M find the second simplex tableau.

Q2// B: Explain the condition of project.

If 1. SPI > 1 , CPI < 1

2. SPI < 1 , CPI > 1

Q3//: Find the shortest path from 1 to 7 by using Dynamic programming method.



Q4//A: What is the difference between least cost method and Vogel method in transportation problems.

B//: Solve the following assignment problem to minimize time.

jobs

		1	2	3	4
Mens	1	6	8	7	6
	2	4	6	5	3
	3	4	2	7	3
	4	5	3	9	5

Q5//: A construction site requires a minimum of 20000 m^3 of sand and gravel mixture. The mixture must contain no less than 6000 m^3 of sand and no more than 7000 m^3 of gravel materials may be obtained from two sites:

Site	Delivery Cost $/m^3	Percent sand	Percent gravel
1	10	40	60
2	12	70	30

1. Formulate the mathematical model.
2. Rewrite the mathematical model formulated in standard form.

حلول اسئلة Planning and management system
للصف الثالث / فرع هندسة البناء وادارة المشاريع

Q السؤال الاول

$$Max\ Z = x_1 + 3x_2$$

s.to

$x_1 + x_2 \leq 6$ —— (1)

$x_1 \geq 3$ —— (2)

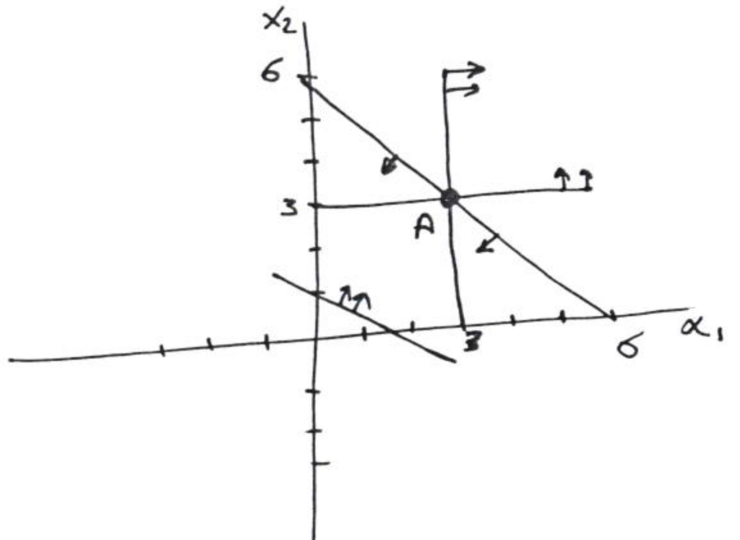
$x_2 \geq 3$ —— (3)

$2x_1 + 3x_2 \geq 3$ —— (4)

$x_1, x_2 \geq 0$

(a)

x_1	x_2	
0	6	(1)
6	0	
3	0	(2)
0	3	(3)
0	1	
1.5	0	



Feasible region is point A.

(b) redundant constraints.

$2x_1 + 3x_2 \geq 3$

(c) $Max\ Z = x_1 + 3x_2$

s.to

$x_1 + x_2 \leq 6$ — — — — y_1

$x_1 \geq 3 \longrightarrow -x_1 \leq -3$ — — y_2

$x_2 \geq 3 \longrightarrow -x_2 \leq -3$ — — y_3

$2x_1 + 3x_2 \geq 3 \longrightarrow -2x_1 - 3x \leq -3$ — y_4

$x_1, x_2 \geq 0$

Dual Problem

$Min\ w = 6y_1 - 3y_2 - 3y_3 - 3y_4$

s.to

$y_1 - y_2 - 2y_4 \geq 1$

$y_1 - y_3 - 3y_4 \geq 3$

$y_1, y_2, y_3, y_4 \geq 0$

Q_2 السؤال الثاني (A) $\text{Min } Z = 4x_1 + x_2$

Constraints .

$$3x_1 + x_2 + R_1 = 3$$

$$4x_1 + 3x_2 - S_1 + R_2 = 6$$

$$x_1 + 2x_2 + S_3 = 3$$

$$x_1, x_2 \geq 0$$

$$\text{Min } Z = 4x_1 + x_2 + MR_1 + MR_2$$

$$\text{Min } Z = 4x_1 + x_2 + M(3 - 3x_1 - x_2) + M(6 - 4x_1 - 3x_2 + S_1)$$

$$\text{Min } Z = 4x_1 + x_2 + 3M + 6M + MS_1$$

$$\text{Min } Z = (4 - 3M - 4M)x_1 + (1 - M - 3M)x_2 - MS_1 = 9M$$

$$\text{Min } Z + (-4 + 7M)x_1 + (-1 + 4M)x_2 - MS_1 = 9M$$

	x_1 ↓	x_2	S_1	S_3	R_1	R_2	R.H.S	Ratio
Z	$-4+7M$	$-1+4M$	$-M$	0	0	0	9M	
← R_1	(3)	1	0	0	1	0	3	← 1
R_2	4	3	−1	0	0	1	6	$\frac{6}{4}$
S_3	1	2	0	1	0	0	3	$\frac{3}{1}$

pivot element 3

pivot equation: $\begin{bmatrix} 1 & \frac{1}{3} & 0 & 0 & \frac{1}{3} & 0 & 1 \end{bmatrix}$

تابع

second tableau

	x_1	x_2	S_1	S_3	R_1	R_2	R.H.S
Z	0	$\frac{1}{3}+\frac{5}{3}M$	$-M$	0	$\frac{4}{3}-\frac{7}{3}M$	0	$4+2M$
x_1	1	$\frac{1}{3}$	0	0	$\frac{1}{3}$	0	1
R_2	0	$\frac{5}{3}$	-1	0	$-\frac{4}{3}$	1	2
S_3	0	$\frac{5}{3}$	0	1	$-\frac{1}{3}$	0	2

Q2// B
السؤال الثاني

① SPI > 1 CPI < 1

if SPI > 1 mean the project is currently a head of schedule.

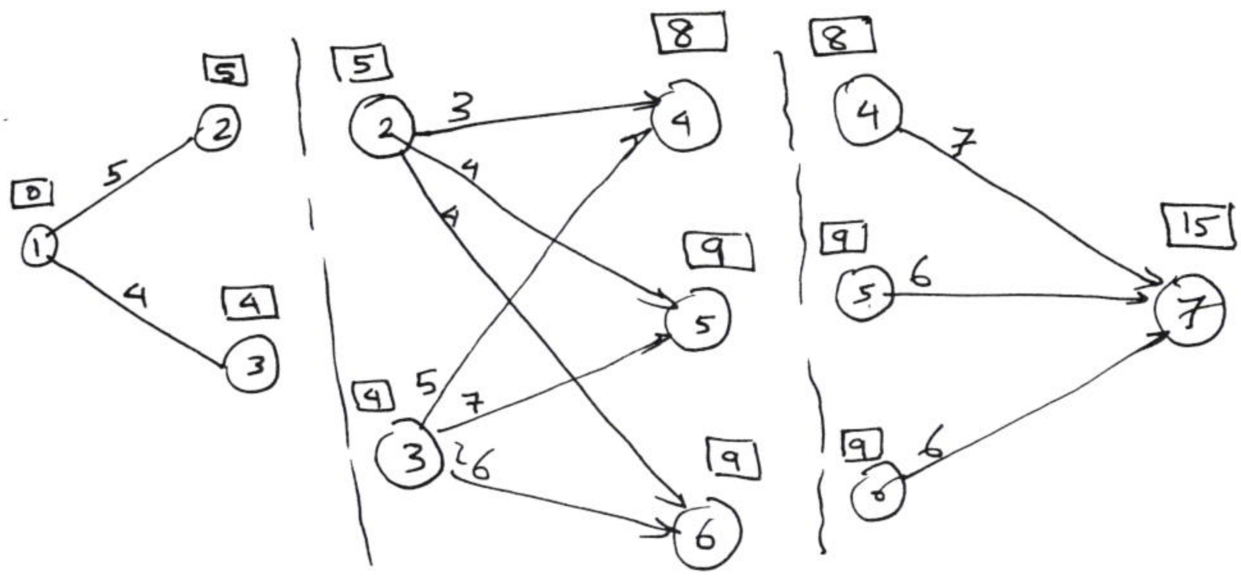
CPI < 1 mean the project currently over budget

② SPI < 1 CPI > 1

if SPI < 1 mean the project is currently behind of schedule

CPI > mean the project is currently under budget.

Q3 السؤال الثالث



stage 1
shortest distance from node 1 to 2 = 5
shortest distance from = = to 3 = 4

stage 2 shortest distance to node 4 $= \min_{i=2,3} = \begin{cases} 5+3=8 \\ 4+5=9 \end{cases} \rightarrow 8$

Shortest distance to node 5 $= \min_{2,3} \begin{cases} 5+4=9 \\ 4+7=11 \end{cases} \rightarrow 9$

shortest distance to node 6 $= \min_{2,3} = \begin{cases} 5+4=9 \\ 4+6=10 \end{cases} \rightarrow 9$

stage 3 shortest distance to node 7 $= \min_{i=4,5,6} = \begin{cases} 8+7=15 \\ 9+6=15 \\ 9+6=15 \end{cases}$

∴ shortest distance from 1 to 7 is = 15

1 → 2 → 4 — 7
1 → 2 — 5 — 7
1 → 2 — 6 — 7

(4-7)

Q_4 (A)

السؤال الرابع

Least cost	Vogel.
The method assigns as much as possible to the cell with the smallest unit cost. Next the satisfied row or column is crossed out and the amount of supply and demand are adjusted accordingly.	- for each row and column determine a penalty measure by subtracting the smallest unit cost element in the row column from the next smallest unit cost element in the same row (column) and identify the row or columns with largest penalty. Break ties arbitrarily, and any column or row with supply or demand equal zero, not enter in the same first step and continue.

السؤال الرابع (B)

	1	2	3	4
1	(6)	8	7	6
2	4	6	5	(3)
3	4	(2)	7	3
4	5	(3)	9	5

	1	2	3	4
1	(0)	2	(1)	(0)
2	1	3	2	0
3	2	(0)	5	1
4	2	0	6	2

(5-7)