University of Technology
Building and Construction Engineering Department
Final Exam 2013-2014

Subject: Planning and Management Systems — **Year: 3rd**

Division: Building and Construction Engineering Management — **Time: Three Hour**

Examiner: Dr. Ibraheem Abid Mohammed, M.Sc. Sagid Mahdi — **Date: 3 / 6 /2014**

Answer Four Questions Only

Q1)A) Define .

1- Degeneracy in graphical, give Example.
2- Unbounded solution in graphical, Give Example.

B) Consider the Following Linear Programming Problem.

Max. $Z = 2X_1 + X_2$

S. to

$3X_1 + 2X_2 \le 6$

$X_1 \le 2$

$X_1 + X_2 \le 8$

$-X_1 + X_2 \ge 4$

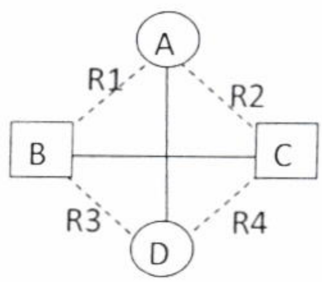
$X_1, X_2 \ge 0$

1- Construct the dual of problem.
2- Find pivot equation from the first tableau of simplex method.

Q2) A highway department plans four new routes (dashed Linen if Fig). To connect communities A & D with industrial areas B&C. Funding at a rate to build one route each year except the third year must build two route and the first year must build one route is an anticipated. Associated with each route in an average user cost per vehicle and amortized construction and maintenance cost.

New Routes	None	1	2	3	4	1,2	1,3	1,4	2,3	2,4
Total Cost	1340	1230	1000	1220	1110	990	1210	960	980	1100

New Routes	3,4	1,2,3	1,2,4	1,3,4	2,3,4	1,2,3,4
Total Cost	950	970	1000	940	930	910



Q3) Find the starting solution in the following transportation problem by the (Vogel) method.

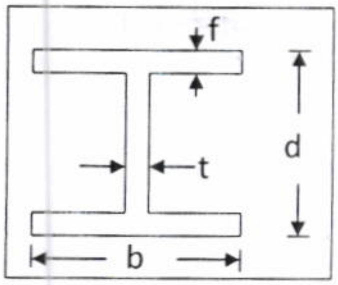
	1	2	3	4	Supply
A	6$	5$	6$	7$	2000
B	8$	7$	9$	10$	3000
C	6$	5$	9$	11$	6000
Demand	2500	3500	1000	2000	

Q4)A) Steel Beam (I) section is shown in fig. below. Use Lagrange Multipliers method to determine the minimum weight (W), consider (d, c, fy and I) are constant. Complete the solution to the end of derivation only.

Objective Function Max. W = (2 b f +(d-2 f) t) c

Subject To $$g_1 = I - \frac{bf}{2}\left[(d-f)^2 + \frac{f^2}{3}\right] - (d-f)^3\frac{f}{12} = 0$$

$$g_2 = \frac{b}{f} - \frac{6000}{\sqrt{fy}}$$



Q4)B) Given the optimization model shown in below, specify the optimum decision variables values, using simulation – uniform grid search . (let n=2)

Obj. function: Min. $C = X_1 + 200X_2 + \frac{1100}{X_1 X_2} + X_3$

Subject to :

$50 \leq X_1 \leq 60$

$0.1 \leq X_2 \leq 0.12$

$10 \leq X_3 \leq 20$

Q5) A company is faced with the problem of assigning six different machines to four different jobs. The costs in hundreds of dollars are estimated as follows.

		Job			
		1	2	3	4
Machine	1	6	5	1	6
	2	2	5	3	7
	3	3	7	2	8
	4	7	7	5	9
	5	12	8	8	6
	6	6	9	5	10

Find the minimum total assignment cost.

Subject: planning and management system.

Division = Building Construction Engineering mangement.

أ.م.د ابراهيم عبد محمد

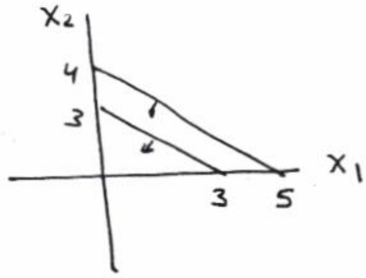
م. ساجد مهدي

حلول اسئلة امتحان النهائي

2013 - 2014 الدور الاول

Q1 // (A)

1- Degeneracy in Graphical is a special Cases occure when redundant Constraints in the Constraints of problem.



Example

$$Max\ Z = X_1 + 2X_2$$

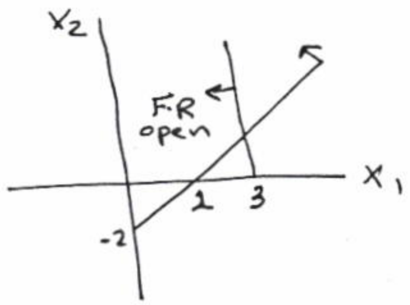
s.to

$$3X_1 + 3X_2 \le 9$$

$$4X_1 + 5X_2 \le 20$$

$$X_1, X_2 \ge 0$$

2. unbounded solution occure when Feasible region open.



Example

$$Max\ Z = X_1 + 4X_2$$

s.to

$$X_1 \le 3$$

$$2X_1 - 2X_2 \le 4$$

$$X_1, X_2 \ge 0$$

Q1// B/ ① Construct dual.

$$\text{Max } Z = 2x_1 + x_2$$

s.to

$3x_1 + 2x_2 \leq 6$ ------ y_1

$x_1 \leq 2$ ------ y_2

$x_1 + x_2 \leq 8$ ------ y_3

$-x_1 + x_2 \geq 4$ ------> $x_1 - x_2 \leq -4$ ------ y_4

$x_1, x_2 \geq 0$

Dual $\text{Min } \omega = 6y_1 + 2y_2 + 8y_3 - 4y_4$

s.to $3y_1 + y_2 + y_3 + y_4 \geq 2$

$2y_1 + y_3 - y_4 \geq 1$

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

B ② $3x_1 + 2x_2 + S_1 = 6$

$x_1 + S_2 = 2$

$x_1 + x_2 + S_3 = 8$

$-x_1 + x_2 - S_4 + R_1 = 4$

$\text{Max } Z = 2x_1 + x_2 - MR_1$

$= 2x_1 + x_2 - M(4 + x_1 - x_2 + S_4)$

$\text{Max } Z + (-2+M)x_1 + (-1-M)x_2 + MS_4 = -4M$

	x_1	x_2 ↓	S_1	S_2	S_3	S_4	R_1	R.H.S	Ration
Z	$-2+M$	$-1-M$	0	0	0	M	0	-4	
S_1 ←	3	2	1	0	0	0	0	6	3
S_2	1	0	0	1	0	0	0	2	—
S_3	1	1	0	0	1	0	0	8	8
R_1	-1	1	0	0	0	-1	1	4	4

∴ pivot eq^n $\boxed{\frac{3}{2} \quad 1 \quad \frac{1}{2} \quad 0 \quad 0 \quad 0 \quad 0 \quad 3}$

Solution Q2)

Stage (1) Year (3)

	Add Routes					
Existing Routes	1,2	1,3	1,4	2,3	2,4	3,4
1	---	---	---	970	1000	940
2	---	970	1000	---	---	930
3	970	---	940	---	930	---
4	1000	940	---	930	---	---
1,2	---	---	---	---	---	910
1,3	---	---	---	---	910	---
1,4	---	---	---	910	---	---
2,3	---	---	910	---	---	---
2,4	---	910	---	---	---	---
3,4	910	---	---	---	---	---

Stage (2) Year (2)

	Add Routes				
Existing Routes	None	1	2	3	4
1	1230 + 940 = 2170	---	990 +910 = 1900	1210+910 =2120	960+910 =1870
2	1000+930 = 1930	990 +910 = 1900	---	980+910 =1890	1100+910 =2010
3	1220+930 = 2150	1210+910 =2120	980+910 =1890	---	950+910 =1860
4	1110+930 = 2040	960+910 =1870	1100+910 =2010	950+910 =1860	---

Stage (3) Year (1)

	Add Routes			
Existing Routes	1	2	3	4
None	1230+1870 = 3100	1000+1890 = 2890	1220+1860 = 3080	1110+1860 = 2970

Year 1 (R2)
Year 2 (R3)
Year 3 (R1 and R4)

Q3 Problem is unbalance

supply − demand = 11000 − 9000 = 2000

add Dummy Column

	1	2	3	4	Dummy	Supply	P1	P2	P3	P4	P5
A	6	5	6 1000	7 1000	0	2000 1000 0	1	1	X	X	X
B	8	7	9	10 1000	0	3000 2000	1	1	1	2	10
C	6 2500	5 3500	9	11	0	6000 2500 0	1	1	1	5	X
Demand	2500 0	3500 0	1000 0	2000 1000 0	2000						

P1	0	0	3	3	X
P2	0	0	X	3	X
P3	2	2	X	1	X
P4	2	X	X	1	X
P5	X	X	X	10	X

total cost = 1000(6) + 1000(7) + 1000(10) + 6(2500)

+ 3500(5)

= 55500 $