Solution QP Code: 64061

Sem-III, Operations Research-I, Set-1, March-April-2019

Q.1a.

i TRUE

ii) TRUE

iii) TRUE

iv) TRUE

v) False: Idle time is the time for which machine remains idle during total elapsed time.

Q.1B.

i) slack variable: If a constraint has ≤ (less than or equal to sign) then in order to make equality. The non-negative quantity (variable) which is added to left hand side is called slack variable.

surplus variable: The non-negative quantity (variable) which is subtracted from the left hand side of the constraint to convert (≥) greater than or equal to type constraint to equation.

ii)

$$\text{New element} = \text{old element} - \frac{\text{Key Row element} \times \text{Key column element}}{\text{Key element}}$$

iii) Number of occupied cells $= m+n-1$

iv) Assigning n jobs to n persons with total cost for performing all jobs is minimum.

v) No passing rule means that passing is not allowed, i.e. the same order of jobs is maintained over each machine.

Q.2 a)

i) 05 marks

- Standard form - (2 ½ marks)
- Canonical form - (2 ½ marks)

ii) 05 marks.

x_1: # of units of refrigerators

x_2: # of units of ranges.

$$\max \quad z = 60x_1 + 40x_2$$

s.t.

$$x_1 \leq 25$$

$$x_2 \leq 35$$

$$2x_1 + x_2 \leq 60$$

$$x_1, x_2 \geq 0$$

Q.2 b

i) - Dual procedure - 2½ marks

- Dual of Dual is primal - 2½ marks

ii)

Standard form

$$\max \quad z = 3x_1 + 2x_2 + 0s_1 + 0s_2 - mA_1$$

s.t.

$$2x_1 + x_2 + s_1 = 12$$

$$3x_1 + 4x_2 - s_2 + A_2 = 12$$

Initial table.

c_B	B	x_B	x_1	x_2	s_1	s_2	A_1	$\frac{x_B}{x_2}$
0	s_1	2	2	(1)	1	0	0	$2/1 = 2$ →
$-m$	A_1	12	3	4	0	-1	1	$12/4 = 3$
	z_j	$-12m$	$-3m$	$4m$	0	m	$-m$	
	$z_j - c_j$	-	$-3m-3$	$-4m-2$ ↑	0	m	0	

Since all $z_j - c_j \leq 0$ current feasible solution is not optimum. the most negative $z_j - c_j$ is $-4m-2$

∴ x_2 variable enters in basis & s_1 leaves the basis.

C_B	B	x_B	3 x_1	2 x_2	0 s_1	0 s_2	$-m$ A_1
2	x_2	1	2	1	1	0	0
$-m$	A_1	4	-5	0	-4	-1	1
	z_j	$4-4m$	$4+5m$	2	$2+4m$	m	$-m$
	z_j-c_j	-	$5m+1$	0	$4m+2$	m	0

since all $z_j - c_j \geq 0$ & artificial variable appears in the basis at positive level hence given LPP does not possess any feasible soln.

Q.2 c. algorithm - 10 marks

Q.3 a) i LPP in mathematical form - 04 marks

ii)

Profit = return - transportation cost

Profit matrix

	D_1	D_2	D_3	D_4
A	6	6	6	4
B	4	2	4	5
C	5	6	7	8

cost matrix = max profit - profit

	D_1	D_2	D_3	D_4
A	2	2	2	4
B	4	6	4	3
C	3	2	1	0

	D_1	D_2	D_3	D_4	Capacity
A	(200) 12	(800) 12	12	14	1000
B	(700) 14	16	14	13	700
C	(0) 13	12	(500) 11	(400) 10	900
Demand	900	800	500	400	

(* soln by using VAM method). Π allocations $= 5 < m+n-1$ hence the solution is non-degenerate.

Q.3b i) Vogel's Approximation method - 04 marks

ii)

	A	B	C	supply
1	(5) 2	7	4	5
2	(2) 3	(6) 3	1	8
3	5	(2) 4	(4) 7	7
4	1	6	2	14
Demand	7	9	18	34

NWCR solution

$x_{11}=5$, $x_{21}=2$, $x_{22}=6$, $x_{32}=3$

$x_{33}=4$, $x_{43}=14$ Total cost = 102

11/5 Least cost method.

$x_{12}=2$, $x_{13}=3$, $x_{23}=8$, $x_{32}=7$

$x_{41}=7$, $x_{43}=7$ Total cost = 83

Q.3 c) MODI method – 10 mark. (step by step procedure)

Q.4 a) i) Travelling Salesman problem ~~not~~ short note – 05 marks

ii)

converting maximization to minimization
(opportunity loss of maximum profit)

biggest element is 14, subtracted ~~from~~ each element in 14.

machine	A	B	C	D	E
1	5	11	10	12	4
2	2	4	6	3	5
3	3	12	5	14	6
4	6	14	4	11	7
5	7	9	8	12	5

opportunity loss table

Machine	A	B	C	D	E
1	9	3	4	2	10
2	12	10	8	11	9
3	11	2	9	0	8
4	8	0	10	3	7
5	7	5	6	2	2

optimum assignment when applying ~~assignment~~ Hungerian method

machine 1 → C, machine 2 → E, machine 3 → D
machine 4 → B machine 5 → A.

Q. 4 b

i) ~~Solve~~ sequencing Algorithm – 04 marks

ii)

optimal sequence : | A | F | D | B | C | E |

Job	machine A In	machine A out	machine B In	machine B out
A	0	1	1	4
F	1	3	4	9
D	3	6	9	17
B	6	10	17	23
C	10	16	23	31
E	16	21	31	32

Total elapsed time = 32 hours.

Q.4 c) step by step procedure of Hungerian method — 10 marks

Q.5a)

i) min $z = x_1 - x_2 + x_3$

s.t
$x_1 - x_3 \geq 4$
$x_1 - x_2 + 2x_3 \geq 3$
$x_1, x_2, x_3 \geq 0$

Dual

max $z' = 4w_1 + 3w_2$
$w_1 + w_2 \leq 1$
$0w_1 - w_2 \leq -1$
$-w_1 + 2w_2 \leq 1$
$w_1, w_2 \geq 0$

Standard form

max $z' = 4w_1 + 3w_2 + 0s_1 - 0s_2 - MA_1$
s.t $w_1 + w_2 + s_1 = 1$
$-w_2 - s_2 + A_1 = 1$
$-w_1 + 2w_2 + s_3 = 1$

Step 1: Enter w_2 & leaves s_3 in initial simplex table

Step 2: Enters w_1 & leaves s_1 in first iteration simplex table

Step 3: All $z_j - c_j \geq 0$ but artificial variable appears in the basis at positive level hence dual has no optimal soln.

Q.5 a) ii) Graphical method procedure — 04 marks

Q.5 b) i) Degenaracy Defn — 2 marks
Solution — 04 marks

ii) - Defn of initial basic feasible soln — 02 marks
- Unbalance transportation problem — 02 marks

Q.5 c i) Assignment problem as LPP — 05 marks

ii) procedure to sequencing n jobs to m machines → 05 marks.