IQRA NATIONAL UNIVERSITY

Computer Science Department

Summer-2020

Subject: Operation Research Time Allowed: 4 hours

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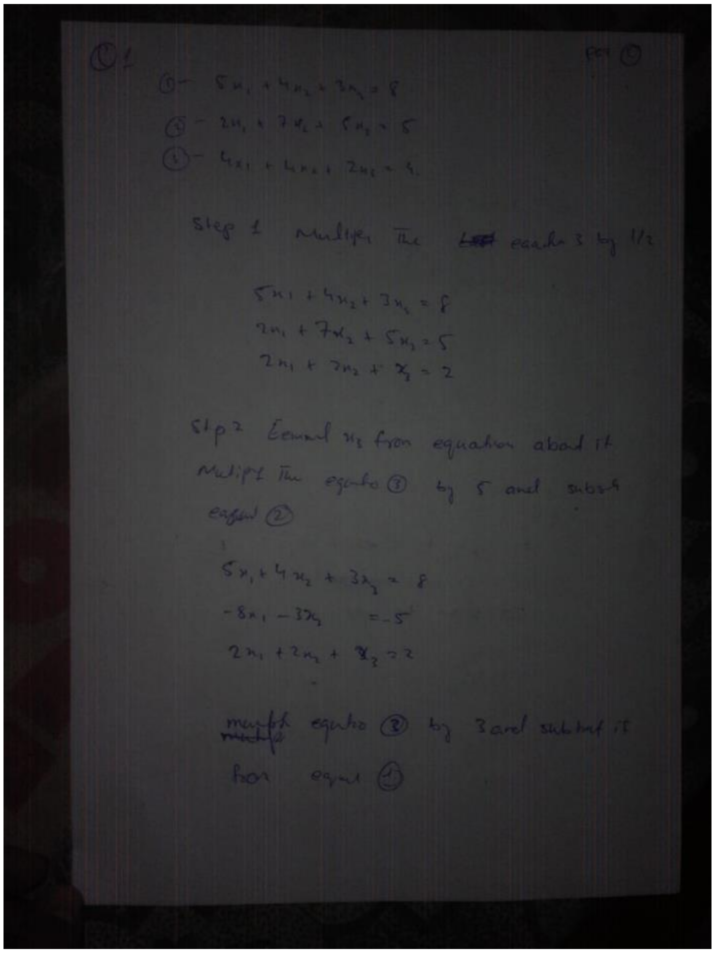
Q 1: Using **simplex** method, solve the following linear programming problem.

$$5x_1 + 4x_2 + 3x_3 = 8$$

$$2x_1 + 7x_2 + 5x_3 = 5$$

$$4x_1 + 4x_2 + 2x_3 = 4.$$

Ans: 

Q1 PCA (C)

(1) – $5x_1 + 4x_2 + 3x_3 = 8$

(2) – $2x_1 + 7x_2 + 5x_3 = 5$

(3) – $4x_1 + 4x_2 + 2x_3 = 4$

Step 1 Multiply The ~~Lst~~ equation 3 by 1/2

$$5x_1 + 4x_2 + 3x_3 = 8$$
$$2x_1 + 7x_2 + 5x_3 = 5$$
$$2x_1 + 2x_2 + x_3 = 2$$

Step 2 Eliminate x_3 from equation about it

Multiply The equation (3) by 5 and subtract equation (2)

$$5x_1 + 4x_2 + 3x_3 = 8$$
$$-8x_1 - 3x_2 = -5$$
$$2x_1 + 2x_2 + x_3 = 2$$

~~multiply~~ multiply equation (3) by 3 and subtract it from equation (1)

Q1 pg(2)

$-x_1 - 2x_1 = 2$

$-8x_1 - 3x_2 = -5$

$2x_1 + 2x_2\ x_3 = 2$

temporarily remove equation (1)

$-x_1 - 2x_2 = 2$

$-8x_1 - x_3 = -5$

$\boxed{\cancel{2x_1 + 2x_2 + x_3 = 2}}$

Step 3

multiply the equation (1) by 1/3
and multiply (2) equation by 2 and
add to eqn (1)

$13/3x_1 = 16/3$

$8/3x_1 + x_2 = 5/3$

$\boxed{\cancel{2x_1 + 2x_2\ x_3 = 2}}$

Q1 pg(3)

Step 4

temporarily remove equation (2)

$13/3x_1 = 16/3$

$\boxed{\cancel{8/3x_1 + x_2 = 5/3}}$

$\boxed{\cancel{2x_1 + 2x_2 + x_3 = 2}}$

multiply eqn (1) by 3/13

$x_1 = 16/13$

$(8/3x_1 + x_2 = 5/3$

$2x_1 + 2x_2 + x_3 = 2$

~~Step~~
Step 6 ~~mult~~ multiply equation (1) by 8/3
and sub from equation (2)

$x_1 = 16/13$

$x_2 = (-21/13)$

$2x_1 + 2x_2 + x_3 = 2$

pg. 5
Q1

multiply the eqn 1 by 2 and sub from eqn 3

$x = (16/13)$
$x_2 = (-21/13)$
$2x_2 + x_3 = (-6/13)$

multiply the equation 2 by 2 and subtract from eqn 3

$$\boxed{\begin{aligned} x_1 &= (16/13) \\ x_2 &= (-21/13) \\ x_3 &= (36/13) \end{aligned}}$$

10 Marks

Q 2: Use **Vogel's approximation** method, to solve the following.

Origin	Destination			Supply
	1	2	3	
1	50	100	100	110
2	200	300	200	160
3	100	200	300	150
Demand	140	200	80	

2

if ~~vara~~

Row 1 $100_{(c_{12})}$ $50_{c_{11}}$ = 50

2 $200_{c_{22}} - 200 (c_{21}) = 6$

3 $200 (c_{32}) - 100 (c_{31}) = 100$

Colom 1 $100_{c_{31}} - 50 c_{11} = 50$

1 $200_{c_{32}} - 100_{c_{12}} = 100$

3 $200_{c_{23}} - 100_{c_{13}} = 100$

min = 100

~~Row~~ seh Row 3

x_{11} = min

min of 150 an 140

Row : $1: 100_{c_{13}} - 100_{11} = 0$

$2: 300_{c_{32}} - 200_{c_{23}} = 100$

$3: 300_{c_{33}} - 200_{c_{32}} = 100$

Col $2: \quad \text{---} \quad = 100$

$3: \quad \text{--} \quad = 100$

$x_{14} = \cancel{100} \; 110$

$x_{22} = 80$

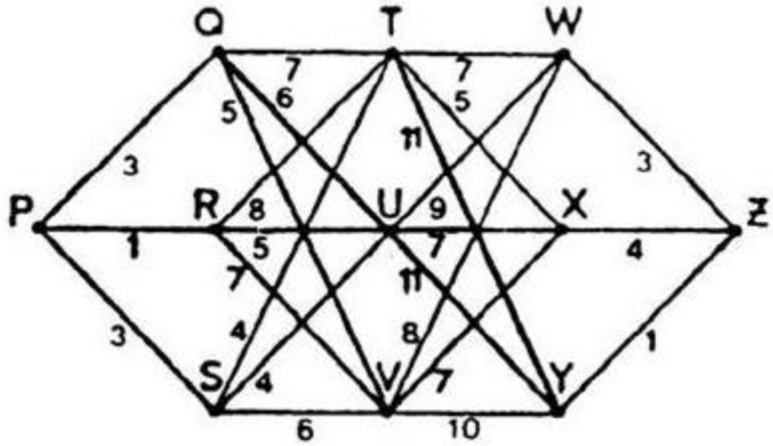
$x_{32} = 80$

$x_{31} = 140$

$x_{22} = 10$

$Z = \$\ 67,000$

Q 3: For the figure given below, use dynamic programming approach to find out the shortest possible path?



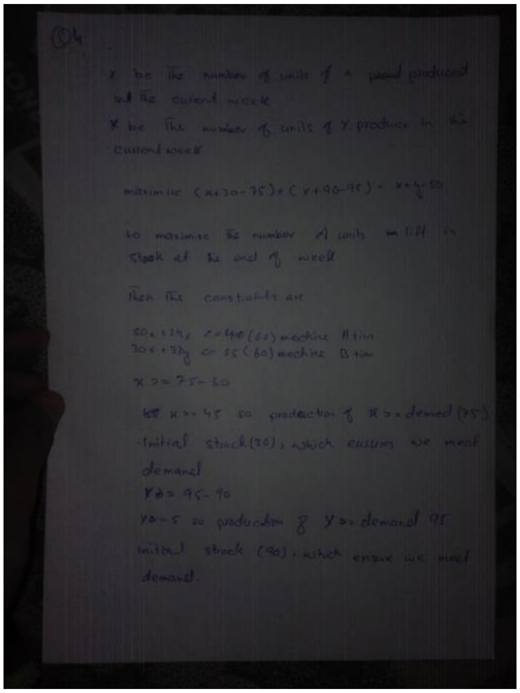
Q 4: A company makes two products (X and Y) using two machines (A and B). Each unit of X that is produced requires 50 minutes processing time on machine A and 30 minutes processing time on machine B. Each unit of Y that is produced requires 24 minutes processing time on machine A and 33 minutes processing time on machine B.

At the start of the current week there are 30 units of X and 90 units of Y in stock. Available processing time on machine A is forecast to be 40 hours and on machine B is forecast to be 35 hours.

The demand for X in the current week is forecast to be 75 units and for Y is forecast to be 95 units. Company policy is to maximize the combined sum of the units of X and the units of Y in stock at the end of the week.

Formulate the problem of deciding how much of each product to make in the current week as a linear program.

10 Marks



Q4

x be the number of units of x ~~good~~ produced in the current week

y be the number of units of y produce in the current week

maximise (x+30-75)+(y+90-95) = x+y-50

to maximise the number of units left in stock at the end of week

Then the constraints are

50x+24y <= 40(60) machine A time
30x+33y <= 35(60) machine B time

x >= 75-30

x >= 45 so production of x >= demand (75) - initial stock (30), which ensures we meet demand

y >= 95-90

y >= 5 so production of y >= demand 95 - initial stock (90), which ensure we meet demand.

Q 5: The ICARE Company has three plants located throughout a state with production capacity 50, 75 and 25 gallons. Each day the firm must furnish its four retail shops R1, R2, R3, & R4 with at least 20, 20, 50, and 60 gallons respectively. The transportation costs (in Rs.) are given below.

Company	Retail				Supply
	R1	R2	R3	R4	
P1	3	5	7	6	50
P2	2	5	8	2	75
P3	3	6	9	2	25
Demand	20	20	50	60	

The economic problem is to distribute the available product to different retail shops in such a way so that the total transportation cost is minimum?

Q 5

Starting from the ~~north~~ north west corner, we allocate min (50, 20) to $P_1 R_1$, 20 unit to cell $P_1 R_1$. The demand for the first column is satisfied. The allocation is ~~a~~ show in the ~~[illegible]~~ # table.

Company	Retail R_1	R_2	R_3	R_4	Sup
P_1	3 (20)	5 (20)	7 (10)	6	50
P_2	2	5	8 (40)	2 (35)	75
P_3	3	6	9	2 (25)	25
Demand	20	20	50	60	

$n = 4$

$m = 3$

number of basic cell $= m+n-1 = 3+4-1 = 6$

The feasible solution is

$x_{11} = 20$ $x_{12} = 5$ $x_{13} = 20$ $x_{23} = 40$ $x_{24} = 35$, $x_{34} = 25$

minimum cost of transportation.

$20\times3 + 20\times5 + 10\times7 + 40\times8 + 35\times2 + 25\times2 = 670$

$\boxed{670}$ Ans