

OPERATIONAL RESEARCH AND OPTIMIZATION (MCSD1133)

Assignment 2

Lecturer Name: Dr. Nor Azizah Ali

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Q1. Find an initial solution to the following transportation problem...

1.a

Northwest-corner method:

	D_1	D_2	D_3	Supply
P_1	50 6	50 18	X 8	100 50 ⁰
P_2	X 17	30 13	30 19	60 30 ⁰
P_3	X 20	X 10	40 24	40 0
Demand	50	80 30 ⁰	70 40 ⁰	

$$\therefore Z = (50 \times 6) + (50 \times 18) + (30 \times 13) + (30 \times 19) + (40 \times 24)$$

$$= 300 + 900 + 390 + 570 + 960$$

$$= 3120$$

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1.b

Lowest cost cell method:

	D ₁	D ₂	D ₃	Supply
P ₁	50 6	X 18	50 8	50 100 0
P ₂	X 17	40 13	20 19	50 20 0
P ₃	X 20	40 10	X 24	40 40 0
Demand	50 0	80 40 0	70 20 0	

$$\begin{aligned} \therefore Z &= (50 \times 6) + (50 \times 8) + (40 \times 13) + (20 \times 19) + \\ &\quad (40 \times 10) \\ &= 300 + 400 + 520 + 380 + 400 \\ &= 2000 \end{aligned}$$

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1.c

Vogel's Approximation Method:

	D ₁	D ₂	D ₃	Supply	Row penalties
P ₁	50 6	X 18	50 8	50 100 0	2 10 10 0
P ₂	X 17	40 13	20 19	50 20 0	4 6 6 6
P ₃	X 20	40 10	X 24	40 40 0	10 (14) 0 0
Demand	50 0	80 40 0	70 20		
column penalties	(11) 0 0	3 3 5	11 11 (11)		

$$\begin{aligned} \therefore Z &= (50 \times 6) + (50 \times 8) + (40 \times 13) + (20 \times 19) + \\ &\quad (40 \times 10) \\ &= 300 + 400 + 520 + 380 + 400 \\ &= 2000 \end{aligned}$$

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1.d

Total cost of each method:

Northwest-corner method = 3120

Lowest cost cell method = 2000

Vogel's approximation method = 2000

Q2. Using the U-V method to optimize the initial basic feasible solution found in question (1). Compute the total cost.

2

From the solution of 1(a) northwest-corner method, we get the following:

Iteration: 1

$v_1 = 6$ $v_2 = 18$ $v_3 = 24$

$u_1 = 0$

$u_2 = -5$

$u_3 = 0$

	50	50	
6	(-)	18	(+)
		30	30
17	(+)	13	(-)
			40
20		10	24

$$p_{ij} = u_i + v_j - c_{ij}$$

$$x_{13} = 0 + 24 - 8 = 16$$

$$x_{21} = -5 + 6 - 17 = -16$$

$$x_{31} = 0 + 6 - 20 = -14$$

$$x_{32} = 0 + 18 - 10 = 8$$

Iteration: 2

$v_1 = 6$ $v_2 = 18$ $v_3 = 8$

$u_1 = 0$

$u_2 = -5$

$u_3 = 16$

	50	20	30
6	(-)	18	(+)
		60	
17		13	19
			40
20	(+)	10	(-)
			24

$$u_i + v_j - c_{ij}$$

$$x_{21} = (-5) + 6 - 17 = -16$$

$$x_{23} = (-5) + 8 - 19 = -16$$

$$x_{31} = 16 + 6 - 20 = 2$$

$$x_{32} = 16 + 18 - 10 = 24$$

Iteration: 3

$$v_1 = 6 \quad v_2 = -6 \quad v_3 = 8$$

$$p_{ij} = u_i + v_j - c_{ij}$$

$$u_1 = 0$$

$$u_2 = 19$$

$$u_3 = 16$$

	50		50
6		18	8
	(-) 17	60	(+) 19
		13	20
20	(+) 10		(-) 24

$$x_{12} = 0 + (-6) - 18 = -24$$

$$x_{21} = 19 + 6 - 17 = 8$$

$$x_{23} = 19 + 8 - 19 = 8$$

$$x_{31} = 16 + 6 - 20 = 2$$

Iteration: 4

$$v_1 = 6 \quad v_2 = 2 \quad v_3 = 8$$

$$u_1 = 0$$

$$u_2 = 11$$

$$u_3 = 8$$

	50		50
6		18	8
		40	20
17		13	19
		40	
20		10	24

$$x_{12} = 0 + 2 - 18 = -16$$

$$x_{21} = 11 + 6 - 17 = 0$$

$$x_{31} = 8 + 6 - 20 = -6$$

$$x_{33} = 8 + 8 - 24 = -8$$

So, the values of x_{ij} is less than or equal to 0. So, we can stop here.

$$Z = (50 \times 6) + (50 \times 8) + (40 \times 13) + (20 \times 19) + (20 \times 18) = 2000$$

From 1(a), we found the value by northwest corner method was 3120.

And after the optimization using U-V method we got the result ~~2000~~ 2000. And this value is also same as the result found from the lowest cost cell method and Vogel's Approximation method.

Q3. Libby Air Filter manufactures room air filter at plants in P1, P2 and P3. These are sent to regional distributors in RD1, RD2 and RD3....

Result from Excel Solver

Based on the given optimal solution, there are leftover air filters from Plant P2, as it has 650 units available but only needs to ship a total of 450 units to the distribution centers. Therefore, the remaining 200 units from Plant P2 cannot be entirely shipped to any distribution center.

Below is amount of air filters for Libby Air Filter to ship from each plant to each regional distribution center to achieve optimal solution with optimum transportation costs of \$14700.

Q4. In the MDS program at top university in Chicago, students bid for electives on the third year of their program....

Student	Electives				Elective	Elective
	AA	BI	OM	FA	e	e
Ally	1	0	0	1	2	2
Garry	0	0	1	1	2	2
Franky	1	1	0	0	2	2
Ellis	0	1	0	1	2	2
Susan	0	1	1	0	2	2
Edward	1	1	0	0	2	2
Dave	1	0	1	0	2	2
Terry	0	1	1	0	2	2
James	0	0	1	1	2	2
Winnie	1	0	0	1	2	2
Limit per Class	5	5	5	5		
Student per Cl	5	5	5	5		
Total Bid	705					

Output shows:			
Students for each electives			
AA	BI	OM	FA
Ally	Franky	Garry	Ally
Franky	Ellis	Susan	Garry
Edward	Susan	Dave	Ellis
Dave	Edward	Terry	James
Winnie	Terry	James	Winnie

Output in Spreadsheet:

- **Student Bids:** The bid values each student places on each elective.
- **Elective Assignment:** The binary matrix indicating the assigned electives for each student.
- **Total Bid:** The sum of the bid values for the assigned electives, which is maximized to 705.

Q5. The Dorwyn Company has two new products (special kinds of doors and windows) that will compete with the two new products for the Wyndor Glass Co....

Result from Excel Solver

The company should produce approximately **1.15** units of doors (D) and **1.5** units of windows (W) per week to maximize profit. Under these conditions, the maximum profit is estimated to be approximately **\$7.58** (in hundreds of dollars, thus \$758).

This product mix satisfies the constraints set forth:

The first constraint, $D + 3W \leq 18$, is met with a total of approximately **5.65**.

The second constraint, $5D + 2W \leq 14$, is satisfied with a total of approximately **8.77**.

Q6. Basyir has inherited RM1000. He has to decide how to invest the money for one year...

Summary of Decisions:

- **Maximax:** Growth Stock
- **Maximin:** Certificate of Deposit (C/D)
- **Minimax Regret:** Junk Bond
- **Hurwicz:** Growth Stock
- **Equal Likelihood:** Gold

Final Recommendation:

Growth Stock stands out as a strong recommendation, particularly under the Maximax and Hurwicz criteria.