Vogel Approximation Method.

	d_1	d_2	d_3	d_4	Supply	P_1	P_2	P_3	P_4	P_5
O_1	11 (200)	13 (50)	17	14	~~250~~ ~~50~~ 0	2	1	-		-
O_2	16	18 (175)	14	10 (125)	~~300~~ ~~125~~ 0	4	4	4	4	-
O_3	21	24	13 (275)	10 (125)	~~400~~ ~~125~~ 0	3	3	3	3	3
demand	~~200~~	~~225~~	~~275~~	~~250~~						
	0	~~175~~	0	~~125~~						
		0		0						

	d_1	d_2	d_3	d_4
P_1	5	5	1	0
P_2	-	5	1	0
P_3	-	6	1	0
P_4	-	-	1	0
P_5	-	-	13	10

$11 \times 200 + 13 \times 50 +$

$18 \times 175 + 10 \times 125 +$

$13 \times 275 + 10 \times 125 +$

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7 Matrix Minima | Low Cost

	D_1	D_2	D_3	D_4	supply
O_1	~~6~~	~~4~~	~~1^{14}~~	~~5~~	~~14~~ 0
O_2	8^{6}	9^{9}	2^{1}	7	~~16~~ ~~15~~ ~~9~~ 0.
O_3	~~4~~	~~3^{1}~~	~~6~~	2^{4}	~~5~~ ~~1~~ 0
demand	~~6~~	~~10~~	~~15~~	~~4~~	35
	0	~~9~~	~~1~~	0	
		0	0		

$1 \times 14 + 8 \times 6 + 9 \times 9 + 2 \times 1 + 3 \times 1 + 2 \times 4$

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North West Corner Rule...

	d_1	d_2	d_3	Supply
O_1	2^{5}	7	4	~~8~~ 0
O_2	3^{2}	3^{6}	1	8 ~~6~~ 0
O_3	5	4^{3}	7^{4}	~~7~~ ~~4~~ 0
O_4	1	6	2^{14}	~~14~~ 0
demand	~~7~~	~~9~~	~~18~~	34
	~~2~~	~~3~~	~~14~~	balanced
	0	0	0	

$2\times5 + 3\times2 + 3\times6 + 4\times3 + 7\times4 + 2\times14$

Dual form

Q. Max $z = x_1 + 2x_2 + x_3$

subject to $2x_1 + x_2 - x_3 \leq 2$

$-2x_1 + x_2 - 5x_3 \geq -6$

$4x_1 + x_2 + x_3 \leq 6$

$x_1, x_2, x_3 \geq 0$

→ max $z = x_1 + 2x_2 + x_3$

subject to $2x_1 + x_2 - x_3 \leq 2$

$2x_1 - x_2 + 5x_3 \leq 6$

$4x_1 + x_2 + x_3 \leq 6$

Dual form

min $z = 2w_1 + 6w_2 + 6w_3$

subject to $\cancel{2x_1 + x_2 - x_3 \geq 1}$

$2w_1 + 2w_2 + 4w_3 \geq 1$

$w_1 - w_2 + w_3 \geq 2$

$-w_1 + 5w_2 + w_3 \geq 1$

$w_1\ w_2\ w_3 \geq 0$

Assignment Problem (RC)

	J_1	J_2	J_3	J_4
1	12	30	21	15
2	18	33	9	31
3	44	25	24	21
4	23	30	28	14

=>

0	18	9	3
9	24	0	22
23	4	3	0
9	16	14	0

⇓

$\boxed{0}$	14	9	3
9	20	$\boxed{0}$	22
23	$\boxed{0}$	3	0
9	12	14	$\boxed{0}$

12 + 9 + 25 + 14

Simplex Method

max $z = 40x_1 + 30x_2$

subject to $x_1 + x_2 \le 12$

$2x_1 + x_2 \le 16$

$x_1 \geq 0 \quad x_2 \geq 0$

x_1	x_2	s_1	s_2	RHS	
1	1	1	0	12	12
$\boxed{2}$	1	0	1	16	8
-40	-30	0	0	0	

$r_2/2$

1	1	1	0	12
1	1/2	0	1/2	8
-40	-30	0	0	0

$-30 + \frac{40}{2}$

$r_1 - r_2 \qquad r_3 + 40r_2$

0	$\boxed{1/2}$	1	-1/2	4
1	1/2	0	1/2	8
0	-10	0	20	320

$r_1 \times 2$

0	1	2	-1	8
1	1/2	0	1/2	8
0	-10	0	20	320

$r_2 - \frac{1}{2}r_1 \qquad r_3 + 10r_1$

0	1	2	-1	8
1	0	-1	1	4
0	0	20	10	$\boxed{400}$

$x_1 = 4 \quad x_2 = 8 \quad z = 400.$