

## Output Software LINDO 6.1

### CRS Primal

Max  $100y_1 + 94y_2 + 8.6y_3$

Subject to

$$100x_1 + 100x_2 + 100x_3 + 100x_4 + 100x_5 + 100x_6 + 50x_7 + 75x_8 = 1$$

$$100y_1 + 94y_2 + 8.6y_3 - 100x_1 - 100x_2 - 100x_3 - 100x_4 - 100x_5 - 100x_6 - 50x_7 - 75x_8 \leq 0$$

$$65y_1 + 95y_2 + 6.9y_3 - 40x_1 - 75x_2 - 75x_3 - 75x_4 - 100x_5 - 75x_6 - 50x_7 - 75x_8 \leq 0$$

$$21y_1 + 90y_2 + 0y_3 - 75x_1 - 100x_2 - 100x_3 - 100x_4 - 100x_5 - 100x_6 - 50x_7 - 75x_8 \leq 0$$

$$y_1 \geq 0$$

$$y_2 \geq 0$$

$$y_3 \geq 0$$

$$x_1 \geq 0$$

$$x_2 \geq 0$$

$$x_3 \geq 0$$

$$x_4 \geq 0$$

$$x_5 \geq 0$$

$$x_6 \geq 0$$

$$x_7 \geq 0$$

$$x_8 \geq 0$$

end

### DMU 1

LP OPTIMUM FOUND AT STEP 1

OBJECTIVE FUNCTION VALUE

1) 1.000000

VARIABLE	VALUE	REDUCED COST
Y1	0.000295	0.000000
Y2	0.010324	0.000000
Y3	0.000000	0.000000
X1	0.000000	0.000000
X2	0.000000	0.000000
X3	0.000000	0.000000
X4	0.000000	0.000000
X5	0.000000	0.000000
X6	0.000000	0.000000
X7	0.000000	0.000000
X8	0.013333	0.000000

ROW	SLACK OR SURPLUS	DUAL PRICES
2)	0.000000	1.000000
3)	0.000000	1.000000
4)	0.000000	0.000000
5)	0.064602	0.000000
6)	0.000295	0.000000
7)	0.010324	0.000000
8)	0.000000	0.000000
9)	0.000000	0.000000
10)	0.000000	0.000000
11)	0.000000	0.000000
12)	0.000000	0.000000
13)	0.000000	0.000000
14)	0.000000	0.000000
15)	0.000000	0.000000
16)	0.013333	0.000000

**DMU 2**

Max  $65y_1 + 95y_2 + 6.9y_3$

Subject to

$$40x_1 + 75x_2 + 75x_3 + 75x_4 + 100x_5 + 75x_6 + 50x_7 + 75x_8 = 1$$

$$100y_1 + 94y_2 + 8.6y_3 - 100x_1 - 100x_2 - 100x_3 - 100x_4 - 100x_5 - 100x_6 - 50x_7 - 75x_8 \leq 0$$

$$65y_1 + 95y_2 + 6.9y_3 - 40x_1 - 75x_2 - 75x_3 - 75x_4 - 100x_5 - 75x_6 - 50x_7 - 75x_8 \leq 0$$

$$21y_1 + 90y_2 + 0y_3 - 75x_1 - 100x_2 - 100x_3 - 100x_4 - 100x_5 - 100x_6 - 50x_7 - 75x_8 \leq 0$$

$$y_1 \geq 0$$

$$y_2 \geq 0$$

$$y_3 \geq 0$$

$$x_1 \geq 0$$

$$x_2 \geq 0$$

$$x_3 \geq 0$$

$$x_4 \geq 0$$

$$x_5 \geq 0$$

$$x_6 \geq 0$$

$$x_7 \geq 0$$

$$x_8 \geq 0$$

end  
 LP OPTIMUM FOUND AT STEP 0

OBJECTIVE FUNCTION VALUE

1) 1.000000

VARIABLE	VALUE	REDUCED COST
Y1	0.000000	0.000000
Y2	0.010526	0.000000
Y3	0.000000	0.000000
X1	0.000000	0.000000
X2	0.000000	0.000000
X3	0.000000	0.000000
X4	0.000000	0.000000
X5	0.000000	0.000000
X6	0.000000	0.000000
X7	0.000000	0.000000
X8	0.013333	0.000000

ROW	SLACK OR SURPLUS	DUAL PRICES
2)	0.000000	1.000000
3)	0.010526	0.000000
4)	0.000000	1.000000
5)	0.052632	0.000000
6)	0.000000	0.000000
7)	0.010526	0.000000
8)	0.000000	0.000000
9)	0.000000	0.000000
10)	0.000000	0.000000
11)	0.000000	0.000000
12)	0.000000	0.000000
13)	0.000000	0.000000
14)	0.000000	0.000000
15)	0.000000	0.000000
16)	0.013333	0.000000

**DMU 3**

Max  $21y_1 + 90y_2 + 0y_3$

Subject to

$$75x_1 + 100x_2 + 100x_3 + 100x_4 + 100x_5 + 100x_6 + 50x_7 + 75x_8 = 1$$

$$100y_1 + 94y_2 + 8.6y_3 - 100x_1 - 100x_2 - 100x_3 - 100x_4 - 100x_5 - 100x_6 - 50x_7 - 75x_8 \leq 0$$

$$65y_1 + 95y_2 + 6.9y_3 - 40x_1 - 75x_2 - 75x_3 - 75x_4 - 100x_5 - 75x_6 - 50x_7 - 75x_8 \leq 0$$

$$21y_1 + 90y_2 + 0y_3 - 75x_1 - 100x_2 - 100x_3 - 100x_4 - 100x_5 - 100x_6 - 50x_7 - 75x_8 \leq 0$$

$$y_1 \geq 0$$

$$y_2 \geq 0$$

$$y_3 \geq 0$$

$$x_1 \geq 0$$

$$x_2 \geq 0$$

$$x_3 \geq 0$$

$$x_4 \geq 0$$

$$x_5 \geq 0$$

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x6 >= 0
x7 >= 0
x8 >= 0
end
LP OPTIMUM FOUND AT STEP      0

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OBJECTIVE FUNCTION VALUE

1)           0.9473684

VARIABLE	VALUE	REDUCED COST
Y1	0.000000	40.578949
Y2	0.010526	0.000000
Y3	0.000000	6.536842
X1	0.000000	33.157894
X2	0.000000	23.684210
X3	0.000000	23.684210
X4	0.000000	23.684210
X5	0.000000	0.000000
X6	0.000000	23.684210
X7	0.000000	0.000000
X8	0.013333	0.000000

ROW	SLACK OR SURPLUS	DUAL PRICES
2)	0.000000	0.947368
3)	0.010526	0.000000
4)	0.000000	0.947368
5)	0.052632	0.000000
6)	0.000000	0.000000
7)	0.010526	0.000000
8)	0.000000	0.000000
9)	0.000000	0.000000
10)	0.000000	0.000000
11)	0.000000	0.000000
12)	0.000000	0.000000
13)	0.000000	0.000000
14)	0.000000	0.000000
15)	0.000000	0.000000
16)	0.013333	0.000000

**CRS Dual**

**DMU 1**

Min z - 0.0001O1 - 0.0001O2 - 0.0001O3 - 0.0001I1 - 0.0001I2 -  
0.0001I3 - 0.0001I4 - 0.0001I5 - 0.0001I6 - 0.0001I7 - 0.0001I8

Subject to

- 100P1 + 65P2 + 21P3 - O1 = 100
- 94P1 + 95P2 + 90P3 - O2 = 94
- 8.6P1 + 6.9P2 + 0P3 - O3 = 8.6
- 100P1 + 40P2 + 75P3 - 100Z + I1 = 0
- 100P1 + 75P2 + 100P3 - 100Z + I2 = 0
- 100P1 + 75P2 + 100P3 - 100Z + I3 = 0
- 100P1 + 75P2 + 100P3 - 100Z + I4 = 0
- 100P1 + 100P2 + 100P3 - 100Z + I5 = 0
- 100P1 + 75P2 + 100P3 - 100Z + I6 = 0
- 50P1 + 50P2 + 50P3 - 50Z + I7 = 0

$75P1 + 75P2 + 75P3 - 75Z + I8 = 0$   
 P1  $\geq 0$   
 P2  $\geq 0$   
 P3  $\geq 0$   
 O1  $\geq 0$   
 O2  $\geq 0$   
 O3  $\geq 0$   
 I1  $\geq 0$   
 I2  $\geq 0$   
 I3  $\geq 0$   
 I4  $\geq 0$   
 I5  $\geq 0$   
 I6  $\geq 0$   
 I7  $\geq 0$   
 I8  $\geq 0$   
 end  
 Free Z

LP OPTIMUM FOUND AT STEP 11

OBJECTIVE FUNCTION VALUE

1) 1.000000

VARIABLE	VALUE	REDUCED COST
Z	1.000000	0.000000
O1	0.000000	0.000000
O2	0.000000	0.000000
O3	0.000000	0.113923
I1	0.000000	0.000000
I2	0.000000	0.000000
I3	0.000000	0.000000
I4	0.000000	0.000000
I5	0.000000	0.000000
I6	0.000000	0.000000
I7	0.000000	0.000000
I8	0.000000	0.012367
P1	1.000000	0.000000
P2	0.000000	0.181240
P3	0.000000	0.986400

ROW	SLACK OR SURPLUS	DUAL PRICES
2)	0.000000	-0.000100
3)	0.000000	-0.000100
4)	0.000000	-0.114023
5)	0.000000	0.000100
6)	0.000000	0.000100
7)	0.000000	0.000100
8)	0.000000	0.000100
9)	0.000000	0.000100
10)	0.000000	0.000100
11)	0.000000	0.000100
12)	0.000000	0.012467
13)	1.000000	0.000000
14)	0.000000	0.000000
15)	0.000000	0.000000
16)	0.000000	0.000000
17)	0.000000	0.000000

18)	0.000000	0.000000
19)	0.000000	0.000000
20)	0.000000	0.000000
21)	0.000000	0.000000
22)	0.000000	0.000000
23)	0.000000	0.000000
24)	0.000000	0.000000
25)	0.000000	0.000000
26)	0.000000	0.000000

## DMU 2

Global optimal solution found.

Min Z - 0.0001O1 - 0.0001O2 - 0.0001O3 - 0.0001I1 - 0.0001I2 -  
0.0001I3 - 0.0001I4 - 0.0001I5 - 0.0001I6 - 0.0001I7 - 0.0001I8

Subject to

100P1 + 65P2 + 21P3 - O1 = 65  
 94P1 + 95P2 + 90P3 - O2 = 95  
 8.6P1 + 6.9P2 + 0P3 - O3 = 6.9  
 100P1 + 40P2 + 75P3 - 40Z + I1 = 0  
 100P1 + 75P2 + 100P3 - 75Z + I2 = 0  
 100P1 + 75P2 + 100P3 - 75Z + I3 = 0  
 100P1 + 75P2 + 100P3 - 75Z + I4 = 0  
 100P1 + 100P2 + 100P3 - 100Z + I5 = 0  
 100P1 + 75P2 + 100P3 - 75Z + I6 = 0  
 50P1 + 50P2 + 50P3 - 50Z + I7 = 0  
 75P1 + 75P2 + 75P3 - 75Z + I8 = 0

P1 >= 0  
 P2 >= 0  
 P3 >= 0  
 O1 >= 0  
 O2 >= 0  
 O3 >= 0  
 I1 >= 0  
 I2 >= 0  
 I3 >= 0  
 I4 >= 0  
 I5 >= 0  
 I6 >= 0  
 I7 >= 0  
 I8 >= 0

end

Free Z

LP OPTIMUM FOUND AT STEP 2

OBJECTIVE FUNCTION VALUE

1) 1.000000

VARIABLE	VALUE	REDUCED COST
Z	1.000000	0.000000
O1	0.000000	0.000000
O2	0.000000	0.009417
O3	0.000000	0.012851
I1	0.000000	0.000000

I2	0.000000	0.000000
I3	0.000000	0.000000
I4	0.000000	0.000000
I5	0.000000	0.000000
I6	0.000000	0.000000
I7	0.000000	0.000000
I8	0.000000	0.012580
P1	0.000000	0.000000
P2	1.000000	0.000000
P3	0.000000	0.154850

ROW	SLACK OR SURPLUS	DUAL PRICES
2)	0.000000	-0.000100
3)	0.000000	-0.009517
4)	0.000000	-0.012951
5)	0.000000	0.000100
6)	0.000000	0.000100
7)	0.000000	0.000100
8)	0.000000	0.000100
9)	0.000000	0.000100
10)	0.000000	0.000100
11)	0.000000	0.000100
12)	0.000000	0.012680
13)	0.000000	0.000000
14)	1.000000	0.000000
15)	0.000000	0.000000
16)	0.000000	0.000000
17)	0.000000	0.000000
18)	0.000000	0.000000
19)	0.000000	0.000000
20)	0.000000	0.000000
21)	0.000000	0.000000
22)	0.000000	0.000000
23)	0.000000	0.000000
24)	0.000000	0.000000
25)	0.000000	0.000000
26)	0.000000	0.000000

### DMU 3

Global optimal solution found.  
 LP OPTIMUM FOUND AT STEP 1

OBJECTIVE FUNCTION VALUE

1) 0.9298674

VARIABLE	VALUE	REDUCED COST
Z	0.947368	0.000000
O1	40.578949	0.000000
O2	0.000000	0.010209
O3	6.536842	0.000000
I1	33.157894	0.000000
I2	23.684210	0.000000
I3	23.684210	0.000000
I4	23.684210	0.000000

I5	0.000000	0.000000
I6	23.684210	0.000000
I7	0.000000	0.000000
I8	0.000000	0.012400
P1	0.000000	0.022639
P2	0.947368	0.000000
P3	0.000000	0.070133

ROW	SLACK OR SURPLUS	DUAL PRICES
2)	0.000000	-0.000100
3)	0.000000	-0.010309
4)	0.000000	-0.000100
5)	0.000000	0.000100
6)	0.000000	0.000100
7)	0.000000	0.000100
8)	0.000000	0.000100
9)	0.000000	0.000100
10)	0.000000	0.000100
11)	0.000000	0.000100
12)	0.000000	0.012500
13)	0.000000	0.000000
14)	0.947368	0.000000
15)	0.000000	0.000000
16)	40.578949	0.000000
17)	0.000000	0.000000
18)	6.536842	0.000000
19)	33.157894	0.000000
20)	23.684210	0.000000
21)	23.684210	0.000000
22)	23.684210	0.000000
23)	0.000000	0.000000
24)	23.684210	0.000000
25)	0.000000	0.000000
26)	0.000000	0.000000

## VRS

### DMU 1

Min Z - 0.0001O1 - 0.0001O2 - 0.0001O3 - 0.0001I1 - 0.0001I2 -  
0.0001I3 - 0.0001I4 - 0.0001I5 - 0.0001I6 - 0.0001I7 - 0.0001I8

Subject to

$$100P1 + 65P2 + 21P3 - O1 = 100$$

$$94P1 + 95P2 + 90P3 - O2 = 94$$

$$8.6P1 + 6.9P2 + 0P3 - O3 = 8.6$$

$$100P1 + 40P2 + 75P3 - 100Z + I1 = 0$$

$$100P1 + 75P2 + 100P3 - 100Z + I2 = 0$$

$$100P1 + 75P2 + 100P3 - 100Z + I3 = 0$$

$$100P1 + 75P2 + 100P3 - 100Z + I4 = 0$$

$$100P1 + 100P2 + 100P3 - 100Z + I5 = 0$$

$$100P1 + 75P2 + 100P3 - 100Z + I6 = 0$$

$$50P1 + 50P2 + 50P3 - 50Z + I7 = 0$$

$$75P1 + 75P2 + 75P3 - 75Z + I8 = 0$$

$$P1 + P2 + P3 = 1$$

$$P1 \geq 0$$

$$P2 \geq 0$$

$$P3 \geq 0$$



O1 >= 0  
 O2 >= 0  
 O3 >= 0  
 I1 >= 0  
 I2 >= 0  
 I3 >= 0  
 I4 >= 0  
 I5 >= 0  
 I6 >= 0  
 I7 >= 0  
 I8 >= 0  
 end  
 Free Z

LP OPTIMUM FOUND AT STEP 11

OBJECTIVE FUNCTION VALUE

1) 1.000000

VARIABLE	VALUE	REDUCED COST
Z	1.000000	0.000000
O1	0.000000	0.000000
O2	0.000000	0.000000
O3	0.000000	0.007312
I1	0.000000	0.000000
I2	0.000000	0.000000
I3	0.000000	0.000000
I4	0.000000	0.000000
I5	0.000000	0.000000
I6	0.000000	0.000000
I7	0.000000	0.000000
I8	0.000000	0.012367
P1	1.000000	0.000000
P2	0.000000	0.000000
P3	0.000000	0.069541

ROW	SLACK OR SURPLUS	DUAL PRICES
2)	0.000000	-0.000100
3)	0.000000	-0.000100
4)	0.000000	-0.007412
5)	0.000000	0.000100
6)	0.000000	0.000100
7)	0.000000	0.000100
8)	0.000000	0.000100
9)	0.000000	0.000100
10)	0.000000	0.000100
11)	0.000000	0.000100
12)	0.000000	0.012467
13)	0.000000	-0.916859
14)	1.000000	0.000000
15)	0.000000	0.000000
16)	0.000000	0.000000
17)	0.000000	0.000000
18)	0.000000	0.000000
19)	0.000000	0.000000
20)	0.000000	0.000000
21)	0.000000	0.000000

22)	0.000000	0.000000
23)	0.000000	0.000000
24)	0.000000	0.000000
25)	0.000000	0.000000
26)	0.000000	0.000000
27)	0.000000	0.000000

## DMU 2

Min Z - 0.0001O1 - 0.0001O2 - 0.0001O3 - 0.0001I1 - 0.0001I2 -  
0.0001I3 - 0.0001I4 - 0.0001I5 - 0.0001I6 - 0.0001I7 - 0.0001I8

Subject to

100P1 + 65P2 + 21P3 - O1 = 65  
 94P1 + 95P2 + 90P3 - O2 = 95  
 8.6P1 + 6.9P2 + 0P3 - O3 = 6.9  
 100P1 + 40P2 + 75P3 - 40Z + I1 = 0  
 100P1 + 75P2 + 100P3 - 75Z + I2 = 0  
 100P1 + 75P2 + 100P3 - 75Z + I3 = 0  
 100P1 + 75P2 + 100P3 - 75Z + I4 = 0  
 100P1 + 100P2 + 100P3 - 100Z + I5 = 0  
 100P1 + 75P2 + 100P3 - 75Z + I6 = 0  
 50P1 + 50P2 + 50P3 - 50Z + I7 = 0  
 75P1 + 75P2 + 75P3 - 75Z + I8 = 0  
 P1 + P2 + P3 = 1  
 P1 >= 0  
 P2 >= 0  
 P3 >= 0  
 O1 >= 0  
 O2 >= 0  
 O3 >= 0  
 I1 >= 0  
 I2 >= 0  
 I3 >= 0  
 I4 >= 0  
 I5 >= 0  
 I6 >= 0  
 I7 >= 0  
 I8 >= 0  
 end  
 Free Z

LP OPTIMUM FOUND AT STEP 0

OBJECTIVE FUNCTION VALUE

1) 1.000000

VARIABLE	VALUE	REDUCED COST
Z	1.000000	0.000000
O1	0.000000	0.000000
O2	0.000000	0.000000
O3	0.000000	0.007312
I1	0.000000	0.000000
I2	0.000000	0.000000
I3	0.000000	0.000000
I4	0.000000	0.000000
I5	0.000000	0.000000

I6	0.000000	0.000000
I7	0.000000	0.000000
I8	0.000000	0.012580
P1	0.000000	0.000000
P2	1.000000	0.000000
P3	0.000000	0.069541

ROW	SLACK OR SURPLUS	DUAL PRICES
2)	0.000000	-0.000100
3)	0.000000	-0.000100
4)	0.000000	-0.007412
5)	0.000000	0.000100
6)	0.000000	0.000100
7)	0.000000	0.000100
8)	0.000000	0.000100
9)	0.000000	0.000100
10)	0.000000	0.000100
11)	0.000000	0.000100
12)	0.000000	0.012680
13)	0.000000	-0.932859
14)	0.000000	0.000000
15)	1.000000	0.000000
16)	0.000000	0.000000
17)	0.000000	0.000000
18)	0.000000	0.000000
19)	0.000000	0.000000
20)	0.000000	0.000000
21)	0.000000	0.000000
22)	0.000000	0.000000
23)	0.000000	0.000000
24)	0.000000	0.000000
25)	0.000000	0.000000
26)	0.000000	0.000000
27)	0.000000	0.000000

### **DMU 3**

Global optimal solution found.

Min Z - 0.0001O1 - 0.0001O2 - 0.0001O3 - 0.0001I1 - 0.0001I2 -  
0.0001I3 - 0.0001I4 - 0.0001I5 - 0.0001I6 - 0.0001I7 - 0.0001I8

Subject to

$$100P1 + 65P2 + 21P3 - O1 = 21$$

$$94P1 + 95P2 + 90P3 - O2 = 90$$

$$8.6P1 + 6.9P2 + 0P3 - O3 = 0$$

$$100P1 + 40P2 + 75P3 - 75Z + I1 = 0$$

$$100P1 + 75P2 + 100P3 - 100Z + I2 = 0$$

$$100P1 + 75P2 + 100P3 - 100Z + I3 = 0$$

$$100P1 + 75P2 + 100P3 - 100Z + I4 = 0$$

$$100P1 + 100P2 + 100P3 - 100Z + I5 = 0$$

$$100P1 + 75P2 + 100P3 - 100Z + I6 = 0$$

$$50P1 + 50P2 + 50P3 - 50Z + I7 = 0$$

$$75P1 + 75P2 + 75P3 - 75Z + I8 = 0$$

$$P1 + P2 + P3 = 1$$

$$P1 \geq 0$$

$$P2 \geq 0$$

$$P3 \geq 0$$

O1 >= 0  
 O2 >= 0  
 O3 >= 0  
 I1 >= 0  
 I2 >= 0  
 I3 >= 0  
 I4 >= 0  
 I5 >= 0  
 I6 >= 0  
 I7 >= 0  
 I8 >= 0  
 end  
 Free Z

LP OPTIMUM FOUND AT STEP 1

OBJECTIVE FUNCTION VALUE

1) 0.9809100

VARIABLE	VALUE	REDUCED COST
Z	1.000000	0.000000
O1	44.000000	0.000000
O2	5.000000	0.000000
O3	6.900000	0.000000
I1	35.000000	0.000000
I2	25.000000	0.000000
I3	25.000000	0.000000
I4	25.000000	0.000000
I5	0.000000	0.000000
I6	25.000000	0.000000
I7	0.000000	0.000000
I8	0.000000	0.012400
P1	0.000000	0.012430
P2	1.000000	0.000000
P3	0.000000	0.019090

ROW	SLACK OR SURPLUS	DUAL PRICES
2)	0.000000	-0.000100
3)	0.000000	-0.000100
4)	0.000000	-0.000100
5)	0.000000	0.000100
6)	0.000000	0.000100
7)	0.000000	0.000100
8)	0.000000	0.000100
9)	0.000000	0.000100
10)	0.000000	0.000100
11)	0.000000	0.000100
12)	0.000000	0.012500
13)	0.000000	-0.969810
14)	0.000000	0.000000
15)	1.000000	0.000000
16)	0.000000	0.000000
17)	44.000000	0.000000
18)	5.000000	0.000000
19)	6.900000	0.000000
20)	35.000000	0.000000
21)	25.000000	0.000000

22)	25.000000	0.000000
23)	25.000000	0.000000
24)	0.000000	0.000000
25)	25.000000	0.000000
26)	0.000000	0.000000
27)	0.000000	0.000000

**Peer Group**

**Proximity Matrix**

Case	Squared Euclidean Distance		
	1	2	3
1	.000	7328.890	6955.960
2	7328.890	.000	5733.610
3	6955.960	5733.610	.000

This is a dissimilarity matrix

