

Optimization_Method_HW2_Report

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Question 1:

a) 3-days: MTW, TWR, WRF, RFS;

4-days: MTRF, MTFS, TWFS;

b) Decision Variables:

X11: # of high skill agents working on MTW

X12: # of high skill agents working on TWR

X13: # of high skill agents working on WRF

X14: # of high skill agents working on RFS

X21: # of high skill agents working on MTRF

X22: # of high skill agents working on MTFS

X23: # of high skill agents working on TWFS

Y11: # of low skill agents working on MTW

Y12: # of low skill agents working on TWR

Y13: # of low skill agents working on WRF

Y14: # of low skill agents working on RFS

Y21: # of low skill agents working on MTRF

Y22: # of low skill agents working on MTFS

Y23: # of low skill agents working on TWFS

Objective Function:

Min

$$(X11+X12+X13+X14)*450+(X21+X22+X23)*540+(Y11+Y12+Y13+Y14)*300+(Y21+Y22+Y23)*360$$

Constraints:

$$M: X11+X21+X22 \geq 60$$

$$X11+X21+X22+Y11+Y21+Y22 \geq 100$$

$$T: X11+X12+X21+X22+X23 \geq 90$$

$$X11+X12+X21+X22+X23+Y11+Y12+Y21+Y22+Y23 \geq 120$$

$$W: X11+X12+X13+X23 \geq 40$$

$$X11+X12+X13+X23+Y11+Y12+Y13+Y23 \geq 90$$

$$R: X12+X13+X14+X21 \geq 30$$

$$X12+X13+X14+X21+Y12+Y13+Y14+Y21 \geq 140$$

$$F: X13+X14+X21+X22+X23 \geq 40$$

$$X13+X14+X21+X22+X23+Y13+Y14+Y21+Y22+Y23 \geq 150$$

$$S: X14+X22+X23 \geq 80$$

$$X14+X22+X23+Y14+Y22+Y23 \geq 120$$

$$X11, X12, X13, X14, X21, X22, X23, Y11, Y12, Y13, Y14, Y21, Y22, Y23 > 0$$

c) Solve with Excel Solver

	A	B	C	D	E	F	G	H	I	J	K
1		Three days agents				Four days agents					
2		MTW	TWR	WRF	RFS	MTRF	MTFS	TWFS			
3		X11	X12	X13	X14	X21	X22	X23			
4	high-skill	35	5	0	30	0	50	0			
5	low-skill	0	35	15	40	15	0	0			
6		Y11	Y12	Y13	Y14	Y21	Y22	Y23			
7											
8	Objective	=SUM(B4:E4)*450+SUM(F4:H4)*540+SUM(B5:E5)*300+SUM(F5:H5)*360									
9											
10	constraints	=B4+F4+G4	>=		60	=B4+F4+G4+B5+F5+G5	>=		100		
11		=B4+C4+F4+G4+H4	>=		90	=B4+C4+F4+G4+H4+B5+C5+F5+G5+H5	>=		120		
12		=B4+C4+D4+H4	>=		40	=B4+C4+D4+H4+B5+C5+D5+H5	>=		90		
13		=C4+D4+E4+F4	>=		30	=C4+D4+E4+F4+C5+D5+E5+F5	>=		140		
14		=D4+E4+F4+G4+H4	>=		40	=D4+E4+F4+G4+H4+D5+E5+F5+G5+H5	>=		150		
15		=E4+G4+H4	>=		80	=E4+G4+H4+E5+G5+H5	>=		120		

Solver Parameters

Set Objective:

\$B\$8

To:

☐ Max
☒ Min
☐ Value Of:

0

By Changing Variable Cells:

\$B\$4:\$H\$5

Subject to the Constraints:

\$B\$10:\$B\$15 >= \$E\$10:\$E\$15

\$F\$10:\$F\$15 >= \$K\$10:\$K\$15

Add

Change

Delete

Reset All

Load/Save

☒ Make Unconstrained Variables Non-Negative

Select a Solving Method:

Simplex LP

Options

Solving Method

Select the GRG Nonlinear engine for Solver Problems that are smooth nonlinear. Select the LP Simplex engine for linear Solver Problems, and select the Evolutionary engine for Solver problems that are non-smooth.

Help

Solve

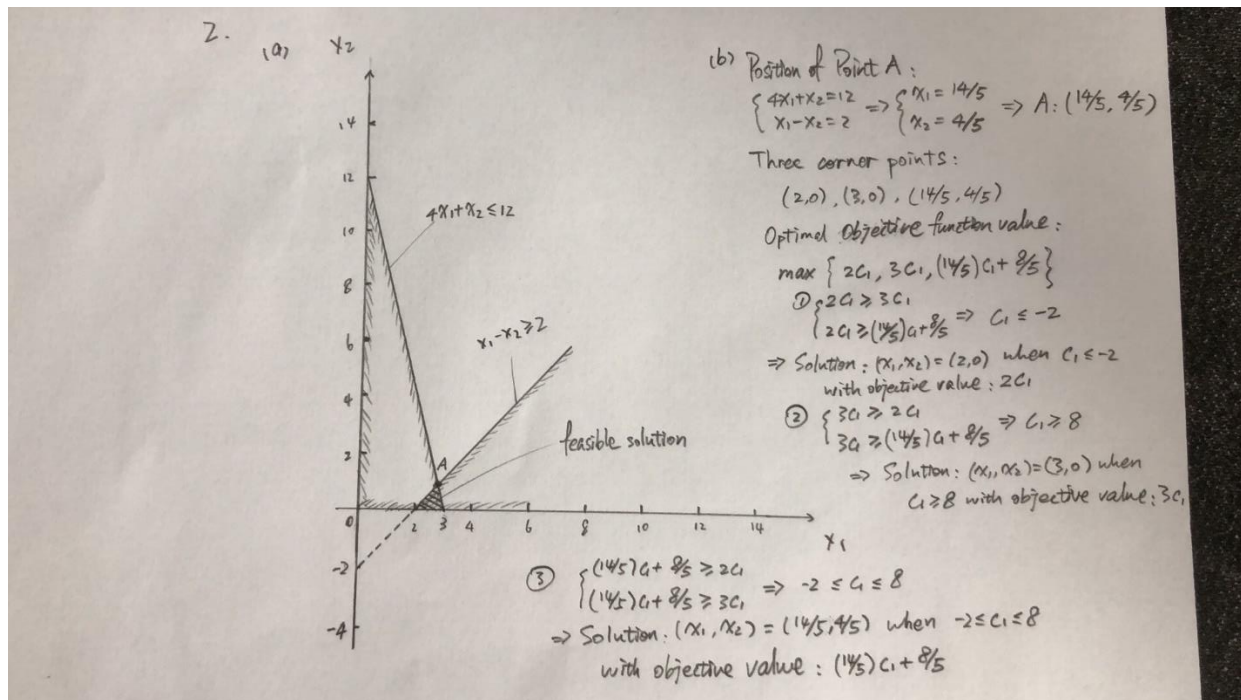
Close

The optimal solution to our optimization problem is:

(X11,X12,X13,X14,X21,X22,X23,Y11,Y12,Y13)=(35,5,0,30,0,0,50,0,0,35,15,40,15,0,0), providing the objective value of 90900.

Question 2:

a)



b)

Optimal solution:

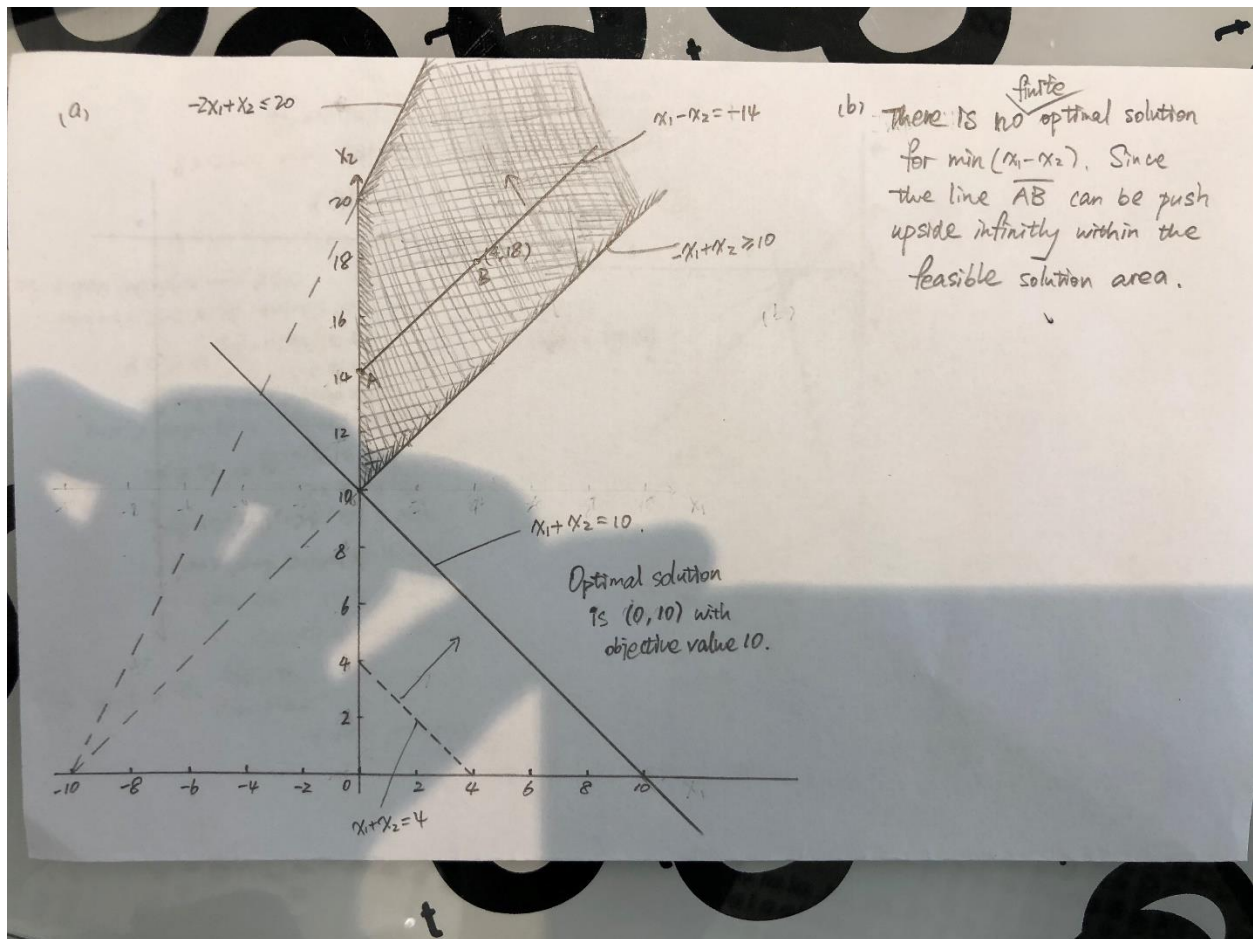
$(x_1, x_2) = (2, 0)$ when $c_1 \leq -2$, with objective value: $2 \cdot c_1$

$(x_1, x_2) = (3, 0)$ when $c_1 \geq 8$, with objective value: $3 \cdot c_1$

$(x_1, x_2) = (14/5, 4/5)$ when $-2 \leq c_1 \leq 8$, with objective value $(14/5) \cdot c_1 + 8/5$

Question 3:

a)



The Optimal solution is (0, 10) with objective value 10.

- b) There is no finite optimal solution for $\min(x_1 - x_2)$ since the line AB can be pushed upside infinitely within the feasible solution area.

Question 4:

$$\textcircled{1} \left[\begin{array}{ccc|ccc} 5 & 0 & -2 & 1 & 0 & 0 \\ 1 & -2 & 2 & 0 & 1 & 0 \\ 2 & -1 & 0 & 0 & 0 & 1 \end{array} \right]$$

$$\textcircled{2} \left[\begin{array}{ccc|ccc} 1 & 0 & -\frac{2}{5} & \frac{1}{5} & 0 & 0 \\ 1 & -2 & 2 & 0 & 1 & 0 \\ 2 & -1 & 0 & 0 & 0 & 1 \end{array} \right]$$

$$\textcircled{3} \left[\begin{array}{ccc|ccc} 1 & 0 & -\frac{2}{5} & \frac{1}{5} & 0 & 0 \\ 0 & -2 & \frac{12}{5} & -\frac{4}{5} & 1 & 0 \\ 2 & -1 & 0 & 0 & 0 & 1 \end{array} \right]$$

$$\textcircled{4} \left[\begin{array}{ccc|ccc} 1 & 0 & -\frac{2}{5} & \frac{1}{5} & 0 & 0 \\ 0 & 1 & -\frac{4}{5} & \frac{1}{10} & -\frac{1}{2} & 0 \\ 2 & -1 & 0 & 0 & 0 & 1 \end{array} \right]$$

$$\textcircled{5} \left[\begin{array}{ccc|ccc} 1 & 0 & -\frac{2}{5} & \frac{1}{5} & 0 & 0 \\ 0 & 1 & -\frac{4}{5} & \frac{1}{10} & -\frac{1}{2} & 0 \\ 1 & -\frac{1}{2} & 0 & 0 & 0 & \frac{1}{2} \end{array} \right]$$

$$\textcircled{6} \left[\begin{array}{ccc|ccc} 1 & 0 & -\frac{2}{5} & \frac{1}{5} & 0 & 0 \\ 0 & 1 & -\frac{4}{5} & \frac{1}{10} & -\frac{1}{2} & 0 \\ 0 & -\frac{1}{2} & \frac{2}{5} & -\frac{1}{5} & 0 & \frac{1}{2} \end{array} \right]$$

$$\textcircled{7} \left[\begin{array}{ccc|ccc} 1 & 0 & -\frac{2}{5} & \frac{1}{5} & 0 & 0 \\ 0 & 1 & -\frac{4}{5} & \frac{1}{10} & -\frac{1}{2} & 0 \\ 0 & 1 & -\frac{4}{5} & \frac{2}{5} & 0 & -1 \end{array} \right]$$

$$\textcircled{8} \left[\begin{array}{ccc|ccc} 1 & 0 & -\frac{2}{5} & \frac{1}{5} & 0 & 0 \\ 0 & 1 & -\frac{4}{5} & \frac{1}{10} & -\frac{1}{2} & 0 \\ 0 & 0 & \frac{2}{5} & \frac{3}{10} & \frac{1}{2} & -1 \end{array} \right]$$

$$\textcircled{9} \left[\begin{array}{ccc|ccc} 1 & 0 & 0 & \frac{1}{2} & \frac{1}{2} & -1 \\ 0 & 1 & -\frac{4}{5} & \frac{1}{10} & -\frac{1}{2} & 0 \\ 0 & 0 & \frac{2}{5} & \frac{3}{10} & \frac{1}{2} & -1 \end{array} \right]$$

$$\textcircled{10} \left[\begin{array}{ccc|ccc} 1 & 0 & 0 & \frac{1}{2} & \frac{1}{2} & -1 \\ 0 & 1 & 0 & 1 & 1 & -3 \\ 0 & 0 & \frac{2}{5} & \frac{3}{10} & \frac{1}{2} & -1 \end{array} \right]$$

$$\textcircled{11} \left[\begin{array}{ccc|ccc} 1 & 0 & 0 & \frac{1}{2} & \frac{1}{2} & -1 \\ 0 & 1 & 0 & 1 & 1 & -3 \\ 0 & 0 & 1 & \frac{3}{4} & \frac{3}{4} & -\frac{5}{2} \end{array} \right]$$

Result!