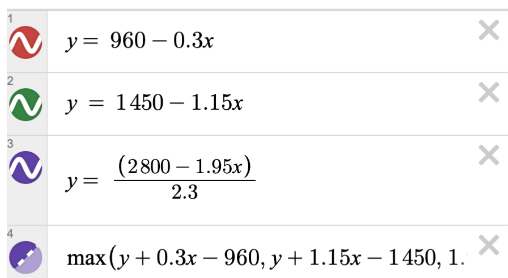
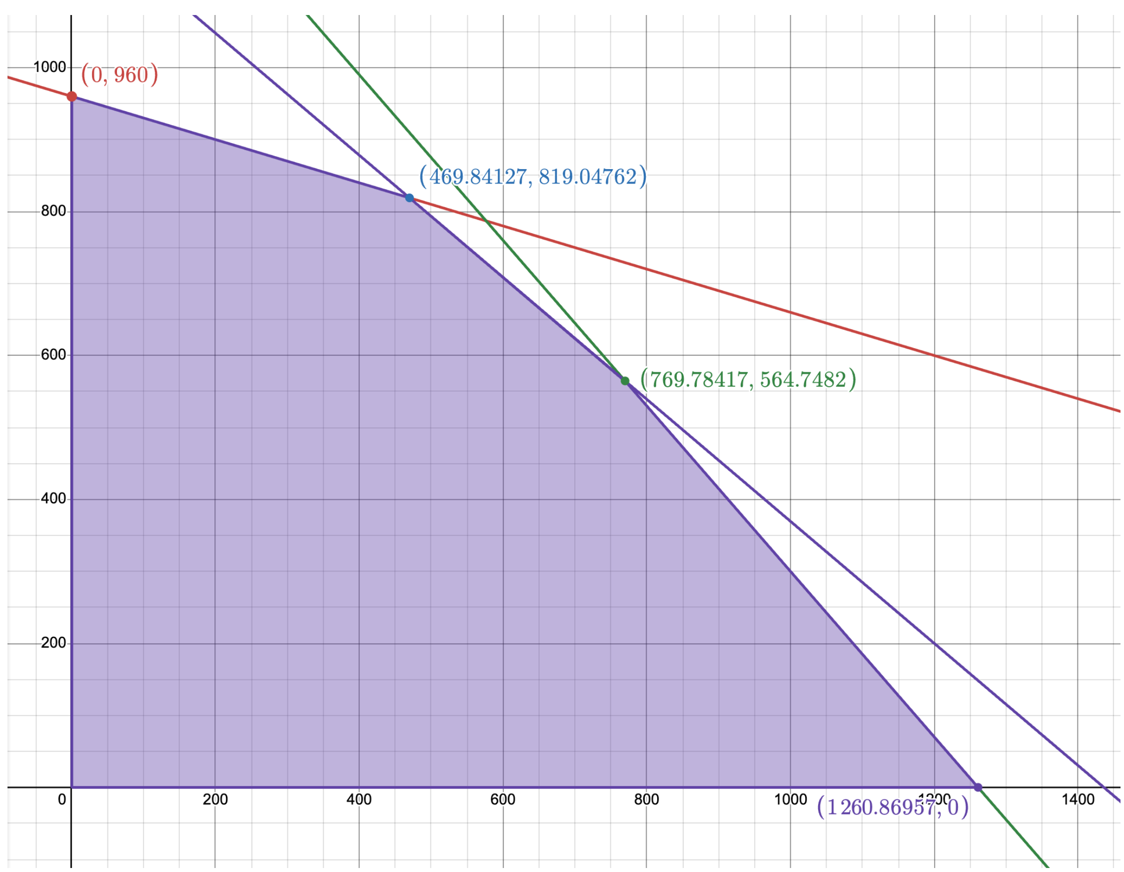
Problem 1

a) Solve the problem graphically. State the optimal solution in your plot. No sketches are acceptable. State the value of the objective function for the optimal solution found. In the graphical solution, label the corner points and state the objective function value at each point.

You can use Desmos, Excel, MATLAB, or another tool to plot the graph, and the optimal solution based on the graph is when x1 = 769.78 and x2 = 564.75.



To draw it, treat x_2 as variable y. And substitute the coordinates of the four corner points into the objective function to identify which one maximizes it.



b) Solve the problem by hand using the Simplex Method explained in class. Show all your steps and tableaus. Indicate the Basic Variables (BV) and the Non-Basic Variables (NBV) in every tableau. Also, highlight the objective function's value in each tableau.

Objective

$$Maximize\ Z = 1650x_1 + 1530x_2$$

Subject to

$$0.3x_1 + x_2 \leq 960$$

$$1.15x_1 + x_2 \leq 1450$$

$$1.95x_1 + 2.3x_2 \leq 2800$$

$$x_1, x_2 \geq 0$$

Step 1) Add a Slack variable to make ≤ to = constraints. Therefore, the standard formula will be:

$$Z - 1650x_1 - 1530x_2 = 0$$

$$0.3x_1 + x_2 + x_3 = 960$$

$$1.15x_1 + x_2 + x_4 = 1450$$

$$1.95x_1 + 2.3x_2 + x_5 = 2800$$

$$x_1, x_2, x_3, x_4, x_5 \geq 0$$

Step 2) Make an initial tableau using the standard form and identify the NBV and BV

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS
Z	1	-1650	-1530	0	0	0	0
x_3	0	0.3	1	1	0	0	960
x_4	0	1.15	1	0	1	0	1450
x_5	0	1.95	2.3	0	0	1	2800

BV = X3, X4, X5 and NBV = X1, X2

Step 3) Find the pivot column/row. For the pivot column, we select the lowest value, and for the pivot row, we apply the ratio test and use the row with the lowest ratio.

- Pivot column

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS
Z	1	-1650	-1530	0	0	0	0
x_3	0	0.3	1	1	0	0	960
x_4	0	1.15	1	0	1	0	1450
x_5	0	1.95	2.3	0	0	1	2800

- Pivot row

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS	Ratio (RHS/pivot column value)
Z	1	-1650	-1530	0	0	0	0	
x_3	0	0.3	1	1	0	0	960	3200 (960/0.3)
x_4	0	1.15	1	0	1	0	1450	1260.87 (1450/1.15)
x_5	0	1.95	2.3	0	0	1	2800	1435.90 (2800/1.95)

Step 4) Since the value of the pivot column/row intersection is 1.15, we need to divide the pivot row by 1.15 to make it 1.

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS
Z	1	-1650	-1530	0	0	0	0
x_3	0	0.3	1	1	0	0	960
x_4	0	1	0.87 (1/1.15)	0	0.87 (1/1.15)	0	1260.87
x_5	0	1.95	2.3	0	0	1	2800

Step 5) Do row operations to all rows except for the pivot row.

For Z row = x4 row * 1650 + z

Z	1	0	-94.5 (0.87*1650-1530)	0	1435.5 (0.87*1650-0)	0	2,080,435.5

After the row operation for Z

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS
Z	1	0	-94.5	0	1435.5	0	2,080,435.5
x_3	0	0.3	1	1	0	0	960
x_4	0	1	0.87	0	0.87	0	1260.87
x_5	0	1.95	2.3	0	0	1	2800

Step 5-1) Do row operations to all rows except for the pivot row.

For x_5 row = x4 row * (-1.95) + x5

x_5	0	0	0.60	0	-1.70	1	341.30

After the row operation for x5

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS
Z	1	0	-94.5	0	1435.5	0	2,080,435.5
x_3	0	0.3	1	1	0	0	960
x_4	0	1	0.87 (1/1.15)	0	0.87 (1/1.15)	0	1260.87
x_5	0	0	0.60	0	-1.70	1	341.30

Step 5-2) Do row operations to all rows except for the pivot row.

For x3 row = x4 row * (-0.3) + x3

x_3	0	0	0.74	1	-0.26	0	581.74

After the row operation for x3

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS
Z	1	0	-94.5	0	1435.5	0	2,080,435.5
x_3	0	0	0.74	1	-0.26	0	581.74
x_4	0	1	0.87 (1/1.15)	0	0.87 (1/1.15)	0	1260.87
x_5	0	0	0.60	0	-1.70	1	341.30

Step 6) Since we did a row operation for the pivot column, we need to check if it is an optimal solution or not. Since the coefficient of x2 is still a negative value, we need another iteration of it.

Step 7) Make a second tableau and find the pivot column/row. For the pivot column, we select the lowest value, and for the pivot row, we apply the ratio test and use the row with the lowest ratio.

- Pivot column

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS
Z	1	0	-94.5	0	1435.5	0	2,080,435.5
x_3	0	0	0.74	1	-0.26	0	581.74
x_1	0	1	0.87	0	0.87	0	1260.87
x_5	0	0	0.60	0	-1.70	1	341.30

BV = X3, X1, X5 and NBV = X2, X4

- Pivot row

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS
Z	1	0	-94.5	0	1435.5	0	2,080,435.5
x_3	0	0	0.74	1	-0.26	0	581.74
x_1	0	1	0.87	0	0.87	0	1260.87
x_5	0	0	0.60	0	-1.70	1	341.30

Step 8) Since the value of the pivot column/row intersection is 0.6, we need to divide the pivot row by 0.6 to make it 1.

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS
Z	1	0	-94.5	0	1435.5	0	2,080,435.5
x_3	0	0	0.74	1	-0.26	0	581.74
x_1	0	1	0.87	0	0.87	0	1260.87
x_5	0	0	1	0	-2.83	1.67	568.83

Step 9) Do row operations to all rows except for the pivot row.

For Z row = x5 row * 94.5 + z

Z	1	0	0	0	1168.07	157.82	2134189.94

After the row operation for Z

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS
Z	1	0	0	0	1168.07	157.82	2134189.94
x_3	0	0	0.74	1	-0.26	0	581.74
x_1	0	1	0.87	0	0.87	0	1260.87
x_5	0	0	1	0	-2.83	1.67	568.83

Step 9-1) Do row operations to all rows except for the pivot row.

For X1 row = x5 row * (-0.87) + x1

x_1	0	1	0	0	3.33	-1.45	765.99

After the row operation for x1

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS
Z	1	0	0	0	1167.03	157.50	2,134,190.25
x_3	0	0	0.74	1	-0.26	0	581.74
x_1	0	1	0	0	3.33	-1.45	765.99
x_5	0	0	1	0	-2.83	1.67	568.83

Step 9-2) Do row operations to all rows except for the pivot row.

For X3 row = x5 row * (-0.74) + x3

x_3	0	0	0	1	1.83	-1.25	160.81

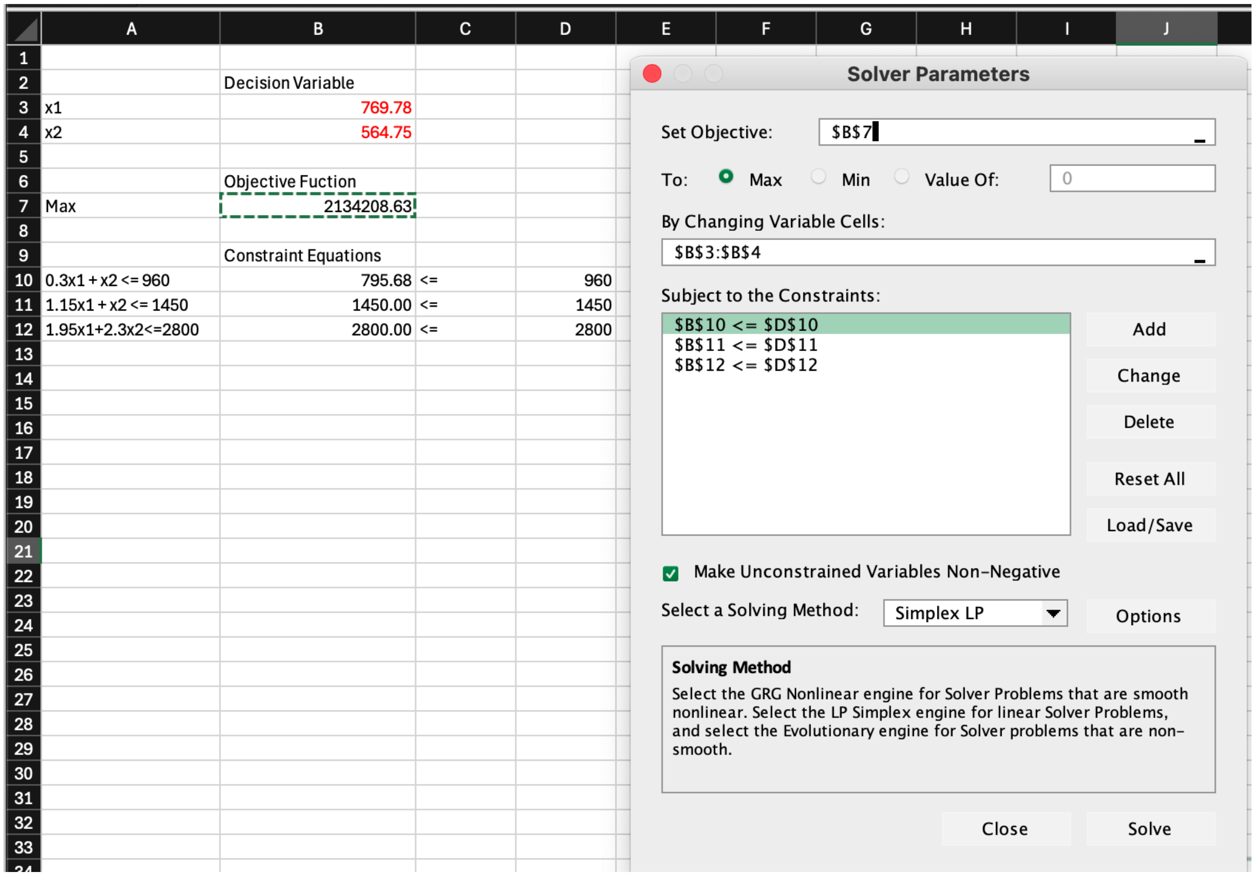
After the row operation for x3

BV	Z	x_1	x_2	x_3	x_4	x_5	RHS
Z	1	0	0	0	1167.03	157.50	2,134,190.25
x_3	0	0	0	1	1.83	-1.25	160.81
x_1	0	1	0	0	3.33	-1.45	**765.99**
x_2	0	0	1	0	-2.83	1.67	**568.83**

The BV: x3, x1, x2 and NVB: x4, x5

Step 10) Since we did a row operation for the pivot column, we need to check if the current solution is optimal solution or not. **Since there are no negative values for the Z row, we can say that it is an optimal solution**. The optimal solution is x1 = 765.99 and x2 = 568.83. When comparing it to the value obtained from the graphic, x1 = 769.78 and x2 = 564.75. They are slightly offset, but the values are quite close.

C) Solve the problem using Excel Solver. State the solution found by Excel for the two decision variables. State the value of the objective function for the optimal solution found. Compare the Excel Solver solution with the solution obtained manually in parts (A-B).



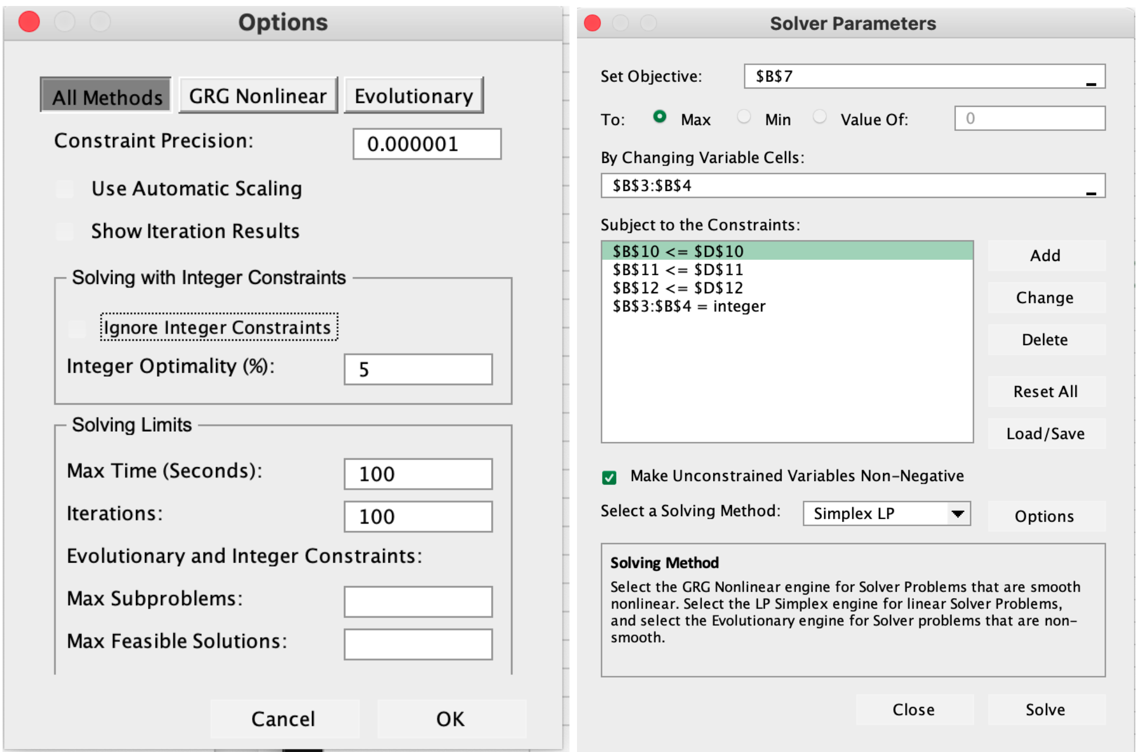
Method	x1	x2	Max
Graph	769.78	564.75	2134208.63
Hand calculation	765.99	568.83	2,134,190.25
Excel	769.78	564.75	2,134,208.63

The optimal values between the Graph/Excel are off by 18.38 (close enough in engineering calculations). The hand calculation considered two decimal places.

d) Since the number of beams to be produced needs to be an integer solution, solve the problem with Excel to obtain an integer solution. State the value of the objective function for the optimal solution found.

The optimal value of the objective function with an integer solution is when x1 = 770 and x2 = 564.

Note: Please **uncheck** the 'Ignore integer constraints' in the options of the solver.



	A	B	C	D
1				
2		Decision Variable		
3	x1	770		
4	x2	564		
5				
6		Objective Fuction		
7	Max	2133420		
8				
9		Constraint Equations		
10	0.3x1 + x2 <= 960	795	<=	960
11	1.15x1 + x2 <= 1450	1450	<=	1450
12	1.95x1+2.3x2<=2800	2799	<=	2800
13				

Problem 2

a) Set up the problem as a linear programming problem. The objective is to minimize excavation and transportation costs when procuring concrete for the airport project.

Objective

$$Minimize\ Z\ =\ 600x_1 + 565x_2 + 580x_3 + 375x_1 + 400x_2 + 390x_3 \text{ or}$$

$$Minimize\ Z\ =\ 975x_1 + 965x_2 + 970x_3$$

Subject to

$$x_1 + x_2 + x_3 \geq\ 565{,}000$$

$$0.42x_1 + 0.43x_2 + 0.54x_3 \geq 275{,}000$$

$$0.58x_1 + 0.57x_2 + 0.46x_3 \leq\ 300{,}000$$

$$x_1 \leq\ 223{,}000$$

$$x_2 \leq\ 256{,}000$$

$$x_3 \leq\ 243{,}000$$

$$x_1, x_2, x_3\ \geq\ 0$$

b) Use the Simplex method to solve the first two tableaus of the problem by hand. For each table, indicate the Basic Variables, Non-Basic Variables, and the value of the objective function (Z).

Step 1) Add a Slack and Artificial variable to make ≤ to = constraints (called standard form). For the ≥ constraint, we need to subtract the slack variable and add the artificial variable. For the ≤ constraint, we only need to add the slack variable. Therefore, the formula will be:

Objective

$$Maximize\ -\ Z\ =\ -975x_1 - 965x_2 - 970x_3 \text{ or}$$

$$Maximize\ -Z\ \ + 975x_1 + 965x_2 + 970x_3 +\ M(a_1 +\ a_2) =\ 0$$

Subject to

$$x_1 + x_2 + x_3 - s_1 + a_1 = 565{,}000$$

$$0.42x_1 + 0.43x_2 + 0.54x_3 - s_2 + a_2 = 275{,}000$$

$$0.58x_1 + 0.57x_2 + 0.46x_3 + s_3 = 300{,}000$$

$$x_1 + s_4 = 223{,}000$$

$$x_2 + s_5 = 256{,}000$$

$$x_3 + s_6 = 243{,}000$$

$$x_1, x_2, x_3 \geq 0$$

Where s_n are Slack Variables and a_n are Artificial Variables

Step 2) Make an initial tableau with the Big M method

	BV	z	x1	x2	x3	a1	a2	s1	s2	s3	s4	s5	s6	RHS
	z	-1	975	965	970	M	M	0	0	0	0	0	0	0
"-M"	a1	0	1	1	1	1	0	-1	0	0	0	0	0	565000
"-M"	a2	0	0.42	0.43	0.54	0	1	0	-1	0	0	0	0	275000
	s3	0	0.58	0.57	0.46	0	0	0	0	1	0	0	0	300000
	s4	0	1	0	0	0	0	0	0	0	1	0	0	223000
	s5	0	0	1	0	0	0	0	0	0	0	1	0	256000
	s6	0	0	0	1	0	0	0	0	0	0	0	1	243000

Step 3) Perform row operations for z row to eliminate M from the artificial data.

BV	z	x1	x2	x3	a1	a2	s1	s2	s3	s4	s5	s6	RHS
z	-1	975	965	970	M	M	0	0	0	0	0	0	0
a1	0	1	1	1	1	0	-1	0	0	0	0	0	565000
a2	0	0.42	0.43	0.54	0	1	0	-1	0	0	0	0	275000

new z row = z -M * (a1) - M *(a2)

BV	z	x1	x2	x3	a1	a2	s1	s2	s3	s4	s5	s6	RHS
z	-1	(-1.42M+975)	(-1.43M+965)	(-1.54M+970)	0	0	"M"	"M"	0	0	0	0	"-840000M"
a1	0	1	1	1	1	0	-1	0	0	0	0	0	565000
a2	0	0.42	0.43	0.53	0	1	0	-1	0	0	0	0	275000
s3	0	0.58	0.57	0.46	0	0	0	0	1	0	0	0	300000
s4	0	1	0	0	0	0	0	0	0	1	0	0	223000
s5	0	0	1	0	0	0	0	0	0	0	1	0	256000
s6	0	0	0	1	0	0	0	0	0	0	0	1	243000

BV	z	x1	x2	x3	a1	a2	s1	s2	s3	s4	s5	s6	RHS	Ratio
z	-1	(-1.42M+975)	(-1.43M+965)	(-1.54M+970)	0	0	"M"	"M"	0	0	0	0	"-840000M"	
a1	0	1	1	1	1	0	-1	0	0	0	0	0	565000	565000
a2	0	0.42	0.43	0.53	0	1	0	-1	0	0	0	0	275000	518867.9245
s3	0	0.58	0.57	0.46	0	0	0	0	1	0	0	0	300000	652173.913
s4	0	1	0	0	0	0	0	0	0	1	0	0	223000	inf
s5	0	0	1	0	0	0	0	0	0	0	1	0	256000	inf
s6	0	0	0	1	0	0	0	0	0	0	0	1	243000	243000

Step 4) Do row operations to all rows except for the pivot row. We expect to see the row operation for each row in this step.

For Z row =s6 *-(-1.54M+970) + z
For a1 row = s6*(-1)+z
For a2 row = s6*(-0.54)+z
For s3 row = s6*(-0.46)+z
For s4 row = s6*(0)+z
For s5 row = s6*(0)+z
For s6 row = s6*(-1)+z

- Second Tableau

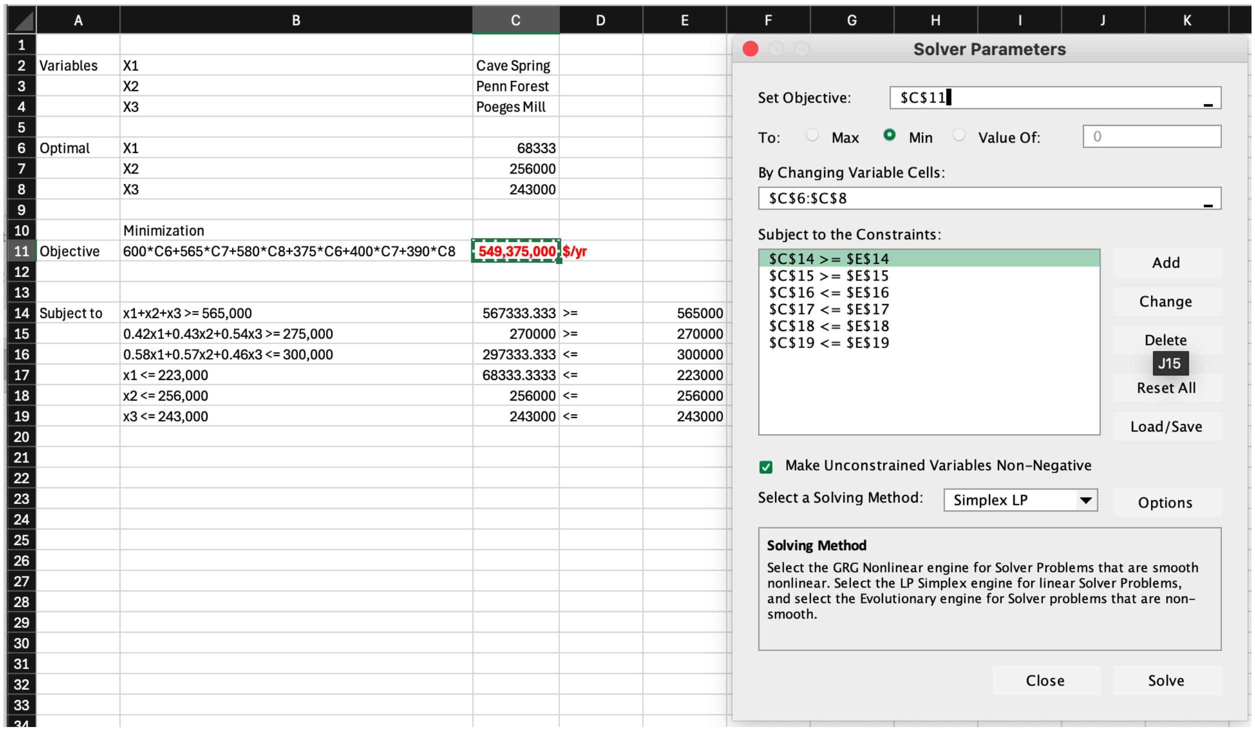
BV	z	x1	x2	x3	a1	a2	s1	s2	s3	s4	s5	s6	RHS
z	-1	(-1.42M+975)	(-1.43M+965)	0	0	0	"M"	"M"	0	0	0	-1.54M+970	" -465,780M - 235,710,000"
a1	0	1	1	0	1	0	-1	0	0	0	0	-1	322000
a2	0	0.42	0.43	0	0	1	0	-1	0	0	0	-0.54	143,780
s3	0	0.58	0.57	0	0	0	0	0	1	0	0	-0.46	188,220
s4	0	1	0	0	0	0	0	0	0	1	0	0	223000
s5	0	0	1	0	0	0	0	0	0	0	1	0	256000
x3	0	0	0	1	0	0	0	0	0	0	0	1	243000

c) Find the optimal solution that minimizes the total transportation and excavation cost using Excel Solver. Clearly state the values of the decision variables and the optimal objective function value.

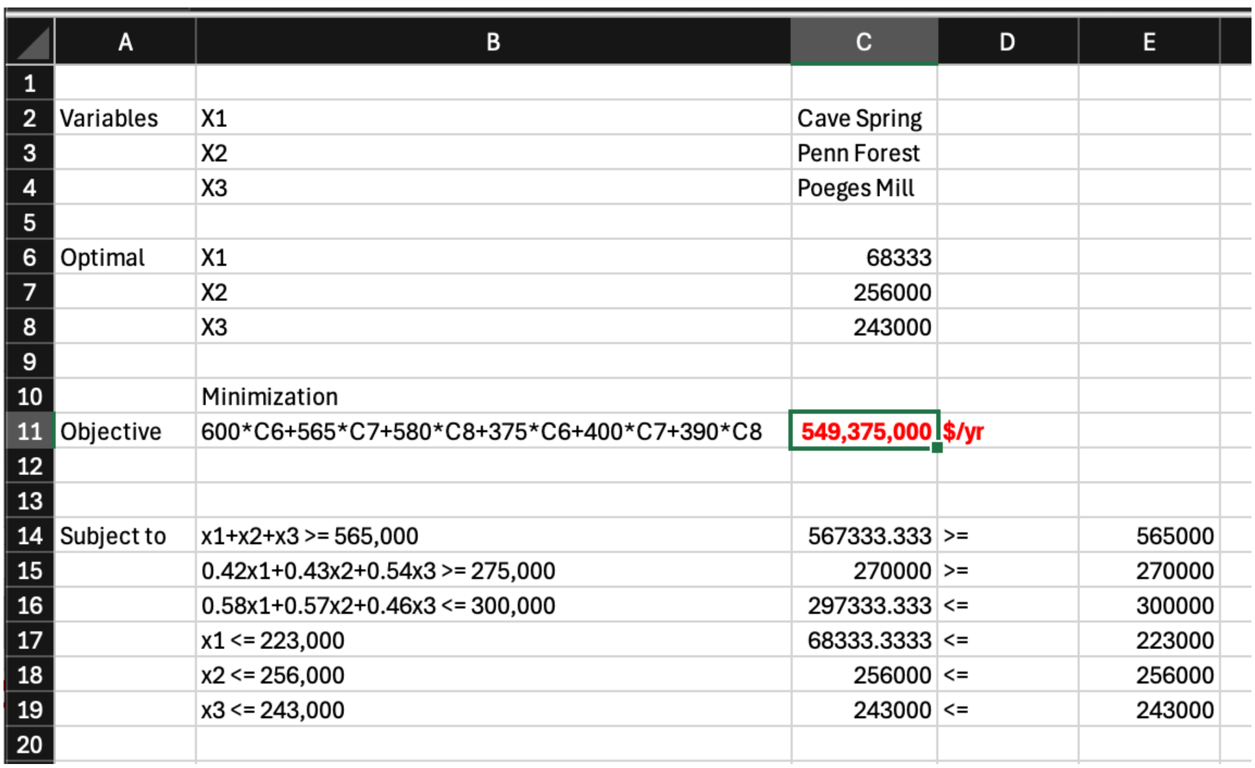
The values of the decision variables are:

X1 = 68,333, X2 = 256,000, X3 = 243,000

The optimal objective function value is 549,375,000



	A	B	C	D	E
1					
2	Variables	X1	Cave Spring		
3		X2	Penn Forest		
4		X3	Poeges Mill		
5					
6	Optimal	X1	68333		
7		X2	256000		
8		X3	243000		
9					
10		Minimization			
11	Objective	600*C6+565*C7+580*C8+375*C6+400*C7+390*C8	549,375,000	$/yr	
12					
13					
14	Subject to	x1+x2+x3 >= 565,000	567333.333	>=	565000
15		0.42x1+0.43x2+0.54x3 >= 275,000	270000	>=	270000
16		0.58x1+0.57x2+0.46x3 <= 300,000	297333.333	<=	300000
17		x1 <= 223,000	68333.3333	<=	223000
18		x2 <= 256,000	256000	<=	256000
19		x3 <= 243,000	243000	<=	243000



	A	B	C	D	E
1					
2	Variables	X1	Cave Spring		
3		X2	Penn Forest		
4		X3	Poeges Mill		
5					
6	Optimal	X1	68333		
7		X2	256000		
8		X3	243000		
9					
10		Minimization			
11	Objective	600*C6+565*C7+580*C8+375*C6+400*C7+390*C8	549,375,000	$/yr	
12					
13					
14	Subject to	x1+x2+x3 >= 565,000	567333.333	>=	565000
15		0.42x1+0.43x2+0.54x3 >= 275,000	270000	>=	270000
16		0.58x1+0.57x2+0.46x3 <= 300,000	297333.333	<=	300000
17		x1 <= 223,000	68333.3333	<=	223000
18		x2 <= 256,000	256000	<=	256000
19		x3 <= 243,000	243000	<=	243000
20					

Problem 3

a) Formulate the problem as a linear programming problem to minimize the cost of pollution removal.

Objective

$$Maximize\ Z = 305x_1 + 320x_2 + 310x_3 + 405x_4 + 630x_5 + 245x_6$$

Subject to

$$x_1 \geq \frac{1}{3} \times 22{,}400$$

$$x_2 \geq \frac{1}{3} \times 32{,}400$$

$$x_3 \geq \frac{1}{3} \times 23{,}500$$

$$x_4 \geq \frac{1}{2} \times 24{,}600$$

$$x_5 \geq \frac{1}{2} \times 38{,}300 \times (1 - y)$$

$$x_6 \geq \frac{1}{2} \times 38{,}300 \times y$$

$$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 \geq 70{,}000\ (or = 70{,}000)$$

$$x_1 \leq 22{,}400$$

$$x_2 \leq 32{,}400$$

$$x_3 \leq 23{,}500$$

$$x_4 \leq 24{,}600$$

$$x_5 \leq 38{,}300 \times (1 - y)$$

$$x_6 \leq 38{,}300 \times y$$

$y \in \{0, 1\}$ - *optional*

$$x_1, x_2, x_3, x_4, x_5, x_6 \geq 0$$

b) Set up the problem in standard form, including slack and artificial variables and the penalty in the objective function. Do not solve.

Objective

$$Maximize\ -Z\ =\ -305x_1 - 320x_2 - 310x_3 - 405x_4 - 630x_5 - 245x_6 \text{ or}$$

$$Maximize\ -Z\ \ + 305x_1 + 320x_2 + 310x_3 + 405x_4 + 630x_5 + 245x_6\ +\ M(a_1 +\ a_2 + a_3 + a_4 + a_5 + a_6 + a_7) =\ 0$$

Subject to

$$x_1 - s_1 + a_1\ =\ \frac{1}{3} \times 22{,}400$$

$$x_2 - s_2 + a_2\ =\ \frac{1}{3} \times 32{,}400$$

$$x_3 - s_3 + a_3\ =\ \frac{1}{3} \times 23{,}500$$

$$x_4 - s_4 + a_4\ =\ \frac{1}{2} \times 24{,}600$$

$$x_5 - s_5 + a_5\ =\ \frac{1}{2} \times 38{,}300 \times (1 - y)$$

$$x_6 - s_6 + a_6\ =\ \frac{1}{2} \times 38{,}300 \times y$$

$$x_1 + x_2 + x_3 +\ x_4 + x_5 + x_6 - s_7 + a_7\ \ =\ 70{,}000$$

$$x_1 + s_8 = 22{,}400$$

$$x_2 + s_9 = 32{,}400$$

$$x_3 + s_{10} = 23{,}500$$

$$x_4 + s_{11} = 24{,}600$$

$$x_5 + s_{12} - 38{,}300 \times (1 - y) =\ 0$$

$$x_6 + s_{11}\ -\ 38{,}300 \times y = 0$$

$$y\ \in \{0, 1\}$$

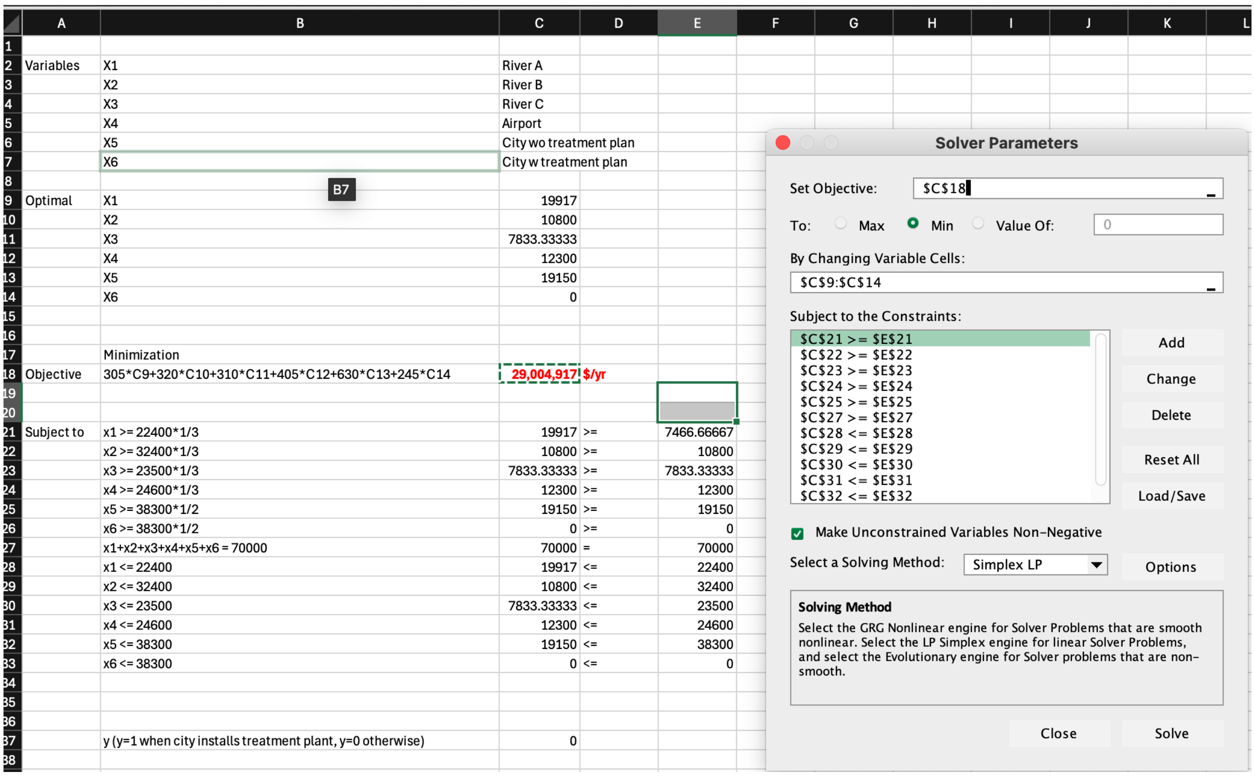
$$x_1, x_2, x_3, x_4, x_5, x_6\ \geq\ 0$$

Where s_n *are Slack Variables and* a_n *are Artificial Variables*

C) Solve the water pollution control problem if the total desired pollution removal is now 70,000 kg. Find out the total cost of pollution removal per year without a water treatment plant.

The cost of pollution removal will be $29,004,917.

We can adjust the amount of total desired pollution removal by changing the constraint below.



	A	B	C	D	E
1					
2	Variables	X1	River A		
3		X2	River B		
4		X3	River C		
5		X4	Airport		
6		X5	City wo treatment plan		
7		X6	City w treatment plan		
8					
9	Optimal	X1	19917		
10		X2	10800		
11		X3	7833.33333		
12		X4	12300		
13		X5	19150		
14		X6	0		
15					
16					
17		Minimization			
18	Objective	305*C9+320*C10+310*C11+405*C12+630*C13+245*C14	**29,004,917**	**$/yr**	
19					
20					
21	Subject to	x1 >= 22400*1/3	19917	>=	7466.66667
22		x2 >= 32400*1/3	10800	>=	10800
23		x3 >= 23500*1/3	7833.33333	>=	7833.33333
24		x4 >= 24600*1/3	12300	>=	12300
25		x5 >= 38300*1/2	19150	>=	19150
26		x6 >= 38300*1/2	0	>=	0
27		x1+x2+x3+x4+x5+x6 = 70000	70000	=	70000
28		x1 <= 22400	19917	<=	22400
29		x2 <= 32400	10800	<=	32400
30		x3 <= 23500	7833.33333	<=	23500
31		x4 <= 24600	12300	<=	24600
32		x5 <= 38300	19150	<=	38300
33		x6 <= 38300	0	<=	0
34					
35					
36					
37		y (y=1 when city installs treatment plant, y=0 otherwise)	0		
38					

D) Solve the water pollution control problem if the total desired pollution removal is now 70,000 kg. In solving the new problem, assume the city invested $45,000,000 in a new pollution treatment plant. Find out the total cost of pollution removal (per year) for this task.

$65,885,167 = $20,885,167 (minimum cost when operating new pollution treatment plant) + $45,000,000 (cost to build a new pollution treatment plant)

We can choose to install the treatment plant or not, using the binary constraint below (optional)

y (y=1 when city installs treatment plant, y=0 otherwise)	1

	A	B	C	D	E
1					
2	Variables	X1	River A		
3		X2	River B		
4		X3	River C		
5		X4	Airport		
6		X5	City wo treatment plan		
7		X6	City w treatment plan		
8					
9	Optimal	X1	7467		
10		X2	10800		
11		X3	7833.33333		
12		X4	12300		
13		X5	0		
14		X6	31600		
15					
16					
17		Minimization			
18	Objective	305*C9+320*C10+310*C11+405*C12+630*C13+245*C14	20,885,167	$/yr	
19					
20					
21	Subject to	x1 >= 22400*1/3	7467	>=	7466.66667
22		x2 >= 32400*1/3	10800	>=	10800
23		x3 >= 23500*1/3	7833.33333	>=	7833.33333
24		x4 >= 24600*1/3	12300	>=	12300
25		x5 >= 38300*1/2	0	>=	0
26		x6 >= 38300*1/2	31600	>=	19150
27		x1+x2+x3+x4+x5+x6 = 70000	70000	=	70000
28		x1 <= 22400	7467	<=	22400
29		x2 <= 32400	10800	<=	32400
30		x3 <= 23500	7833.33333	<=	23500
31		x4 <= 24600	12300	<=	24600
32		x5 <= 38300	0	<=	0
33		x6 <= 38300	31600	<=	38300
34					
35					
36					
37		y (y=1 when city installs treatment plant, y=0 otherwise)	1		

e) Assume the treatment plant's life is 60 years. Estimate if the construction of such a facility is justified by comparing the solution of removal costs over the 60-year life cycle

Cost when the treatment plant is not installed - Cost when the city installs the treatment plant) * 60

= (29,004,917-20,885,167) * 60 = $487,185,000

$ 45,000,000 (installation cost) < $487,185,000

Yes, it is justified because the saving cost is way higher than the installtion cost.

Problem 4

A) How did Dr. Dantzig get involved in the development of the Simplex Method?

Dantzig solved the Simplex method after arriving late to a graduate school class. "With the outbreak of World War II, Dantzig took a leave of absence from the doctoral program at Berkeley to work as a civilian for the United States Army Air Forces. Dantzig was asked to work out a method the Air Force could use to improve their planning process."

B) Which movie used the urban legend of George Dantzig?

- Good Will Hunting

C) Name three universities that employed George Dantzig.

-Stanford University, University of California, Berkeley, University of Michigan, University of Maryland

D) State three examples used in industry that use George Dantzig's methods.

1. An airline industry for crew scheduling and fleet assignments,

2. An oil industry for raw product

3. manufacturing, revenue management, telecommunications, advertising, architecture, circuit design, and countless other areas.