

CE 339 Assignment 1

Dana Cyr, Jake Raynor, Adam Bowker, Brayden Golas

Problem 1

Part A

Files: `ass01-1a.lp` , `ass01-1a.log`

Results:

VARIABLE	VALUE
x	25
y	54.6875
z	70.3125

Conclusion: Solution is consistent with Revelle

Part B

Files: `ass01-1b.lp` , `ass01-1b.log`

The results, using a **hardness of 1200**, were:

VARIABLE	VALUE
x	25
y	54.6875
z	70.3125

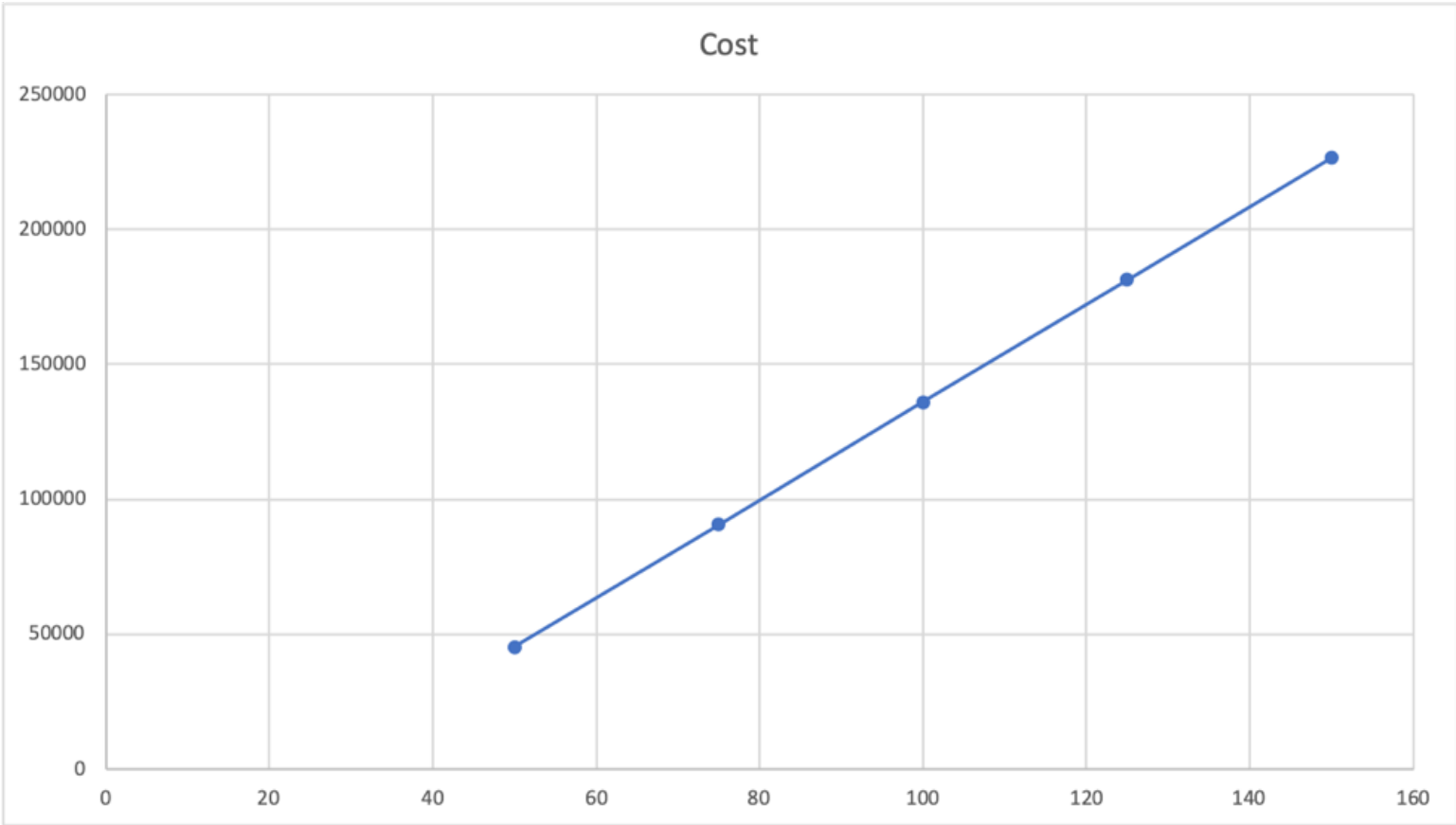
resulting in a total cost of: $25 \times 500 + 54.7 \times 1000 + 70.3 \times 2000 = \$207,800$

...and with a **hardness of 1000**:

VARIABLE	VALUE
x	25
y	35.9375
z	89.0625

resulting in a total cost of: $25 \times 500 + 35.9 \times 1000 + 89.1 \times 2000 = \$226,600$ (a 9% increase)

Part C



👉 **Part D**

Given the data in the chart below:

x1 coeff	500			
x2 coeff	1000			
x3 coeff	2000			
Supply	Cost	x1	x2	x3
50	45312.5	25	17.1875	7.8125
75	90625	25	21.875	28.125
100	135937.5	25	26.5625	48.4375
125	181250	25	31.25	68.75
150	226562.5	25	35.9375	89.0625
	MAX:	25	35.9375	89.0625

The maximum amount of water supplied from the three sources is:

x1: 25 mgd

x2: 35.94 mgd

x2: 89.06 mgd

🔥 **Problem 2**

👉 **Part A**

Files: ass01-2a.lp , ass01-2a.log

Results: The model, from Revelle, results in the following values for x_{ij} :

VARIABLE	VALUE
x11	250
x12	100
x13	50
x21	0
x22	0
x23	300

👉 Part B

The real world problem that problem 2 is based on obviously would have been much more difficult had certain things not been simplified, such as all of the numbers being discrete and within a workable range, the small and finite range of areas being cut and filled, that all of the area being cut and filled will be the same- assuming a uniform base foundation being cut and added to-, and assuming it will all go smoothly and there will be no mistakes in the measurements taken. There are definitely more, there are always more variables that could be taken into account, but because of these simplifications and more it was a lot easier to break down the variables and linearly model this system. To consider every single outside force that could affect this experiment would not only add more dependent and independent variables, but it would overall complicate the model and possibly make it nonlinear. Any mistakes made, or base not being what was anticipated, will completely alter any assumed equations or variables and would be near impossible to graph perfectly.

🔥 Problem 3

👉 Part A

Checking calculations used to formulate $(3/4) x_1 + (1/4) x_2 \geq 9000$ and $(1/4) x_1 + (3/4) x_2 \geq 13000$.

City 1:

$$\begin{aligned} 0.0075(12000 - x_1) + 0.0025(20000 - x_2) &\leq 50 \\ 90 - 0.0075x_1 + 50 - 0.0025x_2 &\leq 50 \\ 0.0075x_1 + 0.0025x_2 &\geq 90 \\ (3/4) x_1 + (1/4) x_2 &\geq 9000 \end{aligned}$$

Result: Calculation here matches the model in the book.

City 2:

$$\begin{aligned} 0.0025(12000 - x_1) + 0.0075(20000 - x_2) &\leq 50 \\ 30 - 0.0025x_1 + 150 - 0.0075x_2 &\leq 50 \\ 0.0025x_1 + 0.0075x_2 &\geq 130 \\ (1/4) x_1 + (3/4) x_2 &\geq 13000 \end{aligned}$$

Result: Calculation here matches the model in the book.

👉 Part B

Files: ass01-3b.lp , ass01-3b.log

Results:

VARIABLE	VALUE
x1	7000
x2	15000

Comment on the solution: The solution reached using Gurobi determined X1 to be 7000 and X2 to be 15,000. This means that there would need to be a reduction of 7000 kg/month at plant 1 and a reduction of 15000 kg/month at plant 2, resulting in a yearly cost of \$22,000,000 per year. This is a high cost, but that makes sense considering the massive amount of pollution that needs to be filtered from the smoke to reach the 50g per unit area mark desired in the problem.



Problem 4

Files: ass01-4.lp , ass01-4.log

Results:

VARIABLE	VALUE
p11	0
p12	0
p13	0
p21	125
p22	80
p23	0
o11	100
o12	0
o13	269
o21	0
o22	0
o23	0
sc11	0
sc12	0
sc13	0
sc21	0
sc22	340
sc23	0
sb11	0
sb12	0
sb13	331
sb21	77
sb22	0
sb23	0
sc33	0



Problem 5



Part A

Files: ass01-5a.lp , ass01-5a.log

Results: In order to maximize Trucko's profit, we should advise they produce **700 Type 2 trucks** and **0 Type 1 trucks**. This will result in a profit of **\$350,000.00**.

VARIABLE	VALUE
t1	0
t2	700

👉 Part B

Part A, solved graphically, yeilds the following plot:

