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BUSM3021
Business Analytics
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Homework 2

Due 10/28/2021

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1. (50pts) GS Mining Company owns a mine in Colorado and a mine in Nevada. Each ton excavated in Colorado yields 40lbs of gold, 40lbs of silver, and 30lbs of copper. Each ton excavated in Nevada yields 60lbs of gold, 50lbs of silver, and 20lbs of copper. Excavation costs in Colorado are $1,800/ton, while excavation costs in Nevada are $2,400/ton. During its next production cycle, GS Mining Company want to extract at least 1,600lbs of gold, 1,200lbs of silver, and 1,000lbs of copper.

a) Formulate a Linear Program that can be used to determine the most efficient excavation plan for the next production cycle. Clearly specify
   1) the decision variables,
   2) the objective function,
   3) the constraints.

b) Solve the formulation using the graphical method. Make sure to
   1) plot and label the constraints,
   2) shade the feasible region,
   3) graph the objective function, and
   4) identify the optimal solution.

OH: just pick a value. you use this for your slope to see. your minimums are still the same since you need to be looking at the feasible region

1A 1P

decision variables:

x_1 = number of tons excavated in colorado

x_2 = number of tons excavated in nevada

objective function: minimizing cost

$$1800x_1 + 2400x_2 = 36000$$

$x_1 = 20 \quad x_2 = 0$

$x_1 = 0 \quad x_2 = 15$

constraints:

amount of gold

$40x_1 + 60x_2 \geq 1600$ lbs gold

amount of silver

$40x_1 + 50x_2 \geq 1200$ lbs silver

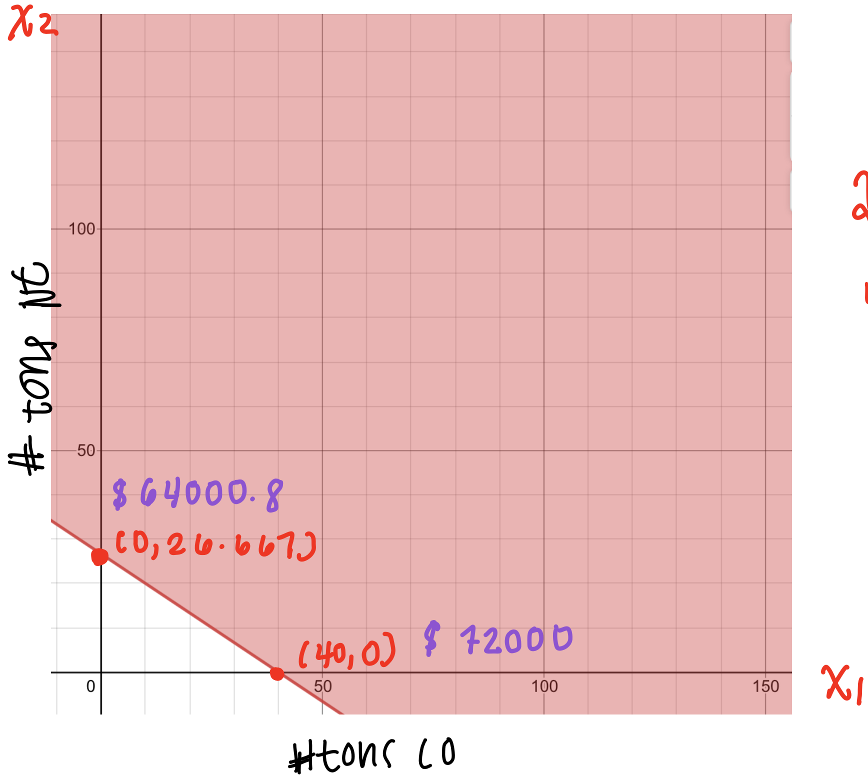
amount of copper

$30x_1 + 20x_2 \geq 1000$ lbs copper

$x_1 \geq 0$

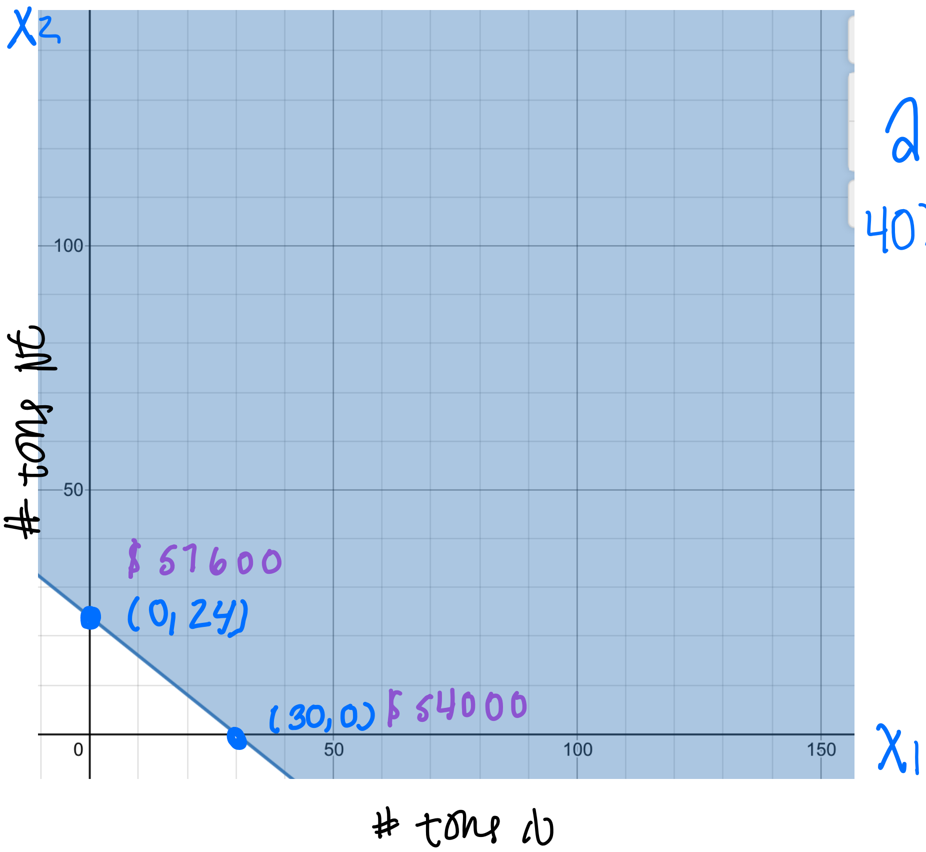
$x_2 \geq 0$

(1B) graphing + cost



amount of gold

$40x_1 + 60x_2 \geq 1600$ lbs gold

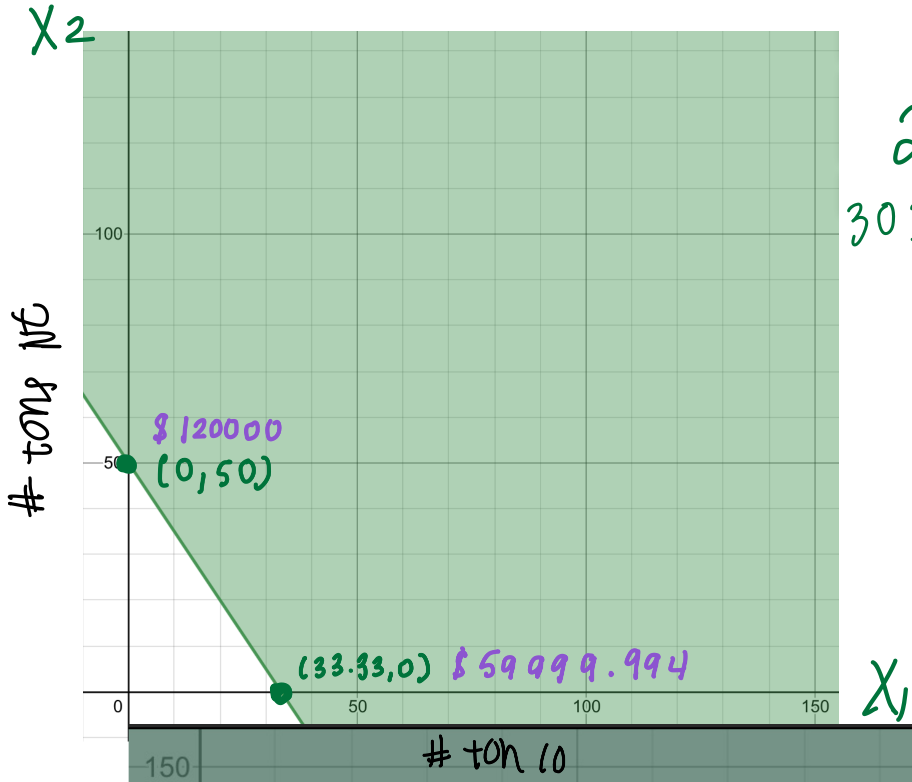


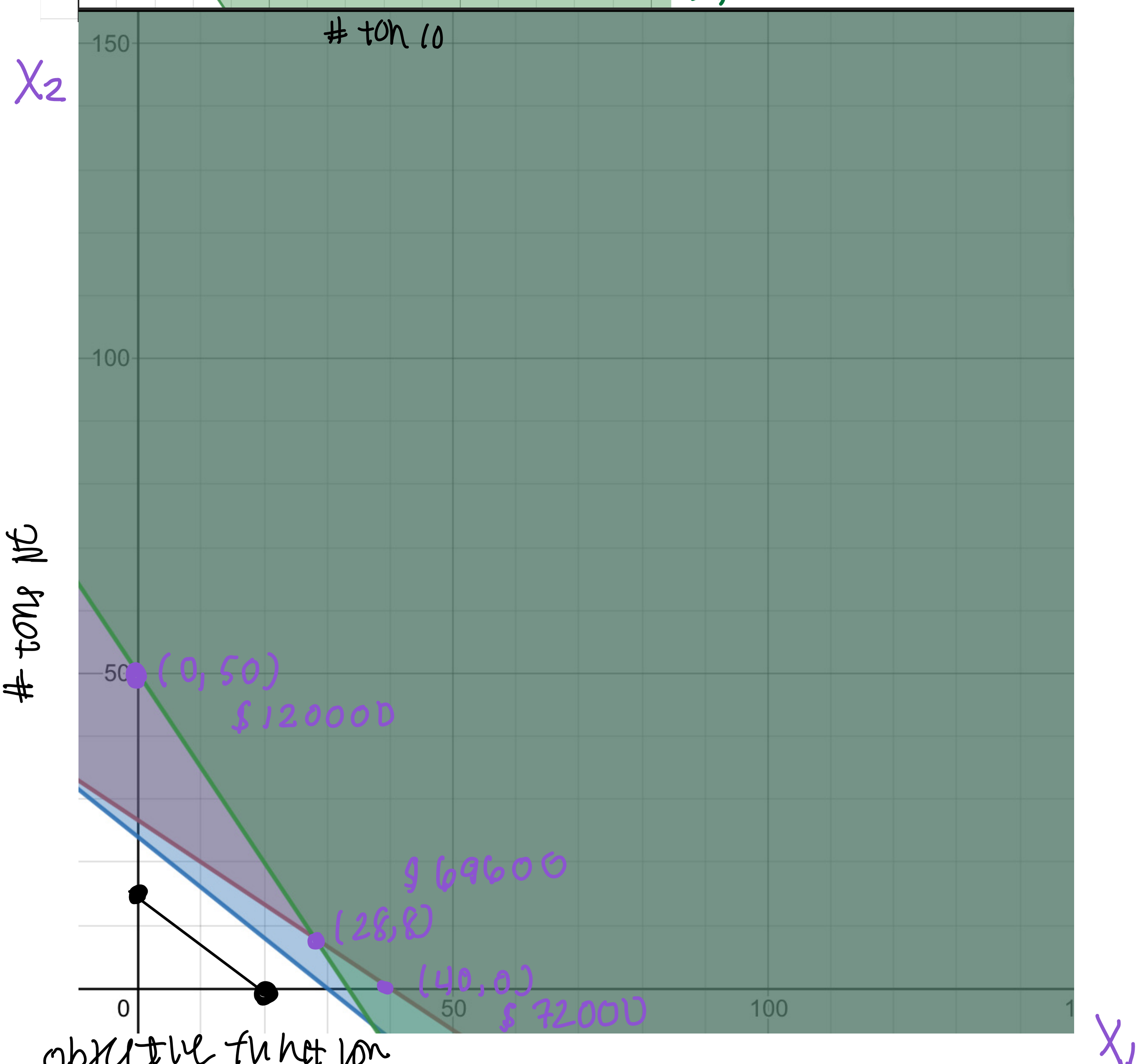
amount of silver

$40x_1 + 50x_2 \geq 1200$ lbs silver

amount of copper

$30x_1 + 20x_2 \geq 1000$ lbs copper

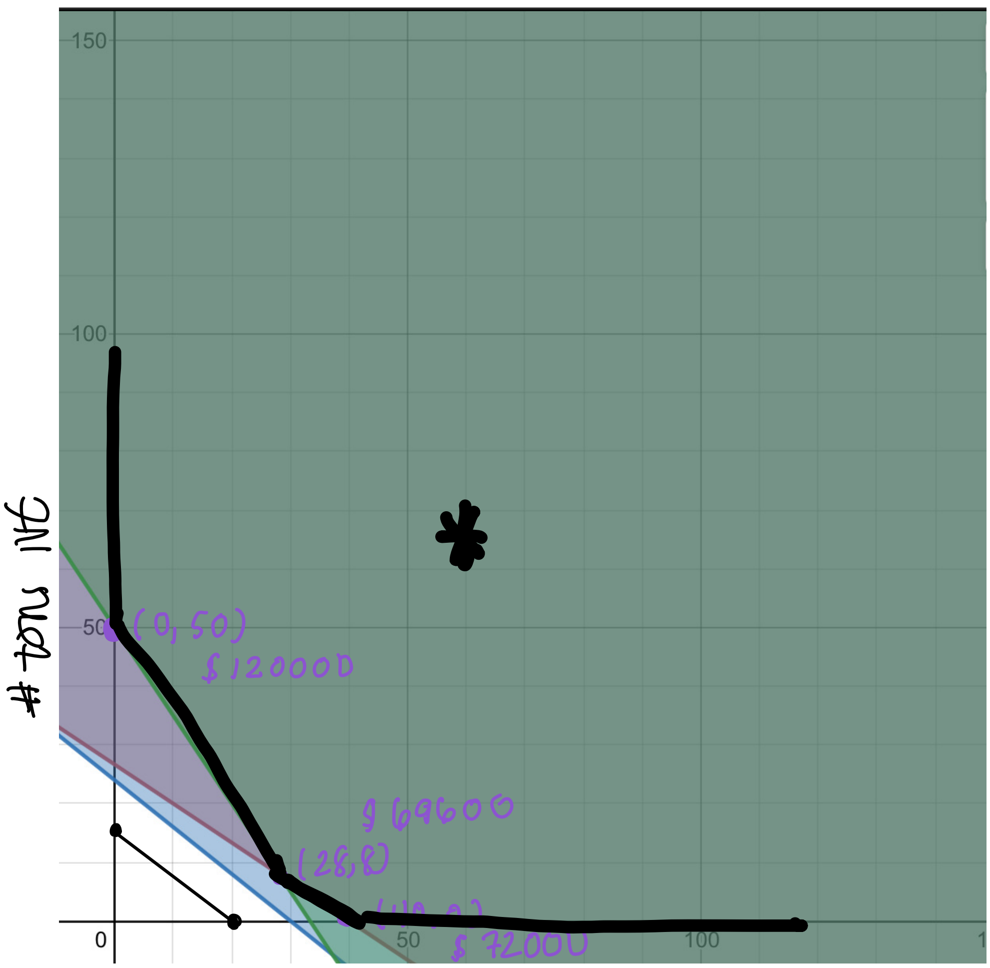




objective function

$1800x_1 + 2400x_2 = 36000$

tons co



tons CO

objective function
1800 X1 + 2400 X2 = 36000

* fesible region

Solution:

the optimal solution is excavating 28 tons from colorado and 8 tons from nevada for a minimal cost $69,600.

1P

2. (50pts) Consider the following linear programming problem:

MIN $5X_1 + 2X_2$ =10

$x_1 = 2$ $x_2 = 0$

$x_2 = 5$ $x_1 = 0$

ST

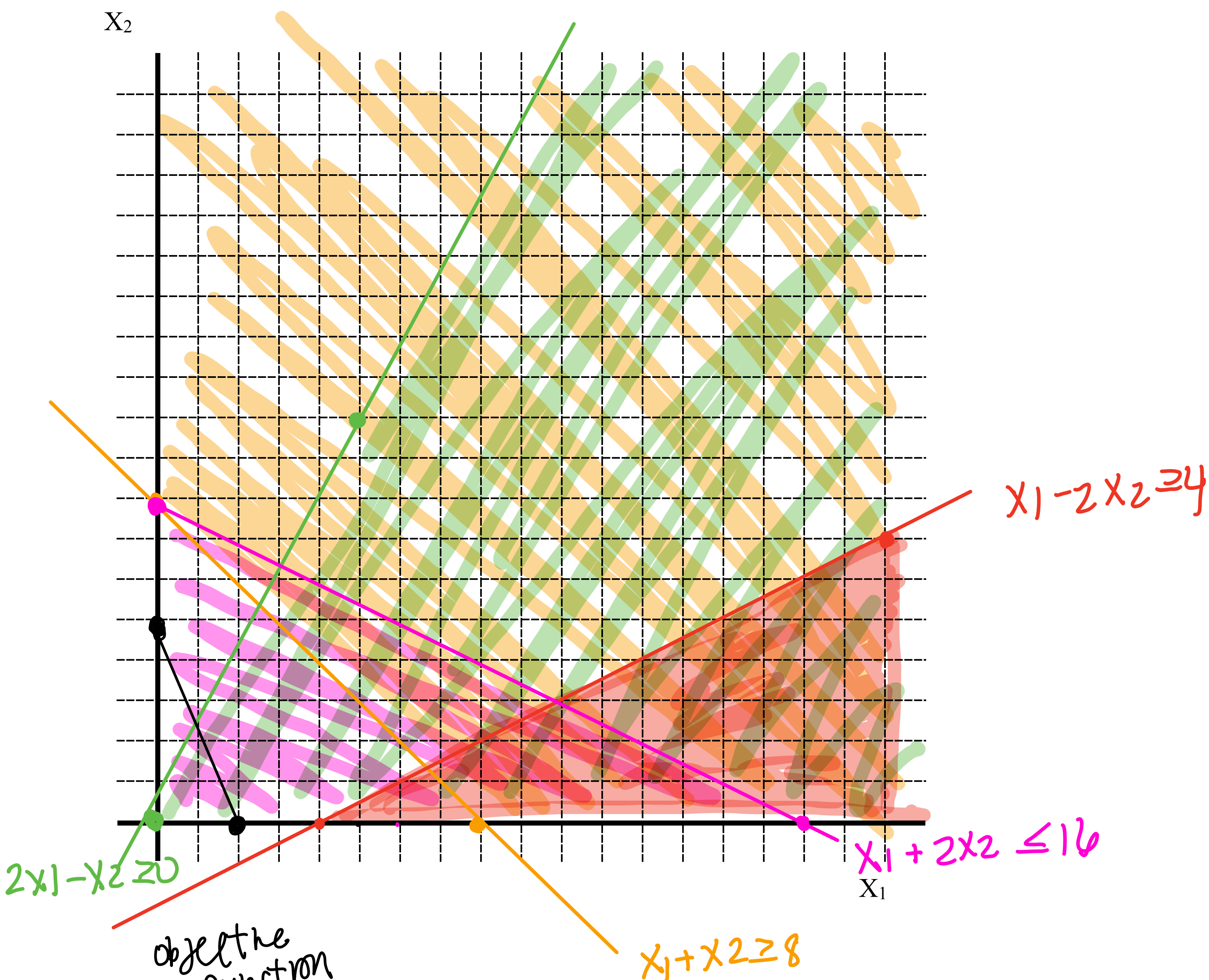
$X_1 + X_2 \geq 8$ (C1)

$X_1 - 2X_2 \geq 4$ (C2)

$X_1 + 2X_2 \leq 16$ (C3)

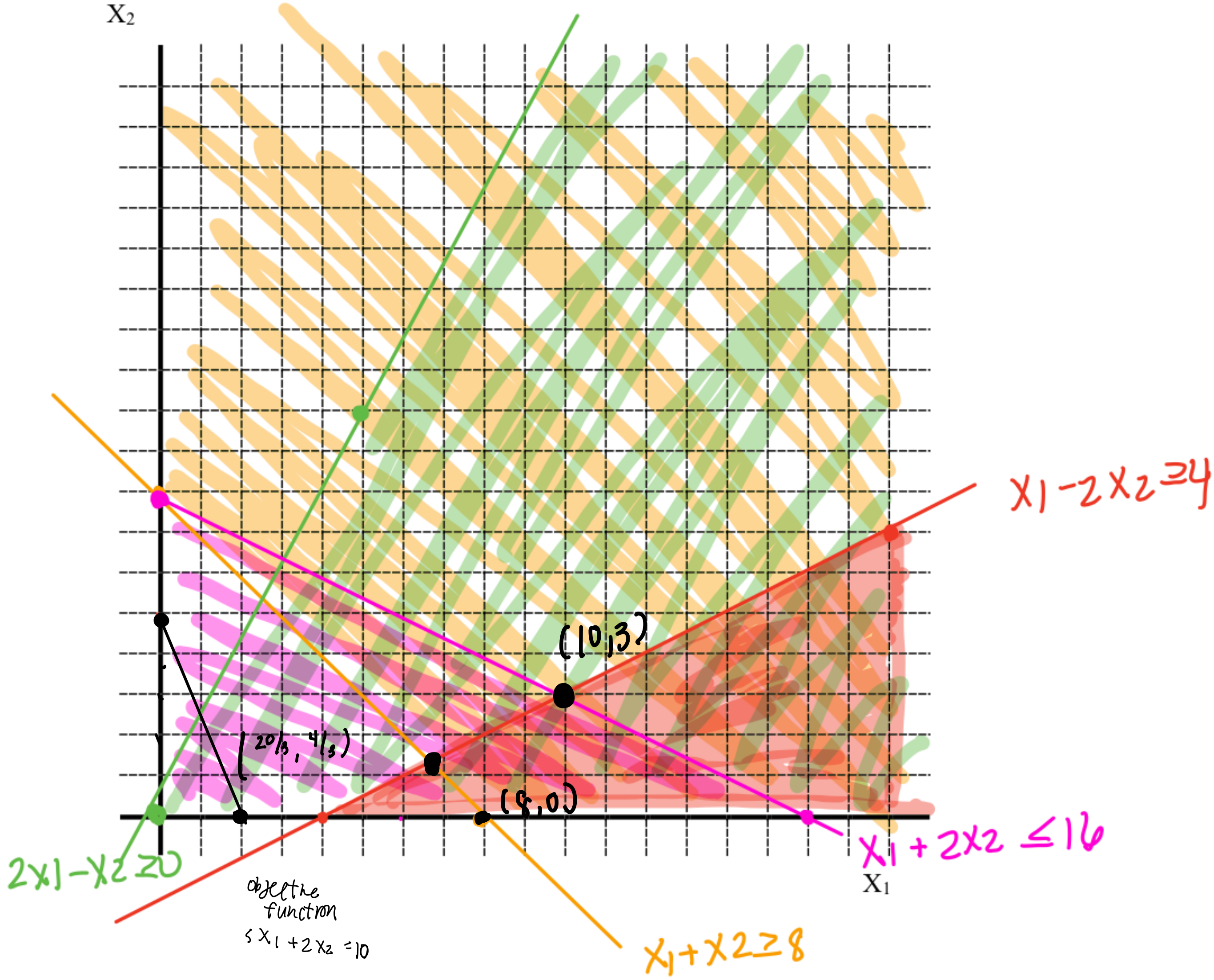
$2X_1 - X_2 \geq 0$ (C4)

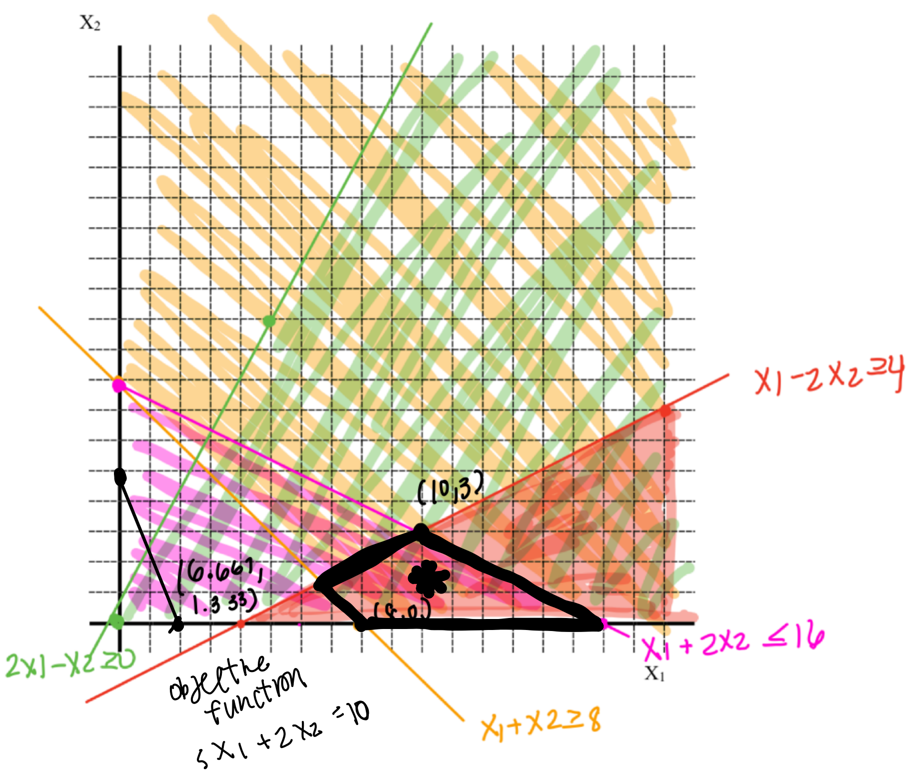
$X_1, X_2 \geq 0$



objective function

$5X_1 + 2X_2 = 10$





* feasible region

(2D)

potential solutions: (x_1, x_2) $\quad 5x_1 + 2x_2$

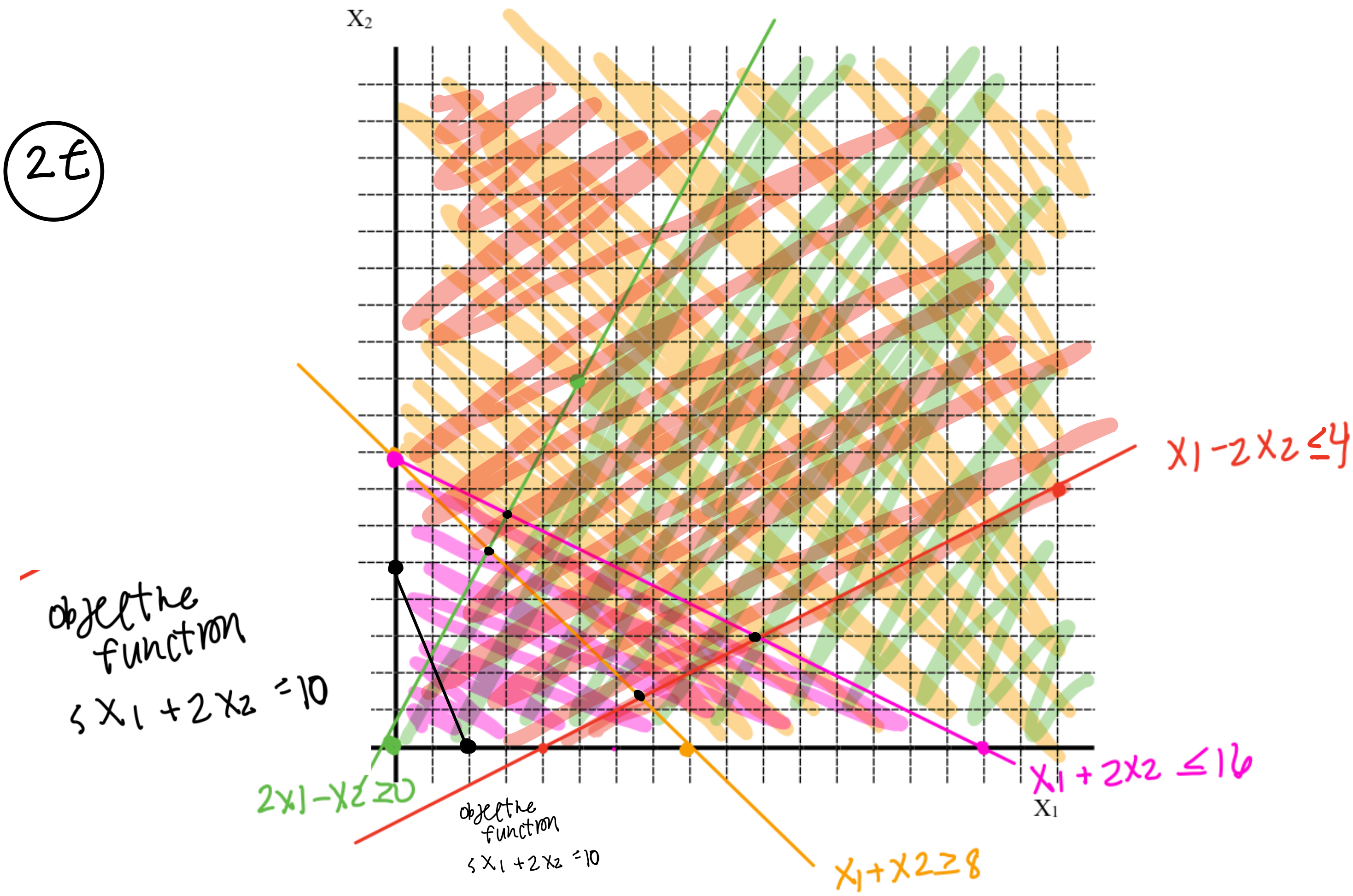
$(10, 3) \rightarrow 5(10) + 2(3) = 56$

$(8, 0) \rightarrow 5(8) + 2(0) = 40$

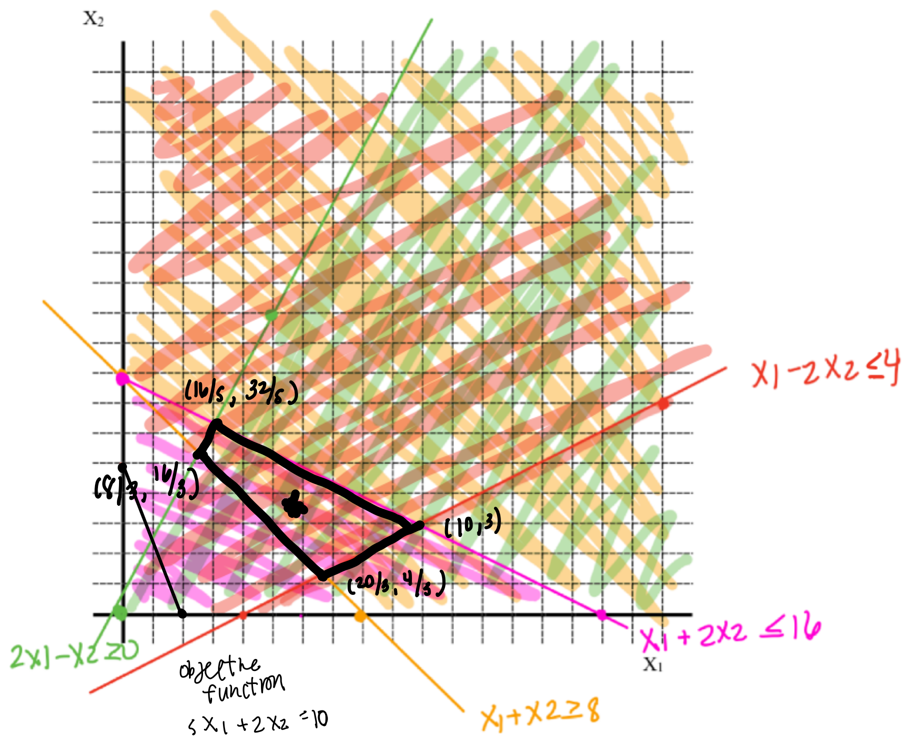
$(20/3, 4/3) \rightarrow 5(20/3) + 2(4/3) = 36$

the optimal solution is when $x_1 = 20/3$ and $x_2 = 4/3$ with a minimum objective $(5x_1 + 2x_2)$ of 36

(2E)



If the sign of constraint C2 is changed to ≤ the feasible region we are looking at would change. We would be looking for an optimal sol in the following region:



we would have different options for feasible solutions (X_1, X_2) as: $(8/3, 16/3)$, $(20/3, 4/3)$, $(16/5, 32/5)$, $(10, 3)$

the new optimal solution would be $(8/3, 16/3)$

where $5(8/3) + 2(16/3) = 24$.

The newest minimized optimal sol is $(8/3, 16/3)$

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On the diagram above:

a. Plot and label the constraints

b. Shade the feasible region

c. Graph the objective function

d. Calculate and label the optimal solution. If none exists, explain why.

e. If the sign of constraint C2 is changed to ≤, what is the effect on the problem? Explain.

- Unbounded problem
- Infeasible problem
- Multiple optima
- No change
- Other…

Notes:

- If you encounter problems, please ask for help.
- You may discuss this assignment with one another, but you must *write up each assignment individually.* Note that this precludes copying material or from sharing computer files – the work you submit must be your own.
- Please put each problem on a separate page.
- Handwritten work is acceptable (and encouraged) if legible and well organized.