# Math 115

# Fall 2017

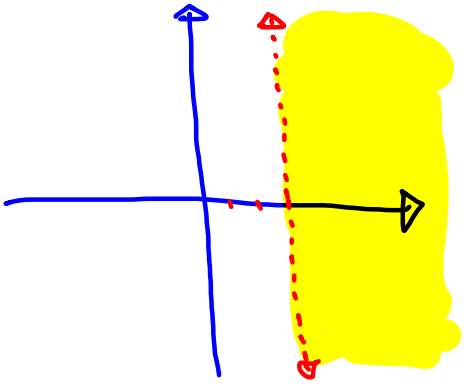
# Lecture 13


## Graphing / Shading linear inequalities:

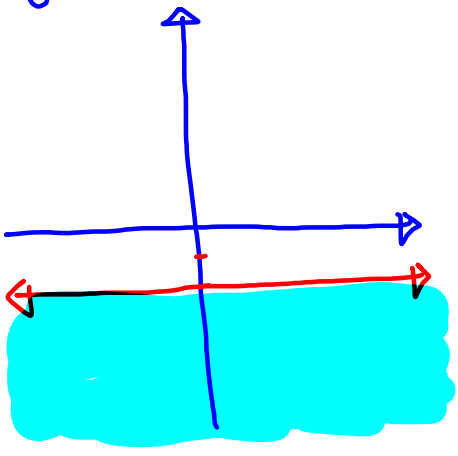
| Dashed lines | | Solid lines | |
|---|---|---|---|
| $x < a$ | Left | $x \leq a$ | Vertical lines |
| $x > a$ | Right | $x \geq a$ | |
| $y < b$ | below | $y \leq b$ | Horizontal line |
| $y > b$ | Above | $y \geq b$ | |
| $y < mx + b$ | below | $y \leq mx + b$ | Slant lines |
| $y > mx + b$ | Above | $y \geq mx + b$ | |

Graph & shade

$x > 3$



$y \leq -2$

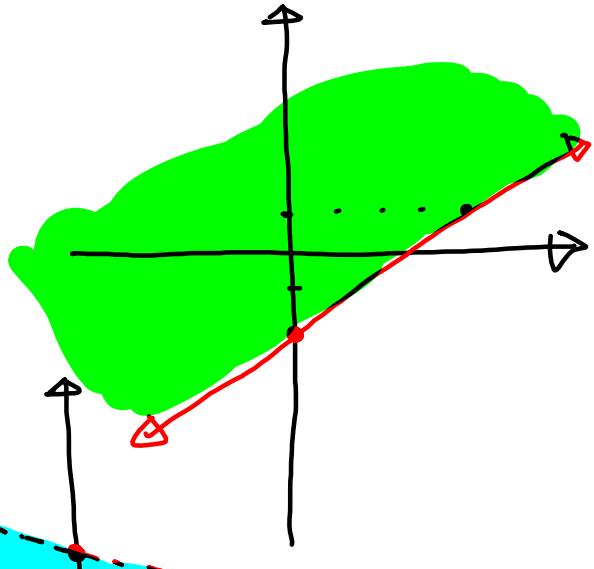


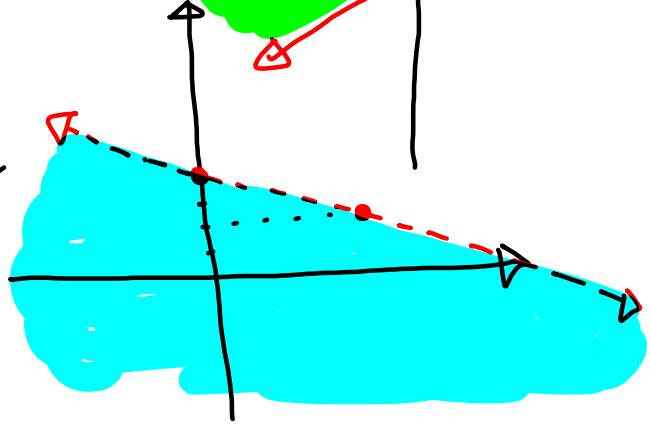
Graph & shade

$y \geq \frac{3}{4}x - 2$

$y < \frac{-2}{5}x + 4$

Graph & shade





Graph & Shade

$2x - 3y \leq 6$

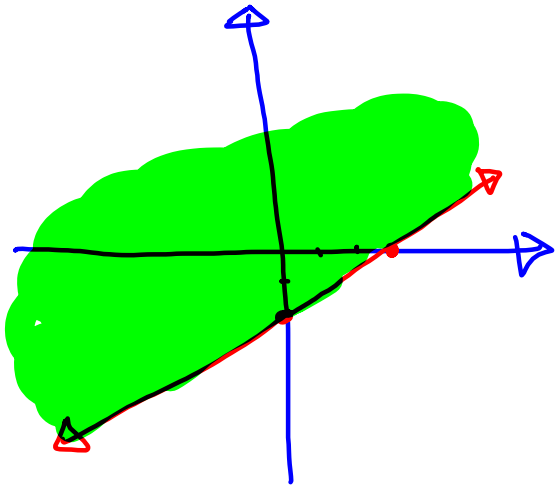
Hint: Write in Slope-Int form

$-3y \leq -2x + 6$

Divide by $-3$

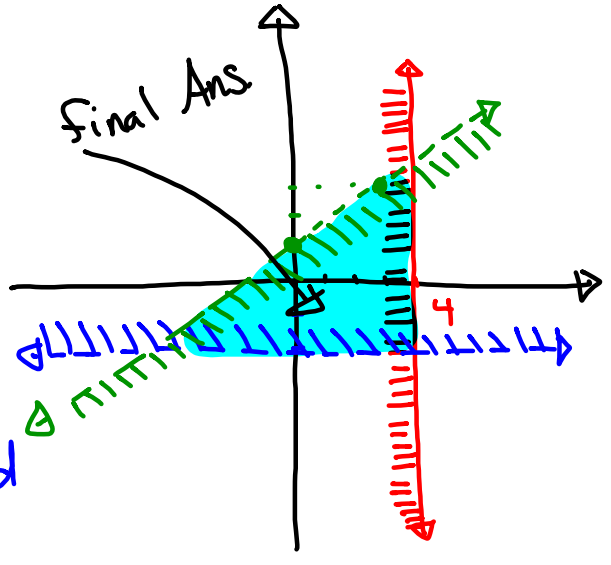
$\frac{-3}{-3}y \geq \frac{-2}{-3}x + \frac{6}{-3}$

$y \geq \frac{2}{3}x - 2$



Graph & Shade

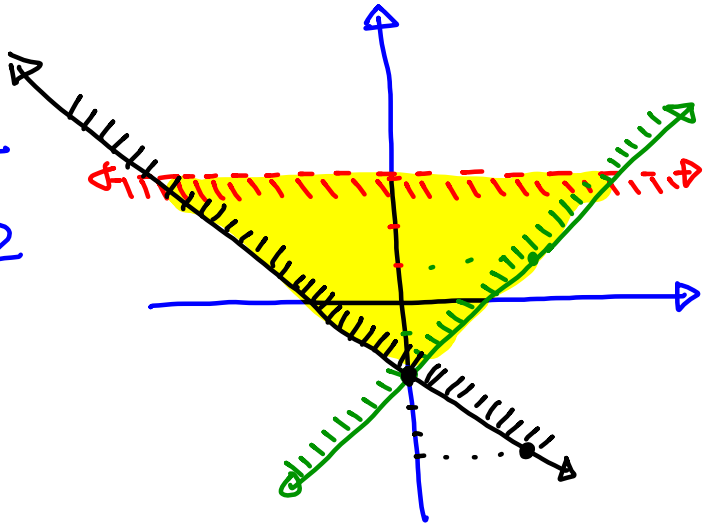
$$\begin{cases} x \leq 4 \\ y > -2 \\ y < \frac{2}{3}x + 1 \end{cases}$$




Final answer should be the region shaded by all three.

## Graph & Shade

$$\begin{cases} y < 3 \\ y \geq \frac{3}{4}x - 2 \\ y \geq \frac{-3}{4}x - 2 \end{cases}$$



## System of linear Equations in 2-Variables:

$$\begin{cases} x + y = 5 \\ x - y = 1 \end{cases}$$

A solution if exists, is an ordered-pair that has to satisfy all equations in the system.

Is $(1,4)$ a Solution for the system above?

$x + y = 5$

$1 + 4 = 5$ ✓

$x - y = 1$

$1 - 4 = 1$

$-3 = 1$ false

$(1,4)$ is not a Solution.

Is $(3,2)$ a Solution of

$$\begin{cases} x+y=5 \\ x-y=1 \end{cases}$$

$3+2=5$ $\quad$ $3-2=1$

$5=5$ ✓ $\quad$ $1=1$ ✓

So $(3,2)$ is a Solution of the system.

Is $(-4,2)$ a Solution of $\begin{cases} x+2y=0 \\ -3x+4y=-20 \end{cases}$ ?

$x+2y=0$ $\quad$ $-3x+4y=-20$

$-4+2(2)=0$ $\quad$ $-3(-4)+4(2)=-20$

$-4+4=0$ ✓ $\quad$ $12+8=-20$ ✗

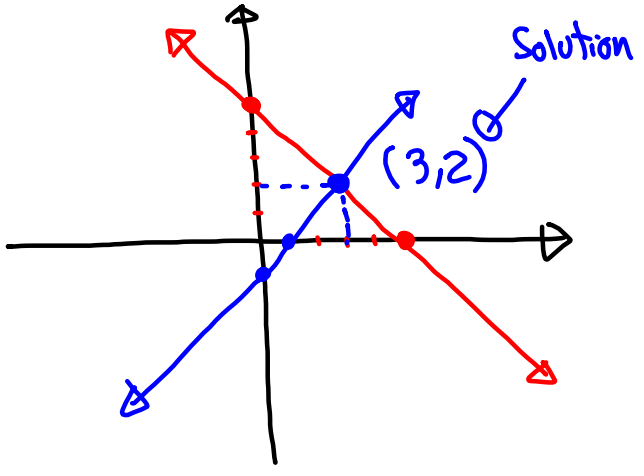
$20=-20$ false

$(-4,2)$ is not a Soln

We Study 3 methods in this class on how to Solve System of equations

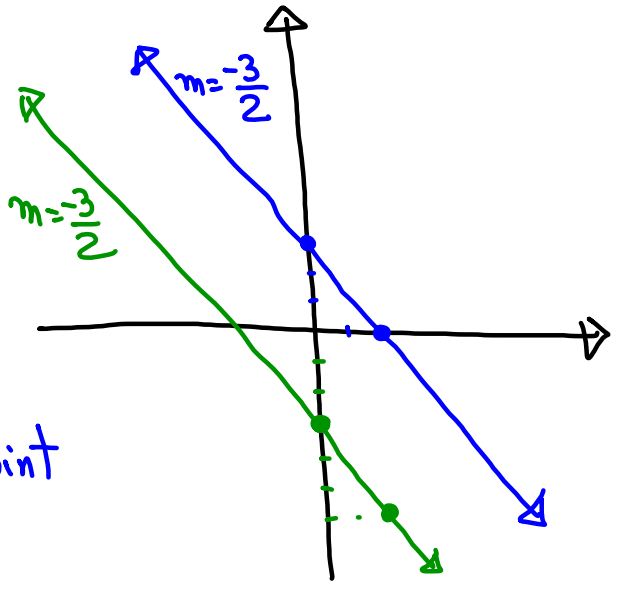
1) Graphing $\quad$ 2) Substitution $\quad$ 3) Elimination

$$\begin{cases} x+y=5 \\ x-y=1 \end{cases}$$



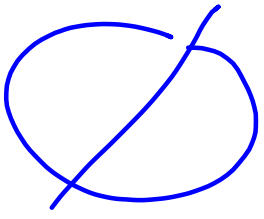
Solve by graphing

$$\begin{cases} 3x + 2y = 6 \\ y = \frac{-3}{2}x - 3 \end{cases}$$



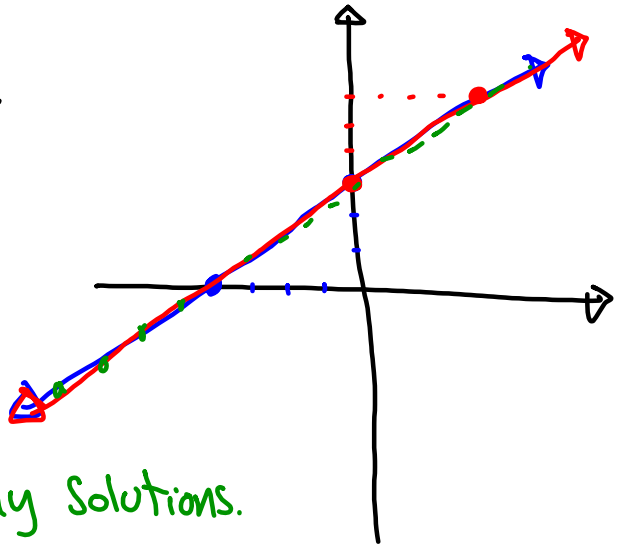

Parallel lines

No intersection Point



Solve by graphing

$$\begin{cases} 3x - 4y = -12 \\ y = \frac{3}{4}x + 3 \end{cases}$$



Infinitely Many Solutions.

$$\begin{cases} 3x - 2y = 5 \\ y = x - 4 \end{cases}$$

Substitution method

$3x - 2(x-4) = 5$

$3x - 2x + 8 = 5$

$x = 5 - 8$

$\boxed{x = -3}$

$y = -3 - 4$

$\boxed{y = -7}$

$(-3, -7)$

Solve by Subs. method:

$$\begin{cases} 5x + 2y = -10 \\ y = -4 - 2x \end{cases}$$

$5x + 2(-4 - 2x) = -10$

$5x - 8 - 4x = -10$

$x - 8 = -10$

$x = -10 + 8$

$\boxed{x = -2}$

$y = -4 - 2(-2)$

$= -4 + 4$

$\boxed{y = 0}$

$(-2, 0)$

The sum of two numbers is 5 one of them is 3 more than the other one. Use system of linear eqns in two variables to find them.

$\begin{cases} x + y = 5 \\ x = y + 3 \end{cases}$

Use Subs. method.

$(y+3) + y = 5$

$2y = 2$ $\quad y = 1$

$x = 1 + 3$ $\quad x = 4$

Numbers are 4 and 1.

Perimeter of a rectangular room is 44 ft. Its length is 1 ft more than twice its width.

Use system of linear eqns in two variables to find its dimensions.


$\begin{cases} 2L + 2W = 44 \\ L = 2W + 1 \end{cases}$

$2(2W+1) + 2W = 44$

$4W + 2 + 2W = 44$

$6W = 42$ $\quad W = 7$

$L = 2(7) + 1$

$L = 15$

Solve by Subs.

$$\begin{cases} 6x - 3y = 5 \\ y = 2x - 3 \end{cases}$$

$6x - 3(2x - 3) = 5$

$6x - 6x + 9 = 5$

$9 = 5$ False

$\varnothing$

$$\begin{cases} 4x - y = 8 \\ y = 4x - 8 \end{cases}$$

$4x - (4x - 8) = 8$

$4x - 4x + 8 = 8$

$8 = 8$

Infinitely Many Solutions True

Recall

Elimination Method

$$\begin{cases} x + y = 5 \\ x - y = 1 \end{cases}$$

$$2x = 6$$

$$\boxed{x = 3}$$

$$3 + y = 5$$

$$\boxed{y = 2}$$

Some books call this Addition method.

Final Ans $(3, 2)$

Solve by Addition/Elimination method:

$$3\begin{cases} 2x - y = -2 \\ -x + 3y = -4 \end{cases} \Rightarrow \begin{cases} 6x - 3y = -6 \\ -x + 3y = -4 \end{cases}$$

$$5x = -10$$

$$-(-2) + 3y = -4$$

$$\boxed{x = -2}$$

$$2 + 3y = -4$$

$$3y = -4 - 2$$

$$3y = -6$$

$$\boxed{y = -2}$$

$$(-2, -2)$$

Solve by elimination method

$$\begin{cases} x + 4y = 14 \\ 5x + 3y = 2 \end{cases} \xrightarrow{\times -5} \begin{cases} -5x - 20y = -70 \\ 5x + 3y = 2 \end{cases}$$

$$-17y = -68$$

$$\boxed{y = 4}$$

$$x + 4(4) = 14$$

$$x + 16 = 14$$

$$\boxed{x = -2}$$

$$(-2, 4)$$

Solve by elimination

$$\begin{cases} -2x + 3y = 10 \\ 3x + 4y = 2 \end{cases} \xrightarrow{\begin{matrix} \times 3 \\ \times 2 \end{matrix}} \begin{cases} -6x + 9y = 30 \\ 6x + 8y = 4 \end{cases}$$

$$17y = 34$$

$$\boxed{y = 2}$$

$$3x + 4(2) = 2$$

$$3x + 8 = 2$$

$$3x = 2 - 8$$

$$3x = -6$$

$$\boxed{x = -2}$$

$$(-2, 2)$$

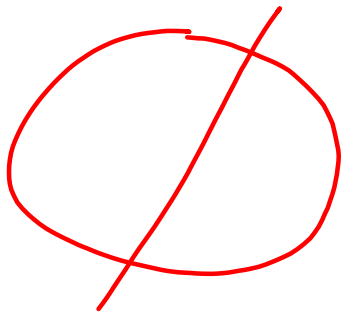
Solve by elimination/addition:

$$\begin{cases} 3x + y = 4 \\ 9x + 3y = -6 \end{cases} \quad -3$$

$$\Rightarrow \begin{cases} -9x - 3y = -12 \\ 9x + 3y = -6 \end{cases}$$

$$0 = -18$$

false



Solve

$$\begin{cases} 4x - 6y = 8 \\ 6x - 9y = 12 \end{cases} \quad \begin{matrix} \div 2 \\ \div 3 \end{matrix}$$

even, Divisible by 2

Divisible by 3

$$\begin{cases} 2x - 3y = 4 \\ 2x - 3y = 4 \end{cases} \quad -1$$

$$\Rightarrow \begin{cases} 2x - 3y = 4 \\ -2x + 3y = -4 \end{cases}$$

$$0 = 0$$

True

Infinitely Many Solns.

$$\begin{cases} x - \frac{y}{3} = -1 & \text{LCD}=3 \\ \frac{-x}{2} + \frac{y}{8} = \frac{1}{4} & \text{LCD}=8 \end{cases}$$

$$\begin{cases} 3x - y = -3 \\ -4x + y = 2 \end{cases}$$

$-4x + y = 2$

$-x = -1$

$x = 1$

$-4(1) + y = 2$

$-4 + y = 2$

$y = 6$

$(1, 6)$

Solve

Hint: Clear fractions by using LCD.

$$\begin{cases} \frac{x}{2} + \frac{y}{8} = 3 & \text{LCD}=8 \\ x - \frac{y}{4} = 0 & \text{LCD}=4 \end{cases}$$

$$\begin{cases} 4x + y = 24 \\ 4x - y = 0 \end{cases}$$

$8x = 24$

$x = 3$

$4(3) - y = 0$

$12 = y$

$(3, 12)$

Solve

Hint: See last example.

$$\begin{cases} \frac{x}{2} + \frac{y}{4} = 1 & \text{LCD}=4 \\ -\frac{x}{4} - \frac{y}{8} = 1 & \text{LCD}=8 \end{cases}$$

$$\begin{cases} 2x + y = 4 \\ -2x - y = 8 \end{cases}$$

$$0 = 12$$

False $\quad \emptyset$

Jose has \$3.80 in Dimes & Quarters.

He has 20 coins. How many of each?

$$\begin{cases} D + Q = 20 \\ 10D + 25Q = 380 \end{cases} \div 5 \quad \Rightarrow \quad \begin{cases} D + Q = 20 \\ 2D + 5Q = 76 \end{cases} \times -2$$

$$\begin{cases} -2D - 2Q = -40 \\ 2D + 5Q = 76 \end{cases}$$

$$3Q = 36$$

$$Q = 12$$

12 Quarters & 8 Dimes

Find eqn of a line that contains $(-4, 2)$ and parallel to $y = \frac{1}{2}x - 1$.

Same slope $m = \frac{1}{2}$

$y - y_1 = m(x - x_1)$

$y - 2 = \frac{1}{2}(x - -4)$

$y - 2 = \frac{1}{2}(x + 4)$ $\quad$ $y - 2 = \frac{1}{2}x + 2$

$\boxed{y = \frac{1}{2}x + 4}$

Find eqn of a line that contains $(3, -5)$ and perpendicular to $y = \frac{-3}{4}x + 2$.

Product of slopes is $-1$, $m = \frac{4}{3}$

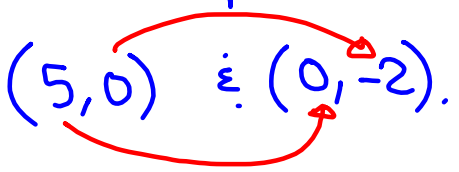
$\frac{4}{3} \cdot \frac{-3}{4} = -1$

$y - -5 = \frac{4}{3}(x - 3)$

$y + 5 = \frac{4}{3}x - 4$

$\boxed{y = \frac{4}{3}x - 9}$

Find eqn of a line that contains $(5,0)$ & $(0,-2)$.



$$m = \frac{0-(-2)}{5-0} = \frac{2}{5}$$

$$y - (-2) = \frac{2}{5}(x - 0)$$

$$y + 2 = \frac{2}{5}x$$

$$\boxed{y = \frac{2}{5}x - 2}$$

Exam II Monday

Project I Monday

Be prepared to turn in

SG 9 & 10 tomorrow.