

# Linear Systems and The Number of Solutions

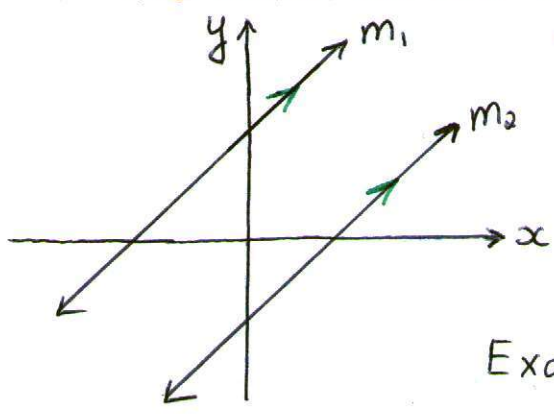
## Case 1: Two Parallel Lines

The lines do not intersect  $\rightarrow$  no POI (no solution)

lines stay same distance away from each other, while being two distinct lines

Condition:

$$m_1 = m_2 \text{ but } b_1 \neq b_2 \text{ (so lines do not coincide)}$$



Example: 
$$\begin{cases} y = 3x + 1 \\ y = 3x - 2 \end{cases}$$

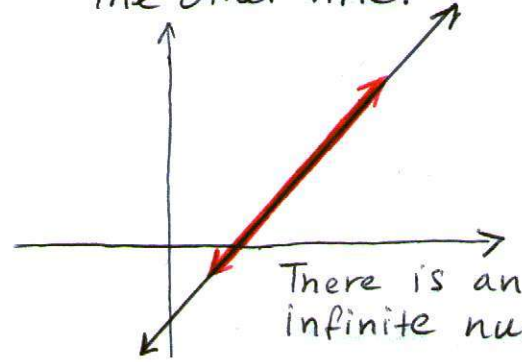
## Case 2: The Lines Coincide: One Line is Drawn Directly on The other line.

Lines are identical, though could be in different form

Condition:

$$\begin{cases} m_1 = m_2 \\ b_1 = b_2 \end{cases}$$

Equation of one line could be a multiple of equation of the other line.



There is an infinite number of solutions.

Example 1: 
$$\begin{cases} y = -2x + 1 \\ y = -2x + 1 \end{cases}$$

or

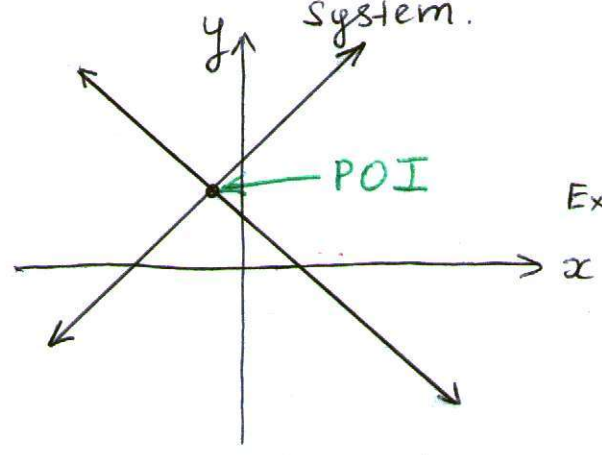
Example 2: 
$$\begin{cases} y = -2x + 1 \\ 2y = -4x + 2 \end{cases}$$

## Case 3: Two Lines Intersect at One Point.

There is one POI: one solution to the linear system.

$$m_1 \neq m_2$$

The y-intercepts may or may not be the same.



Example: 
$$\begin{cases} y = 3x - 1 \\ y = 5x + 3 \end{cases}$$