3.2/3.3 Using Matrices to Solve Systems of Equations

Ex $2x - y = 3$
$-x + 2y = -4$

$$\left[\begin{array}{cc|c} 2 & -1 & 3 \\ -1 & 2 & -4 \end{array}\right]$$ ← Setup

Calculator

2nd Matrix
Edit
Go back home
2nd Matrix
↳ Math
↳ rref
Enter
2nd Matrix
Select your matrix

Show ↓

$$\left[\begin{array}{cc|c} 1 & 0 & 2/3 \\ 0 & 1 & -5/3 \end{array}\right]$$

$x = \frac{2}{3}$
$y = -5/3$] Solution

Check $2\left(\frac{2}{3}\right) - \left(\frac{-5}{3}\right) = 3$

$\frac{-2}{3} + 2\left(\frac{-5}{3}\right) = -4$

Ex $\frac{-2}{3}x + \frac{1}{2}y = -3$

$\frac{1}{4}x - y = \frac{11}{4}$

x	y	sols/RHS
$-2/3$	$\frac{1}{2}$	-3
$1/4$	-1	$\frac{11}{4}$

Row Reduced

$$\left[\begin{array}{cc|c} 1 & 0 & 3 \\ 0 & 1 & -2 \end{array}\right]$$

$x = 3$
$y = -2$] Solution

Calculator

2nd Matrix
Edit
Go Home
2nd Matrix
↳ Math
↳ rref
2nd Matrix
Sel our matrix

Ex $2x + y + 3z = 1$

$4x + 2y + 4z = 4$

$x + 2y + z = 4$

Matrix

$$\left[\begin{array}{ccc|c} 2 & 1 & 3 & 1 \\ 4 & 2 & 4 & 4 \\ 1 & 2 & 1 & 4 \end{array}\right]$$

Reduced

$$\left[\begin{array}{ccc|c} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & -1 \end{array}\right]$$

$x = 1$

$y = 2$

$z = -1$] Sol

Ex Infinitely many Solutions

$x + y + z = 1$

$\frac{1}{4}x - \frac{1}{2}y + \frac{3}{4}z = 0$

$x + 7y - 3z = 3$

Matrix

$$\left[\begin{array}{ccc|c} 1 & 1 & 1 & 1 \\ 1/4 & -1/2 & 3/4 & 0 \\ 1 & 7 & -3 & 3 \end{array}\right]$$

Reduced

$$\left[\begin{array}{ccc|c} 1 & 0 & 5/3 & 2/3 \\ 0 & 1 & -2/3 & 1/3 \\ 0 & 0 & 0 & 0 \end{array}\right]$$

Quiz/Exam Row 3 has all 0's, so the system has inf. many solutions

$x + \frac{5}{3}z = \frac{2}{3}$

$y - \frac{2}{3}z = \frac{1}{3}$

$0x + 0y + 0z = 0$] Always true $(0 = 0)$

Ex No Sols.

$x + y + z = 1$

$2x - y + z = 0$

$4x + y + 3z = 3$

Matrix

$$\left[\begin{array}{ccc|c} 1 & 1 & 1 & 1 \\ 2 & -1 & 1 & 0 \\ 4 & 1 & 3 & 3 \end{array}\right]$$

Row-Reduced

$$\left[\begin{array}{ccc|c} 1 & 0 & 2/3 & 0 \\ 0 & 1 & 1/3 & 0 \\ 0 & 0 & 0 & 1 \end{array}\right]$$

$x + \frac{2}{3}z = 0$

$y + \frac{1}{3}z = 0$

$0x + 0y + 0z = 1$ $(0 = 1)$

Quiz/Exam As the last row of the row-reduced matrix tells us that $0 = 1$, this system has no sols.

Ex Purchase Airplanes
↳ 4800 person capacity

Plane A: 320 pass, costs $200 M
Plane B: 250 pass, costs $125 M
Plane C: 275 pass, costs $200 M

Cost of Fleet $3,100 M

Told 2x Plane C's as Plane B's · (E.g., C=4, b=2)

Capacity $320a + 250b + 275c = 4800.$
Cost $200a + 125b + 200c = 3100.$
2x Plane C's as B's $2b - c = 0$

Matrix

$$\left[\begin{array}{ccc|c} 320 & 250 & 275 & 4800 \\ 200 & 125 & 200 & 3100 \\ 0 & 2 & -1 & 0 \end{array}\right]$$

$a = 5$
$b = 4$
$c = 8$
Sols