Tickets for a concert sell for $75 in Section A, $55 in Section B, and $30 in Section C. There are 3 times as many seats in Section B as in Section A. There are 23,000 seats sold. The income from selling all of the seats is $870,000.

This information can give us a System of 3 Linear Equations.
Let x = The Number of seats in Section A
Let y = The Number of seats in Section B
Let z = The Number of seats in Section C

From the first Statement: 75x + 55y + 30z Represents all money collected
From the second Statement: 3x = y
From the third Statement: x + y + z = 23,000
From the fourth Statement along with the first Statement: 75x + 55y + 30z = 870,000

This gives us a system of equations:

$$\begin{cases} 3x = y \\ x + y + z = 2300 \\ 75x + 55y + 30z = 870{,}000 \end{cases}$$

We will start by substituting 3x for each instance of y in equations 2 and 3.

$$\begin{cases} x + 3x + z = 23{,}000 \\ 75x + 55(3x) + 30z = 870{,}000 \end{cases} \rightarrow \begin{cases} 4x + z = -23{,}000 \\ 240x + 30z = 870{,}000 \end{cases}$$

Next We Multiply the top Equation by -30 to get opposite z terms, then Add the equations.

$$\begin{cases} -120x - 30z = -690{,}000 \\ 240x + 30z = 870{,}000 \end{cases} \rightarrow -120x = 180{,}000 \rightarrow x = 1500 \rightarrow y = 4500 \rightarrow z = 17{,}000$$

The Solution:
There are 1500 Seats in Section A
There are 4500 Seats in Section B
There are 17,000 Seats in Section C

Solve the System:

$$\begin{cases} x+4y-6z=-1 \\ 2x-y+2z=-7 \\ -x+2y-4z=5 \end{cases}$$

Find a way to make x-terms cancel, or y-terms cancel, or z-terms cancel

If we multiply the top by -2 and the bottom by 2, then we can eliminate x from top and bottom, using the 2nd equation.

$$\begin{cases} -2x-8y+12z=2 \\ 2x-y+2z=-7 \\ -2x+4y-8z=10 \end{cases} \rightarrow$$

After Adding Equation 1 + Equation 2 and also Adding Equation 2 + Equation 3, we get:

$$\begin{cases} -9y+14z=-5 \\ 3y-6z=3 \end{cases} \rightarrow$$

Multiply Equation 2 by 3 to get opposite y-terms:

$$\begin{cases} -9y+14z=-5 \\ 9y-18z=9 \end{cases} \rightarrow$$

Add Equations 1 + Equation 2:

$-4z=4 \rightarrow z=-1$

Find an Equation from above that has z and y to solve for y:

$3y-6z=3 \rightarrow 3y-6(-1)=3 \rightarrow 3y+6=3 \rightarrow y=-1$

Find an Equation from above that has x and solve for it:

$-x+2y-4z=5 \rightarrow -x+2(-1)-4(-1)=5 \; -x-2+4=5 \rightarrow -x+2=5 \rightarrow x=3$

The ordered triple is (3, -1, -1).

Sometimes a System can have multiple solutions.

$$\begin{cases} 7x+8y-6z=31 \\ -2x-3y+z=-6 \\ x+y-z=5 \end{cases}$$

Multiply the second equation by 6 and the 3rd by -6 to get opposite z terms, then Add Equation 1 + Equation 2 and also Add & Equation 1 + Equation 3.

$$\begin{cases} 7x+8y-6z=31 \\ -12x-18y+6z=-36 \\ -6x-6y+6z=-30 \end{cases} \rightarrow \begin{cases} 7x+8y-6z=31 \\ -5x-10y=-6 \\ x+2y=1 \end{cases}$$

Now, Multiply Equation 3 by 5 then Add Equation 2 + Equation 3.

$$\begin{cases} 7x+8y-6z=31 \\ -5x-10y=-6 \\ 5x+10y=5 \end{cases}$$

We notice that our assumption that there is a unique answer leads to a contradiction that 0 = -1
Therefore we can let y stay as y, and x = -2y + 1.
Looking at the top Equation, we can get 6z = 7x + 8y – 31.
With our Substitutions we get: 6z = 7(-2y + 1) + 8y – 31 = -14y + 7 + 8y – 31 = -6y – 24
Therefore z = -y – 4
The Ordered Triple: (-2y + 1, y, -y – 4)

Assignment 008
01.04 Solving Linear Systems – Page 34, #'s 3, 5, 6, 20, 25, 26.

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01.04 Solving Linear Systems – Page 34, #'s 3, 5, 6, 20, 25, 26.

Solve each system of equations.

3. $\begin{cases} x+y-2z=5 \\ -x+2y+z=2 \\ 2x+3y-z=9 \end{cases}$

5. $\begin{cases} 2x+y-z=9 \\ -x+2y+z=-17 \\ 5x+7y+z=4 \end{cases}$

6. $\begin{cases} 3x+2y-z=8 \\ -3x+4y+5z=-14 \\ x-3y+4z=-14 \end{cases}$

20. $\begin{cases} x-6y-2z=-8 \\ -x+5y+3c=2 \\ 3x-2y-4z=18 \end{cases}$

25. $\begin{cases} x+y-z=4 \\ 3x+2y+4z=17 \\ -x+5y+z=8 \end{cases}$

26. $\begin{cases} 2x-y-z=15 \\ 4x+5y+2z=10 \\ -x-4y+3z=-20 \end{cases}$