**Activity 8.4.1** **Solving Systems of Linear Equations with Matrix Algebra**

1. At the movie theater, the cost of two theater tickets and four soft drinks is $25.00 The cost of three theater tickets and one soft drink is $30.00 What is the cost of each theater ticket and soft drink?

You have solved problems like this before using several strategies. Give several examples of strategies you have used in the past to solve problems like this.

1. Write an equation and define the variables for this sentence:

The cost of two theater tickets and four soft drinks is $25.00. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Write an equation for this sentence:

The cost of three theater tickets and one soft drink is $30.00. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Now use any method familiar to you to solve the system of two equations.
2. What is the cost of each theater ticket? \_\_\_\_\_\_ and soft drink? \_\_\_\_\_\_
3. Look at the system of equations in standard form and write the numerical coefficients of the equations in a 2×2 matrix:

We can use vector notation to write the two variables for the above equation as a vector:

1. Now multiply the matrix by the vector:

Notice that this gives the left sides of the two equations.

So the matrix equation is another way of writing the original system:

1. We will solve the matrix equation using the inverse of matrix *A.* Use your graphing calculator to find the inverse of matrix

Write your answer below:

1. Next, fill in the inverse matrix entries and multiply both sides of the matrix equation by the inverse matrix. Why must we multiply from the left on both sides?
2. Now complete the multiplication by hand:
3. Verify that by showing your work, and so , so *x* = 9.5, *y* = 1.5

So by multiplying both sides of the matrix equation by the inverse matrix, we solved the system of equations, and found that:

 and a ticket is $9.50 and a soda $1.50.

If we name the vector then the whole process looks like this:

* Start with a system of equations in standard form
* Write the matrix equation
* Find the inverse matrix
* Multiply the matrix equation by the inverse matrix
* Since **,** We have our solution

Now that we know how useful the inverse of a matrix can be, we will work on ways to find it. Remember that only square matrices have inverses and not all square matrices have an inverse.

Matrices without an inverse are called singular matrices.

1. Example: During matinees, the theater tickets and soft drinks are at a reduced price. Two theater tickets and four soft drinks cost $23.00 Three theater tickets and one soft drink is $28.25
2. Since we already know , and we know that finding the solution only requires multiplying **:**
3. What is the cost of each theater ticket? \_\_\_\_\_\_ and soft drink? \_\_\_\_\_\_\_\_