**Activity 8.4.3 More Contextual Applications with Matrix Algebra**

In the last activity you found that the inverse of matrix $A=\left[\begin{matrix}a&b\\c&d\end{matrix}\right]is A^{-1}=\frac{1}{ad-bc}\left[\begin{matrix}d&-b\\-c&a\end{matrix}\right]$

The quantity $ad-bc$ has a specific name, called the determinant of *A.* So a matrix *A* has an inverse as long as $detA\ne 0$.

Remember the steps for solving a system of equations using matrix algebra:

* Start with a system of equations expressed in standard form
* Write the matrix equation $A\vec{x}=\vec{b}$
* Find the inverse matrix $A^{-1}$
* Multiply the matrix equation by the inverse matrix $A^{-1}A\vec{x}=A^{-1}\vec{b}$
* Since $A^{-1}A\vec{x}=I\vec{x}=\vec{x}$**,** we have our solution $\vec{x}=A^{-1}\vec{b}$
1. Use this method for the following example: Two theater tickets and four beverages cost $59.50 while three theater tickets and two beverages cost $68.75. What is the price for a theater ticket and what is the price for one beverage?
2. Write the system of equations and define the variables:
3. Write the matrix equation:
4. Find the inverse of the matrix:
5. Multiply the matrix equation by the inverse matrix:

Follow the same procedure above to solve the following systems of equations:

1. A series/parallel electrical circuit with a voltage source of 12 volts has a 6 ohm resistor and then a 12 ohm resistor and a 4 ohm resistor in parallel. Resistance is measured in ohms. The symbol for ohms is $Ω$. Current is measured in amperes (amps) and electrical potential is measured in volts.



To find the equivalent resistance, we need to apply Kirchhoff’s laws and Ohm’s law. You do not need to know the details of these laws for this activity. These are the two equations that involve Ohm’s law because the current $i\_{1} $travels through the12 ohm resistor and the current $i\_{2} $travels through the 4 ohm resistor, while the sum of the two currents $i\_{1}+i\_{2 }$travels through both resistors. This gives these two equations:

$$6\left(i\_{1}+i\_{2}\right)+12i\_{1}=6i\_{1}+6i\_{2}+12i\_{1}=18i\_{1}+6i\_{2}=12$$

$$6\left(i\_{1}+i\_{2}\right)+4i\_{2}=6i\_{1}+6i\_{2}+4i\_{2}=6i\_{1}+10i\_{2}=12$$

1. Using the system above, write the matrix equation:
2. Find the inverse of the matrix of coefficients:
3. Multiply the matrix equation by the matrix inverse to solve:
4. The equivalent resistance is found by dividing the voltage (12 volts) by the total current $i\_{1}+i\_{2}$.

What is the equivalent resistance of this circuit?

1. Another series/parallel electrical circuit with a voltage source of 12 volts has a 3 ohm resistor and then a 12 ohm resistor and a 36 ohm resistor in parallel.



1. As before, to find the equivalent resistance, we need to apply Kirchhoff’s laws and Ohm’s law. These are the two equations that involve Ohm’s law because the current $i\_{1} $travels through 36 ohm resistor and the current $i\_{2} $travels through the 12 ohm resistor, while the sum of the two currents $i\_{1}+i\_{2}$travels through both resistors. This time see if you can create the system of equations using the previous example for guidance.
2. Using the system above, write the matrix equation:
3. Find the inverse of the matrix of coefficients:
4. Multiply the matrix equation by the matrix inverse to solve:
5. The equivalent resistance is found by dividing the voltage (120 volts) by the total current $i\_{1}+i\_{2}$.

What is the equivalent resistance of this circuit?