

Congratulations! You passed!

Grade received 92.86% To pass 80% or higher

Go to next item

You go to the shops on Monday and buy 1 apple, 1 banana, and 1 carrot; the whole transaction totals €15. On
Tuesday you buy 3 apples, 2 bananas, 1 carrot, all for €28. Then on Wednesday 2 apples, 1 banana, 2 carrots, for
€23.

1/1 point

1/1 point

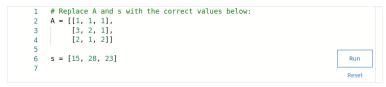
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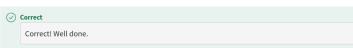
Construct a matrix and vector for this linear algebra system. That is, for

$$A egin{bmatrix} a \ b \ c \end{bmatrix} = egin{bmatrix} s_{ ext{Mon}} \ s_{ ext{Tue}} \ s_{ ext{Wed}} \end{bmatrix}$$

Where a, b, c, are the prices of apples, bananas, and carrots. And each s is the total for that day.

Fill in the components of A and ${f s}.$





2. Given another system, $B\mathbf{r}=\mathbf{t}$,

We wish to convert this to echelon form, by using elimination. Starting with the first row, ①, if we divide the whole row by 4, then the top-left element of the matrix becomes 1.

$$\begin{array}{ccccc}
\textcircled{1} & 3/2 & 1/2 \\
\textcircled{2}' : \begin{bmatrix} 1 & 3/2 & 1/2 \\ 3 & 4 & 1 \\ 2 & 8 & 13 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 9/4 \\ 7 \\ 2 \end{bmatrix}$$

Next, we need to fix the second row. This results in the following,

What steps did we take?

- \bigcirc The new second row, @'' is the old second row minus two times the old first row, i.e., @''=[@'-2@'].
- \bigcirc The new second row, ${\mathfrak D}''$ is the old second row minus three, i.e., ${\mathfrak D}''={\mathfrak D}'-3$.
- \bigcirc The new second row, @'' is the old second row divided by four minus the old first row, i.e., @''=@'/4-@'.
- **()** The new second row, \mathbb{Q}'' is the old second row minus three times the old first row, then all multiplied by -2, i.e., $\mathbb{Q}'' = [\mathbb{Q}' 3\mathbb{D}'] \times (-2)$.

⊘ Correct

We've made the new second row a linear combination of previous rows.

3. From the previous question, our system is almost in echelon form.

Fix row 3 to be a linear combination of the other two. What is the echelon form of the system?

$$\begin{array}{c|cccc}
 & 1 & 3/2 & 1/2 \\
0 & 1 & 1 \\
0 & 5 & 1
\end{array}
\begin{bmatrix}
a \\
b \\
c
\end{bmatrix} = \begin{bmatrix} 9/4 \\
-1/2 \\
-5/2
\end{bmatrix}$$

$$\begin{array}{c|cccc}
 & 1 & 3/2 & 1/2 \\
0 & 1 & 1
\end{array}
\begin{bmatrix}
a \\
b
\end{bmatrix} = \begin{bmatrix} 9/4 \\
-1/2
\end{bmatrix}$$

$$\bigcirc \quad \begin{bmatrix} 1 & 3/2 & 1/2 \end{bmatrix} \quad \begin{bmatrix} a \end{bmatrix} \qquad \begin{bmatrix} 9/4 & 1/2 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} b \\ c \end{bmatrix} = \begin{bmatrix} -1/2 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 9/4 \\ -1/2 \\ -1/4 \end{bmatrix}$$



The matrix is not in echelon form.

4. Taking your answer from the previous part, use back substitution to solve the system.

1/1 point

What is the value of $\begin{bmatrix} a \\ b \\ c \end{bmatrix}$?

$$\mathbf{r} = \begin{bmatrix} 3 \\ -1/2 \\ 0 \end{bmatrix}$$

$$\mathbf{r} = \begin{bmatrix} 9/4 \\ -1/2 \\ 0 \end{bmatrix}$$

$$\bigcirc \mathbf{r} = \begin{bmatrix} 3/2 \\ 1/2 \\ 1 \end{bmatrix}$$

$$\bigcirc \mathbf{r} = \begin{bmatrix} 9 \\ 7 \\ 2 \end{bmatrix}$$



 $\textbf{5.} \quad \text{Let's return to the apples and bananas from Question 1.}$

3 / 3 points

Take your answer to Question 1 and convert the system to echelon form. I.e.,

$$\begin{bmatrix} 1 & A'_{12} & A'_{13} \\ 0 & 1 & A'_{23} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} s'_1 \\ s'_2 \\ s'_3 \end{bmatrix}.$$

Find values for A^\prime and $s^\prime.$

Correct! Well done.

6. Following on from the previous question; now let's solve the system using back substitution.

3 / 3 points

What is the price of apples, bananas, and carrots?

Correct! Well done.

7. If every week, you go to the shops and buy the same amount of apples, bananas, and oranges on Monday, Tuesday, and Wednesday; and every week you get a new list of daily totals - then you should solve the system in general. 3 / 3 points

That is, find the inverse of the matrix you used in Question 1.

⊘ Correct

Correct! Well done

1/1 point

8. In practice, for larger systems, one never solves a linear system by hand as there are software packages that can do this for you - such as *numpy* in Python.

Use this code block to see *numpy* invert a matrix.

You can try to invert any matrix you like. Try it out on your answers to the previous question.

In general, one shouldn't calculate the inverse of a matrix unless absolutely necessary. It is more computationally efficient to solve the linear algebra system if that is all you need.

Use this code block to solve the following linear system with $\mathit{numpy}.\,A\mathbf{r}=\mathbf{s},$

⊘ Correct

In cases when you don't need the inverse matrix itself, linear algebra routines are quicker to solve the system for each case.