✓ **Congratulations! You passed!**

TO PASS 80% or higher

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GRADE
100%

Solving linear equations using the inverse matrix

TOTAL POINTS 14

1. 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

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

$$A \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} s_{\text{Mon}} \\ s_{\text{Tue}} \\ s_{\text{Wed}} \end{bmatrix}$$

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 $\mathbf{s}$.

```
# Replace A and s with the correct values below:
A = [[1, 1, 1],
     [3, 2, 1],
     [2, 1, 2]]

s = [15, 28, 23]

```

Run

Reset

[15, 28, 23]

✓ **Correct**

Correct! Well done.

$$\begin{matrix} ②' : \\ ③'' : \end{matrix} \begin{bmatrix} 0 & 1 & 1 \\ 2 & 8 & 13 \end{bmatrix} \begin{bmatrix} b \\ c \end{bmatrix} = \begin{bmatrix} -1/2 \\ 2 \end{bmatrix}$$

What steps did we take?

- ○ The new second row, ②″ is the old second row minus two times the old first row, i.e., $② '' = [②' - 2①']$.
- ○ The new second row, ②″ is the old second row minus three, i.e., $②'' = ②' - 3$.
- ○ The new second row, ②″ is the old second row divided by four minus the old first row, i.e., $②'' = ②'/4 - ①'$.
- ◉ The new second row, ②″ is the old second row minus three times the old first row, then all multiplied by -2, i.e., $②'' = [②' - 3①'] \times (-2)$.

$$\begin{bmatrix} 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} c \end{bmatrix} \quad \begin{bmatrix} 0 \end{bmatrix}$$

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

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

✓ **Correct**

This system is now in echelon form.

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

✓ **Correct**

Well done!

5. 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.,

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?

```
# Replace a, b, and c with the correct values below:
s = [3, 7, 5]

```

Run

Reset

[3, 7, 5]

✓ **Correct**

Correct! Well done.

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.

1 / 1 point

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.

```
import numpy as np

      [2, 8, 13]]

s = [9, 7, 2]

r = np.linalg.solve(A, s)

```

Run

Reset

[3. -0.5 0.]

✓ **Correct**

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