1.6.8

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If three points $(x, -1)$, $(2, 1)$ and $(4, 5)$ are collinear, find the value of x.

given data

Point	x	y
A	x	-1
B	2	1
C	4	5

Formula

collinearity matrix can be expressed as

$$\begin{pmatrix} A - B & A - C \end{pmatrix} = \begin{pmatrix} x - 2 & x - 4 \\ -2 & -6 \end{pmatrix}$$

Row reduction

$$\begin{pmatrix} x-2 & x-4 \\ -2 & -6 \end{pmatrix} R_2 \leftrightarrow R_1 \implies \begin{pmatrix} -2 & -6 \\ x-2 & x-4 \end{pmatrix}$$

$$\begin{pmatrix} -2 & -6 \\ x-2 & x-4 \end{pmatrix} R_2 \rightarrow R_2 + ((x-2)/2)*R_1 \implies \begin{pmatrix} -2 & -6 \\ 0 & -2x+2 \end{pmatrix}$$

To make the following matrix Rank 1. (i.e., To prove collinearity) Thus, we make the bottom row elements zero.

$$-2x + 2 = 0$$
$$\Rightarrow x = 1$$

Hence, The value of $x = 1$.

Python Code

```python
import matplotlib.pyplot as plt

# Coordinates of the points
points = {'A': (1, -1), 'B': (2, 1), 'C': (4, 5)}
```

Python Code

```python
# Extract x and y coordinates separately
x = [coord[0] for coord in points.values()]
y = [coord[1] for coord in points.values()]
```

```python
# Plot the points
plt.scatter(x, y, color='deepskyblue', label='Points')

# Annotate each point with its label
for label, (x_coord, y_coord) in points.items():
    plt.annotate(label, (x_coord, y_coord), textcoords=offset
        points, xytext=(5,-10), ha='center')

# Plot the line through the points
plt.plot(x, y, color='red', label='Line')

# Label axes
plt.xlabel('x')
plt.ylabel('y')
plt.title('Collinear Points with Labels')

# Display legend
```

C Code

```c
#include <stdio.h>

int main() {

    double y1 = -1.0;
    double x2 = 2.0, y2 = 1.0;
    double x3 = 4.0, y3 = 5.0;
    double x1;
    double numerator = y1 * (x2 - x3) - (x2 * y3 - x3 * y2);

    double denominator = y2 - y3;

    x1 = numerator / denominator;

    printf(Using the matrix determinant method for collinear
        points:\n);
    printf(The value of x is: %.1f\n, x1);

    return 0;
```

```python
import subprocess

# 1. Compile the C program
subprocess.run([gcc, collinear.c, -o, collinear])

# 2. Run the compiled C program
result = subprocess.run([./collinear], capture_output=True, text=
    True)

# 3. Print the output from the C program
print(result.stdout)
```
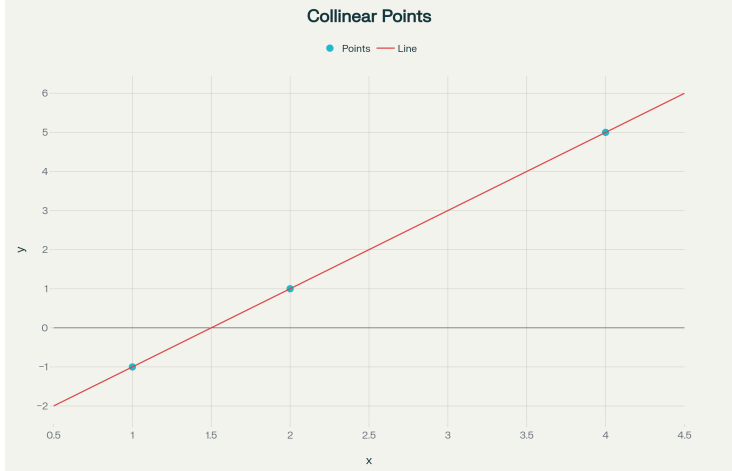
Figure: Collinearity