

Distance Between L And P Line L Contains Points (0,-3)and (7,4) Point P Coordinates(4,3)Help Plsss

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Understanding the concept of the distance between a point and a line is fundamental in coordinate geometry. Whether you're a student studying math, a teacher preparing lessons, or someone working on practical applications involving geometry, knowing how to calculate this distance accurately is essential. In this article, we will explore the problem: "What is the distance between the line L, which contains points (0, -3) and (7, 4), and the point P with coordinates (4, 3)?" We will guide you through the process step-by-step, providing clear explanations, formulas, and examples to ensure you grasp the concept thoroughly.

Understanding the Problem

Before diving into calculations, let's clarify the problem statement and the key elements involved:

- Line L passes through two points: (0, -3) and (7, 4).
- Point P has coordinates: (4, 3).
- Goal: Find the shortest distance from point P to line L.

This problem involves basic principles of coordinate geometry, including the equation of a line and the distance formula from a point to a line.

Step 1: Find the Equation of Line L

To determine the distance from point P to line L, we first need the equation of line L.

Calculating the Slope of Line L

The slope (m) of a line passing through points $((x_1, y_1))$ and $((x_2, y_2))$ is given by:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

\]

Applying this to our points:

$$\begin{aligned} & \backslash[\\ m &= \frac{4 - (-3)}{7 - 0} = \frac{7}{7} = 1 \\ & \backslash] \end{aligned}$$

Therefore, the slope of line L is 1.

Finding the Equation of Line L

Using point-slope form:

$$\begin{aligned} & \backslash[\\ y - y_1 &= m(x - x_1) \\ & \backslash] \end{aligned}$$

Choose point (0, -3):

$$\begin{aligned} & \backslash[\\ y - (-3) &= 1 \times (x - 0) \\ & \backslash] \\ & \backslash[\\ y + 3 &= x \\ & \backslash] \\ & \backslash[\\ \boxed{y} &= x - 3 \\ & \backslash] \end{aligned}$$

Line L's equation in slope-intercept form is $(y = x - 3)$.

Step 2: Convert the Line Equation to Standard Form

The point-to-line distance formula is easiest to apply when the line is expressed in standard form:

$$\begin{aligned} & \backslash[\\ Ax + By + C &= 0 \\ & \backslash] \end{aligned}$$

Rearranged from $(y = x - 3)$:

$$\begin{aligned} & \backslash[\\ & x - y - 3 = 0 \\ & \backslash] \end{aligned}$$

Here:

$$\begin{aligned} & - \backslash(A = 1\backslash) \\ & - \backslash(B = -1\backslash) \\ & - \backslash(C = -3\backslash) \end{aligned}$$

Step 3: Apply the Point-to-Line Distance Formula

The distance (d) from a point $((x_0, y_0))$ to a line $(Ax + By + C = 0)$ is:

$$\begin{aligned} & \backslash[\\ & d = \frac{|A x_0 + B y_0 + C|}{\sqrt{A^2 + B^2}} \\ & \backslash] \end{aligned}$$

Substitute $((x_0, y_0) = (4, 3))$ and the line coefficients:

$$\begin{aligned} & \backslash[\\ & d = \frac{|1 \times 4 + (-1) \times 3 - 3|}{\sqrt{1^2 + (-1)^2}} \\ & \backslash] \end{aligned}$$

Calculate numerator:

$$\begin{aligned} & \backslash[\\ & |4 - 3 - 3| = |-2| = 2 \\ & \backslash] \end{aligned}$$

Calculate denominator:

$$\begin{aligned} & \backslash[\\ & \sqrt{1 + 1} = \sqrt{2} \\ & \backslash] \end{aligned}$$

Thus,

$$\begin{aligned} & \backslash[\\ & d = \frac{2}{\sqrt{2}} = \frac{2 \times \sqrt{2}}{2} = \sqrt{2} \\ & \backslash] \end{aligned}$$

Final answer:

```
\[
\boxed{\text{Distance from point P to line L} = \sqrt{2} \approx 1.414}
\]
```

Additional Considerations and Applications

Beyond the calculation, understanding the significance of this distance can be useful in various contexts:

- Navigation and Mapping: Calculating the shortest path from a point to a route.
- Physics: Determining the minimum distance from an object to a boundary.
- Engineering and Design: Ensuring components are within specified tolerances.

Let's explore some related concepts and tips to deepen your understanding.

Key Concepts Related to Point-to-Line Distance

- Perpendicular Distance: The shortest distance from a point to a line is always along the perpendicular from the point to the line.
- Line Equations: Converting between slope-intercept, point-slope, and standard form is essential for various calculations.
- Coordinate Geometry Tools: Using formulas and algebraic manipulations enables precise computations.

Common Mistakes to Avoid

- Forgetting to take the absolute value in the distance formula.
- Using incorrect line equations or miscalculating the slope.
- Mixing up the numerator and denominator in the formula.
- Not converting the line to standard form before applying the formula.

Practical Example: Visualizing the Problem

Visualizing the problem helps solidify understanding. Imagine plotting points (0, -3) and (7, 4) on a coordinate plane and drawing line L through them. Then, locate point P at (4, 3). The perpendicular from P to line L intersects the line at the closest point, and the length of this perpendicular segment is the shortest distance, which we've calculated as $\sqrt{2}$.

Summary and Key Takeaways

- The line L passing through points $(0, -3)$ and $(7, 4)$ has the equation $(y = x - 3)$.
- Converting this to standard form yields $(x - y - 3 = 0)$.
- The shortest distance from point $P(4, 3)$ to line L is given by the formula:

$$d = \frac{|A x_0 + B y_0 + C|}{\sqrt{A^2 + B^2}}$$

which evaluates to $(\sqrt{2})$.

- The process involves finding the line equation, converting it to standard form, and then applying the point-to-line distance formula.
- Understanding these steps enhances your ability to solve similar problems involving distances in coordinate geometry.

Additional Resources and Tools

- Graphing Calculators and Software: Use tools like GeoGebra or Desmos to visualize lines and points.
- Online Tutorials: Websites like Khan Academy offer in-depth lessons on coordinate geometry.
- Practice Problems: Regular practice improves accuracy and confidence in solving geometry problems.

Conclusion

Calculating the distance between a point and a line is a fundamental skill in coordinate geometry, applicable in academic, professional, and everyday contexts. By mastering the process—deriving the line's equation, converting it to standard form, and applying the distance formula—you can solve a wide range of problems efficiently. Remember, visualization and practice are key to internalizing these concepts. Whether you're tackling homework, preparing for exams, or applying geometry in real-world scenarios, understanding how to find the shortest distance from a point to a line empowers you to analyze

spatial relationships accurately and confidently.

Frequently Asked Questions

How do I find the distance between the point P(4,3) and the line L passing through (0,-3) and (7,4)?

First, find the equation of line L using the two points, then use the point-to-line distance formula to calculate the distance from P to L.

What is the slope of line L passing through (0,-3) and (7,4)?

The slope $m = (4 - (-3)) / (7 - 0) = 7 / 7 = 1$.

How do I write the equation of line L given points (0,-3) and (7,4)?

Using point-slope form: $y - (-3) = 1(x - 0)$, so $y + 3 = x$, or simplified as $y = x - 3$.

What is the formula for the distance from a point to a line in coordinate geometry?

The distance d from point (x_0, y_0) to line $Ax + By + C = 0$ is $d = |Ax_0 + By_0 + C| / \sqrt{A^2 + B^2}$.

How can I find the line equation in standard form for line L?

From $y = x - 3$, rewrite as $x - y - 3 = 0$.

What is the distance from point P(4,3) to the line $x - y - 3 = 0$?

Calculate as $|(1)(4) + (-1)(3) - 3| / \sqrt{1^2 + (-1)^2} = |4 - 3 - 3| / \sqrt{2} = |-2| / 1.4142 \approx 2 / 1.4142 \approx 1.414$.

Can I verify the distance using a visual graph or coordinate geometry tools?

Yes, plotting the points and line or using graphing software can help visualize and verify the perpendicular distance.

What is the significance of the distance between point P and line L?

It represents the shortest possible distance from point P to any point on line L, which is along the perpendicular from P to L.

Are there any shortcuts to find the perpendicular distance without deriving the line equation?

No, you need the line's equation or coefficients to directly apply the point-to-line distance formula; otherwise, deriving the line is necessary.

What steps should I follow to solve similar distance problems in coordinate geometry?

Find the line's equation through the given points, convert to standard form if needed, then use the point-to-line distance formula with the given point.

Additional Resources

Understanding the Distance Between a Point and a Line in Coordinate Geometry

In the realm of coordinate geometry, calculations involving the shortest distance from a point to a line are fundamental for various applications—from engineering design and navigation to computer graphics and physics. Specifically, determining the distance from a point to a line involves understanding the geometric relationships and applying precise mathematical formulas. This article provides a comprehensive analysis of the problem: finding the distance between a line L, which contains points $(0, -3)$ and $(7, 4)$, and a point P with coordinates $(4, 3)$. Through detailed explanations, step-by-step derivations, and contextual insights, we aim to clarify this classic geometric problem and its significance within the broader mathematical landscape.

Defining the Problem: Key Components and Objectives

Before delving into calculations, it's essential to understand the problem's core components:

- Line L: Contains points $(0, -3)$ and $(7, 4)$. Our goal is to determine the shortest distance from point P, located at $(4, 3)$, to this line.
- Point P: Coordinates $(4, 3)$ serve as the reference point from which the shortest distance to line L is measured.

The primary objective is to derive a precise numerical value representing this shortest distance, often called the perpendicular distance, which is the length of the segment from P to the line L along a perpendicular dropped from P to L.

Mathematical Foundations: Coordinates and Line Equations

To accurately calculate the distance, a thorough understanding of how to derive the line's equation from two points and how to use the point-to-line distance formula is crucial.

1. Coordinates of Points

- Point A: (0, -3)
- Point B: (7, 4)
- Point P: (4, 3)

These serve as the basic data points for the calculations.

2. Equation of Line L

Given two points, the line passing through them can be expressed in various forms, with the slope-intercept form being most practical here.

- Calculating the slope (m):

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - (-3)}{7 - 0} = \frac{7}{7} = 1$$

- Equation of the line:

Using point-slope form:

$$y - y_1 = m (x - x_1)$$

Substituting point A (0, -3):

$$y - (-3) = 1 (x - 0) \rightarrow y + 3 = x$$

Simplified to slope-intercept form:

$$\begin{aligned} & \backslash[\\ & y = x - 3 \\ & \backslash] \end{aligned}$$

Thus, line L is represented by the equation:

$$\begin{aligned} & \backslash[\\ & y = x - 3 \\ & \backslash] \end{aligned}$$

Alternatively, converting to standard form:

$$\begin{aligned} & \backslash[\\ & x - y = 3 \\ & \backslash] \end{aligned}$$

which is advantageous for the point-to-line distance calculation.

Calculating the Shortest Distance from P to Line L

The shortest distance from a point to a line in a plane can be calculated using a well-established formula derived from the line's standard form.

1. The Point-to-Line Distance Formula

For a line in the standard form:

$$\begin{aligned} & \backslash[\\ & A x + B y + C = 0 \\ & \backslash] \end{aligned}$$

and a point $((x_0, y_0))$, the perpendicular distance (d) is:

$$\begin{aligned} & \backslash[\\ & d = \frac{|A x_0 + B y_0 + C|}{\sqrt{A^2 + B^2}} \\ & \backslash] \end{aligned}$$

Applying this to our line:

- Standard form: $(x - y = 3)$

- Rewrite as:

$$\begin{aligned} & \backslash[\\ & A = 1, \text{quad } B = -1, \text{quad } C = -3 \\ & \backslash] \end{aligned}$$

- Coordinates of point P: $((x_0, y_0) = (4, 3))$

Plugging into the formula:

$$\begin{aligned} & \backslash[\\ d &= \frac{|1 \times 4 + (-1) \times 3 - 3|}{\sqrt{1^2 + (-1)^2}} = \frac{|4 - 3 - 3|}{\sqrt{1 + 1}} = \frac{|-2|}{\sqrt{2}} = \frac{2}{\sqrt{2}} = \sqrt{2} \\ & \backslash] \end{aligned}$$

Thus, the shortest distance from point P to line L is:

$$\begin{aligned} & \backslash[\\ & \boxed{\sqrt{2} \approx 1.4142} \\ & \backslash] \end{aligned}$$

This precise value indicates that the perpendicular segment from P to L measures approximately 1.4142 units.

Geometric Interpretation and Visualization

Understanding the geometric meaning of this calculation enriches comprehension beyond the raw number.

1. Visualizing the Line and Point

- The line $(y = x - 3)$ is a straight line with a slope of 1, crossing the y-axis at -3, which means it's inclined at 45 degrees.
- The point P (4, 3) lies above and to the right of the line, depending on the coordinate system.

2. The Perpendicular Distance

- The shortest path from P to L is along a line perpendicular to L.
- Since the slope of L is 1, the slope of the perpendicular line is (-1) .
- The perpendicular line passing through P:

$$\begin{aligned} & \backslash[\\ y - 3 &= -1 (x - 4) \rightarrow y = -x + 7 \end{aligned}$$

\]

- The intersection point (Q) of this perpendicular with L can be found by solving the system:

```
\[
\begin{cases}
y = x - 3 \\
y = -x + 7
\end{cases}
\]
```

Set equal:

```
\[
x - 3 = -x + 7 \Rightarrow 2x = 10 \Rightarrow x = 5
\]
```

Plug into $(y = x - 3)$:

```
\[
y = 5 - 3 = 2
\]
```

The foot of the perpendicular, (Q) , is at $(5, 2)$.

- Distance from $P (4, 3)$ to $Q (5, 2)$:

```
\[
d = \sqrt{(5 - 4)^2 + (2 - 3)^2} = \sqrt{1^2 + (-1)^2} = \sqrt{1 + 1} = \sqrt{2}
\]
```

This confirms the earlier calculation, demonstrating the consistency of the geometric and algebraic approaches.

Applications and Broader Context

Understanding how to compute the distance from a point to a line has widespread applications across multiple disciplines:

- Engineering and Architecture: Ensuring components are aligned correctly or calculating clearances.
- Navigation and GPS: Determining the shortest route or proximity to a path or boundary.
- Computer Graphics: Collision detection and rendering often require such calculations.

- Physics: Analyzing trajectories or force vectors relative to surfaces.
- Mathematics Education: Fundamental exercises in understanding coordinate systems and geometric concepts.

Furthermore, mastering this calculation enhances problem-solving skills, especially in more complex scenarios involving multiple lines, points, or three-dimensional space.

Advanced Considerations and Variations

While the calculation above covers the classic case of a point and a line in two dimensions, several advanced topics and variations extend this foundational knowledge:

- Distance from a point to a line segment: When the line is finite, the perpendicular may fall outside the segment, requiring additional checks.
- Distance in three-dimensional space: Extending the concepts involves vector calculus and three-dimensional equations.
- Line equations in different forms: Implicit, parametric, or vector forms can be used depending on context.
- Numerical methods: For complex or non-linear boundaries, computational algorithms approximate shortest distances.

These extensions demonstrate the versatility and importance of the fundamental principles discussed.

Conclusion: Synthesizing the Mathematical and Practical Significance

The calculation of the shortest distance between point P (4, 3) and line L passing through points (0, -3) and (7, 4) exemplifies the elegance and utility of coordinate geometry. By deriving the line's equation, transforming it into standard form, and applying the point-to-line distance formula, we find that the minimal distance is $\sqrt{2}$, approximately 1.4142 units. This result is not just a number but a reflection of the underlying geometric relationships and the power of algebraic methods to quantify spatial concepts precisely.

Understanding such calculations is essential for professionals and students alike, providing foundational skills that underpin more advanced mathematical modeling, engineering design, and scientific analysis. The ability to visualize, derive, and verify these distances fosters deeper geometric

intuition and analytical proficiency—skills that are invaluable across scientific disciplines and practical applications.

In summary, the problem of determining the distance from a point to a line is a quintessential example of how algebra and geometry intersect to solve real-world problems with clarity and precision.

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