

Find The Distance Between The Points (9, 1) And (4, 10).

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Understanding how to calculate the distance between two points on a coordinate plane is a fundamental skill in geometry and algebra. Whether you're a student preparing for exams, a teacher designing lesson plans, or someone working on a project that involves spatial data, knowing how to find the distance between two points accurately is essential. In this comprehensive guide, we'll walk through the process of calculating the distance between the points (9, 1) and (4, 10), explain the underlying formula, and provide practical examples and tips to master this concept.

Understanding the Coordinate Plane and Points

Before diving into the calculation, it's important to understand the basics of the coordinate plane and how points are represented.

What Is a Coordinate Plane?

- A two-dimensional surface formed by two perpendicular axes:
- The horizontal axis is called the x-axis.
- The vertical axis is called the y-axis.
- The point where the axes intersect is called the origin, represented as (0, 0).

Representing Points

- Points are located on the plane using ordered pairs (x, y):
- The x-coordinate indicates the position along the horizontal axis.
- The y-coordinate indicates the position along the vertical axis.
- For example, the point (9, 1) is located 9 units along the x-axis and 1 unit along the y-axis.

The Distance Formula: Concept and Derivation

The key tool for finding the distance between two points is the distance formula, which is derived from the Pythagorean theorem.

Understanding the Pythagorean Theorem

- In a right-angled triangle, the square of the hypotenuse (the side opposite the right angle) equals the sum of the squares of the other two sides.
- Expressed mathematically as: $c^2 = a^2 + b^2$

Applying the Theorem to Coordinates

- Consider two points, $P_1(x_1, y_1)$ and $P_2(x_2, y_2)$.
- The horizontal distance between the points is $|x_2 - x_1|$.
- The vertical distance is $|y_2 - y_1|$.
- These form the legs of a right triangle, with the distance between the points as the hypotenuse.

The Distance Formula

- Combining these ideas, the distance d between P_1 and P_2 is:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

- This formula allows you to compute the straight-line (Euclidean) distance between any two points on the coordinate plane.

Calculating the Distance Between (9, 1) and (4, 10)

Now, let's apply the distance formula step-by-step to find the distance between the specific points (9, 1) and (4, 10).

Step 1: Identify Coordinates

- First point: $P_1(9, 1)$
- Second point: $P_2(4, 10)$

Step 2: Calculate the Differences in Coordinates

- Horizontal difference: $x_2 - x_1 = 4 - 9 = -5$
- Vertical difference: $y_2 - y_1 = 10 - 1 = 9$

Step 3: Square the Differences

- $(-5)^2 = 25$
- $9^2 = 81$

Step 4: Sum the Squares

- Sum: $25 + 81 = 106$

Step 5: Take the Square Root

- $(d = \sqrt{106})$

Step 6: Simplify the Result

- $(\sqrt{106})$ is an irrational number, approximately equal to 10.2956.

Interpreting the Result

The calculated distance between the points (9, 1) and (4, 10) is approximately 10.30 units. This measurement represents the straight-line distance connecting the two points in the Cartesian plane.

Visualizing the Distance

Understanding the geometric interpretation can enhance comprehension:

- Plot both points on graph paper or a digital graphing tool:
- Draw the horizontal line segment from (9, 1) to (4, 1).
- Draw the vertical line segment from (4, 1) to (4, 10).
- The hypotenuse of the right triangle formed is the direct distance between the points.

This visualization aligns with the Pythagorean theorem and reinforces why the distance formula works.

Practical Applications of Finding the Distance

Calculating distances between points is not just a theoretical exercise; it has numerous real-world applications:

1. **Navigation and GPS:** Determining the shortest path between two geographical locations.
2. **Computer Graphics:** Calculating pixel distances in rendering images.
3. **Robotics:** Path planning and obstacle avoidance.
4. **Physics:** Measuring displacement in mechanics.

5. **Data Analysis:** Computing Euclidean distances in clustering algorithms.

Common Mistakes to Avoid

While calculating the distance, be mindful of these common errors:

- **Incorrect coordinate subtraction:** Always subtract the coordinates in the correct order, but remember that the square of a number is the same regardless of sign.
- **Forgetting to square the differences:** Squaring is essential; missing this step leads to incorrect results.
- **Misapplying the square root:** Ensure you take the square root after summing the squares, not before.

Practice Problems to Master Distance Calculation

To enhance your skills, try solving these practice problems:

1. Find the distance between (2, 3) and (5, 7).
2. Calculate the distance between (0, 0) and (6, 8).
3. Determine the distance between (-3, -4) and (4, 3).
4. Find the distance between (10, -2) and (10, 5).

By practicing these problems, you'll develop confidence and proficiency in applying the distance formula.

Using Technology to Find the Distance

In addition to manual calculations, various tools can help:

- **Graphing Calculators:** Many models have built-in distance or coordinate functions.

- **Online Calculators:** Websites like Desmos, WolframAlpha, or GeoGebra allow quick computation.
- **Spreadsheet Software:** Programs like Excel or Google Sheets can compute distances using formulas.

Example: To calculate the distance in Excel:

- Enter the coordinates in cells, e.g., A1: 9, B1: 1, A2: 4, B2: 10.
- Use the formula: `=SQRT((A2-A1)^2 + (B2-B1)^2)`.

Conclusion

Calculating the distance between two points in coordinate geometry is an essential skill that combines algebraic manipulation with geometric intuition. By understanding the distance formula, practicing its application, and visualizing the problem, you'll be well-equipped to handle a variety of mathematical and real-world challenges. Remember, the key steps involve identifying the coordinates, calculating the differences, squaring, summing, and taking the square root. With consistent practice, finding the distance between any two points becomes a straightforward and intuitive process.

Frequently Asked Questions

How do you find the distance between the points (9, 1) and (4, 10)?

You can use the distance formula: $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$. Substituting the coordinates, it's $\sqrt{(4 - 9)^2 + (10 - 1)^2} = \sqrt{(-5)^2 + 9^2} = \sqrt{25 + 81} = \sqrt{106} \approx 10.3$.

What is the exact distance between the points (9, 1) and (4, 10)?

The exact distance is $\sqrt{106}$ units.

Can you explain the steps to calculate the distance between (9, 1) and (4, 10)?

Yes. First, find the differences in x and y coordinates: $4 - 9 = -5$ and $10 - 1 = 9$. Then, square these differences: $(-5)^2 = 25$ and $9^2 = 81$. Add them: $25 + 81 = 106$. Finally, take the square root: $\sqrt{106}$.

Is the distance between (9, 1) and (4, 10) more than 10 units?

No, the distance is approximately 10.3 units, which is slightly more than 10 units.

How can I visualize the distance between these two points on a coordinate plane?

Plot both points on the graph, then draw the straight line connecting them. The length of this line represents the distance, which can be measured using the distance formula.

Why is the distance formula $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ used to find the distance between two points?

This formula is derived from the Pythagorean theorem and calculates the length of the hypotenuse of a right triangle formed by the differences in x and y coordinates, representing the straight-line distance between the points.

Additional Resources

Distance Between Points: An In-Depth Exploration of How to Calculate the Spatial Separation Between (9, 1) and (4, 10)

When it comes to understanding the spatial relationships between two points in a coordinate system, calculating the distance is fundamental. Whether you're a student tackling geometry problems, a data analyst working with spatial data, or an engineer designing systems that depend on spatial awareness, grasping how to find the distance between two points is a crucial skill. In this article, we'll delve deeply into the process of determining the distance between the points (9, 1) and (4, 10), exploring the underlying mathematical principles, providing step-by-step guidance, and illustrating the importance of this calculation across various fields.

Understanding the Coordinate System

Before we jump into the calculation process, it's important to understand the context in which these points exist—the Cartesian coordinate system.

The Cartesian Plane

The Cartesian plane is a two-dimensional space defined by two perpendicular axes:

- The x-axis (horizontal)
- The y-axis (vertical)

Any point in this space is represented by an ordered pair (x, y), where:

- x is the horizontal coordinate
- y is the vertical coordinate

In our case:

- Point A: (9, 1)
- Point B: (4, 10)

Understanding these coordinates allows us to visualize their positions relative to each other, which is essential for grasping the concept of distance.

Visualizing the Points

Plotting the points on a coordinate grid:

- Point (9, 1) is located 9 units along the x-axis and 1 unit along the y-axis.
- Point (4, 10) is located 4 units along the x-axis and 10 units along the y-axis.

Visually, these points are separated both horizontally and vertically, and calculating the straight-line distance between them provides insight into their true spatial separation.

The Mathematical Foundation: The Distance Formula

The core mathematical principle for calculating the distance between two points in a plane is derived from the Pythagorean theorem. This theorem relates the lengths of the sides of a right triangle.

The Pythagorean Theorem Recap

- In a right triangle, the square of the hypotenuse (the side opposite the right angle) equals the sum of the squares of the other two sides.
- Mathematically: $c^2 = a^2 + b^2$

Applying this to coordinate points involves constructing a right triangle where:

- The horizontal leg corresponds to the difference in x-coordinates
- The vertical leg corresponds to the difference in y-coordinates
- The hypotenuse represents the distance between the points

The Distance Formula

Based on the Pythagorean theorem, the distance (d) between two points $((x_1, y_1))$ and $((x_2, y_2))$ can be computed using:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

This formula calculates the straight-line (Euclidean) distance.

Step-by-Step Calculation of the Distance

Applying the formula to our specific points, (9, 1) and (4, 10):

Step 1: Identify the Coordinates

- $(x_1 = 9)$
- $(y_1 = 1)$
- $(x_2 = 4)$
- $(y_2 = 10)$

Step 2: Calculate the Differences

- Horizontal difference: $(x_2 - x_1 = 4 - 9 = -5)$
- Vertical difference: $(y_2 - y_1 = 10 - 1 = 9)$

Note: When squaring these differences, the negative sign becomes irrelevant because $((-5)^2 = 25)$.

Step 3: Square the Differences

- $((-5)^2 = 25)$
- $(9^2 = 81)$

Step 4: Sum the Squared Differences

- Sum: $(25 + 81 = 106)$

Step 5: Take the Square Root

- $(d = \sqrt{106})$

This is an exact form; for practical purposes, we often approximate the square root:

$$d \approx \sqrt{106} \approx 10.2956$$

Interpreting the Result

The computed distance between the points (9, 1) and (4, 10) is approximately 10.30 units. This measurement represents the shortest path connecting the two points in a straight line, also known as the Euclidean distance.

Why is this important?

- In navigation, this distance helps determine the shortest route.
- In data analysis, it quantifies similarity or dissimilarity between data points.
- In physics, it measures the spatial separation between objects.
- In computer graphics and game development, it aids in collision detection and movement calculations.

Extensions and Variations

While this calculation pertains to two-dimensional space, the concept extends to higher dimensions.

Distance in 3D Space

For points $((x_1, y_1, z_1))$ and $((x_2, y_2, z_2))$, the distance formula becomes:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

This is especially relevant in fields like robotics, aerospace, and 3D modeling.

Applications in Real Life

- GPS Technologies: Calculating the shortest path between two geographical points.
- Urban Planning: Determining the direct distance between infrastructure points.
- Physics Simulations: Computing distances between particles or objects.

Key Takeaways

- The distance formula is rooted in the Pythagorean theorem and calculates the straight-line distance between two points.
- For points $((9, 1))$ and $((4, 10))$, the distance is approximately 10.30 units.
- The calculation involves subtracting coordinates, squaring differences, summing, and taking the

square root.

- Understanding this process is vital across numerous disciplines, from mathematics to engineering.

Final Thoughts

Calculating the distance between two points may seem straightforward at first glance, but it embodies fundamental principles of geometry and algebra that underpin much of modern science and technology. Mastery of this calculation empowers professionals and students alike to interpret spatial relationships accurately and apply these insights in practical scenarios. Whether plotting points on a graph, designing navigation algorithms, or analyzing spatial data, knowing how to find the distance between points like (9, 1) and (4, 10) is an essential tool in the analytical toolkit.

By understanding the mathematical principles, following a structured step-by-step process, and appreciating its broad applications, you can confidently perform these calculations and leverage them in your academic, professional, or everyday endeavors.

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