Please Solve It Fastt[11 Ma Given The Points P(2.1.3). Q(1.1.1).R(2.3.4) And S(0,1,2) A) Find The Equation

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Introduction to Coordinate Geometry and Equation of Lines

Coordinate geometry, also known as analytic geometry, is a branch of mathematics that combines algebra and geometry to study geometric figures using coordinate systems. One of the fundamental problems in coordinate geometry is to find the equation of a line passing through given points or satisfying certain conditions.

In this article, we will explore how to find the equation of a line or a curve based on a set of points: P(2, 1, 3), Q(1, 1, 1), R(2, 3, 4), and S(0, 1, 2). Although the problem statement is somewhat ambiguous, it appears to involve determining an equation based on these points, possibly a plane or a line, depending on the context.

Understanding the Given Points

Analyzing the Coordinates

The points provided are:

- P(2, 1, 3)
- Q(1, 1, 1)
- R(2, 3, 4)
- S(0, 1, 2)

Most likely, these points exist in a three-dimensional coordinate system, with each point defined by (x, y, z). Understanding their positions helps in deducing the relationship between them, such as collinearity, coplanarity, or defining a specific plane or line.

Significance of the Points

- Points P, Q, R, and S could define lines or planes.
- The problem asks to "find the equation," which could imply the equation of a line passing through two points, the equation of a plane through three points, or the equation of some curve satisfying the given points.

Determining the Type of Geometric Figure

Are the Points Collinear?

To determine if points are collinear (lie on the same straight line), check if the vectors between points are scalar multiples.

- Vector PQ = Q - P = (1 - 2, 1 - 1, 1 - 3) = (-1, 0, -2)
- Vector PR = R - P = (2 - 2, 3 - 1, 4 - 3) = (0, 2, 1)
- Vector PS = S - P = (0 - 2, 1 - 1, 2 - 3) = (-2, 0, -1)

If PQ, PR, and PS are scalar multiples, the points are collinear. Checking:

- Is PQ proportional to PR? No, as (-1, 0, -2) and (0, 2, 1) are not scalar multiples.
- Is PQ proportional to PS? No, as (-1, 0, -2) and (-2, 0, -1) are not scalar multiples.

Hence, points are not collinear.

Are the Points Coplanar?

In three-dimensional space, four points are coplanar if the volume of the tetrahedron they form is zero. This can be checked using the scalar triple product:

Volume = $|(PQ) \cdot [(PR) \times (PS)]| / 6$

If the scalar triple product is zero, the points are coplanar.

Finding the Equation of the Plane Passing Through Points P, Q, R

Since the points are not collinear, they can define a plane. The typical approach involves:

1. Calculating two vectors lying on the plane.
2. Finding the normal vector to the plane via the cross product of these vectors.
3. Using the normal vector and a point to write the equation of the plane.

Step 1: Calculate Vectors on the Plane

- Vector PQ = Q - P = (-1, 0, -2)
- Vector PR = R - P = (0, 2, 1)

Step 2: Find the Normal Vector via Cross Product

Normal vector n = PQ × PR

Calculating:

n = |i j k |
|-1 0 -2 |
| 0 2 1 |

Expanding:

$n_x = (0)(1) - (-2)(2) = 0 + 4 = 4$

$n_y = - [(-1)(1) - (-2)(0)] = - [-1 - 0] = - (-1) = 1$

$n_z = (-1)(2) - (0)(0) = -2 - 0 = -2$

Thus, the normal vector n = (4, 1, -2)

Step 3: Write the Equation of the Plane

Using point P(2, 1, 3) and the normal vector:

Equation: $n \cdot (r - r_0) = 0$

Where $r = (x, y, z)$, $r_0 = (2, 1, 3)$

Plugging in:

$4(x - 2) + 1(y - 1) - 2(z - 3) = 0$

Expanding:

$4x - 8 + y - 1 - 2z + 6 = 0$

Simplify:

$4x + y - 2z - 3 = 0$

Final Equation of the Plane:

$4x + y - 2z = 3$

Determining the Equation of a Line Through Two Points

If the goal is to find the equation of a line passing through points P and Q or R and S, the method involves:

1. Calculating the direction vector.
2. Writing the parametric equations.

Example: Line Through P(2,1,3) and Q(1,1,1)

- Direction vector: V = Q - P = (-1, 0, -2)

Parametric equations:

- $x = 2 - t$
- $y = 1$
- $z = 3 - 2t$

Where t is the parameter.

Equation of the Line or Plane: Summary

Geometric figure	Equation	Description
Plane through P, Q, R	$4x + y - 2z = 3$	Derived from cross product of vectors
Line through P and Q	$x = 2 - t$, $y = 1$, $z = 3 - 2t$	Parameterized form

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Additional Considerations and Complexities

- The problem mentions S(0,1,2), which might be relevant if analyzing for coplanarity or other geometric relationships.
- If S is also involved in defining a plane, one could check if all four points are coplanar by calculating the scalar triple product for P, Q, R, and S.

Conclusion

In summary, based on the provided points, we can:

- Confirm that the points are not collinear but coplanar.
- Derive the equation of the plane passing through points P, Q, and R as $4x + y - 2z = 3$.
- Write parametric equations of lines passing through specific points as needed.
- Recognize that further context might be necessary to determine which particular line or curve the problem seeks.

This comprehensive approach demonstrates how to analyze points in 3D space and find their associated geometric equations, essential for solving advanced problems in coordinate geometry.

SEO Keywords:

- Coordinate geometry
- Equation of plane through points
- Equation of line passing through two points
- 3D points coordinate system
- Finding plane equation from points
- Line equation in 3D space

- Calculating vectors in 3D geometry
- Cross product for normal vector
- Scalar triple product in geometry
- Coplanarity of points

Final Tips for Solving Geometric Problems with Points

- Always verify the type of geometric figure (line, plane, or curve).
- Use vectors and their operations (subtraction, cross product) to find normal vectors.
- Employ parametric equations for lines and standard form for planes.
- Check for coplanarity when dealing with multiple points in 3D space.
- Practice with different sets of points to become proficient in these methods.

End of Article

Frequently Asked Questions

How do I find the equation of the plane passing through points P(2,1,3), Q(1,1,1), and R(2,3,4)?

To find the equation of the plane, first determine two vectors on the plane, such as PQ and PR, then compute their cross product to find the normal vector. Use the point-normal form with one of the points to write the equation.

For example:
PQ = Q - P = (1-2, 1-1, 1-3) = (-1, 0, -2)
PR = R - P = (2-2, 3-1, 4-3) = (0, 2, 1)

Normal vector, n = PQ × PR = |i j k|
|-1 0 -2|
|0 2 1|

Calculate the determinant to find n, then substitute into the plane equation.

Equation: n•(X - P) = 0.

What is the step-by-step process to find the equation of a plane given three points?

1. Find two vectors lying on the plane by subtracting coordinates of the given points.
2. Calculate the cross product of these vectors to find the normal vector of the plane.
3. Use one of the points and the normal vector in the point-normal form equation of the plane: n•(X - P) = 0.
4. Expand and simplify to get the standard form of the plane equation.

Can I use point S(0,1,2) to find the plane equation passing through points P,

Q, and R?

Yes, if points P, Q, and R define the plane, you can use any of these points, including S(0,1,2), to find the plane equation once you have the normal vector. Ensure that S lies on the plane by substituting its coordinates into the equation to verify or to include it in the calculation.

What is the significance of the cross product in finding the plane equation?

The cross product of two vectors on the plane gives a normal vector perpendicular to the plane. This normal vector is essential in formulating the plane's equation because it defines the orientation of the plane in space.

How do I verify if a point lies on the obtained plane equation?

Substitute the point's coordinates into the plane equation. If the equation holds true (satisfies the equation), then the point lies on the plane. Otherwise, it does not.

What is the general form of the equation of a plane passing through three points?

The general form is $(X - X_0)\cdot n = 0$, where n is the normal vector obtained from the cross product of two vectors on the plane, and X_0 is a point on the plane. Expanding this gives the standard form: $Ax + By + Cz + D = 0$.

Additional Resources

Please Solve It Fast – A Comprehensive Guide to Finding the Equation of a Plane from Given Points

When tackling geometric problems involving points in three-dimensional space, one common task is to find the equation of a plane passing through a set of points. The phrase "Please Solve It Fast" resonates with students and professionals alike who seek efficient methods to derive such equations. This article aims to thoroughly analyze the problem involving points P, Q, R, and S, and guides you step-by-step on how to find the equation of the plane they define. Whether you're a student preparing for exams or a professional working on spatial analysis, understanding the process and nuances of solving such problems is essential.

Understanding the Problem: Find the Equation of a Plane Given Points

The primary goal here is to determine the mathematical equation of a plane that passes through four specified points:

- P(2, 1, 3)
- Q(1, 1, 1)
- R(2, 3, 4)
- S(0, 1, 2)

Given these points, our first step is to understand the geometric relationships and the methods for deriving the plane's equation.

Key considerations:

- The plane must pass through at least three non-collinear points.
- The fourth point must also lie on the same plane for the problem to be valid.
- The general form of a plane's equation is ax + by + cz + d = 0, where (a, b, c) is the normal vector to the plane.

Step-by-Step Approach to Find the Equation

1. Verify the Points Lie on the Same Plane

Before deriving the plane's equation, ensure that all four points are coplanar. If they are not, the problem would be invalid or require a different approach.

Method:

- Use vectors to check if the points are coplanar.
- Calculate vectors between points, for example:

$$
\vec{PQ} = Q - P = (1 - 2, 1 - 1, 1 - 3) = (-1, 0, -2)
$$

$$
\vec{PR} = R - P = (2 - 2, 3 - 1, 4 - 3) = (0, 2, 1)
$$

$$
\vec{PS} = S - P = (0 - 2, 1 - 1, 2 - 3) = (-2, 0, -1)
$$

- Calculate the scalar triple product:

$$
(\vec{PQ} \times \vec{PR}) \cdot \vec{PS}
$$

If this value equals zero, the points are coplanar.

Calculation:

- Cross product $\vec{PQ} \times \vec{PR}$:

$$
\begin{vmatrix}
\mathbf{i} & \mathbf{j} & \mathbf{k} \\
-1 & 0 & -2 \\
0 & 2 & 1
\end{vmatrix}
= \mathbf{i}(0 \times 1 - (-2) \times 2) - \mathbf{j}(-1 \times 1 - (-2) \times 0) + \mathbf{k}(-1 \times 2 - 0 \times 0)
$$

$$
= \mathbf{i}(0 + 4) - \mathbf{j}(-1 - 0) + \mathbf{k}(-2 - 0)

\]

\[
= 4 \mathbf{i} + 1 \mathbf{j} - 2 \mathbf{k}
\]

- Dot product with \(\vec{PS}\):

\[
(4, 1, -2) \cdot (-2, 0, -1) = 4 \times (-2) + 1 \times 0 + (-2) \times (-1) = -8 + 0 + 2 = -6
\]

Since the scalar triple product is not zero, the points are not coplanar. However, in typical planar problems, all points should lie on the same plane. Because of the negative result, this indicates the four points do not lie on the same plane, implying an inconsistency or the need to clarify the problem.

Note: For the purpose of this tutorial, assuming the problem intends for us to find the plane passing through three points, say P, Q, and R, and then verify whether S lies on that plane.

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2. Find the Equation of the Plane through Points P, Q, and R

Since P, Q, and R are coplanar (by assumption or after verification), proceed to find the plane's equation.

Step 1: Find two vectors lying on the plane:

\[
\vec{PQ} = (-1, 0, -2)
\]
\[
\vec{PR} = (0, 2, 1)
\]

Step 2: Calculate the normal vector:

\[
\vec{n} = \vec{PQ} \times \vec{PR}
\]

From previous calculation:

\[
\vec{n} = (4, 1, -2)
\]

Step 3: Write the plane equation:

Using point P(2, 1, 3) and normal vector \(\vec{n} = (a, b, c) = (4, 1, -2)\):

\[
a(x - x_0) + b(y - y_0) + c(z - z_0) = 0
\]

\[
4(x - 2) + 1(y - 1) - 2(z - 3) = 0
\]

Expanding:

$$
4x - 8 + y - 1 - 2z + 6 = 0
$$

Simplify:

$$
4x + y - 2z - 3 = 0
$$

This is the equation of the plane passing through P, Q, and R.

---

3. Verify if Point S Lies on the Plane

Substitute S(0, 1, 2) into the plane equation:

$$
4(0) + 1(1) - 2(2) - 3 = 0 + 1 - 4 - 3 = -6 \neq 0
$$

Since the result isn't zero, S does not lie on this plane. Therefore, the four points are not coplanar, and the initial assumption needs to be revisited.

Key Takeaways and Alternative Strategies

Given the above, it's clear that:

- Not all four points are coplanar; hence, a single plane cannot pass through all four.
- The problem may require finding the plane through three points and then checking the position of the fourth.

Finding the Plane Equation in Practice

Features:

- Efficient use of vector algebra simplifies the process.
- Cross product yields the normal vector directly.
- Using point-normal form makes substitution straightforward.

Pros:

- Clear geometric interpretation.
- Suitable for computational implementation.
- Works well with standard coordinate points.

Cons:

- Requires verifying coplanarity.
- Assumes points are in general position.
- May involve complex calculations for large data sets.

Conclusion: Practical Recommendations

- Always verify coplanarity before finalizing the plane's equation.
- Use vector cross products to find the normal vector efficiently.
- Apply the point-normal form of the plane equation for straightforward computation.
- When points are not coplanar, consider alternative geometric constructs or multiple planes.

Final Thoughts

The phrase "Please Solve It Fastt[11 Ma Given The Points P(2.1.3), Q(1.1.1), R(2.3.4), and S(0,1,2)" underscores the importance of speed and accuracy in solving spatial geometry problems. Mastery over vector operations, verification of coplanarity, and systematic approach are key to solving such problems efficiently. While the specific points in this example reveal that not all four points are coplanar, the methodology outlined remains a fundamental technique for approaching similar problems in geometry, physics, and engineering.

Remember: Always verify your assumptions, choose appropriate methods, and double-check your calculations for accuracy. With practice, solving these types of problems can become quick and intuitive, fulfilling the demand implied by the phrase "Please Solve It Fastt."

Please Solve It Fastt 11 Ma Given The Points P 2 1 3 Q 1 1 1 R 2 3 4 And S 0 1 2 A Find The Equation

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