2s+5h=154 3s+4h=168

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Understanding how to solve systems of linear equations is a fundamental skill in algebra, with applications spanning various fields including engineering, economics, and physical sciences. Among these, the equations:

2s + 5h = 154

3s + 4h = 168

represent a classic example of a system of two linear equations with two variables, s and h. These equations can be approached using various methods such as substitution, elimination, and graphical analysis, each offering insights into the relationships between the variables.

In this article, we will explore the process of solving this particular system step-by-step, analyze the solutions, and discuss the broader applications of such systems. Whether you're a student aiming to master algebra or a professional seeking to understand how systems of equations model real-world problems, this comprehensive guide will provide clarity and depth.

Understanding the System of Equations

Before diving into solving techniques, it’s essential to understand what these equations represent and how they are structured.

Variables and Coefficients

- s and h are the variables, which could represent quantities like speed, height, hours, or other measurable factors depending on context.
- Coefficients (numbers multiplying variables) indicate how strongly each variable influences the equation.

Equations in Context

While the equations are abstract, they could model practical scenarios such as:
- A problem involving work, where s and h represent units of time or work done.
- Budget allocation, with s and h representing expenditure in different categories.
- Physical systems, where s and h might denote distances or forces.

The key goal is to find the values of s and h that satisfy both equations simultaneously.

Methods for Solving the System

There are several techniques to find the solution set for the equations:

1. Substitution Method

- Solve one equation for one variable.
- Substitute this expression into the other equation.
- Solve for the remaining variable.

2. Elimination Method

- Equalize the coefficients of one variable by multiplying equations.
- Subtract or add the equations to eliminate one variable.
- Solve for the remaining variable.

3. Graphical Method

- Plot both equations on a coordinate plane.
- The intersection point(s) represent the solution(s).

In this guide, we will primarily focus on the elimination method, as it is straightforward for these equations.

Step-by-Step Solution Using the Elimination Method

Let's proceed to solve the system:

Original Equations:

1. $2s + 5h = 154$
2. $3s + 4h = 168$

Step 1: Make the coefficients of one variable equal

To eliminate s, find the least common multiple (LCM) of the s coefficients (2 and 3), which is 6.

- Multiply Equation 1 by 3:
- $(3)(2s + 5h) = 3\ 154$
- $6s + 15h = 462$

- Multiply Equation 2 by 2:
- $(2)(3s + 4h) = 2\ 168$

- 6s + 8h = 336

Step 2: Subtract equations to eliminate s

- Subtract the second from the first:
- (6s + 15h) - (6s + 8h) = 462 - 336
- 6s - 6s + 15h - 8h = 126
- 7h = 126

Step 3: Solve for h

- h = 126 / 7 = 18

Step 4: Substitute h back into one of the original equations

Using Equation 1:
- 2s + 5h = 154
- 2s + 5(18) = 154
- 2s + 90 = 154
- 2s = 154 - 90 = 64
- s = 64 / 2 = 32

Solution Summary

- s = 32
- h = 18

This solution indicates that when s is 32 and h is 18, both equations are satisfied simultaneously.

Verification of the Solution

To ensure accuracy, substitute s and h into the second original equation:

- 3s + 4h = 168
- 3(32) + 4(18) = 96 + 72 = 168

Since the left side equals the right side, the solution is verified.

Broader Applications of Systems of Linear Equations

The method demonstrated is versatile and applicable to numerous real-world problems:

1. Business and Economics

- Determining optimal product mixes.
- Analyzing cost and revenue models.

2. Engineering

- Calculating forces and stresses in structures.
- Circuit analysis involving multiple variables.

3. Physics

- Solving for unknown quantities like velocity and acceleration.
- Analyzing systems with multiple constraints.

4. Computer Science

- Algorithm design involving linear programming.
- Data fitting and machine learning models.

Additional Techniques and Considerations

While elimination worked well here, other techniques might be preferable depending on the context:

Graphical Approach

- Plotting the lines:
- 2s + 5h = 154
- 3s + 4h = 168
- The intersection point on the graph visually confirms the solution.

Using Matrix Methods

- Express the system in matrix form:
\[
\begin{bmatrix}
2 & 5 \\
3 & 4
\end{bmatrix}
\begin{bmatrix}
s \\
h
\end{bmatrix}
=

\begin{bmatrix}
154 \\
168
\end{bmatrix}
\]
- Apply methods like Cramer's rule or Gaussian elimination for larger systems.

Conclusion

The system of equations:

2s + 5h = 154

3s + 4h = 168

has a unique solution: s = 32 and h = 18. Solving such systems is essential for modeling and solving practical problems across various disciplines. Mastering techniques like elimination, substitution, and graphical analysis equips students and professionals with powerful tools to analyze complex systems efficiently.

By understanding the structure and solution methods for systems of equations, you can approach a wide array of real-world challenges with confidence. Whether you're optimizing resources, analyzing physical systems, or designing algorithms, the principles outlined here serve as foundational knowledge for advanced mathematical problem-solving.

Keywords for SEO Optimization:
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- Elimination method for equations
- Linear equations solutions
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- Solving two-variable equations
- Practical algebra problems
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Frequently Asked Questions

How do I solve the system of equations 2s + 5h = 154 and 3s +

4h = 168?

You can use the method of elimination or substitution. For example, multiply the first equation by 3 and the second by 2 to align coefficients and then subtract to find h, then substitute back to find s.

What is the value of s and h in the system 2s + 5h = 154 and 3s + 4h = 168?

Solving the system yields s = 34 and h = 16.

Can substitution be used to solve the equations 2s + 5h = 154 and 3s + 4h = 168?

Yes, you can solve one of the equations for s or h and substitute into the other to find the solutions.

What are common methods for solving two-variable linear equations like these?

Common methods include substitution, elimination, and graphing. In this case, elimination is often efficient.

Are the equations 2s + 5h = 154 and 3s + 4h = 168 consistent and solvable?

Yes, they are consistent and have a unique solution as they are linear equations with different slopes.

How can I verify the solutions for s and h once I find them?

Substitute the found values back into both original equations to ensure both are satisfied.

What real-world applications might these equations represent?

They could model scenarios like resource allocation, mixture problems, or financial distributions involving two related variables.

Additional Resources

Investigating the System of Equations: 2s + 5h = 154 and 3s + 4h = 168

Mathematics often presents us with systems of equations that require careful analysis to uncover their solutions. Among these, the pair of linear equations:

\[2s + 5h = 154 \]
\[3s + 4h = 168 \]

serves as a classic example of simultaneous equations that can be approached through various algebraic techniques. This article aims to delve deeply into these equations, exploring their origins, solution methods, implications, and potential applications, all within an investigative framework suitable for academic or analytical review.

Understanding the Equations: Context and Significance

Before diving into solving the system, it is crucial to understand what these equations might represent and why they are significant.

Possible Real-World Interpretations

These equations could model numerous real-world scenarios, such as:

- Resource Allocation: where s and h represent quantities of two resources, and the equations specify constraints based on total available resources.
- Production Planning: where s might be units of one product, h units of another, with constraints on combined production costs or capacities.
- Economics or Finance: representing relationships between two variables influencing profit, cost, or investment allocations.

Without explicit context, these equations serve as a mathematical abstraction, but their structure suggests a linear relationship between two variables constrained by specific totals.

Mathematical Foundations: Techniques for Solving Systems of Equations

Linear systems like this are fundamental in algebra and can be solved using various methods:

Substitution Method

- Solve one equation for one variable.
- Substitute into the other to find the second variable.
- Back-substitute to find the first variable.

Elimination Method (Addition/Subtraction)

- Multiply equations to align coefficients.

- Add or subtract them to eliminate one variable.
- Solve for the remaining variable.

Graphical Method

- Plot both equations as lines on a coordinate plane.
- The intersection point(s) represent the solution(s).

Matrix Methods

- Use matrix algebra, such as Cramer's rule, especially for larger systems.

Given the simplicity of this system, substitution and elimination are most straightforward.

Step-by-Step Solution of the System

Let's proceed to analyze and solve the equations systematically.

Original Equations:

$$ 2s + 5h = 154 \quad \quad (1) $$
$$ 3s + 4h = 168 \quad \quad (2) $$

Method 1: Substitution

Step 1: Solve equation (1) for s:

$$ 2s = 154 - 5h $$
$$ s = \frac{154 - 5h}{2} $$

Step 2: Substitute into equation (2):

$$ 3 \times \frac{154 - 5h}{2} + 4h = 168 $$

Step 3: Simplify:

$$ \frac{3(154 - 5h)}{2} + 4h = 168 $$

$$ \frac{462 - 15h}{2} + 4h = 168 $$

Multiply through by 2 to clear denominator:

$$ 462 - 15h + 8h = 336 $$

$$ 462 - 7h = 336 $$

Step 4: Isolate h:

$$ -7h = 336 - 462 $$
$$ -7h = -126 $$
$$ h = \frac{-126}{-7} = 18 $$

Step 5: Find s using the expression from earlier:

$$ s = \frac{154 - 5(18)}{2} = \frac{154 - 90}{2} = \frac{64}{2} = 32 $$

Solution: The system's solution is:

$$ s = 32 $$
$$ h = 18 $$

Method 2: Elimination

Step 1: Multiply equations to align coefficients for one variable. Let's eliminate s.

Multiply equation (1) by 3:

$$ 3 \times (2s + 5h) = 3 \times 154 \Rightarrow 6s + 15h = 462 \quad (3) $$

Multiply equation (2) by 2:

$$ 2 \times (3s + 4h) = 2 \times 168 \Rightarrow 6s + 8h = 336 \quad (4) $$

Step 2: Subtract (4) from (3):

$$ (6s + 15h) - (6s + 8h) = 462 - 336 $$
$$ 6s - 6s + 15h - 8h = 126 $$
$$ 7h = 126 $$
$$ h = 18 $$

Step 3: Substitute h into one of the original equations, e.g., equation (1):

$$ 2s + 5(18) = 154 $$
$$ 2s + 90 = 154 $$
$$ 2s = 64 $$
$$ s = 32 $$

The same solution emerges, confirming the consistency of the methods.

Implications and Consistency of the Solution

The solution $\boxed{s=32,\, h=18}$ satisfies both equations, showcasing the system's consistent and independent nature. The intersection point of the lines represented by the equations is at (32, 18) on the coordinate plane.

This result indicates:

- Unique Solution: The system has exactly one solution, typical for two independent linear equations.
- Geometric Interpretation: The lines intersect at a single point, corresponding to the solution.

Exploring the Solution Space: Graphical Perspective

Plotting the lines:

- For $2s + 5h = 154$: The intercepts are at $(s=77, h=0)$ and $(s=0, h=30.8)$.
- For $3s + 4h = 168$: The intercepts are at $(s=56, h=0)$ and $(s=0, h=42)$.

Visualizing these lines confirms they intersect at (32, 18), confirming the algebraic solution.

Potential Applications and Broader Significance

Understanding such systems is vital in various domains:

Operational Research

- Optimizing resource allocation based on constraints.
- Modeling production limits and costs.

Economics

- Balancing inputs to meet economic targets.
- Analyzing trade-offs between variables.

Education

- Teaching fundamental algebraic techniques.
- Demonstrating real-world problem-solving.

Data Analysis

- Fitting models with multiple variables under constraints.
- Sensitivity analysis based on parameter variations.

Further Investigations and Extensions

While the current system is straightforward, deeper investigations might include:

- Parameter Variations: How does changing constants affect solutions?
- Non-Linear Extensions: Introducing quadratic or higher-order terms.
- Multiple Systems: Analyzing larger systems with more variables.
- Computational Methods: Using algorithms for systems with complex coefficients.

Conclusion

The system of equations:

$$ 2s + 5h = 154 $$
$$ 3s + 4h = 168 $$

has a clear, unique solution: $s=32$, $h=18$. Through algebraic techniques—substitution and elimination—the solution emerges consistently, reinforcing the robustness of linear algebra methods. Beyond their mathematical neatness, such systems serve as foundational tools for modeling and solving real-world problems across diverse fields, illustrating the enduring relevance of linear systems analysis.

Understanding and solving these equations not only deepens mathematical comprehension but also equips analysts, researchers, and students with essential skills for tackling complex, constrained problems in a systematic way.

2s 5h 154 3s 4h 168

2s 5h 154 3s 4h 168

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