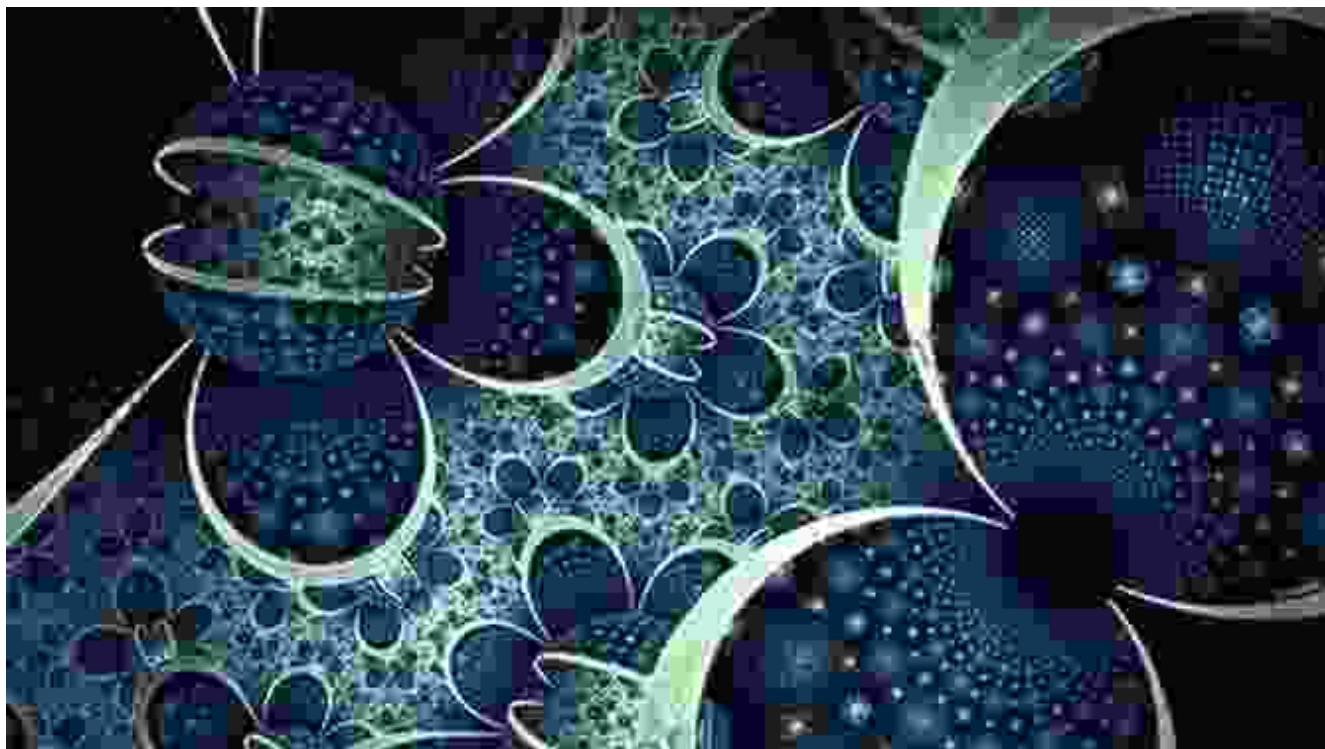


# Unveiling the Secrets of Mathematical Discovery: An Elementary Approach to Ideas and Methods





Let us apply these concepts to the lasso problem. Let us initially ignore the non-smooth penalty term. One can show (Exercise 13.1) that

$$\frac{\partial}{\partial w_j} \text{RSS}(w) = w_j w_j - e_j \quad (13.48)$$

$$e_j = y - \sum_{i=1}^n x_{i,j} w_i \quad (13.49)$$

$$e_j = 2 \sum_{i=1}^n x_{i,j} (w_i - w_i^* x_{i,j}) \quad (13.50)$$

where  $w_{-j}$  is  $w$  without component  $j$ , and similarly for  $x_{-j}$ . We see that  $e_j$  is (proportional to) the correlation between the  $j$ th feature  $x_{-j}$  and the residual due to the other features,  $\tilde{r}_{-j} = y - X_{-j} w_{-j}$ . Hence the magnitude of  $e_j$  is an indication of how relevant feature  $j$  is for predicting  $y$  (relative to the other features and the current parameters).

Adding in the penalty term, we find that the subderivative is given by:

$$\partial_{w_j} J(w) = (w_j w_j - e_j) \pm \lambda \partial_{w_j} \|w\|_1 \quad (13.51)$$

$$= \begin{cases} (w_j w_j - e_j - \lambda) & \text{if } w_j < 0 \\ [-e_j - \lambda, -e_j + \lambda] & \text{if } w_j = 0 \\ (w_j w_j - e_j + \lambda) & \text{if } w_j > 0 \end{cases} \quad (13.52)$$

We can write this in a more compact fashion as follows:

$$\partial_{w_j} J(w) \ni \begin{cases} -\lambda & \text{if } w_j < 0 \\ [-\lambda, \lambda] & \text{if } w_j = 0 \\ \lambda & \text{if } w_j > 0 \end{cases} \quad (13.53)$$

Depending on the value of  $e_j$ , the solution to  $\partial_{w_j} J(w) = 0$  can occur at 3 different values of  $w_j$ , as follows:



## What Is Mathematics?: An Elementary Approach to Ideas and Methods by Ian Stewart

★★★★☆ 4.6 out of 5

- Language : English
- File size : 11870 KB
- Text-to-Speech : Enabled
- Screen Reader : Supported
- Enhanced typesetting : Enabled
- Print length : 593 pages
- Lending : Enabled



Mathematics, often perceived as an abstract and elusive subject, holds immense power in shaping our understanding of the world around us. From the intricate patterns in nature to the technological advancements that drive our lives, mathematics plays a pivotal role in unraveling the complexities of existence. In his seminal work, "An Elementary Approach to Ideas and Methods," renowned mathematician George Pólya imparts a profound understanding of the fundamental principles and techniques that underpin mathematical discovery, empowering readers to embark on their own mathematical journeys.

## **A Journey into Mathematical Exploration**

Pólya's "An Elementary Approach to Ideas and Methods" is not merely a textbook; it is an invitation to delve into the captivating world of mathematical exploration. Through a series of engaging examples and thought-provoking exercises, Pólya guides readers through the intricate tapestry of mathematical ideas, fostering a deep appreciation for the subject's beauty and power.

The book is structured around four central themes, each exploring a fundamental aspect of mathematical reasoning and discovery:

1. **Heuristics:** Pólya unveils the art of problem-solving, providing a systematic approach to tackling mathematical challenges. He emphasizes the importance of understanding the problem, devising a plan, carrying out the plan, and looking back to reflect on the solution.

2. **Induction:** Readers are introduced to the concept of mathematical induction, a powerful technique for proving general statements about mathematical objects. Pólya demonstrates how induction can be used to establish the validity of complex mathematical claims.
3. **Analogy:** The book delves into the role of analogy in mathematical discovery. Pólya highlights how drawing parallels between different mathematical concepts can lead to unexpected insights and innovative solutions.
4. **Generalization:** Readers are guided through the process of generalizing mathematical results, extending their applicability to broader contexts. Pólya emphasizes the importance of identifying patterns and structures within mathematical problems to facilitate generalization.

## **Mathematics as a Creative Endeavor**

Throughout the book, Pólya dispels the misconception that mathematics is a static and rigid subject. He portrays mathematics as a dynamic and creative endeavor, constantly evolving through the contributions of mathematicians worldwide. Pólya encourages readers to embrace the spirit of mathematical exploration, to question assumptions, and to seek out new and innovative solutions.

Pólya's approach to teaching mathematics is deeply rooted in the belief that students learn best by actively engaging in the process of discovery. He provides ample opportunities for readers to test their understanding through a diverse range of exercises. These exercises vary in difficulty, catering to both beginners and seasoned mathematicians alike.

## A Timeless Classic for Mathematical Enthusiasts

First published in 1945, "An Elementary Approach to Ideas and Methods" has stood the test of time as a timeless classic in mathematical education. Its clear and engaging writing style, combined with its insightful content, has made it an indispensable resource for generations of students, teachers, and mathematicians.

Whether you are a seasoned mathematician seeking to expand your knowledge or a novice eager to delve into the captivating world of mathematics, "An Elementary Approach to Ideas and Methods" is an invaluable companion. It is a book that will challenge your assumptions, spark your curiosity, and inspire you to embark on your own mathematical adventures.

Embrace the opportunity to unlock the secrets of mathematical discovery with "An Elementary Approach to Ideas and Methods." Let this seminal work be your guide as you navigate the intricate tapestry of mathematical knowledge and unveil the hidden beauty and power that mathematics holds.



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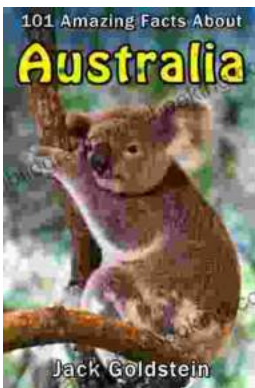
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