Mathematics Textbooks with Open Licenses

Pacific Northwest Project NExT, Seattle University

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Design of Open Online Textbooks

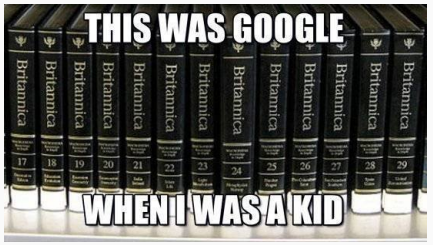
Legal

- Copyright is a government-granted monopoly
- Copyright Act of 1976: now death + 70 years
- An open license provides additional freedoms
  - Unlimited copying
  - In perpetuity
  - Modifications for personal use
  - Possibly: the right to distribute modifications
  - “Copyleft”

“freely available”
$\neq$
distribute with an explicit open license

Advantages of Online Textbooks with Open Standards

- **Not** proprietary interfaces, not **PDF**
- Compact and Portable: 64 Gigabytes is
  - 64 Encyclopedia Britannica (text only)
  - 1 English Wikipedia (text only)
  - 10,000 400-page math textbooks
- Ubiquitous: laptop, tablet, or phone
- Current: edit, and refresh, at will
- Accurate: crowd-sourced proof-reading
- Open: never out-of-print
- Intellectually honest: not marketing
- Accessible: best tech practices
- **FREE!!!!!**



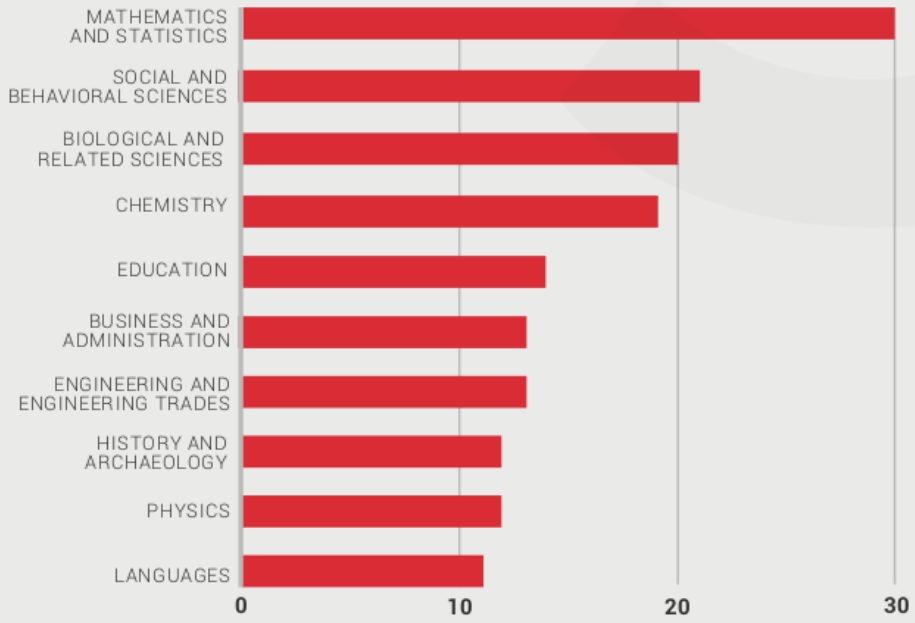
The Movement

SPARC Report, Connect OER 2016-17

KEY INSIGHT #3: MATHEMATICS AND STATISTICS IS THE ACADEMIC SUBJECT WITH THE MOST OER TRACTION

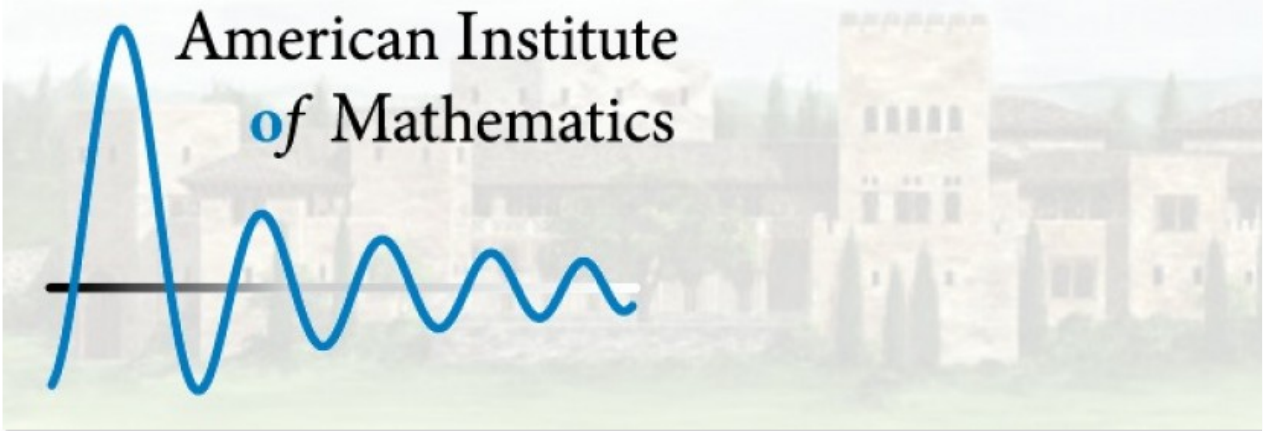
Institutions were asked to note which academic subjects had the greatest OER traction. Amongst the 65 institutions that answered this question, mathematics and statistics ranked the highest with nearly half (30) indicating it had traction, followed by social and behavioural sciences (22), biological and related sciences (21), and chemistry (20). Figure 6 depicts the top 10 academic subjects with the most OER traction.

Figure 6. Top 10 academic subjects with the most OER traction.



SPARC SPARC SPARC SPARC SPARC

American Institute of Mathematics (AIM)



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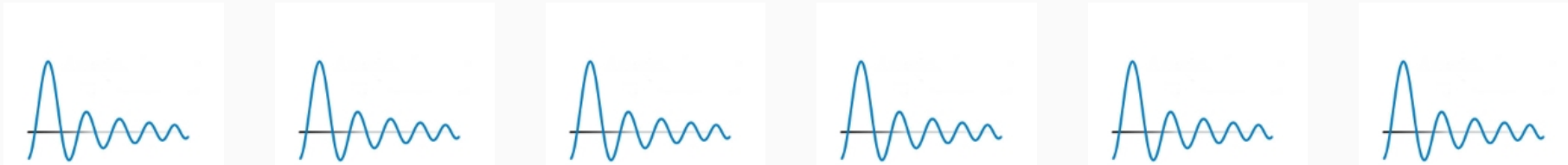
Approved Textbooks • Evaluation Criteria • Guide for Authors • Editorial Board

Approved Textbooks

The list below groups open textbooks by course title. All the books have been judged to meet the evaluation criteria set by the AIM editorial board.

- Liberal Arts Math
- College Algebra and Precalculus
- Calculus
- Differential Equations
- Linear Algebra
- Introduction to Proofs
- Discrete Math
- Combinatorics
- Mathematical Computing
- Numerical Analysis
- Abstract Algebra
- Number Theory
- Real Analysis
- Complex Analysis
- Geometry and Topology
- Probability
- Statistics
- Logic



AIM Open Textbook Initiative

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- Liberal Arts Math
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- Linear Algebra
- Introduction to Proofs
- Discrete Math
- Combinatorics
  - *Applied Combinatorics*
    Mitchel T. Keller and William T. Trotter
  - *Combinatorics Through Guided Discovery*
    Kenneth Bogart
  - *Foundations of Combinatorics with Applications*
    Edward A. Bender and S. Gill Williamson
- Mathematical Computing
- Numerical Analysis
- Abstract Algebra
- Number Theory
- Real Analysis
- Complex Analysis
- Geometry and Topology
- Probability
- Statistics
- Logic






Bogart's Combinatorics Through Guided Discovery

Combinatorics Through Guided Discovery

Kenneth P. Bogart

Digital versions	PDF and HTML
PreTeXt source	Yes
Exercises	Yes
Solutions	Solution manual available to instructors
License	GNU Free Documentation License

- Text for a first course in combinatorics
- Copyright 2004 by author
- 200 pages, 6 chapters, 3 supplemental sections
- Over 400 exercises, many with hints
- Paperback version available for about $9
- For more information and to access PDF or online version

As the title suggests this book is designed for a "discovery method" course. The heart of the book is the hundreds of exercises that guide the student through the key ideas of enumerative combainatorics and a brief introduction to graph theory. The exercises are marked with special symbols to indicate their role in the course, for example, whether they are essential or motivational. The chapter titles are

1. What is Combinatorics?
2. Applications of Induction and Recursion in Combinatorics and Graphy Theory
3. Distribution Problems
4. Generating Functions
5. The Principle of Inclusion and Exclusion
6. Groups Acting on Sets

The three supplmental sections deal with relations, mathematical induction, and exponential generating functions.

This book is the result of an NSF project led by Ken Bogart and is currently maintained by the Mathematics Department of Dartmouth College.






PreTeXt

- New markup language for scholarly documents
- **Rigorously** seperate content from presentation
- Easier and more powerful than LaTeX
- An author-friendly XML vocabulary
- Enables many output formats from common source:
  - Print-On-Demand hardcopy
  - Electronic PDF
  - Online Web Pages
  - EPUB (esp. iBooks)
  - Jupyter Notebooks

An Open Textbook, Online

Abstract Algebra: Theory and Applications, by Tom Judson

- #4 in Google for "`abstract algebra`"
- Openly licensed
- Hardcopy: $25
- PDF download: Free! (Legally!)
- Online: Includes Sage Cell examples

Thank-you for your attention

PreTeXt: `mathbook.pugetsound.edu`

`buzzard.pugetsound.edu/talks.html`

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PreTeXt Example

PreTeXt Example

```
<theorem xml:id="power-rule">
    <title>Power Rule</title>
    <idx>power rule</idx>

    <statement>
        <p>The derivative of <m>f(x)=x^n</m>
        is <m>f'(x)=nx^{n-1}</m>.</p>
    </statement>

    <proof>
        <p>Apply induction to the product
            <me>f(x)=x^n=x\cdot x^{n-1}</me>
        using <xref ref="product-rule"/>.</p>
    </proof>
</theorem>
```

Theorem 4.4 (Power Rule)**.** *The derivative of* $f(x) = x^n$ *is* $f'(x) = nx^{n-1}$.

Proof. Apply induction to the product

$$f(x) = x^n = x \cdot x^{n-1}$$

using Theorem 4.1. □

Theorem 4.4 (Power Rule). *The derivative of* $f(x) = x^n$ *is* $f'(x) = nx^{n-1}$.

Proof. Apply induction to the product

$$f(x) = x^n = x \cdot x^{n-1}$$

using Theorem 4.1. □