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Mathematics  Science: A study in citation rates over time

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Mathematics ≠ Science
A study in citation rates over time

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University of Michigan
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2 Data & Methodology

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Mathematics ≠ Science

Introduction

STE & M???

- Mathematics and Science often studied together
Mathematics ≠ Science

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- Mathematics and Science often studied together
  - Both came from Natural Philosophy tradition
Mathematics ≠ Science

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  - Mathematics provides the foundation for Science
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Mathematics ≠ Science

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  - Gauss: ”Mathematics is the queen of the sciences”
STE & M???

- Mathematics and Science often studied together
  - Both came from Natural Philosophy tradition
  - Mathematics provides the foundation for Science
  - Gauss: ”Mathematics is the queen of the sciences”

- But are they really that similar?
A Foreign Queen

- Mathematical Vs. Scientific Knowledge
A Foreign Queen

- Mathematical Vs. Scientific Knowledge
  - Proof - Experiment
A Foreign Queen

- Mathematical Vs. Scientific Knowledge
  - Proof - Experiment
  - Axiomatic - Theoretic
Introduction

A Foreign Queen

- Mathematical Vs. Scientific Knowledge
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  - Non-Empirical - Empirical
Mathematics ≠ Science

Introduction

A Foreign Queen

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- Chalkboard Vs. Laboratory
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- Chalkboard Vs. Laboratory
- Funding Structures
Dataset

- Clarivate Web of Science 1900-2017
- Big Ten Academic Alliance
Dataset

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- Web of Science Categories
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  - Mathematics, Interdisciplinary Applications
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  - Mathematics, Applied
  - Mathematics, Interdisciplinary Applications
  - Physics*
  - Computer Science*
Methodology

- References & Citations
Methodology

- References & Citations
  - References are the publications listed in a the original publication’s bibliography (Past)
  - Citations are the publications which cite the original publication (Future)
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- Publication level analysis
Methodology

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- Caveats
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- **References & Citations**
  - References are the publications listed in a the original publication’s bibliography (Past)
  - Citations are the publications which cite the original publication (Future)

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  - Incomplete Data
Methodology

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  - References are the publications listed in a the original publication’s bibliography (Past)
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- Publication level analysis
- Caveats
  - Incomplete Data
  - Reference date errors
Total Mathematical Publications

Mathematics ≠ Science
 Mathematical References & Citations Over Time

![Graph showing the growth of mathematical publications over time, with categories for All, Mathematics, Applied, and Interdisciplinary Applications.]

<table>
<thead>
<tr>
<th>Year</th>
<th>Mathematics</th>
<th>Applied</th>
<th>Interdisciplinary Applications</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>742541</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1920</td>
<td></td>
<td>611160</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1940</td>
<td></td>
<td></td>
<td>199652</td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table:** Mathematical Publications in Web of Science
Figure: Median Reference Age for Mathematical Publications
Citation Age

Figure: Median Citation Age Per Mathematical Publications
Citation Age

Figure: Median Oldest Citation Per Mathematical Publications
Mathematics ≠ Science

Mathematical References & Citations Over Time

Citation Age

![Graph showing the percentage of citations over 20 years old over time.]({})

**Figure:** % of Citations over 20 Years Old
Total Publications

Table: Publications in Web of Science

<table>
<thead>
<tr>
<th>Mathematics</th>
<th>Applied</th>
<th>Interdisciplinary Applications</th>
<th>Mathematics Total</th>
<th>Physics</th>
<th>Computer Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>74,2541</td>
<td>611,160</td>
<td>199,652</td>
<td>1,343,970</td>
<td>4,597,628</td>
<td>2,332,244</td>
</tr>
</tbody>
</table>
Mathematics ≠ Science

Mathematics Vs. Physics & Computer Science

Citation Age

Figure: % of Citations over 20 Years Old
Figure: Median Oldest Citation Per Mathematical Publications
Citation Age

Figure: Median Citation Age Per Mathematical Publications
Reference Age

Figure: Median Reference Age for Mathematical Publications
Impact on Impact

- Need to expand time frames for measuring mathematics
Impact on Impact

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  - 20 Years?
Impact on Impact

- Need to expand time frames for measuring mathematics
  - 20 Years?
  - 50 Years?
Impact on Impact

- Need to expand time frames for measuring mathematics
  - 20 Years?
  - 50 Years?
  - 100 Years?
Impact on Impact

- Need to expand time frames for measuring mathematics
  - 20 Years?
  - 50 Years?
  - 100 Years?
- And/or we need to use different metrics
Impact on Collections & Acquisitions

- Collections
Impact on Collections & Acquisitions

- Collections
  - Can’t predict when something will become relevant
Impact on Collections & Acquisitions

- Collections
  - Can’t predict when something will become relevant
  - No cut-off age
Impact on Collections & Acquisitions

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- Acquisitions
  - Age is irrelevant (for research publications)
Impact on Collections & Acquisitions

- **Collections**
  - Can’t predict when something will become relevant
  - No cut-off age
  - Can anything be weeded?

- **Acquisitions**
  - Age is irrelevant (for research publications)
  - Stay on top of old material which has become relevant
Questions

¿?