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
Outline

1. Introduction

2. Data & Methodology

3. Mathematical References & Citations Over Time

4. Mathematics Vs. Physics & Computer Science

5. Mathematical Aging’s Impact

6. Questions
STE & M???

- Mathematics and Science often studied together
Mathematics ≠ Science

Introduction

STE & M???

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

Introduction

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Mathematics and Science often studied together

- Both came from Natural Philosophy tradition
- Mathematics provides the foundation for Science
Mathematics ≠ Science

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  - Gauss: ”Mathematics is the queen of the sciences”
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Introduction

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

A Foreign Queen

- Mathematical Vs. Scientific Knowledge
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- Chalkboard Vs. Laboratory
A Foreign Queen

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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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  - Big Ten Academic Alliance
- Web of Science Categories
Dataset

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  - Mathematics
  - Mathematics, Applied
  - Mathematics, Interdisciplinary Applications
Dataset

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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
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  - Incomplete Data
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- Caveats
  - Incomplete Data
  - Reference date errors
Total Mathematical Publications

<table>
<thead>
<tr>
<th>Mathematics</th>
<th>Applied</th>
<th>Interdisciplinary Applications</th>
<th>Total</th>
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<tr>
<td>742541</td>
<td>611160</td>
<td>199652</td>
<td>1343970</td>
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</tbody>
</table>

Table: Mathematical Publications in Web of Science
Mathematics $\neq$ Science

Mathematical References & Citations Over Time

Reference Age

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
Citation Age

Figure: % of Citations over 20 Years Old
Mathematics ≠ Science

Mathematics Vs. Physics & Computer Science

Total Publications

Table: Publications in Web of Science

<table>
<thead>
<tr>
<th>Mathematics</th>
<th>Applied</th>
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<th>Mathematics Total</th>
<th>Physics</th>
<th>Computer Science</th>
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</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>
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</tbody>
</table>
Mathematics ≠ Science

Mathematics Vs. Physics & Computer Science

Citation Age

Figure: % of Citations over 20 Years Old
Citation Age

Figure: Median Oldest Citation Per Mathematical Publications
Citation Age

**Figure:** Median Citation Age Per Mathematical Publications
Reference Age

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Impact on Impact

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

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  - 20 Years?
  - 50 Years?
Mathematics ≠ Science

Mathematical Aging’s Impact

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

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  - 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