Mathematics  Science: A study in citation rates over time

Hansen, Samuel

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Mathematics ≠ Science
A study in citation rates over time

Samuel Hansen
University of Michigan
Mathematics ≠ Science

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
Mathematics ≠ Science

Introduction

STE & M???

- Mathematics and Science often studied together
STE & M???

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  - Both came from Natural Philosophy tradition
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?
Mathematics ≠ Science

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- But are they really that similar?
A Foreign Queen

- Mathematical Vs. Scientific Knowledge
A Foreign Queen

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  - Proof - Experiment
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  - Axiomatic - Theoretic
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  - Non-Empirical - Empirical
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- Funding Structures
Dataset

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

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

- Clarivate Web of Science 1900-2017
  - Big Ten Academic Alliance
- Web of Science Categories
  - Mathematics
  - Mathematics, Applied
  - Mathematics, Interdisciplinary Applications
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Data & Methodology

Dataset

- Clarivate Web of Science 1900-2017
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- Web of Science Categories
  - Mathematics
  - Mathematics, Applied
  - Mathematics, Interdisciplinary Applications
  - Physics*
  - Computer Science*
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Data & Methodology

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)
Methodology

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- Publication level analysis
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  - Incomplete Data
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- Publication level analysis

- Caveats
  - Incomplete Data
  - Reference date errors
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Mathematical References & Citations Over Time

Total Mathematical Publications

<table>
<thead>
<tr>
<th>Year</th>
<th>All</th>
<th>Mathematics</th>
<th>Applied</th>
<th>Interdisciplinary Applications</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>1900</td>
<td>742541</td>
<td>611160</td>
<td>199652</td>
<td>1343970</td>
<td></td>
</tr>
</tbody>
</table>

Table: Mathematical Publications in Web of Science
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
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Mathematical References & Citations Over Time

Citation Age

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>
Citation Age

Figure: % of Citations over 20 Years Old
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Mathematics Vs. Physics & Computer Science

Citation Age

Figure: Median Oldest Citation Per Mathematical Publications
Citation Age

Figure: Median Citation Age Per Mathematical Publications
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Mathematics Vs. Physics & Computer Science

Reference Age

Figure: Median Reference Age for Mathematical Publications
Impact on Impact

- Need to expand time frames for measuring mathematics
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Mathematical Aging’s Impact

Impact on Impact

- Need to expand time frames for measuring mathematics
  - 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
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- Collections
  - Can’t predict when something will become relevant
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

¿?