Measuring Similarity Between Mathematics Research and Its References Using Bibliographic Coupling

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**WHO?**
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**WHAT?**
An analysis of the development of mathematics research overtime, with a focus on similarity between publication-reference and citation-publication pairs.

**WHY?**
In order to understand mathematics it is important to develop knowledge of how it has grown and the ways it builds upon itself.

**USING?**
The data used is from the Clarivate Web of Science citation database, 1900-2017. All records with Web of Science category designations were included in the analysis.

**Observations**
- While raw coupling strength for Publication-Reference pairs has increased over time, especially for higher strengths, relative coupling strength on the other hand shows a flattening for lower relative strengths and a decrease for higher one since the 1960s. This is likely related to the dramatic increase in references per publication, from a median around 7 to over 20 since 1960.
- The relative coupling strength of Citation-Publication pairs shows a steady increase over time, but evidence indicates this may be caused by citing publications sharing fewer references with older publications, behavior which would drive down relative strength as a publication ages.
- There is a noticeable decrease in the raw coupling strength of Citation-Publication pairs when publications with more than 100 citations are considered. There are many possible causes of such behavior, including popular papers serving as stand-ins for the publications they reference or highly cited publications being cited due to popularity instead of applicability.
- The more applied publications had higher raw coupling strength, while the more pure reference or highly cited publications being cited due to popularity instead of applicability.

**Observations**

**HIGHLY CITED PUBLICATIONS**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation-Publication Pairs</th>
<th>At least 1 Shared Reference (% of total)</th>
<th>At least 3 (% of total)</th>
<th>At least 5 (% of total)</th>
<th>10 or more (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>4967056</td>
<td>3273539 (65.91%)</td>
<td>1442886 (29.05%)</td>
<td>675081 (13.59%)</td>
<td>131860 (2.65%)</td>
</tr>
<tr>
<td>Applied</td>
<td>3390481</td>
<td>2391880 (70.61%)</td>
<td>1175232 (35.66%)</td>
<td>599890 (17.69%)</td>
<td>136802 (4.02%)</td>
</tr>
<tr>
<td>Interdisciplinary</td>
<td>815449</td>
<td>358437 (71.79%)</td>
<td>306705 (37.61%)</td>
<td>165914 (20.35%)</td>
<td>46696 (5.48%)</td>
</tr>
<tr>
<td>Total</td>
<td>7919132</td>
<td>5361943 (67.71%)</td>
<td>2485050 (31.41%)</td>
<td>122186 (15.42%)</td>
<td>264558 (3.34%)</td>
</tr>
</tbody>
</table>

For references and a work-in-progress paper please visit tinyurl.com/shbibpapersla2019