Measuring the Quality of Science

A look at citation analysis tools & altmetrics to evaluate research impact
Learning aims:

By the end of this session you will know:

• How research evaluation works

• Journal Impact factor & h-index

• The strengths and the weaknesses of the different metrics

• Alternative metrics
Citation analysis

- Scopus
- Web of Science
- Google Scholar

Journal Citation Reports
- Highly Cited in Field
- Highly Cited Researchers
- Hot Papers in Field

Tenure

Lib4RI Training Series · Measuring the Quality of Science · Autumn 2018
## Sources of citation data


<table>
<thead>
<tr>
<th>Source</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
</table>
| **Web of Science** (part of the Web of Knowledge, WoK, suite of resources) | - Advanced citation searching and analysis features  
- Citation data available from 1900 to date  
- Broad coverage of high impact journals  
- Additional citation data is available in WoK by searching **All Databases**  
- Strong in STEM  
- Patents included* | - Books, book chapters  
- Conference papers, dissertations excluded*  
- Limited coverage of non-English language titles  
- SSH & Arts  
*depends on libraries license |
| **Scopus** | - Advanced citation searching and analysis features  
- Better title coverage than WoS  
- Includes conference proceedings  
- Strong in STEM | - Books, book chapters, dissertations excluded  
- SSH & Arts still underrepresented  
- non-English language titles |
| **Google Scholar** | - Free  
- Covers non-English language titles  
- Covers all types of publications including books and conference papers | - No quality control, lots of errors in data  
- Does not cover all journals  
- Covers non-scholarly content  
- Coverage un-even across disciplines  
- Difficult to deal with name variants |
Scopus & Web of Science coverage comparison

- Scopus: limited pre 1970 data
- Coverage of Google Scholar ???

From: JISC now hosted on http://edesiderata.crl.edu/

Journal Impact: Journal Impact Factor (JIF)

• Created by Eugene Garfield and Irving H. Sher in the early 1960s to help select journals for the *Science Citation Index* (association-of-ideas index)

• Allows comparison of journals independent of journal size

• Updated every year and published in the Journal Citation Reports (Clarivate Analytics)

  https://jcr.incites.thomsonreuters.com

• Use it to find influential journals for reading or potential publication
Calculation of the Journal Impact Factor

\[
\text{JIF} \ 2017 = \frac{\text{Citations in 2017 to articles published in 2016 & 2015}}{\text{Number of articles published in 2016 & 2015}}
\]

- The Journal Impact Factor is the average number of times articles from the journal published in the past two (five) years have been cited.
Where can I find Journal Impact Factors?
Exercise

What is the 2016 journal impact factor for the journal Ambio?

Which journal has the highest JIF in the category Toxicology in 2017?
Don’t compare JIFs across disciplines

Source: InCites Journal Citation Reports 2016, Clarivate Analytics
Don’t compare JIFs across disciplines

From: http://www.slideshare.net/gradschoolmediazoo/bytes3-impact-factors
Don’t judge an article by its cover

- Skewed distribution of citations
- The most cited 15% of the articles account for 50% of the citations
  → The median would be a better impact factor

From: Dwight J. Kravitz and Chris I. Baker (2011)
https://doi.org/10.3389/fncom.2011.00055 (CC BY-NC 3.0)
Don’t judge an article by its cover

- Influence of single articles
- Top cited article >6’600 citations, second in 2008: 28 citations
- JIF of Acta Crystallographica Section A was higher than Nature and Science
Journal impact: Others

- 5-year Impact Factor (JCR, Clarivate Analytics)
- Eigenfactor Score (JCR, eigenfactor.org)
  - Journals are rated according to the number of incoming citations, citations from highly ranked journals are weighted stronger
- Cite Score (Scopus, Elsevier)
  - 3 years impact factor, counting all document types
- SCImago Journal Rank (SJR, Scopus, Elsevier)
  - 3 years impact factor, citations are weighted by the prestige of the citing journal
- Source Normalized Impact per Paper (SNIP, Scopus, Elsevier)
  - 3 years impact factor, citations are weighted by the citation potential of the journal’s subject category → more comparable across different disciplines.
How to calculate the *h*-index?

- An author’s number of articles (h) that have received at least *h* citations

- Calculate it **manually**:
  1. Create a list of all your publications and the number of times each publication has been cited
  2. Sort your papers in descending order by number of citations
  3. Look down through the list to find all papers where the number of citations is ≥ the rank for a given paper
     \[ \Rightarrow \text{# paper} = h\text{-index} \]

- **Automatically** calculated in Citation Indices:
  - Web of Science
  - Scopus
  - Google Scholar

<table>
<thead>
<tr>
<th>Rank</th>
<th>Paper</th>
<th># Citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Paper A</td>
<td>33</td>
</tr>
<tr>
<td>2</td>
<td>Paper B</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Paper C</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Paper D</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Paper E</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Paper F</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Paper G</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>Paper H</td>
<td>4</td>
</tr>
</tbody>
</table>

Scientist A: *h*-index = 5

<table>
<thead>
<tr>
<th>Rank</th>
<th>Paper</th>
<th># Citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Paper A</td>
<td>155</td>
</tr>
<tr>
<td>2</td>
<td>Paper B</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Paper C</td>
<td>22</td>
</tr>
<tr>
<td>4</td>
<td>Paper D</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Paper E</td>
<td>1</td>
</tr>
</tbody>
</table>

Scientist B: *h*-index = 3

**h-index in Web of Science**

1. Go to Web of Science (via Quicklinks on www.lib4ri.ch)  
   http://isiknowledge.com/wos
2. Select Web of Science Core Collection
3. Enter the name of the author and select Author from the drop-down menu
4. Click on Search
5. Click on Create Citation Report on the right hand corner of the results page, the h-index is on the right of the screen
$h$-index in Web of Science

Citation report for 80 results from Web of Science Core Collection between 1900 and 2018.

- Total Publications: 80
- $h$-index: 29
- Average citations per item: 45.29
- Sum of Times Cited: 3,623
  - Without self citations: 3,418
- Citing articles: 2,558
  - Without self citations: 2,507
**h-index in Scopus**

1. Go to [Scopus](http://www.scopus.com) (via Quicklinks on [www.lib4ri.ch](http://www.lib4ri.ch))
2. Click on the Author search tab
3. Enter the name of the author in the search box or use his ORCID ID & click Search
4. On author search results page, click the name of the author whose publishing output you want to evaluate.
5. On the author’s profile page, you will find the h-index listed
$h$-index in Scopus

Sommer, Marc A.

Duke University, Department of Biomedical Engineering, Durham, United States
Author ID: 7103108797
Other name formats: Sommer, Mark A. · Sommer, Marc · Sommer, M. A.

Subject area: Neuroscience · Biochemistry, Genetics and Molecular Biology · Psychology · Computer Science · Agricultural and Biological Sciences
Multidisciplinary · Social Sciences · Arts and Humanities

Document and citation trends:

Follow this Author

27

View potential author matches

Documents by author
67

Total citations
3377 by 2283 documents
**h-index in Google Scholar**

Quick & Easy if author has created a user profile on Google Scholar:

1. Search for author name
2. Click on user profile (if available)
$h$-index in Google Scholar

Marc A. Sommer
Associate Professor of Biomedical Engineering, Duke University
Bestätigte E-Mail-Adresse bei duke.edu - Startseite
Biomedical Engineering, Neuroscience

No user profile on Google Scholar?
- Use Publish or Perish (POP) program: http://www.harzing.com/pop.htm

h-index: 30
Exercise

- Find the $h$-index for **Christa P. H. Mulder** (currently at University of Alaska Fairbanks) in Web of Science, Scopus & Google Scholar!
- Use:
  - “Mulder CPH” in WoS
  - Mulder Christa PH ind Scopus
  - Mulder Christa in Google Scholar
Some limitations & Caveats

- Academic disciplines differ in the average number of references per paper and the average number of papers published by each author. *Don’t* compare your $h$-index with someone working in a different field!

- The length of the academic career will impact the number of papers published and the amount of time papers have had to be cited. *Don’t* compare your $h$-index with that of an older or younger colleague!

‘Obviously a single number can never give more than a rough approximation to an individual’s multifaceted profile, and many other factors should be considered in combination in evaluating an individual.’

[Jorge E. Hirsch]
Metrics for researchers: Others

• Raw Data:
  • Number of publications
  • Total citations

• $h$-index variations
  • 5 years $h$–index: Counts only citations in the last 5 years $\rightarrow$ better for young scientists
  • $i10$–index: only articles with >9 citations are counted

• Metrics derived from journals
  • E.g.: author-level eigenfactor and author impact factor
Citation analysis & Altmetrics

Citation Analysis
- Citation-based metrics on different levels:
  - Article
  - Researcher
  - Journal
  - Institution

Altmetrics
- Citation + non-citation-based metrics on different levels:
  - Views
  - Downloads
  - Discussed
  - Recommended
  - Cited

- PLoS article level metrics
- Altmetric Score
- PlumX Metrics

Ranking journals
Ranking researchers
Ranking articles
Ranking institutions & countries
Measuring the quality of science:

- Impact factor, h-index, citations and publication counts are the most important research metrics

- Officially research funders are looking for alternatives to the IF, but in practice it is still widely used

- Improved metrics were proposed - none are really established yet

- Altmetrics take the outreach of research into account → not established