

Scientific metrics

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Agenda

1 Introduction

- Introduction to Research Impact
- Types of Scientific Metrics
- Bibliographic Databases

2 Altmetrics

- Altmetric Attention Score

3 Bibliometrics

- Impact Factor
- CiteScore
- SNIP
- SJR

4 Researcher's metrics

- h-index
- g-index
- c-index
- l-index

The original purpose of scientific publishing was to enable the global sharing of scientific results, ideas, and discussions within the academic society for more effective scientific achievements.

Influence of a publication is used for

- Allocation of funding resources
- Industrial and economic growth priorities
- Education policies
- The hiring of personnel academics

Types of Scientific Metrics

Journal-level metrics are used to determine the impact a journal has on the scientific community

- Impact Factor

Article-level metrics include any measures of the influence of a single publication.

- Citation Counts

Author-level metrics assess the impact an author makes on the scientific community or field of the study.

- H-Index

Alternative metrics assess other measures of use and influence, such as the number of times a publication is read, downloaded, saved, mentioned, or cited in popular online sources.

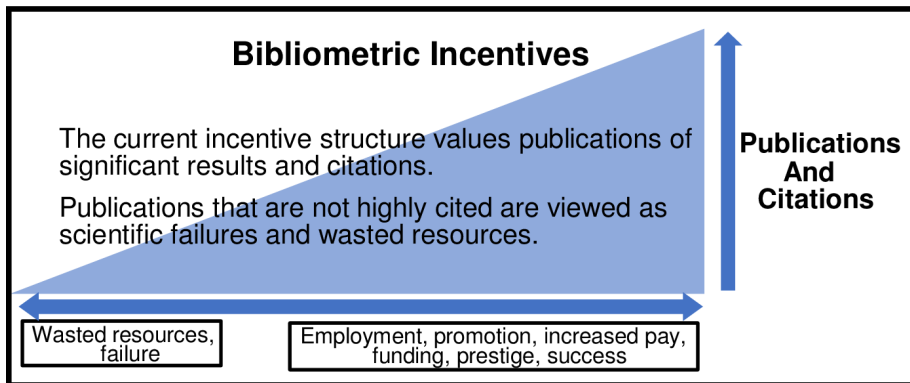


Figure 1: Bibliometric incentives model¹

¹<https://doi.org/10.1371/journal.pone.0195321.g001>

Bibliographic Databases

Scopus®



What is a bibliographic database?

A bibliographic database is a repository of bibliographic or publication records.

Citations in science serve as linkages between similar research items, and lead to related scientific literature

Frequently used biomedical databases include

- Web of Science
- Scopus
- Google Scholar

Bibliographic Databases: advantages and disadvantages

Pros

- ✓ Easy access to publication metadata and citation metrics

Cons

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- ✗ Bias towards the English language

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- ✗ Most databases only include published articles
- ✗ Bias towards the English language
- ✗ Limited to specific fields

Altmetric Attention Score

What is Altmetric Attention Score?

The Altmetric Attention Score is an automatically calculated, weighted count of all of the attention a research output has received

It is calculated using data collected from research articles such as mentions on social media, news outlets, blogs, patents, etc.

The Colors of the Donut

- | | |
|-------------------------------|-----------------------------|
| Policy documents | Google+ |
| News | LinkedIn |
| Blogs | Reddit |
| Twitter | Research highlight platform |
| Post-publication peer-reviews | Q&A (Stack Overflow) |
| Facebook | Youtube |
| Sina Weibo | Pinterest |
| Syllabi | Patents |
| Wikipedia | |



Figure 3: The colors of different sources of attention

Altmetric Attention Score: advantages and disadvantages

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- ✓ Quicker to accumulate

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- ✗ Not an indicator of quality
- ✗ Not everything gets shared

Bibliography metrics

IF (Impact Factor)

What is Impact Factor?

Impact Factor[Garfield, 1972] — a per-year metric based on *Web of Science* database which reflect the mean number of citations to the papers published within prior 2 year.

The Impact Factor is calculated by the following formula:

$$IF(y) = \frac{C(y)}{D(y-1) + D(y-2)}$$

where

- $C(y)$ – number of citations to the articles published in $[y-2, y-1]$ years
- $D(y)$ – number of published articles in year y

IF: advantages and disadvantages

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- ✓ Easily calculated and interpreted

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✗ Limited availability

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- ✗ Unstable
- ✗ Doesn't allow to compare titles from different fields

What is CiteScore?

CiteScore[Zijlstra and McCullough, 2016] — a per-year metric provided by *Scopus* which measure rate between the received citations to **all peer-reviewed documents** of a title published within 4 years.

The CiteScore is calculated by the following formula:

$$\text{CiteScore}(y) = \frac{CD_{y-3}(y)}{D(y) + D(y-1) + D(y-2) + D(y-3)}$$

where

- $CD_x(y)$ – the number of citations in year range from x to y to all documents published within those years.
- $D(y)$ – the number of all **peer-reviewed** documents published in year y

CiteScore 2016 vs CiteScore 2019

CiteScore 2019-2021 vs CiteScore 2016-2018

Previously CiteScore has been calculated within 3 year range, and count citation received only in year y .

$$\text{CiteScore} = \frac{\sum \text{orange}}{\sum \text{blue}}$$

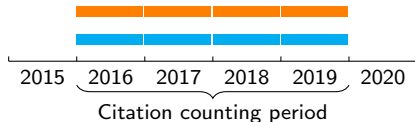


Figure 4: CiteScore 2019

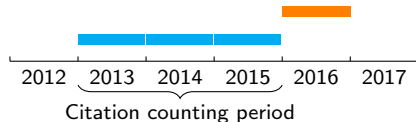


Figure 5: CiteScore 2016

orange – number of citation received by publications published in citation counting period

blue – number of documents (in CiteScore 2019 only peer-reviewed) published in corresponding year

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SNIP (Source Normalized Impact per Paper)

What is SNIP?

SNIP[Moed, 2010] measures a journal's contextual citation impact, taking into account subject field with use of, so called, citation potential of the field of science. The SNIP score is calculated based on *Scopus* database.

The SNIP is calculated by the following formula:

$$\text{SNIP}(y) = \frac{RIP(y)}{RDCP(y)}$$

where

- $RIP(y)$ – raw impact per paper in year y (IPP / CiteScore 2016)
- $RDCP(y)$ – relative database citation potential in a journal's subject field in year y

$$RDCP^j(y) = \frac{DCP^j(y)}{\text{med}_i DCP^i(y)}$$

where DCP – database citation potential in a journal's subject field:

$$DCP^j(y) = \frac{\sum_{p \in CP(y)} DCP_p^j(y)}{\#CP^j(y)}$$

where

- $CP^j(y)$ – papers citing the journal j and **published in journals processed for the database** in the range $[y - 3, y - 1]$ years
- $DCP_p^j(y)$ – number of references to the papers published in those years from paper $p \in CP^j(y)$

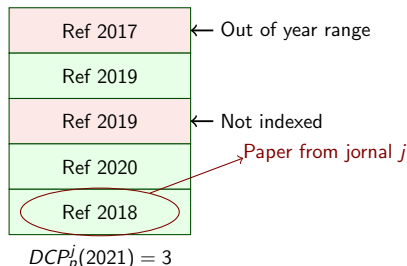


Figure 6: Example of DCP_p^j calculation

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- ✗ Calculation is more complicated

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- ✗ Calculation is more complicated
- ✗ Citation potential tends to be highest for topical journals

What is SJR?

SJR[González-Pereira et al., 2009] is a metric provided by *Scopus* which is based on the number of citations and the prestige of the titles which cite this journal.

Key points of SJR:

- Based on PageRank[Page et al., 1999] algorithm to calculate the prestige of the journal: citations issued by more important journals will be more valuable than those issued by less important ones
- Self-citation limited to 33% of the total references
- Citation time frame is 3 year

The SJR indicator is computed in two phases:

- 1 Prestige SJR (PSJR) – size- dependent measure that reflects the overall journal prestige
- 2 normalization of this measure to give a size-independent metric

The formula for the SJR metric (2 stage) is the following:

$$SJR_i(y) = c \cdot \frac{PSJR_i(y)}{Art_i(y)}$$

where

- $Art_i(y)$ – number of primary items (articles, reviews, and conference papers) of journal i published in three previous years $[y-3, y-1]$.
- c – common constant to prettify values of SJR

The PSJR calculation is an iterative process which started with **identical amount** of prestige to each journal until the differences between journal prestige in consecutive iterations is under threshold.

$$PSJR_i = \underbrace{\frac{1-d-e}{N}}_{\text{min value}} + \underbrace{e \cdot \frac{Art_i}{\sum_{j=1}^N Art_j}}_{\text{number of papers}} + d \cdot \overbrace{\left[\sum_{j=1}^N C_{ji} \cdot \frac{PSJR_i}{C_j} \cdot CF + \frac{Art_i}{\sum_{j=1}^N Art_j} \cdot \sum_{k \in DN} PSJR_k \right]}^{\text{number and "importance" of the citations from other journals}}$$

where

- C_j – number of references of journal j
- C_{ji} – references from journal j to journal i
- d – constant: 0.9
- N – number of journals in the database
- DN – journals that do not cite other journals
- e – constant: 0.0999

Prestige SJR

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where

- CF(Correction Factor) is introduced that spreads the undistributed prestige over all the journals proportionally to their accumulated prestige

$$CF = \frac{1 - \sum_{k \in DN} PSJR_k}{\sum_{h=1}^N \sum_{l=1}^N C_{lh} \cdot \frac{PSJR_l}{C_l}}$$

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- ✗ Hard to interpret and calculate
- ✗ Still windowed approach

Author-level metrics

h-index

What is the h-index?

The **h-index**[Hirsch, 2005] is a measure used to quantify the cumulative impact and relevance of an individual's scientific research output.

First introduced by Professor Jorge E. Hirsch in 2005.

h-index formula:

$$h = \max i \in N : f(i) \geq i$$

where

- i is the published paper
- $f(i)$ is the number of citations for i

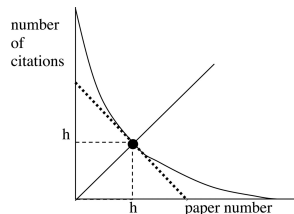


Figure 7: Graphical representation of the h-index

Example

4 publications: A,B,C,D citations per paper: 7,5,4,3
h-index=3

Pros

- ✓ It avoids previous indexes' problems

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- ✗ Exposed to manipulation
- ✗ Time-dependent

h-index variations

m quotient

It allows comparisons between scientists with different career lengths.

m quotient formula:

$$m = \frac{h}{n}$$

where

- n the number of years of academic activity

normalized h-index

It reduces the discipline bias.

normalized h-index formula:

$$|h| = \frac{h}{d}$$

where

- d the average number of academics in the field

individual h-index or hl

It reduces the effects of co-authorship.

hl formula:

$$hl = \frac{h}{\sum_{i=1}^n a_i}$$

where

- h – the h-index
- n – the number of papers and
- a_i – average number of authors

What is the g-index?

The **g-index**[Egghe, 2006] is a modified version of the h-index

First introduced by Leo Egghe in 2006.

How is it calculated?

Decreasingly order the papers based on the number of citations for each. The index is the largest number $s.t.$ the top g articles received together at least g^2 citations.

g-index

g-index formula:

$$g^2 = \sum_{i=1}^g c_i$$

where

- c_i – number of citations for each i paper

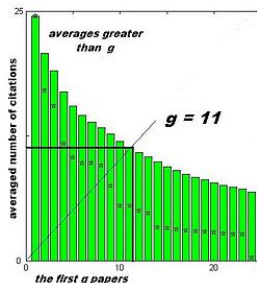


Figure 8: Graphical representation of the g-index

Example

Top publications: 5
Citations: 25
g-index=5

g is always greater or equal to h .

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- ✗ Saturation value
- ✗ It lacks discriminatory power
- ✗ It only favours academics with many publications

What are c-indexes?

c-indexes[Post et al., 2018] are the result of the augmentation of the h-index based on the citation order.

Introduced in 2018 in the magazine Cureus.

c-indexes formulas:

$$c_p = h + i_p \quad c_s = h + i_s \quad c_o = h + i_p + i_s$$

The augmentations are given by the following formulas:

$$i_p = n_f + 0.5n_s$$

$$i_s = n_l + 0.5n_s$$

Pros

- ✓ All the advantages of the h-index

Cons

Pros

- ✓ All the advantages of the h-index
- ✓ More accurate

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- ✓ More accurate
- ✓ Takes citation order into account

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- ✗ Field of research is ignored

What is the I-index?

The **I-index**[Lando and Bertoli-Barsotti, 2014] is a bibliometric based measure derived from the h-index which enhances highly cited papers.

Introduced in 2014.

I-index formula:

$$L(x) = \sum_{i=1}^n \ln \left(1 + \frac{x_i}{x_i^*} \right) x_i^*$$

After normalization:

$$I(x) = \sqrt{\frac{L(x)}{\ln 2}}$$

where

- x – real citation distribution
- x^* – ideal citation distribution

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- ✗ Field of research is ignored
- ✗ Complex calculation

CONCLUSION

- Simple metrics like number of publications, number of citations or impact factor are often inappropriate to quantify the impact of a journal or an academic.
- More complex metrics must be employed.
- Deciding which metric to use depends on its specific properties and on the academic context.

- [Egghe, 2006] Egghe, L. (2006). Theory and practise of the g-index. *Scientometrics*, 69(1):131–152.
- [Garfield, 1972] Garfield, E. (1972). Citation analysis as a tool in journal evaluation: Journals can be ranked by frequency and impact of citations for science policy studies. *Science*, 178(4060):471–479.
- [González-Pereira et al., 2009] González-Pereira, B., Guerrero-Bote, V., and Moya-Anegón, F. (2009). The sjr indicator: A new indicator of journals' scientific prestige. *arXiv preprint arXiv:0912.4141*.
- [Hirsch, 2005] Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National academy of Sciences*, 102(46):16569–16572.

- [Lando and Bertoli-Barsotti, 2014] Lando, T. and Bertoli-Barsotti, L. (2014). A new bibliometric index based on the shape of the citation distribution. *PLoS One*, 9(12):e115962.
- [Moed, 2010] Moed, H. F. (2010). Measuring contextual citation impact of scientific journals. *Journal of informetrics*, 4(3):265–277.
- [Page et al., 1999] Page, L., Brin, S., Motwani, R., and Winograd, T. (1999). The pagerank citation ranking: Bringing order to the web. Technical report, Stanford InfoLab.
- [Post et al., 2018] Post, A., Li, A. Y., Dai, J. B., Maniya, A. Y., Haider, S., Sobotka, S., and Choudhri, T. F. (2018). c-index and subindices of the h-index: New variants of the h-index to account for variations in author contribution. *Cureus*, 10(5).

[Zijlstra and McCullough, 2016] Zijlstra, H. and McCullough, R. (2016). Citescore: a new metric to help you track journal performance and make decisions.

<https://www.elsevier.com/connect/editors-update/citescore-a-new-metric-to-help-you-choose-the-right-journal>.

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