

Impact of Journal Metrics and Author Indices: A Review

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ABSTRACT

Background: Journal Metrics is a term used to describe various parameters which measure the quality of a journal. Not only the journals even the quality of authors can be assessed through various parameters. All these parameters are entirely dependent on citation analysis. Journal metrics are basically of two types, one type determines the impact of journal and the other type determines the impact of author. There are various agencies which measures the journal metrics most important one being Journal citation reports (JCR) by Thomson Reuters which measures Impact factor, immediacy index and cited half-life. Scopus calculates Citescore metrics, Scimago Journal rank (SJR), Source normalised impact per paper (SNIP), Impact per publication (IPP). Eigen factor also measures the journal impact. Author impact is measured by h-index, m-index, e-index and i10-index. This article gives a review of various metric systems available to calculate the impact of journals and authors.

Keywords: Journal metrics, Impact factor, SciMago journal rank, H-index.

INTRODUCTION

Earlier a scientific publication was relatively easy but now there are end numbers of journals so it becomes very difficult to choose the journal where the research can be published. Not only are the journals even for the authors, their publications are now being used for the evaluation of their research quality so it becomes very important to understand the topic of journal metrics. The measures of assessing journal quality are known as journal metrics or bibliometric indicators. All these indicators are entirely dependent on citation analysis. Citation analysis is the process whereby the impact or quality of an article is assessed by counting the number of times other authors mention it in their work.¹ Journal metrics are now increasingly being used by librarians and authors to decide the choice of

journals. This article describes various parameters used in relation to journal metrics.

There are two types of impact which can be measured in relation to journals.²

1. Journal Impact
2. Author impact

Journal impact is measured by

1. Thomson Reuters which publishes Journal citation reports, it measures
 - a. Impact factor
 - b. Immediacy Index
 - c. Cited half life
2. Scopus which measures
 - a. Cite Score metrics

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- b. SCImago Journal Rank (SJR)
- c. Source Normalised Impact Per Paper (SNIP)
- d. Impact Per Publication (IPP)

- 3. Google scholar metrics
- 4. Eigen factor

Author impact is measured by

- 1. H-Index
- 2. m-index
- 3. g-index
- 4. e-Index
- 5. i10 Index

IMPACT FACTOR (IF)^{3,4}

History

Garfield in 1955 suggested that number of references could be used to measure the impact of a journal, and the term "Impact Factor" was introduced in 1963 by Garfield and Sher. The primary goal of impact factor analysis was to improve the management of library journal collections. This finally led to publication of Thomson Reuter's Journal Citation Reports (JCR). In 1964, Garfield introduced the first science citation index (SCI) in 5 volume print edition.

Definition:

Impact factor is defined as number of times articles from a journal are cited within 2 years divided by total number of articles published in the same journal during 2 year period

$$IF = A/B$$

A= Total number of citations of journal article during the 2 year before the year considered

B= Total number of articles published during the 2 years before the year considered

More the citation listed, the higher the impact factor

Various factors which influence the number of citations are

- i. Preference for English as a language
- ii. The content of review and basic research articles

- iii. Articles available online with open access policy

Various factors affecting Journal Impact Factor (JIF)

1. Directly related to area of research The larger the scope of journal, higher the journal impact factor. This means that best journals in specialised areas like dermatology or ophthalmology never achieve the journal impact factor of general medicine journal.
2. Favouritism for faster specialities- Two year period used to calculate impact factor favours disciplines in which scientific progress is rapid such as Immunology, Molecular Biology and Genetics as opposed to specialised clinical disciplines such as Dermatology or Ophthalmology.
3. Subject area of journal: IF varies from subject to subject, it is higher in fundamental and Pure subjects and lower in specialised or applied fields so comparison of JIF should be made on same subject areas.
4. Number of Authors- Since many authors have tendency to cite their own work (Self citation), this practice distort true picture.
5. Publication type and Impact Factor: Impact factor may be unintentionally tweaked in rapid publication journals and articles of current review type. Journal with high number of review articles have an advantage in the impact factor over those that published primarily research papers.
6. Journal Size: Size means number of articles published per annum and the size of measurement window, which in case of JCR is 2 years.
7. Time lag in publication: If reviewing and publication are delayed and references are no longer current they will not be included in the impact calculation. Since IF works on 2 years frame, it favours research that takes less time to complete. Research in medicine takes longer than that, so it is a kind of penalty on investigators so the review process should be rigorous yet fast.

8. Title /Abstract: As they become the key words for finding an article in an online database.
9. Journal Title: When a journal changes its name, the old and new titles are not unified eg Scandinavian Journal of Dental Research (SJDR) is now called European Journal of Oral Sciences. SJDR has a history of 105 years of publication. However when its title was changed in 1996, impact factor lowered for the new title
10. Language and Impact Factor: Availability of work in English alone increases its citation
11. Variability in Impact Factor due to Numerator and Denominator: The SCI database includes normal articles, notes and reviews as citable items in denominator but citation of all types of articles such as editorials, letters and meeting abstracts are included in numerator. Inclusion of these additional items causes substantial increase in impact factor. Editors could raise the impact factor of a journal by frequent reference to their previous editorials since database makes no correction for self-citation.

Immediacy Index^{5,6}

The immediacy index is the average number of times an article is cited in the year it is published. It is calculated by dividing the number of citations to articles published in a given year by the number of articles published in that year in the journal. It gives the advantage to large journals than small ones as it is a per article average. Frequently issued journals have an advantage because articles published early in year have a better chance of being cited than published later in the year. It shows which journals are publishing hot or cutting edge articles.

Cited Half Life^{4,6}

Definition: The cited half-life is the calculated point (Age in years) where 50% citations are under the age and 50% of citations are over that age. The cited half-life is a measure of the rate of decline of citation curve. It is the number of years that number of current citations takes to decline to 50% of its initial value. It provides an estimate of how long a publication will continue to impact the literature. According to some while impact factor tells how many times article has been cited, it is the

cited half-life that is more relevant. More cited half-life means journal has a good track record and was producing good articles in the past. It is useful to library staff to carry out collection management.

CiteScore Metrics by Scopus^{7,8,9}

CiteScore Metric is a new metric to help track journal performance. It's a family of eight complementary indicators, which are CiteScore, CiteScore Tracker, CiteScore Percentile, CiteScore Quartile, CiteScore Rank, Citation count, Document count, Percentage Cited.

CiteScore is the average citations per document that a title receives over a three year period. CiteScore Tracker shows how the current year's CiteScore builds up each month. CiteScore Percentile indicates the relative standing of a serial title in its subject field. CiteScore Rank indicates rank position of the title in its subject area. Citation count indicates citation received in one year for the documents published in the previous three years. Document count indicates sum of documents published in the serial title in the three year period. Percentage cited is the proportion of the document that have received at least one citation.

Advantages of CiteScore Metrics

1. The three year citation window – two year period is too short for slower moving fields and five year period is too long for faster moving fields, so three year is the best compromise.
2. Both numerator and denominator are consistent, it includes all document types.
3. Transparent calculations with no secret algorithms or hidden details.
4. Current- it is calculated on an annual basis, so provides a current view of how a journal is performing during the course of the year.

Scimago Journal Rank (SJR)¹⁰

Developed by Professor Felix de Moya, SJR is a prestige metric based on the idea that all citations are not created equal. With SJR, the subject field, quality and reputation of journal have direct effect on the value of citation. SJR is a measure of scientific influence of scholarly journals

that accounts for both the number of citations received by a journal and importance or Prestige of the journals where such citation come from. It is provided by SCOPUS. It uses a weighted citation score meaning that citations from a prestigious journal are scored more highly than those from a title that has a smaller citation network. Impact factor on the other hand uses absolute counts, one citation means one citation.

The SJR indicator which is inspired by the page Rank Algorithm was developed for extensively large and heterogeneous journal citation networks. It is size independent indicator and ranks journals by their average prestige per article and can be used for journal comparison in science evaluation process.

SNIP (Source Normalised Impact Per Paper)¹¹

SNIP was created by professor H.F Moed at Centre of Science and Technology Studies (CWTS), university of Leiden. It is provided by Scopus and measures a source's contextual citation impact. SNIP is ratio of source's average citation count per paper, and the citation potential of its subject field. Citation potential of a subject field is the average number of references per document citing that source.

When citation potential is equal to average of the whole database, SNIP has same value as standard impact per paper. But in fields with higher citation potential SNIP is lower than impact per paper. In fields in which citation potential is lower SNIP tends to be higher than the impact per paper.

IPP (Impact per Publication)¹²

Same as impact factor, it uses 3 year window calculated by scopus

Advantages of SJR , SNIP and IPP ^{10,11,12}

1. Transparency- calculated directly from main database. Whereas IF can only be calculated by Thomson Reuters.
2. Subject field normalisation- for SJR and SNIP, subject differences are not to be worried.
3. Three year citation window

4. Manipulation resistant- because IF takes into consideration even the citations which are non peer reviewed like editorials. Whereas SNIP and SJR consider citation made by peer reviewed content.
5. Breadth of coverage- Scopus provides journal metrics to all peer reviewed journals indexed in the database.

Weak points of SJR and SNIP

1. Complicated- more complex algorithms
2. Doesn't address the bias of review articles

Google Scholar Metrics ^{13,14}

It is freely accessible and provides an easy way for authors to quickly gauge the visibility and influence of recent articles in scholarly publications. It calculates five year h-index and h-median metrics.

Eigen Factor¹⁵

It is developed by Jevin west and Carl Bergstrom at University of Washington. Eigen Factor is basically a measure of how many people read a journal and think its contents are important. It is measured indirectly by counting the total number of citations a journal receives over five year period. Therefore Journal A which publishes 1000 articles a year will have twice Eigen factor of Journal B which put out 500 articles annually if each article is cited same number of times.

It is meant to measure the importance of journal throughout the scientific community and rewards large journals.

H-Index ¹⁶

Originally described in 2005 by its namesake Jorge Hirsch, is a measurement that aims to describe the scientific productivity and impact of a researcher. H-Index is a measure of the number of highly impactful papers a scientist has published. The larger the number of important papers, the higher the h-index regardless of where the work was published. To calculate h-index, two pieces of information are required- Total number of Paper Published (Np) and the number of citations (Nc) for each paper. The h-index is defined by how many h of a researcher's publications (Np) have at least h

citation each. If I have published one paper and it is cited once that means H-index is one. If I have published 2 papers that have been cited twice that means the H-Index is two.

Advantages of H-Index

1. It relies on citation of your paper not the journal which is a true measure of quality.
2. It is not influenced by a single well cited paper (unlike total number of citations)
3. It is not increased by large number of poorly cited papers (unlike total number of paper would be)
4. It minimizes the politics of publication. A high impact paper counts regardless of whether your competitor kept it from being published in the top tier journals
5. It is good for comparing scientists with in a field at similar stages in their career.
6. It may be used to compare not just individuals but also departments, programs or any other group of scientist.

Disadvantages of H-Index

1. It counts a highly cited paper regardless of why it is being referenced e.g. For negative reasons.
2. It doesn't account for variation in average number of publications and citation in various fields
3. It ignores the number and position of authors on a paper
4. It limits authors by the total number of publications so shorter careers are at a disadvantage
5. It has relatively low resolution in that many scientist ends up in same range. It is difficult to increase the H-Index, the higher it gets. (an H-index of 100 corresponds to minimum of 10,000 citations)
6. Like all metrics, it is also based on data from the past and may not be valid predictor of future performance.

m-Index¹⁶

Introduced by same creator, it is defined as h- Index divided by the number of years since the researcher's first publication. It is meant to normalise the H-index so that early and late

scientist can be compared. It averages period of high and low productivity throughout a career.

g-Index¹⁶

By Leo Egghe, h-index is relatively unaffected by a small number of exceptionally well cited articles. When researcher's publications are listed in decreasing order of citations received, the g- index is largest number that the top g-articles received.

e- Index¹⁶

e-index aims to address the number of excess citations above and beyond h-index .The e-index is defined as square root of the sum of excess citations in the paper that contributed to the h-index.

i10-Index¹⁷

It is created by Google Scholar and used in Google's my citation feature and is another way to help gauge the productivity of scholar. i10-index is the number of publications with at least 10 citations. It is free and easy to use and very simple and straight forward to calculate.

DISCUSSION

Journal metrics were basically introduced to improve the library journal collections but now it's being used by authors to decide the choice of journal where research can be published. It was first started by Thomson Reuters in 1964 which led to publication of JCR. Impact factor given by it is entirely dependent on the number of citations received over a period of 2 years. But Impact factor favours research of faster specialties and also favours fundamental subjects more than specialised subjects. According to Hoeffel and Garfield Impact Factor is not a perfect tool to measure the quality of articles but there is nothing better and it has advantage of already being in existence and is therefore good technique for scientific evaluation.⁴ SCImago Journal Rank (SJR) by scopus uses a weighted citation score meaning that citations from a prestigious journal are scored more highly than those from a title that has a smaller citation network.¹⁰ Impact factor on the other hand uses absolute counts, one citation means one citation. But SJR is much more transparent and has a three

year window as compared to two year window of impact factor. IPP also uses three year window.¹² Eigen factor basically tells how many people read this particular journal whereas impact factor tells how many people read this article i.e. how many citations an individual article receives on an average.¹⁵ On the other hand h-index has nothing to do with the journal, it measures impact of the author and it relies only on the citations of your paper regardless of where it is published. It minimizes the politics of publication but it has a relatively low resolution.¹⁶

CONCLUSION

No single tool is perfect to gauge the quality of a journal and a researcher. So, one should look into multiple parameters for scientific evaluation of a journal. Metrics measured by Thomson Reuters i.e. Impact factor is not that transparent and is biased whereas those measured by scopus i.e. SJR, SNIP and IPP are transparent and are not biased and have a window of three years as compared to two year window of impact factor. Google scholar metrics is free and easily accessible.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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