A Brief introduction to Metrics

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A brief introduction to metrics

Quantitative indicators or 'metrics' for research first appeared in the 1960s and various metrics have been developed since: these include bibliometric indicators such as journal impact factors, citation counts, *h*-indices and many more. The Science Citation Index was first published in 1961 followed by Derek de Solla Price's 1965 article "Networks of scientific papers" [1] which described the network of citations. In recent decades, algorithms have been developed that automatically count citations for articles and patents; Google's PageRank algorithm has its origins in citation analysis.

Bibliometrics: the statistical analysis of written publications such as articles and books.

Citation analysis: the examination of the patterns and frequency of citations in documents.

The use of these metrics to assess research is currently the subject of debate and opinions on how they should be used are mixed.

Tracking interactions

The volume of articles in the scholarly literature grows every year, as does the number of researchers authoring these articles. In the sciences, over 2.5 million articles are published in more than 30,000 journals annually [2] and this is before accounting for thousands of articles that may be in under peer review during this period. Researchers are reading more too: an average of 270 articles per year [2]. A growth in the number of researchers, publications and digital tools has been accompanied by a rise in various types of metrics to track interactions with scholarly outputs.

As mentioned above, metrics are not new to scholarly communication, but advances in web technology have enabled the addition of a range quantitative indicators that can be integrated into digital tools and traditional methods of research distribution such as journals. It is now possible for a journal to integrate functions into their website that track the number of citations, downloads, views and saves of a published article and to post these numbers alongside the article. These article level metrics (ALMs) allow the authors and readers to track interactions with a particular article and watch them change over time.

There are now over 600 digital tools for scholarly communication [3] and many of these have integrated metrics into their platforms. Google Scholar, a search engine for articles and patents, also allows individual researchers to build a profile and that lists their publications. They can track the citations their articles receive and view a list of other articles that have cited their paper. The site also calculates an *h*-index, a researcher level metric that links the number of publications by an individual to the number of citations that their publications have received.

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Level of metric	Description
Journal	Quantitative indicators at the journal level (e.g. journal impact factor)
Article	Article level metrics (ALMs). Quantitative indicators at the article level (e.g. citation counts, PDF downloads, HTML views)
Individual researcher	Quantitative indicators at the individual author level (e.g. h-index, i10 index)

Altmetrics

"Altmetrics is the creation and study of new metrics based on the social web for analyzing, and informing scholarship."

- The altmetrics manifesto

The term "altmetrics", or alternative metrics, was proposed in 2010 in Jason Priem's Almetrics manifesto [5] which proposes an alternative approach to tracking interactions and filtering scholarly outputs. Altmetrics can be applied to articles, books, datasets, code, article preprints and other outputs from research.

When you view an article via a journal's website, you may see a link beside the article to the metrics for that article, or a link to the AM score or "Altmetric doughnut", a multi-coloured circle with a number in the centre. Although not all journals display metrics, several articles will now have a range of quantitative indicators that are associated with how they have been viewed and shared.

For example, this is a link to the article metrics for an article published in Nature in 2016: https://www.nature.com/articles/nature19332/metrics

The numerical indicators include citation counts, mentions in news/blogs/Google+, online attention and Twitter demographics. The page lists:

- the number of people that have tweeted and blogged about the article;
- the number of times it was linked to from Facebook pages and mentioned on Google+;
- links to news articles and blogs that mention the article.

The company Altmetric also posts an annual list of the most discussed journal articles from the previous year.

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The limitations of metrics

The use of metrics is controversial: on the one hand they can be used to track interactions that may be informative; on the other hand they are frequently criticised for being reductive. The Journal Impact Factor (JIF), which has been around since the 1970s, was originally designed to help librarians decide which journals to purchase subscriptions for, however, an unintended consequence of this indicator is that it is often misused to assess the quality of individual articles and authors [4, 6, 7, 8], even though it is a journal level metric.

One of the advantages of new article level metrics is that they allow a more timely indication of interactions with an article: views and downloads can be counted instantly whereas citations take time to accrue, so it is possible to see engagement with an article instantly. On the other hand, if an article is viewed thousands of times in the space of a week this is not necessarily an indicator of higher quality. The interpretation of quantitative indicators should be done with caution; ultimately, as pointed out by Lariviere et al. (2016), the best way to judge a journal article is to read it [4].

A particular metric can vary considerably across fields and disciplines so comparing between these is difficult and misunderstandings frequently arise in their interpretation. They can also be "gamed" so that the numbers do not truly reflect the interactions with research outputs. As a result of these and other limitations, the debate over the use of metrics continues.

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Further Reading & Videos

Further reading:

The Metric Tide (http://www.hefce.ac.uk/pubs/rereports/year/2015/metrictide/)

The role for metrics in research assessment is still undefined and this subject was explored in James Wilsdon's *The Metric Tide* report from 2015 [9].

Leydesdorff et al. (2016) Professional and citizen bibliometrics: complementarities and ambivalences in the development and us of indicators – a state-of-the-art report. Scientometrics 109:2129-2150. DOI 10.1007/s11192-016-2150-8

The altmetrics manifesto (http://altmetrics.org/manifesto/)

A summary of the reasoning behind developing altmetrics including how they help to filter research, include other research outputs such as datasets and using social channels to drive interest.

Twitter, peer review and altmetrics (http://bit.ly/2GfDdtG)

Discussion of the use of altmetrics in research (see the comments).

Videos:

Of shapes & style: visualising innovations in scholarly communication (http://bit.ly/2HesOzL)

Bianca Kramer & Jeroen Bosman, Universitat Utrecht

(From 4th Annual ReConEvent conference, 2016)

Inputs, Outputs and emergent properties: The new Scientometrics (http://bit.ly/2Gcf47h)

Phill Jones, Digital Science

(From 5th Annual ReConEvent conference, 2017)

Journals with a focus on metrics:

Scientometrics - https://link.springer.com/journal/11192

Research evaluation - https://academic.oup.com/rev

Journal of Informetrics - https://www.journals.elsevier.com/journal-of-informetrics

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Innovations in scholarly communication project https://101innovations.wordpress.com/about-1/

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