Bibliometrics — Ranking of the Scientific Journals

A SET OF METHODS that are used to quantify the importance of the scientific publications, bibliometrics [1] can be used to rank the scientific journals by determining quantitatively the relative impact of the journals on their field of study. Journals that have a high impact within their field are highly regarded by researchers. Publishing in such "top journals" can be very competitive — only articles that are considered of the highest originality and quality are considered for publication, with the reviews typically done by professors and researchers who are leaders in their field. Publishing there is not only viewed as a hallmark of quality, but also helps in divulging more effectively one's research.

How can we determine which journals are the most influential? In the physical sciences alone, there are currently more than 20,000 journals. Out of those, only about 500-1000 are considered top-level where almost all papers of high importance are published. Although the researchers within a specific field of study know well which journals are the most influential (through reputation), it sometimes becomes necessary (for performance evaluation and bonus distribution) to rank the journals quantitatively through some bibliometrics method.

In this thread, a short outline is given of the most well-known methods in bibliometrics. It is noteworthy that the most reputed journals in computational mathematics, fluid mechanics, and aerospace engineering (i.e. Journal of Computational Physics [1], Journal of Fluid Mechanics [1], AIAA Journal [1]) rank highly independently of the ranking method.

Science Citation Index (SCI)

The higher-ranked journals in the physical sciences are generally SCI-ranked (SCI stands for Science Citation Index). There are 3748 journals that are part of the SCI classification, with the list provided by Thomson-Reuters [1] [SCI_Journals_List.htm]. Note that not all journals that are part of the SCI have a high reputation — some actually have a lower reputation than non-SCI journals. Nonetheless, there are no leading journals in aerospace engineering or in fluid mechanics that are not SCI ranked. Another classification that is sometimes used in bibliometrics is SCIE (Science Citation Index Extended). Such includes all SCI journals and other journals deemed worthy. As of 2009, the SCIE classification comprised 8060 journals, and is continuously expanding (see Table 7 in Ref. [1] below). A list of the SCIE journals can be found on Thomson-Reuters [1].

References

[1] PO Larsen and M von Ins, "The rate of growth in scientific publication and the decline in coverage provided by Science Citation Index", *Scientometrics*, 84(3), 2010, pages 575-603.

Impact Factor

One parameter that is widely used to rank the journals is the "impact factor" [1]. By definition, the impact factor of a journal corresponds to the average number of times its articles have been cited per year within the last two years. For instance, let's say that in a certain journal, each article has been cited on average 5 times within the last two years. Then, the impact factor is of 2.5. The impact factor is often criticized as a means to assess quality. Indeed, the quality of an article is not necessarily related to how many times it is cited — the number of citations doesn't only depend on the quality of the article but also depend on other factors such as the size of the community in a particular field, the frequency of publication in a particular field, etc. Nonetheless, it occurs often that within a given field, the journals that are more highly reputed have a higher impact factor. You can find the 2009 impact factor as well as the quartile ranking by field of study from Thomson-Reuters [JCR-FI 2009 SCIENCE.xls].

Excellence in Research in Australia (ERA)

To overcome the limitations of the impact factor, the Australian Research Council (ARC) came up with a different approach to rank the scientific journals. Through a poll, the professors and researchers working in Australian universities were asked by the ARC to give a "grade" to journals within their research field (A*, A, B, or C):

Grade	Significance
A*	Leading Journal (Journal where almost all the articles are of high quality)
A, B	Journal with some articles of high quality, but with a substantial fraction of the articles being of dubious quality.
C	Journal where essentially none of the articles are of high quality

In the fields of fluid mechanics and aerospace engineering, I find that the ERA rankings [ERA2010_journal_title_list.xls] are more reliable than rankings solely based on the impact factor — the journals that are ranked as A* are indeed the leading journals, and the journals ranked as C are indeed of poor reputation.

Source Normalized Impact per Paper (SNIP)

The Impact Factor is often criticized as a means to assess quality of a scientific journal due to the citation frequency varying significantly from field to field. For instance, the health/medical journals typically receive 3-5 times more citations than the mathematics/engineering journals. Of course, this is not due to the

research being done in the health-medical sector being of higher quality but rather due to researchers in the health/medical fields having the tendency to write more numerous (and shorter) papers and to cite each other's work more often. The SNIP [1,2] takes this into consideration by normalizing the number of citations a journal receives by the average number of citations that the journals in its field receive. The field to which a journal belongs is determined through its citations — for instance, if one journal receives citations from other journals in aerospace engineering and computer science, then its fields are assumed to be aerospace engineering and computer science. A higher SNIP indicates a higher quality, with a SNIP of 1 indicating that the journal is average in its field. The scale is not linear, but logarithmic, and ranges from 0-10. The SNIP of all journals (physical sciences, social sciences, etc) can be found on journalmetrics.com [1]. Although the SNIP ranking has some deficiencies, I find that it often does a better job than the Impact Factor in identifying the leading journals (at least within fluid mechanics and aerospace engineering).

References

[1] HF Moed, "Measuring contextual citation impact of scientific journals", *Journal of Informetrics*, Vol. 4, No. 3, Pages 265-277, 2010.

[2] L Colledge, F de Moya-Anegon, VP Guerrero-Bote, C Lopez-Illescas, M El Aisati, HF Moed, "SJR and SNIP: two new journal metrics in Elsevier's Scopus", *Serials*, Volume 23, Number 3, Pages 215-221, 2010.

h5 Index

The h5 index is the h-index for articles published in the last 5 complete years. It is the largest number h such that h articles published in the last 5 years have at least h citations each. For instance, let's say that in a certain journal, there are 32 papers that have obtained 32 or more citations each in the last 5 years. Then, such a journal would be given a h5 index of 32. The h5 index is particularly good at identifying the leading journals. While there exists some journals that have a high impact factor but are not influential, it is unlikely for a journal to have a high h5 index and not be influential. Perhaps for this reason, Google chooses the h5 index and a similar parameter, the h5 median, to rank the scientific journals by research field (see the Aviation & Aerospace Engineering h5-index [1], the Computational Mathematics h5-index [1], or the Fluid Mechanics h5-index [1]).

Eigenfactor and Article Influence

The Eigenfactor score [1] of a scientific journal scales with the number of citations a journal receives within the last 5 years, with the citations from highly ranked journals being given more weight than those from poorly ranked journals. As well, similarly to the SNIP, the Eigenfactor makes an adjustment to the scores to take into consideration the difference in citation frequency between different fields of study. One noteworthy aspect of the Eigenfactor is that it is not normalized with the number of papers published: everything else being equal,

should the size of the journal double, the Eigenfactor will also double. The "Article Influence" seeks to address this issue by normalizing the Eigenfactor by the number of papers published. At least in engineering and the physical sciences, the leading journals are characterized by having both a high Eigenfactor and a high Article Influence. Some non-leading journals may exhibit a high Article Influence or a high Eigenfactor, but not both at the same time. Perhaps an "optimal" bibliometrics parameter could thus be obtained by summing the Eigenfactor percentile and the Article Influence percentile.. Anyhow, the raw and percentile scores for the Article Influence and Eigenfactor can be found on eigenfactor.org [1].