

Impact Factor and Mathematics : A Debate

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1. Overview

The **Impact Factor**, often abbreviated IF, is a measure of the citations to science journals. It is frequently used as a proxy for the importance of a journal to its field. The impact factor was devised by Eugene Garfield, the founder of the Institute for Scientific Information, now part of Thomson, a large world wide US-based publisher. Impact factors are calculated each year by Thomson Scientific for those journals which it indexes, and the factor and indices are published in *Journal Citation Report (JCR)*.

The measures to calculate the impact factor apply only to journals, not individual articles or individual scientists. The relative number of citations an individual article receives is better viewed as citation impact. It is, however, possible to measure the impact factor of the journals in which a specific person has published articles. This use is widespread, but controversial. Eugene Garfield warns about the *misuse in evaluating individuals* because there is *a wide variation from article to article within a single journal*. On the other hand, impact factors have a huge, but controversial, influence on the way published scientific research is preserved and evaluated.

A *citation index* is an index of citations between publications, which allows the user to easily establish which later documents cite which earlier document. The first citation indices were legal citators such as Shepard's Citations (1873). In 1960, Eugene Garfield's *Institute for Scientific Information (ISI)* introduced the first citation index published in academic journals, starting with the *Science Citation Index (SCI)*. There are two publishers of general – purpose academic citation indices, those are available to libraries by subscription : ISI is now a part of Thomson Scientific, Elsevier publishes Scopus, available online only.

Although citation indices were originally designed for information retrieval purpose yet they are increasing used for *bibliometrics* and other, involving research evaluation. Citation data is the basis of the popular journal impact factor. *Scientometrics*, a term advented by Vasily Nalimov, is a large body of literature on citation analysis. The field of citation index brought revolution with the advent of SCI, which (as per information available) now covers literature from the year 1900 on. One may, for leading journals of the field, see *Scientometrics* and the *Journal of*

the American Society of Information Science and Technology (ASIST).

The *Web of Science* provides access to current and retrospective multidisciplinary information from over 8,500 of the most high impact research journals in the world. The benefits are : you can find who is citing your research and the impact factor your work is having; unveil the seminal research of an important theory or concept; you may follow the path and direction of today's hottest concepts; you may determine if a theory has been confirmed, changed or improved; you may locate relevant articles missed through a topic or subject search, among many more. Web of science helps finding research collaborators internationally.

2. Calculation of Impact Factor

The impact factor for a journal is calculated based on a three-year period. It can be viewed as an approximation of the average number of citations in a year, given to those papers in a journal those were published during the two preceding years. For example, the 2010 impact factor for a journal is calculated as follows :

Let A denote the number of time articles published in 2008-09 were cited in indexed journals during 2010

Let B denote the number of citable items published in 2008-09

Thus, the 2010 impact factor = A/B

Note : *2010 impact factor is actually due for publication in 2011, owing to the fact that it could not be calculated until all the 2010 publications are received.*

One may refer to Milman [2], from where we borrowed many concepts to write this article.

3. The Debate

Ever since the advent of impact factor and citation analysis, much water has flown over the bridge in regard to their impact on mathematics. We pick up the debate somewhere in the mid stream. There are minor differences to the above mentioned calculation : ISI excludes certain types of articles, viz. news items, correspondence, and errata from the denominator of the above formula. New journals, which are indexed from their first published issue, will receive an IF after the completion of indexing

of two years. In this case, citations to the year prior to volume one and the number of articles published in the year prior volume one are known zero values. Journals those are indexed starting with a volume, other than the first volume, will not have an IF published until three complete data – years are known.

Why the impact factor of journals should not be used for evaluating research ?, Is the journal impact factor really representative of the individual journal articles ?, Is the impact factor of an article increased by publication in a high impact journal ? are among many more such questions undergone several discussions. Evaluating scientific (more particularly, mathematics in our debate) quality is a notoriously difficult problem which has no standard solution. Ideally, published scientific results should be scrutinized by true experts in the field and given scores for quality and quantity according to established rules. In practice, however, what is called peer review is usually performed by committees with general competence rather than with the specialist's insight.

The Journal Impact Factor, writes Per O Seglen [4], has troubled many for sometime, people who use it to measure the quality of journals often add the admonition that the IF represents only one view of quality. Impact factor is a quantitative measure not qualitative. In some other debate, some anonymous author mentions that it is some times useful to be able to compare different journals and research groups. A sponsor of scientific research, for example, might wish to compare the results to assess the productivity of its project. An objective measure of the importance of different publications is then required and the IF (or number of publications) are the only ones publicly available. It is, in all apparent cases, only relevant to consider the rank of the journal in a category of its peers, rather than the raw impact factor value.

Impact factors are not always the correct measure of the quality of a journal. For instance, it is not clear whether the number of citations a paper garners measures its actual quality or simply reflects the sheer number of publications in that particular area of research and whether there is a difference between them. In a journal, which has long lag time between submission and publication, it might be impossible to cite articles within the three year frame. For some journals (very common with many mathematics journals), the time between submission and publication can be over two years, which leaves less than a year for citation. Thus, although the IF is appropriate for some fields of science, it is not appropriate for subjects with slower publication pattern, one of which is mathematics.

By looking into the information collected from Journals Impact Factor/index, Milman [2] opines, it is observed that, for mathematical community at least, this index gives a misleading impression of the relative standing of journals. Despite having the knowledge that IF has little to do with real quality of journal, editors have no choice but to try somehow to improve the IF of their journals, which causes an anti-scientific form. We math-

ematicians, he continues, should work to create a different index, more suitable for mathematics research.

The impact factor, as mentioned in the preceding paragraph, calculation and its concepts perhaps be a very appropriate approach for medical sciences or biology or even chemical sciences, where the influence of a publication is decided in the first year or so after publication, and after three or more years many results are irrelevant. But such cases do not have any meaning in mathematics. Let X be a paper, published in the year 2008, which influences the work of group of researchers. Working even very fast, it may consume a few months to produce results and write them down. Then new papers with reference to paper X are submitted, which may take at least a year, sometimes even two years, to get accepted and published. Now it gets too late for the reference in these papers to be included in the calculation for the IF for 2010. It is more worse for papers published in 2009.

The IF, published by ISI in Philadelphia in its Journal Citation Report (JCR), is used by some department chairmen in some countries in faculty assessments. But nowhere in the world is the IF used as a criterion for rating and ranking scientists across the board nationally, as has done in Pakistan, writes Mustaq [3]. He continues to write that ISI's impact factor puts mathematicians in a disadvantageous position, because the index is not suitable for research in mathematics. The author (of this article) feels that the list provided by ISI itself is defective. Let me quote, for instance, that there are a number of high standard journals (including Indian) which are not enlisted. By a critical study of the ISI has revealed that there are only five journals directly related to mathematics. Many young mathematicians around the world, more so specifically in India and Pakistan, are now reluctant to do research in mathematics, because these students feel that publishing papers in top mathematical journals is not only difficult but receives no appreciation due to low impact factors. One can make an interesting reading by referring to Krantz [1].

The report, issued in June 2008 by the *International Mathematical Union* (IMU) entitled *Citation Statistics*, is about the use and misuse of citation data in the assessment of scientific research. It says, further, that the research assessment must be done using *simple and objective* methods. There are many more very wrong ideas pour our mind when we think about impact index. There is a important current structure of the index, which appears to bring positive influence. Many journals have begun to make all accepted papers online, which increases the exposure. We all in the mathematical community should (not *may*) influence the Thomson Company to change the system for mathematics and create an IF suitable for mathematics. By merely counting the frequency of citations per article and disregarding the prestige of the citing journals, the impact factor becomes merely a metric popularity, not of prestige.

Figures are only as good as the premises on which the figures are based, and often the premises of many widely touted

management figures are flawed, as in the case of Impact Factors. The only real criterion for an individual's scholarship is quality of work, and that does not admit of ordinary numerical assessment, writes Mustaq [3]. The joint committee on quantitative assessment of research summarizes its report by writing. Relying on statistics is not more accurate when statistics are improperly used. Indeed, statistics may mislead when they are misapplied or misunderstood. The sole reliance on citation data provides at best an incomplete and often shallow understanding of research, an understanding that is valid when reinforced by other judgments. *Numbers are not inherently superior to sound judgments.* The summary concludes by appealing *understand not only the limitations of citation statistics but also how better to use them.*

4. References

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