

# The Impact of Impact Factors on Mathematics

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**ABSTRACT:** Concerns of the mathematicians regarding the use, or misuse, of the journal impact factors (JIF) are discussed here. It is contended that the JIF does not permit assessment of the quality of an individual article or author.

**KEYWORDS:** journal impact factors, mathematics, quality.

The journal impact factor (JIF) was first described in 1955 by Dr. Eugene Garfield and was used in the early 1960 as a criterion for journal selection, later becoming the Science Citation Index<sup>1</sup>. The JIF is based on the number of citations occurring during a given year ( $i$ ), to the journal articles published in the two preceding years ( $i-1$  and  $i-2$ )<sup>2</sup>. Thus, an article in a journal has a two-year window, namely the first and second years, after its publication, to contribute to that journal's impact factor<sup>2</sup>.

This may be appropriate for journals in the medical science or biological fields, in which the influence or impact of an article is decided on the first year or two after publication, and many of the published results may be already irrelevant after three or four years<sup>3</sup>. But this cannot be applied to mathematics.

The work of a group of mathematic researchers can take many months before they can produce, write, and submit their paper  $P$ . Suppose this paper refers to a paper  $Q$ , appeared in the year  $i-2$ . It usually takes a least a year or more for the paper  $P$  to be accepted and published. So, it may now be too late for the reference to paper  $Q$  to be included in the JIF of the year  $i-1$ <sup>3</sup>.

As stated in a note by A. Bultheel, the President of Belgian Mathematical Society, and J. Teugels, the President of the National Committee of Mathematics<sup>4</sup>, "Most articles referred to in mathematics papers are more than 10 years old. For example, in 2001 there were about 5,000 citations in 'Annals of Mathematics' of which about 80% were more than 10 years old. As compared to mathematics, the number of citations in other disciplines is enormous." JIF of the mathematics journal with the highest impact factor is 20 times lower than that of a biology journal with the highest impact factor<sup>4</sup>.

Admittedly, evaluating scientific quality is a notoriously difficult problem with no standard solution<sup>5</sup>. Ideally, a published research result should be evaluated by true experts in the field. Practically, however, 'peer review' is usually performed by committees with general competence rather than by

the scrutiny of specialists in the specific research area. Such unreliability of the process of peer review led the scientific community to search for alternative methods for evaluating research outputs, such as citation rates and JIF, which appear to be quantitative and objective indicators which could be related directly to published results<sup>5</sup>.

It is alarming that journal impact factors have more and more been used in the evaluation of individuals as well as of institutions, and have been proposed, or actually used, as one of the premises for allocation of university resources and positions<sup>5</sup>. Resource allocation based on impact factors has also been reported from Canada and Hungary, and colloquially, from several other countries, including Thailand. Since JIFs are so readily available, it is tempting to use them for evaluating individual scientists or research groups.

However, the inventor of the JIF, E. Garfield, advised strongly against the use of the Impact Factor for the evaluation of scientific research<sup>4</sup>. The primary use of JIFs is, in actual fact, in assisting librarians in their decisions on which journals to include in their collections, and JIFs are increasingly used by publishers to promote and market their journals to subscribers and advertisers<sup>6</sup>.

Of greatest concern for mathematics, according to the Council for the Mathematical Sciences<sup>7</sup>, is that JIFs for its journals are a lot lower than for other sciences. A mathematical journal with any hint of interdisciplinary will have a high JIF, irrespective to its quality or the quality of articles therein<sup>7</sup>. Taking the first 20 mathematical journals from the list with descending values of the Impact Factor, it is pointed out by Bultheel and Teugels<sup>4</sup> that hardly any of these journals are fundamental (pure) mathematics, but rather journals which have a big overlaps with biology, economy, and so on<sup>4</sup>.

Many have suggested ways by which these concerns of the mathematics society about JIF could be somewhat appeased. For example, Mitman<sup>3</sup> suggested that JIF should be calculated from a few more years back than

2 years, since we know that a few more than just 2 years are necessary to estimate, appreciate, and understand real mathematical progress, and real achievement. Others<sup>7</sup> have suggested the inclusion of the *accumulated* impact factor, and not only a local one, for a more meaningful index to reflect the relative value of different publications. However, this still does not really address the problem created by the use, or misuse, of the JIF, since, in the author's opinion, whichever way it is calculated, the JIF cannot be considered to represent the quality of an individual article or author.

As pointed out by Kurmis<sup>1</sup>, "the JIF cannot be considered to represent the citation rate of an individual article, and does not permit assessment of the quality of an individual article or author. While the impact factor may, in certain circumstances, be useful subjective tool for grading journal quality, it is not appropriate for quality assessment of individual articles or authors. Individuals and governing bodies that use the impact factor for these purposes demonstrate a poor understanding of a tool that should perhaps more appropriately be termed the 'journal citation ratio' or the 'journal citation index'. The inappropriate use of impact factor may reflect the increasing pressure on such bodies to judge the quality of articles and researchers and the decreasing time devoted to appropriate review of articles ..."

The impact of such misuse of JIF can perhaps be more clearly underlined by the following conversation, taken from a correspondence by Karandikar and Sunder<sup>8</sup>

Q: How do you improve the quality of the scientific papers appearing in journals A and B?

A: Simply encourage the authors of A and B to refer to one another. Then, the citation index, *and hence the quality of both A and B* will go up.

Conclusion: The quality of science can be improved without changing the science at all; you only have to encourage 'co-citation' and fiddle around with the references!"

According to this correspondence of the Indian Statistical Institute<sup>8</sup>, the sort of things that are now actively discussed and propagated in a number of scientific meetings is concerned with how to encourage co-citation, almost in the same breath as how to improve the standard of scientific journals.

Thus, there has been a dangerous rise in the tendency to judge a scientist by the number of citations and the impact factor of the journal in which the paper appears, instead of an objective scrutiny of his/her research work. Resource allocation and evaluation of individuals are increasingly done on the basis of impact factors. As a result, we have observed a shift in scientists' publication behavior towards publishing in journals with higher impact, often at the expense of specialist journals that

might actually be more appropriate venue for the publication of that research work. Moreover, and more worrisome, increasing numbers of theoretical or pure mathematics researchers have turned their attention to applied research due to the pressure of the current mode of evaluation that puts greater emphasis on the number of citations and JIFs. This trend portends alarming consequence in the scientific community, as less and less theoretical discoveries shall be made to form the basis for future development of science and technologies, perhaps several decades from now.

Several countries have understood the limitations of the JIF<sup>4</sup>. In Thailand, on the other hand, advocates for the imposition of number of citations and JIF on the evaluation of research works, mathematical ones included, are heard too often for our peace of mind, their voices drowning out other voices of cautions. For a long time mathematicians have had at their disposal a German, an American, and a Russian journal which are exclusively devoted to reviews of mathematical articles. The American Mathematical Society, and Zentralblatt MATH are among the leading bodies that provide the abstracting, reviewing, and database services in pure and applied mathematics. Their reviewing processes are adjusted to the publishing policy of mathematicians, based on the firm belief that there is no alternative to assessing research work but purely on the basis of its content. Citations and impact factors are not and cannot substitute for evaluation based on an understanding of the research work, performed by true experts in the field.

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