Impact Factor and how it relates to quality of journals

At the touch of a computer key, statistical information is so readily available nowadays that many of us may be tempted to overestimate its value.

I have just been looking into the question of the validity of information gleaned from the Journals Impact Index, and again noted that, for the mathematical community at least, it gives, in some cases, a misleading impression of the relative standing of journals. At the same time, this data is often used by department heads in faculty assessments, and people have begun to check Impact Factors (IF) of journals before submitting papers. So, editors of mathematical journals have no choice but to try somehow to improve the IF ranking of their journals, although they are aware that it has not much to do with the real quality of the journal. Unfortunately, most actions to increase the IF have an anti-scientific form, and we, mathematicians, should work to create a different index, more suitable for mathematics research.

Below I would like to describe why the Impact Factor, as it is calculated today, is not suitable for mathematical journals; and would like to open a discussion of how to adapt the present method of IF calculation to reflect the realities of mathematics research.

First, let me explain how impact index is computed: The IF of a journal for year Y (say, for $Y := 2003$) is the ratio C/N, where C is the number of citations during year Y (i.e. 2003 in our example) of papers published in a particular journal in years $Y-1$ and $Y-2$ (i.e. 2002 and 2001). N is the number of published papers during these two years ($Y-1$ and $Y-2$) in this journal.

This may, perhaps, be a very appropriate approach for, say, Medical Sciences or Biology, where the influence of a publication is decided in the first year or so after publication, and, after three or four years many results are already irrelevant. However, what does this mean for Mathematics?

Let, say, a paper P, published in the year $Y-2$, influences the work of a group of researchers. Even if they work very quickly, it can take a few months for them to produce results and write them down. Then new papers, with references to P are submitted. It takes at least a year, and more often

up to a year and a half or two, for these papers to be accepted and published. However, it is now too late for these references in these papers to be included in the IF of year Y. The situation is even worse with papers published in the year $Y-1$.

You may then ask, how do mathematical journals show any positive index? The answer is that mathematics papers are very often distributed and known much before publication. What can editors do to influence this? Very simply, not to publish the best papers too quickly!! (Please don't take this suggestion too seriously, but, well, are you sure it doesn't enter their heads?) Also, the number of papers is used for IF computations, and not the number of pages. This means that a paper of a hundred pages, with many parts, which may be of interest to people in different fields, has a much better chance to raise the impact index of the journal than a short (and possibly brilliant) paper of, say, five pages long.

There are many more very "wrong" ideas which may come to mind when we think about our impact index. However, I have learnt recently of one consequence of the current structure of the Index which is actually having a positive influence. Many journals have begun to make all accepted papers available online. This increases the exposure time before year Y, the "critical" time! This is a very crucial one year period.

In light of this, I would like to discuss a different approach for computing the IF value for mathematical journals. The idea is simple. We know that a few more years are necessary to estimate, appreciate, and understand real mathematical progress, real achievement. So why not calculate data from a few more years back?

I checked a few examples, 10 journals which came to mind as being highly thought of, but of different levels. The table below was calculated for articles published in the year 1999; the number of articles published in that year shown in column No. Arts. The "Citations" column shows the number of references until October 2004 to articles published in each journal in 1999. The Mathematical Impact Factor (Math. IF) is a ratio of number of citations to number of articles.

Journal	No. arts.	Citations	Math. IF
J. AMS	34	470	13.824
Annals of Math.	68	630	9.265
Acta Math.	19	164	8.667
GAFA	34	266	7.834
Invent.	85	646	7.600
Duke	94	570	6.009
J. Funct. Anal.	141	666	4.723
Adv. Math	66	274	4.660
Trans. AMS	216	724	3.352
Isr. J. Math.	108	280	2.593

I believe these examples reflect well our understanding of the status of journals. A suprising results can be seen for the J. of the AMS; there is a large gap between JAMS' Math. Impact Factor and that of the other journals. I believe this could be connected to the fact that some directions in mathematics have much higher citation index, e.g. theoretical computer science or related discrete mathematics papers; firstly because of different styles of references acceptable in those fields, but also because many more mathematicians now work in these fields. J. AMS publishes papers of these directions, whereas, Acta, for example, does not. Nor do most of the other journals in our sample list (although I may be mistaken here.)

Many more ideas come to mind for how one may compute a meaningful index reflecting the relative value of different journals. Also, clearly, journals which publish around fifteen paper a year (like Acta Math.) or publish around fifty paper (or over 100), should be judged differently. However, as I have already said, I am just trying to correct the existing structure with the hope that our mathematical community may influence the THOMSON company, which regularly publishes the Impact Factor, to change the system for mathematics and create (and use) an Impact Factor suitable for mathematics.

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