

Hirsch Index is a creative and appealing construct but be cautious when using it to evaluate individual scholars

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The bibliometric index proposed by Hirsch is beyond any doubt a most creative and appealing one. Any author who connects to the Web of Science (produced by Thomson Scientific/ISI) can select all his or her papers, have them ranked by descending citation counts, start from the top of the ranking, move downwards item by item, to the point where the listed item's rank is (approximately) equal to the number of cites it collected. This point provides the value of the Hirsch Index.

Hirsch discusses the application of his index in the evaluation of individual researchers, and proposes thresholds that they should meet in order to be promoted. For instance, he suggests that for faculty in research universities a Hirsch Index value of about 18 should be a typical value for advancement to full professor.

Hirsch's proposal generated a lively debate among researchers – including bibliometricians and information scientists – and policymakers, not only about the index's validity and applicability, but also about the pros and cons of the use of citation analysis in research evaluation. In this note I focus on two specific issues. Firstly, how does the shape of the citation distribution of a scientist's papers influence the value of the Hirsch Index? The second issue is a more general one: To what extent can citation analysis assess the research performance of an individual scientist?

Being primarily a methodological paper introducing the index, discussing some of its mathematical aspects, and suggesting ways to use it in research evaluation, it needs not to deal with all the technicalities involved in compiling a complete list of an author's paper and generating accurate citation counts for each paper. But the effect of the shape of the distribution of citations amongst an author's cited papers upon the value of the Hirsch Index is an interesting and relevant issue, not only from the point of view of accuracy in data collection, but particularly also from the perspective of its validity.

Mathematically speaking, under 'normal' circumstances a scientist's value of the Hirsch index would not change if one would raise for instance the citation frequency of the paper ranked on top by any number of additional citations, nor would it be affected by adding any number of papers to an author's list cited less than the obtained index value. On the one hand, this property makes the index robust. But on the other hand, its value still depends upon the shape of the distribution of citations amongst an author's papers.

It is a common practice to denote the papers (co-) authored by a particular scientist as 'his or her papers'. But it should not be overlooked that, in science, research is teamwork, carried out by research *groups*, supervised or directed by senior researchers. The publications (co-)authored by an individual researcher are often, if not always, the result of research to which other scientists have contributed as well, sometimes even dozens of them.

If one conceives a scientist's research articles as elements from coherent publication ensembles of research groups carrying out a research programme, citing authors acknowledging a research group's works do not distribute their citations evenly among all papers emerging from its programme, but rather cite particular papers that have become symbols or 'flags' of such a programme. Such flag papers in a sense lure away citations from the other papers (Moed, 2005, p. 217).

Some groups may have their citation impact concentrated in a limited number of most highly cited flag papers (possibly even in one single paper), whereas other groups may have a series of flag papers, so that their citation impact is less concentrated. The latter groups may tend to have higher values of the Hirsch Index than the former, but it is at least questionable whether these differences reflect differences in research performance or quality. Differences in citation distributions, what they reflect, and how they influence the various citation based indicators, particularly the Hirsch Index, represent one set of issues that need further study (e.g., van Raan, 2005).

To what extent can citation analysis, particularly the Hirsch Index, assess the research performance of an individual scientist? Above it was already emphasized that scientific work is team work. Performance of an individual and citation impact of the papers he or she (co-)authored relate to two distinct levels of aggregation. The crucial issue is how one should relate the citation impact of a team's papers to the performance of an individual working in that team. This can be done properly only on the basis of sufficient background knowledge of the particular role of the scientist in the research presented in his/her publication ensemble, for instance, whether this role has been leading, instrumental, or technical.

In the policy domain, the use of citation analysis is more appropriate the more it is carried out openly according to transparent procedures with clear objectives; subjected entities are able to verify data and comment on results; potentialities and limitations, technical and validity issues are explicitly stated; its outcomes contribute to insight, or pose problems or address particular questions that participants in the process seek to answer; and the process ensures the availability of expert knowledge on the entities involved and the fields in which they are active.

References:

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