The Hirsch index of scholarly output: New measure, ongoing debate

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Abstract

In August 2005, physicist Jorge E. Hirsch of UC San Diego proposed a new bibliometric measurement "to quantify an individual's scientific research output." The Hirsch index (*h*-index) has since re-ignited the controversy over quantifying scholarly output and using such measurements in research, hiring, tenure, funding, membership and award decisions. This measure and ongoing debate have implications in the areas of liaison services, reference, instruction, and collection management.

The *h*-index

The *h*-index is a single number, described as "unbiased" by its creator, used to represent the scholarly output of a researcher. Simply put, a researcher has an index of *h*, if *h* papers have at least *h* citations each. Because it involves a relationship between <u>both</u> the volume of papers published, and the number of citations for those papers, the *h*-index is less easily skewed than each of those measures separately. The *h*-index is calculated using a citation index such as Thomson ISI Web of Science, and in fact has since been incorporated as an automatic calculation within the Citation Report feature. For a manual calculation, conduct a General Search and sort by Times Cited, then scroll to find the record with the highest number that has at least as many citations as its record number.

Since its introduction, the *h*-index has been used to 'rank' researchers in several fields, which has resulted in some surprises. For example, the well-known physicist Stephen Hawking of the University of Cambridge (author of *A Brief History of Time*) was determined by Hirsch to have an *h*-index of 62. Yet this was less than half the *h*-index of the top-ranking physicist worldwide, Edward Witten of Princeton University – not quite a household name.

Applying the *h*-index

In April 2006, a faculty member approached the director of Kurt F. Wendt Library at the University of Wisconsin-Madison, seeking assistance for a project involving the Hirsch index. As the liaison to that faculty member's department, I was asked to take on the project, which appealed to my love of data gathering and analysis.

The professor with whom I worked wanted to compare the *h*-index of his department faculty to those in the remaining nine top-ranked departments (U.S. News & World Report) across the country. He had already calculated the *h*-index for his own department's eighteen faculty for the date range of 2000-2006, which he said took him about thirty minutes. We discussed the difference between publication and citation rates of new hires compared to long-standing faculty, and he explained that he wasn't comparing individual faculty per se, but instead getting an overall sense of h-index distributions for different departments. I set about finding the faculty webpages for each department, at which point I encountered the first difficulty – departments at other institutions do not cover the exact same areas as ours – so I obtained feedback from the UW-Madison professor about which faculty to include at each institution. Next, despite an undergraduate background related to my liaison department, I found it very difficult to ascertain whether particular articles attributed to researchers with the same surnames and first initials were actually written by the faculty on my list. As obvious as it may be, the fact that it is difficult to gather data about and compare different researchers when you are not intimately familiar with their research is an underlying concern for librarians attempting to calculate bibliometric measures. I did the best I could, and indicated on my spreadsheet where questionable data could have impacted the h-index I calculated. Lastly, I decided to go through the UW-Madison department faculty, to check my calculations against the professor's. To my chagrin, there were <u>several</u> differences between our calculations, which I pointed out to the professor. Likely due to author disambiguation errors, these differences left me with an unsettling feeling. How well did I know my own liaison departments' faculty? How well does anyone know the research areas for which they calculate bibliometric measures?

Later that summer, the same professor approached me about a second *h*-index project. He was the chair of a committee that awarded a visiting professorship every two years, and he wanted to know the *h*-index of all the researchers who had held that position, at the time it was awarded, back to 1979. This proved to be much more challenging than the first project. There were three added difficulties, on top of those I had already encountered. First, although Web of Science results can be limited by publication date, the citation numbers associated with each paper are cumulative to the present. I did not have the

time necessary to look through each citation list and calculate the number of citations as of the award date, so we settled for the cumulative number. Second, determining when each researcher began to publish, and all the institutions they'd been associated with, added a dimension of difficulty to author disambiguation. Lastly, I realized that all Webs of Science are not created equal. That is, the UW-Madison subscription included citations back to 1970, but this could not adequately capture the entire careers of the earliest awardees.

Discussion and debate

Certain limits of the *h*-index have been discussed in the literature, and variations have been proposed – generally adding complexity to the calculation. Alternative applications of the *h*-index have also been suggested, including its use as a journal impact index (searching by journal title rather than author), and a means by which students might choose a worthwhile research topic (searching by subject rather than author). These applications could be used by libraries in their collection management decisions, and in reference and instruction services.

The main areas of debate concern bibliometric difficulties, publication index issues, and the value of quantifying scholarly output. The value placed on bibliometric measures such as the h-index, and by extension, on scholarly output in the form of publication, is probably the most contested issue of all. 'Publish or perish' has long been a career reality for researchers, who are subject to ranking according to various bibliometric measures for the purposes of hiring, promotion, tenure, societal memberships, awards, and funding. Comparing bibliometric measures among researchers within the same general subject area is fairly commonplace, though the quantification of scholarly value is hotly debated. Interdisciplinarity makes such measures more questionable, and it is generally agreed upon that comparing researchers in completely different fields using the same bibliometric measure is useless. Librarians are sometimes asked to assist in such calculations, and so should be aware of the issues surrounding these activities.

At the forefront of my own concerns is full disclosure of methodology used in the calculations of any *h*-index. In order for one *h*-index, or any other bibliometric measure, to be compared to another, the calculations must be carried out in an identical manner, using the same citation index, date range, etc. It should be disclosed whether review articles and other non-original research was included in the calculation. Author disambiguation is a continuing difficulty in bibliometrics, despite the application of parsing algorithms in online citation indexes. It is my belief that the sole use of surnames and first initials for identification is no longer tenable in today's era of information access, globalization, and interdisciplinarity – instead, we must devise and assign truly unique identifiers.

Bibliometric measures rely on robust citation indexes. In his article proposing the *h*-index, Hirsch specifically cites the Thomson ISI Web of Science, which is the largest such index. Yet no citation index is comprehensive, and a bibliometric measure using one citation index cannot be compared to a measure calculated using another index. Further, it can take years for new periodicals to be included in an index, including most open access titles. But the most disturbing problem is the use of Google Scholar as a 'citation index' to compute any bibliometric measure. Unless the exact contents of an index are known at the time of a calculation, it is simply not a source of reliable data. Google has not yet disclosed which publications are included, whether they are fully indexed, for what date ranges, or whether any of these factors has changed or will change over time. This is especially unfortunate, as Google Scholar may include material that is not contained in any other index.

The most useful aspect of the h-index may, in fact, be its ability to inspire passionate discussion about the current state of scholarly communications, and the robustness of publication and citation data. An extremely timely example can be found in the posts from April 13, 2007 to date, on the Chemical Information Sources Discussion List (CHMINF-L); archives can be accessed at http://www.indiana.edu/~cheminfo/network.html.

Works Cited

Hirsch, J.E. (Nov 15 2005). An index to quantify an individual's scientific research output. Proceedings of the National Academy of Sciences, 102(46): 16569-16572. 10.1073/pnas.0507655102

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