

◆ Bridging the Geographic Science Gap: Modes of Quantitative Analysis for Scientific Papers

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Let's face it: Science can be a competitive enterprise. Journals, despite everyone's best intentions, must compete to stay viable, and every editor wants to know his or her place in the pecking order. Scientists have been developing ever more sophisticated methods for determining relative influence. This session provided an overview of the latest metrics for evaluating journal and scientific-paper performance.

Patricia Brennan, of Thomson Reuters, began the session with a survey of current metrics, starting with the journal impact factor (IF), the first and still most widely used measure of journal performance. IF is calculated by adding a year's citations of items published in the previous 2 years and dividing the total by the number of articles published during that time. There is a danger in using the IF of comparing apples with oranges in that specific disciplines

have distinctly different citation practices. Other gray areas include how to define a citable item (Should a letter with citations be counted?) and the narrow time window of 2 years. To address the time-window issue, Journal Citation Reports (JCR) now includes both the 2-year and the 5-year IFs, and this allows broader comparisons in some fields.

Complements to the IF are already in use. The Hirsch index (H index) focuses specifically on citations of an individual researcher's publications. It is defined as follows: "A scientist has index h if h of his or her N_p papers have h citations and the other $(N_p - h)$ papers have $\leq h$ citations each." In essence, as David Tempest, of Elsevier, explained, the H index rates a person's publications on the basis of career publications as measured by the lifetime number of citations of an article. Thus, it is a more accurate measure of the influence of an individual scientific paper than the IF is. Because it is not time limited, however, it favors established researchers.

Eigenfactor metrics offer another way to assess the influence of scholarly journals. Jevin West, of the University of Washington, explained that the application of the Eigenfactor algorithm to citation networks is similar to the use of Google's PageRank algorithm to estimate the relative influence of Web pages. The Eigenfactor algorithm applied to the JCR data estimates the percentage of time that a hypothetical researcher would spend with a particular journal randomly following citations in the JCR. The Eigenfactor metrics include the Eigenfactor Score, which is a measure of total value, and Article Influence, which is a measure of journal prestige. In addition, pricing data can be combined with citation data to produce a cost-effectiveness measure, which can help

librarians to determine which journals to buy. Finally, the Eigenfactor Project develops visual tools for mapping and navigating the scholarly literature. More information on Eigenfactor metrics can be found at eigenfactor.org.

Tempest rounded out the discussion with a look at how editors and others are using various metrics. Editors tend to use the H index to identify experts in a specialized topic as potential peer reviewers. Many editors have been using IF and H index data to identify articles that have had a significant effect on a journal's IF and to identify "hot" topics and institutions that are centers of excellence in a given research field. Authors use the metrics when choosing which journals to submit manuscripts to.

All presenters stressed the importance of using any of these measures carefully, taking the inherent limitations of each into account. Audience members expressed concern that innovation might be discouraged by excessive focus on quantitative measures as indicators of quality. Tempest offered the hope that such metrics might actually encourage editors to find ways to use innovative research.

Finally, Adrian Stanley noted that only a year ago, editors were still learning about the different ways to measure journal and article performance, but now there is definite interest in using them. The *Proceedings of the National Academy of Sciences of the United States of America* now publishes its Eigenfactor and impact factor, and Stanley expects that more and more attention will be paid to the newer metrics. 