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SAVVY SEARCHING

Eigenfactor and article influence scores in the *Journal Citation Reports*

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Abstract

Purpose – This sequel to the earlier testing and evaluation of the five-year Journal Impact Factor (JIF-5) in the enhanced version of the *Journal Citation Reports* (*JCR*) (released in January and July 2009 for the 2007 and 2008 journal collections, respectively) seeks to assess and compare the impact on the ranking of journals by two other performance indicators.

Design/methodology/approach – Both the Eigenfactor Score (EFS) and the Article Influence Score (AIS) use a five-year target window in the algorithm to quantify the scholarly impact at the overall journal level and at the article level, respectively.

Findings – The paper examines how the rank positions of 52 library and information science journals change when the set of journals are ranked by the Eigenfactor metrics in relation to the JIF-5 indicator.

Originality/value – The principle behind Google's PageRank is where a web page or site got ranked in the search results based not merely on the number of incoming links, but also on the status/prestige of the linking sites based on the PageRank scores of those linking sites. This is a recursively calculated permanent value until the next year's edition.

Keywords Influence, Information science, Serials, Eigenvalues and eigenfunctions, Libraries

Paper type Literature review

This sequel to the earlier testing and evaluation of the five-year Journal Impact Factor (JIF-5) in the enhanced version of the *Journal Citation Reports* (*JCR*) (released in January and July 2009 for the 2007 and 2008 journal collections, respectively) assesses and compares the impact on the ranking of journals by two other performance indicators. Both the Eigenfactor Score (EFS) and the Article Influence Score (AIS) use a five-year target window in the algorithm to quantify the scholarly impact at the overall journal level and at the article level, respectively. This issue examines how the rank positions of 52 library and information science journals change when the set of journals are ranked by the Eigenfactor metrics in relation to the JIF-5 indicator.

Background

The *JCR* have been available for nearly 40 years if we count the print, microfiche, CD-ROM and online formats. The *JCR* and the traditional Journal Impact Factor based on a two-year target window (JIF-2) have been controversial but have also been widely (if not always wisely) used directly or as a proxy for a variety of purposes, ranging from library collection development to evaluating the research quality of college departments, institutions and countries, to making decisions in tenure, promotion and grant applications.

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There have been thousands of papers published about the pros and cons of the Journal Impact Factor in general, and the results of its use in ranking journals in specific disciplines and application areas. It is quite telling that the National Library of Medicine added – in addition to the long standing, broader subject heading "Bibliometrics" – the narrower term "Journal Impact Factor" as a Medical Subject Heading (MeSH) in 2008, and that in two years it was assigned to 288 MEDLINE records. The free text search in the abstracting/indexing records for journal* AND impact factor* (as an exact phrase for the latter, and accommodating both the singular and plural formats of both terms to retrieve journal impact factors, impact factor of journals and other variations) finds more than 1,000 records, obviously from medical, and life sciences journals alone.

There is a very high level of redundancy in the majority of papers on the subject, parroting the same old reasons for the pros and the cons that were described, admitted and well explained decades ago by Eugene Garfield and his fellow scientist, Irving Sher (Garfield and Sher, 1963; Garfield, 1972). Fortunately, the most competent, real experts in bibliometrics, scientometrics and informetrics have also published enlightening papers (Glänzel, 2009; Leydesdorff, 2008; Moed and van Leeuwen, 1995; Nisonger, 1994, 2000, 2004; Pendlebury, 2009; Rousseau, 2001, 2005), or have summarised the essential issues and positions in their objective and informative reviews of the broader literature (Bar-Ilan, 2008; Wilson, 1999).

On a personal level, I have been using the *JCR* from my early years as a practitioner and later as an academic with great appreciation (Jacsó, 2005) and with reservation (Jacsó, 2000, 2001). I found the introduction of the JIF-5 indicator an important and much needed step forward (Jacsó, 2009).

Amid the many unusually extremist standpoints, a recent case study by Butler (2008) showed the refreshingly rational attitude of adopting a balanced approach in using bibliometric indicators. This goes hand in hand with Harnad's (2008) principle of validating research performance metrics against peer rankings. The more, the better, I would add, especially as the nationwide projects of the research assessment of universities and colleges through the prism of faculty publications output in journals ranked by peers into four tiers are getting in full gear. This is especially so in the UK and Australia, where Charles Oppenheim's original idea (first presented about 15 years ago) of using citation counts in the Research Assessment Exercise (Oppenheim, 1996) are embraced, but not in the manner of an exclusive (either this or that but not both) Boolean XOR operation. It must be also borne in mind that administrators might be too eager to look up, accept and use just the indicators reported, without understanding their limitations, and face the situation that Gary Gorman (2008) described in his editorial, "They can't read, but they sure can count", about the flawed rules and malpractice in assessing the performance of researchers. Neither is it likely that all decision-makers would consistently apply the standards of good practice in interpreting the results of bibliometric searches (Bornmann *et al.*, 2008) or would be fully aware of the metadata mega mess in Google Scholar, coupled with a very loose citation matching algorithm (Jacsó, 2010), let alone of other, less obvious database content and software limitations that can distort bibliometric measures calculated from cited reference enhanced databases (Jacsó, 2008a, b, 2006).

The incorporation of the Eigenfactor metrics

Apparently, the launch of the open access service at the eigenfactor.org site in 2007 gave the impetus to Thomson (now Thomson-Reuters) to enhance the *JCR*. The developers, Associate Professor Carl Bergstrom and his team, of the free service at eigenfactor.org applied a smart idea, borrowed from the principle of Google's PageRank. They used the underlying data collected and processed by Eugene Garfield's company, and they strongly criticised the *JCR* itself. It was not difficult to perceive the service in its initial year as a derivative work, getting the precious data from a proprietary source that is not like the phone listings in the White Pages – unprotected (at least in the US) by copyright law.

I can only presume and speculate that after many rounds of discussions (and Thomson-Reuters's decision to enhance the traditional JIF-2 scores with a five-year version (JIF-5), as JIF-2 relies on a too narrow target window considering that in most disciplinary areas the citation zenith is reached three to four years after publication), the parties must have made an agreement that the two Eigenfactor metrics would be incorporated into the *JCR*, and the developers of the eigenfactor.org site would continue using the *JCR*'s base datasets for the 1995-2007 editions of more than 10 million master records and about 200-250 million references, and, among others, explicitly and prominently display the note that Thomson-Reuters provided the data used for the Eigenfactor service.

Whatever the details were, the subscriber community now can enjoy the advantage of having three additional journal indicators integrated into the *JCR*, and anyone can make use of the Eigenfactor service free of charge, which is more restricted (by not showing the very informative and precious details of the *JCR* records) and more comprehensive, by virtue of computing additional metrics and presenting additional scientometric information through top-notch maps and motion charts about the citation network of sharing scientific information through references in publications. It is an impressive, very well designed system that deserves a dedicated review of its own.

There is an excellent section at the website www.eigenfactor.org/methods.htm that describes and illustrates the Eigenfactor methodology, and a paper published in *College & Research Libraries* (Bergstrom, 2007) also provides additional background. So it suffices to state here that the Eigenfactor score (EFS) is a size-dependent measure of the overall prestige or importance of the journals from the perspective of the advanced researcher community (but not necessarily for the college libraries with undergraduate and graduate programmes), while the Article Influence Score (AIS), a normalised score produced by dividing the EFS by the number of papers published in the journal, indicates the average impact of each of the journal's articles.

It is this second indicator that is comparable (in principle) to the JIF-5. It is comparable only in principle because while the JIF scores treat all citations received as being of equal value, the Eigenfactor scores reflect the prestige of the citing journal, that is, it makes a distinction between citations received from a high ranking, important journal and a low ranking journal. This was the principle behind Google's PageRank, where a web page or site got ranked in the search results based not merely on the number of incoming links, but also on the status/prestige of the linking sites based on the PageRank scores of those linking sites. This is a recursively calculated permanent value until the next year's edition.

Taking the risk of sounding blasphemous, it is the scholarly analogue of the Hollywood practice, where it not only matters how many people attended one's party or how many air-kisses the host received, but also how many of them were celebrities and how big their celebrity in the invisible college of the Hollywood glitterati, where these scores are very up-to-date and much better known than the influence scores of journals by researchers.

Integrated presentation of the Eigenfactor metrics and the JIF metrics

The new hub page of the *JCR* shows all the formerly displayed metadata and metrics along with the new metrics in a matrix format. The JIF and Eigenfactor metrics are in different scales so they are difficult to compare, especially because of the tiny values of the EFS with five decimal points (see Table I).

By removing the ISSN from this page (where it has no relevance), and hiding the columns for the Immediacy Index, the number of articles in the census year, and the Cited Half-life, the really important rank positions of the journals by JIF-5, EFS and AIS could be shown. A mock-up of a more helpful hub page (see Table II) was created by downloading the data into a spreadsheet to do many calculations with the indicators and to illustrate the feasibility of a screen that provides an at-a-glance view showing only the most critical indicators for the journals. I used only 52 of the 56 journals from the information and library science category, as four journals did not have a JIF-5 value because they have not been covered for five years or were not even in existence for that many years. This layout and content immediately gives a sense about the rank position differences.

There is a dramatic change only in the rank positions of two serials (the *Annual Review of Information Science and Technology* (*ARIST*) and the *Information Systems Journal*) between the ranking based on JIF-5 and EFS, which are not the primary comparators but which jump out at the user. Their 20 and 21 rank positions demotion may be explained (if not justified) by the very low number of typical items per year (about 15 and 18). The opposite is true for the *Journal of the American Society of Information Science & Technology*, which is eight positions higher by Eigenfactor than by JIF-5, and which is not only highly cited (by many high ranking journals both in the sciences and the social sciences) but is also very productive, and productivity has a high impact on EFS. The same is true for *Scientometrics*.

The changes are visually more prominent when I created bump charts for an at-a-glance view (see Figure 1).

The remarkable changes in rank positions between JIF-5 and AIS are surprising, especially for *Library and Information Science Research*, as the AIS is normalised by volume of papers published – just as JIF-5 is. The seven-position drop in rank of the *Journal of the Medical Library Association* is also enigmatic. The downward position change of *Scientometrics* can be explained by its high self-citation rate, but this does not explain the same degree of demotion of *Information Systems Journal*. However, *ARIST* is one of the journals that rightly keep the same position by JIF-5 and AIS ranking (see Figure 2).

In the bottom 20-stratum by JIF-5, *Library Journal* and the *Scientist* move up from their very low positions of 48 and 50 to the 15th and the 20th positions when ranked by AIS. This is obviously because of their highest productivity among the 52 journals. *Online* moves up by nine positions, sharing the 34th position with *Social Science*

Table I. Excerpt of the summary hub page of the *JCR* with new indicators

				JCR data (i)						Eigenfactor™ metrics (i)	
Mark	Rank	Abbreviated journal title (linked to journal information)	ISSN	2007 Total cites	IF	Five-year IF	Immediacy index	2007 Items	Cited half-life	Eigenfactor™ score	Article influence™ score
✓	1	*Mis. Quart.*	0276-7783	4,329	5.825	9.257	0.533	30	9.4	0.01128	3.567
✓	2	*Inform. Syst. Res.*	1047-7047	2,146	2.682	6.579	0.130	23	8.3	0.00766	3.079
✓	3	*J. Am. Med. Inform. Assn.*	1067-5027	2,394	3.094	3.489	0.699	93	5.2	0.00948	1.096
✓	4	*J. Manage. Inform. Syst.*	0742-1222	1,861	1.867	3.229	0.175	40	7.7	0.00571	1.307
✓	5	*Annu. Rev. Inform. Sci.*	0066-4200	378	1.963	2.810	0.533	15	6.1	0.00137	0.934
✓	6	*Inform. Manage-Amster.*	0378-7206	1,833	1.631	2.756	0.127	55	6.0	0.00687	0.891
✓	7	*Inform. Syst. J.*	1350-1917	380	1.531	2.085	0.611	18	6.2	0.00108	0.564
✓	8	*Int. J. Geogr. Inf. Sci.*	1365-8816	1,410	1.822	2.068	0.186	59	8.4	0.00318	0.619
✓	9	*J. Inf. Technol.*	0268-3962	477	1.605	2.045	0.086	35	6.3	0.00201	0.785
✓	10	*J. Health Commun.*	1081-0730	709	1.836	2.021	0.136	44	4.0	0.00433	0.773
✓	11	*J. Am. Soc. Inf. Sci. Tec.*	1532-2882	3,026	1.436	1.840	0.409	186	7.7	0.00864	0.620
✓	12	*Inform. Process Manag.*	0306-4573	1,441	1.500	1.639	0.211	109	7.9	0.00418	0.545
✓	13	*Scientometrics*	0138-9130	1,515	1.472	1.538	0.147	129	5.7	0.00445	0.380
✓	14	*J. Doc.*	0022-0418	714	1.309	1.392	0.316	19	9.7	0.00211	0.573

Table II.
Rank position differences by key journal indicators

Abbreviated journal title	2007 Total cites Received	2007 Total cites Rank	Two-year IF	Two-year IF Rank	Five-year IF	Five-year IF Rank	Eigenfactor Score	EFS Rank	Article influence Score	AIS Rank
Mis. Quart.	4,329	1	6.826	1	9.257	1	0.01128	1	3.567	1
Inform. Syst. Res.	2,146	4	2.682	2	6.579	2	0.00766	4	3.079	2
J. Am. Med. Inform. Assn.	2,394	3	3.094	2	3.489	3	0.00948	2	1.096	4
J. Manage. Inform. Syst.	1,861	5	1.867	5	3.229	4	0.00571	6	1.307	3
Annu. Rev. Inform. Sci.	378	17	1.963	4	2.810	5	0.00137	25	0.934	5
Inf. Manage	1,833	6	1.631	8	2.756	6	0.00687	5	0.891	6
Inform. Syst. J.	380	16	1.531	10	2.085	7	0.00108	28	0.564	13
Int. J. Geogr. Inf. Sci.	1,410	9	1.822	7	2.068	8	0.00318	10	0.619	10
J. Inf. Technol.	477	12	1.605	9	2.045	9	0.00201	13	0.785	7
J. Health Commun.	709	11	1.836	6	2.021	10	0.00433	8	0.773	8
J. Am. Soc. Inf. Sci. Tec.	3,026	2	1.436	13	1.840	11	0.00864	3	0.620	9
Inform. Process Manag.	1,441	8	1.500	11	1.639	12	0.00418	9	0.545	15
Scientometrics	1,515	7	1.472	12	1.538	13	0.00445	7	0.0380	19
J. Doc.	714	10	1.309	15	1.392	14	0.00211	11	0.573	12
J. Med.. Libr. Assoc.	388	15	1.392	14	1.368	15	0.00199	14	0.332	22
Inf. Res.	291	25	1.027	17	1.309	16	0.00171	19	0.446	17
Inf. Soc.	377	18	0.719	24	1.287	17	0.00202	12	0.579	11
Libr. Inf. Sci. Res.	367	20	0.870	19	1.239	18	0.00151	23	0.557	14
Coll. Res. Libr.	474	13	0.820	20	1.067	19	0.00178	18	0.511	16
J. Inf. Sci	448	14	1.080	16	0.018	20	0.00186	17	0.363	20

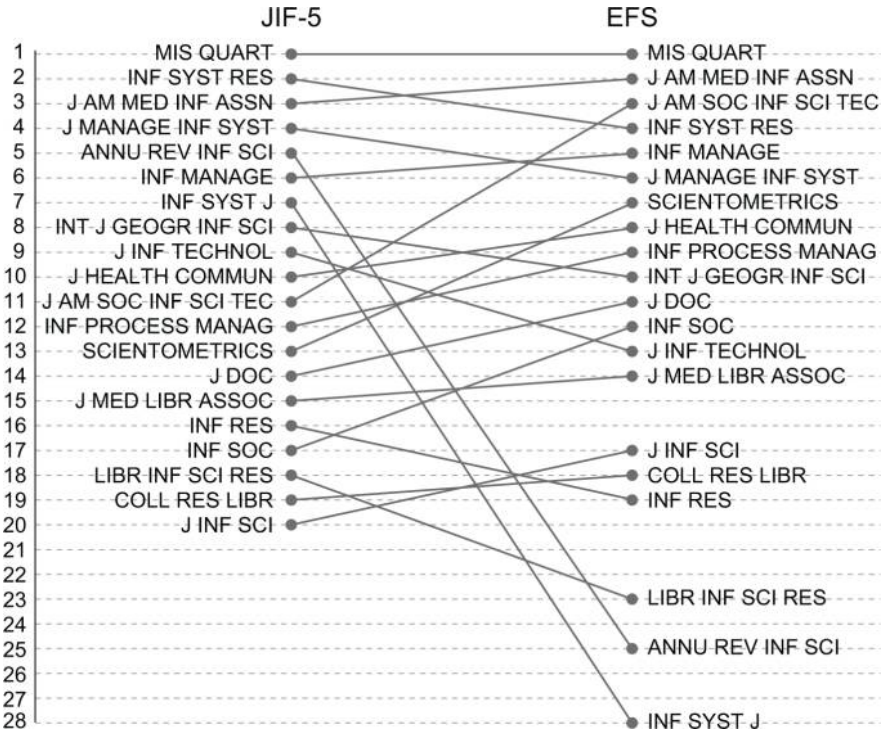

Figure 1.
Bump chart for better visualisation of rank position changes by JIF-5 versus EFS

Information, which rose slightly, but *Libri* falls 11 positions, sharing the spot with *Knowledge Organization*, whose rank is the same by both rank criteria. There are similar changes among the bottom 20 journals ranked by AIS, and none of the journals keep the same positions, and the degree of convergence is significantly lower by the two rankings in this stratum. For reasons of page size, for the print edition I could not reproduce the entire rank lists of 52 journals, but an online version of the chart will show the whole set at www.jacso.info/jcr-eigenfactor.

Conclusion

The rankings by the three different methods yield very different rank positions that rank correlation coefficients would not reveal, as well as the display of the rank positions in the same row and especially the bump charts. It deserves further investigation why the supposedly similar measures are not as similar as expected, even in the top 20 group where ranks usually converge much more than in the bottom 20 group. Minor position changes come with the limitations of the ordinal rank numbers, and are common in rankings based on opinion of peers. Those cannot be explored let alone recreated, but with citations-based ranking this can be done. As the 2007 *JCR* set remains in a "frozen" state, so further tests can be made.

Unfortunately, the information-rich detail pages of the *JCR* (about citations received and given by the journals, their exact share, distribution rate per year) do not provide information about the self-citation rate for the five-year time span as readily as for the

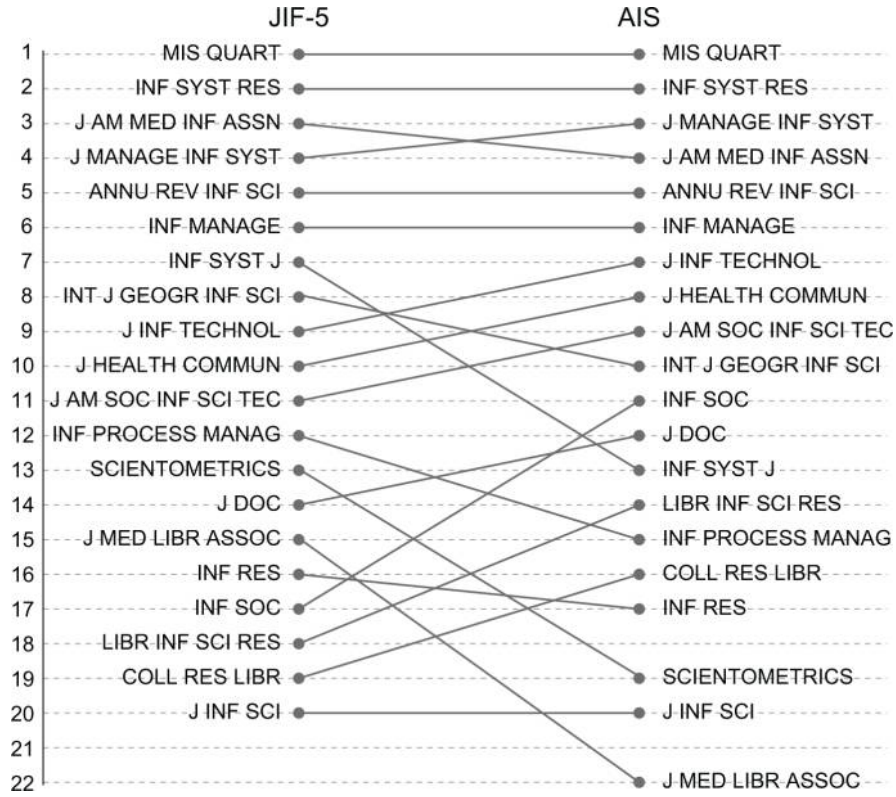

Figure 2.
Bump chart for better visualisation of rank position changes by JIF-5 versus AIS

two-year window. This is important, as the major reason for the differences in the most divergent rank positions is the different treatment of self-citations by JIS-5 and the Eigenfactor methods. The former includes self-citations, the latter excludes them. This has made the greatest difference in the rank position of many of the sample journals, especially in the case of *Law Library Journal* that had an excessively high, more than 80 per cent self-citation rate. I started to calculate self-citation rates for the 52 LIS journals, but it is a tedious process. After having completed that process, it is easy to calculate the JIF-5 scores without self-citations, and compare them with the EFS and AIS indicators.

Given the same raw dataset, this would give an opportunity to focus on the other big difference between the JIF and Eigenfactor scores – the prestige of the journals giving the citations.

Looking up the many extra features at the Eigenfactor site would reveal – among others – an additional bibliometric measure, that happens to be called "journal impact factor". It is expressed in the much more readily comprehensible, comparable and finer percentile figures in order to validate the convergence between the AIS and JIF-5 indicators. Examination of this will come as a sequel to this preliminary exploration.

The smartest approach is to use and compare the variety of bibliometric indicators not by themselves alone, but as a tool to inform the peers of the disciplinary areas, who

compile the great variety of journal league lists, and make their decisions better, and reach more consensus in determining the best journals of the disciplines for different purposes and target audiences.

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