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Rankings of information and library science journals by JIF and by *h*-type indices

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ABSTRACT

In this paper we compute journal rankings in the Information and Library Science JCR category according to the JIF and according to several *h*-type indices. Even though the correlations between all the ranked lists are very high, there are considerable individual differences between the rankings as can be seen by visual inspection, showing that the correlation measure is not sensitive enough. Thus we also compute other measures, Spearman's footrule and the *M*-measure that are more sensitive to the differences between the rankings in the sense that the range of values is larger than the range of correlation values when comparing the JIF ranking to the rankings induced by the *h*-type indices.

1. Introduction

A lot has been written about journal impact factors (JIF), its uses and misuses and how the JIF should not be used for evaluations (for example, see Garfield, 1955, 2006; Seglen, 1997). Still the JIF and journal rankings within a JCR subject category are widely used for evaluations.

In 2005, the physicist Jorge Hirsch (2005) introduced a new measure, the *h*-index, which combines publication and citation counts. This new measure raised huge interest among informetricians. Some tried to apply it, others criticized it and suggested improvement and some suggested ways to model the *h*-index. One of the first applications, suggested by Braun, Glänzel, and Schubert (2005, 2006) was to apply the *h*-index to journals. Glänzel and Schubert (2007) tested a theoretical model of dependence of the journal-type *h*-index on the JIF and the number of publications.

The JIF computed in the JCR, is the 2-year impact factor, i.e. the number of citations of articles published in years *y*-1 and *y*-2 in the journal, that appeared in articles published in year *y* are divided by the number of "citable documents" published in the journal in years *y*-1 and *y*-2. See discussion of what is meant by "citable documents" in the next paragraph. This paper uses data for 2007, i.e., citations that the journal received in 2007 to articles that were published in 2005 and 2006 divided by the number of "citable documents" the journal published in 2005 and 2006. The publication years are 2005 and 2006 and the citation window is 2007. ISI (Thomson Reuters) also publishes the 5-year impact factor, i.e. for 2007 it counts the citations in 2007 to items published in the journal in the years 2002–2006 and divides it by the number of "citable documents" the journal published in the given year.

What are "citable documents"? There is no clear definition of this term, but it is supposed to mean that one only counts items published in a journal that have potential to be cited. The definition of the number of "citable documents" is crucial, because it is the denominator of the JIF calculation, it is a normalizing factor that allows JIF's of journals in the same

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subject category to be compared. It was noticed by Moed and van Leeuwen (1995) that ISI counts only a subset of the items published by journals as "citable", most probably excluding letters and editorials, while all citations irrespective of the target of the citation ("citable" or "non-citable") are counted. They demonstrated that this inflates the JIF of some journals with large number of letters that receive citations. Recently, Rossner, van Epps, and Hill (2007) complained about ISI's impact factor calculations. In a reply to these complaints Pendelbury (2008) explained: "Although all primary research articles and reviews (whether published in front-matter or anywhere else in the journal) are included, a citable item also includes substantive pieces published in the journal that are, bibliographically and bibliometrically, part of the scholarly contribution of the journal to the literature. Research at Thomson has shown that, across all journals, more than 98% of the citations in the numerator of the Impact Factor are to items considered "citable" and counted in the denominator". Thus there is no uniform definition of a "citable document". Following the evidence found by Moed and van Leeuwen (1995) often only articles, reviews and notes are counted, but as Moed and van Leeuwen note editorials and letters are also citable. Thus in this study the document types considered citable were: article, reviews, proceeding papers, letters and editorials.

ISI currently publishes two impact factors, the regular, 2-year impact factor and the 5-year impact factor. These impact factors are called "synchronous impact factors" (Ingwersen, Larsen, & Wormell, 2000). The impact factor is synchronous if only the citations received during a fixed period are counted. The citation window is usually of 1 year. For the case of synchronous impact factor the citation year is fixed and the publication years lie in the past, and thus this can be considered a retrospective measure (Glänzel, 2004).

Another type of impact factor is the "diachronous impact factor" where the citations received since the publication of the item and until a given point in time are counted. The publication window is usually of 1 year. The citations counted are the number of citations the publications in the publication window received during y years since their publication. Thus a 2007 diachronous impact factor with a citation window of 3 years, counts all the citations that items published in the journal in 2005 received in the years 2005, 2006 and 2007. The diachronous impact factor can be seen as a prospective measure, it considers the citations accumulated since publication (Glänzel, 2004).

The h-index of an author as defined by Hirsch is the number h such that the author has h publications with at least h citations each and the rest of publications received at most h citations. Hirsch did not limit the period in which the citations were received. This calculation puts young scientists at a disadvantage and it is also unfair to recently established journals if the h-index of journals is to be calculated. Thus Braun et al. (2005, 2006) calculated the diachronous h-index of journals; they looked at the 2001 items published in the journals and counted all the citations these items received until September 2005. The h-index of a journal is defined as the unique number h such that h items in the journal that were published in the given publication year(s) received at least h citations during the citation period and all other items received h citations or less. Glänzel and Schubert (2007) tested their model against a diachronous h-index with a 3-year citation window.

Harzing and van der Wal (2009) computed the h-index of some journals using Google Scholar. They too calculated a diachronous h-index. It is extremely difficult to calculate a synchronous h-index for journals using Google Scholar. To compute a 2-year synchronous h-index for journals for the year 2007, one needs to fix the publication years, 2005 and 2006 and to count all the citations these items received in 2007. From this point onwards the calculation is analogous to the calculation for the diachronous h-index.

Currently the Web of Science supports synchronous computations through its "Citation Report" interface. The procedure is explained in detail by Liang and Rousseau (2009): the citation report interface allows us to download the publications in a comma delimited format, where not only the total citation counts are given, but the citations per year are tabulated. This allows simple calculation of the synchronous h-index. The JIF can also be calculated easily using the downloaded data from the "Citation Report" interface. Liang and Rousseau calculated the h-index and related measures for journals in three JCR subject categories: environmental and resource economics, cybernetics, and information and library science. They showed that the h-index and its variants correlate highly with the JIF. In this paper we will also examine the rankings resulting from the JIF and from variants of the h-index, but we will compare the rankings using an additional measure, especially suited for comparing rank lists (Aguillo, Bar-Ilan, Levene, & Ortega, 2009; Bar-Ilan, Levene, & Lin, 2007). In addition we computed both synchronous and diachronous h-indexes. Bornmann, Werner, and Schier (2009) computed the synchronous h-index and some of its variants for 20 organic chemistry journals.

2. Definitions

The journal impact factor (JIF) and the h-index were already defined in the previous section. We will compute both the synchronous and the diachronous h-indices (3-year citation window) for 2007. The h-index does not have enough discriminatory power to rank all 56 journals in the Information and Library Science section of the JCR, because the journal with the highest h-index has h-index 11 or 12 (depending whether the synchronous or the diachronous case is considered). Thus we calculated the values for some variants of the h-index.

The g-index was introduced by Egghe (2006); it takes into account that top-cited articles in the h-core (the set of articles that received at least h citations) usually receive much more than h citations. The exact definition is: "A set of papers has a g-index g if g is the highest rank such that the top g papers have, together, at least g^2 citations." (Egghe, 2006, p. 132).

Both the h- and the g-indices are integers; in order to increase their discriminative power, following Ruane and Tol (2008), Guns and Rousseau (2009) formalized the definitions of the rational h- and g-indices, denoted h_{rat} and g_{rat}:

$$h_{\text{rat}} = \frac{h+1-n}{2h+1}$$

where n is the smallest number of additional citations needed to increase the h-index to $h+1$

$$g_{\text{rat}} = \frac{g + (\sum \text{citations of } g+1 \text{ top items})}{2g+1}$$

Spearman's footrule (see for example Diaconis & Graham, 1977) is a well-known measure that compares two permutations. Different rank orderings of a set of items can be viewed as permutations. There is a slight problem with ties, but these can be handled. In this paper all tied items were assigned the mid position. Thus for example if there was a tie on the 2 and third place, both journals were assigned "rank" 2.5, and if there were three tied journals in positions 8,9 and 10, all three were "ranked" as 9.

Spearman's footrule is defined as

$$Fr^{|S|}(\sigma_1, \sigma_2) = \sum_{i=1}^{|S|} |(\sigma_1(i) - \sigma_2(i))|.$$

where σ_1 and σ_2 are two rankings, and $\sigma_j(i)$ is the rank position of the ith item in ranking σ_j, S is the set of items and $|S|$ it the size of the set.

When the two lists are identical, $Fr^{|S|}$ is zero, and its maximum value is $(1/2)|S|2$ when $|S|$ is even, and $(1/2)(|S|+1)(|S|-1)$ when $|S|$ is odd. If we divide the result by its maximum value, $Fr^{|S|}$ will be between 0 and 1, independent of the size of the overlap; we note that this is defined only for $|S|>1$. Thus we compute the normalized Spearman's footrule, NFr, for $|S|>1$

$$NFr = \frac{Fr^{(|S|)}}{\max Fr^{(|S|)}}$$

NFr ranges between 0 and 1; it attains the value 0 when the two lists are identically ranked and the value 1 when the lists appear in opposite order.

In addition we define the M-measure that allows us to compare two ranked lists and gives higher value to agreement on the top values. The M-measure as defined by Bar-Ilan et al. (2007) for comparing two ranked lists A and B:

Let

$$N^{(k)}(\sigma_1\sigma_2) = \sum_{i\in Z}\left|\frac{1}{\sigma_1(i)} - \frac{1}{\sigma_2(i)}\right| + \sum_{i\in S}\left|\frac{1}{\sigma_1(i)} - \frac{1}{(k+1)}\right| + \sum_{i\in T}\left|\frac{1}{\sigma_2(i)} - \frac{1}{(k+1)}\right|$$

where k is the length of the ranked lists, Z is the set of overlapping elements, S is the set of non-overlapping elements in list A and T is the set of non-overlapping elements in list B. $\sigma_1(i)$ is the rank of journal i in list A and $\sigma_2(i)$ is the rank of journal i in list B.

This measure is normalized so that its values are between 0 and 1.

$$M^{(k)} = 1 - \frac{N^{(k)}}{\max N^{(k)}}$$

where

$$\max N^{(k)} = 2\sum_{i=1}^{k_1}\left(\frac{1}{i} - \frac{1}{k+1}\right)$$

In this paper we compare different rankings of the same underlying set. In the general case one of the advantages of the M-measure over the footrule is that it takes into account the non-overlapping elements in the two sets that are being compared. This was the main reason Bar-Ilan et al. (2007) introduced the M-measure. For the current case, its advantage over the footrule is mainly the fact that higher weight is given to agreement on the top ranked items. For the sake of comparison, in this paper we calculate the footrule, the M-measure and Spearman's correlation between the ranked lists.

3. Data collection and data cleansing

At first we intended to compute h, g, h_{rat}, g_{rat} for both the synchronous and the asynchronous cases and compare all resulting ranked lists to the 2007 JIF as it appears in the JCR (Journal Citation Reports). Somewhat to our surprise it turned out that in several cases the JIF computed based on the data downloaded from the "Citation Report" interface differed greatly from the values that appear in the JCR. As an example, according to the JCR, the 2007 impact factor of Information Research is 1.027 (75 "citable documents" in 2005 and 2006 and 75 citations to these items in 2007). The data provided by the "Citation Report" interface contained 84 "citable documents", but only 10 citations to these documents in 2007. The "Cited reference"

Table 1
The JIF and the synchronous *h*-type indices.

Journal title	computed_JIF	computed_JIF_rank	h-rat-synch	h-rat_rank-synch	g-rat-synch	g-rat_rank_synch	h_synch	h_rank_synch	g_synch	g_rank_synch
MIS Quarterly	4.64	1	11.87	1	15.32	1	11	1	15	1
Journal of the American Medical Informatics Association	2.58	2	9.95	2	12.40	3	9	2.5	12	2.5
Information Systems Research	2.30	3	5.91	9	8.18	8	5	10.5	8	9.5
Annual Review of Information Science and Technology	1.83	4	4.89	13.5	5.55	15	4	15	5	14.5
Information & Management	1.72	5	8.88	4	9.84	5	8	4.5	10.5	4
International Journal of Geographical Information Science	1.62	6	6.85	7	7.80	9	6	7	7	9.5
Scientometrics	*1.51*	*7*	*9.89*	*3*	*12.76*	*2*	*9*	*2.5*	*12*	*2.5*
Journal of Management Information Systems	1.44	8	5.73	10	5.91	13	5	10.5	5	14.5
Information Processing & Management	1.41	9	6.85	7	8.35	6	6	7	8	6.5
Journal of Health Communication	1.41	10	6.85	7	8.29	7	6	7	8	6.5
Journal of the American Society for Information Science and Technology	1.39	11	8.76	5	10.38	4	8	4.5	10	5
Information Systems Journal	1.33	12	4.67	15	5.36	16	4	15	5	14.5
Journal of Global Information Management	1.11	13	4.44	16.5	4.67	18	4	15	4	18
Journal of Documentation	1.10	14	5.64	11.5	6.46	12	5	10.5	6	12
Journal of Information Science	1.01	15	4.89	13.5	7.47	11	4	15	7	9.5
Journal of the Medical Library Association	1.00	16	5.64	11.5	7.60	10	5	10.5	7	9.5
Health Information and Libraries Journal	0.72	17	4.44	16.5	4.78	17	4	15	4	18
Government Information Quarterly	0.69	18	3.86	19	5.64	14	3	22.5	5	14.5
Library & Information Science Research	0.68	19	3.86	19	3.86	22.5	3	22.5	3	24
Portal-Libraries and the Academy	0.66	20	3.86	19	3.86	22.5	3	22.5	3	24
College & Research Libraries	0.59	21	3.43	25	3.43	27	3	22.5	3	24
Information Society	0.58	22	3.43	25	4.22	19	3	22.5	4	18
Research Evaluation	0.47	23	3.43	25	3.43	27	3	22.5	3	24
Library Quarterly	0.47	24	2.80	28	3.86	22.5	2	32	3	24
ASLIB Proceedings	0.46	25	3.57	23	3.86	22.5	3	22.5	3	24
Social Science Computer Review	0.42	26	2.60	30	2.80	29.5	2	32	2	32.5
Telecommunications Policy	0.42	27	3.71	21.5	3.86	22.5	3	22.5	3	24
Journal of Academic Librarianship	0.39	28	3.71	21.5	3.86	22.5	3	22.5	3	24
Interlending & Document Supply	0.37	29	3.29	27	3.43	27	3	22.5	3	24
Library Collections Acquisitions & Technical Services	0.31	30	2.60	30	2.80	29.5	2	32	2	32.5
Information Technology and Libraries	0.28	31	2.40	33	2.40	33.5	2	32	2	32.5
LIBRI	0.26	32	2.40	33	2.60	31.5	2	32	2	32.5
Library Trends	0.24	33	2.60	30	2.60	31.5	2	32	2	32.5
Journal of Scholarly Publishing	0.24	34	2.20	35.5	2.20	35.5	2	32	2	32.5
Knowledge Organization	0.21	35	1.33	37	1.33	37	1	37	1	37
Electronic Library	0.18	36	2.40	33	2.40	33.5	2	32	2	32.5
Reference & User Services Quarterly	0.13	37	2.20	35.5	2.20	35.5	2	32	2	32.5

Table 2
The JIF and the diachronous *h*-type indices.

Journal title	computed_JIF	computed_JIF_rank	h-rat-dia	h-rat_rank-dia	g-rat-dia	g-rat_rank_dia	h_dia	h_rank_dia	g_dia	g_rank_dia
MIS Quarterly	4.64	1	11.87	2	18.38	1	11	2	18	1
Journal of the American Medical Informatics Association	2.58	2	12.92	1	16.45	2	12	1	16	2
Information Systems Research	*2.30*	*3*	*6.77*	*10*	*9.26*	*8*	*6*	*10*	*9*	*7*
Annual Review of Information Science And Technology	1.83	4	3.86	22	5.91	15	3	24	5	17.5
Information & Management	1.72	5	8.94	3	11.87	4	8	3.5	11	4
International Journal of Geographical Information Science	1.62	6	7.93	5.5	9.89	6	7	7	9	7
Scientometrics	1.51	7	7.93	5.5	12.80	3	7	7	12	3
Journal of Management Information Systems	1.44	8	7.60	9	7.67	11	7	7	7	11.5
Information Processing & Management	1.41	9	7.80	7.5	8.88	9	7	7	8	9
Journal of Health Communication	1.41	10	7.80	7.5	9.37	7	7	7	9	7
Journal of the American Society for Information Science and Technology	1.39	11	8.82	4	10.71	5	8	3.5	10	5
Information Systems Journal	1.33	12	5.73	14	7.27	12	5	13	7	11.5
Journal of Global Information Management	1.11	13	5.55	15	5.73	16.5	5	13	5	17.5
Journal of Documentation	1.10	14	5.91	11	7.93	10	5	13	7	11.5
Journal of Information Science	1.01	15	4.56	18.5	5.55	18	4	18	5	17.5
Journal of the Medical Library Association	1.00	16	5.82	12.5	6.77	14	5	13	6	14
Health Information and Libraries Journal	0.72	17	4.56	18.5	5.73	16.5	4	18	5	17.5
Government Information Quarterly	0.69	18	5.82	12.5	7.13	13	5	13	7	11.5
Library & Information Science Research	0.68	19	4.91	16	5.36	19.5	4	18	5	17.5
Portal-Libraries and the Academy	0.66	20	4.33	20	4.33	25	4	18	4	23.5
College & Research Libraries	0.59	21	3.57	25.5	4.33	25	3	24	4	23.5
Information Society	0.58	22	4.67	17	5.36	19.5	4	18	5	17.5
Research Evaluation	0.47	23	2.80	29.5	3.43	31	2	31.5	3	29
Library Quarterly	0.47	24	2.80	29.5	4.78	22	2	31.5	4	23.5
ASLIB Proceedings	0.46	25	3.71	24	4.89	21	3	24	4	23.5
Social Science Computer Review	0.42	26	2.60	32.5	2.80	32.5	2	31.5	2	34
Telecommunications Policy	0.42	27	3.86	22	4.33	25	3	24	4	23.5
Journal of Academic Librarianship	0.39	28	3.57	25.5	3.57	30	3	24	3	29
Interlending & Document Supply	0.37	29	3.86	22	4.44	23	3	24	4	23.5
Library Collections Acquisitions & Technical Services	0.31	30	3.29	27	3.71	28	3	24	3	29
Information Technology and Libraries	0.28	31	2.80	29.5	3.71	28	2	31.5	3	29
LIBRI	0.26	32	2.20	35	2.40	34.5	2	31.5	2	34
Library Trends	0.24	33	2.60	32.5	3.71	28	2	31.5	3	29
Journal of Scholarly Publishing	0.24	34	2.40	34	2.40	34.5	2	31.5	2	34
Knowledge Organization	0.21	35	1.33	37	1.33	37	1	36.5	1	37
Electronic Library	0.18	36	2.80	29.5	2.80	32.5	2	31.5	2	34
Reference & User Services Quarterly	0.13	37	1.67	36	2.20	36	1	36.5	2	34

Table 3
The *M*-measure and the Spearman correlations when the lists are compared to the computed JIF ranking.

List 1	List 2	*NFr*	*M*	Spearman
computed_JIF_rank	h-rat_rank_synch	0.860	0.841	0.950**
computed_JIF_rank	g-rat_rank_synch	0.836	0.770	0.933**
computed_JIF_rank	h_rank_synch	0.857	0.807	0.926**
computed_JIF_rank	g_rank_synch	0.827	0.789	0.927**
computed_JIF_rank	h-rat_rank_dia	0.819	0.682	0.901**
computed_JIF_rank	g-rat_rank_dia	0.836	0.846	0.933**
computed_JIF_rank	h_rank_dia	0.822	0.692	0.895**
computed_JIF_rank	g_rank_dia	0.833	0.844	0.931**

** Result is significant at level $p < .01$.

search on WOS listed many more unidentified citations, and these could be the source of the extra citations in the JCR; however, in order to compute the *h*-index one needs to know exactly what item is cited. Therefore we computed the JIF based on the information in the "Citation Report" interface and decided to exclude all cases where this impact factor differs by more than 30% from the JIF reported in the JCR. Note that in a few cases, the JCR reported less citations than retrieved from the "Citation Report" interface. This procedure left us with 37 journals. For these 37 journals, the correlation between the JCR JIF and "our" JIF was 0.971. Table 1 displays these 37 journals, the values of the computed JIF, the h_{rat}, $g_{rat,}$ *h*- and *g*-indices and the rank of each journal according to each of the measures for the synchronous case. Table 2 displays the results for the diachronous case. Note that in case of ties, each journal in the tied group was given the mid rank, i.e. if journals in the 11th and 12th place were tied, both were ranked 11.5 and if the journals in places 18, 19 and 20 were tied, then each was ranked 19.

Table 3 shows the correlations and the values of Spearman's footrule and the *M*-measure when all the ranked lists are compared to the ranking resulting from the computed JIF. Note that all the correlations are high and significant. The *NFr* and the *M*-values are also rather high, but they are lower. They reflect better the fact that there are considerable differences between the list resulting from the JIF ranking and the ranking based for example on the synchronous h_{rat}. As an example let us consider Scientometrics which is 7th on the JIF list but third on the h_{rat} list and 2nd on the h_{rat} list (italicized in Table 1). On the other hand, ARIST is ranked much lower on the *h*-type lists than of the JIF list, this maybe due to the fact that as a review journal it produces only a small number of articles each year, and thus there is an a-priori limit on its *h*-index. Information Systems Research is another journal whose rankings are much lower when ranked according to the *h*-type indices (italicized in Table 2). JASIST, on the other hand is ranked higher when the ranking is according to the *h*-type indices. The *M*-values provide the highest separation between the different rankings.

4. Conclusion

We reiterated the applicability of the *h*-type indices for ranking journals. The correlations between the different rankings are significant and very high, but a closer examination of the different rankings shows that they are not identical and there are considerable differences in the rankings for a number of journals. The *M*-measure shows more clearly that there are differences between the rankings and the *M*-values have a much wider range (0.162 the difference between the lowest and the highest value) than the correlations (the difference is 0.055). The range of values for the *M*-measure is higher than the range for the footrule (the difference is 0.041) as well. The *M*-measure gives the widest spread of values. It gives higher weight to agreement on the top ranking items, which is according to our expectations when comparing different rankings.

It should be noted that even when the correlations are very high there can be considerable differences in the rank position of individual journals. Consider as an example JASIST that is ranked 11th on JIF, but 4th on some of the *h*-type indices.

Which ranking is "better"? There is no answer to this question here. One option is to survey information science researchers and to ask them to provide their own ranking, and to see which of the rankings is most similar to some average ranking based on the answers of the surveyed scientists, although survey methods also have their shortcomings.

The results of this study rely only on data from the JCR category "information and library science". We recommend carrying out further studies in other categories as well.

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