SJR and SNIP: two new journal metrics in Elsevier's Scopus

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This paper introduces two journal metrics recently endorsed by Elsevier's Scopus: SCImago Journal Rank (SJR) and Source Normalized Impact per Paper (SNIP). SJR weights citations according to the status of the citing journal and aims to measure journal prestige rather than popularity. SNIP compensates for disparities in citation potential and aims to account for differences in topicality across research fields. The paper underlines important points to keep in mind when using journal metrics in general; it presents the main features of the two indicators, comparing them one with another, and with a journal impact measure similar to Thomson Reuters' journal impact factor; and it discusses their potentialities in regard to specific interests of a user and theoretical beliefs about the nature of the concept of journal performance.

Introduction

Journal citation measures were originally developed as tools in the study of the scientific-scholarly communication system[1,2]. But soon they found their way into journal management by publishers and editors, and into library collection management, and then into broader use in research management and the assessment of research performance. Typical questions addressed with journal citation measures in all these domains are listed in Table 1. Table 1 also presents important points that users of journal citation measures should take into account.

Many authors have underlined the need to correct for differences in citation characteristics between subject fields, so that users can be sure that differences are due only to citation impact and

Domain	Typical questions	Points to keep in mind
Journal publishers and editors	What is the status of my journal? Has the ranking of my journal increased? How can I increase the ranking of my journal? How does my journal compare with its competitors?	Differences in citation frequencies not only occur between journal subject categories, but also between subfields *within* a journal subject category. Are different rankings really only due to status, or just to the citation frequencies that are characteristic of my field? Not all citations are 'equal': citations from high quality sources tend to have more visibility than those from low quality journals
Librarians	Which journals are likely to be the most useful for the researchers in my institution?	Level of a journal's citation impact is only one of several criteria for utility. Other useful indicators are number of document downloads from publisher platforms, inter-library loan requests, requests from faculty, for example.
Research performance assessors; research managers	What has been the research performance of a particular researcher, group, network, project team, department, etc?	Although journal quality is an aspect of research performance in its own right, it should never be assumed that the actual citation impact of a single publication equated to the journal average. Is a strong research performance due to strong research capability, or to strong networking skills? Do I care?
Researchers	How can I ensure that the papers written in my group gain the widest attention and visibility?	Specialist journals may reach a maximal audience of interested readers worldwide, but they may not be among the top in terms of ranking; how do I balance this with needs of performance assessment? Prolific authors publish both in high impact and in lower impact journals.

Table 1. Questions addressed with journal citation measures

not to the fact that journals sit in different subject fields that happen to have distinct citation characteristics[3]. Much has been published on the various approaches to journal ranking: Pinski and Narin[4] were the first to develop a journal citation measure (influence weight) that weights citations with the prestige of the citing journal. Recent studies explored usage-based journal impact metrics as additional indicators of journal performance[5]. Moed[6] underlined the importance to prolific authors of specialist journals often with relatively low journal impact factors. Finally, Garfield[7], Seglen[8] and many others have underlined that journal impact factors should never be used as surrogates of measures of actual citation impact of individuals and research groups.

The journal impact factor, developed by Eugene Garfield as a tool to monitor the adequacy of coverage of the Science Citation Index, is probably the most widely used bibliometric indicator in the scientific, scholarly and publishing community. It is published in Thomson-Reuters' *Journal Citation Reports* (JCR) and will be labelled as 'JIF' in this paper. However, its extensive use for purposes for which it was not designed has raised a series of criticisms, all aiming to adapt the measure to the new user needs or to propose new types of indicators. (For reviews, the reader is referred to Glänzel and Moed[9,10].)

In January 2010, Scopus endorsed two such measures that had been developed by their partners and bibliometric experts SCImago Research Group, based in Spain and headed by Professor Felix de Moya, and the Centre for Science and Technology Studies (CWTS), based in Leiden, Netherlands, and headed until recently by Professor Anthony van Raan. The two metrics that were endorsed are SCImago Journal Rank (SJR) and Source Normalized Impact per Paper (SNIP). The aim of this paper is to provide an introduction to these two indicators. The following section gives a concise description of the methodologies underlying their calculation, and highlights their characteristics, comparing one with the other, and each of them with JIF. (For technical details about SJR and SNIP, the reader is referred to González-Pereira et al[11] and Moed[12].)

Two newly endorsed journal metrics

Elsevier partners with several expert bibliometric groups around the world to ensure that their approach and developments are valuable and accurate. The following metrics have been developed

for Elsevier by the SCImago Research Group and CWTS. The metrics are calculated by the bibliometric teams externally from Elsevier, using Scopus raw data supplied by Elsevier, and the values supplied are displayed in Scopus and other locations. Apart from customer demand, an important incentive for Elsevier to include journal metrics in Scopus is to stimulate more discussion on appropriate journal metrics and appropriate use amongst the people who use them in evaluations, and whose careers are affected by said evaluations.

SJR

One of the limitations of traditional citation analysis is that all citations are considered 'equal'. A citation from a widely-read, multidisciplinary journal counts as strongly as one from a more focused or local-interest source. SJR is a prestige metric inspired by Google's PageRank™, whereby a journal's subject field, quality and reputation have a direct effect upon the value of the citations it gives to other journals.

The basic idea is that when a journal A is cited, say, 100 times by the most highly ranked journals in the field, it receives more prestige than a journal B that also receives 100 citations, but from less prestigious periodicals with a low visibility at the international research front. SJR makes a distinction between journal *popularity* and journal *prestige*. One could say that journals A and B have the same popularity, but A has a larger *prestige* than B. A and B would have the same JIF, but A would have a higher SJR than B.

Generalizing, JIF can be considered as a measure of popularity, as it sums up all citations a journal receives, regardless of the status of the citing journals, whereas SJR measures prestige. The idea of recursion, or iterative calculation, is essential. Step by step, SJR weights citations in the current step according to the SJR of the citing journal in the previous step. Under certain conditions this process converges so that the SJR values do not change significantly any more with additional steps, and in the end a citation from a source with a relatively high SJR is worth more than a citation from a source with a relatively low SJR.

SJR also aims to limit excessive benefits derived from journal self-citation. When calculating SJR,

the SCImago Research Group discount journal self-citations once they exceed one-third of the total citations received by a journal. In this way, the value of journal self-citations is still recognized, but SJR attempts to limit what are often seen as manipulative citation practices.

SNIP

SNIP corrects for differences in *topicality* between subject fields. It is a ratio of a journal's citation impact and the degree of topicality of its subject field. SNIP's numerator gives a journal's raw impact per paper (RIP), which is very similar to the JIF. Its denominator is the *citation potential* in a journal's subject field, a measure of the citation characteristics of the field the journal sits in, determined by how often and how rapidly authors cite other works, and how well their field is covered by the database (in this case, Scopus).

Citation potential can be conceived as a measure of the field's *topicality*. Fields with a high topicality tend to attract many authors who share an intellectual interest, and in this sense can be qualified as 'popular'. Developments in the field go quickly. Papers are written in a limited number of highly visible periodicals, and authors tend to cite – apart from the common intellectual base – the most recent papers of their colleagues. These popular fields will tend to have higher JIFs.

A journal's subject field is defined as the collection of articles citing the journal. Citation potential is calculated for this set of citing articles. This 'tailor-made' subject field delimitation takes into account a journal's current focus, and is independent of pre-defined and possibly out-of-date field classifications. SNIP takes into account differences not only between, but also within journal subject categories.

Table 2 shows a typical example illustrating the SNIP methodology. The mathematical and the molecular biological journal have very different raw impacts per paper (1.5 versus 13.0), but the citation potential in the former journal's subject field is much smaller than for the latter (0.4 versus 3.2). Compensating for this difference by dividing RIP by citation potential, the SNIP values of the two journals are almost identical.

Journal	RIP	Citation potential	SNIP (2008)	SJR (2008)
Inventiones Mathematicae	1.5	0.4	3.8	0.075
Molecular Cell	13.0	3.2	4.0	6.073

Table 2. An illustrative example of the SNIP methodology

SJR and SNIP

In fields in which practitioners publish mainly in journals that are covered by the citation database they use, there is a high immediacy of citation, and a clear structure in terms of core journals and more peripheral ones. SJR tends to indicate a journal's membership of this core more clearly than SNIP does. On the other hand, in fields that are heterogeneous in terms of subject coverage and citation practices, and fields in which journals are not the dominant publication channels, SNIP tends to evaluate a journal's citation impact more in context than SJR does.

SJR, SNIP and JIF calculations give different ranges of values. In the analysis presented in Table 3, we have used RIP as a proxy for JIF, so that all journals in Scopus can be included in the information for each of these metrics, and not only for SJR and SNIP. For each indicator and main field, Table 3 gives the 10th, 25th (first or bottom quartile), 50th (median), 75th (third or top quartile) and 90th percentile of the distribution of indicator values among journals. Journals have been grouped into five main fields. Interesting observations from Table 3 are as follows:

- Overall, indicator values (for instance, their means or medians) tend to be highest for RIP, followed by SNIP; SJR tends to have the lowest values across all fields.

Main subject field	# journals	Mean	P10	P25	P50	P75	P90	Skew-ness	Std	Std/Mean
SJR										
Social Sciences	4,256	0.045	0.027	0.028	0.032	0.042	0.068	13.59	0.05	1.17
Engineering & Computer Science	2,175	0.070	0.028	0.031	0.040	0.062	0.108	12.07	0.15	2.12
Physical Sciences	2,784	0.098	0.029	0.033	0.047	0.090	0.192	12.82	0.21	2.15
Health Sciences	5,167	0.161	0.028	0.033	0.060	0.156	0.320	17.43	0.45	2.81
Life Sciences	3,214	0.305	0.030	0.040	0.097	0.274	0.628	8.97	0.81	2.66
SNIP										
Health Sciences	5,167	0.68	0.04	0.14	0.48	0.98	1.48	13.35	0.91	1.35
Social Sciences	4,256	0.84	0.08	0.24	0.59	1.15	1.87	2.95	0.88	1.06
Physical Sciences	2,784	0.9	0.12	0.31	0.69	1.22	1.76	7.21	1.03	1.14
Life Sciences	3,214	0.94	0.12	0.34	0.77	1.2	1.73	10.32	1.12	1.19
Engineering & Computer Science	2,175	1.3	0.13	0.34	0.82	1.66	2.84	3.82	1.6	1.23
RIP										
Social Sciences	4,256	0.74	0.03	0.12	0.42	1.03	1.82	4.01	0.98	1.32
Engineering & Computer Science	2,175	1.08	0.07	0.21	0.64	1.45	2.43	4.34	1.42	1.32
Physical Sciences	2,784	1.22	0.1	0.29	0.72	1.54	2.67	6.78	1.82	1.5
Health Sciences	5,167	1.32	0.04	0.17	0.75	1.81	3.04	11.65	2.16	1.64
Life Sciences	3,214	2.00	0.14	0.43	1.35	2.56	4.11	5.14	2.75	1.37

Table 3. Distribution of indicator values between journals per main field

Mean, P10, P25, P50, P75, P90, Skewness, Std, Std/Mean indicate the mean, 10th, 25th (first or bottom quartile), 50th (median), 75th (third or top quartile) and 90th percentiles, skewness, standard deviation, and the ratio of standard deviation and mean of the distribution of indicator values among journals in Scopus, respectively. For instance, the Table shows that 3,214 journals are allocated to the Scopus main field Life Sciences. The mean value of RIP (presented as a proxy for JIF that can be calculated for all journals in Scopus) of these 3,214 journals is 2.00. The 10th percentile (P10) is 0.14, meaning that 10 per cent of the 3,214 journals in this main field has value of RIP below 0.14. The median (Q2) is 1.35, meaning that 50 per cent of journals have an RIP value up to or below 1.35, and another 50 per cent above 1.35. For each indicator main fields are ordered by descending median (column P50).

Data relate to the citing year 2008, and to all journals in the Scopus source list created in April 2010 that satisfy the following three criteria: they are active; both SNIP and SJR values are available for the year 2008 at the website www.journalmetrics.com, hosted by and freely available from Elsevier; and they have published more than ten peer-reviewed papers (articles, reviews or conference papers in Scopus classification) during the time period 2005–2007. Detailed data on SJR are freely available at the SCImago website (www.scimagojr.com)[13]. Data on SNIP components (RIP, citation potential) were extracted from the freely available website www.journalindicators.com, hosted by the Centre for Science and Technology Studies at Leiden University, The Netherlands[14].

■ Focusing on skewness and especially the ratio of standard deviation and mean, SJR reveals the largest variability among journals in a main field, and SNIP the lowest. In other words, compared to RIP, SNIP tends to make differences between journals smaller, and SJR emphasizes the differences.

■ Differences between main fields are largest for RIP (range in median values across main fields is 0.42-1.35) and SJR (range is 0.032-0.097) and smallest for SNIP (range is 0.49-0.82).

■ Compared to other main fields, life sciences and health sciences tend to reveal the highest SJR and RIP values. But the highest SNIP values are in engineering & computer science and in social sciences, especially the scores related to the top of the distribution.

For the reader interested in more technical details about the indicators, we refer to Table 4 and its legend, presenting an overview of the main differences between SJR, SNIP and the 'classical' JCR journal impact factor.

Aspect	SJR	SNIP	JIF
Publication window	3 years	3 years	2 and 5 years
Citation window	1	1	1
Inclusion of journal self-citations	Percentage of journal self-citations limited to a maximum of 33%	Yes	Yes
Subject field normalization	Yes, prestige is distributed over all references, accounting for different citation frequencies between fields	Yes, relative to set of articles citing a journal, and based on the length of reference lists and database coverage	No
Subject field delimitation	Not needed by methodology, inherent within calculation	The collection of articles citing a particular target journal, independent of database categorization	No
Document types used in numerator	Peer reviewed only: articles, conference papers and reviews	Peer reviewed only: articles, conference papers and reviews	All
Document types used in denominator	Peer reviewed only: articles, conference papers and reviews	Peer reviewed only: articles, conference papers and reviews	'Source items' only: articles, conference papers and reviews
Status of citing source	Weights citations on the basis of the prestige (SJR) of the journal issuing them	No role	No role
Effect of including more reviews	Depends on the prestige (SJR) of the journals that cite the reviews	Reviews tend to be more cited than original research articles, so increasing the number of reviews tends to increase indicators' value	Reviews tend to be more cited than original research articles, so increasing the number of reviews tends to increase indicators' value
Underlying database	Scopus	Scopus	Web of Science/ Journal Citation Reports
Effect of increasing extent of database coverage	Database has a fixed prestige. Prestige is shared between more journals, and is also redistributed so that more prestige is represented in fields where the database coverage is more complete	No effect. SNIP corrects for differences in database coverage across subject fields	Overall increase JIF because more citations are present in database. JIF does not correct for differences in database coverage between subject fields

Table 4. Comparison of the three journal metrics discussed in this paper

The choice for a publication window in SNIP and SJR of three years rather than two or five is based on the observation that in many fields citations have not yet peaked after two years, and in other fields citations have peaked too long before five years. Application of a window of three years is the optimal compromise to give fields in which impact matures slowly to reach its maximum while not penalising fields in which impact matures rapidly[15]. SJR and SNIP are not affected by 'free' citations to documents that are categorized as 'uncitable' and that, even when they are cited, are not counted in the measurement of a journal's number of published articles (e.g., Moed, 2005). Eigenfactor[16], not included in Table 4, is a journal impact measure to some extent similar to SJR, but showing the following main differences: a) SJR is based on a publication window of three years against five years for Eigenfactor; b) SJR normalizes prestige by the total number of cited references in a journal, whereas Eigenfactor applies this normalization based on the number of cited references within the (five-year) publication window; c) SJR limits the percentage of journal self-citations to a maximum of 33 per cent (while Eigenfactor does not include journal self-citations at all;

Concluding remarks, and which metric should I use?

Tables 3 and 4 illustrate that the two indicators SJR and SNIP are to a certain extent complementary. Compared to the basic, JIF-like RIP, SJR tends to make the differences between journals larger, and enhances the position of the most prestigious journals, especially – though not exclusively – in life and health sciences. SNIP makes differences among journals smaller in all main fields, and is highest amongst journals in engineering & computer science.

In view of the heterogeneity of engineering & computer science and social sciences in terms of citation characteristics, citation potential and database coverage, for users interested in assessing journals in these fields, SNIP is probably more informative than SJR. On the other hand, if one considers that the heterogeneity in quality among journals due to Scopus' broad coverage heightens the need to account for the prestige of citing journals, SJR is more appropriate than SNIP.

If one considers that topicality is important in journal performance, in the sense that the best journals cover the most topical research themes, it is appropriate to focus on SJR rather than on SNIP. Moreover, if one considers that it is appropriate to weight citations on the basis of the status of the citing journal, SJR is a better indicator than SNIP. On the other hand, if one considers that journal impact and topicality or citation potential are two distinct concepts that should be measured and assessed separately, SNIP and its components, especially raw impact per paper and citation potential, are more informative.

The fact that Scopus introduced these two complementary measures reflects the notion that journal performance is a multi-dimensional concept, and that there is no single 'perfect' indicator of journal performance.

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