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Research Article

Journal Impact Factor Weighted by SJR and 5-Year If indicators of Citing Sources

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ABSTRACT

Introduction: The publication of numerous periodicals have led to the rapid growth of scientific information in recent periods. There emerged a need to evaluate the quality of those periodicals and to review their impact on other sectors for the purpose of the management of large-volume information. IF indicator of a journal is based on Web of Science (WoS) database and presented by Journal Citation Reports annually. Despite the broad use of Impact Factor (IF) in the assessment of scientific journals in last 60 years, it has been subject to critique. Among its limitations, the disregard of the prestige of a citing source and the consideration of the two-year period only are emphasized. The consideration of self citation in methodological aspects of index computation, the low comparability among resources and English as the primary language of publications create challenges in assessing the quality of citation. **Method:** Numerous researchers have proposed various approaches to the evaluation of scientific journals. Their reflections are comprised while considering the prestige of obtained citation. Modified versions of the IF have been suggested in recent years. The primary aim of those is to eliminate the limitations indicated by IF researchers. The most noteworthy among these limitations is that the indicator ignores the prestige of citing source. **Conclusion:** For this purpose, a weighted IF is proposed in the article which takes into consideration the prestige of a citing source. As a measure of the prestige of the source – the indicators of WoS and Scopus databases (5IF and SJR indicators) are selected. In the article comparison of proposed weighted IF with other indicators carried out on various metrics. Experiment results demonstraed that correlation between IF and weighted IF is not so high. It means that consideration of citing source prestige is important.

Keywords: Impact Factor, Weighted Impact Factor, SJR, SNIP, Journal prestige, Five Year Impact Factor.

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INTRODUCTION

The publication of numerous periodicals have led to the rapid growth of scientific information in recent periods. There emerged a need to evaluate the quality of those periodicals and to review their impact on other sectors for the purpose of the management of large-volume information. First article devoted to the consideration of citations was written in 1927[1] in order to evaluate the scientific journals. IF as the main indicator of scientific journals measuring the impact of citations on the article has been proposed by Eugene Garfield.[2] IF indicator of a journal is based on Web of Science (WoS) database and presented by Journal Citation Reports annually. Despite the broad use of IF in the assessment of scientific journals in last 60 years, it has been subject to critique. Among its limitations, the disregard of the prestige of a citing source and the consideration of the two-year period only are emphasized. It is because two-year period is considered as insufficient for measuring IF of journals in several fields. Hence, 5-year IF has been developed which considers the longer citation period later.[3]

The consideration of self citation in methodological aspects of index computation, the low comparability among resources and English as the primary language of publications create challenges in assessing the quality of citation. Numerous researchers have proposed various approaches to the evaluation of scientific journals. Their reflections are comprised while considering the prestige of obtained citation. Therefore, Eigenfactor Score indicator has been developed by researchers of the University of Washington in following periods. In 2004, SJR indicator has been developed based on PageRank algorithm on Scopus database by the SCImago Research Laboratory. SJR indicator is a quality indicator of journals included in Scopus database and carries out calculations considering 3 year period of references included in the database. SNIP indicatos was developed by Henk Meod based on Scopus database in 2010.[4-5]

The aforementioned allow to say that, the consideration of the prestige of a citing source in IF calculations is of great importance. A question can emerge in this case on how to determine the importance of a citing source and which indicator must be taken as primary. Considering that 5IF is a stability measure of importance and SJR indicator characterizes the prestige of a citation, this article calculates a weighted IF by using two main prestige indicators of WoS and Scopus databases.

MATERIALS AND METHODS

The evaluation of the quality of research bears importance for institutions and organizations, as well as scholars. Traditionally, journals have been ranked by expert evaluation (for example, Association of Business Schools). Notewithstanding this, new indicators considering various factors have been proposed, for example: IF, 5IF, SJR, Eigenfactor, h-index, etc.[6]

IF is calculated as a ratio of the number of citations to articles published in recent 2 years in current year to the number of articles published in those two years.[2,7-8]

$$\mathrm{IF}_j^t = \frac{\sum_{i=1}^{n_j^t} c_{ij}^t}{a_j^{t-1} + a_j^{t-2}} \tag{1}$$

Here, IF_j^t – denotes the IF of a *j* journal in *t* year, n_j^t – is the number of journals referring to *j* journal in *t* year; c_{ij}^t – denotes the number of references from *i* journal to *j* journal in *t* year, and a_j^t – is the number of articles published in t year.

Huang and Lin reckoned that, 2 year period is not sufficient for the IF calculation of a journal and it is more purposeful to develop indicators covering various citation periods for various fields. Another group of researchers emphasized that, IF covered the narrower time period due to the disconsideration of a particular period of time devoted to collecting citations in particular fields. Considering the critical points published in Thomsom Reuters, Leydersdorff, Zhou and Bornmann has mentioned that, 5IF indicator covering 5 years extended from 2 years is being developed.[3]

The Professor of the University of Washington Karl Bergsterm and his colleagues have developed Eigenfactor Score covering not only the number of citations of scientific journals, but also the prestige of a source and based on PageRank algorithm.[9]

It is also to be mentioned that all journals are not indexed in WoS and hence, researchers require other indicators for the evaluation of their quality. Scopus database covering larger scale journals has been established later and these journals used indicators such as SJR and SNIP. SJR indicator usable in very large networks was developed by SCImago Research Laboratory in 2004. This indicator not only considers the total number of citations, but also the prestige of those. SJR applies PageRank algorithm and is a metric alternative to IF.[10-11]

SNIP indicator compares articles (publications) of various scientific subject fields by considering the intensity of being cited in each scientific field. SNIP indicator is calculated as a ratio of citation corresponding to each paper (raw impact per paper, RIP) to the relative database citation potential (RDCP) indexed by a journal.[12-13]

RIP denotes the ratio of the number of citations to a journal published in the analyzed year to the total number of articles published in last 3 years. For instance, if 100 papers were published in one journal in 2008-2010 years and 200 references were made to these articles in 2011, then journal RIP is

$$= \frac{200}{100} = 2$$

It is to be noted that, RIP is similar to IF, however, the time period is taken not as 2, but 3 years.[14]

Comparison of WoS and Scopus databases indicators is illustrated in Table 1. As mentioned, citations play an important role for the evaluation of research. 2-year IF is considered as one of the most useful tools demonstrating the scientific prestige of a journal.[15-18] However, the weakness of IF is the equal weight assigned to citations obtained from various prestige journals. It is because the citations obtained from more prestige journal is more important than that obtained from less prestige journal.

In order extend the evaluation of the quality and importance of a journal, it is more purposeful to assign weights to citations obtained from a more prestige journal unlike citations obtained from a less prestigious journal. Considering the aforementioned, several researchers have proposed a weighted Impact Factor (WIF) covering not only the citation as such, but also the prestige of a citing journal. Despite the existence of accurate calculation tools of citations obtained from prestigious journals, Kochen[19] and Pinski and Narin have proposed another approach.[20] In the approach proposed by Pinski and Narin, weight coefficients for the normalization scheme and the evaluation of a weight of a particular journal are determined with the following formula:

$$W = \frac{\text{total number of citations to certain journal from other journals}}{\text{total number of references from that journal to other journals}} \tag{2}$$

At present, PageRank algorithm employed by Google™[21] for web-page ranking is also applied in the assignation of equal weighting to citations during weighted IF calculation. In order to determine PR algorithm of a web-page via iterative process, Google™ considers not only the number of citations made to a page from other pages, but also the degree of importance of citations made to that page.

Y-factor index proposed by Bollen, Rodriguez, and Sompel[22] for weight calculation has been developed as a result of a merge of an IF value of a journal and PR algorithm. Y-factor index is determined as a product of IF value of a particular journal and PR value.

$$Y = F \times R \tag{3}$$

Later, IF considering the prestige of a citation has been proposed by Buela-Casal,[23] Habibzadeh and Yadollahie,[24] Waltman and Eck,[25] Zitt and Small,[26] Zyczkowski,[27] Zitt.[28] As noted, this approach encountered in scientific literature has been officially proposed in writings by Pinksi and Narin.[20]

Among those, WIF proposed by Habibzadeh and Yadollahie (H and Y)[24] in 2008 can be shown.

$$\mathrm{WIF}_j^t = \frac{\sum_{i=1}^{n_j^t} w_{ij}^t \times c_{ij}^t}{a_j^{t-1} + a_j^{t-2}} \tag{4}$$

Here, w_{ij}^t denotes the weight of the journal i to the relative journal j in year t:

$$w_{ij}^t = 10 \times \frac{1 - 0.828 \times e^{-q_{ij}^t}}{1 + 16.183 \times e^{-q_{ij}^t}} \tag{5}$$

Here, q_{ij}^t is a ratio of IF of a citing journal to IF value of a cited journal and calculated as following:

$$q_{ij}^t = \frac{\mathrm{IF}_t^{t-1}}{\mathrm{IF}_j^{t-1}} \tag{6}$$

The weakness of WIF proposed by H and Y is that q coefficient of a citation obtained by a prestigious journal is smaller than the coefficient of a citation obtained from a less prestige journal. If the IF value of a citing journal in WIF is equal to the IF value of a cited journal, then the weight is equal to 1, if the IF of a citing journal is larger than the IF of a cited journal the weight is greater than 1 and vice versa, if the prestige of a citing journal is lower than than of a cited journal, then the weight is denoted as less than 1.

For instance, assume that a journal with $F_i = 4$ is given and this journal has been cited in two journals with different IF values as $F_{j1} = 1$, $F_{j2} = 2$. In this case, according to results obtained from (5) formula, q_{ij}^t coefficient of first journal will be smaller than that of second journal ($w_{ij1} > w_{ij2}$). It can be concluded that, the weight of a citing journal with smaller IF will be greater than that with larger IF.

Alguliyev, Aliguliyev and Ismayilova[8] proposed the following version of the JCR IF.

$$\mathrm{W5IF}_j^t = \frac{\sum_{i=1}^{n_j^t} (5\mathrm{IF}_i^{t-1} + 1) c_{ij}^t}{a_j^{t-1} + a_j^{t-2}} \tag{7}$$

where n_j^t – denotes the number of journals citing j journal in t year; c_{ij}^t is the number of references from i journal to j journal in t year, a_j^t denotes the number of articles published in the year t, and $5\mathrm{IF}_j^t$ – denotes 5-year IF of the journal i in the year t.

In,[29] linearly and non-linearly penalized impact factors by self-citations, encouraged impact factor, considering distribution scale of citing sources are proposed.

Impact factor linearly penalized by self-citations is defined as follows:

$$\mathrm{LPIF}_j^t = \frac{\beta_1 \times sc_j^t + \beta_2 \times (c_j^t - sc_j^t)}{a_j^{t-1} + a_j^{t-2}} \tag{8}$$

where β_1 and β_1 are the rate coefficients of self-citations and non-self-citations which $0 < \beta_1 \le \beta_2 < 1$ and $\beta_1 + \beta_2 = 1$, where $\beta_1 = \frac{1}{3}$ and $\beta_2 = \frac{2}{3}$.

c_j^t is the total number of citations received by journal j in the year t, c_j^t denotes the number of self-citations of journal j in the year t, $a_j^{t-1} + a_j^{t-2}$ is the total number of articles published in journal j in the two previous years $t - 1$ and $t - 2$.

Impact factor non-linearly penalized by self-citations is defined as follows:

$$\mathrm{nLPIF}_j^t = \mathrm{IF}_j^t \times \log\left(\frac{c_j^t}{sc_j^t}\right) \tag{9}$$

Impact factor encouraged by the number of citing sources takes into consideration an influence sphere of the journal:

$$\mathrm{EIF}_j^t = \frac{N_j^t}{N^t} \times \mathrm{IF}_j^t \tag{10}$$

where n^t is the number of journals registered in JCR in the year t, n_j^t is the number of journals citing the journal j in the year t.

In[30] a network scientometric approach is proposed for the identification of contextual productivity. In this work, for the assessment of contextual productivity of authors and journals, weighted 2 mode networks indices are analyzed and these indices can be used for gathering insights about most productive authors and journals by online databases and digital libraries.

In[31] research IF uses mathematical and statistical methods to analyze scientific publications and IF is a fundamental and universal measure of the journal's value. Authors intend to publish their works in prestigious journals but journals' editors intend to publish contributions that will be cited. In generally, compare with other tools for the evaluations of journals exist, the IF last 50 years has a strong prestige.

In[32] is showed presented that journal IF is able to discriminate between researchers who published their paper not only in the short term, but also in a long term.

In[33] are described general over view and approaches the Highly Cited Researchers by Clarivate Analytics. In paper JIF is proposed for assessment of "quality" of a researcher, their work, or a journal, and contributes to a great extent to driving scientific activities towards a futile endeavor.

Vincent Larivière and Cassidy R. Sugimoto research on a brief history, critique, and discussion of adverse effects of the JIF.[34]

In[35] research are discussed results on the use of the journal impact factor for assessing the research contributions of individual authors. "Minimum performance standards" include "number of authors on a paper", "difference in citation density in various fields and subfields", "citations differ in importance". Imperfections and limitations of citation-based indicators make it difficult to gauge the differences in performance among highly productive authors. In research noted that, using a set of bibliometric indices (total citation number, Hirsh index, JIFs) and peers' reviews are preferable for analysis of individual performance.

Proposed Version of Impact Factor

This section employs the indicators of two different WoS and Scopus databases in order to review the impact of the prestige of obtained citation on its IF. Hence, 5IF and SJR indicators are taken together as a measure of the prestige of a citation and weighted IF (IF^{α}) is determined by Eq.(11):

$$\mathrm{IF}_j^{\alpha} = \mathrm{IF}_j^{\alpha}(5\,\mathrm{IF}, SJR) = \frac{\sum_{i=1}^{n_j^t}\left(1+\alpha\times 5\mathrm{IF}_i + (1-\alpha)\times SJR_i\right)c_{ij}}{a_j^{t-1}+a_j^{t-2}} \quad (11)$$

Where α $(0 \le \alpha \le 1)$ is a weight coefficient, SJR_i is SJR indicator of a citing journal, respectively.

Unlike other weighted IFs (4, 7), in the proposed version, indicators of two various databases (WoS and Scopus) such as 5IF and SJR are used for the consideration of citing source prestige. For these indicators control their weighted linear combination are taken. Here you can control the effect of SJR and 5IF on the final IF^{α} indicator by changing $\alpha \in [0;1]$ parameter. If $\alpha = 0$, then the prestige of the citing source will only be determined by the SJR indicator. If $\alpha = 1$, then the 5IF indicator will be included as the prestige of the citing source. If $\alpha = 0.5$, then both indicators will be equally attributed, as the prestige of the citing source.

If, 5IF and SJR indicators equal 0 for any source, 5IF=SJR=0. In this case, if formula (11) did not have the first term (i.e. 1) under the sign of sum, then citations from this source(s) would not be taken into account in weighted calculation. Considering this case in formula (11), 1 was added to the expression. Thus, as the value of α increases from 0 to 1, in formula (11) the effect of the 5IF indicator will increase, and the effect of the SJR indicator will be decrease.

Data collection

In order to evaluate the weighted IF^{α} indicator, journals in computer science field indexed in WoS and Scopus databases in 2013 is selected. In Table 2, 5IF and SJR values of citing journals in 2013 are presented in Table 3.

In order to evaluate the proposed version IF^{α} we have selected 20 journals in the Computer Science field indexed in JCR 2013. The proposed indicator has been calculated for these journals and compared with their 5-year IF, SJR, SNIP indicators and with the indicator W5IF proposed in.[8] Table 2 gives a list of the random selected journals analyzed in this study and their bibliometric characteristics, i.e. number of articles published in 2011-2012 and number of citations in 2013.

RESULTS

Table 4 presents the results of the proposed weighted by IF^{α} taking 5IF and SJR indicators together as a measure of prestige of a citing source.

ANALYSIS

In order to compare the results obtained by IF^{α} indicator with the results of IF, W5IF, SJR and SNIP indicators, we have used Pearson correlation, cosine measure and Euclidean distance.

The cosine dissimilarity measure between the vectors $A = (a_1, a_2, \ldots, a_n)$ and $B = (b_1, b_2, \ldots b_n)$ can be calculated as follows:

$$1-\cos(A, B) = \mathrm{diss}_{\cos}(A, B) \quad (12)$$

where cos(A,B) is the cosine similarity measure between the vectors A and B:

$$\cos(A,B) = \frac{\sum_{i=1}^{n} a_i b_i}{\sqrt{\sum_{i=1}^{n} a_i^2}\sqrt{\sum_{i=1}^{n} b_i^2}} \quad (13)$$

The Euclidean distance between A and B vectors can be calculated by the following formula:

Table 1: Comparison of WoS and Scopus databases indicators.

Database	Web of Science		Scopus	
	IF	5IF	SJR	SNIP
Cıtation period	1 year	1 year	3 years	3 years
Citation window	2 preceding years	5 preceding years	3 preceding years	3 preceding years
Journals providing citations	Only cited journals		All	
Weight of citations	Equal	Equal	Depending on the prestige of the citing journal	Not important
Self citation	Included		Not included	Included
Cited articles	Only cited (article and review)		All	

Table 2: Indicators of random selected journals in WoS and Scopus databases.

№	Title of Journal	Number of articles published in 2011-2012	Number citations to articles published in 2011-2012 in 2013
1	Neural Computation	226	383
2	Swarm Intelligence	26	48
3	Neural Processing Letters	76	94
4	Artificial Life	48	93
5	Cognitive Computation	88	97
6	Computer Speech And Language	67	121
7	Fuzzy Optimization and Decision Making	45	67
8	Genetic Programming and Evolvable Machines	42	45
9	International Journal of Applied Mathematics and Computer Science	136	189
10	Journal of Ambient Intelligence and Smart Environments	74	80
11	ACM Transactions on Applied Perception	40	42
12	ACM Transactions on Knowledge Discovery from Data	37	42
13	ACM Transactions on Information Systems	42	55
14	ACM Transactions on the Web	39	62
15	ACM Transactions on Sensor Networks	54	79
16	ACM Transactions on Software Engineering and Methodology	37	54
17	IEEE Transactions on Computational Intelligence and AI in Games	50	58
18	IEEE Transactions on Dependable and Secure Computing	143	163
19	IEEE Transactions on Autonomous Mental Development	54	73
20	World Wide Web: Internet and Web Information Systems	58	94

$$dist(A,B) = \sqrt{\sum_{i=1}^{n}(a_i - b_i)^2} \qquad (14)$$

The results of Pearson correlation between F^α and other indicators are given in Table 5.

As seen from Table 5, the correlation between the IF^α and IF is not strong and as the value of α incrases in [0;1] interval, in other words, as the weight of SJR in weighed IF^α increases, the correlation weakens. The most noteworthy feature is that, IF^α is more poorly correlated with 5IF [0.2837; 0.6139] than with IF [0.5937; 0.6139]. That is, as the value of α increases, the correlation becomes weaker due to the fact that, the proposed IF^α considers the impact of SJR indicator. Among these indicators, IF^α is the most weakly correlated with SNIP indicator. Same case is also observed between IF and SNIP (– 0.0704). However, the correlation between IF^α and SNIP [–0.3273; –0.2093] is lower in than the correlation between IF and SNIP (– 0.0704).

The results of **cosine dissimilarity** between the weighed IF^α and other indicators is given in Table 6.

As seen from Table 6, the results of the IF^α and IF are more similar [0.0306; 0.0517] than the results of 5IF, W5IF, SJR and SNIP. As the value of α increases, in order words, as the weight of SJR in weighted IF^α proposed becomes larger, the similarity increases. The results of IF^α and 5IF [0.0863; 0.1076] are more similar rather than IF^α and IF results [0.0306; 0.0517]. As the value of α of IF^α increases, the similarity of W5IF results

Table 3: 5-year impact factor and SJR of citing journals and number of citations from them.

№	Journal 1 Neural Computation															Journal 2 Swarm Intelligence		
	5IF	SJR	Num. of cit.	№	5IF	SJR	Num. of cit.	№	5IF	SJR	Num. of cit.	№	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.
1	35.890	14.46	1	29.	4.049	1.508	7	57.	2.610	1.124	20	85.	1.572	0.563	1	6.226	3.242	1
2	34.360	27.85	1	30.	4.017	2.128	1	58.	2.567	1.128	1	86.	1.550	0.633	1	5.165	1.810	2
3	31.020	19.58	3	31.	3.879	2.63	1	59.	2.526	1.869	1	87.	1.529	1.037	2	3.448	2.234	1
4	23.170	0.923	1	32.	3.879	2.336	1	60.	2.525	1.178	1	88.	1.402	0.557	1	3.405	1.685	1
5	16.410	11.79	1	33.	3.844	1.473	1	61.	2.501	0.977	10	89.	1.402	2.240	1	3.097	1.178	2
6	16.400	12.68	4	34.	3.710	2.597	1	62.	2.496	1.048	1	90.	1.386	0.557	2	2.747	1.888	1
7	14.560	5.119	1	35.	3.707	1.527	1	63.	2.484	1.203	2	91.	1.338	0.472	1	1.957	0.832	1
8	14.460	10.05	1	36.	3.676	2.764	1	64.	2.384	0.88	31	92.	1.336	1.528	1	1.615	1.019	1
9	13.440	7.721	1	37.	3.668	1.257	2	65.	2.339	1.535	1	93.	1.319	2.004	1	1.545	0.536	2
10	11.340	6.318	3	38.	3.646	1.21	1	66.	2.307	1.289	3	94.	1.314	1.711	1	1.364	1.056	1
11	10.580	6.967	9	39.	3.632	2.853	9	67.	2.287	0.95	3	95.	1.305	1.108	1	0.953	0.333	2
12	10.440	4.835	1	40.	3.612	2.598	2	68.	2.270	0.808	1	96.	1.231	0.533	1			
13	9.924	5.586	2	41.	3.607	2.621	8	69.	2.158	1.323	1	97.	1.216	0.290	1			
14	7.869	2.63	10	42.	3.568	1.444	1	70.	2.143	1.632	2	98.	1.192	1.136	1			
15	7.463	5.316	2	43.	3.291	2.341	1	71.	2.000	0.8	1	99.	1.183	0.563	1			
16	7.063	4.374	4	44.	3.219	1.777	1	72.	1.947	1.254	1	100.	1.182	0.832	1			
17	6.895	2.141	3	45.	3.146	1.94	1	73.	1.938	1.075	3	101.	1.140	0.732	3			
18	6.144	7.212	5	46.	3.108	2.033	1	74.	1.922	0.279	3	102.	1.074	0.470	1			
19	6.000	2.998	1	47.	3.069	3.865	1	75.	1.871	0.841	1	103.	1.032	1.056	1			
20	5.939	3.272	14	48.	3.068	3.297	3	76.	1.811	1.007	8	104.	0.970	0.594	1			
21	5.484	3.346	1	49.	3.050	1.355	1	77.	1.767	0.822	1	105.	0.840	0.405	1			
22	4.885	4.27	1	50.	2.998	1.283	3	78.	1.745	1.205	1	106.	0.816	0.478	1			
23	4.544	2.126	1	51.	2.927	1.829	2	79.	1.732	0.632	1	107.	0.697	0.949	1			
24	4.479	1.856	4	52.	2.895	1.706	1	80.	1.724	0.969	1	108.	0.672	0.422	2			
25	4.422	1.472	1	53.	2.892	1.554	4	81.	1.643	1.293	1	109.	0.600	0.436	1			
26	4.284	1.874	5	54.	2.743	1.525	1	82.	1.600	0.483	1	110.	0.548	0.394	1			
27	4.250	2.049	1	55.	2.733	1.196	1	83.	1.596	0.716	1	111.	0.297	0.000	1			
28	4.244	1.722	11	56.	2.653	1.407	2	84.	1.595	1.167	1	112.	0.187	0.246	2			

№	Journal 3 Neural Processing Letters							Journal 4 Artificial Life			Journal 5 Cognitive Computation			Journal 6 Computer Speech and Language			Journal 7 Fuzzy Optimization and Decision Making		
	5IF	SJR	Num. of cit.	№	5IF	SJR	Num. of cit.	17.710	10.49	1	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.
1	7.854	3.422	1	34.	0.640	0.355	1	13.560	5.736	1	9.924	5.586	1	7.694	2.094	2	3.676	2.764	3
2	4.268	2.161	1	35.	0.622	0.731	1	7.510	2.819	1	7.869	5.682	1	2.643	1.676	1	2.218	1.701	2
3	3.676	2.764	1	36.	0.561	0.648	1	7.435	5.703	1	7.298	3.727	1	2.395	0.649	2	2.167	1.497	1
4	3.632	2.853	2	37.	0.497	0.241	1	6.690	0.989	1	4.479	1.856	1	2.339	1.535	2	2.165	1.573	1
5	3.513	1.641	1	38.	0.497	0.339	1	6.226	3.242	1	4.372	2.427	1	1.952	1.534	2	1.814	1.465	15
6	3.219	1.777	1					5.165	1.810	2	4.244	1.722	3	1.936	1.078	1	1.721	0.725	1
7	2.501	0.977	2					4.728	1.727	1	4.017	2.128	1	1.915	0.758	2	1.674	1.160	2
8	2.457	1.200	3					4.446	1.501	1	3.674	1.828	1	1.708	1.537	1	1.579	1.314	2
9	2.384	0.880	2					4.406	1.899	1	3.598	1.376	1	1.520	0.844	8	1.386	0.557	1
10	2.339	1.535	1					4.244	1.722	7	3.262	2.381	1	1.423	1.014	5	1.364	1.056	4
11	2.143	1.632	1					2.496	1.048	1	2.998	1.283	2	1.410	1.140	1	1.183	0.563	2
12	1.831	0.662	1					2.333	0.705	1	2.847	1.040	1	1.146	0.207	1	0.846	0.358	2
13	1.811	1.007	8					2.307	1.289	1	2.538	0.998	1	1.137	0.587	4	0.746	0.557	1
14	1.710	0.121	1					2.000	0.794	1	2.525	1.178	1	1.074	0.470	2	0.612	0.403	1
15	1.529	1.037	1					1.945	0.666	1	2.501	0.977	3	0.977	0.298	1	0.269	0.000	16
16	1.454	1.195	2					1.777	1.066	1	2.445	1.449	1	0.959	0.614	1			
17	1.420	0.531	1					1.545	0.508	1	2.339	1.535	1	0.932	0.438	1			
18	1.360	0.996	1					1.454	1.195	1	2.194	1.402	1	0.767	0.260	1			
19	1.329	0.625	1					1.364	0.441	1	2.158	1.323	1	0.664	0.303	1			
20	1.231	0.533	10					1.336	0.664	1	1.938	1.075	2	0.617	0.822	1			
21	1.216	0.290	1					0.953	0.333	2	1.936	1.078	1	0.505	0.490	1			
22	1.183	0.563	2					0.816	0.478	1	1.811	1.077	2	0.466	0.215	1			
23	1.074	0.470	5					0.617	0.822	1	1.745	1.205	1	0.305	0.336	1			
24	1.074	0.682	1					0.480	0.353	1	1.596	0.680	1						
25	1.040	0.515	3					0.417	0.247	1	1.529	1.037	2						
26	0.898	0.509	1								1.520	0.844	1						
27	0.866	0.391	1								1.423	0.519	1						
28	0.840	0.405	2								1.157	0.460	2						
29	0.774	0.564	5								1.137	0.587	14						
30	0.755	0.324	1								0.846	0.273	1						
31	0.753	0.559	1								0.735	0.346	1						
32	0.716	0.627	1								0.592	0.650	1						
33	0.682	0.254	5								0.326	0.282	1						

№	Journal 8 Genetic Programming and Evolvable Machines			Journal 9 International Journal of Applied Mathematics and Computer Science							Journal 10 Journal of Ambient Intelligence and Smart Environments			Journal 11 ACM Transactions on Applied Perception			Journal 12 ACM Transactions on Knowledge Discovery from Data			Journal 13 ACM Transactions on Information Systems		
	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.	№	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.
1	3.676	2.764	1	4.244	1.722	1	24.	1.216	0.290	3	3.382	2.035	1	6.144	7.212	1	4.395	3.705	1	3.676	2.764	1
2	3.027	5.082	1	3.676	2.764	1	25.	1.201	0.772	2	2.700	1.512	1	4.283	2.912	2	4.244	1.722	1	3.371	1.996	3
3	2.526	1.869	1	3.601	3.715	1	26.	1.183	0.563	2	2.632	1.516	1	4.017	2.128	1	4.017	2.128	1	3.037	1.844	2
4	2.501	0.977	1	3.212	1.545	1	27.	1.182	0.832	1	2.525	1.178	1	2.620	2.096	1	3.959	2.586	1	2.566	1.905	1
5	1.938	1.075	1	2.640	1.287	2	28	1.158	0.524	1	2.339	1.535	1	2.610	1.124	1	3.676	2.764	3	2.446	1.672	1
6	1.811	1.007	1	2.620	2.096	1	29.	1.146	0.756	52	2.003	0.998	1	2.566	1.010	1	3.371	1.996	1	2.339	1.535	2
7	1.795	1.743	1	2.457	1.200	1	30.	1.024	0.321	1	1.947	1.254	1	2.445	1.449	2	3.263	1.571	1	1.745	1.205	1
8	1.726	0.810	2	2.382	2.837	1	31.	0.932	0.438	1	1.811	1.007	2	2.395	0.649	1	3.068	3.297	1	1.716	3.637	3
9	1.625	0.875	1	2.255	0.000	1	32.	0.898	0.509	2	1.640	0.583	16	2.292	1.306	1	2.426	1.858	1	1.586	0.427	1
10	1.390	0.882	1	2.151	2.286	1	33.	0.829	0.587	1	1.529	1.037	1	2.007	0.000	1	2.339	1.535	3	1.318	2.637	1
11	1.349	0.604	1	2.040	1.545	4	34.	0.800	0.316	1	1.169	0.951	1	2.000	0.000	1	1.838	1.836	1	1.109	0.706	2
12	1.282	1.221	8	1.758	0.733	1	35.	0.800	0.999	3				1.905	1.413	1	1.811	1.007	1	0.466	0.215	1
13	1.231	0.533	1	1.674	1.160	1	36.	0.671	0.637	1				1.360	0.0321	2	1.359	0.622	2			
14				1.651	0.691	1	37.	0.610	0.000	1				1.269	0.663	5	0.739	0.740	1			
15				1.625	0.875	1	38.	0.594	0.510	3				1.216	0.290	1	0.707	0.323	1			
16				1.529	1.037	2	39.	0.548	0.394	1				1.112	0.559	1						
17				1.504	0.832	1	40.	0.483	0.422	1				0.675	0.360	1						
18				1.454	0.503	1	41.	0.436	0.378	1				0.500	0.302	1						
19				1.368	1.340	2	42.	0.410	0.236	1				0.453	0.301	1						
20				1.364	1.181	1	43.	0.395	0.277	1												
21				1.364	1.056	1	44.	0.370	0.290	1												
22				1.359	0.622	1	45.	0.269	0.000	1												
23				1.289	1.350	2																

№	Journal 14 ACM Transactions on the Web			Journal 15 ACM Transactions on Sensor Networks			Journal 16 ACM Transactions on Software Engineering and Methodology			Journal 17 IEEE Transactions on Computational Intelligence and AI in Games			Journal 18 IEEE Transactions on Dependable and Secure Computing						
	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.	№	5IF	SJR	Num. of cit.
1	7.854	3.422	2	6.348	3.897	2	3.612	2.598	1	3.212	1.545	1	6.895	2.141	1		1.106	1.609	1
2	4.395	3.705	1	6.146	2.712	1	3.371	1.8	1	3.071	2.449	1	3.676	2.764	4		1.093	0.761	3
3	3.676	2.764	2	3.587	3.548	2	2.063	1.304	3	2.339	1.535	2	3.371	1.996	2		1.019	0.628	1
4	3.371	1.996	1	3.371	1.996	1	2.031	1.344	2	1.936	1.078	1	3.191	2.844	1		0.954	0.577	2
5	3.037	1.844	2	2.747	1.888	1	1.756	1.298	1	1.625	0.875	11	3.071	2.449	3		0.945	0.163	1
6	2.927	1.829	1	2.485	1.002	2	1.692	1.129	2	1.282	1.221	1	2.744	3.081	1		0.874	0.324	1
7	2.446	1.672	5	2.395	0.649	1	1.322	0.863	1	0.954	0.577	1	2.426	1.858	1		0.867	0.362	2
8	2.424	0.000	2	2.203	1.714	1	1.167	1.154	4	0.832	0.424	1	2.339	1.535	2		0.819	0.348	1
9	2.339	1.535	3	1.957	0.832	1	0.867	0.362	1	0.723	0.261	3	2.259	1.532	4		0.793	0.408	1
10	2.158	1.323	3	1.859	1.443	1	0.819	0.348	1				2.067	1.444	1		0.712	0.569	1
11	2.033	1.255	1	1.758	0.733	2	0.785	0.564	1				2.021	1.585	1		0.701	0.133	1
12	1.469	1.863	1	1.227	0.681	1	0.727	0.769	1				1.894	1.371	1		0.697	0.330	1
13	1.452	0.846	1	1.183	0.563	4	0.721	0.685	1				1.726	0.810	10		0.697	0.949	2
14	1.388	0.806	2	1.169	0.951	1	0.682	0.396	2				1.576	0.918	2		0.625	0.454	2
15	1.384	1.102	1	1.092	0.763	1	0.43	0.249	1				1.420	0.799	1		0.606	0.750	1
16	1.322	0.863	2	1.002	0.569	1	0.336	0.288	2				1.390	0.882	1		0.605	0.231	1
17	1.109	0.706	1	0.765	0.385	1	0.269	0	1				1.341	1.645	1		0.497	0.339	2
18	0.943	0.427	2	0.605	0.231	1	0.268	0.215	1				1.322	0.863	2		0.463	0.263	2
19	0.785	0.564	1	0.43	0.249	5							1.317	0.889	1		0.43	0.249	3
20	0.765	0.385	1										1.291	0.749	1		0.395	0.277	2
21	0.605	0.231	1										1.234	1.123	1		0.297	0.000	1
22													1.227	0.681	1		0.187	0.246	1

№	Journal 19 IEEE Transactions on Autonomous Mental Development							Journal 20 World Wide Web: Internet and Web Information Systems						
	5IF	SJR	Num. of cit.	№	5IF	SJR	Num. of cit.	5IF	SJR	Num. of cit.	№	5IF	SJR	Num. of cit.
1	4.244	1.722	4	11	1.423	0.519	1	3.676	2.764	1	11.	1.586	0.427	1
2	3.587	3.548	1	12	1.137	0.587	1	3.219	1.777	2	12.	1.452	0.846	23
3	2.501	0.977	4	13	1.043	0.080	1	3.191	2.844	1	13.	1.251	0.938	1
4	2.258	1.000	17	14	0.898	0.509	1	2.446	1.672	1	14.	1.169	0.951	1
5	2.202	1.522	1	15	0.817	0.408	1	2.426	1.858	1	15.	0.940	0.366	1
6	1.947	1.254	1	16	0.675	0.360	1	2.403	0.000	1	16.	0.332	0.194	1
7	1.859	1.443	1	17	0.567	0.291	1	2.339	1.535	2	17.	0.302	0.249	1
8	1.615	1.019	3					2.031	1.344	1	18.	0.174	0.276	1
9	1.545	0.536	2					1.955	0.000	1				
10	1.529	1.037	1					1.838	1.547	1				

Table 4: Results of the proposed weighted IF.

№	Title of Journal	IF 2013	5IF 2013	W5IF 2013	SJR 2013	SNIP 2013	IF^{α}										
							α = 0	α = 0.1	α = 0.2	α = 0.3	α = 0.4	α = 0.5	α = 0.6	α = 0.7	α = 0.8	α = 0.9	α = 1
1	Neural Computation	1.694	2.221	7.544	0.88	1.097	4.9497	5.2091	5.4685	5.7279	5.9873	6.2467	6.5061	6.7655	7.0248	7.2842	7.5436
2	Swarm Intelligence	1.833	0	3.472	0.757	1.695	2.6027	2.6897	2.7766	2.8636	2.9506	3.0375	3.1245	3.2115	3.2984	3.3854	3.4724
3	Neural Processing Letters	1.237	1.328	2.805	0.533	1.545	2.0700	2.1435	2.2171	2.2906	2.3642	2.4377	2.5112	2.5848	2.6583	2.7319	2.8054
4	Artificial Life	1.93	1.8	4.762	0.508	1.174	3.2025	3.3584	3.5143	3.6702	3.8261	3.9820	4.1379	4.2938	4.4497	4.6056	4.7615
5	Cognitive Computation	1.1	1.394	2.594	0.587	1.138	1.8747	1.9466	2.0186	2.0905	2.1624	2.2344	2.3063	2.3782	2.4502	2.5221	2.5941
6	Computer Speech And Language	1.812	1.776	2.904	1.014	3.227	2.3681	2.4217	2.4754	2.5290	2.5826	2.6363	2.6899	2.7435	2.7972	2.8508	2.9044
7	Fuzzy Optimization and Decision Making	1	2.055	3.151	1.465	2.555	2.6666	2.7150	2.7634	2.8119	2.8603	2.9088	2.9572	3.0057	3.0541	3.1026	3.1510
8	Genetic Programming and Evolvable Machines	1.065	1.4	2.014	1.221	3.568	1.8129	1.8331	1.8532	1.8734	1.8935	1.9137	1.9339	1.9540	1.9742	1.9943	2.0145
9	International Journal of Applied Mathematics and Computer Science	1.39	1.317	2.465	0.756	1.71	2.0961	2.1330	2.1700	2.2069	2.2438	2.2807	2.3176	2.3545	2.3914	2.4283	2.4652
10	Journal of Ambient Intelligence and Smart Environments	1.082	1.252	1.758	0.583	1.63	1.3967	1.4329	1.4690	1.5051	1.5412	1.5773	1.6135	1.6496	1.6857	1.7218	1.7579
11	ACM Transactions on Applied Perception	1.051	1.566	2.247	0.663	2.024	1.6160	1.6791	1.7422	1.8054	1.8685	1.9316	1.9947	2.0579	2.1210	2.1841	2.2472
12	ACM Transactions on Knowledge Discovery from Data	1.147	0	2.61	1.104	3.343	2.1327	2.1805	2.2283	2.2761	2.3240	2.3718	2.4196	2.4674	2.5152	2.5630	2.6108
13	ACM Transactions on Information Systems	1.3	1.67	2.31	0.836	3.261	2.1641	2.1788	2.1934	2.2080	2.2226	2.2372	2.2519	2.2665	2.2811	2.2957	2.3103
14	ACM Transactions on the Web	1.595	1.966	3.828	1.672	4.976	2.9146	3.0059	3.0973	3.1887	3.2801	3.3714	3.4628	3.5542	3.6456	3.7369	3.8283
15	ACM Transactions on Sensor Networks	1.463	2.754	2.607	1.002	3.193	2.1421	2.1885	2.2350	2.2815	2.3280	2.3745	2.4210	2.4675	2.5140	2.5605	2.6070
16	ACM Transactions on Software Engineering and Methodology	1.472	1.694	2.413	1.304	3.971	2.1241	2.1530	2.1819	2.2108	2.2397	2.2686	2.2975	2.3264	2.3553	2.3842	2.4131
17	IEEE Transactions on Computational Intelligence and AI in Games	1.167	1.274	1.88	0.875	2.733	1.5754	1.6059	1.6364	1.6669	1.6973	1.7278	1.7583	1.7888	1.8192	1.8497	1.8802
18	IEEE Transactions on Dependable and Secure Computing	1.137	1.276	1.985	0.918	3.174	1.6962	1.7251	1.7539	1.7828	1.8116	1.8405	1.8693	1.8982	1.9270	1.9559	1.9847
19	IEEE Transactions on Autonomous Mental Development	1.348	1.875	3.037	1	2.586	2.1571	2.2451	2.3330	2.4210	2.5090	2.5969	2.6849	2.7729	2.8608	2.9488	3.0368
20	World Wide Web	1.623	1.36	2.832	0.846	2.427	2.3364	2.3859	2.4354	2.4850	2.5345	2.5840	2.6335	2.6830	2.7326	2.7821	2.8316

Table 5: Pearson correlations between each pair of journal indicators.

	5IF	W5IF	SJR	SNIP	IF^{α}										
					α = 0	α = 0.1	α = 0.2	α = 0.3	α = 0.4	α = 0.5	α = 0.6	α = 0.7	α = 0.8	α = 0.9	α = 1
IF	0.1046	0.5937	-0.0489	−0.0704	0.6139	0.6123	0.6104	0.6083	0.6062	0.6040	0.6018	0.5997	0.5976	0.5956	0.5937
5IF		0.2838	0.2325	0.1233	0.3019	0.2998	0.2977	0.2957	0.2937	0.2918	0.2900	0.2883	0.2867	0.2851	0.2837
W5IF			0.0166	−0.3274	0.9803	0.9860	0.9902	0.9933	0.9956	0.9972	0.9984	0.9992	0.9997	0.9999	1.0000
SJR				0.8209	0.1451	0.1252	0.1075	0.0918	0.0776	0.0649	0.0534	0.0429	0.0334	0.0246	0.0166
SNIP					−0.2093	−0.2284	−0.2452	−0.2599	−0.2729	−0.2845	−0.2949	−0.3043	−0.3127	−0.3204	−0.3273

Table 6: Cosine dissimilarity measure between all pair of indicators.

	5IF	W5IF	SJR	SNIP	IF^{α}										
					α = 0	α = 0.1	α = 0.2	α = 0.3	α = 0.4	α = 0.5	α = 0.6	α = 0.7	α = 0.8	α = 0.9	α = 1
IF	0.0876	0.0517	0.0724	0.0965	0.0306	0.0326	0.0347	0.0369	0.0390	0.0412	0.0433	0.0455	0.0476	0.0497	0.0517
5IF		0.1076	0.0946	0.1254	0.0863	0.0884	0.0906	0.0927	0.0949	0.0971	0.0992	0.1014	0.1035	0.1055	0.1076
W5IF			0.1233	0.1935	0.0061	0.0046	0.0034	0.0025	0.0017	0.0011	0.0007	0.0004	0.0002	0.0000	0.0000
SJR				0.0229	0.0826	0.0872	0.0917	0.0961	0.1003	0.1045	0.1085	0.1123	0.1161	0.1197	0.1232
SNIP					0.1420	0.1481	0.1539	0.1596	0.1650	0.1702	0.1752	0.1801	0.1847	0.1892	0.1935

Table 7: Euclidean distance between all pair of indicators.

	5IF	W5IF	SJR	SNIP	IF^{α}										
					α = 0	α = 0.1	α = 0.2	α = 0.3	α = 0.4	α = 0.5	α = 0.6	α = 0.7	α = 0.8	α = 0.9	α = 1
IF	2.9932	8.6756	2.7572	7.1551	4.9656	5.3280	5.6933	6.0610	6.4307	6.8020	7.1746	7.5485	7.9233	8.2991	8.6756
5IF		8.5608	3.7950	6.9082	5.1035	5.4259	5.7559	6.0923	6.4340	6.7803	7.1306	7.4842	7.8407	8.1997	8.5609
W5IF			10.7730	8.5354	3.8447	3.4603	3.0758	2.6913	2.3068	1.9224	1.5379	1.1534	0.7690	0.3846	0.0015
SJR				8.0889	7.0170	7.3885	7.7613	8.1352	8.5100	8.8856	9.2619	9.6390	10.0164	10.3945	10.7730
SNIP					6.3206	6.4737	6.6456	6.8347	7.0399	7.2596	7.4925	7.7376	7.9936	8.2597	8.5348

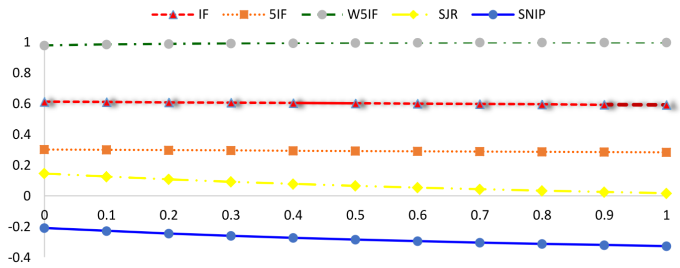

Figure 1: Impact of the parameter α to the Pearson's correlation coefficient between IF^{α} and other indicators.

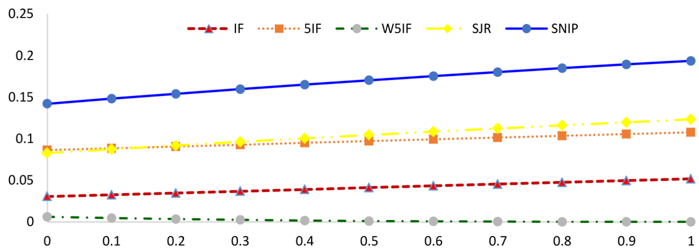

Figure 2: Impact of the parameter α to the cosine dissimilarity measure between IF^{α} and other indicators.

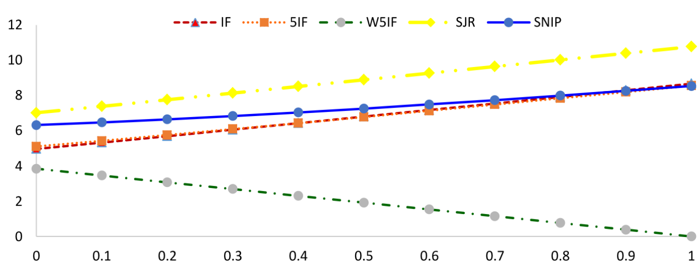

Figure 3: Impact of the parameter α to the Euclidean distance between IF^{α} and other indicators.

decline [0; 0.061]. The similarity between the weighted IF^{α} and SJR is stronger [0.0826; 0.1232] than the similarity between IF and SJR (0.0724). The similarity between the results of IF^{α} and SNIP [0.1420; 0.1935] is stronger than the similarity between IF itself and SNIP (0.0965).

The results of Euclidean distance between the weighted IF^{α} proposed and other indicators is given in Table 7.

As seen from the Table 7, as the value of α increases the Euclidean distance between IF^{α} and IF increase thus their results diffren from each other [4.9656; 8.6759]. The results of the Euclidean distance of IF^{α} and 5IF differ more as the value of α increases. The results of the Euclidean distance varies less as the value of α of IF^{α} and W5IF increases. The results of the proposed weighted IF^{α} differs from SJR more [7.017; 10.773] than the results of IF^{α} (2.7572). As the value of α increases, the results of Euclidean distance of the proposed weighted IF^{α} and SNIP differ more [6.3206; 8.5348] than IF and SNIP results (7.1551).

In conclusion of all results, it is clear that, the proposed weighted IF^{α} has made an impact on W5IF results. Figures have been used in order to visually illustrate the aforementioned in Tables.

As seen from the Figure 1, 2, 3, the indicators IF, 5IF and SNIP have demonstrated a deterioration from the value of α in [0;1] interval, however, W5IF has shown an improvement within [0;1] interval in all graphs.

CONCLUSION

Consideration of the reputation of citing source is necessary for the assesment of Journal IF. In this regard, a number of IF modifications are proposed by various researchers. The study showed that using only one indicator as a prestige of citing source is not so good. For this purpose, as prestige of citing source it is advisable to use different indicators. In paper to verify the accuracy of the results, it is inevitable to use various metrics (Pearson correlation coefficient, cosine and Euclidean distances) for comparing value with IF value. Because outcome can differ from one metric to another. Experiments affirmed it once again. In the proposed method as the prestige of citing source using two various indicators at the same time are suggested. Using not only two but also more indicators are the advantages of proposed method. Considering all aforementioned, prospective research works will review new and modified methods for more efficient evaluation of journals.

CONFLICT OF INTEREST

We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work, there is no professional or other personal interest of any nature or kind in any product, service and/or company that could be construed as influencing the position presented in, or the review of, the article entitled, "Journal Impact Factor Weighted by SJR and 5-Year IF indicators of Citing Sources". The study was conducted by the authors, no other people involved in conceiving, performing, and writing this study.

ABBREVIATIONS

IF: Impact Factor; **WIF:** Weighted IF; **5IF:** Five Year Impact Factor; **W5IF:** Weighted Five year Impact Factor; **SJR:** Scientific Journal Rankings; **SNIP:** Source Normalized Impact per Paper; **WoS:** Web of Science; **RIP:** Raw Impact per Paper; **RDCP:** Relative Database Citation Potential.

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