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Simple Technique to Normalise Impact Factor of Journals

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ABSTRACT

Various methods have been suggested in the literature to normalise the impact factor of journals. However, these methods have their own limitations. Present communication suggests a simple alternative method to normalise the impact factor of journals based on average impact of journals.

Keywords: Impact factor, normalised impact factor, standardised impact factor

1. INTRODUCTION

The impact factor of a journal is basically a ratio between citation and citable items published in a journal and indicate the relative standing and influence of the journal within its disciplinary boundaries. It is calculated by dividing the number of citations a journal receives for papers published during the last two years by the number of articles this journal published during the same time. However, Moed[1], *et al.* and van Leeuwen & Moed[2] have questioned the accuracy and validity of the impact factor of journal.

Due to diversity of citing behaviour in different disciplines, Balaban[3] and Makino[4] argued that direct comparison between impact factor of journals dedicated to different disciplines is inadequate. Using the same rational it is not advisable to use impact factor of journals for an inter-institutional or inter-country assessment of research performance in different disciplines. To overcome this problem, use of normalised impact factor (NIF) has been suggested. Different authors[5-11] have suggested different methods to normalise the impact factor of the journals.

According to Sen[5] the impact factor of the publishing journal is divided by the highest impact factor of the journal within the sub-field excluding review journals, which is then multiplied by a constant number. Fromter[6] suggests another method, according to which the impact factor of the publishing journal is divided by the arithmetic mean of all impact factors of the category excluding review journals.

The methods suggested by Sen[5] & Fromter[6] exclude review journals, while Marshakova-Shaikevich[7] takes into consideration five journals with highest impact factor of the specialty in the calculation of the NIF. According to Pudovkin & Garfield,[8] the methodologies suggested by Sen[5] and Marshakova-Shaikevich[7] are not quite satisfactory, as these involve either the maximal impact factor or a few of the highest impact factors in a speciality. The champion values are not always characteristics of impact factor values of the majority of journals within the specialty, and thus, introduce fortuitous elements in the NIF.

Moed[9], *et al.* suggested normalised impact factor of journal, that takes into account both the citation characteristics in the sub-fields covered by a journal, as well as the composition of the journal in terms of types of documents, particularly 'normal' research articles, notes, and review articles. In the methodology suggested by Moed[9], *et al.* one has to examine the citations of all the documents published in a journal X under the category C for a particular year. Examining the citations of all documents published in a journal is not only cumbersome but also a time-consuming process and necessitates the use of citation index.

Pudovkin & Garfield[8] have suggested the use of rank-normalised impact factor to compare journal performance across subject categories. Egghe & Rousseau[10] also suggested relative impact factor to compare the impact of journals belonging to different fields. The methods suggested by Pudovkin & Garfield[8] and Egghe & Rousseau[10] are simple to use but have practical difficulties. The calculation of rank-normalised impact

factor requires the use of *Journal Citation Report* (JCR) for recording the rank of the journal in the specialty. Similarly, for calculating the relative impact factor, one needs JCR for recording the citations and the source items for a specified journal in the field.

In view of the above limitations in the methods suggested by different authors, a simple alternative method for calculating NIF is suggested.

2. METHODOLOGY

In the suggested procedure, average impact factor of the journals in the sub-disciplines is calculated. Based on the average impact factor of the journals, the journals in the sub-discipline are divided into three categories as low impact factor journals, medium impact factor journals, and high impact factor journals. Piecewise linear mapping technique has been applied to calculate the normalised impact factor. Stepwise procedure for computations of NIF by the suggested procedure is as follows:

Step 1: Arrange the journals within a sub-discipline in ascending order of impact factor (column 2 of Table 1).

Step 2: Calculate the average impact factor of the journals in the sub-discipline using the formula $(1/n)\sum_{j=1}^{n} IF_j$, where, IF denotes the impact factor of the journals and *n* denotes the number of journals in the sub-discipline. In the set of journals given in the Appendix 1, *n*=139 and $(1/n)\sum_{j=1}^{n} IF_j = 73.619$. Average impact factor is thus 73.619 /139 = 0.530.

Step 3: Based on the average impact factor of the journals, divide the journals into three categories as low impact factor journals, medium impact factor journals, and high impact factor journals. In the present case, low impact factor journals are those whose impact factor is $\leq$ average impact factor of the sub-discipline, i.e., $\leq$ 0.530; medium impact factor journals are those whose impact factor is more than average impact factor but less than or equal to twice the average impact factor, i.e., > 0.530 $\leq$ 1.06; and high impact factor journals are those whose impact factor is more than twice the average impact factor, i.e.>1.06.

Step 4: Calculate the average impact factor for each category of the journals as illustrated in Table 2 for the list of journals given in the Appendix 1.

Step 5: Calculate pre-normalised impact factor (PNIF) values for each journal by piecewise linear mapping technique using the following formula:

$$PNIF_j = AIF_{r-1} + \frac{\left[\left(AIF_r - AIF_{r-1}\right)\left(IF_j - Max\left(IF_{r-1}\right)\right)\right]}{\left[Max\left(IF_r\right) - Max\left(IF_{r-1}\right)\right]}$$

Table 2. Calculation of average impact facor

Category {*r*}	Number of journals	Total impact factor (IF)	Average impact factor (AIF)
1	86	18.163	18.163 / 86 = 0.211
2	34	25.524	25.524 / 34 = 0.751
3	19	29.932	29.932 / 19 = 1.575

where, $PNIF_j$ denotes the pre-normalised impact factor of the journal *j*; and $Max\,(IF_r)$ denotes maximum impact factor of corresponding category.

In case of *r* = 1, i.e., the *I*st category, the value of IF_{r-1} would assume the value of zero, since there is no category prior to the *I*st category. Hence, in case of *I*st category the values of AIF_{r-1} and $Max\,(IF_{r-1})$ would be zero. Calculation for *PNIF* for different categories of journals given in the Appendix 1 are:

$$PNIF_j = AIF_{r-1} + \frac{\left[\left(AIF_r - AIF_{r-1}\right)\left(IF_j - Max\left(IF_{r-1}\right)\right)\right]}{\left[Max\left(IF_r\right) - Max\left(IF_{r-1}\right)\right]}$$

Example for calculation of PNIF for different categories:

$$(1^{st}\ category)\ PNIF_6 = 0 + \frac{\left[(0.211-0)(0.012-0)\right]}{\left[0.514-0\right]} = 0.005$$

Step 6: Normalise the PNIF to the scale of 10 using the following formula:

$$NIF_j = \left(\frac{PNIF_j}{Max\left(PNIF\right)}\right) * 10$$

3. ADVANTAGES

The advantages of using the suggested method for calculating the NIF are:

(a) It does not exclude review journals or any other high impact factor journal in the calculation of NIF as suggested by Sen[5] and Fromter[6], and thus takes into consideration the wide variations in the range of impact factors.

(b) It does not take into consideration only the journals with highest impact factor as suggested by Marshakova-Shaikevich[7].

(c) It does not require the tools like JCR for obtaining the ranks of the journals in a speciality as suggested by Pudovkin & Garfield[8] and data on source items and number of citations as suggested by Egghe & Rousseau[10] as well as the *Science Citation Index* for examining citations for different types of citable items as pointed out by Moed[9], *et al.*

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REFERENCES

1. Moed, H.F.; van Leeuwen, Th.N. & Reedijk, J. Towards appropriate indicators of journal impact. *Scientometrics,* 1999, **46**, 575-89.

2. van Leeuwen, Th.N. & Moed, H.F. Development and application of journal impact measures in the Dutch science system. *Scientometrics,* 2002, **53**, 249-66.

3. Balaban, A.T. How should citations to articles in high- and low-impact journals be evaluated, of what is a citation worth? *Scientometrics,* 1996, **37**, 495-98.

4. Makino, J. Productivity of research groups–Relation between citation analysis and reputation within research communities. *Scientometrics,* 1998, **43**, 87-93.

5. Sen, B.K. Normalized impact factor. *Journal of Documentation,* 1992, **48**, 318-25.

6. Fromter, E., *et al.* Evaluierung publizierter forschungsbeitrage in der medizin. *Deutsche medizinische wochenschrift*,1999, **124**, 910-15. *In* Citation rates, knowledge export and international visibility of dermatology journals listed and not listed in the *Journal Citation Reports,* edited by J. Stegmann & G. Grohmann. *Scientometrics*, 2001, **50**, 483-02.

7. Marshakova-Shaikevich, I. The standard impact factor as an evaluation tool of science fields and scientific journals. *Scientometrics*, 1996, **35**, 283-90.

8. Pudovkin, A.I. & Garfield, E. Rank-normalised impact factor: A way to compare journal performance across subject categories. *In* American Society for Information Science and Technology Annual Meeting, 17 November 2004. http://www.garfield.library.upenn.edu/papers/asistranknormalization2004.pdf

9. Moed, H.F.; van Leeuwen, T.N. & Reedijk, J. A new classification system to describe the aging of scientific journals and their impact factors. *Journal of Documentation,* 1998, **54***,* 387-19.

10. Egghe, L. & Rousseau, R. A general framework for relative impact indicators. *Canadian J. Infor. Libr. Sci.,* 2002, **27**, 29-48.

11. Ramirez, A.M.; Garcia, E.O. & Del Rio, J.A. Renormalised impact factor. *Scientometrics,* 2000, **47**(1), 3-9.

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Appendix 1

S. No.	Journal	IF	PNIF	NIF
1.	*Sharp Tech J*	0.000	0.000	0.000
2.	*Izv Vuz Radioelectr*	0.000	0.000	0.000
3.	*Electronics*	0.003	0.001	0.006
4.	*Electron Prod*	0.007	0.003	0.019
5.	*IFIP Trans C*	0.010	0.004	0.025
6.	*Electron Eng*	0.012	0.005	0.032
7.	*Siemens Rev*	0.014	0.006	0.038
8.	*Int J Elec Eng Edu*	0.014	0.006	0.038
9.	*Electronica*	0.015	0.006	0.038
10.	*Control Eng*	0.016	0.007	0.044
11.	*Telecomm Radio Eng*	0.017	0.007	0.044
12.	*Comput Des*	0.018	0.007	0.044
13.	*Onde Electr*	0.019	0.008	0.051
14.	*Electron World Wirel*	0.021	0.009	0.057
15.	*Electron Inform Plan*	0.024	0.010	0.063
16.	*NEC Res Dev*	0.025	0.010	0.063
17.	*EDN*	0.027	0.011	0.070
18.	*Electron Des*	0.031	0.013	0.083
19.	*Electr Commun*	0.035	0.014	0.089
20.	*Brit Telecommun Eng*	0.037	0.015	0.095
21.	*Microwave Rf*	0.038	0.016	0.102
22.	*Electr Pow Syst Res*	0.044	0.018	0.114
23.	*Electr Mach Pow Syst*	0.049	0.020	0.127
24.	*Fujitsu Sci Tech J*	0.050	0.021	0.133
25.	*Hewlett Packard J*	0.056	0.023	0.146
26.	*IEE Rev*	0.062	0.025	0.159
27.	*IEICE T Fund Electr*	0.088	0.036	0.229
28.	*NTT Review*	0.091	0.037	0.235
29.	*Int J Elect Power*	0.093	0.038	0.241
30.	*Compel*	0.101	0.041	0.260
31.	*IEEE T Educ*	0.104	0.043	0.273
32.	*Eur T Electr Pow*	0.119	0.049	0.311
33.	*Comput Electr Eng*	0.133	0.055	0.349
34.	*J Micriwave Power Ee*	0.145	0.060	0.381
35.	*Microprocess Microsy*	0.149	0.061	0.387
36.	*Microelectron Reliab*	0.152	0.062	0.394
37.	*GEC – J Res*	0.156	0.064	0.406
38.	*IEE P Commun*	0.167	0.069	0.438
39.	*IEICE T Electron*	0.170	0.070	0.444
40.	*Radiotekh Elektron*	0.173	0.071	0.451
41.	*Arch Electrotech*	0.181	0.074	0.470
42.	*J Electrostat*	0.184	0.076	0.483
43.	*Contr Theor Adv Tech*	0.185	0.076	0.483
44.	*Frequenz*	0.190	0.078	0.495
45.	*IEEE T Broadcast*	0.194	0.080	0.508
46.	*Int J Adapt Control*	0.211	0.087	0.552
47.	*Microwave J*	0.213	0.088	0.559
48.	*Appl Artif Intell*	0.217	0.089	0.565
49.	*Electron Commun Eng*	0.239	0.098	0.622

50.	*Analog Integr Circ S*	0.239	0.098	0.622
51.	*IEEE T Energy Conser*	0.243	0.100	0.635
52.	*IEICE T Commun*	0.247	0.101	0.641
53.	*Mechatronics*	0.250	0.103	0.654
54.	*IEEE T Consum Electr*	0.252	0.104	0.660
55.	*Int J Elecron*	0.258	0.106	0.673
56.	*Electromagnetics*	0.260	0.107	0.679
57.	*IEEE Circuit Devic*	0.274	0.113	0.717
58.	*IEE P-Elect Pow Appl*	0.291	0.120	0.762
59.	*IEEE T Ind Appl*	0.292	0.120	0.762
60.	*IEE P-Gener Transm D*	0.310	0.127	0.806
61.	*Int J Microwave Mill*	0.318	0.131	0.832
62.	*Microw Opt Techn Let*	0.320	0.131	0.832
63.	*IEEE T Power Deliver*	0.346	0.142	0.902
64.	*Circ Syst signal Pr*	0.357	0.147	0.933
65.	*Expert Syst Appl*	0.366	0.150	0.952
66.	*Bt Technol J*	0.370	0.152	0.965
67.	*AEU-Arch Elektron Ub*	0.374	0.154	0.978
68.	*IEEE T Instrum Meas*	0.402	0.165	1.048
69.	*IEE P – Sci Meas Tech*	0.403	0.166	1.054
70.	*Kvantovaya Elektron*	0.409	0.168	1.067
71.	*Microelctron Eng*	0.414	0.170	1.079
72.	*Multidim Syst Sign P*	0.419	0.172	1.092
73.	*Int J Softw Eng Know*	0.420	0.173	1.098
74.	*IEE P-Circ Dev Syst*	0.424	0.174	1.105
75.	*Signal Process*	0.440	0.181	1.149
76.	*Int J Infrared Milli*	0.442	0.182	1.156
77.	*J Mater Sci- Mater El*	0.443	0.182	1.156
78.	*IEEE T Compon Hybr*	0.447	0.184	1.168
79.	*IEEE T Reliab*	0.450	0.185	1.175
80.	*IEEE T Aero Elec Sys*	0.459	0.189	1.200
81.	*IEEE T Knowl Data En*	0.461	0.189	1.200
82.	*IEEE T Ind Electron*	0.471	0.194	1.232
83.	*Comput Networks ISDN*	0.479	0.197	1.251
84.	*IEE P Contr Theor Ap*	0.500	0.205	1.302
85.	*Concurrency Pract Ex*	0.500	0.205	1.302
86.	*J Electromagnet Wave*	0.514	0.211	1.340
87.	*IEEE T Circuits II*	0.540	0.240	1.524
88.	*IEEE T Electronagn C*	0.549	0.250	1.587
89.	*Solid State Technol*	0.571	0.274	1.740
90.	*IEEE T Power Syst*	0.577	0.280	1.778
91.	*IEEE T Oceanic Eng*	0.577	0.280	1.778
92.	*IEEE T Semiconduct M*	0.581	0.285	1.810
93.	*Math Control Signal*	0.595	0.300	1.905
94.	*Image Vision Comput*	0.602	0.308	1.956
95.	*IEEE Spectrum*	0.623	0.331	2.102
96.	*Int J Circ Theor App*	0.627	0.335	2.127
97.	*IEEE Expert*	0.629	0.337	2.140
98.	*IEEE T Syst Man Cyb*	0.649	0.359	2.279
99.	*J Supercomput*	0.656	0.367	2.330

100.	*Pattern Recogn*	0.691	0.405	2.571
101.	*Sensor Actuat A- Phys*	0.704	0.420	2.667
102.	*IEE P – Optoelectron*	0.727	0.445	2.825
103.	*IEEE T Circuits –I*	0.732	0.450	2.857
104.	*Radio sci*	0.753	0.473	3.003
105.	*IEEE T Magn*	0.758	0.479	3.041
106.	*Solid State Electron*	0.759	0.480	3.048
107.	*IEEE T Electr Insul*	0.776	0.498	3.162
108.	*IEEE T Veh Technol*	0.796	0.520	3.302
109.	*IEEE T Antenn Propag*	0.806	0.531	3.371
110.	*IEEE Commun Mag*	0.840	0.569	3.613
111.	*IEEE T Automat Contr*	0.867	0.598	3.797
112.	*IEEE J Solid St Circ*	0.903	0.638	4.051
113.	*IEEE T Comput*	0.904	0.639	4.057
114.	*IEEE T Parall Distr*	0.905	0.640	4.063
115.	*IEEE t Ultrason Ferr*	0.927	0.664	4.216
116.	*Adv Mater Opt Electr*	0.957	0.697	4.425
117.	*IEEE J Sel Area Comm*	0.964	0.705	4.476
118.	*IEEE T Commun*	0.969	0.710	4.508
119.	*IEEE T Mirowave Theory*	1.004	0.749	4.756
120.	*IEEE T Robotic Autom*	1.006	0.751	4.768
121.	*Sensor Actuat B- Chem*	1.074	0.785	4.984
122.	*IEEE T Software Eng*	1.117	0.807	5.124
123.	*Electron Lett*	1.159	0.829	5.263
124.	*IEEE T Nucl Sci*	1.183	0.841	5.340
125.	*Network Comp Neural*	1.196	0.848	5.384
126.	*IEEE t Signal Proces*	1.234	0.867	5.505
127.	*J Electron Mater*	1.238	0.869	5.517
128.	*Opt Quant Electron*	1.303	0.903	5.733
129.	*IEEE T Geosci Remote*	1.356	0.930	5.905
130.	*Semicond Sci Tech*	1.389	0.947	6.013
131.	*P IEEE*	1.494	1.000	6.349
132.	*IEEE Electr Device L*	1.610	1.060	6.730
133.	*IEEE T Electron Dev*	1.630	1.070	6.794
134.	*Prog Quant Electr*	1.818	1.166	7.403
135.	*IEEE T Neural Network*	1.941	1.229	7.803
136.	*IEEE T Inform Theory*	1.971	1.244	7.898
137.	*IEEE T Pattern Anal*	2.006	1.262	8.013
138.	*IEEE J Quantum Electr*	2.595	1.564	9.930
139.	*Semiconduct Semimet*	2.618	1.575	10.000
	Total	**73.619**		

AIF_1 = 0.211 for journals at S.No. 1- 86 (86 journals)

AIF_2 = 0.751 for journals at S.No. 87-120 (34 journals)

AIF_3 = 1.575 for journals at S.No. 121- 139 (19 journals)

Source: Science Citation Index Journal Subject Category listing 1994 (Electrical and Electronic Engineering)