Analysis of Generalized Impact Factors and the Indices of Journals

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Abstract— Analyzing the relationships among the parameters for quantifying the quality of research published in journals is a challenging task. In this paper, we analyze the relationships between the impact factor, h-index, and g-index of a journal. To keep our analysis simple and easy to understand, we consider a generalized version of the impact factor where there is no time window. In the absence of the time window, the impact factor converges to the number of citations received per paper. This is not only justified for the impact factor, it also simplifies the analysis of the h-index and g-index as well because addition of a time window in the form of years complicates the computation of indices too. We derive the expressions for the relationships among impact factor, h index, and g-index and validate them using a given set of publication-citation data.

Keywords—Information Systems, Quality of Research, Impact factor, h-index, g-index

1. Introduction

1.1 Problem statement

Sometimes, one needs to rank the journals where the outcomes of the research carried out by authors working in a particular field of research are published. The ranking of the journals may vary depending upon which parameter is selected for ranking. Generally, the journals are ranked based on the parameters that are derived from the citations of the papers published in the journals. One such parameter is the impact factor, which tells about the number of citations divided by the number of papers published in a constant number of the preceding years. Another parameter is the *h*-index that tells about how many papers published in the journal possess at least the same number of citations as that of the number of papers. Yet, another parameter is the *g*-index, which is the largest number so that the summation of the citations is at least the square of the number, and this applies only when papers are arranged in the decreasing number of their citations. It is discussed in [3] that *h*-type indices, which were proposed for evaluating the quality of research produced by an author, can be applied to journals as well.

Although, these parameters seem to be different, however, they might be related in some sense. There is a need to investigate the relationships among these parameters so that given the value(s) of some parameter(s), one can determine the other ranking parameter. Alternatively, from a set of values of one ranking parameter, one is able to predict the values of the other ranking parameter. Sometimes, the analysis of the relationships among different ranking parameters enables one to get clues as to why the rankings of the journals differ by changing the parameter used for ranking.

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1.2 Contributions

In this paper, we have addressed the following research question: "Can we relate indices and the impact factor from their very basic definitions without assuming a particular model and/or distribution to be followed by any of them?" To answer it, we analyze the relationships among the impact factor, *h*-index, and *g*-index of a given journal. We assume that the impact factor of a given journal is the average number of citations of the paper published in the journal. This assumption seems to be realistic because the impact factor of a journal, in the long term, is nothing but the average number of citations per paper. The same assumption is used in [6], where a relationship between the impact factor and *h*-index is described using Lotka's power law model. Our relationships are generalized in the sense that they can be applied to any journal (whose papers are cited in an indexing database) irrespective of the domain and the longevity of its publication.

The rest of the paper is organized as follows: in Section 2, we present an overview of the impact factor and indices. Section 3 contains the analysis of the relationships among the impact factor and indices. In Section 4, we present results and discussion. Section 5 contains a comparison between the analyses presented in this paper with the related work. The last section contains the conclusion.

2. An Overview of Indices and Impact Factors

In this section, we present an overview of the indices and impact factors.

2.1 The h-Index

Suppose the papers are arranged in a descending order based on the number of citations. Let c_i be the number of citations of a paper numbered *i*. The *h*-index [9], when papers are arranged in descending number of their citations, can be defined as follows.

$$h = \max(i) : c_i \geq i \; . \tag{1}$$

By definition, the *h*-index is the largest number, *h*, such that the papers arranged in their decreasing order of citations have at least *h* number of citations.

2.2 The g-Index

According to the definition of the *g*-index, if the papers are arranged in the descending order of their number of citations, *g* is the largest number such that the summation of the number of citations is at least g^2. In other words, when papers are arranged in descending order of their citations, *g*-index can be defined as follows.

$$g = \max(i) : \sum_i c_i \geq i^2 \; . \tag{2}$$

Note that *g*-index is the largest number *i* such that $\sum_i c_i \geq i^2$. In the definitions of *h*-index (as given by (1)) and that of the *g*-index (as given by (2)), we have intentionally ignored the time

T at which we are considering their values. This is done to keep their definitions simple, and defining so there is no loss of generality as far as the discussion in this work is concerned. For precise definitions of the indices incorporating the time, one is referred to [14].

2.3 The Impact Factor

Generally, the impact factor of a journal is defined using a time window. For example, an impact factor may be computed for a time window of either five years or two years, and are termed as *five year impact factor* or *two year impact factor*, respectively. We now provide a general definition of the impact factor with a time window constraint.

Definition 1 (Impact Factor with a Time Window)

Let W be the time window for computing the impact factor, and let y_b be the starting (or the base) year for computing the impact factor. Then, the impact factor of a journal, in general, can be defined as follows

.

$$(IF)_{y_{\{b+W\}}} = \frac{C_{y_{\{b+W\}}}}{\sum_{i=0}^{W-1} P_{y_{\{b+i\}}}} . \tag{3}$$

We say that this definition of the impact factor is *general* in the sense that it is able to incorporate any time window. For example, if W=2, the impact factor is on a two year basis; and W=5 makes the impact factor on five year basis. Moreover, one is not confined to only these two values, as one can choose any other value for W.

Our goal in this paper is to relate the impact factor of a journal with the indices. Specifically, we wish to find out a relationship between the impact factor, h-index, and g-index. To relate them, either the h-index or g-index should be defined taking the same time window as for that of the impact factor, or the time window should be eliminated from the impact factor so that all these parameters become coherent. We now define an impact factor that we call a *generalized impact factor* (or a *windowless impact factor*) as follows:

Definition 2 (Impact Factor Without a Time Window)

Let the total number of papers published in the journal be P and the total number of citations received by the journal be C. The *generalized impact factor* or an impact factor without a time window constraint is as follows.

$$IF = \frac{C}{P} . \tag{4}$$

The *generalized impact factor*, I_f, resembles the average number of citations of the journal per published paper, and that is in accordance with the definition of the impact factor. In other words, if the time window constraint is removed, the impact factor turns out to be the average number of citations per published paper. We wish to point out that we are not the first ones who adopted a definition of the impact factor without any time window constraints, there are other researchers such as [14] who have also taken into account a similar kind of definition (i.e. without any time window) of the impact factor, and who agree that there is no harm in taking this type of definition for the purpose of relating indices and the impact factor. The reason is that the definition without a time window constraint puts aside the complications of redefining indices from a window-less scenario to a windowed scenario so as to make them coherent with the impact factor with a time window constraint.

3. ANALYSIS OF RELATIONSHIPS

We now analyze the relationships among the *h*-index, *g*-index, and impact factor. For that purpose, we consider two parameters at a time and describe the relationship between them.

3.1 An Impact Factor and the h-Index

Let P be the number of papers published in a journal, and let c_i be the number of citations of ith paper. Then, a *windowless impact factor* (I_f) of a journal can be expressed as follows.

$$I_f = \frac{\sum_i c_i}{P}. \tag{5}$$

According to the definition of *h*-index, *h* papers have at least *h* number of citations, therefore, h^2citations are taken into account by the *h*-index. In other words, if a journal has an *h*-index, *h*, then h^2 of the citations are taken care of by the *h*-index. The rest of the citations are not taken into account by the *h*-index. We can write the total citations as follows.

$$\sum_{i=1}^{P} c_i = h^2 + \sum_{i=1}^{h} (c_i - h) + \sum_{i=h+1}^{P} c_i . \tag{6}$$

Using (5), we can write (6) as follows.

$$I_f \times P = h^2 + \sum_{i=1}^{h} (c_i - h) + \sum_{i=h+1}^{P} c_i . \tag{7}$$

Or,

$$I_f = \frac{1}{P}\left[h^2 + \sum_{i=1}^{h} (c_i - h) + \sum_{i=h+1}^{P} c_i \right]. \tag{8}$$

This gives a relationship between the *h*-index and the impact factor of a journal. In what follows, we analyze a relationship between the impact factor and *g*-index.

3.2 An Impact Factor and the g-Index

Using the definition of *g*-index, which is given by (2), we have,

$$g = \max(i) : \sum_i c_i \geq i^2 . \tag{9}$$

The above equation can be written as

$$\sum_{i=1}^{g} c_i \geq g^2 . \tag{10}$$

However, the difference between $\sum_{i=1}^{g} c_i$ and g^2 is less than or equal to c_g, which is the number of citations at i=g. For all practical purposes, one can take,

$$\sum_{i=1}^{g} c_i \approx g^2 \tag{11}$$

As we did for the *h*-index, breaking the total number of citations into two parts, one ranging from 1 to *g*, and the other ranging from *g*+1 to *P*, we have,

$$\sum_{i=1}^{P} c_i = \sum_{i=1}^{g} c_i + \sum_{i=g+1}^{P} c_i . \tag{12}$$

Combining (11) and (12), we have,

$$\sum_{i=1}^{P} c_i \approx g^2 + \sum_{i=g+1}^{P} c_i . \tag{13}$$

Using (5) and (13), we have,

$$I_f \approx \frac{1}{P}\left[g^2 + \sum_{i=g+1}^{P} c_i \right]. \tag{14}$$

This gives a relationship between the *g*-index and the impact factor. We now wish to relate the *h*-index and *g*-index.

3.3 The h-index and the g-Index

From (14), we have,

$$I_f \times P \approx g^2 + \sum_{i=g+1}^{P} c_i . \tag{15}$$

Using (8) and (14), we have,

$$\frac{1}{P}\left[h^2+\sum_{i=1}^{h}(c_i-h)+\sum_{i=h+1}^{P}c_i\right]\approx\frac{1}{P}\left[g^2+\sum_{i=g+1}^{P}c_i\right]. \tag{16}$$

Or,

$$h^2+\sum_{i=1}^{h}(c_i-h)+\sum_{i=h+1}^{P}c_i\approx g^2+\sum_{i=g+1}^{P}c_i\ . \tag{17}$$

Taking out the summations on one side, (17) can be written as

$$g^2-h^2\approx\sum_{i=1}^{h}(c_i-h)+\sum_{i=h+1}^{P}c_i-\sum_{i=g+1}^{P}c_i\ . \tag{18}$$

An index called the *e*-index is proposed in [7, 8], which is as follows.

$$e^2=\sum_{i=1}^{h}(c_i-h)\ . \tag{19}$$

Using (18) and (19), we have,

$$g^2-h^2\approx e^2+\sum_{i=h+1}^{P}c_i-\sum_{i=g+1}^{P}c_i\ . \tag{20}$$

Note that we can write the first summation on the right of (20) as shown below.

$$\sum_{i=h+1}^{P}c_i=\sum_{i=h+1}^{g}c_i+\sum_{i=g+1}^{P}c_i\ . \tag{21}$$

Using (20) and (21), we have,

$$g^2-h^2\approx e^2+\sum_{i=h+1}^{g}c_i\ . \tag{22}$$

Note that for $(h+1)\le i\le g$, $c_i\le h$. Therefore,

$$\sum_{i=h+1}^{g}c_i\le(g-h)h\,. \tag{23}$$

Using (22) and (23), we have,

$$g^2 - h^2 \le e^2 + (g-h)h \,. \tag{24}$$

Simplifying (24), we have,

$$g^2 \le e^2 + gh \,. \tag{25}$$

Solving (25), we have,

$$h \ge g - \frac{e^2}{g} \,. \tag{26}$$

Since, all these indices are whole numbers, therefore, we write,

$$h \ge \left\lceil g - \frac{e^2}{g} \right\rceil . \tag{27}$$

The above inequality gives a relation between the h-index and g-index (through the use of the *e*-index).

4. Results and Discussion

We computed a generalized impact factor, the *h*-index, and the *g*-index for journals based on the citations in the Microsoft Academic Search (MAS) [11]. A reason for choosing MAS is that it is freely accessible. The impact factor and indices are listed for top ranked journals in the *networks and communication* group of the Computer Science area and are shown in Table 1. Journals are ranked according to the decreasing values of their impact factors.

Figure 1 shows the *h*-index and the *g*-index of the journals considered in this paper (as given in Table I) as a function of the impact factor. Note that for Figure 1 journals are arranged in the increasing order of their impact factors. We observe that as the impact factor increases, the *h*-index and the *g*-index also increase, in general. In other words, a larger impact factor, in general, means larger values of the *h*-index and the *g*-index. For some of the journals, even though the impact factor is small, the values of the *h*-index and *g*-index are comparatively large. A closer look at Figure 1 in conjunction with Table I reveals that it happens in the case of those journals, which have a large number of citations, $\sum_i c_i$, and a large number of papers published, *P*. As a result, the impact factor, which is taken to be the average number of citations per paper, is small. However, there is a fairly large number of papers to increase the *h*-index as well as the *g*-index. Another point to observe from Figure 1 is that the journals that possess a large value of *h*-index also possess a large value of the *g*-index. This can be understood on the basis of (18), which implies a larger value of the *g*-index for a larger value of the *h*-index, and vice versa.

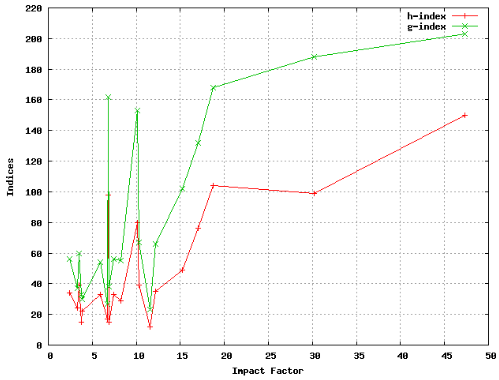

Fig. 1. The values of the h-index and the g-index as a function of the impact factor, where journals are arranged according to the increasing values of their impact factors.

Table 1. Impact factor, the *h*-index, and the *g*-index of journals in networks and communication group.

S. No.	Journal	Acronym	$\sum_i c_i$	P	I_f	h	g
1.	ACM Computer Communication Review	CCR	85,809	1,813	47.330	150	203
2.	IEEE Transactions on Networking	ToN	49,148	1,628	30.189	99	188
3.	IEEE Journal on Selected Areas in Communication	JSAC	64,330	3,441	18.695	104	168
4.	ACM Performance Evaluation Review	PER	27,795	1,630	17.052	76	132
5.	Wireless Networks	WINET	13,588	894	15.199	49	102
6.	ACM Mobile Computing Communication Review	MCCR	5,304	434	12.221	35	66
7.	Journal of Communication & Networks	JCN	645	56	11.517	12	23
8.	Mobile Networks and Applications	MONET	7,582	738	10.273	39	67
9.	Computer Networks	COMNET	38,758	3830	10.119	80	153
10.	Ad Hoc Networks	AHN	3,937	477	8.253	29	55
11.	IEEE Transactions on Mobile Computing	TMC	5,253	707	7.429	33	56
12.	Journal of High Speed Networks	JHSN	1,681	243	6.91	15	38
13.	IEEE Transactions on Communication	TCOM	70,982	10360	6.851	98	162
14.	ACM Transactions on Sensor Networks	TOSN	1,074	174	6.712	17	27
15.	Queuing Systems- Theory and Applications	QUESTA	6,944	1179	5.889	33	54
16.	Networks	NETWORKS	2,890	745	3.879	22	30
17.	Journal of Network & Computer Applications	JNCA	1,645	439	3.747	15	33
18.	IEEE Transactions on Wireless Communication	TWC	10,086	2,876	3.506	39	60
19.	Telecommunication Systems	TELESYS	2,565	765	3.352	24	37
20.	Computer Communications	COMCOM	9,497	3,964	2.395	34	56

Figure 2 shows the impact factor and indices as a function of the total number of citations of journals. Here, journals are arranged in the ascending order of their total number of citations,

$\sum_i c_i$. We observe that the *h*-index and the *g*-index, generally, increase with an increase in the total number of citations. However, this is not true for the impact factor because it depends on the number of citations, as well as on the number of paper published. For journals with more number of papers published and whose number of citations is not so large, the impact factor is low. However, increasing the number of citations helps some papers gain enough number of citations resulting in an increase in the *h*-index as well as in the *g*-index. As opposed to the indices, the impact factor represents the quality of a journal in totality; therefore, it might not have increased in the same proportion as that of the indices.

Table 2 shows impact factor and indices of journals in the increasing order of their total number of citations. The values of $\sum_{i=g+1}^{P} c_i$, the difference of the summations of citations beyond the indices (as given by (20)), are given. Also, we listed the values for the difference of the squares of the indices in addition to the values of the parameters already listed in Table 2.

Figure 3 shows the values of h^2, g^2, and g^2-h^2 as a function of the total number of citations, where journals are arranged according to the increasing number of their citations. Also, it contains the number of papers published by the respective journal. We observe that there is a decrease in the values of g^2-h^2 at some places. A closer look reveals that the decrease in the values of g^2-h^2 is mainly due to the following reasons: (i) a decrease in the value of *g*-index for the respective journal, and/or (ii) an increase in the number of papers published by the respective journal, and the total number of citations for the respective journal might not have increased in the same proportion as that of the number of paper.

Figure 4 shows the values of g^2-h^2 and its constituents, namely, $\sum_{i=g+1}^{P} c_i$, $\sum_{i=1}^{P} (c_i - h) - \sum_{i=h+1}^{P} c_i$, as a function of the total number of citations, where journals are arranged according to increasing number of their citations. We observe that the value of g^2-h^2 for the sequence of journals, arranged in the increasing order of their citations, decreases for a journal if $\sum_{i=g+1}^{P} c_i$ is decreased.

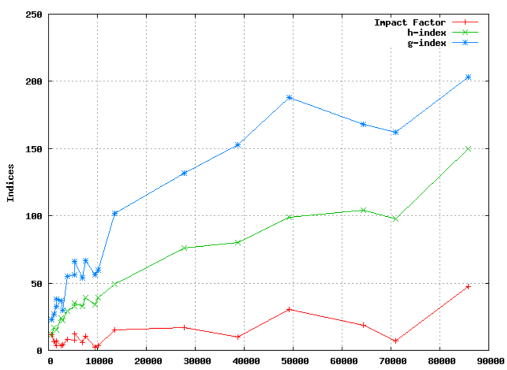

Fig. 2. The impact factor, the h-index, and the *g*-index as a function of the total number of citations, where journals are arranged according to the increasing number of citations.

Table 2. The impact factor, the h-index, and the g-index of journals in networks and the communication group with corresponding analytical details (journals are arranged in the increasing number of citations).

Journal	$\sum_{i} c_i$	P	I_f	h	g	h^2	g^2	$\sum_{i=g+1}^{P} c_i$	$\sum_{i=1}^{h}(c_i - h) + \sum_{i=h+1}^{P} c_i$	g^2-h^2
JCN	645	56	11.517	12	23	144	529	116	501	385
TOSN	1,074	174	6.712	17	27	289	729	345	785	440
JNCA	1,645	439	3.747	15	33	225	1,089	556	1,420	864
JHSN	1,681	243	6.91	15	38	225	1,444	237	1,460	1,219
TELESYS	2,565	765	3.352	24	37	576	1,369	1,196	1,989	793
NETWORKS	2,890	745	3.879	22	30	484	900	1,990	2,406	416
AHN	3,937	477	8.253	29	55	841	3,025	912	2,096	2,184
TMC	5,253	707	7.429	33	56	1,089	3,136	2,117	4,164	2,047
MCCR	5,304	434	12.221	35	66	1,225	4,356	948	4,079	3,131
QUESTA	6,944	1,179	5.889	33	54	1,089	2,916	4,028	5,855	1,827
MONET	7,582	738	10.273	39	67	1,521	4,489	3,039	6,061	2,968
COMCOM	9,497	3,964	2.395	34	56	1,156	3,136	6,361	8,341	1,980
TWC	10,086	2,876	3.506	39	60	1,521	3,600	6,486	7,210	2,079
WINET	13,588	894	15.199	49	102	2,401	10,404	3,184	11,187	8,003
PER	27,795	1,630	17.052	76	132	5,776	17,424	10,371	22,019	11,648
COMNET	38,758	3,830	10.119	80	153	6,400	23,409	15,349	32,358	17,009
ToN	49,148	1,628	30.189	99	188	9,801	35,344	13,804	39,347	25,543
JSAC	64,330	3,441	18.695	104	168	10,816	28,224	36,106	53,514	17,408
TCOM	70,982	10,360	6.851	98	162	9,604	26,244	44,738	61,378	16,640
CCR	85,809	1,813	47.33	150	203	22,500	41,209	44,600	63,309	18,709

Also, the value of $\sum_{i=1}^{P}(c_i - h) - \sum_{i=h+1}^{P} c_i$ increases with an increase in the total number of citations of the sequence of journals, with a few exceptions. The reason for the decrease at some places, forming an exception, is due to an increase in the number of papers published by the journals appearing in those exceptional places, and the total number of citations has not increased in the same proportion.

Sometimes, the larger values of the h-index and the g-index may not imply a large value of the impact factor. To clarify it, let us consider the following example:

Example 1*:* Assume that for a journal A, there are 1,000 papers published out of which 50 papers have at least 50 citations and the remaining 950 papers have on an average of 10 citations per paper. The summation of the excess citations for papers in the h-core is 200. The total number of citations of the journal A is: (50×50)+(950×10)+200 = 2,500 + 9,500 + 200 = 12,200. The h-index is 50 and suppose that the g-index is 55. The impact factor is $\frac{12200}{1000} = 12.2$.

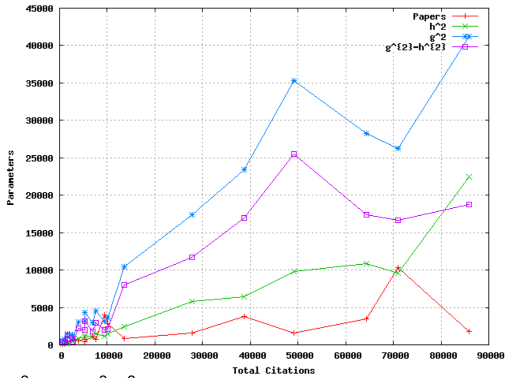

Fig. 3. The values of h^2, g^2, and g^2-h^2 as a function of the total number of citations, where journals are arranged according to the increasing number of citations.

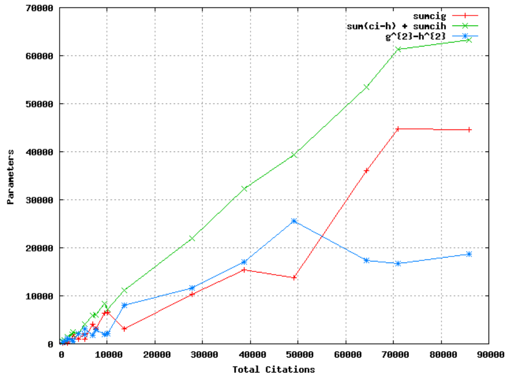

Fig.4. The values of g^2-h^2 and its constituents, namely, $\sum_{i=g+1}^{P} c_i$, $\sum_{i=1}^{P}(c_i - h) - \sum_{i=h+1}^{P} c_i$.

Table 3. A comparison of the relationships between indices and the impact factor of journals.

Work	Parameters	Basis	Comments
Egghe, Liang, & Rousseau [6]	h, I_f	Lotka's model	Power law model
Zhang [8]	h, g, e	e-index	Continuous functions
Schubert & Glanzel [16]	h, I_f	I_f: Pareto Distribution	$H=n^{1/3}\ I_f^{2/3}$
This paper	h, g, I_f	Basic definitions	No model or distribution assumed, simple

Now assume that there is a journal *B* where 500 papers have been published, out of which 40 papers have at least 40 citations. The remaining number of papers has an average citation of 20 per paper, and the summation of the excess citations of the papers that are part of the *h*-core is 200. The *h*-index is 40, the *g*-index is, say, 50. The total number of citations for journal *B* is: $(40\times 40)+(460\times 20)+200$ = 1,600 + 9,200 + 200 = 11,000. The impact factor is $\frac{11000}{500} = 22$.

It means that although journal *B* has smaller values of *h* and *g* indices, its impact factor is larger than journal *A*.

As mentioned above, it may, however, happen exceptionally in cases where the citations of papers published in the journal might not have increased with the proportion of the number of papers published.

5. COMPARISON WITH RELATED WORKS

Many researchers have tried to investigate the relationships among different ranking parameters and for journals in different domains. A systematic analysis of *h*-type indices is carried out in [16], where the *h*-index is defined using Gumbel's *r*th characteristic extreme value. As a result, the *h*-index comes out to be approximately proportional to the (α+1)th root of the number of publications. The impact factor is assumed to be the *expected value* of a two parameter Pareto distribution. A comparative analysis between the impact factor and the *h*-index for pharmacology and psychiatry journals is carried out in [2]. Therein, a hypothesis for modeling the relationship between the *h*-index and the impact factor of a journal is discussed assuming that the citation rate of a paper is a random variable and follows the Pareto distribution.

A stochastic model for *h*-index of an author is proposed in [15] under the assumptions that the rate of publication of an author follows a Poisson distribution, any particular publication acquires a citation rate according to the Poisson process, and the citation rate of the author over a set of publication follows a Gamma distribution. With these assumptions, it is concluded in [14] that Hirsch's *h*-index, Egghe's *g*-index, and Kolsmulski's h_2-index are approximately directly proportional to the carrier length of an author.

On the other hand, an analysis of the *g*-index [10] is described in [4]. A relationship between *h*-index and *g*-index is discussed using Lotka's model, $f(j) = \frac{C}{j^{\alpha}}$, where, $j \geq 1$, $C > 0$, $\alpha > 2$. In [5], an analysis of the relationship between the impact factor and uncitedness factor is carried out assuming that the publication-citation relationship follows Lotka's model. A relationship between the impact factor, the *h*-index, and the *g*-index using the power law model is described in [6]. A relationship between the *h*-index, the *g*-index, and the *e*-index is described in [8], where indices are assumed to be modeled as continuous functions. A relationship between the number of papers published and the number of citations received with *h*-index is described in [12] for Paretian distribution. The role of the *h*-index and the characteristic scores and scales in testing the tail properties of scientometric distributions is studied in [13].

Our work is different from [6] in the sense that we do not use a specific model, such as Lotka's model, to derive the relationship between the impact factor and the indices. Moreover, our work is different from [8] in the sense that in [8], the relationships amongst the *h*-index, the *g*-index, and the *e*-index [7], are analyzed and not the impact factor. However, we do analyze the relationships between the impact factor, the *h*-index, and the *g*-index. Furthermore, as opposed to [8], where indices are assumed to be represented by continuous functions and the analysis is centered around the *e*-index; we use the original definitions of indices, which are discrete in nature, and our analysis is focused around the impact factor of a journal. Furthermore, as opposed to [16], we neither assume that the *h*-index can be defined using Gumbel's *r*th characteristic extreme value, nor do we assume that the impact factor follows a Pareto distribution. In other words, we start from the definitions of indices and the impact factor and derive the relationships between them without assuming that either of them follows a specific distribution or that they are represented by a continuous or smooth function.

In this paper, we have established relationships among the *h*-index, the *g*-index, and the impact factor of journals. These relationships are established using the definitions of indices and the impact factor of journals. Although, these relationships seem to be simple, however, during the course of the establishment of the relationships, we did not assume that any of these ranking parameters follow a specific distribution or a model. Table 3 provides a summary of the relationships between indices and impact factor as described by different researchers. Note that most of the relationships among indexing parameters assume that the indexing parameters follow a specific model/distribution. In the case of journals where the indexing parameters may not follow the particular model/distribution assumed, the relationships among the indexing parameters may not hold. In this paper, since the relationships among the indexing parameters are derived using their basic definitions, the absence of any assumption about a specific model/distribution enables the relationships to hold for all journals.

6. Conclusion

In this paper, we presented an analysis of the relationships between the generalized impact factor, the *h*-index, and the *g*-index. Starting from the basic definitions of *h*-index, *g*-index, and the generalized impact factor, we derived mathematical equations relating these parameters. In an attempt to validate the relationships, we computed these parameters for journals that belong to *networks and communication* groups in the area of computer science and engineering. We observed that journals, which have a greater value of the generalized impact factor, also possess greater values of *h*-index and *g*-index (and vice versa), except in a few cases. The exceptions are the journals with a large number of citations and a large number of papers published. These journals have enough number of highly cited papers to increase the *h*-index and *g*-index, even though they possess a relatively small impact factor. Another factor is that the number of citations might not have increased in the same proportions as that of the number of paper. Further validations for different research domains form the future works.

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