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Letter to the Editor

Ranked list and zonal distribution of periodicals in Bradford law

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Shows how periodicals are ranked in Bradford distribution and why. Also indicates how citations can be divided in three Bradford zones to obtain the value of 'n'.

Keywords: Bradford multiplier; Ranking of periodicals for Bradford distribution; Division of citations for Bradford zones.

This refers to the article 'Application of Bradford's Law on journal citations: A study of PhD theses in social sciences of University of Delhi' by K P Singh and Bebi[1]. In the article, the ranking of journals in Table 4 is incorrect. The mistake has been committed wherever there has been a tie. For example, *Punjab Journal of Politics;* and *Social Work* appearing against serial numbers 19 and 20 respectively have got 70 citations each. Here is a tie. In the Table, the ranking of both the journals is 19. This is OK. However, the ranking of the next journal i.e. *Journal of Development Economics* shown as 20 is wrong. It should be 21. If this method of ranking is followed, then the last periodical of the Table will occupy the 934th rank not 71st.

To show how ranking is done I am reproducing here Table 1 that was used for the deduction of Bradford's law. In Table 1, it can be seen that up to 9th rank all the nine periodicals were having different number of articles and the ranking was straightforward. Thereafter, a tie is observed where as many as four periodicals are having 16 citations each. Hence the ranking has jumped to 13th position. The next rank is 14 as there is only one periodical. This phenomenon can be explained with a simple analogy. Suppose there are 14 students in class. In one particular paper all the first nine students got different marks and they were ranked 1st to 9th in the descending order of marks. The next four students got the same mark. Now, all the 14 students are asked to stand in a queqe in the descending order of their marks. Up to 9th position there is no problem, as all have secured different marks. All the four students securing equal marks cannot occupy the 10th position, as each student has to be given a unique rank. Hence they are to occupy 10th to 13th position. The last student occupies the 14th position, and he cannot claim the 11th position because he is behind 13 students. In Bradford distribution, it is absolutely

Table 1—Productivity-wise distribution of Periodicals*

Rank	No. of Periodical/s	No. of Articles	Cumulative Total of Articles
1	1	93	93
2	1	86	179
3	1	56	235
4	1	48	283
5	1	46	329
6	1	35	364
7	1	28	392
8	1	20	412
9	1	17	429
13	4	16	493
14	1	15	508
19	5	14	578
20	1	12	590
22	2	11	612
27	5	10	662
30	3	9	689
38	8	8	753
45	7	7	802
56	11	6	868
68	12	5	928
85	17	4	996
108	23	3	1,065
157	49	2	1,163
326	169	1	1,332

*[Based on *Current Bibliography of Applied Geophysics* 1928-1931]

essential that periodicals are ranked only in this way. Otherwise different values relating to Bradford distribution cannot be derived correctly. I shall show this with examples.

Bradford law is mathematically expressed as $R(n) = an^b$ $[1 \le n \le c]$ … (1)

Here R(n) stands for the cumulative total of relevant papers found in the first n journals when all the journals are ranked in order of decreasing productivity. Basing the data in Table 1 we can find out the value of a and b[3].

In Table 1, it is seen that the first 20 periodicals account for 590 articles, and the first 30 periodicals account for 689 articles. In the first case. putting these values into the Eq. 1 we get

$590 = a. 20^b$ … (2)

$689 = a. 30^b$ … (3)

Dividing Eq. 3 by Eq. 2, we get

$689/590 = 30^b/20^b$

Taking log we get

log 689 - log 590 =

b log 30 - b log 20 = b (log 30 - log 20)

$\Rightarrow$ 2.8382 - 2.7709 = b (1.4771 - 1.3010)

$\Rightarrow$ 0.0673 = b (0.1761)

$\Rightarrow$ b = 0.382

Now, putting the value of b in Eq. 2, we get

$590 = a. 20^{.382}$

Taking log we get log 590 = log a + .382 log 20

$\Rightarrow$ 2.7709 = log a + .382 x 1.3010

$\Rightarrow$ 2.7709 = log a + .4970

$\Rightarrow$ log a = 2.7709 - .4970 = 2.2739

Taking antilog of 2.2739 we get 187.9 i.e. 188

The values we get are a = 188, and b = .382

With the values of a and b we can now determine the value of the cumulative total of references for the periodical of any rank.

Let us take 45th rank.

We have $R(n) = an^b$

Putting the values , we get $R(n) = 188 \times 45^{.382}$

= 188 x 4.276

= 803.888

=804, which is quite close to the observed value of 802.

The way periodicals have been ranked in Table 5 of Gupta and Bebi's article under discussion, the 45th rank of Table 1 of this writing would have been 18th rank and the number of citations would be

$R(n) = 188 \times 18^{.382} = 188 \times 3{,}016 = 567$

In place of 802 we shall get a totally wrong figure i.e. 567

Number of articles in Bradford zones

Bradford law is defined as "If scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the subject and several groups or zones containing the same number of articles as the nucleus, when the number of periodicals in the nucleus and succeeding zones will be as 1: n: n^2"[2]. According to the law each zone should have equal number of articles. Many a time we take citations instead of articles. In reality we don't find equal number of articles, almost always there is some deviation, which is rather nominal. In this article I find the deviations are pretty large. The total number of citations analysed in the study is 9997. Hence, each zone should have around 3332 citations. Table 6 of the article shows the number of citations in the three zones respectively are 2757 (676 less, i.e. 17% negative deviation), 3098 (234 less i.e. 7% negative deviation), and 4142 (810 more, i.e. 24% positive deviation) which are far from the expected number of citations. In two cases the variations are really wide. It can only be said that the formula used by the authors needs a great deal of refinement.

Instead of going through such tedious procedure for finding the number of citations in three different zones a simple method could have been applied as given below. We know each zone should have one-third of the total number of citations, i.e. 9997÷3 = 3332.3. Rounding off we get 3332 citations. In Table 5 of the article we see that the first 9 periodicals account for 3393 (deviation around +1.8%), next 81 periodicals account for 3332 citations (no deviation), and the last 844 periodicals account for 3272 citations (deviation around –1,8%). In this case the deviations are very small and can assume that the number of citations in all the three zones is more or less equal. Now the periodicals are in the ratio 9:81:844 i.e. 1:9:94. This shows that the value of n is 9. Bradford's data sets provide us the value of n ≈5. Bandyopadhyay[4] studied the values of 'n' aka Bradford multiplier in many disciplines. The values he obtained ranged between 1.79 for political sociology to 7.76 for nuclear physics. For different disciplines of social sciences he found the following values: Philosophy 5.21; Political science – 6.36; Political sociology – 1.79; Politics and government – 3.09; Psychology – 3.26; Socialism – 6.38;. Sociology – 5.22. In the study under discussion the value is quite high, i.e. 9. Why it is so may be the subject of another study.

References

1 Singh K P and Bebi, Application of Bradford's Law on journal citations: A study of PhD theses in social sciences of University of Delhi, *Annals of Library and Information Studies* 61(2) (2014) 112-120.

2 Bradford S C, *Documentation*. London: Crossby Lockwood, 1953. Ch. IX, p. 154.

3 Sen B K, Bradford distribution, Epathshala course material. Ahmedabad: INFLIBNET, 2014.

4 Bandyopadhyay A K, Bradford's law in different disciplines, *Annals of Library Science and Documentation*, 46 (4) (1999) 133-138.