Application of Lotka's Law in Library Science Literature of Select Central Universities in North India

Jyoti Sharma
Library Assistant
Dept.cum Centre for Women Studies and Development
Panjab University, Chandigarh, India,
Email: jyotisharma.puchd@gmail.com

Rupak Chakravarty
Associate Professor
Department of Library & Information Science
Panjab University, Chandigarh, India, Email: rupak@pu.ac.in

Abstract

The research output in the field of Library and Information Science by the faculties of central universities of North India has been carried out. The study covered a period of 36 years spanning between 1978 and 2014. A total of 1292 records of various types comprising Articles, conference proceedings, book & book chapter by 30 faculty members of the above said universities. It reveals that University of Delhi has contributed maximum publications 429 and Central University of Himachal Pradesh has contributed least number of publications 135.Testing of the validity of Lotka's law has been performed. The study has been found that Lotka's law is applicable to the present study.

Keywords

Lotka's Law, Central universities, North India, Library and Information Science, Central University of Himachal Pradesh, Dharmshala (CUHP), University of Delhi, Delhi (DU), Aligarh Muslim University, Aligarh (AMU), Banaras Hindu University, Varanasi (BHU), Babasaheb Bhimrao Ambedkar University, Lucknow (BBA).

Electronic access

The journal is available at www.jalis.in

Journal of Advances in Library and Information Science
ISSN: 2277-2219 Vol. 7. No.1. 2018. pp.36-39

INTRODUCTION

The research and publication have been given significant importance by the academia, the utility of the methods and techniques of measuring the research output or productivity has drawn considerable attention amongst the scholars, authors, and administrators. These methods attempt to quantitatively analyze academic literature. The set of such methods comprises the branch of study called Bibliometrics.There are three regularities originate in bibliometrics to which have been given the name "law": Lotka's law of Scientific Productivity (authors publishing in a certain discipline); Bradford's law of scattering (scattering of articles); Zipf's Law of Word Occurrence (ranking of the word frequency) is of the opinion, that the three laws are basically the same. One of their differences lies in the type of data. Lotka's law dealt with authors publications and the number of papers published; Bradford observed the spread of articles on specific subjects in various journals; Zipf counted frequencies of words. This research paper is dealing with Lotka Law.

In 1926, Alfred J. Lotka published his pioneering study on the frequency distribution of scientific productivity determined from a decennial index (1907-1916) of Chemical Abstracts. It states that the number (of authors) making n contributions is about $1/n^2$ of those making one; and the proportion of all contributors that make a single contribution is in the region of 60 percent. This means that out of all the authors in a given field, 60 percent will have just one publication; 15 percent will have two publications ($1/2^2$ times 60); 7 percent will have three publications ($1/3^2$ times 60), and so on.

OBJECTIVES OF THE STUDY

1. To study the growth of publications of central universities in the field of LIS
2. To test the fitness of Lotka's law on the LIS literature of central universities in North India.

METHODOLOGY

The data used for the present study was obtained by online questionnaire, websites of universities, emails and phone calls. The whole data of the present study based on 5 central universities in North India that are Central University of Himachal Pradesh, Dharmshala (CUHP), University of Delhi, Delhi (DU), Aligarh Muslim University, Aligarh (AMU), Banaras Hindu

University, Varanasi (BHU) and Babasaheb Bhimrao Ambedkar University, Lucknow (BBA). The study covered a period of 36 years spanning between 1978 and 2014. A total of 1292 records of various types comprising Articles, conference proceedings, book & book chapter by 30 faculty members of the above said universities. The study included only permanent teachers working in universities under study.

Table 1: Research Publications

SN	Name of the University	No. of Publications	Percentage	Cumulative Percentage
1	University of Delhi, Delhi (DU)	429	33.20	33.2
2	Babasaheb Bhimrao Ambedkar University, Lucknow (BBAU).	274	21.21	54.41
3	Aligarh Muslim University, Aligarh (AMU)	271	20.98	75.38
4	Banaras Hindu University, Varanasi (BHU)	183	14.16	89.55
5	Central University of Himachal Pradesh, Dharmshala (CUHP)	135	10.45	100.00
	Total	1292	100	

Table 1 presents central universities of North India and their number of publications along with their percentage. There are total 1292 publications contributed by these five central universities of North India. It reveals that University of Delhi has contributed maximum publications i.e. 429, which constitute 33.20 % of total research output of central universities followed by Babasaheb Bhimrao Ambedkar University i.e. 274, which constitute 21.21 %, Aligarh Muslim University i.e. 271, which constitute 20.98 %, Banaras Hindu University i.e. 183, which constitute 14.16 % and Central University of Himachal Pradesh contributed least number of publications i.e. 135, which constitute 10.45 % of total research output of central universities. It can be observed from the table that BBAU and AMU have contributed almost equal i.e. 21.21% and 20.98% respectively.

Testing of Lotka's Law

For the present study, Lotka's Inverse Power Law model that states the function describing the pattern of productivity of authors publishing in a specified subject field i.e., Library and Information Science in a fixed time period has been applied and it is mathematically represented as:

$$y = C \times x^{-n} \qquad (1)$$

where x is the number of publications of interest (1,2, etc.,);

n is an exponent that is constant for a given set of data;

y is the expected percentage of authors with frequency x of publications; and C is a constant The constant C is calculated using the following formula:

$$C = \frac{1}{\Sigma\, 1/x^{n}} \qquad (2)$$

The exponent n is often fixed at 2, in which case the law is known as the inverse square law of scientific productivity. However, given that the exponent n predicts the relative number of authors at each productivity level it would seem useful to calculate it. In the present study, least square method has been used. It can be expressed as follows:

$$N \frac{N\,\Sigma XY - \Sigma X}{N\,\Sigma X^{2} - (\Sigma X)^{2}} \qquad (3)$$

Where N is the number of data pairs considered;

X is the logarithm of x (x=number of articles); and Y is the logarithm of y (y=number of authors)

$$CV = \frac{1.63}{(\Sigma y_x + (\Sigma y_x/10)^{1/2})^{1/2}} \qquad (4)$$

Table 2: Distribution of Author Productivity

SN	No. of Contribution	No. of Authors	Percentage	Cumulative Percentage
1	1	1	3.33	3.33
2	7	1	3.33	6.66
3	10	1	3.33	10.00
4	11	1	3.33	13.33
5	16	1	3.33	16.66
6	18	2	6.67	23.33
7	19	1	3.33	26.66
8	21	1	3.33	30.00
9	27	1	3.33	33.33
10	28	2	6.67	40.00
11	30	2	6.67	46.66
12	36	1	3.33	50.00
13	48	1	3.33	53.33
14	51	1	3.33	56.66
15	55	1	3.33	60.00
16	56	1	3.33	63.33
17	57	2	6.67	70.00
18	59	1	3.33	73.33
19	60	1	3.33	76.66
20	62	1	3.33	80.00
21	66	1	3.33	83.33
22	71	1	3.33	86.66
23	77	1	3.33	90.00
24	79	1	3.33	93.33
25	81	1	3.33	96.66
26	113	1	3.33	100.00
Total	1159 (Total 1292)	30	--	--

Table 2 shows the distribution of number of publications published by each one of the author. In the present study, a total of 30 authors (faculty members) have contributed 1292 publications in the field of Library and Information Science. The study reveals that 6.67% authors have contributed 18, 28, 30 and 57 publications while rest authors 3.33% have contributed between 1 publication to 113 publications.

Table 3: Productivity of Authors based on Lotka's Law

SN	X	Y	XL	YL	SXL	XLYL	YSY	CF_YSY	XN	FE	CF_FE	D
1	1	1	0	0	0	0	0.03	0.03	1	1	1	-0.97
2	7	1	0.85	0	0.71	0	0.03	0.06	1.01	1	2	-1.94
3	10	1	1	0	1	0	0.03	0.1	1.01	1	3	-2.9
4	11	1	1.04	0	1.08	0	0.03	0.13	1.01	1	4	-3.87
5	16	1	1.2	0	1.45	0	0.03	0.16	1.01	1	5	-4.84
6	18	2	1.26	0.3	1.58	0.38	0.07	0.23	1.01	1	6	-5.77
7	19	1	1.28	0	1.64	0	0.03	0.26	1.01	1	7	-6.74
8	21	1	1.32	0	1.75	0	0.03	0.3	1.01	1	8	-7.7
9	27	1	1.43	0	2.05	0	0.03	0.33	1.01	1	9	-8.67
10	28	2	1.45	0.3	2.09	0.44	0.07	0.4	1.01	1	10	-9.6
11	30	2	1.48	0.3	2.18	0.44	0.07	0.46	1.01	1	11	-10.54
12	36	1	1.56	0	2.42	0	0.03	0.5	1.02	1	12	-11.5
13	48	1	1.68	0	2.83	0	0.03	0.53	1.02	1	13	-12.47
14	51	1	1.71	0	2.92	0	0.03	0.56	1.02	1	14	-13.44
15	55	1	1.74	0	3.03	0	0.03	0.6	1.02	1	15	-14.4
16	56	1	1.75	0	3.06	0	0.03	0.63	1.02	1	16	-15.37
17	57	2	1.76	0.3	3.08	0.53	0.07	0.7	1.02	1	17	-16.3
18	59	1	1.77	0	3.14	0	0.03	0.73	1.02	1	18	-17.27
19	60	1	1.78	0	3.16	0	0.03	0.76	1.02	1	19	-18.24
20	62	1	1.79	0	3.21	0	0.03	0.8	1.02	1	20	-19.2
21	66	1	1.82	0	3.31	0	0.03	0.83	1.02	1	21	-20.17
22	71	1	1.85	0	3.43	0	0.03	0.86	1.02	1	22	-21.14
23	77	1	1.89	0	3.56	0	0.03	0.9	1.02	1	23	-22.1
24	79	1	1.9	0	3.6	0	0.03	0.93	1.02	1	24	-23.07
25	81	1	1.91	0	3.64	0	0.03	0.96	1.02	1	25	-24.04
26	113	1	2.05	0	4.22	0	0.03	1	1.02	1	26	-25
Total		30	39.25	1.2	64.13	1.79	1			26		-337.25

It is appropriate to examine and analyse the implications of Lotka's law in relation to author productivity on research publications by select universities. To validate Lotka's law, a calculation was done using the equations (3 and 4) to identify the values of N and CV to test whether the concept of Lotka's law fits into the data of the present study or not. Thus, based on the data presented in Table 3, the calculated values of N and C are 0.01 and 0.04 respectively. The calculated critical value using equation (4) is 0.30 and the value of maximum difference (D) between the real and estimated accumulated frequencies is 0.06. Therefore, it is clear that D value 0.06 (Table 3) is less than the critical value 0.30 which resulted in convincing application of Lotka's law to the present study.

Steps followed while calculating Lotka law

1. Number of publications denoted as X
2. Number of authors denoted as Y
3. Take $\log_{10}$ of X and denoted as XL
4. Take $\log_{10}$ of Y and denoted as YL
5. SXL is Square of XL i.e., $(XL)^2$
6. XLYL is multiply of XL and YL i.e., XL*YL
7. YSY is Calculated by Dividing the Y values with total of Y i.e., $Y/\Sigma Y$
8. Take Cumulative Frequency of YSY i.e. CF_YSY
9. Calculate N according to equation (3)
10. XN is calculated $1/x^n$
11. Calculate C according to equation (2)
12. FE is calculated C*XN
13. Take Cumulative Frequency of FE i.e. CF_FE
14. Calculate D by subtracting CF_FE from CF_YSY i.e., CF_YSY- CF_FE
15. Calculate CV according to equation 4

CONCLUSION

The study reveals that University of Delhi has contributed maximum publications 429 and Central University of Himachal Pradesh has contributed least number of publications 135. Lotka's Law pertaining to author productivity is considered as one of the important classical law's of bibliometrics. This study clearly indicates that Lotka's generalized inverse square law is applicable to Library and Information Science publications by faculty members of central universities of North India during the period of 1978 to 2014. In this study it has been found N= 0.01, C= 0.04, C.V. = 0.30 and D = 0.06 for overall data using least square method.

REFERENCES

[1]. Sivakumar, N., & Sivaraman, P. (2013). Application of Lotka's Law in Biology Literature of Central Universities in India. *International Journal of Library and Information Science*, *2*(1), 61-70. Retrieved May 13, 2014 from http://www.iaeme.com/MasterAdmin/UploadFolder/Lotkas%20Law-2-3-4%5CLotkas%20Law-2-3-4.pdf

[2]. Tamilselvan,N.,Sivakumar,N. & Sevukan,R. (2013). Lotka's Law: A Study with Reference tothe Literature by Faculties of National Institutes of Technology, India. *International Journal of Library and Information Science (IJLIS)*, 2(1), 19-34.

[3]. Sen, B.K. (2010). Lotka's Law: A Viewpoint. *Annals of Library and Information studies*, 57(2),166-167.

[4]. Rowlands, Ian (2005). Emerald Authorship data, Lotka's Law and Research Productivity. Aslib Proceedings : New Information Perspectives, 57(1):5-10.

[5]. Yueh, Ming, Jou, Shiow-Jem and Ma, Sheau-Shin (2000). Bibliometric Study of Semiconductor Literature, 1978-1997. Scientometrics, 49: 491.509.

[6]. Kawamura, M…[et al] (1999). Lotka's Law and the Pattern of Scientific Productivity in the Dental Science Literature. Medical Informatics and the Internet in Medicine, 24(4):309-315.

[7]. Lotka, A.J. (1926). The Frequency Distribution of Scientific Productivity. Journal of the Washington Academy of Sciences, 16:317-323.

[8]. Booksten, A. (1979). Explanations of the Bibliometric Distributions. *Collect Mange* , 3(2-3), 151-162.

[9]. O'Connor, D. and Voos, H. (1981). Empirical Laws, Theory Construction and Bibliometrics. *Library Trends*, 30(1),9-20.