

Application of Lotka's Law in the field of "Human Biology Journal 2007"

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Abstract - This paper offers a sensible insight into the appliance of Lotka's law of author productivity to the question of however seemingly it's that associate degree author can come back to a specific publisher. By examining analysis articles printed in Human Biology Journals between February - November 2007, it's shown that whereas Lotka's inverse square law relating the amount of authors of papers to the amount of papers written by every author doesn't apply, a generalized version of Lotka's law remarked because the inverse-power law fits remarkably well.

Key Words: Bibliometrics, Lotka's law, Bradford's law, Zipf's law.

1.INTRODUCTION

Bibliometrics could be a sort of analysis methodology utilized in library and information science. It utilizes measuring and statistics to explain patterns of publication inside a given field or body of literature. Researchers might use bibliometric strategies of analysis to work out the influence of one author, as an example, or to explain the link between 2 or a lot of writers or works.

2.Definitions

Bibliometrics: The study of quantitative aspects of the assembly, dissemination, and use of recorded data.

It develops mathematical models & measures for these processes and then uses the method and measures for prediction and higher cognitive process.

(Tague-Sutcliffe, 1992)

Alan Pritchard 1969, Coined the term "bibliometrics" "The application of mathematical & applied math strategies to books and different media of communication" *Journal of Documentation* (1969) 25(4):348-349.

3.Application of Bibliometrics in

- ❖ History of science.
- ❖ Sociology of science.
- ❖ Science policy; resource allocation.
- ❖ Library choice, weeding, policies.
- ❖ Information organization.
- ❖ Information management.

4.Examples of usage

- ❖ Indexing.
- ❖ Collection development.
- ❖ Construction and maintenance of information organising systems.
- ❖ Sociology of science.
- ❖ Research analysis.

5.Bibliometrics Laws

One of the main areas in bibliometric research concerns the application of laws of bibliometric. The 3 most commonly used laws in bibliometrics are:

- ❖ Scientific productivity given by Lotka.
- ❖ Bradford's law of scatter.
- ❖ Zipf's law of word occurrence.

6.Bradford's Law

Bradford's Law (1934) is a general guideline to librarians in determinative the amount of core journals in any given field. It states that journals in an exceedingly single field will be divided into 3 components, every containing constant variety of articles:

- 1) A core of journals on the topic, comparatively few in variety, that produces close to tierce of all the articles,
- 2) A second zone, containing constant variety of articles because the 1st, however a bigger changes in journals, and
- 3) A 3rd zone, containing the constant variety of articles because the second, however a still bigger diversity of journals.

The mathematical relationship of the amount of journals within the core to the primary zone could be a constant n and to the second zone the link is n^2 . Bradford expressed this relationship as

$$1: n: n^2.$$

Bradford developed his law once finding out a listing of geology, covering 326 journals within the field. He discovered that nine journals contained 429 articles, fifty nine contained 499 articles, and 258 contained 404 articles. Therefore it took nine journals to contribute tierce of the articles, five times nine, or forty-five, to provide successive third, and five times five times nine, or 225, to provide the last third. As is also seen, Bradford's Law isn't statistically correct, properly speaking. However it's still ordinarily used as a general rule of thumb (Potter 1988).

7. Zipf's Law

Zipf's Law (9149) is commonly accustomed predict the frequency of words inside a text. The Law states that in an exceedingly comparatively drawn-out text, if you "list the words occurring inside that text so as of decreasing frequency, the rank of a word thereon list increased by its frequency can equal a continuing. The equation for this relationship is:

$$r \times f = k$$

Wherever:

- r = that the rank of the word,
- f = that the frequency, and
- k = the constant

(Potter 1988)

Zipf illustrated his law with associate degree analysis of James Joyce's odysseys.

"He showed that the tenth most frequent word occurred a pair of 2,653 times, the hundredth most frequent word occurred two hundred sixty five times, the two hundredth word occurred one hundred thirty-three times, and so on. Zipf found, then that the rank of the word increased by the frequency of the word equals a continuing that's close to 26,500" (Potter 1988). Zipf's Law, again, isn't statistically good; however it's terribly useful for indexers.

8. Lotka's Law

Lotka's Law (1926) describes the frequency of publication by authors in an exceedingly given field. It states that "... the amount (of authors) creating n contributions is regarding $1/n^2$ of these creating one; and therefore the proportion of all contributors, that build one contribution, is regarding sixty percent" (cited in Potter 1988, Lotka 1926). This suggests that out of all the authors in an exceedingly given field, sixty percent can have only one publication, and fifteen percent can have 2 publications ($1/2^2$ times .60). Seven percent of authors can have 3 publications ($1/3^2$ times .60), and so on. Consistent with Lotka's Law of scientific productivity, solely 6 % of the authors in an exceedingly field can manufacture over ten articles. Lotka's Law, once applied to giant bodies of literature over a reasonably long amount of your time, will be correct generally, however not statistically actual. It's usually accustomed estimate the frequency with that authors can seem in a web catalog (Potter 1988).

9. Alfred J. Lotka

Statistics - the statistical distribution of scientific productivity

Lotka's law of authorship describes the publication frequencies for authors inside a given domain- "... the amount (of authors) creating n contributions is regarding $1/n^2$ of these creating one; ... and therefore the proportion of all contributors, that build one contribution, is regarding sixty %."

(Lotka, 1926)

Lotka's law:

$$x^n \cdot y = C$$

The total variety of authors y in an exceedingly given subject, every manufacturing x publications, is reciprocally proportional to some exponential function n of x .

Where:

- x = variety of publications
- y = no. of authors attributable with x publications
- n = constant (equals a pair of for scientific subjects)
- C = constant

10. Review of Literature

A number of primary and secondary sources each printed and unprinted, are surveyed to organize this text. The literature survey reveals that the printed literatures during this field area unit varied scattered. It had been unimaginable to record all the literature for this review therefore; few omissions couldn't be avoided.

1. Han-Chou Lin, Chih-Lun Wu and Jiann-Min Yang (2011) investigates in her studies to explain literature growth and author productivity employing a bibliometric analysis - Lotka's Law of the publication output related to analysis on Theory of Reasoned Action (TRA) throughout the 28-year amount of 1982– 2009. The analysis results show that a comparatively giant share of authors (86.76%) contributed one article, that could be a lot of higher share than the 60% found in Lotka's original knowledge. Consistent with the K-S check, the distribution of frequency indexes of author productivity match Lotka's law.

2. Chang, Shu-Hsun; Chou, Chien-Hsiang; and Yang, Jiann-Mn,(2010) this paper investigates the options of technology acceptance model literature supported bibliometric methodology. The distribution of journal paper was additionally examined victimization Bradford's law and Lotka's law. Because the result, this analysis found that technology acceptance model literature contain a steady growth further because the citations. Concerning articles were concentrating on engineering science, data systems, management, information science, and humanities. The author productivity distribution knowledge in technology acceptance literature was according to Lotka's law.

3. Yu-Hsiang Yang and Rua-Huan Tsaih (2010) this study was to investigate to analyze the characteristics of research associated with evolution of selflessness from 1971 to 2009 inside the science citation index expanded (SCIE) and therefore the social science citation index (SSCI) databases. This article showed however the expansion of analysis associated with evolution of selflessness could be a acknowledge development, that statistics of the Bradford's Law known 10 core altruism-related journals, which the altruism-related knowledge doesn't work Lotka's law.

4. R. Sevukan and Jaideep Sharma (2008), the study presents a close analysis of research performance of biotechnology colleges in central universities of India from 1997-2006. The information used for the study were retrieved from 2 information sources, namely, Pub Med, NCBI (National Centre for Biotechnology Information); and international intelligence agency net of Science database— Science Citation Index Expanded (SCIE). The results indicate that the expansion of literature in biotechnology has steady raised from fifteen articles in 1997 to forty-three articles in a pair of 2006; two-authored publications predominate amongst the pattern of authorship; relevance of Lotka's law is valid from the values $n = 2.12$, $C = 0.669$, and $D = 0.027$ obtained victimization least square methodology.

5. Gregory B. Newby, Jane Greenberg, and Paul Jones (2002) this analysis applies Lotka's Law to data on open supply software system development. Lotka's Law predicts the proportion of authors at completely different levels of productivity. Authors examine data from the UNIX operating system, software system, that documents several open supply comes, and supply forge, one in every of the biggest resources for open supply developers. Authoring patterns found area unit adore previous studies of Lotka's Law for scientific and scholarly business. Lotka's Law was found to be effective in understanding software system development productivity patterns, and supply promise in predicting mixture behavior of open supply developers.

6. [Sen, B. K.](#), [Taib, C.A.b.](#) and [Hassan, M.F.b.](#) (1996) Reports results of a study to check the validity of Lotka's Law with in the field of library and information science (LIS), victimization the private authors taken from the annual Name Index of Library and Information Science Abstracts (LISA) for 1992 and therefore the annual Author Index of LISA for 1993 because the base for getting data. The author productivity patterns for these a pair of years was measured by noting: the amount of authors business one article, the amount of authors business a pair of articles and at last, the amount of authors business five articles. The worth for the Lotka factor (n) was calculated to be 3.23 for 1992 knowledge and 3.1 for 1993 knowledge. Concludes that Lotka's Law is applicable to the LIS field.

11. Objectives

The aim of the study is to look at the influence of Lotka's law. This can be examined from numerous viewpoints –

1. To verify the validity of Lotka's law.
2. To work out the worth of parameter (n) of the Lotka's equation.
3. To search out the sort of fabric this can be principally utilized by the researchers.
4. To search out Authorship Patterns within The journals.

12.Methodology:

This paper show, presumably for the primary time, that the author productivity distribution expected by lotka’s law for subject literatures additionally holds for publisher aggregates, during this case, all Emerald authors.

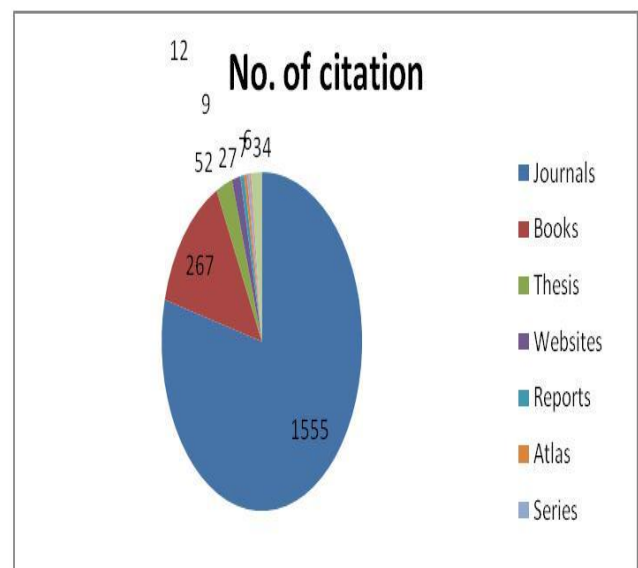
Table 1 - Types of Documents

S. No.	Types of documents	No. of citation	% of Citation	Cumulative	Cumulative %
1	Journals	1555	78.9740	1555	78.9740
2	Books	267	13.5602	1822	92.5342
3	Thesis	52	2.6409	1874	95.1751
4	Websites	27	1.3713	1901	96.5464
5	Reports	12	0.6095	1913	97.1559
6	Atlas	9	0.4571	1922	97.6130
7	Series	7	0.3555	1929	97.9685
8	Conference	6	0.3047	1935	98.2732
9	Others	34	1.7268	1969	100.000

13.Data Analysis:

The data obtained were analyzed victimization statistics ways in which, as this was helpful for making frequency tables for every of the variables. The Human Biology Journal 2007, v 79. No 1 to 6. was analyzed victimization content analysis.

a) Table one show the bulk of the literature has been printed in journals. Table one shows that journal articles from the bulk of the literature output (78.97 per cent) followed the books 13.56 per cent, thesis 2.64 per cent, websites 01.37 per cent, and reports 0.60 per cent. It’s discovered that the articles being a distinguishing supply perpetually raised throughout the amount of study. The table additionally shows that, the Journals area unit principally utilized by the researches.

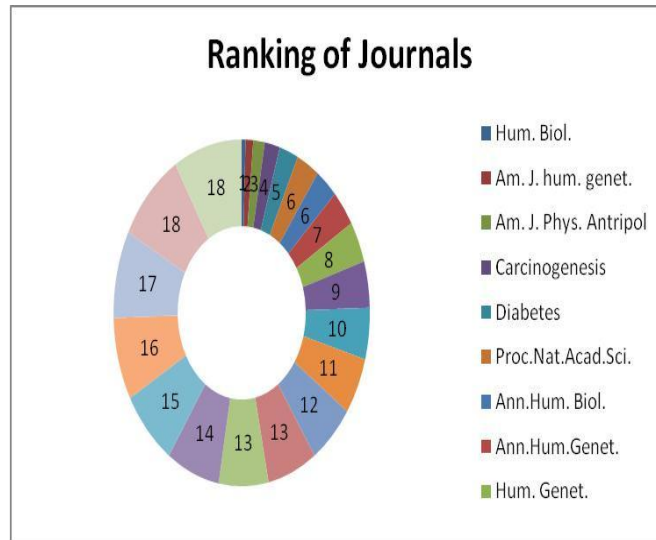


b) Table two shows that top two journals are core journals next four journals are second core and last 16 contain third

zone of core journals. The literature covered in the present study comprises a total of 1555 articles published in 21 journals.

Table 2 - Ranking of Journals

S.N.	Journal Name	Ra. Of Jo.	No. of Cit	% of cit.	Cumula.	Cuma. %
1	Hum. Biol.	1	288	18.5209	288	18.5209
2	Am. J. hum. genet.	2	234	15.0482	522	33.5691
3	Am. J. Phys. Antripol	3	197	12.6688	719	46.2379
4	Carcinogenesis	4	158	10.1608	877	56.3987
5	Diabetes	5	129	08.2958	1006	64.6945
6	Proc.Nat.Acad.Sci.	6	94	06.0450	1100	70.7395
7	Ann.Hum. Biol.	6	94	06.0450	1194	76.7845
8	Ann.Hum.Genet.	7	79	05.0804	1273	81.8649
9	Hum. Genet.	8	68	04.3729	1341	86.2378
10	Genetics	9	51	03.2797	1392	89.5175
11	J.Bone Miner.Res.	10	47	03.0225	1439	92.5400
12	Nature	11	32	02.0579	1471	94.5979
13	Science	12	23	01.4791	1494	96.0770
14	Mol.Biol.Evol.	13	15	00.9646	1509	97.0416
15	J.Am. Med. Assoc.	13	15	00.9646	1524	98.0062
16	Forensic sci. int.	14	12	00.7717	1536	98.7779
17	J.Boil.Chem.	15	8	00.5145	1544	99.2924
18	Biochem.Biophys.res	16	5	00.3215	1549	99.8068
19	Genet. Epidemiol	17	4	00.1929	1553	99.8711
20	Circulation	18	1	00.0643	1554	99.9354
21	Cell	18	1	00.0643	1555	99.9997



C) The table three shows that the current year articles are generally used by the researchers

Table 3 – Chronological study of Journals

S.N.	Years	No. of citation	% of citation	Cumulative	Cumulative %
1	2007	12	0.836	12	00.836
2	2006	54	3.765	66	04.601
3	2005	104	7.252	170	11.862
4	2004	123	8.577	293	20.436
5	2003	116	8.089	409	28.519
6	2002	129	8.995	538	37.514
7	2001	125	8.716	663	46.230
8	2000	104	7.252	767	53.482
9	1999	99	6.903	866	60.385
10	1998	84	5.857	950	66.242
11	1997	70	4.881	1020	71.123

d) The fourth table shows that the last few years printed journals make good library collection.

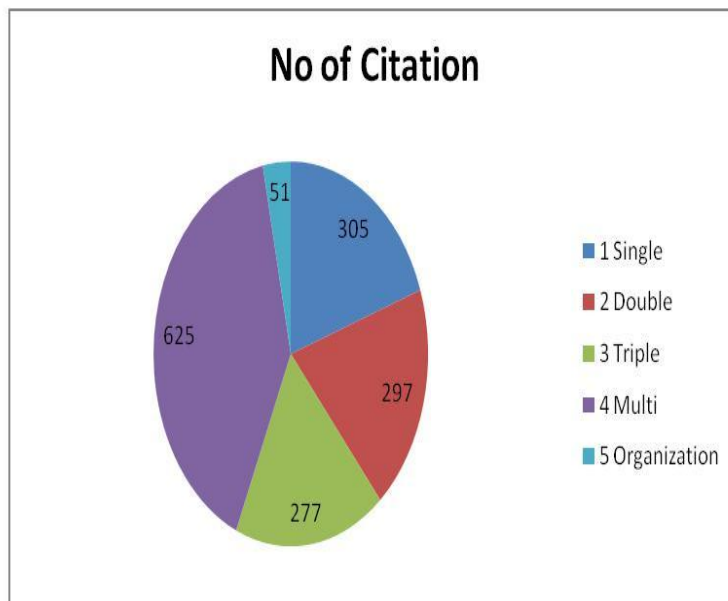
Table 4 – Obsolescence of Journals (Obsolescence Year= 2007)

S.N.	Pub. Year	No. of citation	% of citation	Cumulative	Cumulative %
1	2007	0	0.000	0	0.000
2	2006	1	0.526	1	0.526
3	2005	2	1.052	3	1.578
4	2004	3	1.578	6	3.156
5	2003	4	2.105	10	5.261
6	2002	5	2.631	15	7.892
7	2001	6	3.153	21	11.049
8	2000	7	3.684	28	14.733
9	1999	8	4.210	36	18.943
10	1998	9	4.736	45	23.679
11	1997	10	5.263	55	28.942

e) It is a well known fact that nowadays, research is carried out by group of researchers rather than by a single researcher. Therefore, the data were analyzed to know the authorship pattern. As a result, multi-authorship necessarily increases productivity and always results in high citation impact. It is evident from Table 5 that multi-authored papers rank first in order sharing 40.24 per cent of the total research output. The single-authored papers follow second in order taking 19.62 per cent of the total research contributions. The table shows the Multi-authors are dominant in the subject field.

Table 5 – Authorship Patterns

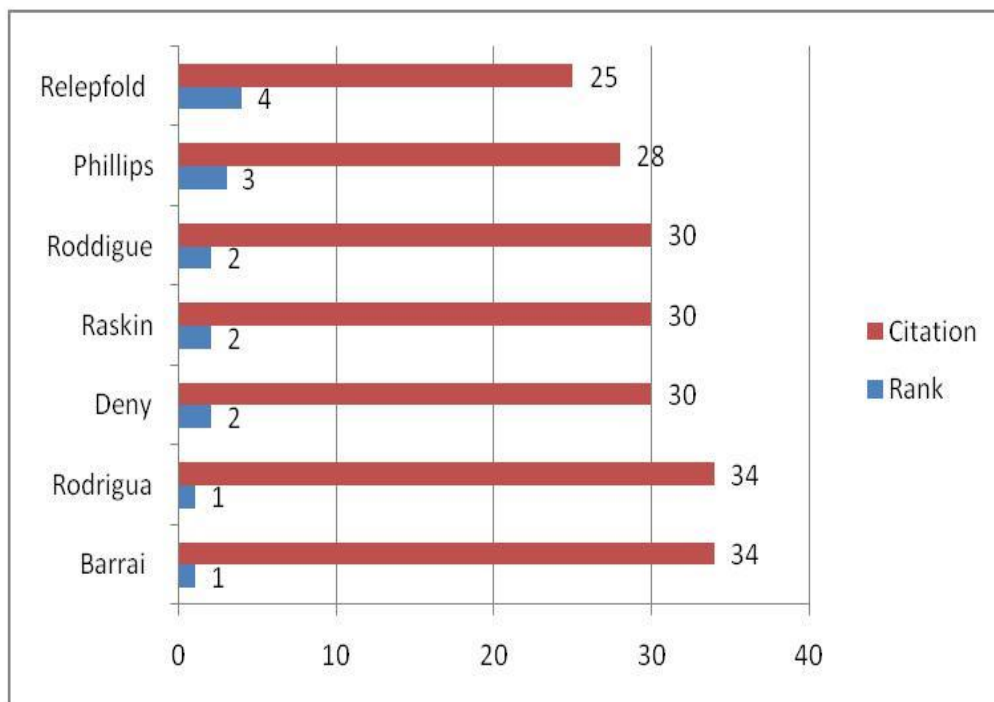
S.N.	Author Type	No of Citation	% of citation	Cumulative	Cumulative %
1	Multi	625	40.24	625	40.24
2	Single	305	19.62	930	59.86
3	Double	297	19.18	1227	79.04
4	Triple	277	17.82	1504	96.86
5	Organization	051	03.13	1555	99.99



f) Table six shows that two authors occupy first rank jointly, three authors score second rank and one author has third rank.

Table 6 - Ranking of Authors

S.N.	Auth.	Rank	Citation	Citation %	Cumulative	Cumulative %
1	Barrai	1	34	04.88	34	04.885
2	Rodrigua	1	34	04.88	68	09.770
3	Deny	2	30	04.31	98	14.082
4	Raskin	2	30	04.31	128	22.706
5	Roddigue	2	30	04.31	158	26.726
6	Phillips	3	28	04.03	186	30.462
7	Relepfold	4	25	03.74	212	34.198



Calculation of the parameter (n) of the Lotka's equation

$$n = \frac{[N \sum (\ln x \ln g(x)) - E \ln g(x) E \ln x]}{[N \sum (\ln x)^2 - (E \ln x)^2]}$$

Where-

x= no. of paper
g (x) = no. of authors contribution
N = total number.

x	g (x)	ln (x)	ln g (x)	lnx*lng(x)	lnx*lnx
1	366	0.00	2.5635	0.0	0.0
2	438	0.3010	2.6415	0.7951	0.0906
3	192	0.4771	2.2833	1.0894	0.2276
4	156	0.6021	2.1931	1.3205	0.3625
5	120	0.6989	2.0792	1.4532	0.4886
6	40	0.7782	1.6021	1.2468	0.6055
7	24	0.8451	1.3802	1.1664	0.7142
8	36	0.9031	1.5563	1.4055	0.8156
9	18	0.9543	1.2553	1.1979	0.9106
10	64	1.0000	1.8062	1.8062	1.000
11	20	1.0414	1.3010	1.3548	1.0845
12	30	1.0792	1.4771	1.5941	1.1643

$$n = \frac{[N \sum (\ln x \ln g(x)) - E \ln g(x) E \ln x]}{[N \sum (\ln x)^2 - (E \ln x)^2]}$$

$$n = \frac{(12*14.4299)-(22.9388*8.6804)}{(12*7.4640)-(8.6803*8.6803)}$$

$$n = \frac{173.1588 - 199.1182}{89.5680 - 75.3476}$$

$$n = \frac{-25.9594}{14.2204}$$

$$n = -1.8255$$

Answer = Thus the value of n is -1.83

14.CONCLUSION:

From above study it is verified that Lotka's law is valid and found to be true. This study can support improvement of evaluating their current situation regarding book selection policy for library professionals. It could be deduced from the above discussion that journal articles predominate over other sources of publications. For authorship patterns it is found that Multi-authors are dominant in the subject field. The value of parameter (n) of the Lotka's equation is -1.8255.

REFERENCES

- [1] Human Biology journal, 2007, v 79. No 1 to 6.
- [2] Informetrics and Scientometrics, IGNOU Study Material (MLIS- E5).
- [3] Gupta, B. M. (ed.) (1996). Bibliometrics, Scientometrics and Infometrics. New Delhi: Segment Books.
- [4] Han-Chou Lin, Chih-Lun Wu & Jiann-Min Yang (2011). A Productivity Review Study on Theory of Reasoned Action Literature Using Bibliometric Methodology: *International Conference on Management and Service Science, IPEDR vol.8 (2011), Singapore, IACSIT Press.*
- [5] Chang, Shu-Hsun; Chou, Chien-Hsiang; and Yang, Jiann-Min, (2010). "The Literature Review of Technology Acceptance Model: A Study of the Bibliometric Distributions" (2010). *Proceedings of PACIS 2010*. Page 158.
<http://aisel.aisnet.org/pacis2010/158>.
- [6] Yu-Hsiang Yang and Rua-Huan Tsaih (2010). An investigation of research on evolution of altruism using informetric methods and the growing hierarchical self-organizing map. *Malaysian Journal of Library & Information Science, Vol. 15, no.3, Dec 2010: 1-17* Page 1.
- [7] R. Sevukan and Jaideep Sharma (2008). Bibliometric Analysis of Research Output of Biotechnology Faculties in Some Indian Central Universities. *DESIDOC Journal of Library & Information Technology, Vol. 28, No. 6, , page no. 11-20, November 2008.*
- [8] Gregory B. Newby, Jane Greenberg, and Paul Jones (2002). Open Source Software Development and Lotka's Law: Bibliometric Patterns in Programming. *Journal of the American society for information science and technology, 54(1):000-000, 2002.*
- [9] [Sen, B. K.](#), [Taib, C.A.b.](#) and [Hassan, M.F.b.](#) (1996). Title: Library and information science literature and Lotka's Law Subjects: [Malaysian Journal of Library & Information Science](#) Volume: 1 Number: 2 page: 89- 93.
- [10]<http://www.ischool.utexas.edu/~palmquis/courses/biblio.html>
- [11]<http://www.emeraldinsight.com/journals.htm?articleid=1464991&show=pdf>