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Revisiting De Solla Price: growth dynamics studies of various subjects over last one hundred years

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The stalwart historian of science, Derek J. De Solla Price delivered a series of lectures at Brookhaven National Laboratory in 1962, which was dedicated to discussing science and its interaction with society. The collection of these lectures was published in 1963 as a book entitled *Little Science, Big Science*. Here, Price empirically established that the initial exponential growth pattern of literature reaches a ceiling after a certain time span, which results a logistic growth pattern. This paper analyses Price's empirical theory on the basis of 198 articles that presented growth of literature of variant subjects published since 1913 to 2018. In all, 214 growth models were reported by the 198 articles that analysed growth of literature of more than 50 subjects. It is found that growth patterns reported by nearly 50% articles followed Price's empirical theory, i.e., exponential and logistic growth pattern while remaining 50% articles followed other growth patterns, viz., power model, linear model, etc. All growth models reported by the 198 articles were broadly categorised into five groups on the basis of statistical characteristics, viz., (exponential + logistic), growing without definite pattern (GWDP), linear, non-linear and decaying models. The null hypothesis formulated states that 214 growth models observed by different subjects described in 198 articles will follow either of the five patterns that will be guided by Bradford's Law of Bibliographic Scattering. The null hypothesis is accepted by Chi-square test. It is inferred that the distribution of different models of growth of literature is guided by Bradford's Law where the core or nucleus zone is occupied by the logistic and exponential model, i.e. Price's empirical model prevails in Bradford's nuclear (core) zone.

Keywords: Growth of literature; De Solla Price; Literature growth; Exponential growth; Logistic growth

Introduction

The term 'growth' indicates an augmentation in original size, which implies a change of state or size. The concept of growth holds extensive spectrum of connotations, for instance, cell growth, bacterial growth or organism growth in the context of biological sciences. The domain auxology covers all aspects of physical growth in the context of human physiology, growth of resource, goods, market and services in the context of economics, commerce and management etc. The patterns of growth curves are described in mathematics by different names, i.e. exponential, power, linear, logistic, hyperbolic etc. The growth of primary or secondary sources of information belonging to any subject domain over time is being studied since 1913. As the sources of information of any subject area is known as the literature, this kind of study is also popularly known as “study of growth of literature”. The scope of this study is normally defined under bibliometrics, informetrics or scientometrics. This kind of study achieved special significance particularly after De Solla Price' masterpiece entitled *Little science, Big science* that he published in 1963[1].

The theoretical foundation of growth dynamics study of literature was laid down by De Solla Price in this book on the basis of simple logical analysis. It was shown argumentatively with aid of few observations that the growth pattern follows exponential graph initially with a ceiling that after a certain time span that is different for different subject domains. The resultant curve as a consequence acquires the logistic 'S'- shaped pattern. Recent studies on scientific growth focus mainly on two aspects— increase in scientific manpower and increase in the stock of scientific knowledge. The number of science periodicals including abstracting sources are the basic indicators of scientific growth.

Growth of scientific literature and knowledge studies are highly interdisciplinary in nature, and significant contributions are from library and information science field, as is evident from the bibliographic databases. This paper surveyed a sample of 198 relevant papers to explore 214 growth models of various subjects. The hypothesis is formulated on the basis of Price's theory and the same has been tested on the basis of practical data obtained from the collected sample.

Review of literature

Many studies in information science (and other subjects) have investigated the growth of science[2,3,4]. The systematic study of growth and obsolescence of literature of any subject is termed as "the study of literature dynamics". Tabah[5] stated, "the information science approach is to follow the published literature and infer from the growth of the literature the movement of ideas and associations between scientists". Besides *Little science, Big science*, Price undertook many significant works on literature dynamics in the years 1961, 1951 and 1965[6]. He analyzed the references listed in the 1961 edition of the Science Citation Index (SCI, Thomson Reuters) and the research papers published in the *Philosophical Transactions of the Royal Society of London*. His results show that science is growing exponentially in a certain period by a certain percentage and doubles every 10 to 15 years. The exponential growth in science established by Price has become today a generally accepted theory which has also been confirmed by other studies[6,7]

The hypergraph model was proposed to represent generalised network of literature of science, where the papers were considered as hypergraph nodes[8]. Kwiek[9] studied systematic inequality in knowledge production as argued by Lotka and Price across highly productive academics in 11 European countries. The academic attitudes, behaviours and perceptions as predictors of becoming top performers across European systems were also incorporated. Urban[10] analysed social, political and cultural impact on growth of science through regression analysis. Price's theory of differences among the sciences included three important points in regard to knowledge in science. It was analysed through citation context studies that described the process of knowledge building[11,12]. These papers described Price's tool to describe and compare differences among the sciences in their processes of knowledge growth along with the continuous change of sciences under the influence of new instruments or new sponsors. The rate of growth of science and the increase of obsolescence with age of scientific papers was observed by Gilbert et al[13].

Gilbert[14] reviewed a number of indicators of the growth of science to assess their strengths and weaknesses. The study focused on the problems involved in measuring two aspects of scientific growth—growth in manpower and growth in knowledge. Dedijer[15] found that since 1945, a rapid growth is seen in the disciplines of sociology, philosophy, psychology and history of science. An index for its socioeconomic development was introduced on the basis of quantitative data on a nation's research effort. Brookes[16] carried out simultaneous growth, utility and obsolescence study of scientific periodical literature (1970). The study of Tague, Beheshti and Lorna[17] showed that the innovative features of an article are reflected through citation counts as predicted by Price and other bibliometricians. In 1963, Price said[1], "There is a possibility that the exponential law is breaking down". Exponential growth cannot go on forever. The study concluded that growth studies of literature need to become more exact in the description of their models and more rigorous in the application of statistical tests to determine how well these models fit reality.

Fernandez-Cano[18] conducted a study to analyze Price's model of scientific growth. The study showed an integrative review using retrieved empirical studies that exposes the complexity and diversity of models of scientific growth and the absence of consistent patterns. Szydlowski & Krawiec[19] discussed the concepts of knowledge and its accumulation used in economic growth theory. They applied differential equations to model the evolution of science including additional aspects such as the death of results, the time required to learn or to apply results to new discoveries. Heinzkill[20] analyzed 9556 footnotes in 15 different journals. The study showed that about 70 percent of all material cited is over ten years old. Meadows[21] verified that the overgrowth had previously been acknowledged in the 19th century, provoking exasperated reactions due to the declining readability of scientific literature.

Many works are based on Price's classic, *Little Science, Big Science*, usually abbreviated as LSBS. Lievrouw[22] discussed the possibility of comeback of little science modes of communication contrasting big science conventions dominating research policy, scientific institutions, and the publishing industry.

The growing use of more participatory, interactive "Web 2.0" technologies and social media in science today (e.g. wikis, blogs, tagging and bookmarking, conferencing, etc.) may signal such possibilities. Furner[23,24]carried out genesis study of LSBS in the context of the of science in the UK and the USA in the late 1950s. He showed that Price's ideas were formulated during a pivotal period in the development of socio-historical studies of science.

Andersen and Hammarfelt[25] studied the production of dissertations in eight research fields in the natural sciences, the social sciences and the humanities on the basis of Price's theory which used PhD dissertations as one of several indicators of scientific growth. Glänzel and Schoepflin[26] said, "Since the beginning of the eighties, bibliometrics has evolved into a distinct scientific discipline with a specific research profile, several subfields and the corresponding scientific communication structures (publication of the international journal *Scientometrics* in 1979 as the first periodical specialised on bibliometric topics). The funding of big projects seems to have become the regular way of financing research in scientometrics. Thus, from "Little Scientometrics" the field has become "Big Scientometrics"." Price's idea of transitional phase of science research from 'little science' to 'big science' is reflected in Glanzel's paper in the context of scientometrics/ bibliometrics.

Growth dynamics study: objectives and limitations

The number of articles published in science periodicals including abstracting periodicals are simple indicators of scientific growth. Price[1] argued that scientific literature over the years show exponential growth pattern and calculated the growth rate as 5% over the eighteenth and nineteenth centuries. He observed that once in fifteen years science literature doubled[27,28,29]. Neelameghan[30] analysed the documents on the history of medicine in India over the period 1954-61. The notable point was that during the period, Indian contribution was 65% and foreign contribution was 30%. He also studied the coverage of Indian medical literature in *Index Medicus* and *Excerpta Medica* and it was found that they covered only 38% and 13.5% of the Indian literature respectively. There are number of articles published on this topic, particularly on the growth of literature in different subjects. These articles chiefly focus the following four issues, i.e., numerical growth of literature and its temporal variation, obsolescence studies, coverage by Science Citation Index (SCI) and other indexing & abstracting databases, and analysis of growth pattern to theorise different growth models based on mathematical functions. This paper focuses on the last point, i.e. theorising growth models.

The empirical theory enunciated by De Solla Price is tested here on the basis of 198 articles that lead to growth of literature of variant subjects published since 1913 to 2018. These articles reported 214 growth models of more than 50 subjects over the years. The research problem is to testify to what extent Price's empirical theory is followed by the concerned subjects. The next objective is to carry out the growth dynamics study of literature on growth of literature of various subjects and to find out the specific subjects considered till date to carry out growth dynamics study.

Methodology and sample collection

In all, 198 articles on growth dynamics published since 1913 to 2018 are collected to find out growth models of the concerned subjects discussed therein. The complete bibliographic details of these 198 articles are given in Annexure I, which comprise the sample for this study. The thorough inspection of these 198 articles instantly categorises the growth models observed therein as follows, i.e. exponential (35%), irregular (31%), logistic (15%), linear (9%), power (5%), decaying (2.3%), epidemic (2%), Gompertz (1%) and logarithmic (0.5%) (Fig. 1).

Nearly one-third (31%) of the articles followed no definite mathematical function that indicates high empirical nature of the subject domain. Of these, epidemic model may be classed under exponential model as it indicates the sharp exponential growth. As the initial part of the logistic growth is exponential, an exponential graph may be considered

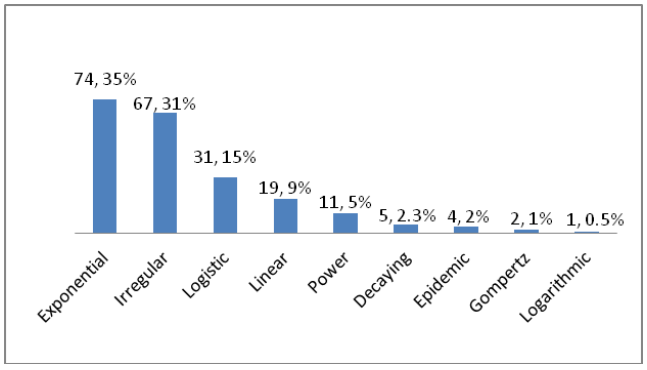

Fig. 1 — Growth models reported in 198 articles

as a component of a logistic graph. The continuing exponential growth results absurd conclusion that is practically impossible. The logistic curve actually limits the exponential growth curve by placing a ceiling of saturation at the tail of it.

The growth models following either of exponential, or logistic patterns are categorised under (Exponential + Logistic) model. The power, Gompertz and logarithmic models are categorised under non-linear model. The irregular growth model indicates the growth pattern following no definite mathematical function or erratic growth most likely resulting in unpredictable inference and are classed under Growing Without Definite pattern (GWDP). Besides, five articles reported negative growth or decaying of literature. The growth models of 198 articles are finally analysed under five categories, i.e. Decaying, Non-Linear, Linear, Growing Without Definite Pattern (GWDP) and (Exponential + Logistic). Some articles reported more than one growth model resulting in the 198 articles belonging to 214 models (Table 1).

Testing of hypothesis formulated

Null hypothesis is that the 214 growth models observed by different subjects described in 198 articles will follow either of the five patterns that will be guided by Bradford's Law of Bibliographic Scattering[31], which estimates the exponentially diminishing returns of searching for references in science journals. It is also stated as if journals in a subject domain are sorted by number of articles into three or more groups, each with about one-third of all articles, then the number of journals in each group will be proportional to $1:n:n^2:n^3$..... [32] Thus, according to null hypothesis, the ratio of 214 growth models described in 198 articles will follow Decaying, Non-Linear, Linear, Growing Without Definite Pattern (GWDP) and (Exponential + Logistic) patterns will be in the ratio, 1:2:4:8:16 (Taking n=2). It is the minimum possible ratio as per Bradford's Law as the minimum possible integral value of 'n' is 2. The total frequency in this case is 1+2+4+8+16 = 31, and the expected frequencies are: (16/31)*214=110, (8/31)*214=55, (4/31)*214=28, (2/31)*214=14 and (1/31)*214=7. As the (exponential + logistic) patterns are logically established by Price's theory, it is taken as most likely model whereas the decaying pattern is taken as most unlikely model as it is just opposite to growth function.

As $\chi^2 = \sum\{(f_o-f_e)^2/ f_e\}$, where f_o = Observed frequency and f_e = Expected frequency, the value of χ^2= 6.079 (Table 1). As all reported growth patterns are grouped into five growth models, therefore the number of classes is five, and the degrees of freedom is (5-1) = 4. Since the observed value of χ^2 (viz. 6.079) is less than the tabulated value 13.28 at 1% for four degrees of freedom, therefore the null hypothesis cannot be rejected at 1% level of significance. The conclusion is that the data are in agreement with the hypothesis that the ratio of 214 growth models described in 198 articles will follow Decaying, Non-Linear, Linear, Growing Without Definite Pattern (GWDP) and (Exponential + Logistic) patterns in the ratio at per Bradford's law.

Analysis

The first article that reported growth of literature on yeast was published in 1913 in German. In all, 198 articles were published since 1918 to 2018, the number of publications (frequency) in different years are presented in Table 2. The cumulative frequencies are also presented. The regression analysis of all observed cumulative frequencies data yielded the polynomial graph, i.e.

$y = a*x^4 + b*x^3 + c*x^2 + d*x + e$, where a, b, c, d and e are constants. The values of these constants are: $a = -4.325660102\cdot10^{-6}$; $b = 1.154595826\cdot10^{-3}$; $c = -7.295568847\cdot10^{-2}$; d = 1.868687038 and e = -6.154763858.

Figure 2 represents the frequency-time graph based on the data in Table 2. The continuous line represents the expected graph and the dots represent the observed values. The Residual Sum of Squares (RSS) = 500.1483258 and the Coefficient of Determination: R^2 = 0.9979708133. As the observed values are in close proximity of the expected values, it may be asserted that the growth of literature on growth dynamics studies follows polynomial pattern.

Table 1 — Observed and expected frequencies of growth models

Growth model	(Exponential + Logistic)	Growing Without Definite Pattern (GWDP)	Linear	Non-Linear	Decaying	Total
Frequency (Observed, f_o)	109	67	19	14	5	214
Frequency (Expected, f_e)	110	55	28	14	7	214

Table 2 — Publication timeline of articles that have reported growth of literature

Year	Frequency (No. of articles published)	Cumulative Frequency (Observed)	Cumulative Frequency (Expected)	Year	Frequency (No. of articles published)	Cumulative Frequency (Observed)	Cumulative Frequency (Expected)
1913	1	1	-4.4	1985	6	71	67.8
1917	1	2	1.5	1986	2	73	70.8
1923	1	3	7.0	1987	1	74	73.8
1927	1	4	9.1	1988	3	77	77.0
1929	1	5	9.8	1989	2	79	80.2
1930	1	6	10.1	1990	3	82	83.5
1931	2	8	10.4	1991	3	85	86.9
1934	1	9	10.9	1992	7	92	90.4
1935	4	13	11.1	1993	4	96	93.9
1937	1	14	11.3	1994	2	98	97.6
1938	1	15	11.4	1995	1	99	101.2
1939	1	16	11.5	1996	2	101	105.0
1947	1	17	12.9	1997	3	104	108.8
1949	1	18	13.5	1998	5	109	112.7
1952	1	19	14.7	1999	7	116	116.7
1957	1	20	17.7	2000	6	122	120.7
1960	1	21	20.2	2001	5	127	124.8
1963	1	22	23.3	2002	2	129	129.0
1966	2	24	27.0	2003	5	134	133.2
1969	1	25	31.5	2004	3	137	137.5
1970	5	30	33.1	2005	5	142	141.8
1971	4	34	34.9	2006	6	148	146.1
1972	3	37	36.7	2007	4	152	150.5
1973	1	38	38.5	2008	5	157	155.0
1974	2	40	40.5	2009	4	161	159.5
1975	1	41	42.6	2010	8	169	164.0
1976	1	42	44.7	2011	3	172	168.6
1977	4	46	46.9	2012	4	176	173.2
1978	3	49	49.2	2013	3	179	177.8
1979	4	53	51.6	2014	2	181	182.5
1980	3	56	54.1	2015	5	186	187.1
1981	3	59	56.7	2016	2	188	191.8
1982	2	61	59.3	2017	7	195	196.5
1984	4	65	64.9	2018	3	198	201.2

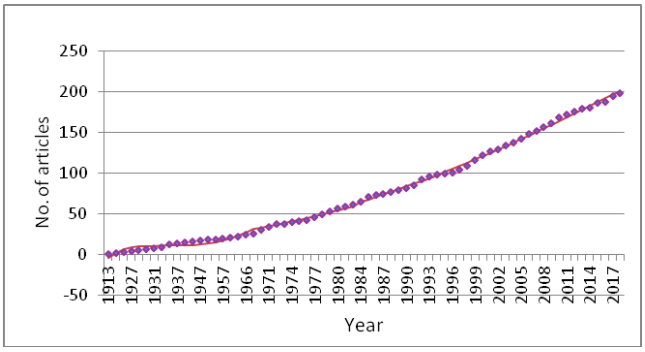

Fig. 2 — Cumulative number of articles published from 1913 to 2018

The subject domains of the 198 articles are listed in Table 3. The Dewey Decimal Class numbers up to second summary of the concerned subjects are also given with respective frequencies and percentages. The variation of subject domains are presented in Fig. 3 while the same in accordance with broad disciplines are presented in Fig. 4. It has been found that largest number of growth dynamics studies were performed in pure sciences (16.2%), followed by medical science (13.1%), life science (11.1%), chemistry (9.1%) and physics (8.6%). Other notable subject areas are engineering science, library and

Table 3 — Subject domains of 198 articles

Subject domains	DDC Class No. (2nd summary)	Frequency & Percent
Computer Science	004	1 (0.5%)
Library & Information Science	020	11 (5.6%)
Psychology	150	1 (0.5%)
Philosophical Logic	160	1 (0.5%)
Social Science	300	6 (3.0%)
Sociology & Social Anthropology	301	3 (1.5%)
Economics	330	2 (1.0%)
Social Service & Social Problems	360	1 (0.5%)
Education	370	1 (0.5%)
Pure Science	500	32 (16.2%)
Mathematics	510	6 (3.0%)
Astronomy	520	2 (1.0%)
Physics	530	17 (8.6%)
Chemistry	540	18 (9.1%)
Earth Sciences (Geology)	550	9 (4.5%)
Life Science (Biology)	570	22 (11.1%)
Botany	580	3 (1.5%)
Zoology	590	1 (0.5%)
Technology (Applied Sciences)	600	3 (1.5%)
Medical Science	610	26 (13.1%)
Engineering Science	620	15 (7.6%)
Agricultural Science	630	1 (0.5%)
Home Science	640	2 (1.0%)
Business & Management	650	2 (1.0%)
Chemical Technology	660	8 (4.0%)
Literature	800	2 (1.0%)
English Literature	820	2 (1.0%)

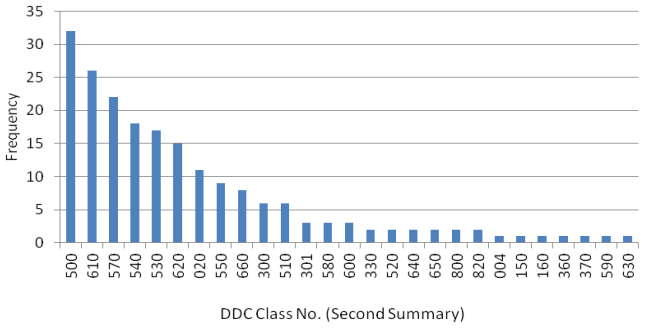

Fig. 3 — Variation of subject domains

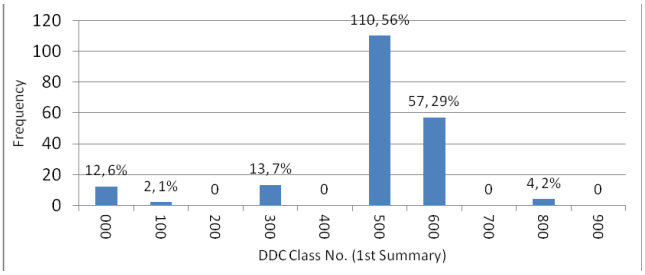

Fig. 4 — Variation of subject domains (Discipline-wise)

information science, earth science chemical technology etc. It is clear from Fig. 4, that the two broad disciplines, pure science and applied science together figure 85% of all growth dynamics studies.

Conclusion

From the Chi-square test, the null hypothesis is accepted, i.e., it is concluded that the distribution of different models of growth of literature over variant subjects is guided by Bradford's Law where the core or nucleus zone is occupied by either of logistic and exponential model. It may be pointed out that Price's empirical model prevails in Bradford's nuclear (core) zone in case of growth dynamics studies. This study shows an application of Bradford's law in Price's empirical theory. Also, the cumulative growth of literature on growth dynamics studies are found to follow fourth degree polynomial pattern as the best fit curve. It is found that largest number of such studies were performed in pure sciences (16.2%), followed by medical science (13.1%), life science (11.1%), chemistry (9.1%) and physics (8.6%) that figures nearly 60% of all studies.

The empirical theory of Price thus needs to be verified by other subject areas like management science, social science, creative and performing arts, language and literature etc. It is still necessary to verify applicability of Bradford's law of scattering in Price's theory for subject areas other than pure science and technology. This study emphasizes the necessity of growth dynamics study as an important tool for genesis and developmental analysis of a subject that may navigate properly in carrying out state-of-the-art-report or trend report of a subject.

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Annexure I

List of sample articles on growth dynamics studies of different subjects

Sl. no.	Year	Author	Subject domain studied	Growth model observed therein	Source item	Title of the article
1	1913	Carlson T	Yeast literature	Logistic	*Biochem. Z*, 57, 313-334.	Übergeschwindigkeit und grösse der hefevermehrung in würze
2	1917	Cole FJ and Eales NB	Anatomy	Irregular	*Science Progress* (1916-1919), 11(44), 578-596.	The history of comparative anatomy: Part I.—A statistical analysis of the literature
3	1923	Hulme EW	Modern Civilization	Irregular	*Grafton & Co.*	Statistical bibliography in relation to the growth of modern civilization
4	1927	Gross PL and Gross EM	Chemistry	Irregular	*Science*, 66(1713), 385-389	College libraries and chemical education
5	1929	Allen ES	Mathematicians	Irregular	*Science*, 70(1825), 592-594	Periodicals for mathematicians
6	1930	McNeely JK and Crosno CD	Electrical Engineers	Irregular	*Science.* 72: 81-84	Periodical for electrical engineers
7	1931	Gross PLK and Woodford AO	Geologists	Irregular	*Science*, 73(1903), 660-664.	Serial literature used by American geologists
8	1931	Jenkins RL	Medical Libraries	Irregular	*J.A.M.A.* 97: 608-610.	Periodicals for medical libraries
9	1934	Mengert WF	Medical Science	Irregular	*Endocrinology*, 18(3), 421-422	Periodicals on endocrinology of sex
10	1935	CunninghamER	Medical and Biological Sciences	Irregular	*Bulletin Medical Library Association.* XXIV, 64-81.	The present status of publication of literature in the medical and biological sciences
11	1935	Wilson P and Fred E	Nitrogen Fixation of Plants	Logistic	*The Scientific Monthly*, 41(3), 240-250.	The Growth Curve of a Scientific Literature
12	1935	Gregory J	Medical Science	Irregular	*Endocrinology*, 19(2), 213-215.	An evaluation of periodical literature from the standpoint of endocrinology
13	1937	Dalziel CF	Electrical Engineers	Irregular	*The Library Quarterly*, 7(3), 354-372.	Evaluation of periodicals for electrical engineers
14	1938	Henkle HH	Biochemistry	Irregular	*Bulletin of the Medical Library Association*, 27(2), 139–147.	The periodical literature of biochemistry
15	1939	Gregory J	Medical Science	Irregular	*Bulletin of the Medical Library Association*, 27(4), 242–244.	The evaluation of medical periodicals
16	1947	Lehman HC	Man's Cultural	Exponential	*Social Forces*, 281-290	The exponential increase of man's cultural output.
17	1949	Boig FS	Organic Chemistry	Irregular	*Science*, 110(2848), 107-109.	Domestic and foreign periodicals in the field of organic chemistry: a statistical analysis
18	1952	Coile RC, SB, SM and EE	Electrical Engineers	Irregular	*Journal of Documentation*, 8 (4): 209 – 226	Periodical literature for electrical engineers
19	1957	Conard GM	Biological literature	Exponential	*Fed Proc.* 16(3):711-5	Growth of biological literature and the future of Biological Abstracts
20	1960	Strong LE and Benfey OT	Chemistry	Exponential	*J. Chem. Educ*, 37(1), 29.	Is chemical information growing exponentially?
21	1963	Price DJS	Physics	Exponential	*Columbia University Press*	Little science, big science
22	1966	May KO	Mathematics	Exponential	*Science*, 154 (3757), 1672-1673	Quantitative growth of the mathematical literature

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List of sample articles on growth dynamics studies of different subjects (*Contd*.)

Sl. no.	Year	Author	Subject domain studied	Growth model observed therein	Source item	Title of the article
23	1966	Nalimov VV, Adler YP and Granovsky YV	Biology	Exponential	*Kibernetica I Dokumentalistik, Mascow*	Information systems in the mathematical theory of experiment
24	1969	Anthony LJ, East H and Slater MJ	Physics	Exponential	*Reports on Progress in Physics*, 32(2), 709.	The growth of the literature of physics
25	1970	Brookes BC	Scientific Literature	Exponential	*Journal of Documentation*, 26(4), 283-294.	The growth, utility, and obsolescence of scientific periodical literature
26	1970	Brookes BC	Special Library Periodicals	Exponential	*Journal of the Association for Information Science and Technology*, 21(5), 320-329.	Obsolescence of special library periodicals: sampling errors and utility contours
27	1970	Goffman W and Warren KS	Medical Science	Exponential	*The American Journal of Tropical Medicine and Hygiene*, 19(2), 278-283	An application of the Kermack-mckendrick theory to the epidemiology of schistosomiasis
28	1970	KonfederatovJ	Social Science	Logistic	*International d'Histoire de Science* (Vol. 2, pp. 63-66)	Exponential or logistic law of scientific development. In Actes du xiiemeCongres
29	1970	Tsay MY and Lin YJ	transport phenomenon	Exponential	*Malaysian Journal of Library & Information Science*, 14(3)	Scientometric analysis of transport phenomenon literature, 1900-2007.
30	1971	Fisher TC and Pry RH	products and technologies	Logistic	*Technological Forecasting and Social Changes*, 3(1), 75-78	A simple substitution model of technological change
31	1971	Goffman W and Harmon G	Symbolic logic	Exponential	*Nature*, 229(5280), 103-104.	Mathematical approach to the prediction of scientific discovery
32	1971	Menard HW	Earth Science	Exponential	*Harvard University Press*	Science: Growth and change.
33	1971	Oliver MR	Semiconductor	Exponential + Power	*Journal of Documentation*, 27(1), 11-17.	The effect of growth on the obsolescence of semiconductor physics literature
34	1972	Crane D	Social Science;	Linear	*University of Chicago Press*	Invisible colleges; diffusion of knowledge in scientific communities
35	1972	Herman R and Montroll EW	Industrial revolution	Logistic	*Proceedings of the National Academy of Sciences*, 69(10), 3019-3023	A manner of characterizing the development of countries.
36	1972	Warren KS and Goffman W	Ecology	Exponential	*American Journal of the Medical Sciences*, 263(4), 267– 273	The ecology of the medical literatures
37	1973	Sengupta IN	Biochemistry	Exponential	*Journal of Documentation*, 29(2), 192-211.	Recent growth of the literature of biochemistry and changes in ranking of periodicals.
38	1974	Baughman JC	Sociology	Irregular	*The Library Quarterly*, 44(4), 293-308.	A structural analysis of the literature of sociology
39	1974	Menard HW	Vertebrate paleontology	Exponential	*Harvard University Press, Cambridge*	Science: growth and change
40	1975	Brooks RR and Smythe LE	Chemistry	Exponential	*Talanta*, 22(6), 495-504.	The progress of analytical chemistry 1910–1970
41	1976	Bennion BC and Neuton, LA	Polywater	Exponential	*Journal of the Association for Information Science and Technology*, 27(1), 53-56.	The epidemiology of research on "anomalous water"
42	1977	Braun T, Lyon WS and Bujdosó E	Activation analysis	Linear	*Analytical Chemistry*, 49(8), 682A-688A.	Literature growth and Decaying: an activation analysis résumé

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List of sample articles on growth dynamics studies of different subjects (*Contd*.)

Sl. no.	Year	Author	Subject domain studied	Growth model observed therein	Source item	Title of the article
43	1977	Manzer BM	Overall Science	Exponential	*Scarecrow Press*	The abstract journal, 1790-1920: Origin, development, and diffusion.
44	1977	Schaefer JM and Levinson D	hologeistic studies	Linear	*Behavior Science Research,* 12(2), 71-108.	The growth of hologeistic studies: 1889-1975.
45	1977	Sullivan D, White DH and Barboni, EJ	Physics	Logistic + Linear	*Social Studies of Science,* 7(2), 167-200	The state of a science: Indicators in the specialty of weak interactions
46	1978	Goffman W	Biomedicine	Exponential	Rockfeller Foundation, New York,	Coping with the biomedical literature explosion: a qualitative approach
47	1978	Marchetti C and NakicenovicN.	Energy Systems	Logistic	*Phenomenological Part*.	The Dynamics of Energy Systems and the Logistic Substitution Model.
48	1978	Singh M	chemical literature	Irregular	*Annals of Library and Information Studies,* 25(1-4)	Studies of chemical literature and changes in the ranking of periodicals by citation analysis of data for 1967-76.
49	1979	Bottle RT and Rees MK	Liquid Crystal	Exponential	*Information Scientist,* 1(2), 117-119.	Liquid crystal literature: A novel growth pattern
50	1979	Chubin D and Studer K	Cancer	Irregular	*Scientometrics,* 1(2), 171-193.	Knowledge and structures of scientific growth measurement of a cancer problem domain.
51	1979	Frame, JD and Baum JJ and Card M	Coal Gastification	Logistic	*Journal of the Association for Information Science and Technology,* 30(4), 193-201.	An information approach to examining developments in an energy technology: Coal gasification.
52	1979	Rangarajan KS and Gupta BM	Indian physicists	Irregular	*Journal of Library and Information Science*, 4(2), 144-161	Analysis of choice of journals for publication by Indian physicists.
53	1980	Gupta BM	Solar Energy	Irregular	*Annals of Library Science and Documentation*. 27(1-4), 61-65	A citation analysis of internal and external connections of a research branch: A case study of solar energy research in the USSR
54	1980	Yablonsky AL	Scientific papers	Irregular	*Scientometrics,* 2(1), 3-34	On fundamental regularities of the distribution of scientific productivity
55	1981	Kochen M and Blaivas A	Mathematical Specialties	Irregular	*Scientometrics,* 3(4), 265-273.	A model for the growth of mathematical specialties
56	1981	Tague J, Beheshti, J and Rees-Potter L	Chemical Abstract (1907-1979)	Exponential	*Library Trends*	The law of exponential growth: evidence, implications and forecasts
57	1981	Tague J, Beheshti, J and Rees-Potter L	Science Abstract (1960-1979)	Linear	*Library Trends*	The law of exponential growth: evidence, implications and forecasts
58	1981	Tague J, Beheshti, J and Rees-Potter L.	Biological Abstract (1960-1970)	Linear	*Library Trends*	The law of exponential growth: evidence, implications and forecasts
59	1982	Adenaike BO	Cowpeas	Exponential	*Journal of Information Science*. 4. 117-121.	Bibliometric studies on a protein-rich crop the cowpea

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List of sample articles on growth dynamics studies of different subjects (*Contd*.)

Sl. no.	Year	Author	Subject domain studied	Growth model observed therein	Source item	Title of the article
60	1982	Ikhizama BO	maize literature	Irregular	*Quarterly Bulletin of the International Association of Agricultural Librarians and Documentalists*, 27(4), 122-128.	The development of maize literature in Nigeria
61	1984	Bottle RT and Efthimiadis EN	LISA, ISA, RZI, BS and CCA	Exponential	*Information Scientist*, 9(3), 107-116.	Library and information science literature: authorship and growth patterns
62	1984	Gupta DK	Geophysics	Decaying	*SRELS Journal of Information Management*, 21(4), 205-226	Periodical literature of exploration geophysics: Obsolescence factors and patterns
63	1984	Kapoor SK	earth science	Irregular	*Annals of Library Science and Documentation*, 31(1-2)	Citation analysis of earth science literature
64	1984	Parmar, CC	chemical literature	Irregular	*International Library Movement*, 6(1), 9-11.v	Growth of Indian chemical literature of primary sources
65	1985	Cole S and Meyer G	Physics	Irregular	*Scientometrics*, 7(3-6), 443-458	Little science, big science revisited
66	1985	Garfield E	Little science big science	Exponential	*Scientometrics*, 7(3-6), 487-503.	In tribute to Derek John de Solla Price: a citation analysis of little science, big sicence
67	1985	Gopinath MA	Biochemistry	Exponential	*Library Science* 22(3)	Bibliographic citations in biochemistry: a chronological analysis
68	1985	Mahapatra M	Scientific literature	Exponential	*In Proceedings of the 15th IASLIC Conference, Bangalore* (pp. 61-70).	On the validity of the theory of exponential growth of scientific literature.
69	1985	Sengupta I	Biophysical literature	Irregular	*Scientometrics*, 8(5-6), 365-375	The growth of biophysical literature
70	1985	Todorov R	Physics	Irregular	*Scientometrics*, 7(3-6), 195-209	Distribution of physics literature
71	1986	Sen S and Kundra R	Alcohol fuel literature	Epidemic	*Scientometrics*, 10(1-2), 43-5	Bibliometrics of English language alcohol fuel literature. A new empirical equation of scatter
72	1986	Simeon VL, Momčilović B, Kralj Z and Grgas B	General science	Linear	*Scientometrics*, 9(5-6), 223-230.	Multivariate statistical analysis of the bibliographic output from a research institution, in relation to the measures of scientific policy
73	1987	Davidson FJ and Narin F	Chinese Science	Exponential	*Scientometrics*, 12(1-2), 135-144.	The growth of chinese scientific research, 1973–84
74	1988	Adeniran OR	Computer Science	Exponential	*International library Review*, 20(3), 347-359	Bibliometrics of computer science literature in Nigeria
75	1988	Garg KC, Karki MMS and Marg KK	General Science	Exponential	*World Patent Information*, 10(4), 237-242.	Bibliometric study of world literature on patents
76	1988	Wood J	Natural Sciences, Social Sciences and Humanities	Irregular	*Scientometrics*, 13(1-2), 53-62.	The growth of scholarship: An online bibliometric comparison of dissertations in the sciences and humanities
77	1989	Kumari L and Sengupta IN	Lectin Literature	Irregular	*Scientometrics*, 17(3-4), 353-361	Growth of Lectin literature: 1954–1982

(*Contd*.)

List of sample articles on growth dynamics studies of different subjects (*Contd*.)

Sl. no.	Year	Author	Subject domain studied	Growth model observed therein	Source item	Title of the article
78	1989	Self PC and Filardo TW and Lancaster FW	AIDS	Epidemic	*Scientometrics*, 17(1-2), 49-60.	Acquired immunodeficiency syndrome (AIDS) and the epidemic growth of its literature
79	1989	Sengupta IN	Neuroscience	Linear	*Scientometrics*, 17(3-4), 253-288.	The growth of knowledge and literature in neuroscience
80	1990	Efthimiadis EN	OPAC	Logistic	*Journal of the American Society for Information Science*, 41(5), 342.	The growth of the OPAC literature
81	1990	Gupta U	Physics	Exponential	*Journal of the American Society for Information Science*, 41(4), 282.	Obsolescence of Physics Literature: Exponential Decrease of the Density of Citations to" Physical Review" Articles with Age
82	1990	Wolfram D, Chu CM and Lu X	Science and Technology, Social Science and Humanities Databases	Power	*Informetrics*, 89(90), 355-372.	Growth of knowledge: Bibliometric analysis using online database data
83	1991	Archibald G and Line M	Serial literature	Irregular	*Scientometrics*, 20(1), 173-196.	The size and growth of serial literature 1950–1987, in terms of the number of articles per serial.
84	1991	Jaschek C	Astronomy	Exponential	*Scientometrics*, 22(2), 265-282	The size of the astronomical community
85	1991	Sengupta I and Kumari L	AIDS Literature	Epidemic	*Scientometrics*, 20(1), 297-315	Bibliometric analysis of AIDS literature
86	1992	Egghe L and Rao R	social sciences and humanities	Gompertz	*Scientometrics*, 25(1), 5-46	Classification of growth models based on growth rates and its applications
87	1992	Hall D	Geoscience	Logistic	*Scientometrics*, 24(2), 237-280.	The science-industry interface: Correlation of time series of indicators and their spectra, and growth models in the nuclear fuels industry
88	1992	Jain A and Garg K	Laser research in India	Irregular	*Scientometrics*, 23(3), 395-415	Laser research in India: Scientometric study and model projections
89	1992	Maheswarappa, BS and Ningoji MM	Applied science and technology in India	Exponential + Logistic	*International Information Communication and Education*; 11(2), 186-197.	Growth of literature in the field of science and technology in India
90	1992	Hall D	Nuclear fuels industry	Logistic	*Scientometrics*, 24(2), 237-280	The science-industry interface: Correlation of time series of indicators and their spectra, and growth models in the nuclear fuels industry
91	1992	Jain A and Garg K	Laser Research	Irregular	*Scientometrics*, 23(3), 395-415	Laser research in India: Scientometric study and model projections
92	1993	Egghe L	Scientific Papers	Exponential + Logistic	*Scientometrics*, 27(2), 195-214	On the influence of growth on obsolescence
93	1993	Kalyane VL	Neem Research	Logistic	*Library Science*, 30(4), 139-145	Informetrics on Neem research in India
94	1993	Maheswarappa, BS and Ningoji MM	Biological Literature	Irregular	*ILA Bulletin*, XXIX (1-2): 47-55.	A Study of the Growth of Biological Literature in India (1965-1989)

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List of sample articles on growth dynamics studies of different subjects (*Contd*.)

Sl. no.	Year	Author	Subject domain studied	Growth model observed therein	Source item	Title of the article
95	1993	Parvathamman, Gunjal, SR and NijagunappaR	Earth Science	Logistic	*Library Science with a Slant to Documentation and Information Studies*, 30(2), 54-64	Growth pattern of literature and scientific productivity of authors in Indian earth science (1978-88): a bibliometric study
96	1994	Arora J and Kaur SP	Immunology	Logistic	*Annals of Library Science and Documentation*, 41(3), 81-94	Bibliometric analysis of core journals on immunology: a study based on the annual review of immunology
97	1994	Mahapatra G	Library and Information Science	Irregular	*Annals of Library Science and Documentation*, 41(1), 8-12	Correlation between growth of publications and citations: A study based on growth curves
98	1995	Freedman B	Biological literature	Irregular	*Publishing Research Quarterly*, 11(3), 61-79	Growth and change in the world's biological literature as reflected in BIOSIS publications
99	1996	Rodríguez K and Moreiro JA	Ecology	Exponential	*Scientometrics*, 35(1), 59-70	The growth and development of research in the field of ecology
100	1996	Shukla MC	Renewable Energy	Irregular	*Handbook of Libraries, Archives & Information Centres in India*, 13, 309-328	Publication patterns in the field of renewable energy. An analysis of Indian Energy Abstracts
101	1997	Gupta BM, Sharma P and KarisiddappaCR	Research Literature in Scientific Specialities	Exponential	*Scientometrics*, 40(3), 507-528	Growth of research literature in scientific specialities. A modelling perspective
102	1997	Schummer J	Chemistry	Exponential	*Scientometrics*, 39(1), 107-123	Scientometric studies on chemistry I: The exponential growth of chemical substances, 1800–1995
103	1997	Vimala V and Pulla RV	Zoology	Decaying	*Malaysian Journal of Library & Information Science*, 2(1).	Obsolescence of literature in zoology
104	1998	ArunachalamS, Srinivasan, R and Raman V	Science literature	Linear	*Current Science*, 74(5), 433-441	Science in India–A profile based on India's publications as covered by Science Citation Index 1989–1992
105	1998	Braun T	Social Science	Exponential	*Journal of Information Science*, 24(1), 59-62	Globalization takes off!.
106	1998	Garg KC and Padhi P	Laser patent	Irregular	*Scientometrics*, 43(3), 443-446	Scientometric study of laser patent literature
107	1998	Gupta BM, Sharma L and Kumar S	Physics	Logistic + power	*Information Processing & Management*, 34(1), 121-131	Literature growth and author productivity patterns in Indian physics
108	1998	Gupta B	Theoretical Population Genetics	Exponential	*Scientometrics*, 42(3), 335-347.	Growth and obsolescence of literature in theoretical population genetics
109	1998	Hart PW and Sommerfeld JT	chemical literature	Irregular	*Scientometrics*, 42(3), 299-311	Relationship between growth in gross domestic product (GDP) and growth in the chemical engineering literature in five different countries
110	1999	Gupta B, Sharma P and Kumar S	Indian physics, World physics	Logistic + Power	*Scientometrics*, 44(1), 5-16	Growth of world and Indian physics literature
111	1999	Karki MMS and Garg KC	Organic chemistry in India	Irregular	*Scientometrics*, 45(1), 107-116	Scientometrics of Indian organic chemistry research

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List of sample articles on growth dynamics studies of different subjects (*Contd*.)

Sl. no.	Year	Author	Subject domain studied	Growth model observed therein	Source item	Title of the article
112	1999	Lipetz BA	Information Science	Exponential	*Journal of the Association for Information Science and Technology*, 50(11), 994	Aspects of JASIS authorship through five decades
113	1999	Meyer PS, Yung JW and Ausubel JH	Mathematics	Logistic	*Technological Forecasting and Social Change*, 61(3), 247-271	A primer on logistic growth and substitution: the mathematics of the Loglet Lab software
114	1999	Ramakrishna NV and Pangannaya, NB	Biotechnolgy	Logistic	*Library Science with a Slant to Documentation and Information Studies*, 36(1), 21-26	Growth of animal cell culture technology literature: A correlation between citations and publications based on growth curves
115		Sangam SL	Psychology	Exponential	*Scientometrics*, 44(1), 33-46	Obsolescence of literature in the field of psychology
116	1999	Seetharam G and Rao IKR	food science and technology	Gompertz	*Scientometrics*, 44(1), 59-79	Growth of food science and technology literature: A comparison of CFTRI, India and the world
117	1999	Tabah AN	literature dynamics	Irregular	*Annual Review of Information Science and Technology (ARIST)*, 34, 249-86.	Literature dynamics: Studies on growth, diffusion, and epidemics
118	2000	Gupta BM, and Karisiddapp CR	Population genetics	Power	*Scientometrics*, 49(2), 321-355.	Modelling the growth of literature in the area of theoretical population genetics
119	2000	Jing P and Kang Z	General science	Irregular	*Journal of the China Society for Scientific and Technical Information*, 19(1), 60-69	On the mathematical models of the growth of scientific literature
120	2000	Karki MMS, Garg KC and Sharma P	Organic Chemistry	Logistic	*Scientometrics*, 49(2), 279-288.	Activity and growth of organic chemistry research in India during 1971–1989.
121	2000	Mahapatra G and Das B	Geology	Decaying	*SRELS Journal of Information Management*, 37(2), 95-105.	Impact of research collaboration on growth of literature in geology: a bibliometric study
122	2000	Tsay MY, Jou SJ and Ma SS	Semiconductor	Linear	*Scientometrics*, 49(3), 491-509.	A bibliometric study of semiconductor literature, 1978–1997
123	2000	Van RAF	General science	Exponential	*Scientometrics*, 47(2), 347-362.	On growth, ageing, and fractal differentiation of science
124	2001	Amaral LAN, Gopikrishna P, Plerou V and Stanley HE	Economic organization	Exponential	*Physica A: Statistical Mechanics and its Applications*, 299(1-2), 127-136	A model for the growth dynamics of economic organizations
125	2001	Garg KC and Padhi P	Laser science and technology	Irregular	*Scientometrics*, 51(2), 415-427.	A study of collaboration in laser science and technology
126	2001	Huber JC and Wagner-Döbler R	Mathematics	Exponential	*Scientometrics*, 50(2), 323-337.	Scientific production: A statistical analysis of authors in mathematical logic
127	2001	Mabe M and Amin M	Super conductivity	Logistic	*Scientometrics*, 51(1), 147-162.	Growth dynamics of scholarly and scientific journals
128	2002	Gupta BM Kumar S, Sangam SL and Karisiddappa CR	Social Science	Power + Logistic	*Scientometrics*, 53(1), 161-164.	Modeling the growth of world social science literature

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List of sample articles on growth dynamics studies of different subjects (*Contd*.)

Sl. no.	Year	Author	Subject domain studied	Growth model observed therein	Source item	Title of the article
129	2002	Sharma P, Gupta, BM and Kumar S	Physics Abstract, Chemical Abstract and Electrical and Electronics Abstract	Power	*DESIDOC Journal of Library & Information Technology*, 22(2).	Application of growth models to science and technology literature in research specialities
130	2003	Bali A	Library	Exponential	*DESIDOC Journal of Library & Information Technology*, 17(2).	Collection development in NISTADS Library
131	2003	Brunk G	US Patent	Decaying	*Scientometrics*, 56(1), 61-80.	Swarming of innovations, fractal patterns, and the historical time series of US patents
132	2003	Deleus F and Van HM	Biotechnology	Exponential	*Scientometrics*, 56(1), 147-160	Monitoring elasticity between science and technology domains and its visualization
133	2003	Furner J	Electronic	Power	*Journal of Librarianship and Information Science*, 35(3), 189-201	Little book, big book: Before and after little science, big science: A review article, part II
134	2003	Kumar S and Gupta BM	chemical sciences	Irregular	*Library Herald*, 41(4), 225-239.	Modelling the growth of literature in the area of chemical sciences
135	2004	Egghe L	Scientific literature	Exponential	*Scientometrics*, 59(2), 225-232	Solution of a problem of Buckland on the influence of obsolescence on scattering
136	2004	Tsay MY	LIS	Logistic	*Journal of the Association for Information Science and Technology*, 55(1), 64-73.	Literature growth, journal characteristics, and author productivity in subject indexing, 1977 to 2000
137	2005	García GP, López MF, Callejo J, Martín ÁB and Álamo C	Obstetrics and Gynecology	Linear	*European Journal of Obstetrics and Gynecology and Reproductive Biology*, 123: 150 – 156.	Evolution of Spanish Scientific Production in International Obstetrics and Gynecology Journals during the Period 1986 – 2002
138	2005	Matia K, Nunes ALA, Luwel M, Moed HF, and Stanley HE	scientific papers	Power	*Journal of the Association for Information Science and Technology*, 56(9), 893-902.	Scaling phenomena in the growth dynamics of scientific output
139	2005	McKechnie LE, Goodall GR, Lajoie PD and Julien H	English literature	Exponential	*Information Research: An International Electronic Journal*, 10(2)	How human information behaviour researchers use each other's work: a basic citation analysis study
140	2005	Rajendran P, Babu BR, and Gopalakrishnan S	Fibre Optics	Irregular	*Annals of library and information studies*, 52(2)	Bibliometric analysis of fiber optics literature
141	2005	Tsay MY and Yang YH	Medical Science	Exponential	*Journal of the Medical Library Association*, 93(4), 450.	Bibliometric analysis of the literature of randomized controlled trials
142	2006	Ackermann E	Polywater and Cold nuclear fusion	Epidemic	*Scientometrics*, 66(3), 451-466	Indicators of failed information epidemics in the scientific journal literature: A publication analysis of Polywater and Cold Nuclear Fusion
143	2006	Patra SK and Mishra S	Bioinformatics	Exponential + Linear	*Scientometrics*, 67(3), 477-489.	Bibliometric study of bioinformatics literature

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List of sample articles on growth dynamics studies of different subjects (*Contd*.)

Sl. no.	Year	Author	Subject domain studied	Growth model observed therein	Source item	Title of the article
144	2006	Small H	Science literature	Linear	*Scientometrics*, 68(3), 595-610	Tracking and predicting growth areas in science
145	2006	López MF, Vieta E, Rubio G, García GP and Alamo C	Bipolar disorder	Exponential	*Journal of affective disorders*, 92(2), 161-170	Bipolar disorder as an emerging pathology in the scientific literature: a bibliometric approach
146	2006	Mitha SB and Leach A	HIV/AIDS literature	Exponential	*Mousaion*, 24(2), 185-210	AIDS in South Africa: A bibliometric study on HIV/AIDS literature in South Africa from 1982 to 2002
147	2006	Vain P	plant transgenic science and technology	Irregular	*Trends in Biotechnology*, 24(5), 206-211	Global trends in plant transgenic science and technology (1973–2003).
148	2007	Allen RS	energy crops and bioenergy	Irregular	*Journal of Agricultural & Food Information*, 8(4), 35-47.	Agricultural energy crops and the search for alternative energy: analysis of the current research and core journal literature on biofuels and bioenergy
149	2007	Saxena A, Gupta BM and Jauhari M	chemical sciences	Exponential	*DESIDOC Journal of Library & Information Technology*, 27(3), 3.	Exploring models for the growth of literature data
150	2007	Payne N and Thelwall M	Academic Web	Exponential	*Scientometrics*, 71(3), 523-539.	A longitudinal study of academic webs: Growth and stabilisation
151	2007	Vijay KR, and Raghavan I	Food Science and Technology	Irregular	*Annals of Library and Information Studies*. 54, 207-212	Journal of Food Science and Technology: a bibliometric study
152	2008	Larivière V, Archambault É and Gingras Y	Scientific literature	Exponential	*Journal of the Association for Information Science and Technology*, 59(2), 288-296.	Long-term variations in the aging of scientific literature: From exponential growth to steady-state science (1900–2004).
153	2008	Patzek TW	Fossil fuel	Exponential	*Archives of Mining Sciences*, 53(2), 131-159	Exponential growth, energetic hubbert cycles, and the advancement of technology
154	2008	Sangam SL, Meera, and Megeri MN	Chemical literature	Exponential + Logistic	*Collnet Journal of Scientometrics and Information Management*, 2(1), 99-110	Growth pattern of Indian Chemical Science literature: A Scientometric analysis
155	2008	Tsay MY	Hydrogen Energy	Exponential	*Scientometrics*, 75(3), 421-438	A bibliometric analysis of hydrogen energy literature, 1965–2005
156	2008	Wani ZA, Bakshi IM and Gul S	Library and Information Science	Irregular	Chinese Librarianship, (26).	Growth and Development of Library and Information Science Literature
157	2009	DeShazo JP, LaVallie DL and Wolf FM	Medical informatics	Irregular	*BMC Medical Informatics and Decision Making*, 9(1), 7	Publication trends in the medical informatics literature: 20 years of" Medical Informatics" in mesh
158	2009	Kulkarni AP	Pharmaceutical Education and Research	Irregular	*Annals of Library and Information Studies*, 56, 242-248	Indian Journal of Pharmaceutical Education and Research (1995-2006): A bibliometrics analysis
159	2009	Urbizagastegui R	Ciência da Informação,	Exponential	*Ciência da Informação*, 38(3), 111-129.	The growth of literature and authors on Lotka's Law
160	2009	Xiao J and Fu H	Business	Logistic	*Journal of Enterprise Information Management*, 22(4), 423-440.	An empirical study of usage of external business services by Chinese smes

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List of sample articles on growth dynamics studies of different subjects (*Contd*.)

Sl. no.	Year	Author	Subject domain studied	Growth model observed therein	Source item	Title of the article
161	2010	Egghe L	scientific papers	Exponential	*Scientometrics*, 82(2), 243-248	A model showing the increase in time of the average and median reference age and the decrease in time of the Price Index
162	2010	Garg KC, Kumar S, Dutt B and Chakraborty O	genetics and heredity	Exponential	*Annals of Library Science and Documentation*, 61(3), 41-48	Scientometric profile of 'genetics and heredity'research in India
163	2010	Han CS, Lee SK and England M	Doctoral Degree	Exponential	*Scientometrics*, 84(2), 391-401	Transition to postmodern science—related scientometric data
164	2010	Larsen PO and Von IM	SCI; SSCI	Irregular	*Scientometrics*, 84(3), 575-603	The rate of growth in scientific publication and the decline in coverage provided by Science Citation Index
165	2010	Rao IKR and Srivastava D	Malaria	Exponential	*Journal of Informetrics*, 4(3), 249-256	Growth of journals, articles and authors in malaria research
166	2010	Ribeiro LC, Ruiz RM, Bernardes AT and AlbuquerqueEM	Science and technology	Irregular	*Scientometrics*, 83(1), 55-75.	Matrices of science and technology interactions and patterns of structured growth: implications for development
167	2010	Sangam SL, Liming L and Ganjihal GA	Liquid Crystal	Power	*Scientometrics*, 84(1), 49-52	Modeling the growth of Indian and Chinese liquid crystals literature as reflected in Science Citation Index (1997–2006).
168	2010	Wong CY and Goh KL	Patent	Logistic	*Journal of Informetrics*, 4(4), 460-474	Growth behavior of publications and patents: A comparative study on selected Asian economies
169	2011	Behrens H and Luksch P	Mathematics	Exponential + Linear	*Scientometrics* 86(1), 179–194	Mathematics 1868-2008: a bibliometric analysis
170	2011	Gupta BM, Har K and Bala A	Diabetes research	Irregular	*DESIDOC Journal of Library and Information Technology* 31(2), 143- 152.	Mapping of India Diabetes research during 1999-2008: A Scientometric Analysis of Publications output
171	2011	Sangwal K	nucleation equations	Irregular	*Journal of Informetrics*, 5(4), 554-564	On the growth of citations of publication output of individual authors
172	2012	Michels C and Schmoch, U	Science	Irregular	*Scientometrics*, 93(3), 831-846.	The growth of science and database coverage
173	2012	Pautasso M	Biological subfields	Exponential + Linear	*Sustainability*, 4(12), 3234-3247	Publication growth in biological sub-fields: patterns, predictability and sustainability
174	2012	Sangam SL and Meera BM	chemical science	Exponential	*Journal of Advances in Librarianship*, 3(1)	Obsolescence factors and pattern of citation distribution in the field of chemical science
175	2012	Yu JJ, Wang MH, Xu M and Ho YS	photosynthesis	Irregular	*Photosynthetica*, 50(1), 5-14	A bibliometric analysis of research papers published on photosynthesis: 1992–2009
176	2013	Dutta B and Rath DS	Cosmology	Linear	*SRELS Journal of Information Management*, 50(5), 639-655.	Scientometric Study of Carbon Nanotube Research in India
177	2013	Dutta B and Rath DS	Carbon nanotube	Logistic	*Library Philosophy and Practice (e-journal).*	Cosmology research in India: A scientometric study

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List of sample articles on growth dynamics studies of different subjects (*Contd*.)

Sl. no.	Year	Author	Subject domain studied	Growth model observed therein	Source item	Title of the article
178	2013	Ramakrishnan J and Thavamani K	Hepatitis C	Irregular	*Library Philosophy and Practice.*	Growth of literature in the field of Hepatitis-C
179	2014	Amudha SS and Sevukan R	Neuroscience	Irregular	*Collnet Journal of Scientometrics and Information Management*, 8(2), 329-340	Indian neuroscience research, 1999-2013: a scientometric analysis
180	2014	Kumar S	HCI Research Literature	Exponential + Logistic	*SRELS Journal of Information Management*, 51(5), 287-298	Application of Growth Models to Human Computer Interaction (hci) Research Literature
181	2015	Rao IKR and Meera BM	Mathematics	Irregular	*3rd International conference on Informetrics : Theory of Informetrics. Calcutta : Indian Statistical Institute*	Growth and obsolescence of literature: an empirical study
182	2015	Thimmaiah, BN and Agadi KB	Cancer Biology	Irregular	*Journal of Information Science Theory and Practice*, 3(3), 75-80	Growth Analysis of Cancer Biology Research, 2000-2011
183	2015	Sangam SL, Madalli D and Arali UB	Genetics	Logarithmic + Linear + Logistic	*Collnet Journal of Scientometrics and Information Management*, 9(2), 175-192	Scientometrics profile of global genetics literature as seen through pubmed
184	2015	Sinatra R, Deville P, Szell M, Wang D, and Barabási AL	Physics	Exponential	*Nature Physics*, 11(10), 791.	A century of physics
185	2015	Yang YT, Iqbal U, Ching JHY, Ting JBS, Chiu HT, Tamashiro H and Hsu YHE	Telemedicine	Irregular	*Computer Methods and Programs in Biomedicine*, 122(3), 471-479.	Trends in the growth of literature of telemedicine: A bibliometric analysis
186	2016	Bhattacharya S	Scientific papers	Exponential	*Current Science* (00113891), 110(8)	Capturing the growth dynamics of science: a publication-based analysis
187	2016	Urbizagastegui AR	Scientific papers	Exponential	*Investigacion Bibliotecologica*, 30(68), 51-72.	Growth of literature on bradford's law
188	2017	Basu T, Mallik A and Mandal N	Herbal Medicine	Irregular	*Scientometrics*, 110(3), 1375-1396.	Evolving importance of anticancer research using herbal medicine: a scientometric analysis
189	2017	Biradar BS	Chemical Science Research	Exponential	*International Journal of Information Dissemination and Technology*, 7(1), 71-73	Mapping of Chemical Science Research in India during 2005-2014
190	2017	Chaman SM, Dharani KP and Biradar BS	Fisheries and Oceanography	Irregular	*Fisheries and Oceanography Open Access Journal*, 5(2): 1-6.	Scientific Productivity of Oceanography Literature: a Scientometric Analysis
191	2017	Kanwal P	FOSS Literature	Exponential + Logistic	*International Journal of Advanced Research in Computer Science*, 8(3): 1067-1072	A Bibliometric Study of World Research Output on Free and Open Source Software Literature during 1960-2016
192	2017	Lyu QJ, Pu QH and Zhang J	Endrocinology	Irregular	*Scientometrics*, 110(1), 105-112.	Bibliometric analysis of scientific publications in endocrinology and metabolism from China, Japan, and South Korea
193	2017	Nayak SN, and Bankapur VM	Agriculture	Linear	*International Journal of Library and Information Studies*, 7(3), 99-111.	Modelling the Growth of Global Agricultural Literature: A Scienometric Study Based on CAB-Abstracts

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List of sample articles on growth dynamics studies of different subjects (*Contd*.)

Sl. no.	Year	Author	Subject domain studied	Growth model observed therein	Source item	Title of the article
194	2017	Teli S and Dutta B	Super conductivity	Logistic + Power	*SRELS Journal of Information Management*, 54(5), 246-252.	Scientometric Study of Superconductivity Research in India from 1989 to 2014
195	2017	Tsay MY and Li CN	Women's studies	Exponential	*Scientometrics*, 113(2), 705-734	Bibliometric analysis of the journal literature on women's studies
196	2018	Gupta BM, Ahmed KM and Gupta R	Obesity	Irregular	*Oncology, Gastroenterology and Hepatology Reports*, 7(1).	Polycystic Ovary Syndrome Research: A Scientometric Assessment of Global Publications Output During 2007-16
197	2018	Gupta R and Ahmed KM	Polycystic Ovary Syndrome Research	Decaying	*OGH Reports.* 2018;7(1):16-24	A Scientometric Assessment of Obesity Research Publications from India during 2007-16
198	2018	Singh MK and Singh K	Biotechnology	Linear	*International Journal of Library and Information Studies*, 8(1)	A Comparative Study of Authorship and Collaboration Pattern of Four SAARC Countries in Biotechnology Research