PUBLICATION PRODUCTIVITY OF MATHEMATICS IN SELECT UNIVERSITIES OF CHANDIGARH AND PUNJAB: A SCIENTOMETRIC VIEW

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Abstract *The present study focuses on publication productivity in some select Universities of Chandigarh and Punjab during the year 2004-2013. The methodology used for analysing the research output in the field of Mathematics is reflected in Scopus Database. The study deals with 532 publications of Panjab University, Chandigarh (PU), Punjabi University, Patiala (PUP) and Guru Nanak Dev University, Amritsar (GNDU) in the field of Mathematics. It examines the Mathematics output by different ways like document type, source type, authorship pattern and degree of collaboration. The study also examines the relative growth rate of publications, doubling time for publications and participative index rate of Universities.*

Keyword: *Panjab University, Chandigarh, Punjabi University, Patiala, Guru Nanak Dev University, Amritsar, Mathematics, Authorship Pattern and Bibliometric / Scientometric Analysis*

INTRODUCTION

Research has now become the very significant aspect of scholarly communication involving theses, dissertation, conference proceedings, books, patents and journal articles, etc. It is important to undertake the analysis of the research output in the discipline. The term 'Bibliometric' and 'Scientometric' were almost simultaneously introduced by Pritchard and by Nalimov and mulchenko in 1969. Scientometrics can be defined as the "quantitative study of science, communication in science, and science policy" In this study authors use scientometric indicators to find out document type, source type, authorship pattern, degree of collaboration, relative growth rate of publications, doubling time for publications and participative index rate of universities. Panjab University, Chandigarh (PU), Punjabi University, Patiala (PUP) and Guru Nanak Dev University, Amritsar (GNDU) is well known Universities in Chandigarh and Panjab.

Background of Universities

Panjab University, Chandigarh offers courses and research in Science, Engineering & Technology, Humanities, Commerce, Social Sciences, Performing Arts and Sports. According to the Times Higher Education's (THE) World University Rankings 2013-2014, Panjab University (PU) is the highest ranked Indian institution. The rankings are based on universally recognized primary core missions such as teaching, research, knowledge transfer and international outlook. Panjab University also got first in India and 13th place in the BRICS (Brazil, Russia, India, China and South Africa) and Emerging Economies Ranking 2014. Punjabi University, Patiala (PUP) and Guru Nanak Dev University, Amritsar (GNDU) are the other two well known universities in Punjab. The PUP was originally conceived as a unitary multi-faculty teaching and research university and GNDU was conceived for imparting education and promoting research in the humanities, learned professions, sciences, especially of applied nature and technology. After this study authors are able to know the research output levels of these three universities in the field of mathematics.

OBJECTIVES

The objective of the study is to present status of publication productivity in the field of mathematics in some select Universities of Chandigarh and Punjab by using different bibliometric indicators.

- To study the participative Index of Universities.
- To examine the relative growth rate and doubling time for publications.
- To find out the degree of collaboration through the authorship pattern
- To analysis the source type of publication
- To calculate proportion of universities in total output

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METHODOLOGY & SCOPE

In this study following methodology is used**:**

- Data Collection Source: Scopus
- Document Type: Articles, Conference papers and reviews only
- Time Span: 2004-2013
- Subject Covered: Mathematics
- Universities: Panjab University, Chandigarh (PU), Punjabi University, Patiala (PUP) and Guru Nanak Dev University, Amritsar (GNDU)

STATISTICAL TOOLS AND TECHNIQUES USED:

Relative Growth Rate

The relative growth rate and doubling time model developed by Mahapatra was applied to examine the growth rate of research publications. The relative growth rate is increased in the number of publications per unit of time. A specified period of interval can be calculated from the following equations.

$$R(1\text{-}2) = \frac{W2 - W1}{T2 - T1}$$

Where,

- R (1-2) is the mean relative growth rate over the specified period of interval.
- W1 = Log W1: (Natural log of initial number of publications).
- W2 = Log W2: (Natural log of final number of publications).
- T2-T1 = the unit difference between the initial time and final time.

Doubling Time

From the calculation, it is found that there is a direct equivalence existing between the relative growth rate and doubling time. If the number of publications of a subject doubles during a given period, then the difference between the logarithm of the numbers at the beginning and at the end of the period must be the logarithms of the number 2. If one uses a natural logarithm, this difference has a value of 0.693. The corresponding doubling time for publications and pages can be calculated by using the following formula:

$$\text{Doubling time (Dt)} = \frac{0.693}{\bar{R}}$$

Degree of Collaboration

The degree of collaboration is defined as the ratio of the number of collaborative research papers to the total number of research papers in the discipline during a certain period of time. The formula suggested by Subramanyam (1983) is used. It is expressed as

$$C = \frac{NM}{NM + NS}$$

Where,

- C = Degree of collaboration of faculty members
- NM = Number of multiple authored papers
- NS = Number of single authored papers

Participative Index

To evaluate the performance level of research of an institution, an index called “Participative Index” (PaI) has been calculated. Pal is the ratio of the number of papers generated in a country or institution and the total number of documents collected in the stock. This can be expressed as:

$$\text{PaI} = \frac{\text{Number of papers generated in a country or institution}}{\text{Total number of documents collected in the stock}}$$

Limitation of the Study

The study is confined to a period 2004-2013 and only in the field of Mathematics covered in the Scopus.

RESULTS AND DISCUSSION:

1. University wise distribution of total documents

It is observed from table 1 that PU has maximum share i.e. 374 (7.50%) in mathematics out of total documents as compared to other two universities followed by PUP with 80 (4.44%) and GNDU with 78 (3%) publications in mathematics.

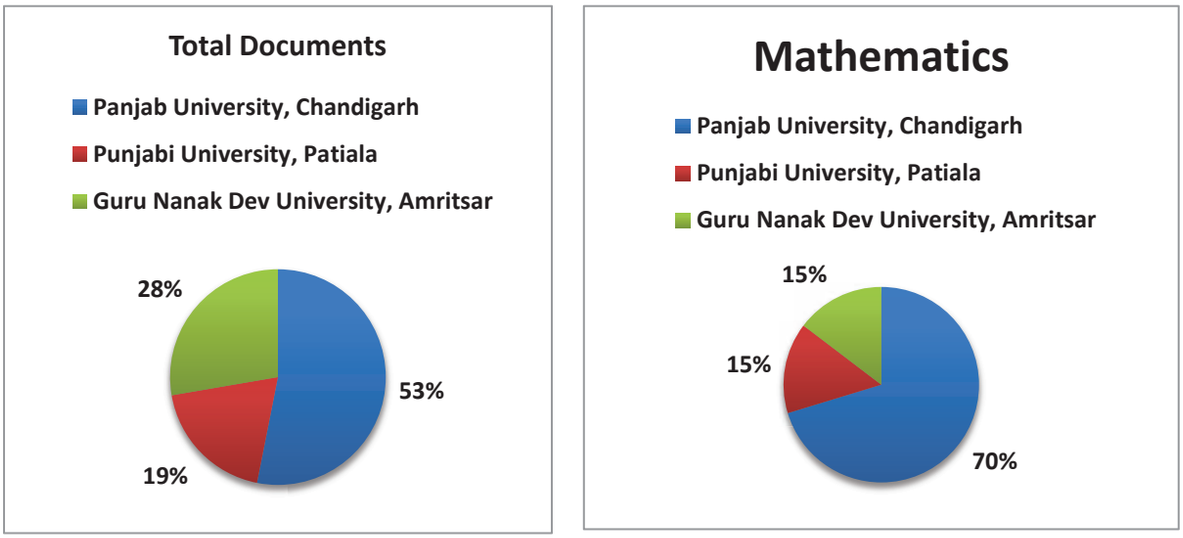
2. Source Type

Table 2 reveals that there are maximum publications in journals by all three universities. There are 94 % publication in journals followed by only 3% and 2.6% by PUP and

Table 1: University Wise Distribution of Total Documents and in Mathematics from 2004-2013

Name of University	Total Documents	Mathematics	Percentage of Mathematics in total documents
Panjab University, Chandigarh	4984	374	7.50%
Punjabi University, Patiala	1800	80	4.44%
Guru Nanak Dev University, Amritsar	2600	78	3%
Total	9384	532	5.67%

Figure 1



GNDU respectively.

Table 2. Type of Source Used in Mathematics Documents from 2004-2013

Name of University	Journals	Conference proceedings	Book Series
Panjab University, Chandigarh	359	7	8
Punjabi University, Patiala	69	6	5
Guru Nanak Dev University, Amritsar	74	3	1
Total	502	16	14

AUTHORSHIP PATTERN AND DEGREE OF COLLABORATION

In the light of the above fact, an attempt has been made to identify the nature of authorship pattern in scientific research output made in Mathematics in select universities of Chandigarh and Panjab. It is evident from table 3 that two-authored papers rank first in order sharing 35.71 percent of the total output. Subramanyam proposed a mathematical formula for calculating author's degree of collaboration in a discipline. The degree of collaboration among authors is the ratio of the number of papers published in a discipline during certain period of time. So far degree of collaboration is concerned, GNDU has a less degree of collaboration, i.e. 0.88 as compared to the other two universities. PU and PUP have the same degree of collaboration, i.e. of 0.95.

4. Participative Index of universities

Table 4 shows that among the 532 publications, 374 i.e. 70.30% are from PU, and remaining 158 i.e. 29.70% are from other universities. The following figure indicates that PU contributes the maximum share of total publication output as compare to PUP and GNDU.

5. Relative growth rate and doubling time of publication of Panjab University, Chandigarh

Table 3.

Name of University	Single authored	Two authored	Three Authored	More than three authored	Degree of Collaboration
Panjab University, Chandigarh	19	116	91	148	0.95
Punjabi University, Patiala	4	38	33	5	0.95
Guru Nanak Dev University, Amritsar	9	36	31	2	0.88
Total	32	190	155	155	---
%age out of 532	6.01	35.71	29.14	29.14	

Figure 2. Type of Source Used in Mathematics Documents from 2004-2013 (10Years)

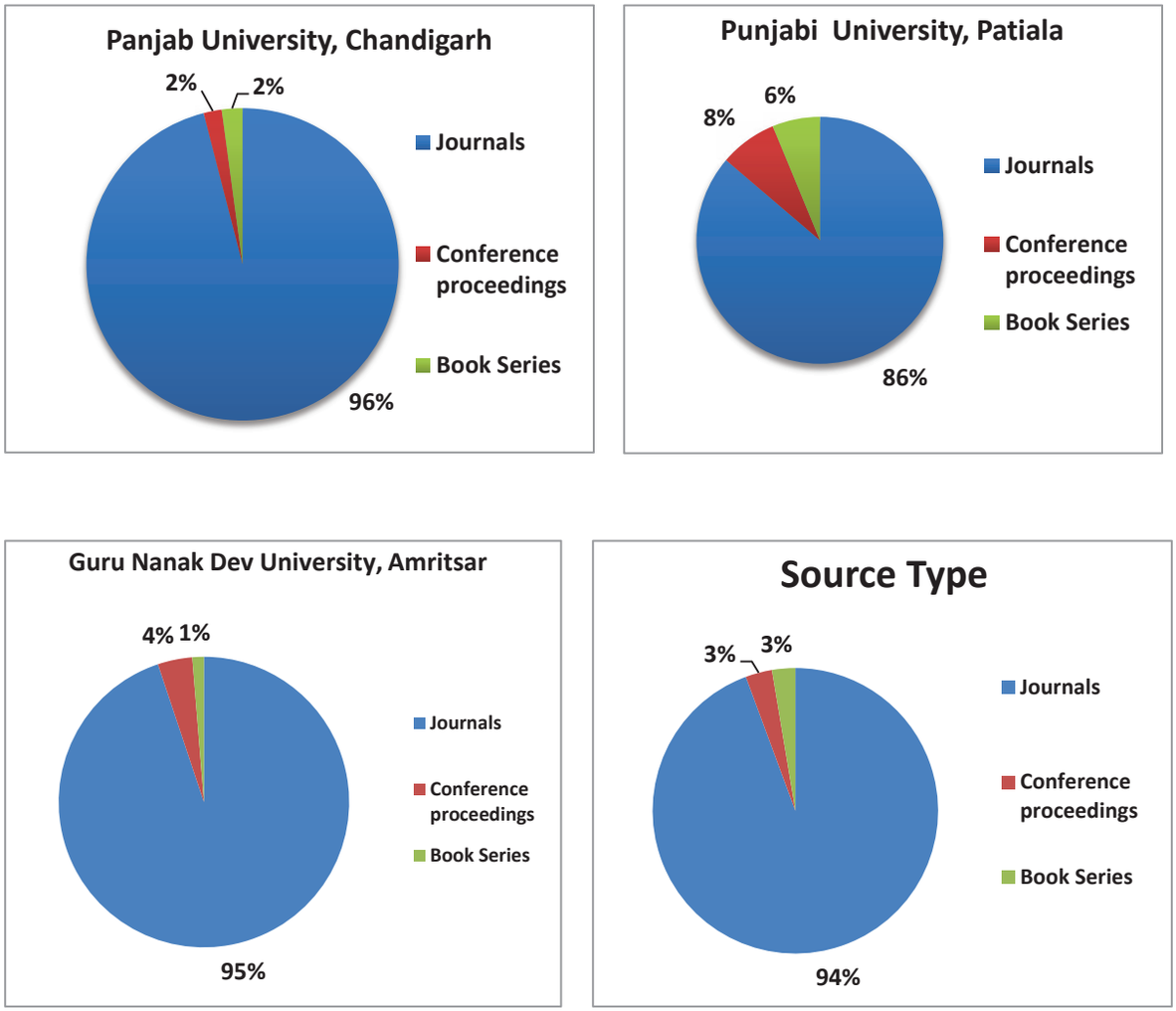


Table 4. Participative Index of Universities

Name of University	Total	Participative Index (Pal%)
Panjab University, Chandigarh	374	70.30%
Punjabi University, Patiala	80	15.04%
Guru Nanak Dev University, Amritsar	78	14.66%
Total	532	100%

Figure 3. Authorship Pattern used in Mathematics Documents from 2004-2013 (10Years)

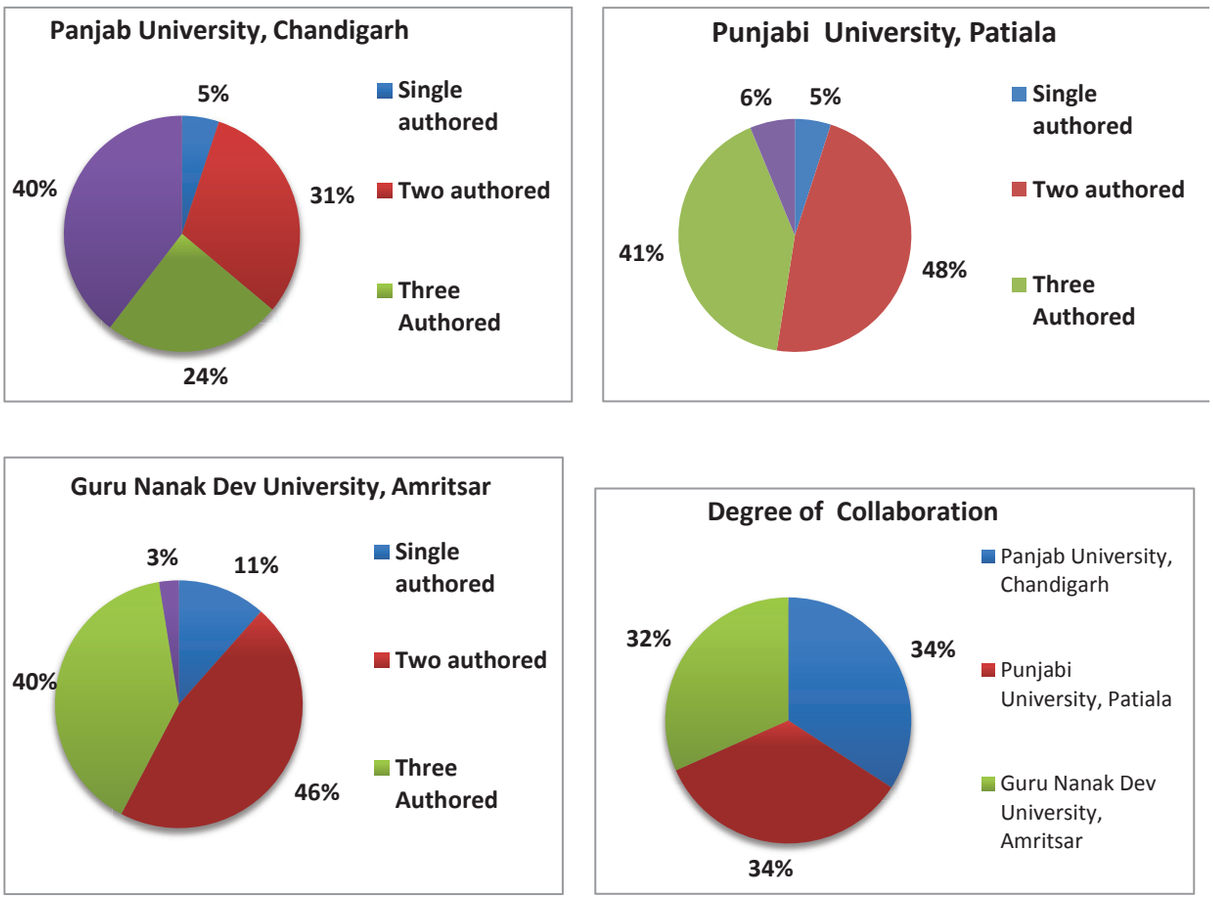


Table 5: Relative Growth Rate and Doubling Time of Publication of Panjab University, Chandigarh

Year	Number of Publications (PU)	Cumulative Sum	W 1	W2	Relative Growth Rate= (W2-W1)/ (T2-T1)	Mean R	Dt (p)	Mean Dt (p)
2004	18	18	-	2.89	-		-	
2005	34	52	2.89	3.95	1.06		0.65	
2006	33	85	3.95	4.44	0.49		1.41	
2007	52	137	4.44	4.92	0.48		1.44	
2008	44	181	4.92	5.20	0.28	0.46	2.48	1.20
2009	29	210	5.20	5.35	0.15		4.62	
2010	52	262	5.35	5.57	0.22		3.15	
2011	31	293	5.57	5.68	0.11		6.30	
2012	45	338	5.68	5.82	0.14		4.95	
2013	36	374	5.82	5.92	0.10	0.14	6.93	5.19

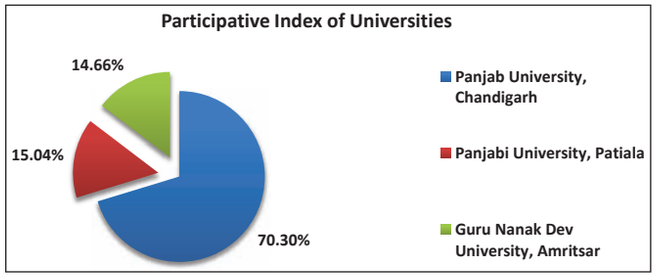
Table 6: Relative Growth Rate and Doubling Time of Publication of Punjabi University, Chandigarh

Year	Number of Publications (PUP)	Cumulative	W 1	W2	R= (W2-W1)	Mean R	Dt (p)	Mean Dt (p)
2004	1	1	-	0	-		-	
2005	3	4	0	1.39	1.39		0.50	
2006	4	8	1.39	2.08	0.69		1.00	
2007	9	17	2.08	2.83	0.75		0.92	
2008	4	21	2.83	3.04	0.21	0.61	3.30	1.14
2009	15	36	3.04	3.58	0.54		1.28	
2010	7	43	3.58	3.76	0.18		3.85	
2011	11	54	3.76	3.99	0.23		3.01	
2012	13	67	3.99	4.20	0.21		3.30	
2013	13	80	4.20	4.38	0.18	0.27	3.85	3.06

Table 7. Relative Growth Rate and Doubling Time of Publication of Guru Nanak Dev University, Chandigarh

Year	Number of Publications (GNDU)	Cumulative	W 1	W2	R= (W2-W1)	Mean R	Dt (p)	Mean Dt (p)
2004	4	4	-	1.39	-		-	
2005	1	5	1.39	1.61	0.22		3.15	
2006	4	9	1.61	2.20	0.59		1.17	
2007	3	12	2.20	2.48	028		2.48	
2008	5	17	2.48	2.83	0.35	5.83	1.98	1.76
2009	12	29	2.83	3.37	0.54		1.28	
2010	10	39	3.37	3.66	0.29		2.39	
2011	13	52	3.66	3.95	0.29		2.39	
2012	14	66	3.95	4.19	0.24		2.89	
2013	12	78	4.19	4.36	0.17	0.31	4.08	2.61

Figure 4. Participative Index of Universities



The growth of Panjab University, Chandigarh were analysed by Relative Growth Rate (RGR) and Doubling time (Dt). RGR is a measure to study the increase in the number of articles on time and the Dt(p) is directly related to RGR. It is the time required for articles to become double of the existing amount. The table 5 shows that the relative growth rate of Panjab University, Chandigarh research output in Mathematics decreases gradually from 1.06 to 0.10 in the ten year period (2004-2013.). The doubling time (Dt) correspondingly increases from 0.65 to 6.93 during this period. The mean growth rate & doubling time for the Panjab University, Chandigarh is 0.6 and 6.39 respectively.

6. Relative growth rate and doubling time of publication of Punjabi University, Patiala

The table 6 shows that the relative growth rate of Punjabi University, Patiala research output in Mathematics also decreases from 1.39 to 0.18 in the ten year period (2004-2013.). The doubling time (Dt) correspondingly increases from 0.50 to 3.85 during this period. The mean growth rate & doubling time for the Punjabi University, Patiala is 0.88 and 4.2 respectively.

7. Relative growth rate and doubling time of publication of Guru Nanak Dev University, Amritsar

Table 7 demonstrates that the relative growth rate of Guru Nanak Dev University, Amritsar research output in Mathematics is not constant in the ten year period (2004-2013.). The doubling time (Dt) also fluctuates in this period. The mean growth rate & doubling time for the Guru Nanak Dev University, Amritsar is 6.14 and 4.37 respectively.

CONCLUSION

In the end the researcher concludes that Panjab University has maximum documents in mathematics indexed by Scopus. All the universities have maximum publications in journals. The study also reveals that two authored publications are more than others categories of authorship pattern. GNDU has a less degree of collaboration, i.e. 0.88 as compared to the other two universities. PU and PUP have the same degree of collaboration, i.e. of 0.95. It was observed that the Relative Growth Rate is not constant in all the years under study in universities of Chandigarh and Punjab. The doubling time (DT) increasing in PU and PUP, but in GNDU fluctuates in different years.

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