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ORIGINAL ARTICLE

Research Contributions of Prof. S.S. Abhyankaran Indo-American Mathematician: A Scientometric Study

Nanabhau Thakare[1], Manjusha Ahirrao[2]

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ABSTRACT

The present study explores deals with the analysis of research contributions of Prof. S.S. Abhyankar, an Indo-American mathematician. He had published 96 research papers in during 1966-2015 in various scientific journals indexed in Web of Science database during 1966-2015. Different scientometric indicators like Relative Growth Rate, Relative Citation Rate, and Authorship Pattern, Title Words, Country-wise, Institution-wise and Author-wise are used. Required data for the present study was obtained from Web of Science database. Data was analyzed by R-programing and MS-Excel Software. The study reveals that, he was contributed 96 papers during 1966-2015, had received total number of 1495 citations each research papers have received an average 15.57. On an average he was publish two research papers for each year. The maximum number of 69 percentile research was contributed by him from 1991-2015. Among the 96 papers, six papers have received highest 47.35% of total (708) citations. Average number of authors per paper is 1.61. J.H. William, S.B. Joshi, T.T. Moh and Ikkwon Yie was the main collaborator of him. Proceedings of the American Mathematical Society, American Journal of Mathematics, Journal of Algebra and Discrete Mathematics were the most preferred journals of him for to reveal the research findings.

KEYWORDS

• S.S. Abhyankar • Scientometric portrait • Bibliometric study • Authorship pattern • Scientific production

INTRODUCTION

Scientometric deals with application of mathematical methods to measure and analyse science, technology and innovations terms of the qualitative and quantitative to the history of Science. Scientists and scholars are the most

AUTHOR'S AFFILIATION:

[1] Arts, Commerce and Science College Onde, Palghar, Maharashtra 401605, India.
[2] SPDM College, Shirpur, Dhule 425405, India.

CORRESPONDING AUTHOR:

Nanabhau Thakare, Arts, Commerce and Science College Onde, Palghar, Maharashtra 401605, India.
E-mail: nanabhau10@gmail.com

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valuable asset for to produce new knowledge. Evaluating the scientific research out-put of Scientists and scholarand measuring the impact of their research is the main objective bio-bolometric analysis. Scientometric Portrait deals with the scientifically and methodologically assessed by the using of biographical bibliometric or bio-bibliometric scientists or scholars. In this paper, we present a concise sketch of Prof. S.S. Abhyankar.

Prof. S.S. Abhyankarwas born on July 22, 1930 at Ujjain, India. He isan Indian American eminent mathematician; he is recognized by his contributions to algebra geometry. He pursued B.Sc. from Bombay University, and then he went to Harvard University, USA and enrolled master's degree and continued to study there for his doctorate advised by Oscar Zariski. Prof. Abhyankar was appointed to Purdue University as a full professor in 1963 and he was named Marshall Distinguished Professor of Mathematics at Purdue in 1967 also he was associated with Columbia and Cornell, Johns Hopkins and University of Pune.

Owing to the contributions in mathematics, he was awarded by McCoy Prize from Purdue University, the Lester Ford Prize and the Chauvenet Prize from the Mathematical Association of America, a Medal of Honour from the University of Valliadolid, Spain, and a Medal from the University of Brasilia, Brazil. He was given the honorary title ofVidnyan *Sanstha Ratna* from the Institute of Science, Mumbai. The Angers University, France, awarded him an honorary doctorate in 1998. Also was elected a Fellow of the Indian National Science Academy (1987) and a Fellow of the Indian Academy of Sciences (1988). The American Mathematical Society introduced a new honour of 'Fellow of the American Mathematical Society' in 2012.

He founded a research institute named Bhaskaracharya Pratishthan at Pune, to inspire the students towards mathematics. He passed away on November 1, 2012 at the age of 82, while sitting at his desk working on mathematics on the morning. This article is meant as a tribute to him and a small attempt provide some glimpses of and his contributions.

REVIEW OF LITARATURE

Scientometric portrait is deals with the biographical assessment of the individual career of scientist and this kind of study was started around early 80s of last century. There are plenty of studies carried out till date from various disciplines. Kademani *et al.* were first to use the term "Scientometric portrait" to carry out bio-bibliometric studies on eminent scientists. A number of studies have been carried out that used the term "Scientometric Portrait" specifically of Nobel laureates. Angadi *et al.* created scientometric portrait of Nobel Laureate Leland H. Hartwell. Kalyane and Kademani executed a lot of scientometric studies on individual scientists. Koganuramah *et al*. analyzed scientometric study of Nobel laureate Wolfgang Ketterle (physics), Kumar and Ruhela has reveals the characteristics of Nobel laureate Michael Morris Rosbash and Jeffrey C. Hall in details, Maurya, and Kumar developed scientometric portrait of Nobel laureate in Chemistry, Serenko *et al*. analysed scientometric portraits of recognized scientists and their research contributions, Sinha studied the scientometric analysis of books authored by Nobel laureate Indian Nobel laureate Dr. Amartya Sen, Sangam *et al*. examined 337 papers of Prof. Peter John Wyllie, the reveals that he was contributed more than 146 papers as a solo author.

OBJECTIVES

The main objectives of the present study are as following:

- To find out the chronology of research publication.
- To study the channels of communication.
- To examine the nature of authorship pattern in mathematic research.
- To find out the most preferred journals.
- To analyze the country-wise scientific production.
- To know the most cited papers.

DATA SOURCE AND RESEARCH METHODOLOGY

The present study is limited to analyses the research publications of S.S. Abhyankar indexed in Web of Science database during 1966-2015. To carry out the study research productivity of Prof. Abhyankar in the field of mathematics indexed in Web of Science database by using the Author Search (Abhyankar, S.S.) keyword. A totalof 96 results have been found. Downloaded data have been

analyzed by R-programing and MS-Excel Software and results were represented in an appropriate tables and bar charts according to the objectives of the study.

RESULTS AND ANALYSIS

Table 1 shows that, the chronologic contribution of Prof. Abhyankar during 1966-2015; he haspublished 96 research papers in different national and international journals. At the age of 30 he has published 1st paper. During his research journey he has published 96 research papers. On an average 2 papers were published by him in an individual year. The maximum numbers of papers (66) were published in 1991 to 2015. In the year 1991, he was publish highest number of publications (8) in the year 1969, 1974, 1977, 1980, 1981, 1982, 1984, 1985, 1986, 2004, 2005 and did not published a paper. The low productivity during these years may be due to reason that, he was visiting faculty to many universities.

Table 1: Chronology of research papers

Age of SSA	Year	Number of papers under different authorships					CT	PPA
		A1	A2	A3	MA	TP		
30	1966	1	_	_	_	1	1	1
31	1967	3	_	_	_	3	4	2
32	1968	3	_	_	_	3	7	3
33	1969	_	_	_	_	_	_	4
34	1970	_	2	_	2	2	9	5
35	1971	1	_	_	_	1	10	6
36	1972	_	_	1	1	1	11	7
37	1973	_	2	_	2	2	13	8
38	1974	_	_	_	_	_	_	9
39	1975	_	1	_	1	1	14	10
40	1976	1	_	_	_	1	15	11
41	1977	_	_	_	_	_	_	12
42	1978	_	1	_	1	1	16	13
43	1979	1	_	_	_	1	17	14
44	1980	_	_	_	_	_	_	15
45	1981	_	_	_	_	_	_	16
46	1982	_	_	_	_	_	_	17
47	1983	2	_	_	_	2	19	18
48	1984	_	_	_	_	_	_	19
49	1985	_	_	_	_	_	_	20
50	1986	_	_	_	_	_	_	21
51	1987	_	2	_	2	2	21	22
52	1988	2	_	_	_	2	23	23
53	1989	1	3	—	3	4	27	24
54	1990	_	2	1	3	3	30	25

Age of SSA	Year	Number of papers under different authorships					CT	PPA
		A1	A2	A3	MA	TP		
55	1991	1	5	2	7	8	38	26
56	1992	3	_	1	1	4	42	27
57	1993	3	1	1	2	5	47	28
58	1994	3	3	1	4	7	54	29
59	1995	_	3	_	3	3	57	30
60	1996	3	1	_	1	4	61	31
61	1997	2	1	_	1	3	64	32
62	1998	1	1	_	1	2	66	33
63	1999	1	1	_	1	2	68	34
64	2000	1	_	1	1	2	70	35
65	2001	1	3	_	3	4	74	36
66	2002	1	_	_	_	1	75	37
67	2003	1	_	_	_	1	76	38
68	2004	_	_	_	_	_	_	39
69	2005	_	_	_	_	_	_	40
70	2006	_	_	_	_	_	_	41
71	2007	_	1	_	1	1	77	42
72	2008	3	1	_	1	4	81	43
73	2009	1	_	_	_	1	82	44
74	2010	1	_	_	_	1	83	45
75	2011	2	2	_	2	4	87	46
76	2012	1	2	_	2	3	90	47
77	2013	2	2	_	2	4	94	48
78	2014	_	1	_	1	1	95	49
79	2015	_	_	1	1	1	96	50
Total		46	41	09	50	96	96	50

Note: A1=One Author, MA=Multiple Author, TP=Total Publication, CT=Cumulative Total, PPA=Publication Productive Age.

CHANNELS OF COMMUNICATION USED

Table 2 reveals that, preferred channels of communication himduring theresearch productivity He was published a total number of 96 scientific research papers which includes, Scientific periodicals (91) and Conference proceeding (05) are the tow form of literature was preferred by him. Among 96 scientific documents, journal articles have received highest citation (98.12%) with compared to papers in conference proceedings (1.88%).

Table 2: Types of documents preferred for publishing research findings

Type of documents	No. of publications (%)	No. of citations received (%)
Journal articles	91 (94.8 %)	1467 (98.12)
Papers in conference proceedings	05 (5.2 %)	28 (1.88)
Total	**96 (100 %)**	**1495 (100 %)**

Authorship Pattern

Figure 1 indicates that, Prof. Abhyankar contributed 96 papers. Among 46 (47.92%) papers were contributed by him as a solo author, followed by 50 papers had been created in collaboration. Whereas 50 (52.08%) papers were multi-authored, among 41 (42.70%) contributed by two authorsand only he made 09 (9.38%) papers were constituted by three authors. It is also reveals that, he was created near around 50% of his research as a solo scientist.

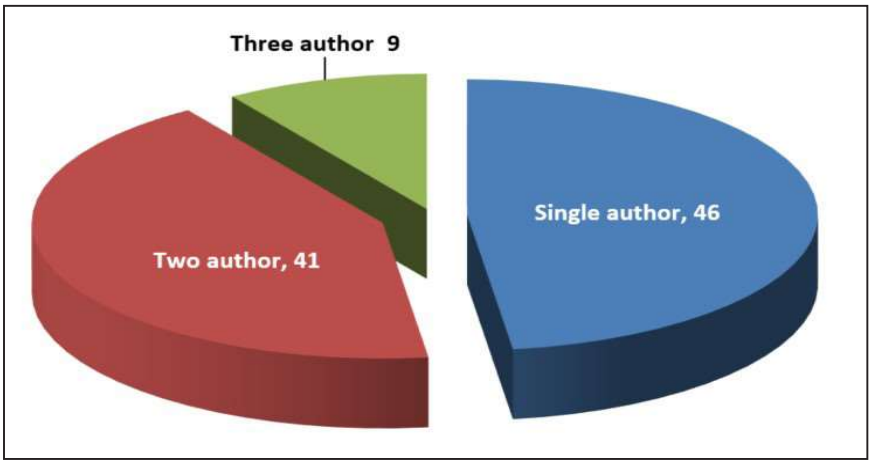


Figure 1: Authorship pattern

Journals preferred to publish research findings

Table 3 shows the journal-wise scattering of publications by Prof. Abhyankar. A total number of 96 research papers were published by him and he was preferred 31 different journals for research findings. The core journals publishing his papers were Proceedings of the American Mathematical Society in which 21 papers were placed, journals, followed by American Journal of Mathematics 11 papers and Journal of Algebra for 10 papers. Further, total numbers of 16 single papers were published in different 16 journals. Number 80 (83.33%) papers were published within 14 different journals and 16 (16.67%) papers were founded in different journals around the world.

Table 3: Journals preferred

Journal	Articles	Country of origin
Proceedings of the American Mathematical Society	21	USA
American Journal of Mathematics	11	USA
Journal of Algebra	10	USA
Discrete Mathematics	8	Netherlands
Proceedings of the Indian Academy of Sciences Mathematical Sciences	6	India
Journal Fur Die Reine und Angewandte Mathematik	5	Germany

Journal	Articles	Country of origin
Transactions of the American Mathematical Society	4	USA
ComptesRendus De l Dcademie Des Sciences Serie i Sathematique	3	France
ACM Transactions on Graphics	2	USA
Advances in Mathematics	2	
Bulletin of the American Mathematical Society	2	USA
computer aided design	2	UK
Finite Fields and their Applications	2	USA
RevistaMatematicaComplutense	1	Italy
American Mathematical Monthly	1	USA
Atti Della Dccademia Nazionale Dei Lincei Rendiconti Classe Di Scienze Fisiche Matematiche Naturali	1	Italy
Current Science	1	India
Discrete Applied Mathematics	1	USA
Duke Mathematical Journal	1	UK
Indian Journal of Pure Applied Mathematics	1	India
Israel Journal of Mathematics	1	Israel
Journal of Pure and Applied Algebra	1	USA
Journal of Statistical Planning and Inference	1	USA
Lecture Notes in Computer Science	1	USA
Mathematical Intelligencer	1	USA
MathematischeAnnalen	1	USA
Notices of the American Mathematical Society	1	USA
Perspectives in Mathematical Sciences ii Pure Mathematics	1	Singapore
Proceedings of Symposia in Pure Mathematics	1	Guyana
RevistaMatematicaIbero Americana	1	USA
Statistical Science and Interdisciplinary Research	1	USA

Country-wise scientific publication

Table 4 shows Prof. Abhyankar was publish his papers in different 11 countries, among these maximun numbers of papers were published in USA (60) followed by India (8) and Netherlands (8) and Germany (6). Within these four countris he was publish 82 research paper (85.41%) and reamaing 14 papers (14.59%) were publishe in different 7 countries. This indicate that more than tow third (62.5%) of the papers bublished by him USA based journals.Hence, India, Netherland and Germany followed by him.

Table 4: Country-wise scientific publications

Country	No. of Papers	Percentile
USA	60	62.5
India	8	8.33
Netherlands	8	8.33
Germany	6	6.25
France	3	3.13
Italy	3	3.13
UK	3	3.13

Country	No. of Papers	Percentile
Spain	2	2.08
Israel	1	1.04
Singapore	1	1.04
Guyana	1	1.04
	96	**100**

MOST CITED RESEARCH PAPERS

Prof. Abhyankar was publish 96 papers and received 1495 citations. Table 5 shows that, only his 6 research papers have received 708 citations (47.35%) till date. Although, these papers are considered to have most cited and high influenced. Most of the three highly cited papers originated from Gemany, these papers receiving total number of 416 citations out 708. Remaining 83 papers have received 787 (52.65%)citations. Hence, 07 have not received any citations till date. The important feature is that, highly cited papers journals were published form developed countries.

Table 5: Most cited papers of Prof. Abhyankar

Authors	Title of the article	Journal / Conference name	Year of publication	No. of citations received	First-last year of citations
Abhyankar, SS, Moh TT	Embeddings of Line in Plane	Journal Fur Die Reine Und Angewandte Mathematik	1975	264	1975-2024
Abhyankar SS, Heinzer W, Eakin P	Uniqueness of Coefficient Ring in a Polynomial Ring	Journal of Algebra	1972	117	1972-2024
Abhyankar SS	Local Rings of High Embedding Dimension	American Journal of Mathematics	1967	105	1967-2024
Abhyankar, SS, Moh TT	Newton-Puiseux Expansion And Generalized Tschirnhausen Transformation	Journal Fur Die Reine und Angewandte Mathematik	1973	92	1973-2024
AbhyankarSS	Galois Theory on the Line in Nonzero Characteristic	Bulletin of the American Mathematical Society	1992	70	1992-2024
Abhyankar, SS, Moh, TT	Newton-Puiseux Expansion and Generalized Tschirnhausen Transformation.2	Journal Fur Die Reine und Angewandte Mathematik	1973	60	1973-2024
			Total	708	

Collaborating authorship

In his entire career as a scientist he has collaborated with 34 eminent scientists and students and has contributrd a total of 96 papers during the years 1966-2015. Among 34 collaborating authors, Prof. Abhyankar has published 46 research papers by him as a solo author whereas 50 papers (42.70) in collaboration with 16authors during 1966-2015. He has published 8 research papers with J. Heinzer William, he also work together and published twice papers with Joshi Santosh, MohTzuong-tsieng and Yie, Ikkwon. Figure 2 reveals the collaboration of authorship network of him.

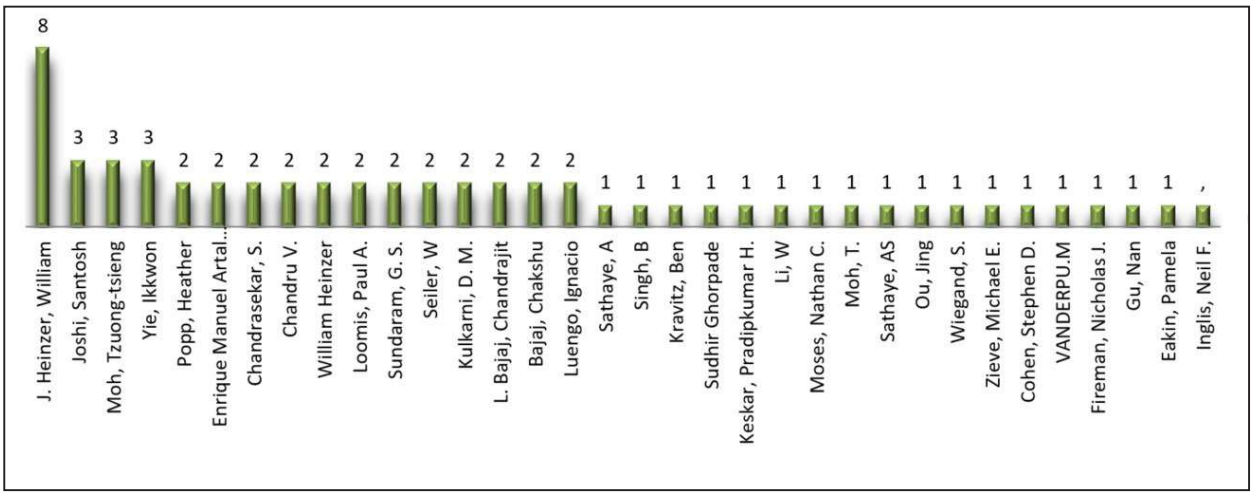


Figure 2: Collaborating authorship

CONCLUSION

Prof. Abhyankarhave long research career in Mathematics hence; he was contributed maximum number of 96 scientific research papers but still his papers had received 1495 citations, it means attracts more fellow scientists towards him. During his research, he was maximum number of 46 papers was publish by him as a solo author. Most of time his highly cited papers origin was developed countries. While publishing the scientific research papers in different journals he was collaborated with limited scientists. Although, owing his scholarly works many new aspirants attracting towards him. Till the last day of life he was works on mathematics. It is evident from the above study that Prof. Abhyankar made great contributions to the field of mathematics .These contributions have been played vital role in to motivate the new researchers.

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