

RESEARCH PRODUCTIVITY OF FACULTY MEMBERS IN SCHOOL OF MATHEMATICAL SCIENCES, NMU JALGAON: A BIBLIOMETRICS STUDY



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ABSTRACT

This paper focuses on Research productivity of faculty members in the School of Mathematical Sciences, NMU, Jalgaon, Proposed research, Objective of the study, Hypothesis of the study, Scope and limitation of the study, Research methodology, Review of literature, Author Productivity: Language wise productivity, Designation wise productivity, subject and Gender wise productivity, Year wise productivity & key authors, Bradford's Law, Lotka's Law, Prices square root law, Authorship Patters, Major findings and Implications.

KEYWORDS : *Research Productivity , Bibliometrics Study , Mathematical Sciences , Faculty Members .*

INTRODUCTION

Faculty adds to the knowledge bases of their fields by doing research and communicating findings in a variety of published formats, which differ according to field. Teachers and research scholar's need information for keeping up with new developments, to get acquainted with the state of art and to provide the background information for preparing to produced new information. The publication of the information gathered by the faculty is a prestige to the institution. It is necessary for the institution to make aware outside world about their output. Mankind is an Individual in its mode of output as in the substance of its thoughts. Printed papers and books label one of the methods of measuring the output of institution in the form of original ideas with the names of its authors, publications then are observable phenomenon that can represent scholarly productivity (Soman, 2002). Bibliometrics is a type of research methods used in library and information science and utilized quantitative analysis and statistics to describe patterns of publication within a given field or body of literature. In fact, many research fields use bibliometric methods to explore the impact of their field, the impact of a set of researchers, or the impact of a particular paper. Bibliometrics are now used in quantitative research assessment exercises of academic output which is starting to threaten practice based research.

PROPOSED RESEARCH

Many information faculty members have used different terms for bibliometric studies. The pioneering work was statistical analysis of the literature by Cole and Eagles in 1917; Second attempt was made by Hulme in 1923. He used the term "Statistical bibliography to refer the application of quantitative techniques to libraries. He defined statistical bibliography as "to shed light on the process of written communication and of the nature and course of development of a discipline by means of counting the various facts of written communication" (Kumar and Kumar 2005).

Dr. S. R. Ranganathan in 1948 at the ASLIB conference held at Lamington Spa coined the term Librametry on the lines of Biometry, Econometry, Psychometry, etc. (Guha, 1993). He defined librametrics as the use of Mathematical and Statistical methods for analyzing library activities and library resources. (Ravichandrarao & Neelamaeghan, 1992). Several subdisciplines such as, Bibliometrics, Scientometrics and Infometrics have emerged. The term infometrics is comparatively speaking, a recent development and is often used to include both Bibliometrics and Scientometrics. Although in practice the three terms are often used interchangeably, there are subtle differences between them as seen by the following definitions. The British Standards Documentation Term (1976) defines bibliometrics as "Study of the use of documents and patterns of publications in which mathematical and statistical methods have been applied".

The North Maharashtra University, Jalgaon

The North Maharashtra University, Jalgaon, established on 15th August, 1990 under the Maharashtra Universities Act, XXIX of 1989, started its academic and administrative functioning from the academic year 1991-92. Within the span of 3 years, the University is recognized under section 2 (f) in 1991 and 12 (B) in 1994 under the University Grants Commission (UGC) Act, 1956. The jurisdiction of the University is extended over three districts i.e. Jalgaon, Dhule and Nandurbar, a pre-dominantly tribal and rural area of Khandesh region. The University has opened its doors of higher education to mostly "first generation learners" of this area. Access, equity and academic excellence are the thrust areas of the University's educational endeavor. There are 220 affiliated colleges and 04 University recognized Research Institutes/Centers under the jurisdiction of University. Out of these, 01 college is recognized as College of Excellence, 05 colleges have been identified as College with Potential for Excellence and 01 college has been granted autonomous status by the UGC, New Delhi Board and Government of Maharashtra. A climate of research, teaching, learning, student development, value education and community outreach programs is nurtured through vital links between the University Schools/Institute and all affiliated colleges. There are eight faculties namely, Arts and Fine Arts, Commerce and Management, Science, Engineering and Technology, Pharmacy, Law, Education and Mental, Moral and Social Sciences covering various UG/PG/M.Phil. /Ph.D. programs on the University Campus as well as in the affiliated colleges. The University has successfully adopted the 'School Concept' with academic flexibility for the optimal use of infrastructure and resources. There are 13 Schools and 01 Institute imparting education in 11-UG, 62-PG and 37-Ph.D. Programs. The University has implemented Cumulative Grade Point Average System from the academic year 2009-10 and Choice Based Credit System from the academic year 2014-15 to all the P.G. courses on the campus. Total 06 Schools/Institute of the University has been recognized for their research activities by National/International agencies like UGC SAP, DST-FIST, UGC Innovative, UGC-NON-SAP, MHRD-TEQIP-World Bank etc.

The School of Mathematical Sciences

The School of Mathematical Sciences includes three Departments as Department of Mathematics, Department of Statistics and Department of Actuarial Science. School offers the applied and job oriented courses/degree programs i.e. M.Sc. (Mathematics) with specialization in Computational Mathematics, M.Sc. (Statistics) with specialization in Industrial Statistics, B.Sc. (Actuarial Science), M.Phil. and Ph.D. in Mathematics and M.Phil. and Ph.D. in Statistics. Students are encouraged for projects in the industrial/social/health/ financial sectors. School regularly organizes activities for UG and PG students, college teachers and researchers. Faculty members in the school are actively engaged in research and their research areas include: Algebra, Analysis, Differential Equations, Fluid Dynamic, Fuzzy Mathematics, Industrial Statistics, Reliability, Probability Models, Health Statistics, Actuarial Science, Applied Statistics and Computational Statistics. Construction of extension building for school is completed.

OBJECTIVE OF THE STUDY

Present study has been undertaken with a view

- To measure productivity patterns of faculty members in the School of Mathematical Sciences, NMU, Jalgaon

However, specific objective of the study are:

1. To know the author productivity;
2. To analyzed domain/subject wise productivity;
3. To find out the Year wise productivity;
4. To find out the Designation-wise productivity; and
5. To find out the Gender wise productivity

HYPOTHESIS OF THE STUDY

The hypothesis formulated for the study as

1. More the publications are published in English Language;
2. More the experience more the productivity;
3. Male faculty members produce more publications than female;
4. Research productivity of faculty members increase their publications year by year; and
5. Higher is the degree of collaboration, higher is the research productivity.

SCOPE AND LIMITATIONS OF THE STUDY

The study is confined to the research productivity of faculty members in the School of Mathematical Sciences, NMU, Jalgaon. Research productivity of faculty members who was working at present. The study is a survey of the research productivity brought out by faculty members. The research productivity included all the (National/International) conferences, seminar, workshops, research papers, Journal's Articles, Ph. D. guided by Supervisor, Books & Chapters in Books by Authors and other Research by faculty members.

RESEARCH METHODOLOGY

Survey of faculty members are used for this study and questionnaire technique is used to collect the data from the faculty members in the School of Mathematical Sciences, NMU, Jalgaon. The Questionnaire was contained with bibliographical description of faculty members' publications only

i.e. personal information, curriculum activities, International and National Journals, Conference, Seminars, workshops, Symposiums, Books, Chapters in Books, Ph. D. guided by Supervisor and others publications. Back ground information about research productivity by faculty members have been collected based on the NMU's Web-site, Internet Searching, NMU's annual report, Published Literature, Journals, Directories, Brochures, their Newsletters and other sources etc. and Relevant data of research productivity of faculty members have been collected. Collected data has been analyzed by statistical techniques and presented data in tabular as well as in graphical form. In graphical form, Bar Charts, Pie Charts, Line Graphs are used for presentation. For the purpose of analyzing the data collected, some statistical techniques have also been used. In addition, some of the tools, techniques used for analyzing includes bibliometrics tools and techniques to come to the conclusions.

REVIEW OF LITERATURE

Prakash B. Hadagali (1983) Citations appended to "Indian Journal Agricultural Economics" published in five volumes (V. 32-36); (1977-1981) have been analyzed. A list of 33 periodicals each having been cited at least five times is compiled. Country wise scattering of cited periodicals and the chronological scattering of citations are presented in tabular form. Institution wise contribution from the author is prepared. Authorship pattern of contribution is also being presented. Identifier the periodical most frequently cited by the Indian Agricultural Economists.4

S. L. Sangam (1986) The paper examined to find out the literature use pattern by the researchers in the field of History gives the principal bibliographic forms. The titles of Journal's used and their distribution according to the country of origin and language citation analysis is shown as a useful tool in assessing actual and potential use of Journal's by the scholars at the Karnataka University Library, Dharwad (Karnataka).13

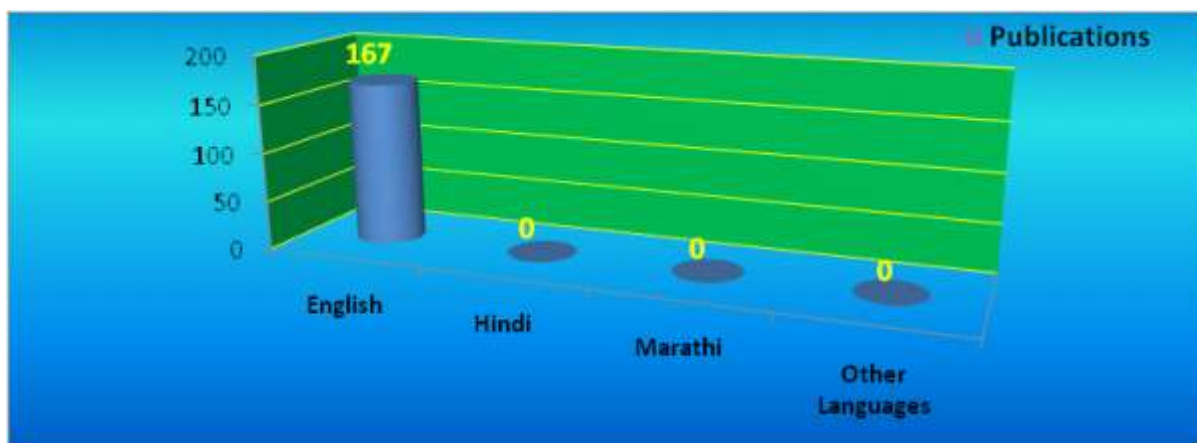
B. U. Kannapanavar, ChidanandaSwamy and M. Vijay Kumar (2004) The present study highlights the authorship trend and collaborative research in chemistry in India during 1996-2000. The study found that team research is preferred in the field of chemistry rather than solo research. The degree of collaboration is calculated and found to be 0.76. The degree of collaboration varies from year to year and is found to be 0.72 to 0.83. Average number of authors per paper has increased from 7.52 to 8.39.6

K. Baby and J. P. S. Kumaravel (2011) Research productivity of Periyar University faculties in India has been analyzed bibliometrically. The data used for the study were retrieved from Scopus database for a period of thirteen years from 1998 to 2010. Bibliometric studies are used to identify the pattern of publication, relative growth rate, authorship pattern, collaborative measures, author's productivity, most prolific authors and most prolific journals. The laws of Lotka and Bradford have also been tested. The results indicate that the growth of research has steadily increased from a single article in 1998 to 102 articles in 2010. The Relative growth rate and doubling time is 0.45 and 2.27 respectively. Three-authored publications predominate amongst the pattern of authorship. Journal articles occupy the entire place among sources of publication. However, the application of Lotka's law and Bradford's law does not fit to the literature analyzed.1

Sudhakar S. Thool (2012) Research productivity of faculty Members in Visvesvaraya National Institute of Technology, Nagpur has been analysed bibliometrically. The data collected from Faculty Members's curriculum vitae and questionnaires. 167 Faculty Members (teachers) are working in various departments of VNIT and present study is limited to the Faculty Members who are working at present in the various departments of VNIT, is also limited up to the year 2012 only. Bibliometric studies are used to identify the pattern of publication, relative growth rate, authorship pattern,

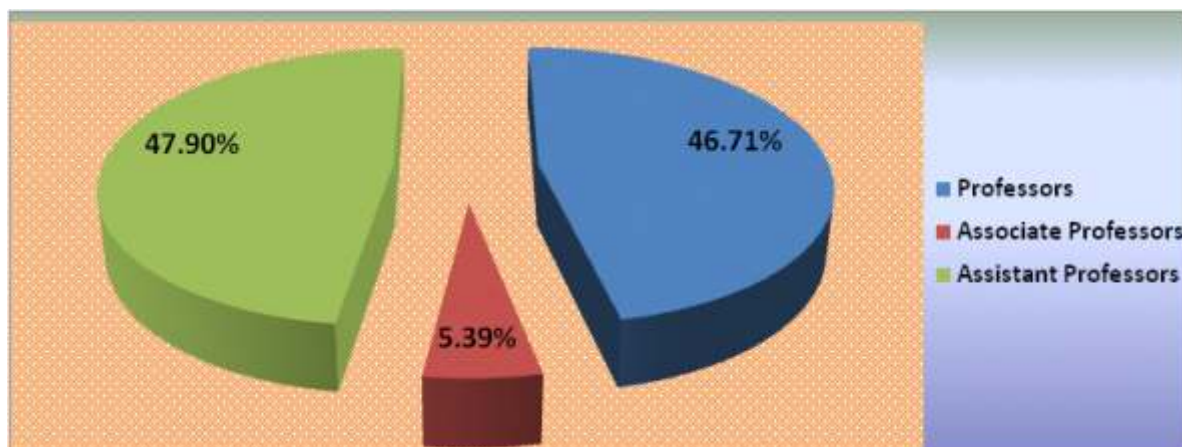
collaborative measures, author's productivity, and most prolific authors. The laws of Lotka and Bradford have also been tested. Total 3684 publications are contributed by 121 faculty members. Professors and Associate Professors, combine have contributed to 79.97% publications. The ratio of publications of male to female Assistant professors is 17.82:49.61, Associate professors 37.58:50.39 and professors 44.60:0. The total numbers of 3684 publications of 121 faculty Members were divided into 3 equal zones is in the ratio of 10:26:85 which indicates that the data fits into the Bradford's law of scattering. The price square root law is applicable to Applied Chemistry, Applied Mechanics, Applied Physics, Architecture & Planning, Chemical Engineering, Civil Engineering, Computer Science & Engineering, Electrical & Electronics Engineering, Electronics & Communication Engineering, Mathematics, Mechanical Engineering, Metallurgical & Materials Engineering and Mining Engineering. However, in no case 80/20 rule was applicable, while it was 20:50 i.e. 20% authors contributed to 50% papers. 20

Figure no. 1: Productivity of Faculty Members : Language Wise Distribution



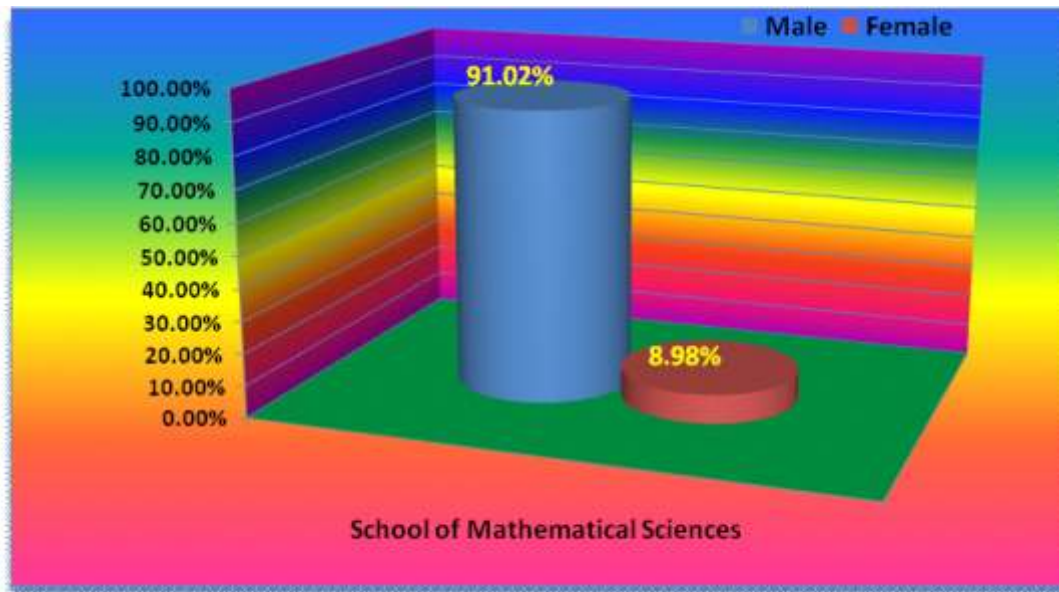
From the above figure, 167(100%) publications are published in alone English language by all faculty members, means the School of Mathematical Sciences subjects are dominated by English language. This indicates that "More the publications are published in English language" (hypothesis no.1) is valid.

Figure no. 2: Productivity of Faculty Members: Designation wise distribution



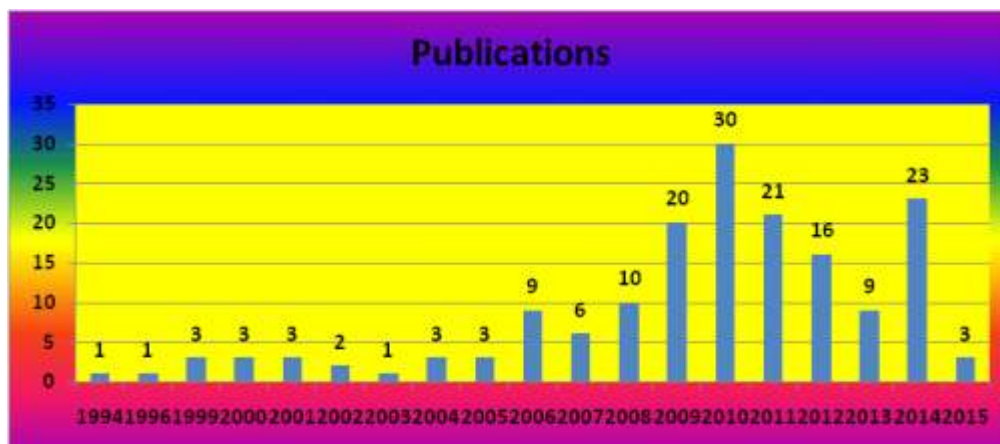
From the above figure, 8 faculty members published total 167 publications, Professors and Associate Professors, combine have contributed to 52.10% publications. It can be further noted that on an average 46.71% publications were published by professors, 5.39% by Associate professors and 47.90% by Assistant professors, which means senior people published more number of publications. This indicates that "More the experience more the productivity" (hypothesis no. 2) is valid.

Figure no. 3: Productivity of faculty Members in School of Mathematical Sciences: Subject and Gender wise distribution



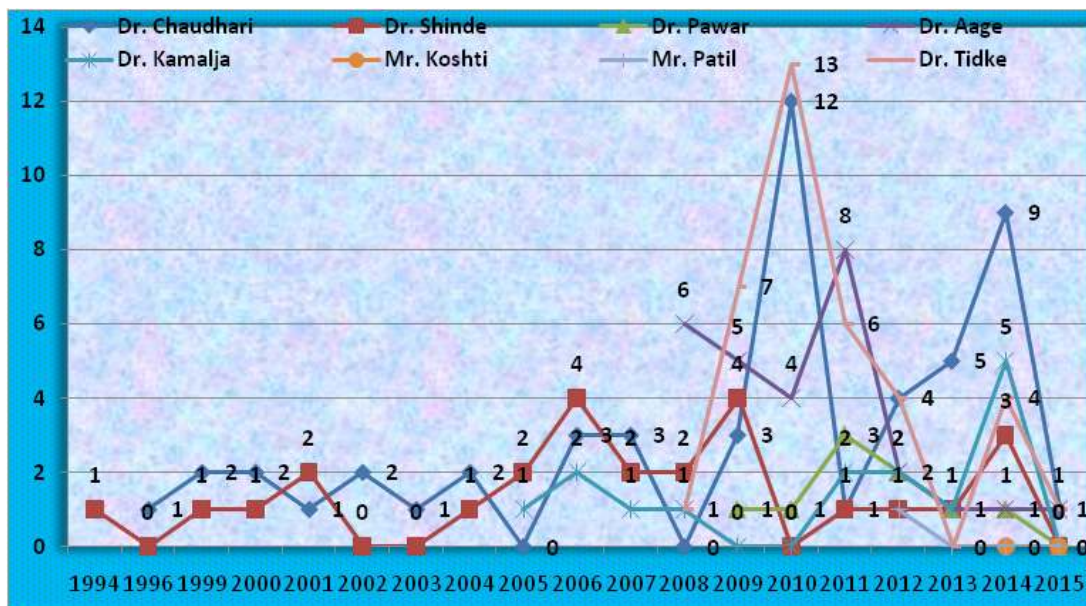
The above figure, Data of in all 8 faculty members was analyzed according to gender. It can be found from the above table that male faculty members have published 152(91.02%) publications out of 167 publications giving 21.71 publications per male faculty members and female faculty members have published 15(8.98%) publications giving 15.00 publications per female faculty members. It can also be observed that male faculty member have published 10.14 times more publications than female faculty members. This indicates that "Male faculty members produce more publications than female" (hypothesis no.3) is valid.

Figure no. 4: Productivity of faculty Members in School of Mathematical Sciences: Year and Subject wise distribution



In this domain, most productive year was 2010, as total productivity in this year was 30 publications, followed by 23 publications in 2014, 21 publications in 2011 and 20 publications in 2009. The year wise productivity is increased from 2007 to 2010, and then it has been decreased in 2011 to 2012, then increased from 2013 to 2014 and then decreased in 2015. It is also observed that decreased-increased manner from 1994 to 2015. It means that the year wise productivity is increased-decreased manner means fluctuation productivity during the period of 1994 to 2006, and then year wise productivity is increased from 2007 to 2010, means productivity is continuously increased up to 4 years. Hence, this indicates that "Research productivity of faculty members increases their publications year by year" (hypothesis no.4) is valid.

Figure no. 5: Productivity of faculty members: year wise distribution and key author in School of Mathematical Sciences



From the above figure, the faculty members of School of Mathematical Sciences have published 13 out of 167 publications in 2010 year, which year is highest publications year, followed by 12 publications in the year of 2010 also. It was also observed from the figure no. 5, in the School of Mathematical Sciences, Dr. H. L. Tidke has published 13 (2010) during the life productivity period of 2008 to 2015, he had been 1 time key author and Dr. S. R. Chaudhari has published 12 (2010) during the life productivity period of 1996 to 2015, he had been 1 time key author in this context. However Dr. S. R. Chaudhari, who has published highest 52 publications amongst all 8 faculty members in this domain is the key author and ranked first.

Table no. 1: Bradford's Law of Scattering

| Zones | No. of Papers | No. of Authors |
|-------|---------------|----------------|
| I | 88 | 2 |
| II | 54 | 2 |
| III | 25 | 4 |

The attempt was made to test applicability of Bradford's Law of Scattering, as shown in above table. The total numbers of 167 publications of 8 faculty members were divided into 3 equal zones,

while numbers of authors writing similar numbers of papers in each zone is in the ratio of 1:1:2. Which indicates that the data fits into the Bradford's Law of Scattering.

Table no. 2: productivity of faculty members: Application of Lotka's Law

| No. of Papers | No. of Authors |
|---------------|----------------|
| 0 | 1 |
| 1 | 1 |
| 9 | 1 |
| 15 | 1 |
| 26 | 1 |
| 28 | 1 |
| 36 | 1 |
| 52 | 1 |

The applicability of Lotka's law was tested on the data but it was found that, the data does not fit into the Lotka's law even though the researcher has attempted to apply it with mathematical method.

Price's Square Root Law of Scientific Productivity

An attempt was made to analyze distribution of publications of 8 faculty members in School of Mathematical Sciences, North Maharashtra University, Jalgaon in increasing order of productivity. The distribution of authors and their contributions are presented in following table.

Table no. 3: Distribution of publications in School of Mathematical Sciences

| No. of Papers | No. of Authors | Percentage | Total Contributions | Percentage of Contributions |
|---------------|----------------|-------------|---------------------|-----------------------------|
| 0 | 1 | 12.5% | 0 | 0% |
| 1 | 1 | 12.5% | 1 | 0.6% |
| 9 | 1 | 12.5% | 9 | 5.39% |
| 15 | 1 | 12.5% | 15 | 8.98% |
| 26 | 1 | 12.5% | 26 | 15.57% |
| 28 | 1 | 12.5% | 28 | 16.77% |
| 36 | 1 | 12.5% | 36 | 21.55% |
| 52 | 1 | 12.5% | 52 | 31.14% |
| Total | 8 | 100% | 167 | 100% |

Table No. 4: Applicability of Price's Square Root Law and 80/20 Rules in School of Mathematical Sciences

| Authors | No. of Authors | Papers | |
|---------------------------------|----------------|---------------|------------|
| | | No. of Papers | Percentage |
| Square root of total authors | 3 | 116 | 69.46% |
| Ten percent of total authors | 1 | 52 | 31.14% |
| Twenty percent of total authors | 2 | 88 | 52.69% |
| Thirty percent of total authors | 2 | 88 | 52.69% |
| Forty percent of total authors | 3 | 116 | 69.46% |

It can be observed from above table that Square root of total authors in School of Mathematical Sciences is 2.82 i.e. 3 authors, contribute to 69.46% of the total papers, which is more than 50% as predicted by De Solla Price, which means the data fits in the price Square Root Law. Similarly, it can be observed that 10%, 20%, 30% and 40% of total authors in School of Mathematical Sciences contribute only 31.14%, 52.69%, 52.69% and 69.46% respectively of the total papers, this is much below the 80% as predicted by 80/20 Rules.

Table no. 5: Productivity of Faculty Members: Author wise distribution and Collaboration Coefficient in School of Mathematical Sciences domain

| Faculty Members | Total Number of authorship | | | | Total no. of Paper | C. C. |
|-------------------|----------------------------|--------------|-------------|-------------|--------------------|-------|
| | 1 | 2 | 3 | 4 | | |
| S. R. Chaudhari | 12 | 39 | 1 | 0 | 52 (31.14%) | 0.77 |
| R. L. Shinde | 1 | 25 | 0 | 0 | 26 (15.57%) | 0.96 |
| K. F. Pawar | 2 | 7 | 0 | 0 | 9 (5.39%) | 0.78 |
| C. T. Aage | 1 | 23 | 3 | 1 | 28 (16.77%) | 0.96 |
| K. K. Kamalja | 3 | 10 | 2 | 0 | 15 (8.98%) | 0.80 |
| R. D. koshti | 0 | 0 | 0 | 0 | 0 (0%) | 0 |
| M. C. Patil | 0 | 1 | 0 | 0 | 1 (0.60%) | 1 |
| H. L. Tidke | 7 | 27 | 1 | 1 | 36 (21.55%) | 0.80 |
| Total | 26 | 132 | 7 | 2 | 167 (100%) | |
| Authorship | 26 | 264 | 21 | 8 | 319 | |
| Percentage | 8.15 | 82.76 | 6.58 | 2.51 | | |

From the above table, by assigning one credit to each collaborator 319 authors have contributed to 167 items. The collaborative index is 1.91. Dr. S. R. Chaudhari has published highest publications i.e. 12 Publications in first authored publications, followed by Dr. H. L. Tidke while in multi authored publications Dr. S. R. Chaudhari leads by 40 publications with collaborative coefficient of 0.77, followed by 29 publications of Dr. H. L. Tidke with collaborative coefficient of 0.80 and 27 publications of Dr. C. T. Aage with collaborate coefficient 0.96. Highest 4 authored publications were observed in Dr. C. T. Aage with collaborative coefficient of 0.96 and Dr. H. L. Tidke with collaborative coefficient of 0.80.

Even though it is stated that higher is the degree of collaboration higher is the research productivity and which leads to greater productivity is not true in case of present data in School of Mathematical Sciences because those faculty members whose collaboration coefficient or degrees of collaboration is 1, have published 1 papers. This indicated that "Higher is the degree of collaboration, higher is the research productivity." (Hypothesis no. 5) is invalid.

MAJOR FINDINGS

1. Total 167 publications are contributed by 8 faculty members in the School of Mathematical Sciences
2. 100% publications are published in alone English language by 8 faculty members, means the subjects of School of Mathematical Sciences are dominated by English language. (Figure no. 1), this indicates that the hypothesis "More the publications are published in English language" (hypothesis no. 1) is valid.

3. The designations of Professors and Associate Professors, combinedly have contributed to 52.10% publications. It can be further noted that on an average 46.71% publications were published by professors, 5.39% by Associate professors and 47.90% by Assistant professors, which means senior people published more number of publications. This indicates that "More the experience more the productivity" (hypothesis no. 2) is valid.

4. It is also found that male faculty members have published 152(91.02%) publications giving 21.71 publications per male faculty members and female faculty members have published 15(8.98%) publications giving 15.00 publications per female faculty members. It can also be observed that male faculty member have published 10.14 times more publications than female faculty members. This indicates that "Male faculty members produce more publications than female" (hypothesis no.3) is valid.

5. In this domain, most productive year was 2010, as total productivity in this year was 30 publications, followed by 23 publications in 2014, 21 publications in 2011 and 20 publications in 2009. The year wise productivity is increased from 2007 to 2010, and then it has been decreased in 2011 to 2012, then increased from 2013 to 2014 and then decreased in 2015. It is also observed that decreased-increased manner from 1994 to 2015. It means that the year wise productivity is increased-decreased manner means fluctuation productivity during the period of 1994 to 2006, and then year wise productivity is increased from 2007 to 2010, means productivity is continuously increased up to 4 years. Hence, this indicates that "Research productivity of faculty members increases their publications year by year" (hypothesis no.4) is valid.

6. Dr. S. R. Chaudhari, who has published highest 52 publications amongst all 8 faculty members in School of Mathematical Sciences domain is the key author and was found ranked first.

7. By test applicability of Bradford's Law of Scattering, the total numbers of 167 publications of 8 faculty members were divided into 3 equal zones, while numbers of authors writing similar numbers of papers in each zone is in the ratio of 1:1:2.

8. The Square root of total authors in School of Mathematical Sciences is 2.82 i.e. 3 authors, contribute to 69.46% of the total papers, which is more than 50% as predicted by De Solla Price, which means the data fits in the price Square Root Law. Similarly, it can be observed that 10%, 20%, 30% and 40% of total authors in School of Mathematical Sciences contribute only 31.14%, 52.69%, 52.69% and 69.46% respectively of the total papers, this is much below the 80% as predicted by 80/20 Rules.

9. The collaborative index is 1.91. Dr. S. R. Chaudhari has published highest publications i.e. 12 Publications in first authored publications, followed by Dr. H. L. Tidke while in multi authored publications Dr. S. R. Chaudhari leads by 40 publications with collaborative coefficient of 0.77, followed by 29 publications of Dr. H. L. Tidke with collaborative coefficient of 0.80 and 27 publications of Dr. C. T. Aage with collaborate coefficient 0.96. Highest 4 authored publications were observed in Dr. C. T. Aage with collaborative coefficient of 0.96 and Dr. H. L. Tidke with collaborative coefficient of 0.80. Even though it is stated that higher is the degree of collaboration higher is the research productivity and which leads to greater productivity is not true in case of present data in School of Mathematical Sciences because those faculty members whose collaboration coefficient or degrees of collaboration is 1, have published 1 papers. This indicated that "Higher is the degree of collaboration, higher is the research productivity." (Hypothesis no. 5) is invalid.

Implications

Based on the results/findings of the study the following are the implications

1. The School of Mathematical Sciences, NMU Jalgaon should make journals peer review journal with

wide circulation at national as well as international level.

2. Authors with highest impact factor should be given rewards.

3. Heads of the School of Mathematical Sciences should motivate their faculty members to write their research articles in peer review journals.

4. Heads of the School of Mathematical Sciences should forward the research activities of faculty members without any bias.

5. Understanding research activity is one of the motivating factor, the faculty members undertake research activity to the maximum extent possible and should write articles on the area of research field.

6. The faculty members should write in peer review journal in the subject concerned with the highest impact factor, which ultimately will increase impact factor of the faculty members.

7. Research is an continuously process, the faculty members should publish their research work on regular basis.

8. Faculty members should write the books or chapters in books in his or her interested field.

9. Faculty members of Associate and Assistant professors should have need to increase their research activity in his/her field.

10. It is suggested that incentives should be given on the basis of publications for the faculty members.

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