

Chapter - III

Research Design

CHAPTER III RESEARCH DESIGN

This chapter comprises the objectives of the study, formulated hypotheses, methodology and limitations of the study.

A) OBJECTIVES

The following objectives are framed for the purpose of present study.

- 1) To examine the pattern of distribution of astronomy science research output in selected countries
- 2) To assess the rate of growth of astronomy science literature by calculating relative growth rate and doubling time for both publications and pages separately
- 3) To identify the authorship pattern and collaboration in astronomy research
- 4) To test the applicability of Lotak's law to the scientific productivity of authors

- 5) To access the institutionwise research output in astronomy science
- 6) To Identify the areas of research concentration in astronomy science
- 7) To examine the effectiveness of various sources of research publications in astronomy science on the basis of impact factor
- 8) To suggest a rational strategy for research development in astronomy research on the basis of findings of the study

B) HYPOTHESES

The following hypotheses are formulated to examine the above framed objectives by employing appropriate statistical tools.

- 1) The journal source of publication of astronomy science research output occupies the predominant place in comparison with other source of publications.
- 2) The relative growth rate of astronomy science literature shows a declining trend and significantly doubling time for publications explains an increasing trend.
- 3) There has been an increasing trend in collaborative research in recent years.

- 4) The Lotka's law does not apply to author productivity in astronomy research.
- 5) There is a considerable level of inter - institutional variation in astronomy science research output.
- 6) There is a significant level of variation in research output performance in various branches of astronomy science.
- 7) There is a considerable variation in impact factor among the journals which publish astronomy science research output.

METHODOLOGY

This study attempts to examine the performance of research output in astronomy science. This study covers two stages. The first one relates to source documents and research output. The published astronomy science, source documents and their research output are analyzed with respect to their distribution in selected countries. An attempt is made to analyze the growth rates of output in terms of both at absolute level and relative level of growth from 1990 to 1998.

The authorship pattern and author productivity are examined to identify the pattern of research contribution in astronomy science. An attempt is made to analyze the areawise research performance with a view to identify the hot area of research importance. Further, an attempt is made to analyze the institutionwise research performance in astronomy science. Thus it is an exploratory way of identifying and measuring the magnitude of research in this field.

In the second stage an attempt is made to analyze the impact of the journals. This has been attempted in the case of journals that have received more attention and usage on the part of the researches.

SAMPLING

Among the disciplines of science, the author has opted astronomy science as a reference mark for this present study randomly. The choice of this field is left with its growing popularity and wider application in analyzing the status of planets, solar system and satellite operation.

Astronomy research is carried out throughout the world. Out of total number of countries in the world,

the researcher has chosen only 8 countries. It includes all the G7 countries, besides India. The choice of these countries is made for their intensive concentration in astronomy research. Thus sampling of this study comes under purposive random sampling method.

DATA COLLECTION

The publications of astronomy science consist of contribution to primary journals, proceedings of the conferences, papers published in books, reports and other secondary sources.

STATISTICAL TOOL.

The performance of astronomy science research output over the years can be calculated with the help of the relative growth rate model. This model has been applied by various researchers in bibliometric analysis. ¹

1) M. Mahapatra on the validity of the theory of exponential growth of scientific literature: proceeding of the 15th IASLIC conference, Bangalore - 1985, pp.61-70.

The relative growth rate is the increase in the number of publications/pages per unit of time. The mean relative growth rate $R (1-2)$ over a specified period of interval can be calculated from the following equation

$$R (1-2) = \frac{\text{Log}_2 - \text{Log}_1}{T_2 - T_1}$$

Where $R (1-2)$ = Mean relative growth rate over the specified period of interval.
 Natural Log of initial

Log_1 = Natural Log of initial number of Publications / pages

Log_2 = Natural Log of final number of Publications / pages

$T^2 - T^1$ = The unit difference between Initial time and final time.

The relative growth rate for both publications and pages can be calculated separately. Therefore

R(a) = Relative growth rate per unit of
publications per unit of time (year).

R(p) = Relative growth rate per unit of
Pages per unit of time (years).

DOUBLING TIME

There is a direct equivalence between the relative growth rate and doubling time. If the number of publications/pages of a subject doubles during a given period, then the difference between the logarithms of the number at the beginning and end of the period must be the logarithms of the number. If one uses natural logarithms, this difference has a value of 0.693. Thus the corresponding doubling time for publications and pages can be calculated by using the following formula

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

Therefore

Doubling Time for publications

$$\text{Dt (a)} = \frac{0.693}{R}$$

Doubling Time for pages

$$Dt(p) = \underline{0.693}$$

R (p)

AUTHOR PRODUCTIVITY

The Lotka's law of author productivity is tested with the application of scientific productivity chi square model and it is applied in relation to number of / authors contributing to the number of publications. ²

It is explained by the equation

$$an = a^1 n^2, n = 1, 2, 3$$

In other words, for every 100 authors muting one contribution each, there would be 25 others contributing two articles each $100 / 2^2 = 25$, about 11 contributing three articles each $100 / 3^3 = 11$ and so on.

Where '*an*' is the number of authors contributing *en*' papers each and *a1* is the number of authors contributing each one paper. The chi-square can be computed as

2) Potter William Grep, Lotka's law revised library trends Vol. - 30 (1), 1981, pp. 21 - 39.

$$(F-p)2/p$$

F = observed number of authors with n publications.

P = expected number of authors.

The percentage of research collaboration in astronomy science research can be computed on the basis of the formula adopted by K. Subramaniyan.³

RESEARCH COLLABORATION

The formula is written as

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

Where

C = percentage of research collaboration in a discipline.

NM = number of papers with multiple authors.

NS = number of papers with single author.

3) K. Subramaniyan, Bibliometric studies of research collaboration: A review, journal of information science, Vol.- 6,1983, p-3.

Further, the author has applied various statistical tools to analyze the empirical data, such as mean, standard deviation, coefficient of variation, percentages and averages. The diagrammatic and graphical representations of the data are also made depending on the requirement of study.

CONCEPTS

The following concepts are operationally defined for the purpose of present study:

RELATWE GROWTH RATE

It explained the increase in the number of publications / pages of astronomy science literature per unit of time.

DOUBLING TIME

It means two fold multiplications are of number of publications/pages of astronomy science research output per unit of time.

PERCENTAGE OF RESEARCH COLLABORATION

It explains the prevalence of proportion of single authored papers and multi authored papers in astronomy science research output.

AUTHORSHIP PATTERN

It denotes the percentage concentration of single authored papers in relation to multi authored papers during the reference period of analysis in astronomy science research output.

AUTHOR PRODUCTIVITY

Author productivity explains the prevailing trend in carrying out the research process in astronomy science in terms of a number of papers contributed by each author.

LIMITATIONS

The findings of this study apply mainly to the astronomy science but it is not applicable to other branches of science. The study period ranges from 1990 to 1998. In the year 1998, the period covers up to the month of June.

The astronomy science research output of G7 countries as well as India is taken as source data and the analysis confines to these countries alone, because studying of astronomy research output of all countries in the world is not possible for an individual author, due to constraints imposed by energy, finance and time.