CHAPTER IV
RESEARCH DESIGN

4.1 SIGNIFICANCE OF THE STUDY

The study has been conducted on the journal articles of “IEEE Transactions on Fuzzy System”.

1. The study focuses on publishing trends, authorship pattern etc.,

2. The study stresses the need for citations.

3. It also highlights the Institutions in the field of engineering sciences.

4. It gives clear picture about leading authors in the field of engineering sciences.

4.2 OBJECTIVES OF THE STUDY

The main objectives of the study are

1. To find out volume wise distribution & average number of contributions per volume.

2. To find out the authorship pattern.

3. To calculate the degree of collaboration.

4. To find out the productivity of authors based on Lotka’s law.
5. To find out most prolific authors and most productive institution.

6. To find out overall per capita authorship.

7. To determine the geographical distributions of contributions in the journal.

8. To find out overall references and Form wise distributions.

9. To prepare a ranked list of journals based on Bradford’s law

10. To find out the percentage of the author self citation and the Journal self citation.

11. To find out the obsolescence and half life period of Journal citations.

4.3 UNIVERSE AND SAMPLE

Collection of Journals in Engineering & Technology subject is taken as universe and the journal IEEE Transactions on Fuzzy System for the period of 2004-2013 is taken as sample.

4.4 METHODOLOGY

A total of 60 issues of the journal IEEE Transactions on Fuzzy System (2004 to 2013) have been taken for the study. The details regarding each published article such as title of the article, number of authors, their institutional affiliations and addresses, number of references with list, page
number were recorded and analyzed for making observations. The citations were counted by the type of document and volume wise. Based on the analysis, a ranked list of cited journal is prepared. Finally all the collected data were recorded, compiled, tabulated and analyzed for making observations.

4.5 SCOPE

This study covers 931 articles included in volume from 12 to 21 of IEEE Transactions on Fuzzy System published during the period from 2004-2013. Citations appended to these articles number 32,312, which form the base of the study. This journal allows any number of citations to be included in the reference section of the article.

4.6 HYPOTHESES OF THE STUDY

The following hypotheses are formulated on the basis of content and coverage of framed objectives and employing appropriate statistical tools tests them:

1. The relative growth rate of publications and pages show a progressive increase and the doubling time for publications reflects an increasing trend.

2. There has been an increasing trend in the collaborative authorship in recent years.
3. The Journal source of citation of IEEE Transactions on Fuzzy Systems occupies a predominant place while compiling other sources of citations.

4. The authors of IEEE Transactions on Fuzzy Systems have a tendency to cite latest literature relevant to their field.

4.7 DATA COLLECTION

The article publications in the journal IEEE Transactions on Fuzzy Systems by the scientists in engineering sciences were taken as a source for the present study. The papers published from 2004-2013 by the scientists were 931. The bibliographical details of publications were entered in the catalogue cards. Finally the cards were arranged in different ways with a view to identify the scientists of Engineering Sciences.

4.8 STATISTICAL TOOLS AND TECHNIQUES USED

4.8.1 Relative Growth Rate

The researcher has applied the relative growth rate and doubling time model by Mahapatra\textsuperscript{1} to examine the growth rate of papers published and weightage has been given to the scientists of engineering science.

The relative growth rate is increased in the number of publications or pages per unit of time. A specified period of interval can be calculated from the following equations.
\[ \bar{R} (1-2) = \frac{W2 - W1}{T2 - T1} \]

Where \( \bar{R} (1-2) \) is mean relative growth rate over the specified period of interval

\[ W1 = \log W1: \text{(Natural log of initial number of Publications/pages)} \]
\[ W2 = \log W2: \text{(Natural log of final number of Publications/pages)} \]
\[ T2 - T1 = \text{The unit difference between the initial time and final time.} \]

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

Therefore,

\[ \bar{R} (a) = \text{Relative growth rate per unit of publications, per unit of time (Year)} \]
\[ \bar{R} (p) = \text{Relative growth rate per unit of pages, per unit of time (Year).} \]

### 4.8.2 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/pages 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 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.

\[
\text{Doubling time (Dt)} = \frac{0.693}{R}
\]

Therefore, Doubling time for publications \(Dt (a) = \frac{0.693}{R(a)}\)

Doubling time for pages \(Dt (p) = \frac{0.693}{R(p)}\)

4.8.3 Lotka's Law

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. Potter (1981)\(^2\) identified the Lotka's fraction \(1/n \sim 4.65\) on the basis of Euler-maclaurin formula of summation. This model is applied in the present study.

The sum was used as a devise for \(1/n\sim 4.65\) to determine the proportion of the total number of authors expected to produce ‘n’ papers (in case of present study \(n=1, 2, 3, ..95\)). The following formula was used to find the proportions.

\[
S = \sum \frac{1}{n} \times 4.65
\]
For the present study 'S' is the sum of Lotka’s modified rations for the value \( n = 4.65 \). The formula is 
\[ a_n = \frac{1}{n} * 4.65 \frac{T}{S} \]  
(n=1, 2, 3….65) where T is total number of authors in the sample and 'an' is the total number of expected authors producing ‘n’ papers.

The Lotka’s law was tested with the application of scientific productivity Chi-square model in relation to a number of authors who contributed 'n' number of publications. It can be expressed by the equation.

\[ a_n = \frac{a_1}{n^2} \quad n = 1,2,3 \ldots \ldots \]

In other words, for every 100 authors making one contribution each, there would be 25 authors contributing two articles each (100/2^2=25) about 11 contributing articles each (100/3^3=11.1) and so on.

Where “an” is the number of authors contributing 'n' papers each “a1” is the number of authors contributing each one paper.

The Chi-square can be computed as 
\[ (f-p)^2/p \]

\[ F = \text{Observed number of authors with 'n' publications.} \]

\[ P = \text{Expected number of authors.} \]

4.8.4 Degree of Collaboration

To examine the extent of research collaboration of scientists of engineering science, Subramaniam's formula is adopted for present study.
\[ C = \frac{N_m}{(N_m + N_s)} \]

\( C \) = Degree of collaboration of scientists

\( N_m \) = Number of multiple authored papers.

\( N_s \) = Number of single authored papers.

### 4.9 OTHER TOOLS

The researcher has applied mean, standard deviation, co-efficient of variation ‘t’ test percentage and average apart from the above statistical tools. Graphic and diagrammatic representations are presented wherever necessary.

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

#### 4.9.1 Relative Growth Rate

It explains the increase in the number of publications/pages of IEEE Transactions on Fuzzy Systems per unit of time.

#### 4.9.2 Doubling Time for Publications

It means two fold multiplication of number of publications/pages of IEEE Transactions on Fuzzy Systems.

#### 4.9.3 Authorship Pattern

It denotes the percentage concentration of single authored papers in relation to multi-authored papers on IEEE Transactions on Fuzzy Systems during the study period of analysis.
4.9.4 Author Productivity

It examines the prevailing trend in carrying out the research process for paper publication in IEEE Transactions on Fuzzy Systems of the extent to which paper publication is concentrated by a single Author.

4.9.5 Degree of Collaboration

It explains the prevalence of proportion of single authored papers and multi-authored papers in paper publications.

4.9.6 Half Life Period of Journal citations

To find out the half-life of Journal citations, the graph is plotted taking the period of years at X-axis and cumulative number of citations at Y-axis. A line parallel to X-axis is drawn from point A to meet the curve at B. Point A represents the half-life of the citation. Then a perpendicular BC is drawn from point X-axis at C. 'C' represents the half life period for journals citations which is x years.
REFERENCES

