Research Metrics:
Impact Factor & *h*-Index

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Research Metrics

- **Research Metrics is the quantitative analysis of scientific and scholarly research outputs and their impacts.**

- **Research Metrics include a variety of measures and statistical methods for assessing the quality and broader impact of scientific and scholarly research, as well as to track researcher impact**

- **Research Metrics measure impact and provide insight into the influence of specific journal publications, individual articles, and authors.**

Research Metrics

Journal Metrics, such as Impact Factor, helps track citation patterns within journals and determine which journals are highly-cited.

❖ Author Metrics measure the impact and productivity of a researcher.

❖ Article Metrics, or citation tracking, is used to determine if an article, book, journal, or particular author has been cited by another work.

❖ Altmetrics help researchers measure their impact from papers, data sets, websites, blog posts, and more.

Research Metrics

Some methods:

- **Total Publications**

- **Total Citations**

- **Average Citations per Paper**

Research Metrics: Use & Issues

These research mesurement can be used:

- **to support applications for grant funding**

- **to support applications for promotion**

- **by a researcher to maintain their own research profile**

- **in Department and Faculty reviews and National Assessment exercises**

Issues to consider

- **Citation counts can be affected in a number of other ways:**

- **No single source is comprehensive.**

- **Publication dates may affect your results.**

- **Frequency of a journal may affect results.**

- **Highly cited articles don't always mean excellent research, *esteem* must also be taken in to account**

- **Research measures across disciplines may differ**

Research Metrics Based on Citations

Cited references

- are always retrospective in nature

- pointing to documents in the past

Citing references

- are always prospective in nature

- referring to previously published documents used by subsequent authors writing at a future time

Citation analysis

Source: ISI Web of Knowledge™, , www.thomsonscientific.com

Kinds of Citation Data

Articles

- Citation Impact

Authors

- Number of papers (Quantity)

- Number of Citations (Quality)

- Average number of citations/article

- h-index (Quantity & Quality Both)

Journals

- Journal Impact Factor

- h-index

Research Metrics Based on Citations

- **Journal Impact Factor**

  - Number of citations to a journal in a given year from articles occurring in the past 2 years, divided by the number of scholarly articles published in the journal in the past 2 years

- **h-index**

  - "A scientist has index h if h of his/her Np papers have at least h citations each and the other (Np-h) papers have no more than h citations each" (Hisrch 2005)

  - Eg an h-index of 25 tells us that an author has written 25 papers which have each been cited at least 25 times

- **i10 index**
  - i10 index refers to the number of paper with 10 or more citations. It was introduced in July 2011 by Google as part of their work on Google Scholar, a search engine dedicated to academic and related papers

Journal Impact Factor

Journal Impact Factor: measure of the frequency with which the average article in a journal has been cited in a particular year.

The impact factor of a journal is calculated by dividing the number of current year citations to the source items published in that journal during the previous two years.

American Journal of Clinical Nutrition

Journal Impact Factor ⓘ

Cites in 2014 to items published in: 2013 = 1948   Number of items published in: 2013 = 332
                                                  2012 = 2500   2012 = 325
                                                Sum: 4448   Sum: 657

Calculation: $\dfrac{\text{Cites to recent items}}{\text{Number of recent items}}$ $\dfrac{4448}{657}$ = **6.770**

h-Index

The *h*-index was born !

- We need an Index both to include quantity & also quality of an authors' paper
  - ✓ Productivity
  - ✓ Impact

  - ✓ Not affected by "big hits"
  - ✓ Not affected by "noise"

Hirsch J E [b. 1953]

h-Index: 41; 22 AUG 2014

Jorge Eduardo Hirsch

Buenos Aires, Argentina

Nationality	Argentine American
Fields	**Physicist**
Thesis	**Low-temperature thermodynamic properties of a random anisotropic antiferromagnetic chain (1980)**

Hirsch J E - Original Paper

An index to quantify an individual's scientific research output

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Abstract. I propose the index h, defined as the number of papers with citation number higher or equal to h, as a useful index to characterize the scientific output of a researcher.

Definition

A scientist has index h if h of his/her N_p papers have at least h citations each, and the other $(N_p - h)$ papers have no more than h citations each.

Definition

In other words, a scholar with an index of h has published h papers each of which has been cited in other papers at least h times.

Definition

- **A scientist has *h-index h* if**

  - *h* of his N_p have received at least *h* citations each

  - the rest N_p-*h* articles have received no more than *h* citations each

Definition

❑ The first part of definition counts those number of papers which have minimum the same number of citations for each papers and that number is postulated to be the exact value of h.

❑ The second part of the definition considers the rest of the papers published by the scholars.

❑ These papers are the sum of the papers minus h papers and each of them does not have equal or more citations than h papers.

The *h*-index

A scientist has index **h** if **h** of his or her Np papers have at least **h** citations each and the other (Np − **h**) have at least ≤ **h** citations each

Papers	1	2	3	4	5	6	7	8	9	10	11
Citations	59	32	19	13	6	4	2	1	1	1	0

The *h*-index example

Author X

Papers	1	2	3	4	5	6	7	8	9
Citations	55	47	26	12	7	4	2	2	1

Author Y

Papers	1	2	3	4	5
Citations	34	22	12	6	5

The *h*-index example

Author A		Author B		Author C	
Article	Citations	Article	Citations	Article	Citations
1	12	1	33	1	235
2	7	2	29	2	199
3	6	3	26	3	97
4	6	4	15	4	39
5	6	5	7	5	38
6	6	6	3	6	2
7	3	7	2	7	0
8	0	8	1	8	1
h-index	**6**	**h-index**	**5**	**h-index**	**5**

The *h*-index example

	Author 1	Author 2	Author 3
Paper 1	100	50	15
Paper 2	90	50	15
Paper 3	70	45	14
Paper 4	50	45	14
Paper 5	35	45	14
h-Index			
Paper 6	4	4	3
Paper 7	4	3	3
Paper 8	1	1	2
Paper 9	1	1	0
Paper 10	0	1	0
Total Cites	355	245	80
Avg. Cites/Paper	35.5	24.5	8.0

Characteristic

- **Thus, the h-index reflects both the number of publications and the number of citations per publication.**

- **The index is designed to improve upon simpler measures such as the total number of citations or publications.**

- **It simultaneously measure the quality and sustainability of scientific output, as well as, to some extent, the diversity of scientific research.**

- **Meaningful when compared to others within the same discipline area.**
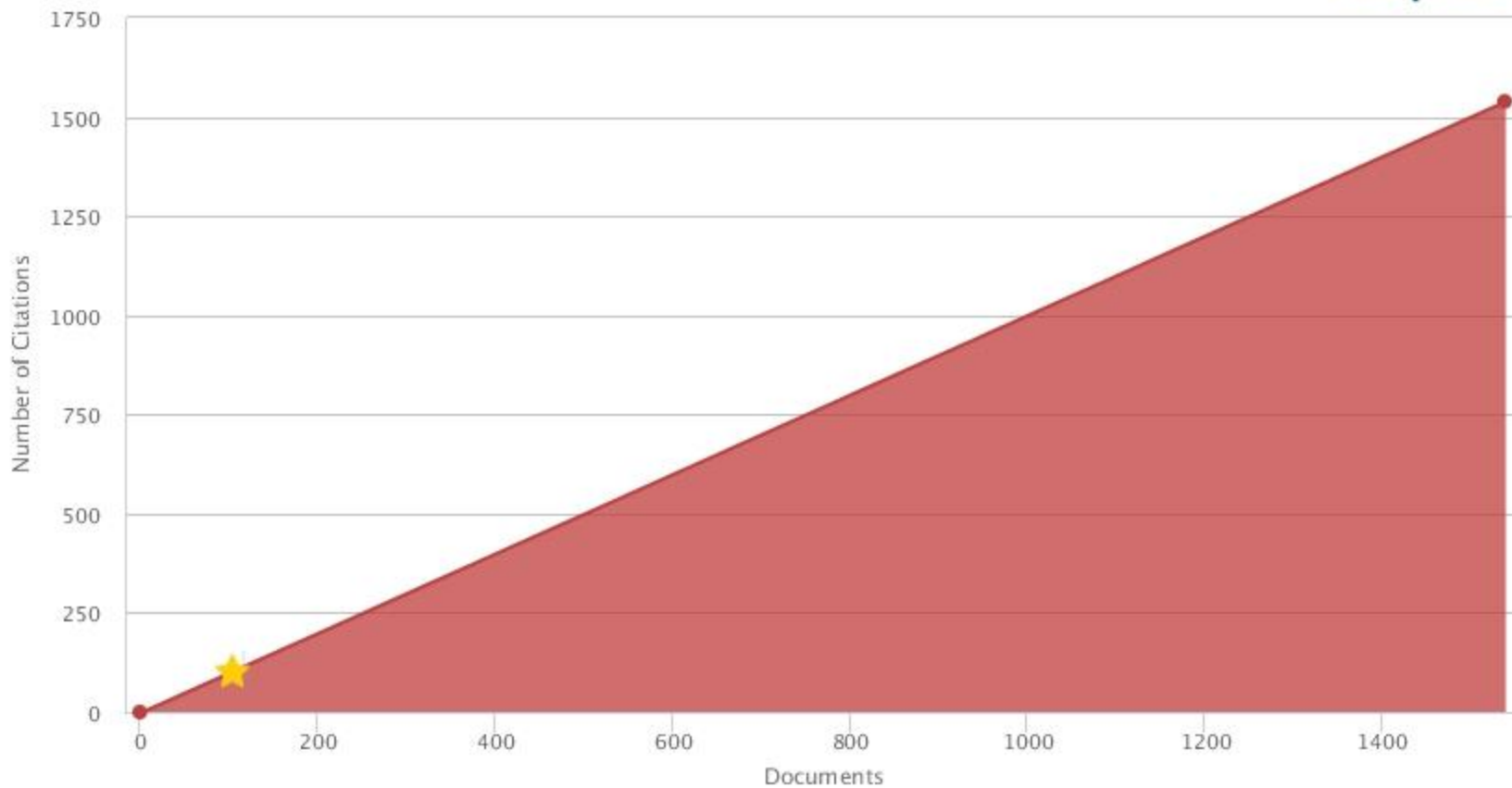
Rao, CNR : Year wise citations
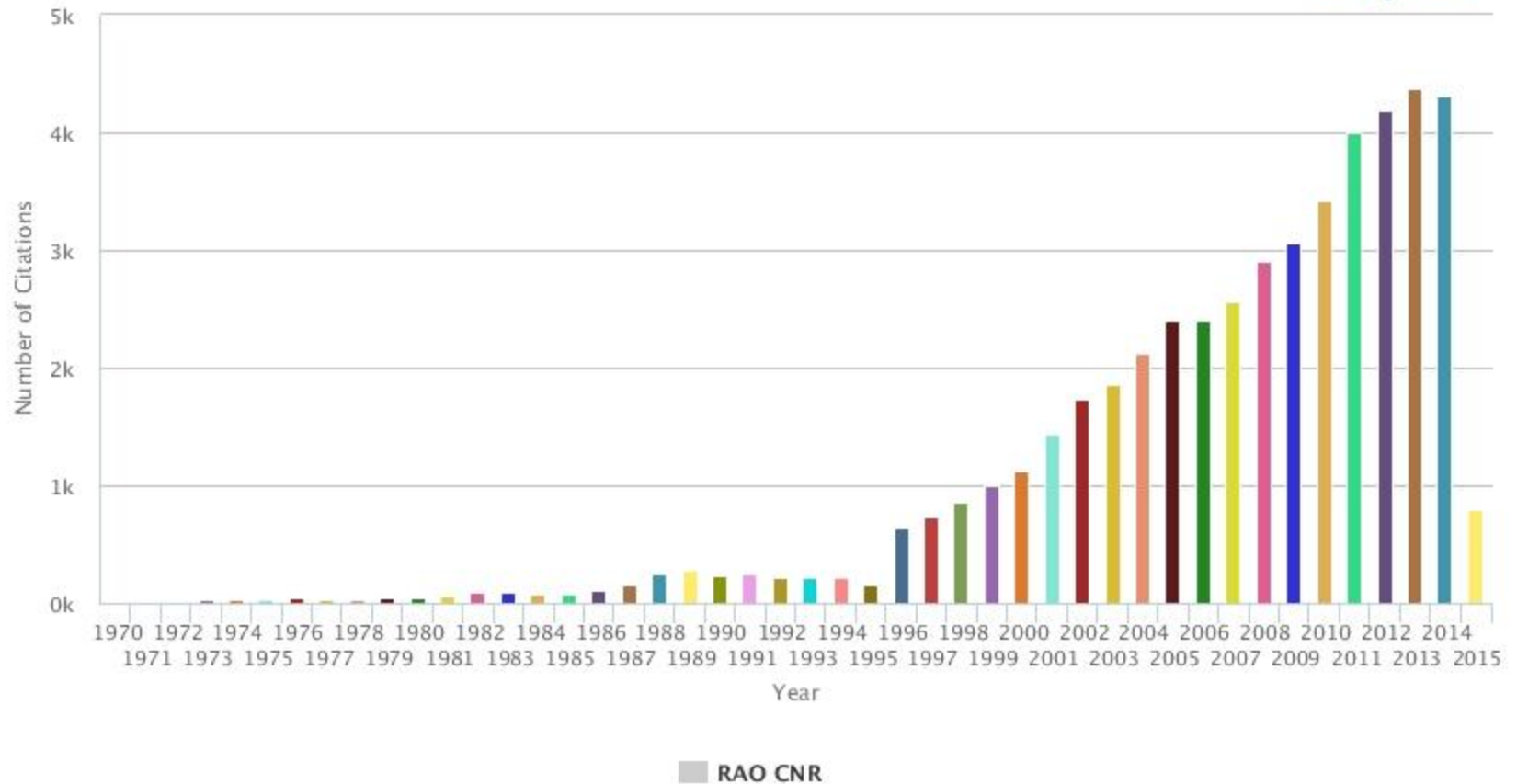
Rao, CNR : h-Index 105

ITP, Ramanujan College, 19

Resources to find the *h*-Index

- Web of Science

- Scopus

- Google Scholar

Web of Science

- Since 1963, formerly produced by ISI

- Covers over 11,500 journal titles and 120,000 conference proceedings

- Consists of:

    - Science Citation Index - 1970 to present

    - Social Sciences Citation Index - 1970 to present

    - Arts & Humanities Citation Index - 1975 to present

- Very good coverage of sciences compared to social sciences and arts and humanities.
- US and English-language biased. Limited coverage of non-English language titles.

- Does not include books, book chapters or theses
- Full coverage of citations.
- Limited downloading options.

Scopus

SCOPUS

- Launched by Elsevier in 2004. Positioning itself as an alternative to ISI.

- More journals from smaller publishers and open access (Covers over 18,000 journal titles and 4.4 million conference papers)

- Source data back to 1960.

- Excellent for physical and biological sciences compared to social sciences, humanities or arts.

- Better international coverage (60% of titles are non-US)

- Better coverage of social science titles than Web of Science

- Better coverage of non-English language publications from Europe than Web of Science

- Citation data only available for papers published from 1996 onwards

- Does not include books, book chapters or theses

- Easy to use in searching for source publications

- Citation tracker works up to 1000 records only.

- Limited downloading options.

Google Scholar

- Launched in 2004

- Better coverage of much wider range of material than Web of Science or Scopus for all citations as it retrieve web !

- More coverage of references also.

- Better coverage of non-English language publications from Africa, Asia and Central and South America than Web of Science or Scopus

- No source list or indication of timescale covered. Coverage not clear

- Inclusion criteria?

- Very limited search options

- No separate cited author search

- Back to 1990 NOT more !

- Free!

The *h*-Index at Career Level

According to Hirsch:

- For physicists, a value for *h* = 12 - Associate professor at major research universities

- A value of about 18 - Professorship,

- 15–20 could mean a fellowship in the **American Physical Society**, and

- 45 or higher could mean membership in the **United States National Academy of Sciences**.

- **About 100 in India – Bharat Ratna**

Importance of the *h*-Index in India

- Research programs like PURSE, FIST, SAP, RUSA;

- Fellowships and awards like SCOPUS-NASI Award, CSIR fellowship and Research Associate ship, INSPIRE faculty position;

- Accreditation by national agencies like NAAC is determined and decided on the basis of *h*-Index.

Three sources for citation data

Thanks