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METRICS OF MASTERY: FACULTY, FUNDING, AND RESEARCH IN NIRF 2024

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ABSTRACT

Here the paper studied about the econometric and scientometric performance in National Institutional Ranking Framework (NIRF) 2024 overall category and the data is from NIRF to create construct validity maps for the top 30 institutions, visually representing their performance across all metrics. The NIRF is introduced as India's primary system for ranking educational institutions, serving as a benchmark for assessing their performance. The framework takes into account various metrics such as research publications, funding received for research, and the qualifications and strength of faculty members to provide a comprehensive evaluation. It helps to highlight how institutions stack up against each other in their research parameters. IIT Madras is highlighted as a leading institution in India. While it has achieved a high ranking. This could mean that IIT Madras is involved in impactful projects, community outreach, and innovative programs that contribute significantly to society.

Keywords: NIRF, Bibliometrics, Scientometric, eXergy, Spend, Econometric, Correlation.

INTRODUCTION

The NIRF has been ranking Indian universities since 2016. Its purpose is to assess and improve the quality of higher education in India by providing a systematic evaluation of institutions. The latest rankings for 2024 have just been released, making the data for various institutions available to the public. By combining this bibliometric analysis, the framework provides a comprehensive view of both the quantity and quality of the institutions. This method offers valuable insights into the strengths and weaknesses of the top universities, helping to better understand their contributions to education and society. For the top 30 overall institutions ranked this year, researchers focused specifically on research excellence by evaluating factors like the number of publications, citations, and overall impact, utilizing two bibliometric databases: Scopus and Web of Science.

Researchers employed second-order composite indicators to evaluate productivity and outcomes at the bibliometric level, using terms like efficiency as needed. Prathap4 found that in the NIRF 2017 bibliometric data, "Loyola College, Chennai," and "Bishop Heber College, Tiruchirappalli," emerged as leading research institutions in India. Prathap5 also analyzed the research output of the Indian Institutes of Technology (IITs) using the Web of Science and

Scopus databases. Although India has a rich history of engineering education, the IITs gained recognition as national assets focused on postgraduate study and research only after independence in 1947. Research affiliated with IITs in engineering science and technology was compared to similarly ranked global universities. Prathap6 examined the NIRF's top 20 engineering institutions, emphasizing research excellence. Instead of relying on a single NIRF score, performance was divided into a size-dependent exergy term and a size-independent productivity term. IIT Bombay and IIT Kharagpur excelled in research quality, while newer IITs in Ropar and Indore demonstrated considerable potential. Abramo and D'Angelo7 distinguished between productivity and impact, defining productivity as the average number of publications per researcher. They critiqued traditional views on productivity by applying economic principles to scientific research. Drawing from microeconomic theory, they introduced a metric called "Fractional Scientific Strength (FSS)," applicable to individuals, fields, departments, institutions, and nations. This FSS measure was later used to compare the rankings of Italian universities.

METHODOLOGY

NIRF 2024 offers bibliometric data from Scopus and Web of Science for all evaluated universities. The primary bibliometric metrics include the total number of publications and citations from the years 2020 to 2022. Additionally, it provides details on faculty strength and overall annual expenditures for 2024, which serve as indicators of both intake and output relative to size. The core of the evaluation involves a bibliometric or scientometric assessment. Economists can view the outer layer as comprising measurements of efficiency and productivity.

For instance, IIT Madras ranks at the top of the Overall Category in the NIRF 2024 rankings, as illustrated in Table 1 with both bibliometric and economic evaluations. Our analysis begins with a single, size-dependent input parameter: the number of full-time faculty members (f). Two databases are utilized to gather bibliometric data for NIRF. The fundamental bibliometric data for 2020–22 consist of the number of publications and citations. We can calculate the impact (i = C/P), which serves as a useful proxy for assessing the quality of the institution's work in that database. Here, P represents research output quantity, i signifies research output quality, and C is a composite measure of size quality and quantity.

A single composite outcome indicator for each institution's research performance can be calculated using a second-order measure known as the exergy term, derived from both quantity (size) and quality (excellence) indicators: $x = i^2P = iC$, where x represents total research output. This means that x/f and x/s assess the institution's productivity and efficiency regardless of size, applied to the top 30 institutions in the NIRF 2024 Overall Category. We utilize Pearson's correlation coefficient to analyze the data using Excel. Pearson's r measures the linear relationship between two variables, indicating both the direction and strength of this relationship. Its value ranges from -1 to +1: +1 indicates a perfect positive linear relationship (as one variable increases, so does the other), 0 signifies no linear relationship, and -1 indicates a perfect negative linear relationship (as one variable increases, the other decreases).

Then

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Where, n: number of data points, x and y are the individual sample points of variables X and Y & ∑xy, ∑x, ∑y are the sums of the products, sums of X and sums of Y respectively.

ANALYSIS

Table 1. Example of Bibliometric and econometric assessment

Institution	**IIT Madras**	**Quantity**
No. of regular faculty	f	674
Spend in crores 2022-23	s	2045
Publication details		
Scopus (2020-22)	Papers P	10132
	Citations C	118596
	Impact i=C/P	11.71
Web of Science(2020-22)	Papers P	7092
	Citations C	95963
	Impact i=C/P	13.53
Total eXergy	x=SiC	214584.24
Per capita eXergy	x/f	318.37
Per spend eXergy	x/s	104.95
NIRF Score		214584.24

Table 2. **Summary of bibliometric indicators for the top 30 Engineering institutes**

NIRF Rank	**Name of Institutes**	**f**	**s**	**x**	**x/f**	**x/s**	**NIRF Score**
1	IIT Madras	674	2044.62	214584.24	318.37	104.95	86.42
2	IISc Bengaluru	476	941.99	207318.50	435.54	220.09	83.28
3	IIT Bombay	759	1339.33	213812.55	281.70	159.64	81.37
4	IIT Delhi	687	1673.61	245677.65	357.61	146.79	80.31
5	IIT Kanpur	655	984.08	155527.91	237.45	158.04	77.56
6	IIT Kharagpur	928	1135.21	237434.26	255.86	209.15	74.77
7	AIIMS Delhi	862	4190.75	217227.32	252.00	51.83	74.27
8	IIT Roorkee	585	688.08	204756.11	350.01	297.58	71.52

9	IIT Guwahati	539	442.38	142573.93	264.52	322.29	69.04
10	“Jawaharlal Nehru University”	693	592.04	103271.13	149.02	174.43	68.53
11	“Banaras Hindu University”	1829	2354.22	219117.04	119.80	93.07	67.56
12	IIT Hyderabad	306	383.75	99545.30	325.31	259.40	66.69
13	“Jamia Millia Islamia”	740	682.37	131875.82	178.21	193.26	66
14	“Manipal Academy of Higher Education, Manipal”	2854	2165.04	237785.91	83.32	109.83	64.94
15	“University of Delhi”	1402	1416.89	199918.39	142.60	141.10	64.81
16	“Aligarh Muslim University”	1464	1258.21	139029.92	94.97	110.50	64.17
17	“Jadavpur University”	907	385.84	112347.59	123.87	291.18	63.84
18	“Amrita Vishwa Vidyapeetham”	1928	1211.93	69035.68	35.81	56.96	63.81
19	“Vellore Institute of Technology”	3326	740.60	286174.70	86.04	386.41	62.97
20	“Anna	941	394.23	421713.89	448.1	1069.70	62.77

	University ”				6		
21	“S.R.M. Institute of Science and Technology”	4120	1507.31	168663.19	40.94	111.90	62.07
22	“Saveetha Institute of Medical and Technical Sciences”	900	512.52	153424.98	170.47	299.35	61.79
23	“Birla Institute of Technology and Science, Pilani”	979	819.87	168109.68	171.72	205.04	60.87
24	“Siksha `O` Anusandhan”	1280	1014.20	68041.72	53.16	67.09	60.73
25	“University of Hyderabad ”	412	288.21	73297.66	177.91	254.32	60.55
26	“Calcutta University ”	1219	220.48	137942.68	113.16	625.64	60.25
27	“Homi Bhabha National Institute”	1184	923.39	207768.89	175.48	225.01	60.13
28	“Kalinga Institute of Industrial Technology”	2058	876.06	122450.34	59.50	139.77	59.94

29	IIT Gandhinagar	143	166.20	58941.26	412.18	354.65	58.77
30	IIT Varanasi	381	430.73	117306.89	307.89	272.35	58.69
Maximum		**4120**	**4190.75**	**421713.89**	**448.16**	**1069.70**	**86.42**
Minimum		**143**	**166.20**	**58941.26**	**35.81**	**51.83**	**58.69**
Maximum/Minimum		**28.81**	**25.22**	**7.15**	**12.52**	**20.64**	**1.47**

Pearson's correlation	f	s	x	x/f	x/s	**NIRF Score**
f	1.00	0.26	0.21	-0.68	-0.16	-0.29
s	0.26	1.00	0.31	-0.11	-0.51	0.42
x	0.21	0.31	1.00	0.34	0.45	0.33
x/f	-0.68	-0.11	0.34	1.00	0.40	0.48
x/s	-0.16	-0.51	0.45	0.40	1.00	-0.26
NIRF Score	-0.29	0.42	0.33	0.48	-0.26	1.00

Table 2 highlights the top 30 institutions based on the NIRF 2024 rankings. A comparison of faculty strength shows that IIT Gandhinagar has 143 faculty members, while SRMIST leads with 4,120 regular faculty members. In terms of financial expenditure for 2022-23, IIT Gandhinagar reported the lowest annual expenditure at ₹166 crores, while AIIMS Delhi had the highest at ₹4,190 crores. Between 2020 and 2022, IIT Madras displayed impressive research productivity with a high volume of publications and citations. The academic component of the NIRF score, which constitutes a smaller percentage of the overall score, is closely clustered across institutions. Pearson's correlations are also provided in Table 2, while Figures 1–5 feature scatter plots illustrating key relationships between faculty strength (f), research output (s), annual expenditure (x), and their respective ratios (x/f and x/s) with the NIRF score.

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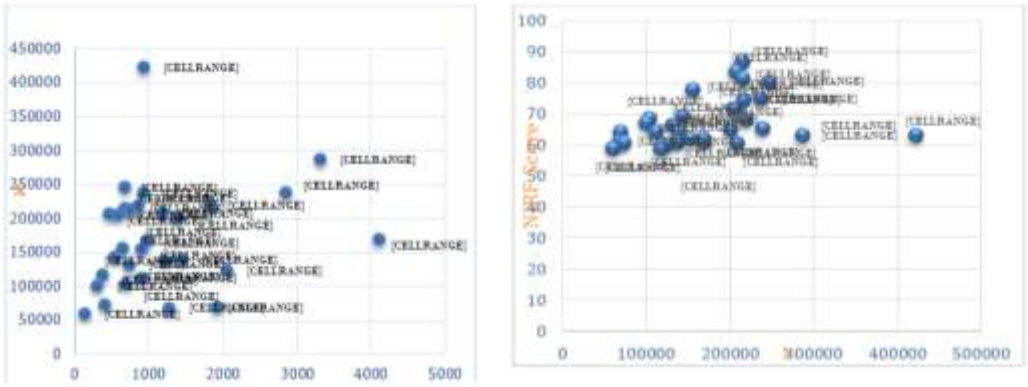
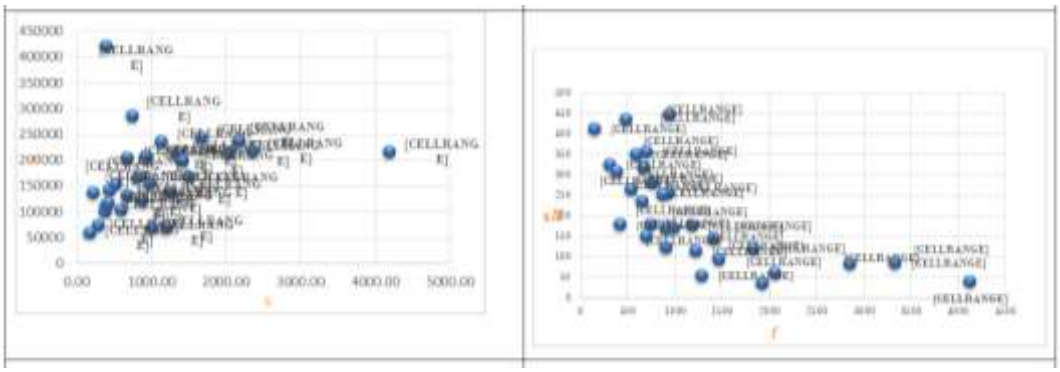


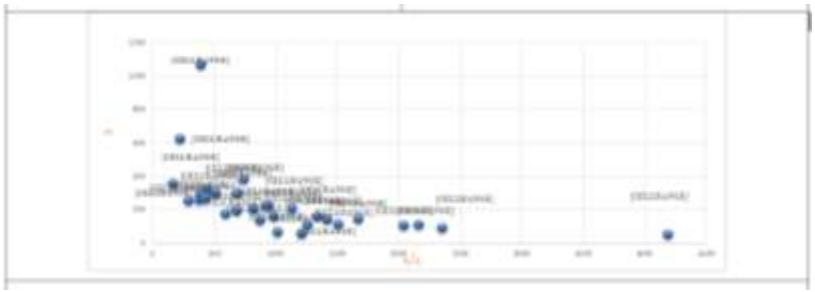
"Figure 1. Scatter plot of exergy (x) versus faculty strength (f)"

"Figure 2. Scatter plot of NIRF Score versus exergy (x)"



"Figure 3. Scatter plot of exergy (x) versus spend (s)"

"Figure 4. Scatter plot of exergy per faculty (x/f) versus faculty strength (f)"



"Figure 5. Scatter plot of exergy per crore of spending (x/s) score versus spend (s)"

IIT Madras tops the NIRF rankings as the best institute in India, followed by IISc and IIT Bombay, based on exergy (x) and faculty strength (f), as shown in Figure 1. Figure 2 illustrates the NIRF score in relation to exergy (x), emphasizing the success of IIT Madras, IIT Delhi, and then IIT Bombay, IIT Kharagpur, and KIIT. Figure 3 presents a scatter plot comparing exergy (x) and expenditure. Figure 4 explores the relationship between exergy per faculty (x/f) and faculty strength, while Figure 5 displays the scatter plot of exergy per crore of expenditure (x/s) in relation to total spending.

CONCLUSION

In conclusion, the NIRF 2024 rankings underscore the critical role of bibliometric data in assessing university performance, with a particular focus on research output, faculty strength,

and financial resources. The success of top institutions like IIT Madras highlights the importance of both the quantity and quality of research in determining academic excellence. By incorporating measures such as size-dependent exergy and size-independent productivity, the rankings provide a comprehensive evaluation of institutional efficiency and performance. The use of correlation analyses and visual tools like scatter plots further enriches the understanding of how these factors interrelate, offering deeper insights into the drivers of success in higher education.

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