Danger of a single score: NIRF rankings of colleges

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The National Institutional Ranking Framework (NIRF) exercise is a good example of what the Nigerian writer Chimamanda Ngozi Adichie called 'The danger of a single story'. All lives are a complex overlap of many stories and yet the human tendency is to compress all this to a simple one-dimensional narrative. NIRF reduces the vast complexity of higher education into a single score. 'Teaching, learning and resources,' 'Research and professional practices,' 'Graduation outcomes,' 'Outreach and inclusivity,' and 'Perception' are further elaborated into sub-heads, and with weights assigned to each broad head, and more weights assigned to the sub-heads within each head, and with complex marking and weighting schemes much fuzziness is added, leading finally to a single score. In this way, the narrative that emerges is no story at all. In this note, we use the NIRF 2017 bibliometric data for top colleges in India to show that Loyola College, Chennai and Bishop Heber College, Tiruchirappalli, among the institutions that participated in the NIRF exercise, are arguably the best research colleges in the country.

Chimamanda Ngozi Adichie, a Nigerian writer gave a memorable TED talk in 2009 on 'The danger of a single story.' Simply, her point was that all lives are a complex overlap of many stories and yet the human tendency is to compress all this to a simple one-dimensional narrative.

The National Institutional Ranking Framework (NIRF) does exactly that – it reduces the vast complexity of higher education into a single score. NIRF has now released its 2017 rankings of higher educational institutions across the country (https://www.nirfindia.org/College-Ranking.html). Already, within days of the announcement many institutions in the private sector have put up advertisements proclaiming their ranks. NIRF, unlike other international university ranking schemes which are based on educational and research excellence, combines broad but often fuzzy parameters which cover aspects classified broadly under the heads 'Teaching, learning and resources,' 'Research and professional practices,' 'Graduation outcomes,' 'Outreach and inclusivity' and 'Perception'. These five broad heads are then elaborated through further sub-heads, with weights assigned to each broad head, and more weights assigned to the sub-heads within each head. Such complex marking and weighting schemes further contribute to the fuzziness. For each sub-head, a score is generated using suitably proposed metrics, and the sub-head scores are then added to obtain scores for each individual head. The overall score is computed based on the weights allotted to each head. This score can take a maximum value of 100. Thus, what is a hugely multi-dimensional problem is compressed into a single score on the basis of which institutions, irrespective of size or resources, are finally rank-ordered based on these scores.

We use one category of rankings, namely that of colleges which participated in the exercise, to show how NIRF scores do not reflect the research excellence of these colleges. NIRF 2017 offers a wealth of scientometric and institutional data in the public domain. As in most university ranking exercises, we confine attention only to the aspect of research excellence measured by publications, citations and impact from three different bibliometric databases for the top 10 colleges ranked in 2017. Research evaluation of the 'top ten' colleges in India is performed by separating out the bibliometric part (inner core) of the chain from the econometric part (outer shell). This combines size-dependent and size-independent terms based on quantity and quality (impact) in a meaningful way. Output or outcome at the bibliometric level is measured using a second-order composite indicator, and the productivity or efficiency terms follow accordingly using the input to output or outcome factors.

Research evaluation combining econometric and scientometric indicators

Savithri and Prathap[1] used data from the 2014 release of the SCImago Institutions Rankings (SIR) to show that the research performance of leading higher education

Table 1. Bibliometric and econometric assessment for a top ranked institution in the 'Colleges' category according to NIRF 2017, namely Loyola College, Chennai

Institution		Loyola College, Chennai
No. of regular faculty	F	329
Spend in crores (Rs) 2015–16	S	41
Publication details		
Indian Citation Index 2013–15	Papers P	0
	Citations C	0
	Impact $i = C/P$	0.00
Scopus 2013–15	Papers P	525
	Citations C	2044
	Impact $i = C/P$	3.89
Web of Science 2013–15	Papers P	305
	Citations C	1673
	Impact $i = C/P$	5.49
Total exergy	$X = \sum iC$	17,134.79
Per capita exergy	X/F	52.08
Per spend exergy	X/S	416.55
NIRF score		68.68

Table 2. Summary of bibliometric indicators for the top ten colleges according to NIRF 2017 rankings

NIRF Rank	Institution	F	S	X	X/F	X/S	NIRF score
1	Miranda House, Delhi	233	40	2488.35	10.68	62.15	69.39
2	Loyola College, Chennai	329	41	17134.79	52.08	416.55	68.68
3	Shri Ram College of Commerce, Delhi	136	18	0.50	0.00	0.03	67.18
4	Bishop Heber College, Tiruchirappalli	119	15	2797.31	23.51	189.25	61.18
5	Atma Ram Sanatan Dharma College, New Delhi	193	24	1791.75	9.28	73.85	60.68
6	St Xavier's College, Kolkata	222	31	1308.13	5.89	41.93	59.12
7	Lady Shri Ram College for Women, New Delhi	103	20	3.79	0.04	0.19	58.28
8	Dyal Singh College, New Delhi	269	37	1820.56	6.77	48.93	58.22
9	Deen Dayal Upadhyaya College, New Delhi	163	22	1459.78	8.96	65.69	58.06
10	The Women's Christian College, Chennai	173	31	112.05	0.65	3.64	57.37
Minimum		103	15	0.50	0.00	0.03	57.37
Maximum		329	41	17,134.79	52.08	416.55	69.39
Maximum/Minimum		3	3	34,269.58	14,166.15	14,892.42	1.21
Pearson's correlation		F	S	X	X/F	X/S	NIRF score
F		1.00	0.91	0.72	0.60	0.58	0.38
S		0.91	1.00	0.52	0.38	0.34	0.34
X		0.72	0.52	1.00	0.96	0.96	0.54
X/F		0.60	0.38	0.96	1.00	1.00	0.50
X/S		0.58	0.34	0.96	1.00	1.00	0.47
NIRF score		0.38	0.34	0.54	0.50	0.47	1.00

institutions can be summarized from the input end to the outcome end using six primary and secondary bibliometric indicators representing the entire chain of activity: input–output–excellence–outcome–productivity. The primary indicators are orthogonal and represent size-dependent quantity and size-independent quality/productivity dimensions respectively. Composite indicators which combine size-dependent and size-independent terms were used to measure output and outcome.

Abramo and D'Angelo[2,3] combined size-independent citation indicators from the bibliometric part (inner core) of the chain with the productivity and efficiency measures from the econometric outer loop of assessment to rank institutions. This requires the bibliometric core of the chain (measuring output or outcome using bibliometric indicators) to be separated from the econometric part (the outcome or output to input ratios). That is, to complete the evaluation chain, we must take up the econometric part where efficiency of the research production process is represented in terms of output and outcome productivities based on faculty size and budget or annual expenditures.

NIRF 2017 gives bibliometric data from three databases, the Indian Citation Index, Scopus and Web of Science, as well as faculty size and annual expenditure for all participating institutions. The total number of publications P reported by the institution and the total number of citations C reported for the three-year window 2013–15 are the basic bibliometric data. It also gives the faculty size F and the total annual expenditure for 2016, which we call the spend S. These are all size-dependent or composite indicators of input and output[1–3].

Methodology

Scientometric or bibliometric assessment is done first as an inner core evaluation and a second-order indicator is computed. Efficiency and productivity measures form the econometric part which can be thought of as the outer shell. It is best to demonstrate this with an example. Table 1 shows the bibliometric and econometric assessment for the institution ranked second in the 'Colleges' category according to NIRF 2017, namely Loyola College, Chennai. We start with one primary size-dependent input parameter: the number of regular faculty, F. NIRF gives bibliometric data from three databases, as mentioned earlier. The total number of publications reported, and the total number of citations reported for the three year window 2013–15 are the basic bibliometric data. From these, we can compute the impact $i = C/P$, which is an accepted proxy for the quality of work reported in that database by the institution. Note that P is a size-dependent proxy of quantity of research output, i is a size-independent proxy of quality of research output and C is a composite size-dependent indicator which combines quality and quantity.

A single-valued composite outcome indicator for the research performance of each institution from each database can be computed as the second-order indicator[4] called the exergy term from the quantity (size) and quality (excellence) indicators, $X = i^2P = iC$. We see that X is a scalar measure of total research output. Therefore X/F and X/S are size-independent measures of productivity or efficiency of the institution. This exercise is repeated for the rest of the colleges in the top 10 institutions in the NIRF 2017 rankings.

Results and discussion

Table 2 is a summary of bibliometric indicators of the top 10 colleges according to NIRF 2017 rankings. Within these there is a huge range in size, from Lady

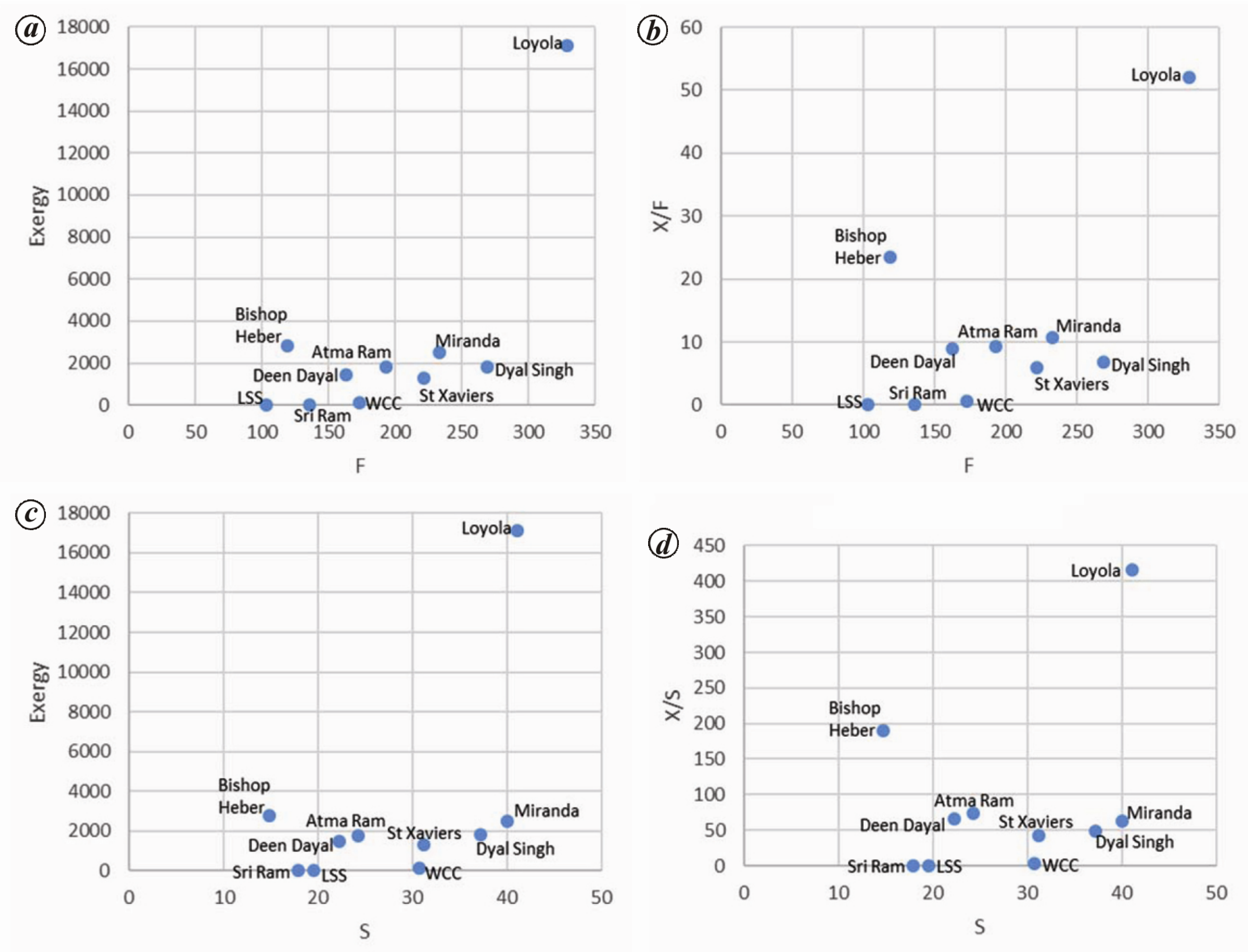

Figure 1. Scatter plots of (***a***) exergy (*X*) versus faculty strength (*F*); (***b***) exergy per faculty (*X*/*F*) score versus faculty (*F*); (***c***) exergy versus spend (S), and (***d***) exergy per crore (Rs) of spending (*X*/*S*) versus spend.

Shri Ram College for Women, New Delhi with 103 faculty members to Loyola College with 329 regular faculty, which is nearly three times more. Bishop Heber College, Tiruchirappalli had the lowest annual expenditure during 2015–16 at Rs 15 crores; Loyola College spent nearly three times more (Rs 41 crores). Shri Ram College of Commerce, New Delhi has the lowest output as measured in exergy terms (0.5) and Loyola College with the highest (17,134.79), is 34,000 times more effective in enlarging the fund of human knowledge through research excellence. This is reflected in per capita output (*X*/*F*); we find Loyola College to be 14,000 times more effective than Shri Ram College of Commerce. One can also look at the output per crore of rupees of annual expenditure: here we find again that Loyola College to be 15,000 times more effective than Shri Ram College of Commerce. This range is not seen in the NIRF scores, where the academic aspect which accounts for only a small fraction of the total score along with scores from all the other heads and sub-heads has been telescoped into a narrow band, a feature noticed last year as well for the top engineering institutions[5].

The Pearson's correlations are also shown in Table 2 and Figure 1 *a*–*d* summarizes in a single montage various scatter plots of exergy (*X*) versus faculty strength (*F*), exergy per faculty (*X*/*F*) score versus faculty (*F*), exergy versus spend (*S*), and exergy per crore (Rs) of spending (*X*/*S*) versus spend respectively. The NIRF ranking of Miranda House, New Delhi as the best college in India is too simplistic a conclusion. Indeed, Loyola College followed by Bishop Heber College, stand head-and-shoulders above the rest where research achievement is the main criterion.

Concluding remarks

Rankings based on NIRF scores are a laughably simplistic conclusion – it is the danger, and consequently, the tragedy of the single story indeed. The bibliometric data that have been released through the NIRF 2017 rankings are used to see how the top ten colleges fare if only research excellence is considered. Even within this single story, many sub-plots emerge when the criterion for performance is considered in various size-dependent exergy and size-independent productivity and efficiency terms. The Pearson's correlation coefficients and scatter plots show that various alternative rankings are possible. Overall, in this case, Loyola

College and Bishop Heber College rank much above the rest. If a productivity measure such as exergy per faculty (*X*/*F*) score is chosen, Miranda House ranks third among this list of ten. If an efficiency measure such as exergy per crore (Rs) of spending (*X*/*S*) score is considered, we find that Miranda House drops to fifth place. It also seems that higher spending or more faculty does not necessarily increase productivity or efficiency in translating money to scientific wealth.

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2. Abramo, G. and D'Angelo, C. A., *Scientometrics*, 2014, **101**(2), 1129–1144.
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OPINION

Polarity, asymmetry and aging: are there Yayatis among bacteria?

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Yayati was a Hindu mythological king who exchanged his age with his son so that the father became young and the son old. Is this possible anywhere in the world of biology?

Bacteria have been shown to age. In an exponentially growing population some cells progressively slow down and stop dividing[1]. This is thought to be due to asymmetric damage segregation in which old pole cells retain damaged components and the new pole cells receive newly synthesized components[2]. Polarity implies functional asymmetry with a predefined direction with or without morphological difference. Cellular polarity and division asymmetry are common to yeast, bacteria and stem cells of multicell organisms[3]. A number of processes in bacteria, including formation of endospores, flagella, stalks or buds show clear polar biases[4].

Experiments in morphologically symmetric rod-shaped *Escherichia coli* showed that the cells inheriting old pole exhibited decreased growth rate, less offspring production, and increased probability of death[1,2]. Although damages could potentially be of many types, a major component that shows demonstrable asymmetric segregation is protein aggregates[5]. Protein aggregates frequently occupy polar positions, although they are also observed at other locations[6].

Often in the context of bacterial aging, the terms 'polarity' and 'asymmetric damage segregation' have been used interchangeably. In principle, asymmetric damage segregation should be possible without predefined polarity. Even if the damaged components go randomly to one of the daughter cells, all the presumed advantages of asymmetric division would be obtained[7–10]. The old pole–new pole axis (OPNPA) is not necessary for this advantage. However, it is possible that the mechanism of asymmetric segregation is such that the old pole receives the damaged components either invariably or with a greater probability. Therefore, there may or may not be a one-to-one association between old pole and old age.

Stewart *et al.*[1] observed 7953 pairs of sister cells among which 54% of the time the new pole divided faster than the old pole, 15% of the time there was no difference and 31% of the time the old pole divided faster than the new pole. Lele *et al.*[11] showed that old pole cells divided slower than the new pole cells in 12 out of 18 experiments, while in the remaining six a reversed pattern was seen. Lindner *et al.*[5] observed that under non-stressed conditions, 28% of the time protein aggregates were localized at mid-cell position, 30% of the time at the new pole and 31% of the time at the old pole when first formed with a noticeable size. It is possible that with subsequent divisions the aggregates end up being at the old pole. Baig *et al.*[6] and Lele *et al.*[11] showed that protein aggregation and symmetry of cell division in *E. coli* is not hard-wired but responsive to environmental conditions and even reversible under certain conditions. There is substantial plasticity as well as evolvability in protein aggregation and functional asymmetry.

All these results suggest that while asymmetric damage segregation is at the centre of aging in bacteria, its association with OPNPA may not be indispensable. If OPNPA is central and critical to asymmetric division and aging in bacteria, then spherical organisms that change their plane of division and thereby do not have a fixed OPNPA could be immune to aging[3,12]. Baig *et al.*[13] showed that cumulative cell division asymmetry exists in *Staphylococcus aureus*. Also, there is no evidence for any equivalence of polarity in these organisms[12]. OPNPA does not seem to be a necessary prerequisite for asymmetric damage segregation and thereby cell senescence.

This might be the solution for an unresolved riddle. Wang *et al.*[14] followed the old pole cell for 200 generations using a microfluidic device and showed that the