Analysing the stability of India Rankings

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India Rankings released by the National Institutional Ranking Framework that ranks the higher education institutions in India has been in existence since 2016. It plays an important role in providing proper assessment of a large number of higher education institutions in India, that fail to get represented in international rankings. In the present study, I have analysed the stability of the India Rankings. In particular, the uncertainty and sensitivity analyses are used for analysing the stability of the ranking results produced by India Rankings 2020. The results indicate that the rankings are highly volatile. The rankings of only top 10–15 institutions are found to be relatively stable while for most of the other institutions, the ranks assigned to them are found to be unstable. The results of the study give useful inputs to policy makers and stakeholders for improving the ranking methodology. It will also help general readers in understanding to what extent they can believe in the ranking results.

Keywords: India Rankings, NIRF, Scientometrics, university rankings, uncertainty and sensitivity.

UNIVERSITY rankings have an ever-increasing impact on the status as well as growth of higher education institutions. Rankings are said to have reshaped the context of higher education[1]. They are of interest for a broad range of stakeholders including students, parents, institutions, academics, policy makers, funding agencies, etc. Students use them for selecting universities, academics look for university jobs and research opportunities, university management care about getting good ranks so that they can recruit best students and faculties, whereas governments want to know whether the public funds spent on universities are delivering world class higher education systems[2].

Ever since the Shanghai Jiao Tang University (SJTU) published the Academic Ranking of World Universities[3] in 2003, there have been continuous efforts towards ranking of higher education institutions across the globe. The ARWU, Times Higher Education[4] and the QS[5] world university rankings are by far the most reputed and known international rankings. Besides these, Leiden[6], SciMago[7], NTU[8], URAP[9] are some other similar ranking schemes. The main purpose of these rankings is to rank world-class universities and therefore, they naturally fail to represent national universities adequately. As pointed out by Robinson-Gracia *et al.*[10], the high representation of Anglo-Saxon universities in the global rankings leaves little space for states of other countries working towards a successful university model. To overcome this, several researchers have proposed the use of national ranking systems or regional ranking systems for ranking national and regional institutions.

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Issues with Rankings

Limited coverage is not the only issue that the world university rankings are criticized for. Since the time they were first released, university rankings have been scrutinized over various aspects. van Raan[11] much earlier pointed out the problems with the use of bibliometric indicators for evaluation of performance of higher education institutions. Since then, several studies have discussed shortcomings of world university rankings and their remedies[12–18]. Soh[19] in his study discussed about seven common problems related to ranking and said that the weight-and-sum approach used by rankings served no useful purpose. He also talked about the problem of indicator weight discrepancies and about the discrepancies between nominal and attained weights of indicators in other studies[20,21]. Another study examined whether a single composite index could truly reflect the overall performance of institutions across a variety of activities, and proposed an alternative approach of grouping rather than using point estimates for assessment[2]. Several studies have performed comparison of well known world university rankings[1,22,23], whereas some others have used them to analyse their national universities and identified the shortcomings of global rankings in providing fair judgement of national universities especially in the context of those outside of US and UK[10,14].

Uncertainty and sensitivity analysis

The debate on the use of composite indicators for rankings is quite old. Yet, there is less chance that composite indicators-based rankings would be discontinued. A wide variety of stakeholders interested in ranking results find the composite indicators rather simple to understand and interpret. Composite indicators tend to summarize the complex methodology employed in collection of data and generation of appropriate results. Keeping this in view, Saisana *et al*.[24] have described general procedures for assessing the uncertainty in building composite indicators. Uncertainty analysis aims to analyse how the uncertainty of input indicators affects the values of composite indicators, while in sensitivity analysis the aim is to find out how much the uncertainty of individual inputs contributes to the output variance.

Uncertainty and sensitivity analysis have been discussed by several previous studies[25–27]. Saisana *et al.*[24] proposed the application of uncertainty and sensitivity analysis in building composite indicators. They provided a methodology for analysing composite indicators for uncertainty and sensitivity while building a composite indicator from different indicators[28]. Some studies have also successfully applied this technique to analyse the stability of global rankings. For example, Dobrota *et al*.[29] applied uncertainty and sensitivity analysis on ARWU rankings and examined the effect of removing award factors on the stability of ARWU rankings. They found that the ranking became more stable when the indicators were reduced to four instead of the original six indicators by excluding the award factors. In another study, Dobrota *et al*.[30] analysed the international rankings in the field of ICT. They compared QS and URAP world university rankings in the field of ICT and found that URAP was relatively more stable than QS rankings. Another study suggested the use of Composite I-Distance Indicator (CIDI) methodology for increasing the stability of QS rankings[31].

University rankings in the Indian context

According to the All India Survey of Higher Education (AISHE) report 2018–19, India has 993 Universities, 39,931 Colleges and 10,725 Stand Alone Institutions. In addition, there is one central open university, fourteen state open universities and one state private open university. These together cater to the needs of around 37.4 million students admitted for higher education[32]. Out of these institutions, only a few top ones find a place in global rankings and most of the other institutions remain unrepresented. Such top institutions are mostly IITs, IISc, IISERs, a few central and state universities and some private institutions. The total number of all such institutions that are represented in at least one international ranking taken together stands at around 30, not even 1% of the total higher education institutions (HEIs) in the country. The under representation of Indian institutions and the proven inability of global rankings in giving due representation of national HEIs pressed the need for a ranking specific to Indian institutions. It was expected that a ranking scheme designed specifically for India will not only help in understanding the true status of higher education in India but also give Indian HEIs a reasonable measure of performance to improve upon[33]. The Government of India responded to this long-standing demand of academicians and policy researchers with the launching of a systematic framework for ranking of Indian HEIs in 2015.

India Rankings

The National Institutional Ranking Framework (NIRF)[34] that produces the India Rankings was launched by the Ministry of Education (formerly Ministry of Human Resource Development), Govt. of India in 2015. The purpose of NIRF is to provide a framework to rank HEIs across India. The first ranking scores were released in 2016.

Before NIRF was launched, most of the previous efforts for ranking and assessment of Indian HEIs were carried out by individuals and were limited in scope and coverage[35–41]. NIRF covers a large number of institutions including private institutions. It provides both overall and discipline-specific ranks for several disciplines. The rankings are based on five broad parameters, viz. Teaching, Learning and Resources, Research and Professional Practice, Graduation Outcomes, Outreach and Inclusivity, and Perception. Each parameter has an overall weight assigned to it and again further divided into sub-heads with appropriate weight distribution.

The total score under each indicator is calculated out of 100. The Teaching, Learning and Resources (TLR) parameter mainly measures the faculty and financial strength of an institution. It consists of several different metrics that measure the strength of faculty, student strength, faculty with Ph.D. and the financial resources available with the institution and its utilization. The Research and Professional Practice (RPP) is the indicator that is primarily concerned with the research performance of the institution and consists of metrics for number of publications, a quality metric, IPR and Patent, and Project and Professional Practice. The TLR and RPP indicators are weighted 0.3 each in the composite rank. The Graduation Outcome (GO) indicator is weighted 0.2 and has two metrics – one for university examination and the other for number of Ph.D. students graduated. The fourth indicator with a weight of 0.1 in the composite rank is Outreach and Inclusivity (OI) and it primarily measures the diversity of students in the institution. It has four sub-indicators, viz. percentage of students from other states/countries, percentage of women, economically and socially challenged students and facilities for physically challenged students. The last indicator is Perception (PR) also having the weight 0.1. This parameter measures the perception of the institution among the public. The indicator values are obtained from surveys conducted among academic peers and employers. The scores of an institution on each indicator (on a scale of 100) are multiplied by the respective indicator weight and added together to obtain the final score which is used for ranking the institutions.

For the year 2020, apart from the overall ranking, rankings for universities, colleges, engineering, medical, pharmacy, management, law, architecture and dental institutions were also released.

Since the release of first ranking scores in 2016, India Rankings has significantly increased its coverage of institutions as well as disciplines. Needless to say, that India Rankings bears significant importance for Indian HEIs. This is reflected in the fact that in mere four years of span since its release, a number of studies have critically examined its results[42–44] while several others used it for further analysis of different institutions[45–52].

Although, India Rankings has been a subject of extensive research among scholars working in the field of bibliometrics and scientometrics, a comprehensive study analysing its stability was found lacking. The present work aims to fill that gap by analysing the stability of India Rankings through uncertainty and sensitivity methodology.

Methodology and data

The uncertainty and sensitivity analysis is based on the relative contribution of indicators, calculated as the ratio of indicator score to overall university score multiplied by the appropriate indicator weight[30]

$$RC_{i,j} = \frac{IS_{ij}}{OS_j} * w_i,$$

where RC_{ij} is the relative contribution of indicator i to the ranking of institution j; IS_{ij}, the indicator score for ith indicator of jth institution; OS_j, the overall score of institution j and w_i is the weight assigned to the ith indicator. In this manner, relative contribution of the indicators to the overall score can be obtained. This procedure is repeated for each university. The obtained information can be used to assess whether some indicators dominate the overall scores[53]. Subsequently, the average relative contribution and their standard deviations are calculated for each indicator.

In the next step, Monte Carlo simulation is used for analysing the uncertainty of ranking scheme. The scores over 10,000 Monte Carlo simulations are used for analysing the stability of ranking scheme. The average relative contribution and standard deviation of the indicators are used as inputs for Monte Carlo simulations[29].

The data for this study was obtained from India rankings 2020 released by NIRF. The ranking results were analysed for top 100 institutions by calculating simulated ranks for the overall institutional ranking results. As the ranking results are released for several different disciplines along with the overall rankings, it was decided to include one of the subject rankings also for the analysis, so as to get a proper assessment of the results. For this purpose, ranking of engineering institutions was selected. Engineering institutions occupy 7 out of top 10 positions under overall rankings. Further, around 1/3rd of the institutions (36) in the overall rankings of the top 100 institutions are engineering institutions. Therefore, ranking of engineering institutions was used for this study. Thus, the stability analysis was conducted for both overall rankings and ranking of engineering institutions.

Results

Overall Rankings

The relative contribution of each indicator and mean relative contribution and standard deviation of the indicators are shown in Table 1. Among the five main indicators of India Rankings 2020, viz. TLR, RPP, GO, OI, and PR, TLR and RPP had weight 0.3, GO 0.2 and OI and PR both weighted 0.1. The total scores are calculated on a scale of 100. As can be seen from Table 1, TLR has highest relative contribution of 0.38 whereas lowest relative contribution is that of PR (0.04). RPP has much lower contribution compared to its original weight and stands at 0.19 instead of 0.3. A look at the standard deviation of relative contribution values shows that RPP has the highest deviation in its values followed by TLR. The standard deviation of the weight of other indicators is relatively less.

Table 2 shows the uncertainties in the ranks of top 15 institutions in the overall institutional rankings for the year 2020. We can see that though the ranks are stable for top 10 institutions, uncertainty in the rankings increases as we move towards the lower side. Particularly interesting is the case of Jadavpur University whose actual rank is 13 but in the simulated ranking it appears in top 15 only about 8% of times.

Variations in the rankings for last 15 institutions are given in Table 3. We can see that the institutions that appear at the bottom in the rankings show much more variations in their simulated ranks compared to the top 15 institutions. No institution in Table 3 has appeared even 50% of times in its original rank bracket. Further, many of the institutions have obtained ranks even below 76 when their original rank is above 86. The rank variations for all the institutions is shown in Figure 1. It can be seen from Figure 1 that the ranks of the institutions are highly unstable. Only the top 15 institutions have a relatively

Table 1. Mean relative contribution and standard deviation of indicators for overall rankings

Indicators	Weights	Mean relative contribution	Standard deviation of relative contribution
Teaching, learning and resources	0.3	0.38	0.06
Research and professional practice	0.3	0.19	0.07
Graduation outcomes	0.2	0.28	0.04
Outreach and inclusivity	0.1	0.11	0.02
Perception	0.1	0.04	0.03

Table 2. Uncertainty of top 15 institutions according to overall ranks

	Ranking position				
Institution	1–5	6–10	11–15	16–20	21–25
Indian Institute of Technology Madras	10,000				
Indian Institute of Science	9,999	1			
Indian Institute of Technology Delhi	9,995	4			
Indian Institute of Technology Bombay	9,975	24	1		
Indian Institute of Technology Kharagpur	3,131	6,848	16	4	2
Indian Institute of Technology Kanpur	1,665	8,329	5	1	
Indian Institute of Technology Guwahati		9,999	1		
Jawaharlal Nehru University	5,204	4,796			
Indian Institute of Technology Roorkee		9,940	58	2	
Banaras Hindu University		3,090	6,910		
Calcutta University		41	7,884	2,048	22
Jadavpur University		2	821	6,529	1,899
Amrita Vishwa Vidyapeetham		11	6,784	3,172	27
Manipal Academy of Higher Education		22	9,656	322	
University of Hyderabad		0	7,462	2,538	

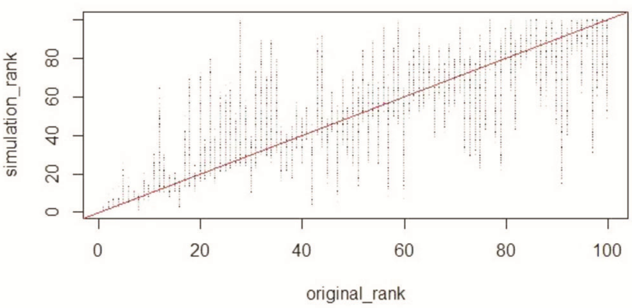

Figure 1. Simulated rank for top 100 institutions according to overall ranks in India Rankings.

stable rank while for most of the other institutions the variations are too high.

Engineering institutions

The indicators and their weights for ranking of engineering institutions are same as those of the overall rankings. The mean relative contribution of the indicators and their standard deviation are given in Table 4. From Table 4, it can be observed that the relative contribution of indicators as well as the standard deviation for engineering rankings is similar to that of overall rankings. We see that the highest contribution is from TLR which stands at 40% in the engineering rankings while PR contributes only 4% instead of the original 10% to the scores. Largest difference in contribution is again seen in case of RPP that contributes only 18% instead of the original 30%. The mean and relative contributions calculated here are used as inputs for 10000 Monte Carlo simulations and ranks are calculated for each of the top 100 engineering institutions.

The ranking uncertainty for top 15 engineering institutions is shown in Table 5. The rank variations of these institutions also show a pattern similar to overall rankings. However, for engineering institutions the ranks are slightly more stable. For institutions at the lower end, the rankings deviate more from the original rank. The ranks for Anna University and Vellore Institute of Technology are less than 25, only about 50% of the times.

Ranking uncertainties for the last 15 engineering institutions are shown in Table 6. Here also, simulation results show that the ranks are highly uncertain. For most of the institutions, simulated ranks are different from the actual assigned rank and vary over a large range. An interesting case is that of Guru Gobind Singh Indraprashtha

Table 3. Uncertainty of last 15 institutions according to overall ranks

	Ranking position				
Institution	76–80	81–85	86–90	91–95	96–100
PSG College of Technology	231	1,874	3,319	3,002	1,440
Bharath Institute of Higher Education and Research	3,954	4,036	106		
Guru Nanak Dev University	390	1,239	2,418	4,300	1,505
Cochin University of Science and Technology	9	68	764	4,950	4,209
University of Jammu	2,931	1,779	62	1	
Sawai Man Singh Medical College	941	481	207	72	21
SVKM’s Narsee Monjee Institute of Management Studies	2,598	3,087	703	76	
Motilal Nehru National Institute of Technology		5	158	2,494	7,343
National Institute of Technology Silchar		4	123	1,590	8,283
Mumbai University	183	1,108	2,719	4,637	1,307
National Institute of Technology Durgapur			6	84	9,910
Datta Meghe Institute of Medical Sciences	1,632	2,361	1,165	367	192
Bharati Vidyapeeth	275	2,062	3,808	2,797	775
Lovely Professional University	37	369	1,983	5,249	2,343
Mizoram University	819	3,552	3,022	1,126	413

Table 4. Mean relative contribution and standard deviation of indicators for engineering institutions

Indicators	Weights	Mean relative contribution	Standard deviation of relative contribution
Teaching, learning and resources	0.3	0.4	0.06
Research and professional practice	0.3	0.18	0.08
Graduation outcomes	0.2	0.26	0.04
Outreach and inclusivity	0.1	0.11	0.02
Perception	0.1	0.04	0.03

Table 5. Uncertainty of top 15 engineering institutions

	Ranking position				
Institution	1–5	6–10	11–15	16–20	21–25
Indian Institute of Technology Madras	10,000				
Indian Institute of Technology Delhi	10,000				
Indian Institute of Technology Bombay	9,994	6			
Indian Institute of Technology Kanpur	10,000				
Indian Institute of Technology Kharagpur	7,703	2,294	2	1	
Indian Institute of Technology Roorkee	1,587	8,413			
Indian Institute of Technology Guwahati	715	9,285			
Indian Institute of Technology Hyderabad		10,000			
National Institute of Technology Tiruchirappalli		9,100	878	22	
Indian Institute of Technology Indore		9,371	627	2	
Indian Institute of Technology (BHU), Varanasi		1,166	8829	5	
Indian Institute of Technology (Indian School of Mines), Dhanbad		80	5,740	2,868	1,145
National Institute of Technology Karnataka			9,669	325	6
Anna University			164	1,602	3,408
Vellore Institute of Technology			24	981	1,894

University whose actual rank is 86 but appears in the 96–100 bracket for more than 91% of times in the 10,000 simulated ranks. The ranking uncertainty of the top 100 engineering institutions according to NIRF rankings is shown in Figure 2. Figure 2 shows that the ranking uncertainty for engineering institutions is less compared to overall rankings. Although, we find that the ranks for many of the institutions are unreliable.

Table 6. Uncertainty of last 15 institutions according to overall ranks

Institution	Ranking position				
	76–80	81–85	86–90	91–95	96–100
Guru Gobind Singh Indraprastha University	20	97	218	457	9194
Lovely Professional University	422	2676	5784	1081	25
University College of Engineering	2321	508	111	17	3
Graphic Era University	5	139	4314	5099	443
Coimbatore Institute of Technology	838	1855	2928	2819	1436
Siddaganga Institute of Technology	509	6894	2538	57	
National Institute of Technology Patna			15	8921	605
C.V. Raman Global University	3566	3106	1620	455	103
PES University	4	221	4896	4703	176
Vel Tech Rangarajan Dr Sagunthala R&D Institute of Science and Technology	21	99	319	3410	6150
Jaypee Institute of Information Technology			8	3487	6505
University College of Engineering	1100	4982	3511	362	8
National Institute of Technology Hamirpur	5	28	70	686	9211
Bharati Vidyapeeth Deemed University College of Engineering	3375	2057	1418	553	194
Atal Bihari Vajpayee Indian Institute of Information Technology and Management	4	22	180	5681	4113

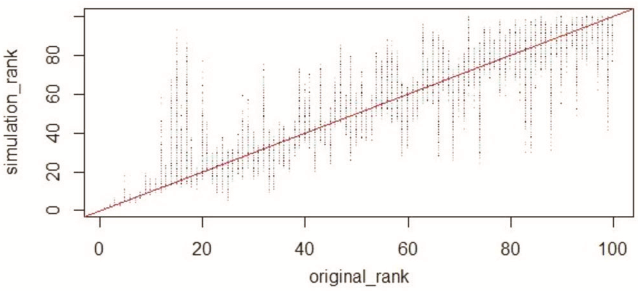

Figure 2. Simulated rank for top 100 engineering institutions in India Rankings.

Discussion

The uncertainty and sensitivity analysis conducted on top 100 organizations of overall India ranking and that of Engineering subject, revealed the instability in the ranking results. We observed that barring some 10–15 top ranked institutions, the ranking positions for other institutions were sensitive to methodological assumptions. Further, ranks assigned to many of the institutions were also found to be unreliable. The extent of variations in the ranking results can be clearly understood from Figures 1 and 2 which give the simulation results for overall ranking and ranking of engineering institutions respectively. The Figures indicate large variation in simulated ranks compared to the original rank (shown by straight line). However, we see a relatively less variation in rankings of engineering institutions compared to overall rankings.

In order to get better insight into the simulation results, it would be interesting to analyse simulated ranks against the original ranks of institutions. The median of simulated ranks is used as a representative of true rank for this purpose[53]. The original rank is then compared with the simulated median rank. Simulated rank range is also analysed to find out the range of ranks obtained by a particular institution. The rank of an institution is said to be sensitive to methodological assumptions if the range of simulated ranks is high. On the other hand, the ranking is said to be unreliable if there is a big difference between the original rank and the simulated (median) rank[53].

For overall ranking, the difference of simulated median rank and original rank was found to be less than 10, for 58% of the institutions, while they both were same for only 7% of the institutions. The range of simulated ranks for institutions in overall rankings was found to be greater than 20, for more than 80% of them. While, for more than 20% of the institutions, the range was more than 50 positions.

For engineering institutions, the situation appeared a little better. Here, for more than 80% of the institutions, the difference of simulated median rank and original rank was less than 10, while they were same for 18% of the institutions. However, the range of simulated ranks was greater than 20, for more than 70% of the institutions. For 16 institutions, the range of ranks was greater than 50. Thus, while ranking positions might be said to be reliable for majority of engineering institutions, the ranks obtained by about 70% of them were still sensitive to methodological assumptions.

It should be noted that, in the present study, only the uncertainty arising due to indicator weights is considered. However, uncertainty in rankings also arises due to several other factors such as normalization approaches, weights of sub-indicators, aggregation rule and the number and type of indicators used[28,53]. The high uncertainty in the ranks of institutions makes the relative positions of institutions in India Rankings irrelevant for many of them, especially for those appearing in the lower rank bracket. This tendency is more prominent in overall rankings compared to engineering institutions rankings.

Conclusion and future work

In this paper, I have analysed the stability of India Rankings using uncertainty and sensitivity analysis. The mean and standard deviation of the relative contribution of indicator weight was used as input to 10,000 Monte Carlo simulations and the variations in the ranks of institutions were analysed. The simulated ranks for most of the institutions in both overall and engineering rankings were found to be highly volatile. One clear indication provided by these results is that the weighting scheme needs to be revised so as to produce more reliable ranking of institutions. However, as pointed out earlier, uncertainty in ranks is a result of several different factors that together make up the rank of an institution. Thus, the deeper conclusion that can be drawn from this study is a need for a complete and systematic review of indicators and sub-indicators used for ranking, the weighting scheme as well as the aggregation rule.

In this context, it seems relevant to discuss the JRC report on Higher Education Rankings[53] that used THES and SJTU (ARWU) rankings for analysing the robustness of global university rankings. The study considered the three main methodological uncertainties arising due to: indicators chosen, weights assigned, and the aggregation rule used for obtaining composite value. It was found that the ranks of most of the institutions considered for the study were highly dependent on the methodology chosen for compiling the rankings for both the ranking schemes. The report suggested that the compilation of university rankings be accompanied with robustness analysis based on a multi-modelling approach. The multi-modelling approach has been successfully applied for development and validation of several composite indicators. This method is also included in the JRC/OECD handbook on composite indicators[54]. A possible extension to the present work could be to analyse India Rankings using the multi-modelling approach.

Another dimension of improvement in the ranking scheme is the revision of indicators, so as to provide better assessment of institutions and removal of inherent biases in ranking (for example favouring old/big institutions). Here, previous studies that examined NIRF in terms of quantitative and qualitative aspects of assessment can prove to be useful starting points[42–44]. This is also an area where policy researchers can play an important role by proposing indicators that are crucial to assessing university performance in the Indian context.

The task of designing a good ranking system suitable to the needs and characteristics of the institutions to be ranked is a significant one, but is also not easily accomplished. A modest goal to achieve in this case could be to design a ranking system such that, upon acknowledging the methodological uncertainties that are intrinsic to the ranking system, the space of inference of ranks for majority of the universities is narrow enough to draw meaningful conclusions[53].

Proper assessment of higher education institutions aids in achieving the multifaceted policy goal of reducing cost, improving efficiency and intensifying universities' contributions in solving societal problems. The publication of India Rankings is thus, a step in the right direction. However, the ranking exercise bears its significance only when the results give a reliable comparison of HEIs and provide useful inputs and opportunities to improve their standards. The present study will prove helpful to policy-makers and stakeholders in taking best actions that will improve the ranking methodology.

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