Nanotechnology Perceptions
ISSN 1660-6795
www.nano-ntp.com

Estimating Balanced Growth in Intake Capacity of Engineering Institutions Across Major States of India through Statistical Methods

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This study is an attempt to predict the intake capacities in engineering institutions across major states in India for the year 2023-25, providing valuable insights for educational planning and resource allocation. Secondary data of intake capacity of major states of India is taken from government reports, educational databases and institutional records. Correlation and Regression analysis is used to examine the relationship between intake capacity and potential determinants such as Population, Per Capita Net State Domestic Product (PCNSDP), Net State Domestic Product (NSDP), Placement in engineering, Number of Pass out students in 12th and Unemployment. Multiple regression techniques are employed to account the simultaneous influence of multiple variables on intake capacity. Based on the analysis, forecasts are generated to predict future intake capacity levels in engineering institutions for each state, taking into account the need for balanced growth. The findings serve as initial evidence to estimate intake capacity of engineering institutions in India and useful in policy making.

Keywords: Balanced Growth, Intake Capacity, Correlation Analysis, Regression, Multiple Regression, PCNSDP, NSDP.

1. Introduction

In the landscape of higher education, particularly in the domain of engineering, India stands as a significant global player, with a burgeoning demand for skilled professionals driving the need for robust educational infrastructure. Central to this infrastructure is the intake capacity of engineering institutions, which plays a pivotal role in shaping the educational landscape and meeting the demands of a dynamic workforce market. The intake capacity of engineering institutions is a critical factor in ensuring equitable access to higher education and promoting regional development. However, disparities in growth rates among states can lead to imbalances in educational opportunities and hinder overall socioeconomic progress.

Several studies have investigated historical trends in the intake capacity of engineering institutions across major states of India. Mishra et al. [5] analyzed data from the All India Council for Technical Education (AICTE) to examine trends in intake capacity over the past decade. They found significant variations in growth rates among states, with some states experiencing rapid expansion while others stagnated. Similarly, Gupta and Singh [3] conducted a longitudinal analysis of intake capacity trends, identifying factors contributing to disparities in growth rates, such as state-level policies, demographic shifts, and industrial demand. Population demographics, including the youth bulge in certain states, have been identified as a significant driver of demand for higher education [4]. Economic indicators, such as GDP growth and industrial development, also play a crucial role in shaping intake capacity [11]. Additionally, government policies, such as reservation quotas and funding allocations, can influence the expansion of engineering education infrastructure [8], [9] conducted a comparative analysis of engineering education infrastructure in different states, revealing disparities in the distribution of institutions and facilities.

A comprehensive literature review reveals several studies that have explored various aspects of engineering education in India, including enrollment trends, infrastructure development, and academic performance. However, there remains a gap in the literature concerning the systematic assessment of the growth trajectory of intake capacity in engineering institutions, particularly at the state level, and the factors influencing this growth. Nevertheless, there is a need for quantitative approaches that employ robust statistical methods to analyze historical data and forecast future trends in intake capacity growth. This study aims to address this gap by employing statistical techniques to estimate the balanced growth in intake capacity of engineering institutions across sixteen major states of India for the year 2023-25 taking 2020 as a base year.

2. Methodology

This section discusses the methodology which is used for estimation and prediction of balanced intake capacity for engineering graduates in the 16 major states in India. The reason behind choosing 16 major states is almost 80% intake capacity is distributed among these 16 major states.

2.1 Parameters for Balanced Growth Intake Capacity

In general, the population should be taken into account while evaluating each state's intake capacity. Population and intake capacity are documented in the literature, but no association

is provided. The literature review also reveals that there are a number of states with higher populations but lower intake capacities, or vice versa. There are numerous factors which influence intake capacity of a state. Generally, population is a factor to be considered for estimating the intake capacity in the states. In the present paper we consider parameters like population which simply describes the number of people in the state, Per Capita Net State Domestic Product (PCNSDP) which describes the economic condition of the individual in the state, Net State Domestic Product (NSDP) which describes the economic condition of the state, the number of passout students in 12^{th}, unemployment etc.

Several sources provides the values of the various parameters considered in the present study for the years 2016 to 2020, and the years 2021 to 2025 were then extrapolated from there. Using statistical techniques such as regression analysis and correlation, it was found that the intake capacity may be determined by only three or four characteristics. The intake capacity that is achieved by using these is known as Balanced Growth Intake Capacity, and they are referred to as Balanced Growth Parameters.

In the present study year 2020 is taken as the base year i.e. from this year we are balancing the intake capacity; and predicting balanced intake capacity up to year 2025.

2.2 Estimation of Balanced Growth Intake Capacity for the year 2020 :

For the year 2020, after collecting various data, we have to find whether individually these parameters are related to intake capacity? Whether there is any relation among these parameters? Answers to these questions are given by finding the correlation of these parameters with intake capacity, and also among themselves with the help of SPSS Software version 16.0 .

The correlation among intake capacity of engineering institutes in each state with all the parameters was established (Table no. 1). After examining the nature of Karl Pearson's coefficient of correlation it is observed that parameters like NSDP, number of passout students in 12^{th}, PCNSDP, Population and Placement in engineering are showing good correlation with the intake capacity. Since, the value of coefficient of correlation (r) for these parameters is between 0.5 to 0.8, which reveals that there is moderate degree positive correlation. Therefore these parameters may be factors for deciding the intake capacity.

After finding correlation, simple regression is found with each of these parameters taken as independent variable and intake capacity as dependent variable that shows that among these parameters which parameter is giving the best result. Best result means the parameters whose statistics like r (coefficient of correlation), r^2, r^2 adj. S.E. (Standard Error of estimate) are good. The parameter, which is showing the best result, will reserve its place as one of the parameters in the multiple regressions. Since, simple regression is not able to describe the intake capacity at very high level; hence we require multiple regression, which can help in explaining the relation of various parameters to the intake capacity.

Table no. 1: Correlation Matrix for Various Parameters

		Intake	Population	Placement	NSDP	PCNSDP	Passout 12^{th}	Unemployment
Intake	Pearson Correlation	1	0.27	.993**	.628**	0.429	0.353	.998**
	Sig. (2-tailed)		0.313	0	0.009	0.097	0.18	0
Population	Pearson	0.27	1	0.251	.581*	-0.35	0.357	0.277

	Correlation							
	Sig. (2-tailed)	0.313		0.348	0.018	0.184	0.175	0.298
Placement	Pearson Correlation	.993**	0.251	1	.635**	0.411	0.37	.985**
	Sig. (2-tailed)	0	0.348		0.008	0.113	0.158	0
NSDP	Pearson Correlation	.628**	.581*	.635**	1	0.397	.573*	.622*
	Sig. (2-tailed)	0.009	0.018	0.008		0.128	0.02	0.01
PCNSDP	Pearson Correlation	0.429	-0.35	0.411	0.397	1	0.019	0.436
	Sig. (2-tailed)	0.097	0.184	0.113	0.128		0.944	0.091
Passout in 12th	Pearson Correlation	0.353	0.357	0.37	.573*	0.019	1	0.342
	Sig. (2-tailed)	0.18	0.175	0.158	0.02	0.944		0.195
Unemployment	Pearson Correlation	.998**	0.277	.985**	.622*	0.436	0.342	1
	Sig. (2-tailed)	0	0.298	0	0.01	0.091	0.195	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table No. 2 Intake Capacity by Simple Regression

Parameters	Population	Placement	NSDP	PCNSDP	Passout 12th	Unemployment
R	0.213	0.993	0.628	0.429	0.353	0.998
R sq.	0.045	0.987	0.395	0.184	0.124	0.997
Rsq.adj	-0.023	0.986	0.351	0.126	0.062	0.996
SE.	37073	2927.167	30356.49	43534.023	29082.685	1570.652
F	0.666	1032.241	9.129	9.129	1.988	4216.474
Significant level	0.233	0.021	0.788	0.981	0.195	0.07
T	1.246	2.607	-0.274	0.024	1.36	-1.965

Table No. 3 Balanced Intake Capacity by Multiple Regression for Year 2020

Models	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
R	0.994	0.639	0.385	0.993	0.994	0.998	0.994
R sq.	0.987	0.409	0.148	0.987	0.987	0.997	0.988
R sq. adj	0.985	0.318	0.017	0.985	0.984	0.996	0.984
SE.	4659.274	31890.304	35075.467	3839.644	4873.764	3311.923	5217.049
F	495.619	4.49	1.129	489.158	313.013	1267.885	318.777
T	1	1	0	1	0	1	1

States	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Andhra Pradesh	149816	65374	62207	151738	151062	155093	150715
Assam	9105	17984	45935	10655	9932	2460	9687
Bihar	12862	24314	109666	9479	14143	18479	9881
Delhi	22969	55071	41455	24971	22519	2716	24040
Gujarat	43728	113511	61253	44137	41629	64442	44397
Haryana	30292	52821	45280	32161	30037	34276	31063
Karnataka	111779	116387	71859	112384	110579	104343	112020
Kerala	42674	57100	55078	44048	42467	56025	42768
Madhya Pradesh	68130	57272	74748	67794	68766	73375	68207
Maharashtra	146041	191579	134134	142413	142875	131477	142644
Odisha	43620	29243	42946	45508	44661	34412	45228
Punjab	29495	34046	50252	31089	29957	33409	29751
Rajasthan	35326	62504	92721	33621	35204	45653	33329
Tamil Nadu	278161	123031	91210	279429	279296	278398	278343
Uttar Pradesh	90865	86872	92886	87309	92009	99517	93939
West Bengal	48852	76608	92088	46979	48578	29641	47704
TOTAL	**1163716**	**1163716**	**1163716**	**1163716**	**1163716**	**1163716**	**1163716**

Model 1 Population, Placement

Model 2 Population, NSDP

Model 3 Population, Passout in 12th

Model 4 Placement, Passout in 12th

Model 5 Populations, Placement, NSDP

Model 6 PCNSDP, Passout in 12th, Unemployment

Model 7 Placements, Population, Passout in 12th

It is found after simple regression that NSDP, PCNSDP, Number of Passout Students in 12^{th} class, Population, Placement, are some good parameters to which the balanced intake capacity is related. Among these Parameters Placement gives the best relation.

Multiple regression is carried out, by forming different groups or models of parameters. Suppose there are 6 parameters or say variables, we can form ${}^6C_2$ different models for 2 variables like population and placement, similarly, ${}^6C_3$ different models for 3 variables like population, placement, NSDP. similarly, ${}^6C_4$different models for 4 variables like population, placement, NSDP, PCNSDP. similarly, ${}^6C_5$ different models for 5 variables like population, placement, NSDP, PCNSDP, number of passout students in 12^{th} and model${}^6C_6$ for all 6 variables like population, placement, NSDP, PCDSDP, number of passout students in 12^{th}, unemployment. Here, we are showing 57 different models form 2, 3, 4, 5 and 6 variables, and among these model that gives the best 'Statistics' is taken as the best model for deciding the intake capacity.

After finding multiple regression of the parameters for the year 2020, We got best model with five parameters, number of passout students in 12^{th}, Population, Placement, NSDP, PCNSDP. Hence, this model is taken as the best model for deciding the balanced intake capacity for year 2020, Table no. 4.

Table No. 4 Balanced Intake Capacity by Multiple Regression

Models	**Model 8**	**Model 9**	**Model 10**	**Model 11**	**Model 12**	**Model 13**	**Model 14**	**Model 15**
R	0.993	0.998	0.994	0.999	0.995	0.998	0.999	**0.996**
R. sq.	0.987	0.997	0.988	0.997	0.989	0.997	0.998	**0.992**
R Sq. Adj.	0.985	0.996	0.983	0.996	0.985	0.996	0.997	**0.989**
SE.	4466.43	3189.698	5087.915	2459.657	8508.141	3483.49	4421.401	**8716.903**
F	301.639	1267.954	220.88	943.824	249.747	881.99	1.052	**261.401**
T	1	1	0	0	0	0	2	**3**

States	**Model 8**	**Model 9**	**Model 10**	**Model 11**	**Model 12**	**Model 13**	**Model 14**	**Model 15**
Andhra Pradesh	151378	154728	151288	154832	149161	154678	151636	**151636**
Assam	10387	2352	10070	2233	6716	2248	4416	**5199**
Bihar	8941	17036	11150	16315	6657	17929	15668	**12497**
Delhi	25085	3458	23590	3580	21324	3015	8249	**12925**
Gujarat	44774	65376	43052	66137	48704	64978	65587	**43973**
Haryana	32183	34073	30780	35678	35944	34048	30530	**41462**
Karnataka	112688	104737	111276	105812	115031	104605	104686	**113446**
Kerala	43987	55624	42630	57079	45898	55729	53747	**49821**
Madhya Pradesh	67671	73315	68566	72477	66189	73305	73793	**66027**
Maharashtra	143010	131646	141382	133182	145212	132146	134256	**138356**
Odisha	45331	34693	45557	33984	42605	34335	36013	**41192**
Punjab	30856	33012	29977	33804	29743	33067	33001	**31713**

Rajasthan	33467	44924	33605	45271	32692	45434	45032	**34071**
Tamil Nadu	279036	277848	278976	278170	276401	277980	279105	**278766**
Uttar Pradesh	87891	101321	94074	95869	94108	100417	95215	**95567**
West Bengal	47031	29570	47743	29294	47330	29803	29245	**47064**
TOTAL	**1163716**	**1163716**	**1163716**	**1163716**	**1163716**	**1163716**	**1163716**	**1163716**

Model 8 Placement, Passout in 12th, NSDP

Model 9 NSDP, PCNSDP, Unemployment

Model 10 Placement, NSDP, Passsout in 12th, Population

Model 11 Population, Unemployment, Passout in 12th, NSDP

Model 12 Population, Placement, Passout in 12th, PCNSDP

Model 13 PCNSDP, Unemployment, NSDP, Passout in 12th

Model 14 Population, PCNSDP, NSDP, Passout in 12th, Unemployment

Model 15 NSDP, Passout in 12th, Population, Placement, PCNSDP

Table No. 5 Intake Capacity in 2021 and 2022 by Regression Model 15

Year	**2021**		**2022**	
States	**Sanctioned**	**By Regression**	**Sanctioned**	**By Regression**
Andhra Pradesh	151338	145784	148952	139409
Assam	4975	5481	4745	5963
Bihar	14726	12705	14345	12739
Delhi	10209	13915	11361	15340
Gujarat	50265	42961	46717	43093
Haryana	31068	38820	29190	36955
Karnataka	111492	109725	109538	106418
Kerala	51324	47574	50463	45822
Madhya Pradesh	72201	63915	68970	61872
Maharashtra	134806	136328	135483	134512
Odisha	37638	39587	38286	38171
Punjab	28999	30514	28069	29577
Rajasthan	37439	33835	35919	33756
Tamil Nadu	265374	268755	250592	257433
Uttar Pradesh	89193	89806	84778	85065
West Bengal	34776	46116	34225	45505
TOTAL	1125823	1125823	1091633	1091633

3.2.2 Balanced Growth Intake Capacity for 2021 and 2022:

The actual intake capacity of 2021 is redistributed using multiple regression by the best model, same has been done for 2022. It has been observed that intake capacity reduced in 2021 and 2022 , it is due to pandemic covid-19.

3.2.3 Forecasting of Balanced Growth Intake Capacity for 2023 up to 2025:

To obtain balanced growth intake capacity for the year 2023, we increase balanced growth intake capacity of year 2022 by 5% and then multiple regression with the same model is carried out. Hence, the balanced growth intake capacity for the year 2023 is obtained. Similar procedure is carried out for various growth percentages like 10% and 15%, shown in Table no. 6. Since, from year 2023 to year 2025 only up to 15% of growth in intake capacity considered to be sustainable.

Table No. 6 Estimated Intake Capacity in 2023 by Regression at Various Growth Percentages

Year	2023		
	Growth Percentage		
States	**5%**	**10%**	**15%**
Andhra Pradesh	146380	153350	160321
Assam	6262	6560	6858
Bihar	13376	14013	14650
Delhi	16107	16874	17641
Gujarat	45248	47403	49557
Haryana	38803	40651	42499
Karnataka	111739	117060	122381
Kerala	48113	50404	52696
Madhya Pradesh	64966	68060	71153
Maharashtra	141238	147964	154689
Odisha	40080	41988	43897
Punjab	31055	32534	34013
Rajasthan	35444	37131	38819
Tamil Nadu	270305	283176	296048
Uttar Pradesh	89318	93571	97825
West Bengal	47781	50056	52331
TOTAL	**1146215**	**1200796**	**1255378**

Following the above procedure for each year, balanced growth intake capacity is obtained for the years 2024 and 2025 with 5%, 10% and 15% growth percentages, shown in Table 7 & Table 8.

Table No. 7 Estimated Intake Capacity in 2024 by Regression at Various Growth Percentages

Year	2024		
	Growth Percentage		
States	**5%**	**10%**	**15%**
Andhra Pradesh	153699	168685	184369
Assam	6575	7216	7887
Bihar	14045	15414	16847
Delhi	16913	18562	20288
Gujarat	47511	52143	56991
Haryana	40743	44716	48873
Karnataka	117326	128766	140738
Kerala	50519	55445	60600
Madhya Pradesh	68214	74866	81826
Maharashtra	148300	162760	177893
Odisha	42084	46187	50481
Punjab	32608	35788	39115
Rajasthan	37216	40845	44642
Tamil Nadu	283820	311494	340455
Uttar Pradesh	93784	102929	112498
West Bengal	50170	55062	60181
TOTAL	**1203525**	**1320876**	**1443685**

Table No. 8 Estimated Intake Capacity in 2025 by Regression at Various Growth Percentages

Year	2025		
	Growth Percentage		
States	**5%**	**10%**	**15%**
Andhra Pradesh	161384	185554	212024
Assam	6903	7937	9070

Bihar	14747	16956	19374
Delhi	17758	20418	23331
Gujarat	49886	57357	65540
Haryana	42780	49188	56204
Karnataka	123192	141642	161848
Kerala	53045	60989	69690
Madhya Pradesh	71625	82352	94100
Maharashtra	155715	179036	204577
Odisha	44188	50806	58053
Punjab	34239	39366	44982
Rajasthan	39077	44929	51339
Tamil Nadu	298011	342643	391524
Uttar Pradesh	98473	113221	129373
West Bengal	52678	60568	69208
TOTAL	**1263702**	**1452964**	**1660237**

3. Conclusion

This study illustrates the scientific method for calculating balanced growth intake capacity in technical institutions based on certain parameters, by using statistical tools. Such analysis is very important and will provide a guideline to the policy makers in deciding the intake capacity in technical institutions, so that output is fully utilized for the development of the country. The intake capacity at degree level is regulated by evolving mathematical model in which population, number of passout students in 12^{th}, net state domestic product and facilities for placement in each state are considered. Intake capacity in the year 2020 is taken as base. Balanced growth intake capacity for major sixteen states is obtained with various growth percentages. It is observed that intake capacities in Andhra Pradesh and Madhya Pradesh have already reached to saturation level in 2022 and thus there is no scope in its increase for 2023, 2024 and 2025. It is observed that in Assam, Delhi, Haryana, Punjab, Tamil Nadu and West Bengal 5% growth may be given according to the parameters. In Odisha, Bihar, Rajasthan, Uttar Pradesh there should be no increase for year 2023. Further if 5% growth may be give in year 2024 and 2025 according to the growth of parameters.

4. Future Scope

It is observed that not only the intake capacity is increasing at a much faster rate than the sustainable growth but the branch wise intake capacity is also increasing in the similar manner. The intake capacity in Computer, IT and connected disciplines has gone more, than as if the country is ready to change the absorption pattern to very large extent in the area Computer, IT, etc. and decrease the absorption pattern in Mechanical, Production and Civil engineering etc. This phenomenon does not appear to be true, since, these graduates are being absorbed in varieties of functions performed according to National Technical Manpower Information System (NTMIS) data interpretation a mathematical model may be involved relating subject wise intake capacity with the function performed by the various types of engineering graduates passing out. It is suggested that by collecting more data from NTMIS for couple of years more, the study suggested above can be done to balanced discipline wise growth of intake capacity in states as well as country.

References

1. Bansal, A., & Verma, R. (2021). Multiple regression analysis for forecasting intake capacity in engineering institutions: A case study of Indian states. International Journal of Engineering Research & Technology (IJERT), 10(1), 315-320.
2. Ghosh, S., & Mukherjee, A. (2021). Regional Disparities in Engineering Education in India: Trends, Challenges, and Policy Implications. Journal of Comparative Education, 1-22.
3. Gupta, V., & Singh, A. (2020). Growth Analysis of Engineering Education in India: A State-Level Study. Journal of Engineering Education Transformations, 34(1), 78-87.
4. Kumar, S., & Rao, M. (2019). Demographic Dividend and its Impact on Higher Education: A Case Study of Indian States. Journal of Higher Education Policy and Management, 41(6), 641-658.
5. Mishra, A., et al. (2018). Analysis of Trends in Intake Capacity of Engineering Institutions in India. Journal of Engineering Education, 43(2), 145-156.
6. Nair, S., & Joseph, J. (2018). Policy Interventions for Balancing Growth in Engineering Education: Lessons from Indian States. International Journal of Educational Development, 62, 78-86.
7. Pandey, R., & Tiwari, A. (2020). Forecasting Intake Capacity in Engineering Institutions: A Time Series Analysis Approach. International Journal of Applied Engineering Research, 15(10), 749-756.
8. Sharma, S., & Pandey, S. (2018). Impact of Government Policies on Intake Capacity Growth in Engineering Institutions: A Case Study of Indian States. Journal of Policy Research in Higher Education, 42(3), 315-332.
9. Sharma, V., et al. (2019). Regional Disparities in Engineering Education Infrastructure: A Comparative Analysis of Indian States. Journal of Educational Planning and Administration, 33(2), 178-192.
10. Singh, R., & Sharma, M. (2019). Correlational Analysis of Intake Capacity Growth in Engineering Institutions: A Case Study of Major Indian States. Indian Journal of Engineering Education and Research, 2(3), 12-18.
11. Sinha, S., & Prasad, R. (2017). Economic Determinants of Intake Capacity Growth in Engineering Institutions: A State-Level Analysis. International Journal of Development Research, 7(5), 13412-13419.
12. Srivastava, A., & Singh, P. (2020). Promoting Balanced Growth in Engineering Education: Policy Recommendations for Indian States. Journal of Public Policy and Governance, 2(2), 25-38.