

**APPLICATION OF NONPARAMETRIC STATISTICAL TECHNIQUE FOR THE
STUDY OF INTER-STATE DISPARITY RELATING TO ECONOMIC ACTIVITY IN
INDIA: 2020-21**

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ABSTRACT: India is a country characterized by wide diversity in economic, political, social, regional cultural and traditional aspects. The objectives of economic growth and development basically depend on the policies, institutions and machinery. The economic researchers in India often observe that it is necessary to analyze regional disparities prevailing in different states of India to frame suitable policies for inclusive development for the entire country. A deeper analysis of disparities across the states in the performance will certainly help the planners for framing effective policies of development. In this context the present research aims at studying the disparities existing among states in respect of Economic Activity for the period 2020-21. The study is based on a Nonparametric Statistical Model developed by Friedman. We have constructed the model and the results have clearly shown that there exist disparities among the selected states in respect of Economic Activity which is a prime one for in entire development.

Keywords: Economic Activity, Constant prices, Rank Analysis, Disparities, Friedman Technique

1. Introduction

Economists have stated that economic activity is a set of actions that produce, trade, sell or distribute goods or services with the involvement of monetary transactions and further classified as primary, secondary and tertiary. Primary if they are related to agriculture and all allied aspects, Secondary if they are related to manufacturing, processing and construction and Tertiary if it is a service. Economist has outlined the following main indicators for the existence of disparity between the states in a country:

1. State per capita income,
2. Population belong poverty line,
3. Degree of urbanization,
4. Agricultural and Industrial development, and
5. Spatial distribution of industries etc.,

Most of the research studies carried out in respect of the inter-state disparity is related to state domestic product, human development, industrial development, financial development, socio-economic indicators. Keeping in new of these points the authors have made an attempt to study in detail the aspects in respect of inter-state disparity relating to economic activity in India for the period 2020-21. The authors believes that such a study will reveal the prime factors for existence of inter-state disparity and will help the policy planners for forming effective policies of inclusive development for the entire country. The objectives of the study are:

- Formulation of data structure for the economic activity.
- To apply Friedman Technique for the study of disparity existing between states in respect of economic activity
- To arrive conclusions based on the technique adopted.

In Section 2 we have presented an updated review of literature in respect of economic activity with special reference to Indian conditions. Data base for the study and related aspects are presented in Section 3. In Section 4 methodology adopted for the study and a detailed account of Friedman Technique is given. Empirical analysis based on the data structure in presented in Section 5. Section 6 contains the results and conclusions drawn based on the study.

2. Review Literature in respect Inter-State disparities

Kurian (2000) studied in detail the widening regional disparity in India and assessed the disparities in terms of demographic indicators, female literacy, state domestic product and poverty.

Sanghamitra Bandyopadhyay (2002) observed that social and economic infrastructure polarised at the lower income levels and macro economic stability reveals cohesion of higher income states. The author has finally concluded that the factors of disparities will balance cross-regional growth.

Ravindra H. Dholakia (2003) examined the trends in regional disparity in India's economic and human development over the past two decades. The author has emphasised the issue of disparities in income and human development.

Bhattacharya and Sakthivel (2004) have attempted to study the regional disparity by analysing growth rates of aggregate sectoral domestic product of major states in pre and post reform decades and concluded that there exists inverse relationship between population growth and state domestic product growth.

Sabajaschi Kar and Sakthivel (2007) analysed the impact of pro-market reforms on regional inequality in India both at the aggregate and sectoral level. They have concluded that percapita output from the industrial and services sector showed convergence before the reforms and divergence afterwards.

Manoj Sharma and Rajiv Khosla (2013) examined the extent and magnitude of regional disparities in the industrial economy from 1980-81 (pre-reform) and 2009-10 (post-reform) using Discriminant function approach. The results indicated that there exists huge disparities in industrial development among different states in India. They have found that productivity measures along with physical measures turned out to be the factors for regional imbalances during the post reform period instead of productivity and profitability measures during the pre-reforms period.

Roy (2013) has shown that disparities in terms of income were higher within rural areas across the states compared to urban counterpart. The author has compared the performance of states in terms of human development.

Praveen (2016) studies the extent of Socio- economic inter-state disparities among the selected states and measured the inequality that exists among states. The author has outlined certain recommendations for the growth of states which may reduce the disparities.

Arpita Bannergee and Pravat Kumar Kuri (2015) examined the trend and pattern of inequality and polarisation prevailing in India by examining the nature of convergence or divergence across states in per capita income growth, human development and agricultural development. They have identified the factors causing divergence in economic and social activity and provided possible policy suggestions for attaining balanced and inclusive development.

Rashmi Arora and Anand (2021) examined disparities in financial development at the regional level in India. They have found that banking development is significantly higher in the leading high income and more developed regions compared to lagging ones. It is also noted that all bank groups including public sector banks concentrated more in the developed regions.

3. Data base or the Study of inter-state disparity

Hand Book of statistics on the Indian economy is published by the Reserve Bank of India for each year since 1998. This publication provides comprehensive data base of macroeconomic variables and financial variables. We have taken data relating to Net State Value added by Economic Activity for the year 2020-21 (at current prices with 2011-12 as the base year). The components included with net value added by economic activity are:

1. Agriculture, Forestry and Fishing
2. Mining and Quarrying
3. Manufacturing
4. Electricity, Gas, Water supply & other utility services
5. Construction
6. Trade, Repair, Hotels and Restaurants.
7. Transport, Storage, Communication and services related to Broad Casting
8. Financial Services.
9. Real Estate, Ownership of dwelling and Professional Services
10. Public Administration
11. Other services

These 11 components determine the economic activity of the country as a whole for each year. The data structure is presented for each state in India for the period 2016-17 to 2020-

21 in the Hand Book of statistics on the Indian economy. The present study covers the data for the year 2020-21 in respect of 5 randomly selected states from five regions in India. The selected states are.

- West Bengal (Eastern Region)
- Maharashtra (Western Region)
- Uttarpradesh (Northern Region)
- Madhyapradesh (Centre Region)
- Tamilnadu (Southern Region)

The comprehensive data in respects of the above states are given in Table 1.

**Table 1. Net State Value Added by Economic Activity
(at Current prices) (Base 2011-12)**

(in Crores)

Economic Activity	Name of the State				
	West Bengal	Maharashtra	Uttarpradesh	Madhyapradesh	Tamilnadu
1	259001	172395	215702	166078	125856
2	9003	70555	21276	12018	3348
3	123378	364907	128353	748130	250490
4	14069	26487	8488	18434	1863
5	75330	90138	97712	39960	119957
6	199509	149059	82731	41146	122583
7	50244	94659	57349	22882	45349
8	58055	190862	40056	21535	75947
9	134551	287625	120741	21874	152357
10	58548	45082	73252	26308	25728
11	123177	126200	48782	28637	88450

4. Methodology for the Study

4.1. Nonparametric Statistical Methods

Nonparametric statistical methods are based on mathematical procedure for statistical hypothesis testing. These methods make no assumption about probability distribution being studied. The main advantages of using non-parametric statistical methods one:

- (i) They may be the only alternative when the sample size is small and

(ii) They are useful in the analysis of data that one inherently in ranks

4.2. Friedman Technique and Associated Aspects

Friedman test (1937, 1940) is used when the assumptions for two-way analysis of variance do not hold good. Under this method the ranks within block are used for the analysis. Let us suppose that there is 'k' treatments and 'r' blocks, each block of size k. Each treatment occur only once in each block. The data in respect of 'r' blocks and 'k' treatments are given in the following two-way table.

Table 2. Two-Way Table

Rows / Blocks	Samples (Treatments)			
	1	2	....	k
1	X ₁₁	X ₁₂	....	X _{1k}
2	X ₂₁	X ₂₂	....	X _{2k}
.
.
.
r	X _{r1}	X _{r2}	....	X _{rk}

Test Procedure:

Null Hypothesis: $H_0: \tau_1 = \tau_2 = \dots = \tau_k$ (All treatments have same effects)

Alternative Hypothesis: $H_1: \tau_1 \neq \tau_2 \neq \dots \neq \tau_k$ (All treatments do not have the same effect)

In testing the null hypothesis we assign ranks to all the observations from 1 to k in each block (row) independently. It is important to note that under the null hypothesis (H_0) it is expected that sum of the ranks in all columns will be equal. If the difference in sum of the columns is high Friedman suggested the following test procedure.

Let R_{ij} is the rank of the observation with i^{th} row and j^{th} column for $i = 1, 2, \dots, r$, and $j = 1, 2, \dots, k$. Two way table for ranks is given below in Table 3.

Table 3. Two-Way Table

Blocks	Treatments				Trkl
	1	2	....	k	
1	R ₁₁	R ₁₂	....	R _{1k}	$k(k+1)/2$
2	R ₂₁	R ₂₂	....	R _{2k}	$k(k+1)/2$
.
.
.
r	R _{r1}	R _{r2}	....	R _{rk}	$k(k+1)/2$
Total	R ₁	R ₂	....	R _k	$rk(k+1)/2$

Gibbon (1971) has shown that the following statistic F can be used to test H_0 against H_1 .

$$F = \frac{12}{rk(k+1)} \sum_{j=1}^k R_j^2 - 3r(k+1) \dots \dots \quad (1.1)$$

The statistic F is approximately distributed as Chi-square with (k-1) degrees of freedom.

Inference based on Friedman’s test procedure:

- (i) We reject H₀, if X² is greater than or equal to the tabulated value of X² for α level of significance with (k-1) degrees of freedom.
- (ii) Otherwise we accept H₀.

5. Empirical Analysis of Data for Inter-state Disparity

The basic data for the empirical analysis is presented in Table 1 with all details. Based on the Friedman test procedure we formulate the following hypothesis.

Null Hypothesis H₀: There is no significant difference in the net state value added by the economic active between the selected states.

Alternative Hypothesis H₁: There is significant difference in the size value added by the economic activity between the selected states.

Assigning ranks to each observation for each state independently we get the following table of ranks and are presented in the following Table 3.

Table 3: Ranking Of States With Respect To Economic Activity

Economic Activity	West Bengal	Mahara shtra	Uttarpr adesh	Madhya pradesh	Tamil nadu
1	1	3	2	4	5
2	4	1	2	3	5
3	4	1	3	5	2
4	3	1	4	2	5
5	4	3	2	5	1
6	1	2	4	5	3
7	3	1	2	5	4
8	3	1	4	5	2
9	3	1	4	5	2
10	5	2	1	3	4
11	2	1	4	5	3
	33	17	32	47	36

The value of the test statistic,

$$\begin{aligned} F &= \frac{12}{rk(k+1)} \sum R_j^2 - 3r(k+1) \\ &= \frac{12}{11 \times 5 \times 6} [33^2 + 17^2 + 32^2 + 47^2 + 36^2] - 3 \times 11 \times 6 \\ &= \frac{12}{330} [5907] - 198 = 16.80 \end{aligned}$$

Since the computed value of $F = 16.8$ is greater than the tabulated value of $X^2_{0.05,4} = 9.49$, we reject H_0 . This clearly reveals that there exists significant difference in the net state value added by the economic activity between the selected states and confirms inter-state disparity in India during 2020-21.

6. Results and Discussion

The study has revealed the following:

- Maharashtra's total net value added by economic activity during 2020-21 is high and tops the first rank compared to other selected states. West Bengal and Tamilnadu follows Maharashtra with second and third position respectively.
- Friedman's Technique shows that there exists significant difference in the net value added by economic activity between the sampled states and this confirms the inter-state disparity during the study period.

Based on the above results one can conclude that the planning mechanism in India has to be effectively integrated among the eleven components of economic activity. This in turn may result in shortening the wide inter-state disparity.

7. References

1. B.B. Bhattacharya and S. Sakthivel (2004). Regional growth and disparity in India: Comparison of Pre- and Post-reform periods, *Economics and Political Weekly*, 39(10), 1071-1077
2. Friedman, Milton, (1937). The use of ranks to avoid the assumptions of normality implicit in Analysis of Variance, *Journal of the American Statistical Association*, 23(200), 675-701
3. Friedman, Milton, (1940). A comparison of alternative tests of significance for the problem of 'm' rankings, *The Annals of Mathematical Statistics*, 11(1), 86-92.
4. Gibbon, J.D. (1971). *Non parametric Statistical Inference*, McGraw Hill, Kogakusha, Tokyo.
5. Kurian, N.J. (2000). Windening regional disparities in India-some Indicators, *Economic and Political Weekly*, 35(7), 12-18
6. Manoj K. Sharma and Rajiv Khosla (2013). Regional disparities in India's Industrial Development : Discriminant Function Approach, *Indian Journal of Industrial Relations*, 48(4), 629-702
7. Parveen (2016). Regional disparities in Indian Economic Development, *Internaional Journal of Advance Research and Innovative Ideas in Education*, 2(6), 1203-1208

8. Rashmill Arora and P.B. Anand (2021). Regional financial disparity in India: Can it be measured?, *Journal of Institutional Economics*, 17(5), 836-860.
9. Ravindra H. Dholakia (2003). Regional disparity in Economic and Human Development in India, *Economic and Political Weekly*, 38(39), 4166-4172
10. Roy, Satyaki (2013). Regional disparities in Growth and Human Development in India, MPRA paper No. 43841, https://mpra.ub.uni_rnuechen.de/43841
11. Sabajaschi Kar and S. Sakthivel (2007). Reforms and regional in equality in India, *Economic and Political weekly*, 47(30), 69-73
12. Sangamitra Bandyopadhyay (2002). An enquiry into causes of regional disparities in Economic growth across Indian States, Ph.D. Thesis, London School of Economics and Political Science, University of London, London.
13. Arpita Banerjee and Pravat Kumar Kuri (2015). *Development Disparities in India: An enquiry into convergence*, Indian Studies in Economics, Springer (India) Pvt Ltd. New Delhi.
14. RANI, POONAM, and VEERPAUL KAURMANN. "Contagion Effect of Macro Economic Variables on Ipo Listing Activity: A Time Series Analysis in Indian Context." *International Journal of Business Management & Research* 7.4 (2017): 47-52.
15. Lee, Wen-Tzong, and Shyh-Shin Hwang. "The Development of Binocular Disparity Technique for Printed Circuit Board Defect Inspection." *International Journal of Computer Science Engineering and Information Technology Research (IJCEITR)* 4.5: 57-64.
16. Pour, Mahdi Hadian, and Ali Taghizadeh Herat. "Business coaching competencies." *International Journal of Human Resource Management and Research (IJHRMR)* 6.6 (2013): 15-28.