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**Rank-Size Distribution and Primate City Characteristics in India and It’s Relationship with Economic Development: A Spatio-Temporal analysis of four Indian states (West-bengal, Andhra Pradesh, Kerala, Uttar Pradesh)**

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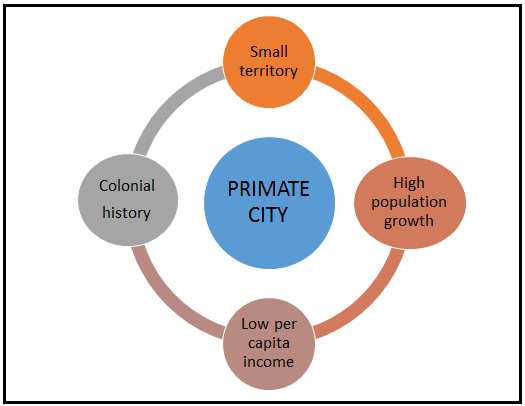
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| **\*Corresponding author**  *Sanu Dolui*  **Article History**  *Received: 23.08.2017*  *Accepted: 28.08.2017*  *Published: 30.09.2017*  **DOI:**  10.36347/sjahss.2017.v05i09.020  **C:\Users\Habibur Rahman\Downloads\SJAHSS.png** | **Abstract:** Geographer who have an aspire to examine the relationship between numbers and size of settlement put forth their very own principle by using set up their own assumption about the real world to suit their analysis and reasoning for explained and proved what they are wanted, then testing it against reality. The concept of city-size distribution has riveted the attention of urban geographer form twentieth century .The existence of three types of city-size distributions has been noted in the literature on city-size distribution and settlement system. These are central place, rank-size and primate city distributions. This paper is primarily focused on last two, law of primate city and rank-size rule distribution both are the hot topics in urban geography measuring the trend in urbanization, as we are try to classify and grouping the cities of a nation or a state or some time globally to measure the trend of urbanization, dependency of main town of nation or a state in its economic, social and political life. present paper try to emphasis on contrast look at the Rank size distribution cautioned by Zipf (1941) and implicit in the earlier suggestion Jefferson (1939) of the existence of primate city in Indian context with example of four selected states of India for find out their trend of urbanization and relationship between city size distribution and Economic development at regional level.  **Keywords:** Rank-Size Rule, Primate City, urbanization, Economic Development, Regional level. |

**INTRODUCTION**

**Concept of primate city**

The concept of primate city was initiated by Mark Jefferson, he studied over fifty one countries and found primacy in 46 countries of major city, on the premise of empirical observations he initiated the concept of Primate City in 1939 in his paper entitled “Law of the primate city” his speculation was “A country's leading city is always disproportionately large and exceptionally expressive of national capacity and feeling. The primate city is commonly at least twice as large as the next largest city and more than twice as significant. ”. For example London is seven times larger than size of Liverpool, Copenhagen nine times larger than Aarhus, and Mexico City five times the size of guadalhara. he observed that such primate cities not merely super eminent in size but also dominated in cultural, social and political scenario of the entire region .This was direct contract to the rank size rule suggested only 2 year later by G.K Zipfs. (K.siddhartha). In Jefferson’s view Migration to cities is partially liable for the growth of cities. The variation in employment opportunities in time and in space that causes migration results in irregularity in city sizes. "But once a city is larger than any other in its country, this mere fact gives it an impetus to grow that cannot affect any other cities ... it becomes the primate city" [1]. Since migrants from different parts of the country contribute to the growth of the primate city, it "expresses the national disposition more completely than any other city" [1]. The migrants do not typically lose connection entirely with their native places. So as Jefferson [1] says "the primate city contributes much to the unification of the country". A high level of education and easy communication make contributions to the development of a strong feeling of nationality which, in flip, is conducive to the development of a primate.

Vapnarsky [2] adopts a natural strategy to the investigation the ecological approach to the study of city-size distribution. A region is an ecological system. Closure is a defining characteristic of this system. It is a quotient that varies between 0 and 1. It is 1 if no interaction occurs between the system and the external world; it is 0 if all interactions initiated or terminated within the system are completed outside it.



**Characteristics of primate cities as per Linsky [3]**

**Degree or level of primacy**

The degree of primacy of the largest can be measured by the ratio of its population to that of the second larger city or to those of some other ranks of cities combined [4]. Primacy is the superlative lead of the largest or primate city over the smaller cities and towns. This could be expressed as a ratio:

Index of primacy = p1/p2Where P1 and P2 are the populations of the first and second largest settlements respectively or Primary Index (2) = P1/P3 Where P1 and P3 are the populations of the first and third settlements respectively. It is necessary under the rank size rule that the primacy index for P1 and P2 settlements be 2; for P1 and P3 it must be 3 and so on. When the second largest city has less than half the population of the largest city, then the degree or level of primacy is said to be high and vice versa. (K.siddhratha).

**CONCEPT OF RANK- SIZE RULE**

The distribution of urban places according to their rank of population size, plotted on a double logarithmic graph paper (log p/log R) which gives “S” size curvilinear trend is known as rank Size rule. this empirical relationship first presented by Auerback [5] in his study of German cities .But it’s was proposed scientifically and popularised by G.K Zips in his book “Human behaviour and the principal of least effort” [6] as a theoretical model to explicit the relationship between observed and empirical regularity in the size of settlement hierarchy either urban or rural .The cities of any region ranked from largest to smallest according to their population size. Thus, the largest city is ranked as No .1, the second largest No. 2, and continuing in the way down to the lower ranking town. According to G.K Zips [7] “if all the urban settlement in an area ranked In descending order of population, the population of the nth town will be 1/nth that of the largest town” in other words the population of an urban settlement in a region can be arranged in the series of 1, ½, 1/3, ¼, 1/5, 1/6……1/n. this regularity can also be expressed by the formula:

PR = pi/ r

Where, pr = population of thr rth rank city

Pi = population of the largest city., r = rank of the city .if this relationship is valid ,plotted rank against rank on long graph paper would produces an inverted J shape if the logarithms of population and ranked are plotted on a graph a straight line will be produced . The formula can be rewritten as:

**Log pR = log PI – log R**

Zipf’s in his study mainly concerned to solve two basic question of city –size distribution, why few large cities dominated in a countries urbanization process, and followed by a large number less important of small cities? And what are the co-relation between populations of cities and their ranks? Zipf’s conceptualize that city size distribution in any country are determined by two kinds of forces: ***forces of diversification*** and ***forces of unification***. These forces represent two works in opposite ways, while diversification tends to minimize the difficulty of moving the raw materials to the places of production; unification minimizes the cost of moving the finished products to the consumers *[8].*

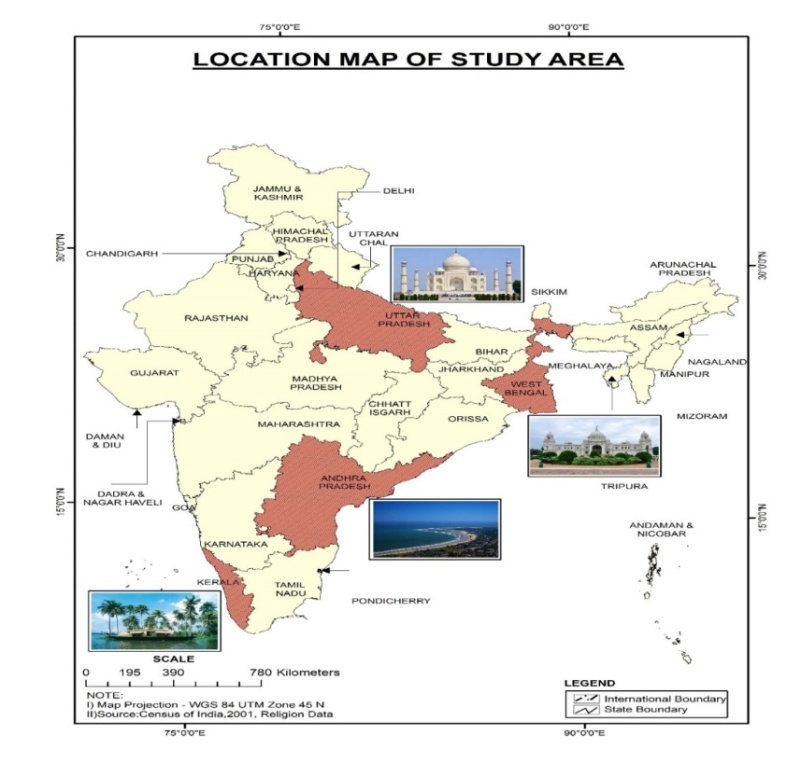
Researchers after reviewing the concept of rank-size rule, argue that Zipf's speculation lacks a valid theoretical basis *[9, 10]*. After this zipf’s hypothesis many researcher across the globe try to test Zipf's hypothesis, and try to providing theoretical explanation for the rank-size rule. Malecki [11] suggests that the rank-size structure of the urban system largely depends on the definition of the system as implied by the threshold size of the cities included in the system

Berry [12] says that primate cities are observed in those countries where until recently ruled by a colonial power or politically and economically dependent on a foreign country. Rank-size distributions are found in countries that have a long history of urbanization (India), are industrially developed (the US) and that are large (Brazil). In his model of city-size distributions, he suggests that primacy is the simplest city-size distribution affected by a few simple strong forces. In contrast, rank-size distributions are found when, "because of complexity of economic and political life or the age of the system of cities. Berry [13].

In Ahmad [14] view, Indian urban system follows rank-size rule. This implies that Indian cities are interactive and interdependent and therefore, form a system. However, Ramachandran [10] denies that India has an integrated urban system. For him, rank-size rule fails in India because in 1981, all the cities having population of 100,000 or more are larger than would be expected under the rank-size rule.

Stewart [9], like Ramachandran, views rank-size rule as an empirical regularity not a logical structure. He finds that the ratio of the population of the largest city to that of the second largest city in 72 countries does not cluster around 2 as postulated by the rank size rule. The median value of the ratios is as high as 3.25. He then tries to fit the model to the sub regions of the six largest countries and finds that the magnitude of the fit between data and the theoretical city-sizes is less at level of subdivisions than at the country level. He therefore, concludes that large heterogeneous areas fit the model better than the small areas.

Davies [15] provides insights into the behavior of the Ontario-Quebec urban system. He finds a very close fit between the empirical and theoretical rank-size distributions. Ettlinger's [16] approach to the city-size distribution is unconventional. In her observation space-economy is characterized by dependency- dominance relation, some cities and regions are dominated than other because of locational advantage and capital investment from private sector organization and location of industries.



**Fig-1: Location map of study area**

**SELECTION CRETERIA FOR STUDY AREA**

India has no such primate city in national level but metropolitan cities like Kolkata , Chennai , Delhi , Mumbai are the major towns in India have their dominant influence in our countries economic, social and cultural affairs, but primacy prevail in regional level ( states level) , after analysis the data of 29 states and their city size (population of cities ), trend of urbanization, geographic location , influence on national and states economy and different economic development criteria like life expectancy at birth , Unemployment , poverty level , economic freedom, GDP income level and overall human development . Were theoretically analysis which states may best fit rank size rule and primate city or in-between ness of both we considering 4 states for present study states Andhra Pradesh ,Kerala and west Bengal , Uttar Pradesh selected for this for their different trend of urbanization and socio-economic status . Here we selected 20 main cities of each states emphasis on rank 1 cities for the present study.

**OBJECTIVES OF STUDY**

Concept of Rank-size distribution and primate city are studied and analysis with example of four states of India at regional levels is Main objectives of present study are:

* Compare trend of urbanization of 4 selected states of India using census data ( 2001 & 2011) of and try to find out city size distribution which it follow primacy or rank size rule.
* Try to find out the relationship between city size distribution and economic development of a place .Compare the growth, economic dependency, development on main cities of that state.
* Suggestive measure on the ideal city size distribution for ideal growth of urbanization and development.

**METHODOLOGY**

The Rank-Size distribution & primate city characteristics of India are studied here using selected urban centres from states of Uttar Pradesh, Andhra Pradesh, Kerala, West-Bengal (Select 20 main city of each state according to size of population) using census data of 2001 & 2011. At first trend of urbanization are studies using census data of 2001 & 2011 to know the growth of cities.

**Rank Size rule**

For each census year, the rank and the respective population size of each of the urban settlements which are arranged in the descending order of their population size are plotted in a log-graph showing ranks on the X-axis and the population size of the urban centres on Y-axis on the basis of Zip’s rank size rule relationship

Pr = P1/r

Where Pr = population of the largest city ranked r

P = population of the largest city

r = rank of city r, largest city divided by the rank of the given city

After calculating expected and actual population of east towns plotted it on the logarithms graph.

**INDEX OF PRIMACY**

Index of primacy of following states (using the population data of twenty main town) to know how much primacy prevail in those states and dependency on primate city following sates using the following formula P1/p2 Where P1 and P2 are the populations of the first and second largest settlements respectively or **Primary Index (2) = P1/P3 Where** P1 and P3 are the populations of the first and third settlements respectively

**RESULT & DISCUSSION**

**(GROWTH OF POPULATION TOP 20 CITIES OF SELECTED STATES BETWEEN 2001& 2011 YEAR)**

**Fig-2: growth of population top 20 cities of Andhra-pradesh (year 2001 & 2011)**

**Fig-3: growth of population top 20 cities of Kerala (year 2001 & 2011)**

**Fig-4: Growth of population of top 20 cities of Uttar-Pradesh (year 2001 & 2011)**

**Fig-5: Growth of population top 20 cities of West -Bengal (year 2001 & 2011) Rank size dist.** **libation of cities (actual & expected population*)***

**Fig-6: Actual & Expected population of Andhra-Pradesh (year 2011)**

**Fig-7: Actual & Expected population of Kerala (year 2011)**

**Fig-7: Actual & Expected population of Uttar-Pradesh (year 2011)**

**Fig-8: Actual & Expected population of West-bengal (year 2011)**

**Fig-9: Percentage of City population to total population of top 20 towns of Andhra-Pradesh**

**Fig-*10*: Percentage of City population to total population of top 20 towns of Kerala (year 2011)**

**Fig-*11*: Percentage of City population to total population of top 20 towns of Uttar –Pradesh**

**Fig-12: Ppercentage of city population to total population of top 20 cities of west\_bengal**

*Figure 10: Percentage of City population to total population of top 20 towns of west-bengal (year 2011)*

**ECONOMIC ACHIEVMENT OF STATES & DEGREE OF URBANIZATION**

After analysis trend of urbanization and degree of primacy here these portions we discuss economic achievement of selected 4 states of India with national average, and compare their achievement in different economic development parameters –

* [**Gross Domestic State Product**](https://en.wikipedia.org/wiki/Gross_Domestic_State_Product)**(GSDP)** is a monetary measure of the market value of all final goods and services produced in a period (quarterly or yearly). Nominal GDP estimates are commonly used to determine the economic performance of a whole country or region, and to make international comparisons is a country's [gross domestic product](https://en.wikipedia.org/wiki/Gross_domestic_product) (GDP), the most comprehensive measure of national economic activity. Highest Goa (₹466,632) & lowest Bihar (₹63,200)
* **Level of poverty*:*** rank is calculated according to the percentage of people below poverty-line and is based on MRP-consumption. The list is compiled from the Annual Report of [Reserve Bank of India](https://en.wikipedia.org/wiki/Reserve_Bank_of_India) published on 2013. [Goa](https://en.wikipedia.org/wiki/Goa) ranks best with least poverty of 5.09% while national average stands at 21.92%.
* [**Life expectancy**](https://en.wikipedia.org/wiki/Life_expectancy)**at birth. :**  is a statistical measure of the average time an organism is expected to live, based on the year of their birth, The figures come from the [Human Development Index](https://en.wikipedia.org/wiki/Human_Development_Index) Report, published in 2011, by [United Nations Development Programme](https://en.wikipedia.org/wiki/United_Nations_Development_Programme) (UNDP) [India](https://en.wikipedia.org/wiki/India) , and Sample Registration Survey (SRS) based life table 2010-14. [Kerala](https://en.wikipedia.org/wiki/Kerala) had the highest [life expectancy](https://en.wikipedia.org/wiki/Life_expectancy) among the [states](https://en.wikipedia.org/wiki/States_and_territories_of_India) in India, while [Assam](https://en.wikipedia.org/wiki/Assam) had the lowest.
* **Unemployment Rates:** defined by the International Labour Organization, "unemployed workers" are those who are currently not working but are willing and able to work for pay, currently available to work, and have actively searched for work .The list is compiled from the Report on Fifth Annual Employment-Unemployment Survey [20] from Ministry of Labour and Employment, [Government of India](https://en.wikipedia.org/wiki/Government_of_India). [Tripura](https://en.wikipedia.org/wiki/Tripura) has the highest unemployment rate and ranks worst, while [Gujarat](https://en.wikipedia.org/wiki/Gujarat) has the least unemployment rate among the states of India. National average stands at 50.
* **Economic freedom:**   is the ability of members of a society to undertake economic actions, data compiled from Assessment of State Implementation of Business Reforms 2016. The Assessment is based on implementation of Department of Industrial Policy and Promotion's Business Reforms Action Plan.Andhra Pradesh and Telangana jointly topped the rankings with 98.78 percent implementation rates. National average stood at 48.93% [12].
* **Human Development Index (consumption based)**is a composite statistic of [life expectancy](https://en.wikipedia.org/wiki/Life_expectancy), [education](https://en.wikipedia.org/wiki/Education), and [per capita income](https://en.wikipedia.org/wiki/Per_capita_income) indicators. *This* data was published by the Indian Government. Note that the 2007-2008 HDI values in the table below is not based on income as is the UNDP standard practice for global comparisons, but on estimated consumption expenditure – an assumption which underestimates the HDI than actual.

**Criteria of economic development of states and their present status compare with national average**

**MAIN FINDINGS FROM THIS STUDY**

At present time in India there is no primate city at national level, absence of primate city in India due to its large size, colonial history, weakness of nationalist force, cultural diversity language barriers and regionalism are the main factors of non-existence of primate city at national level But Primacy prevail at state level.(sources : *K. siddhrtha* ), while investigate the urban system of various countries, berry [17] hypothesis that “primacy is features of under developed countries and a normal rank size distribution is one of the developed countries” findings from this study are outlines below:

* Kolkata is an classic example of primate city, Kolkata is 12 times more larger than 2nd largest city of west Bengal, Asansol.Kolkata did not originate primarily as a response to the need of the surrounding rural areas, smaller towns and cities, but it was mainly a product of the administrative and economic needs of the colonial empire of British India Kolkata as former capital of British India , a reach agricultural hinterland , location of port , and main business hub for east & north east India it’s primacy increases it’s the leading city not only in west-bengal but also in whole east and north-east India .
* After creation of states of Telangana [18] , Hyderabad becomes state capital of Talangana though Hyderabad serve as the joint capital city for Andhra Pradesh and Telangana , now Visakhapatnam is the [largest city](https://en.wikipedia.org/wiki/List_of_cities_in_Andhra_Pradesh) of Andhra, both in terms of area and population in the [Indian](https://en.wikipedia.org/wiki/India) state of [Andhra Pradesh](https://en.wikipedia.org/wiki/Andhra_Pradesh)Actually follow the rank size rule relationship as proposed by G. K. Zipf [19].
* In Kerala states according to 2011 census, Kochi(2,117,990), Kozhikode (2,030,519) , Thrissur (1,854,783) Malappuram (1,698,645), Thiruvananthapuram(1,687,406) the all those city are more or less same population neither follow rank size rule nor follow primate city concept Kerala's rural-urban continuum pattern provides an opportunity to develop small towns as means for improving economic productivity and quality of life of its citizens. Further, the strong and well developed institutional structures and system of decentralised planning in the state.
* In the states of Uttar Pradesh Kanpur (2,920,067), Lucknow (2,901,474) are the main cities of Uttar Pradesh have more or less same population according to 2011 census report , so there is no primate city upper case but in lower order cities actually follow the rank-size rule relationship.
* After compare with different criteria of economic development from table no (1 ) in most of indices State of kerala rank first apart from economic freedom [19] and well above national average but the states of kerala neither follow rank size rule nor follow primate city concept but achieved first rank among the indian states terms of almost all criteria .

**CONCLUSION**

The rank size rule conceptualizes by Zipf and the law of primate city initiated by Jefferson allow us to understand the distribution of cities and their hierarch in an urban system. The ideal rank size distribution of cities in an urban system indicates economically more developed and integrated urban system, whereas, primate city distribution indicates underdevelopment and imbalances in distribution of cities. The distribution of cities in Indian urban system visualize that metropolitan cities have grown at a higher rate than the small cities and consumed the economic growth potentiality of small cities .The rank size distribution of cities as conceptualize by Zipf [19] forces of unification and diversification have balanced each other in ideal situation, has never been achieved in Indian urban system. It indicates that the large cities are growing at a much faster rate in comparison to the small cities. It disallows the small cities to follow a log linear relationship with the large cities of Indian urban system. The rank size rule also explains the size distribution of settlements in relation to economic activities. The disequilibrium between the growth of small and large cities as explained by rank size graphs and slope values indicates dominance of large cities**.** So, after analysis data of selected states in respects of rank-size rule & primate city distribution we conclude that there is no such relationship between rank size relationship or primate city with economic development of states, Kolkata is primate city of westbengal a strong primacy prevail in westbengal but done better in terms of economic development indicators than utttar-pradesh , with no such big cities kerala Economically & politically awakened than other states but Kerala it’s neither follow rank size rule nor follow primate city concept but still the most developed states of India . So two or three medium size town if can grow and developed parallely with time that should give better prospects of economic growth and it’s reduced the dependency on a particular cities and enhanced facilities & business infrastructure in medium and small towns .

**APPENDICES**

**Table-1: Rank of cities according to various economic criteria based on recent census data**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Development  Criteria | Kerala | Rank | Andhra Pradesh | Rank | Uttar Pradesh | Rank | West-bengal | Rank | National average |
| 1GSDP per capita | ₹155005 | 7 | ₹106263 | 18 | ₹49450 | 32 | ₹87672 | 21 | **₹112,432** |
| 2Poverty ( % of population below poverty level)  Year 2013 | 7.05 | 2 | 9.20 | 6 | 29.43 | 20 | 19.98 | 17 | **21.92** |
| 3life expectancy at birth  (year 2010-2014) | 74.9 | 1 | 68.5 | 13 | 64.1 | 20 | 70.2 | 9 | **67.9** |
| 4Unemployment rates  (per 1000 person )  (year 2015-2016) | 125 | 3 | 39 | 23 | 74 | 9 | 49 | 18 | 50. |
| 5economic freedom % (2015-2016) | 26.97 | 19 | 98.78 | 1 | 84.52 | 14 | 84.23 | 15 | 48.93 |
| 6Human Development Index  consumption | 0.7117 | 1 | 0.6164 | 15 | 0.5415 | 18 | 0.6042 | 13 | 0.609 |

**Table-2: Rank-size rule calculation of Andhra Pradesh.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rank of cities | Name of the city | population 2001 | population 2011 | 1/R | EXPECTED POPULATION(PE) | actual pops - expected population |
|
| 1 | Visakhapatnam | 1345938 | 2035922 | 1 | 2254698.275 | -218776.275 |
| 2 | Vijayawada | 1039518 | 1034358 | 0.5 | 1127349.138 | -92991.13751 |
| 3 | Guntur | 514461 | 743354 | 0.333 | 750814.5256 | -7460.525583 |
| 4 | Nellore | 404775 | 499575 | 0.25 | 563674.5688 | -64099.56876 |
| 5 | Kurnool | 342973 | 424920 | 0.2 | 450939.655 | -26019.655 |
| 6 | Kadapa | 262506 | 343054 | 0.1666 | 375632.7326 | -32578.73262 |
| 7 | Rajahmundry | 413616 | 341831 | 0.1428 | 321970.9137 | 19860.08633 |
| 8 | Kakinada | 376861 | 312538 | 0.125 | 281837.2844 | 30700.71562 |
| 9 | Tirupati | 303521 | 287482 | 0.111 | 250271.5085 | 37210.49147 |
| 10 | Anantapur | 243143 | 261004 | 0.1 | 225469.8275 | 35534.1725 |
| 11 | Vizianagaram | 195801 | 228025 | 0.09 | 202922.8448 | 25102.15525 |
| 12 | Eluru | 215804 | 218018 | 0.083 | 187139.9568 | 30878.04317 |
| 13 | Ongole | 153829 | 204746 | 0.076 | 171357.0689 | 33388.9311 |
| 14 | Nandyal | 157120 | 200746 | 0.0714 | 160985.4568 | 39760.54316 |
| 15 | Machilipatnam | 179353 | 169892 | 0.0666 | 150162.9051 | 19729.09488 |
| 16 | Adoni | 162458 | 166537 | 0.0625 | 140918.6422 | 25618.35781 |
| 17 | Tenali | 153756 | 164937 | 0.0588 | 132576.2586 | 32360.74143 |
| 18 | Proddatur | 150309 | 162717 | 0.0555 | 125135.7543 | 37581.24574 |
| 19 | Chittoor | 152654 | 153766 | 0.05263 | 118664.7702 | 35101.22979 |
| 20 | Hindupur | 243143 | 151835 | 0.05 | 112734.9138 | 39100.08625 |

**Table-3: Calculation of Rank-size rule of Kerala states**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rank | Name of the city | population 2001 | Population (2011) | 1/R | Expected population of city | actual pops- expected pops |
|
| 1 | Kochi | 1355972 | 2117990 | 1 | 4193718.757 | -2075728.757 |
| 2 | Kozhikode | 1015681 | 2030519 | 0.5 | 2096859.379 | -66340.37861 |
| 3 | Thrissur | 1030122 | 1854783 | 0.333 | 1396508.346 | 458274.6538 |
| 4 | Malappuram | 170409 | 1698645 | 0.25 | 1048429.689 | 650215.3107 |
| 5 | Thiruvananthapuram | 1055024 | 1687406 | 0.2 | 838743.7514 | 848662.2486 |
| 6 | Kannur | 498207 | 1642892 | 0.1666 | 698673.545 | 944218.455 |
| 7 | Kollam | 380091 | 1110005 | 0.1428 | 598863.0385 | 511141.9615 |
| 8 | Cherthala | 141558 | 455408 | 0.125 | 524214.8447 | -68806.84465 |
| 9 | Kayamkulam | 68585 | 427091 | 0.111 | 465502.7821 | -38411.78205 |
| 10 | Kottayam | 172878 | 357533 | 0.1 | 419371.8757 | -61838.87572 |
| 11 | Palakkad | 283369 | 293566 | 0.09 | 377434.6881 | -83868.68815 |
| 12 | Alappuzha | 282675 | 241072 | 0.083 | 348078.6568 | -107006.6568 |
| 13 | Ottappalam | 49242 | 238238 | 0.076 | 318722.6255 | -80484.62555 |
| 14 | Kanhangad | 129367 | 229706 | 0.0714 | 299431.5193 | -69725.51927 |
| 15 | Kasaragod | 75968 | 192761 | 0.0666 | 279301.6692 | -86540.66923 |
| 16 | Changanassery | 51967 | 127971 | 0.0625 | 262107.4223 | -134136.4223 |
| 17 | Chalakkudy | 48380 | 114901 | 0.0588 | 246590.6629 | -131689.6629 |
| 18 | Kothamangalam | 37173 | 114574 | 0.0555 | 232751.391 | -118177.391 |
| 19 | Chittur-Thathamangalam | 67935 | 70893 | 0.05263 | 220715.4182 | -149822.4182 |
| 20 | Beypore | 66,883 | 69752 | 0.05 | 209685.9379 | -139933.9379 |

**Table-4: Calculation of rank-size rule of Uttar-pradesh**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rank  of cities | Name | Population  2001 | Population 2011 | 1/R | expected population | actual -expected  population |
| 1 | Kanpur | 2715555 | 2920067 | 1 | 6042807.588 | -3122740.588 |
| 2 | Lucknow | 2245509 | 2901474 | 0.5 | 3021403.794 | -119929.7938 |
| 3 | Ghaziabad | 968256 | 2358525 | 0.333 | 2012254.927 | 346270.0733 |
| 4 | Agra | 1331339 | 1746467 | 0.25 | 1510701.897 | 235765.1031 |
| 5 | Varanasi | 1203961 | 1435113 | 0.2 | 1208561.518 | 226551.4825 |
| 6 | Meerut | 1161716 | 1424908 | 0.1666 | 1006731.744 | 418176.2559 |
| 7 | Allahabad | 1042229 | 1216719 | 0.1428 | 862912.9235 | 353806.0765 |
| 8 | Bareilly | 748353 | 979933 | 0.125 | 755350.9484 | 224582.0516 |
| 9 | Aligarh | 669087 | 909559 | 0.111 | 670751.6422 | 238807.3578 |
| 10 | Moradabad | 641583 | 889810 | 0.1 | 604280.7588 | 285529.2412 |
| 11 | Saharanpur | 455754 | 703345 | 0.09 | 543852.6829 | 159492.3171 |
| 12 | Gorakhpur | 622701 | 692519 | 0.083 | 501553.0298 | 190965.9702 |
| 13 | Faizabad | 208162 | 642381 | 0.076 | 459253.3767 | 183127.6233 |
| 14 | Jhansi | 460278 | 549391 | 0.0714 | 431456.4618 | 117934.5382 |
| 15 | Muzaffarnagar | 331668 | 494792 | 0.0666 | 402450.9853 | 92341.01467 |
| 16 | Mathura | 323315 | 454937 | 0.0625 | 377675.4742 | 77261.52578 |
| 17 | Budaun | 148029 | 369221 | 0.0588 | 355317.0861 | 13903.91385 |
| 18 | Rampur | 281494 | 359062 | 0.0555 | 335375.8211 | 23686.17889 |
| 19 | Shahjahanpur | 321885 | 356103 | 0.05263 | 318032.9633 | 38070.03667 |
| 20 | Farrukhabad-cum-Fategarh | 242997 | 318540 | 0.05 | 302140.3794 | 16399.62062 |

**Table-5: Calculation of Rank-size rule of west\_bengal**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rank  Of cities | Name | population 2001 | Population 2011 | 1/R | Expected  population of city | actual population  - expected  population |
|
| 1 | Kolkata | 13205697 | 14112536 | 1 | 5736443.726 | 8376092.274 |
| 2 | Asansol | 1067369 | 1243008 | 0.5 | 2868221.863 | -1625213.863 |
| 3 | Siliguri | 472374 | 701489 | 0.333 | 1910235.761 | -1208746.761 |
| 4 | Durgapur | 493405 | 581409 | 0.25 | 1434110.932 | -852701.9315 |
| 5 | Bardhaman | 285602 | 347016 | 0.2 | 1147288.745 | -800272.7452 |
| 6 | Malda | 224415 | 324237 | 0.1666 | 955691.5248 | -631454.5248 |
| 7 | Baharampur | 170322 | 305609 | 0.1428 | 819164.1641 | -513555.1641 |
| 8 | Habra | 239209 | 304584 | 0.125 | 717055.4658 | -412471.4658 |
| 9 | Jalpaiguri | 100348 | 303874 | 0.111 | 636745.2536 | -332871.2536 |
| 10 | Kharagpur | 272865 | 293719 | 0.1 | 573644.3726 | -279925.3726 |
| 11 | Shantipur | 138235 | 288718 | 0.09 | 516279.9354 | -227561.9354 |
| 12 | Dankuni | 51943 | 249840 | 0.083 | 476124.8293 | -226284.8293 |
| 13 | Dhulian | 72850 | 239022 | 0.076 | 435969.7232 | -196947.7232 |
| 14 | Ranaghat | 145285 | 235583 | 0.0714 | 409582.082 | -173999.082 |
| 15 | Haldia | 170673 | 200762 | 0.0666 | 382047.1522 | -181285.1522 |
| 16 | Raiganj | 175047 | 199758 | 0.0625 | 358527.7329 | -158769.7329 |
| 17 | Krishnanagar | 148709 | 181182 | 0.0588 | 337302.8911 | -156120.8911 |
| 18 | Nabadwip | 125341 | 175474 | 0.0555 | 318372.6268 | -142898.6268 |
| 19 | Medinipur | 149769 | 169127 | 0.05263 | 301909.0333 | -132782.0333 |
| 20 | Balurghat | 143321 | 164593 | 0.05 | 286822.1863 | -122229.1863 |

**Table-6: Calculation of degree of primacy of Andhra-predesh**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rank of cities** | **Name of city** | **population (2011)** | **Ration with**  **primate city** | **Ratio with next order city** | **% of city population to total population of top 20 town** |
| 1 | Visakhapatnam | 2035922 | 1 | 1.96829531 | 25.11853727 |
| 2 | Vijayawada | 1034358 | 1.96829531 | 1.391474318 | 12.76156944 |
| 3 | Guntur | 743354 | 2.738832373 | 1.487972777 | 9.171257617 |
| 4 | Nellore | 499575 | 4.075308012 | 1.175691895 | 6.163592345 |
| 5 | Kurnool | 424920 | 4.791306599 | 1.238638815 | 5.242523463 |
| 6 | Kadapa | 343054 | 5.934698327 | 1.003577791 | 4.232487631 |
| 7 | Rajahmundry | 341831 | 5.95593144 | 1.093726203 | 4.217398659 |
| 8 | Kakinada | 312538 | 6.514158278 | 1.087156761 | 3.855991241 |
| 9 | Tirupati | 287482 | 7.081911215 | 1.101446721 | 3.546858539 |
| 10 | Anantapur | 261004 | 7.800347887 | 1.144628878 | 3.220181667 |
| 11 | Vizianagaram | 228025 | 8.928503454 | 1.04589988 | 2.813297592 |
| 12 | Eluru | 218018 | 9.338320689 | 1.064821779 | 2.689834511 |
| 13 | Ongole | 204746 | 9.943647251 | 1.019925677 | 2.526088932 |
| 14 | Nandyal | 200746 | 10.14178116 | 1.181609493 | 2.476738245 |
| 15 | Machilipatnam | 169892 | 11.98362489 | 1.020145673 | 2.096071722 |
| 16 | Adoni | 166537 | 12.22504308 | 1.009700674 | 2.054678834 |
| 17 | Tenali | 164937 | 12.34363424 | 1.013643319 | 2.034938559 |
| 18 | Proddatur | 162717 | 12.51204238 | 1.058211828 | 2.007548928 |
| 19 | Chittoor | 153766 | 13.24039124 | 1.012717753 | 1.897114428 |
| 20 | Hindupur | 151835 | 13.40877927 | 1.164172923 | 1.873290384 |

**Table-7: calculation of degree of primacy of Kerala states.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Rank of the cities | Name of the city | Population (2011) | Ration with Primate city | Ratio with next Oder city | % of city to total population of 20 cities |
| 1 | Kochi | 2117990 | 1 | 1.043078149 | 14.04902696 |
| 2 | Kozhikode | 2030519 | 1.043078149 | 1.094747472 | 13.46881532 |
| 3 | Thrissur | 1854783 | 1.141907166 | 1.091919147 | 12.30312531 |
| 4 | Malappuram | 1698645 | 1.2468703 | 1.006660519 | 11.26743252 |
| 5 | Thiruvananthapuram | 1687406 | 1.255175103 | 1.027094903 | 11.19288211 |
| 6 | Kannur | 1642892 | 1.289183951 | 1.480076216 | 10.89761236 |
| 7 | Kollam | 1110005 | 1.908090504 | 2.437385817 | 7.362872425 |
| 8 | Cherthala | 455408 | 4.650752732 | 1.066302029 | 3.020807118 |
| 9 | Kayamkulam | 427091 | 4.959107076 | 1.194549874 | 2.832975119 |
| 10 | Kottayam | 357533 | 5.923900731 | 1.217896487 | 2.371583792 |
| 11 | Palakkad | 293566 | 7.214697887 | 1.217752373 | 1.947278622 |
| 12 | Alappuzha | 241072 | 8.785715471 | 1.011895667 | 1.599076023 |
| 13 | Ottappalam | 238238 | 8.89022742 | 1.037143131 | 1.580277567 |
| 14 | Kanhangad | 229706 | 9.220438299 | 1.191662214 | 1.523683203 |
| 15 | Kasaragod | 192761 | 10.98764792 | 1.506286581 | 1.278620053 |
| 16 | Changanassery | 127971 | 16.55054661 | 1.113750098 | 0.848855768 |
| 17 | Chalakkudy | 114901 | 18.43317291 | 1.002854051 | 0.762159994 |
| 18 | Kothamangalam | 114574 | 18.48578211 | 1.616153922 | 0.759990942 |
| 19 | Chittur-Thathamangalam | 70893 | 29.87586927 | 1.016357954 | 0.470246634 |
| 20 | Beypore | 69752 | 30.36457736 |  | 0.462678166 |

**Table-8: calculation for Degree of primacy of uttar-pradesh**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Rank of cities | Name of city | Population (2011) | ration with  primate city | ration with next  oder city | percentage of  population to  total population  of top 20 town |
| 1 | Kanpur | 2920067 | 1 | 1.006408122 | 13.44236529 |
| 2 | Lucknow | 2901474 | 1.006408122 | 1.230207015 | 13.35677346 |
| 3 | Ghaziabad | 2358525 | 1.238090332 | 1.350454947 | 10.85733807 |
| 4 | Agra | 1746467 | 1.671985214 | 1.216954344 | 8.039763261 |
| 5 | Varanasi | 1435113 | 2.034729669 | 1.007161866 | 6.606462517 |
| 6 | Meerut | 1424908 | 2.04930213 | 1.171106887 | 6.55948437 |
| 7 | Allahabad | 1216719 | 2.399951838 | 1.241634887 | 5.60109794 |
| 8 | Bareilly | 979933 | 2.979863929 | 1.077371561 | 4.511066818 |
| 9 | Aligarh | 909559 | 3.210420654 | 1.022194626 | 4.187104041 |
| 10 | Moradabad | 889810 | 3.28167474 | 1.265111716 | 4.096190622 |
| 11 | Saharanpur | 703345 | 4.151685162 | 1.015632784 | 3.237809412 |
| 12 | Gorakhpur | 692519 | 4.216587559 | 1.078050254 | 3.187972526 |
| 13 | Faizabad | 642381 | 4.545693288 | 1.169260144 | 2.957165044 |
| 14 | Jhansi | 549391 | 5.31509799 | 1.110347378 | 2.529090775 |
| 15 | Muzaffarnagar | 494792 | 5.901605119 | 1.087605537 | 2.277747329 |
| 16 | Mathura | 454937 | 6.418618402 | 1.232153642 | 2.094277063 |
| 17 | Budaun | 369221 | 7.908724043 | 1.028293164 | 1.699688246 |
| 18 | Rampur | 359062 | 8.132486869 | 1.008309394 | 1.652921857 |
| 19 | Shahjahanpur | 356103 | 8.200062903 | 1.117922396 | 1.639300265 |
| 20 | Farrukhabad-cum-Fategarh | 318540 | 9.167033967 |  | 1.466381094 |

**Table-9: calculation of degree of primacy of west-bengal**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rank of cities** | **Name** | **Population**  **(2011)** | **Ration with Primate city** | **Ratio with next oder city** | **% of city to total population of 20 cities** |
| 1 | Kolkata | 14112536 | 1 | 11.35353594 | 68.43589761 |
| 2 | Asansol | 1243008 | 11.35353594 | 1.77195651 | 6.02771665 |
| 3 | Siliguri | 701489 | 20.11797191 | 1.206532751 | 3.401729454 |
| 4 | Durgapur | 581409 | 24.27299199 | 1.675453005 | 2.819425707 |
| 5 | Bardhaman | 347016 | 40.66825737 | 1.070254166 | 1.682784118 |
| 6 | Malda | 324237 | 43.52537187 | 1.060953702 | 1.572321951 |
| 7 | Baharampur | 305609 | 46.17840443 | 1.003365246 | 1.481989221 |
| 8 | Habra | 304584 | 46.33380611 | 1.002336495 | 1.47701869 |
| 9 | Jalpaiguri | 303874 | 46.4420648 | 1.034573861 | 1.473575688 |
| 10 | Kharagpur | 293719 | 48.04774632 | 1.0173214 | 1.424331064 |
| 11 | Shantipur | 288718 | 48.88000055 | 1.155611591 | 1.400079722 |
| 12 | Dankuni | 249840 | 56.48629523 | 1.045259432 | 1.211548701 |
| 13 | Dhulian | 239022 | 59.04283288 | 1.014597828 | 1.159088991 |
| 14 | Ranaghat | 235583 | 59.90472997 | 1.173444178 | 1.142412254 |
| 15 | Haldia | 200762 | 70.2948566 | 1.005026082 | 0.973554836 |
| 16 | Raiganj | 199758 | 70.64816428 | 1.102526741 | 0.968686141 |
| 17 | Krishnanagar | 181182 | 77.89149032 | 1.032529036 | 0.878605575 |
| 18 | Nabadwip | 175474 | 80.42522539 | 1.037528011 | 0.85092578 |
| 19 | Medinipur | 169127 | 83.44342417 | 1.027546736 | 0.820147283 |
| 20 | Balurghat | 164593 | 85.74201819 |  | 0.798160564 |

**REFERENCES**

1. Jefferson M. Why geography? the law of the primate city. Geographical review. 1989 Apr 1;79(2):226-32.
2. Vapnarsky CA. On rank-size distributions of cities: an ecological approach. Economic Development and Cultural Change. 1969 Jul 1;17(4):584-95.
3. Linksy, Arnold S. Some Generalisations Concerning Primate Cities. Annals of the Association of American Geographers. Vol. 55(3). 1965. pp: 506-513.
4. Gibbs JP, Browning HL. The division of labor, technology, and the organization of production in twelve countries. American Sociological Review. 1966 Feb 1:81-92.
5. Auerback, F. Das Gesetz Der Bevolkerungskonzentation, Petermnn‟s Geographischa Mittilungen, (1913)Vol. 59, No. 1, pp. 74-6 as quoted in Robson 1973.
6. Trigger BG. Monumental architecture: a thermodynamic explanation of symbolic behaviour. World Archaeology. 1990 Oct 1;22(2):119-32.
7. Dartmann G, Demir MÖ, Laux H, Lücken V, Bajcinca N, Kurt GK, Ascheid G, Ziefle M. Tutorial on Information Theoretic Metrics Quantifying Privacy in Cyber-Physical Systems. Security and Privacy in Cyber-Physical Systems: Foundations, Principles and Applications. 2017 Nov 13.
8. Das RJ, Dutt AK. Rank-size distribution and primate city characteristics in India—A temporal analysis. GeoJournal. 1993 Feb 1;29(2):125-37.
9. Stewart CT. The size and spacing of cities. Geographical Review. 1958 Apr 1;48(2):222-45.
10. Ramachandran R. Urbanization and urban systems in India. OUP Catalogue. 1992.
11. Malecki EJ. Dimensions of R&D location in the United States. Research Policy. 1980 Jan 1;9(1):2-2.
12. Berry BJ. City size distributions and economic development. Economic development and cultural change. 1961 Jul 1;9(4, Part 1):573-88.
13. Berry BJ. City size and economic development: conceptual synthesis and policy problems with special reference to South and Southeast Asia.
14. Ahmad QS. Indian cities: characteristics and correlates. Dept. of Geography, University of Chicago; 1965.
15. Davies JB. Behavior of the Ontario-Quebec urban system by size distribution. Urban Systems Development in Central Canada. 1972:35-49.
16. Ettlinger N. Dependency and urban growth: a critical review and reformulation of the concepts of primacy and rank-size. Environment and planning A. 1981 Nov;13(11):1389-400.
17. Berry BJ, Garrison WL. Alternate explanations of urban rank-size relationships 1. Annals of the Association of American Geographers. 1958 Mar 1;48(1):83-90.
18. Rao CH. The New Telangana State. Economic and Political Weekly. 2014 Feb 21;49(9):10-3.
19. Florence PS. Human Behaviour and the Principle of Least Effort.
20. Mittra S. Blue Economy: Beyond an Economic Proposition.2015-16.

**DATA USED FOR ECONOMIC DEVELOPMENT INDICATORS:**

[1]Economic Statistical Organisation Punjab. Central Statistical Organisation, New Delhi.

Archived from [the original](http://www.esopb.gov.in/static/PDF/GSDP/Statewise-Data/state%20wise%20data.pdf) (PDF) on 10 March 2017. Retrieved 17 February 2017.

[2]  [Number and Percentage of Population Below Poverty Line"](http://www.rbi.org.in/scripts/PublicationsView.aspx?id=15283). Reserve Bank of India, Government of India. 2013. Retrieved April 20, 2014.

[3]  ["Report on Fifth Annual Employment-Unemployment Survey (2015-16)"](http://labourbureaunew.gov.in/UserContent/EUS_5th_1.pdf) (PDF). [Ministry of Labour and Employment](https://en.wikipedia.org/wiki/Ministry_of_Labour_and_Employment_(India)). p. 120. Retrieved 24 November 2016.

[4] ["Assessment of State Implementation of Business Reforms"](http://eodb.dipp.gov.in/Press%20Release.pdf) (PDF). Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, Government of India. Retrieved 20 January 2017.

[5] ["Inequality-Adjusted Human Development Index for India's States 2011"](http://www.in.undp.org/content/dam/india/docs/inequality_adjusted_human_development_index_for_indias_state1.pdf) (PDF). United Nations Development Programme. 2011. Retrieved February 13, 2013.

[6]Ponnapalli et al. (2013), Aging and the Demographic Transition in India and Its States: A Comparative Perspective, International Journal of Asian Social Science, 3(1), pp 171-193.

[7] ["Urban Agglomerations/Cities having population 1 lakh and above"](http://www.censusindia.gov.in/2011-prov-results/paper2/data_files/India2/Table_3_PR_UA_Citiees_1Lakh_and_Above.pdf) (PDF). Provisional Population Totals, Census of India 2011. Retrieved 2011-10-10.