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Concept of Rank-Size Rule

Introduction

The theory of Rank-size rule which is related to the analysis of urban system, was propounded by Zipf explains that there is specific relationship between the population size of settlements, their ranks and the relative abundance of settlements. The rule states that the population of any given town should be inversely proportional to its rank in the country's hierarchy of cities. Rank size rule is applied to the regions, the country or the cities of the world as a whole. The settlements having smallest size of population should always be most abundant in number. The higher rank settlements will be larger in population size and relatively less in number. The highest rank settlement will have largest population size and in any region or in any country there will be only one settlement of highest rank. The rank-size rule explains that cities of different population size are related to each other forming an orderly pattern of urban system. This is the basic postulation of rank-size rule. It is a method to explain urban system on the basis of population size of cities and ranks of cities.

Background of Urban System Analysis

Before the postulation of rank-size rule by Zipf, several scholars have tried to analyse the pattern of urban settlement, specially postulating models to find out any orderly or systematic pattern of urban settlements in context of their size, location, distribution and functional significance.

The most important theory was Christaller's central place theory (1933) which was later modified by Losch. In 1957, A.K. Philbrick postulated his model of nested hierarchy of central places.

Though Losch's approach presented a modification of a clear-cut unequivocal hierarchy of Christaller, however, later two other ways of ordering towns in a system have been propounded. These are (a) Rank-size distribution and (b) Primate city distribution.

The basis of rank-size rule was originally put forward by German Scholar Felix Auerbach in 1913. He first tried to record the existence of regular relationship between the size of cities and their ranks. In 1936, H.W. Singer attempted to apply Pareto's Law to city size and found that the law holds good to the classification of urban settlements on the basis of size.

The theory of rank-size rule aims to explain the relationship between the population size of the town and its rank within any specific region. It is explained that the second and the subsequently smaller cities should represent a proportion of the largest city.

Zipf's Rank-size Rule

Zipf's general theory known as rank-size rule was presented to explain the regularity regarding the population of a town and its rank in relation to the largest town which is assigned number 1 in the hierarchy. He formulated an equation after the thorough study of 100 largest cities of United States and their population of the year 1940. His formula is

$$P_r = P_1/r$$

Where

P_r = Population of a town of the rank in question

P_1 = Population of the largest city

r = rank of town in question.

Zipf's rule states that if all towns in a region are arranged in descending order according to size of population then the population size

of r town will be 1/r the size of the largest town. Thus, the second largest town will have ½ of the population of largest town, third largest town will have 1/3rd, 4th largest town 1/4th of the population of the largest town. When plotted on a double logarithmic graph paper this creates a straight but downward sloping lines having a gradient of 45 degrees. This theoretical rank-size distribution consists of a few large metropolitan areas, a large number of medium-sized cities and a very large number of smaller cities. Zipf believed that a rank-size distribution is the result of a balanced system for cities. This rule does not always fit well with the very large metropolitan area e.g. Paris, London, New York, Moscow, Shanghai, etc. Zipf found that in United States the largest city i.e. New York has more than twice the population of second largest city i.e. Los Angeles. However, the metropolitan areas of these two cities i.e. New York and Los Angeles are very close in population. Metropolitan areas of New York city is 1.3 times greater than that of Los Angeles.

The population of required rank town is known as P_n and to know the population of town of any particular rank the formula is

$P_n = P_1 \ (n)^{-1}$

P_n = Rank of the town

P_1 = Population of the first rank town

n^{-1} = the rank of the town

Explanation – If the population of the largest town is 1000,000 then the population of second rank town will be

$P_2 = \frac{1000,000}{2} = 500,000$

Similarly, $P_5 = \frac{1000,000}{5} = 200,000$ $P_{10} = \frac{1000,000}{10} = 10,000$

According to this rule it is expected that the second rank town will have ½ the population of the largest town, similarly 3rd, 4th, 5th, 10th rank town will have 1/3rd, 1/4th, 1/5th and 1/10th respectively the population of largest town. Thus, the cities will form a harmonic progression within

urban hierarchy. Zipf presented same views in volume published in 1941 entitled "National Unity and Disunity". In this he stated that in loose terms the rank size rule stated that if the population of a town is multiplied by its rank, then it will equal the population of the largest and highest ranked city.

Zipf acknowledged that his rank size rule is applicable in a system which is 'mature' in the sense that the forces of unification and the forces of diversification were in equilibrium. The forces of unification favors the growth of large towns but in small number. The forces of diversification leads to the growth of small towns in large number where a large number communities benefited from being located near to raw material sources and minimized transportation cost. If there is equilibrium between these two forces then a perfect system of hierarchy of towns on the basis of population size will emerge.

Views of other scholars

Views of some scholars related to the explanation of rank-size rule are:

N. Rashevsky (1947) presented a generalized theory regarding spatial distribution of settlement and level of economic opportunities which is known as 'Mathematical Theory of Human Relations'.

Herber A. Simn (1955) attempted a theoretical scheme to explain rank size rule regularities. Based on frequency distribution he found a general system of size of cities.

Walter Isard (1956) presented an analysis of rank-size relations of cities in U.S.A. He found that in U.S.A, New York is the largest city which he called as primate city of U.S.A.

Charles T. Stewart (1958) has found that the rank-size rule fits well with the distribution of cities in the larger heterogenous areas. There is close relationship between size of towns and their level of economic development.

Criticism

Berry and Garrison have pointed out that the proposed explanation put forward in rank-size rule is obscure and seemingly devoid of logical information.

- Berry has shown that the smooth rank-size distribution of cities do not necessarily have a high level of economic maturity.
- Stewart has indicated that the data on city size for certain countries are fitted more closely by a S-shaped curve on a logarithmic graph paper than by a straight line.

Boal and Johnson (1965) suggested that the rank-size pattern might be used as a norm or optimum towards which planning programmes could be directed.

Rollman (1968) who has made an analysis of city size of cities of Argentina. His findings do not confirm to the rank-size rule of Zipf.

Conclusion

It has been found that rank-size rule is not applicable in most of the developing countries which have long past history of colonial rule. In such countries the rule of rule of primate city is more applicable. On the other, in developed and modernized and which did not have history of colonial rule where there is dominance of non-agricultural economy, there are chances that rank-size rule is found true regarding city sizes.

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