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# A NOTE ON MEASURING THE CENTRALITY OF SMALL AND MEDIUM SIZE CENTRAL PLACES

JAYAMALA DIDDEE and K. R. DIKSHIT, Pune

ABSTRACT : A suitable method for determining the centrality of small and medium size central places has been outlined after a discussion of some of the previous well known methods. Though based on previous thinking, a comparison with two other methods helps to illustrate the advantage of the new approach.

## Introduction

Centrality by definition is a measure of the total importance of a central place, as a source of goods and services for its surrounding area. Several geographers, using a wide variety of criteria, ranging from single indicator functions to multiple ones have tried to express this central importance of a place (Davies 1966). Though the geographical interpretation of the concept is concerned mainly with the ranking and organisation of central places, it has been observed that no single method finds world-wide application for all categories of central places. Thus, the nature of central places, the region to which they belong, the availability of data, and the purpose of investigation, all would be important considerations in the method to be adopted. Bearing this in mind, it is the purpose of the present study to develop a suitable measure of centrality for the small and medium size central places.

## Area of application

The region to which the centrality measure was applied was Poona District, an area of 15,640 sq. km. and 2,178,029 inhabitants in 1971. The total number of central places whose centrality was calculated is 120 of which Poona is a million city. It has been excluded from the analysis on account of its size. The rest of the central places are largely small and medium size rural service centres with population between 2–5 thousand. With the exception of the 9 towns in the Poona metropolitan area, the remaining 13 towns are all Tehsil headquarters with average populations of 10–15 thousand. It must be noted here that the selection of central places has been made largely on the basis of their service functions. For a great majority, (90%) trade and commerce did not figure prominently in their occupational structure. Instead, most of them qualified for central place status merely on account of the social services they provided for their surrounding areas. Their areal linkages appear significant, solely for the provision of social amenities like schooling, primary health, veterinary aid, post and telegraph, bus-stop and weekly marketing. Permanent shopping facilities at most of the smaller central places are either poor or virtually non-existent.

## Methods for determining centrality

It is not intended to review in detail, all the methods of determining centrality. A casual reference to some of the commonly used methods is made here, and only those that have been used for the purpose of

comparison with the method adopted will be discussed in order to emphasize the limitations as well as the usefulness of the different techniques, when applied to the same area.

Most studies use indicators such as total population, number of functions or functional units, certain selected functions and services, and population thresholds of functions to measure centrality. Christaller (1966) uses the density of telephones in the area to determine centrality, whereas Smailes (1944) and Dickinson (1947) consider key functional institutions and central services like banks, shops, offices, schools, hospitals and cinemas as indicators. Brush (1953) similarly believes that the importance of trade centres was determined by the functions they perform, by a combination or association of distinctive sets of functions (trait complex). Bracey (1933) determines centrality by actually measuring the area dependent on the centre for various goods and services, by ascertaining consumer preferences for certain functions. Green (1948) measures the centrality of a place by a bus service index. Recently, Berry and Garrison (1958) used the population threshold for each function to determine the importance of a centre. In the absence of functional data, Godlund (1956) derives an index of centralization by using the relationship between the total population at a centre and the number of persons employed in retail trade and commerce. A common shortcoming of many of these methods lies in awarding equal weightage to all the services and functions at a centre, irrespective of their importance. Abiodun (1967) to overcome this difficulty, used multivariate analysis for classifying settlements in Nigeria. As a substitute to such elaborate and complex methods, Davies (1967) formulated a Locational Index wherein he assigns a score for every function in the region.

**Method used for determining centrality in the area**

**Surplus function method**

The basic principle underlying most methods of determining centrality is the assessment of the role of a central place in supplying goods and services to the population besides its own. This can be quite a time consuming and laborious process if one has to actually examine the services rendered and goods supplied by the central place to the countryside. More often, this is actually a measure of the surplus of functions at a central place, i. e. the excess of functions, over and above its own requirement for its population. The surplus of functions thus determined can conveniently be converted into centrality scores and used for determining the centrality of a place. In this method of determining centrality, where it is necessary to isolate for each central service or function, the surplus functional component at a centre, one requires data for the population and functions of the central places, and the population of the area forming the universe.

In all this, there are two underlying assumptions which must be mentioned.

1. While determining the functional requirement of central places, one assumes their level of consumption to be similar to that of the rest of the population in the area, an assumption for which there is no empirical basis.
2. Secondly, one assumes that the surplus of functions at a central place, over and obove those required for its own population, are necessarily utilized by the countryside to justify their conversion into centrality scores.

Both these assumptions though largely valid are not wholly true, and to that extent, the determined centrality values will be an approximation of the real values.

**Table I**

**The sixteen functions used to determine centrality**

| | |
|---|---|
| 1. Kirana Grocer's | 2. Cloth stores |
| 3. Utensils and pots | 4. Chemist |
| 5. Hardware | 6. Electrical goods |
| 7. Banks | 8. Cinema |
| 9. High School | 10. College |
| 11. Doctor | 12. Telephone connections |
| 13. Telegraph office | 14. Market-Yards |
| 15. Police station | 16. Administrative status |

The centrality of a place can be expressed as :

$$Ca = Ca_x + Ca_y + Ca_z + \ldots\ldots + Ca_n \qquad (i)$$

where

$Ca$ is the centrality of a place A

$Ca_x$ is the centrality of a place A in terms of function 'x'

$$Ca_x = (x_a - x_e)\, Kfm_x \qquad (ii)$$

where

$x_a$ is the actual number of functional units of function x at a centre and

$x_e$ is the expected number of functional units of function x

$$X_e = X.\frac{P}{Pr}$$ where p is the population of a place A, Pr is the population of the region and X is the total functional units of function x in the region

$$Kfm_x = \frac{P}{X}$$ is the constant of functional maintenance (iii)

To illustrate this method, any five central places out of a total of 120 in Poona district are taken and their centrality values for a single function x ( banks ) are worked out.

In the region, P = 2,042,995 (The region here includes the population of Poona
X = 124 ( Banks ) district excluding that of Poona City ).

The constant of functional maintenance for banks

$$Kmf_x = \frac{2,042,995}{124} = 16,475.75$$

Thus, the centrality scores of all the central places for a single function x, here banks, can be tabulated as in Table II.

To make the centrality scores more manageable, they could be reduced by dividing them uniformly by some figure. Since the centrality values here are fairly large, they are divided by 10,000. The above procedure can be repeated for the other functions to obtain their respective centrality scores. The summation of the centrality scores for individual fuctions at each place represents its centrality. In this manner the centrality scores for each one of the 120 central places has been determined. For illustration, the above 5 places are chosen from the area.

Two other methods of determining centrality were examined for the purpose of comparison, as well as to establish whether in the absence of functional data which is always difficult to acquire, a simple substitute measure would also lead to a realistic picture of the true importance of a central place.

**Table II Centrality scores of 5 central places for a single function x, (banks)**

| Central places | Population of the central place | Actual No. of functional units of banks | Expected No. of functional units of banks | Surplus of function | Centrality score of function x ( bank ) |
|---|---|---|---|---|---|
| | P | $x_a$ | $x_e = x.\frac{p}{p}$ | $x_a - x_e$ | $Ca_x (x_a - x_e)\ kfm_x$ |
| Junnar | 14,952 | 4 | 0.91 | 3.09 | 50,910.00 |
| Narayangaon | 10,183 | 2 | 0.62 | 1.38 | 22,736.53 |
| Otur | 11,507 | 2 | 0.70 | 1.30 | 21,418.48 |
| Belhe | 8,901 | 2 | 0.54 | 1.45 | 23,889.84 |
| Ale | 7,764 | 1 | 0.14 | 0.85 | 14,169.15 |

**Table III Centrality scores of different functions for the above 5 central places**

| Central places | Centrality scores of different functions | | | | Total centrality scores |
|---|---|---|---|---|---|
| | x | y | z | .....n (16) | |
| Junnar | 5.10 | 3.47 | 16.98 | ..... | 152.41 |
| Narayangaon | 2.27 | 1.37 | – | ..... | 89.57 |
| Otur | 2.14 | 1.35 | 17.32 | ..... | 40.66 |
| Belhe | 2.39 | 0.49 | – | ..... | 11.92 |
| Ale | 1.42 | 0.37 | – | ..... | 13.26 |

**Locational Index as a masure of centrality**

This method has been used by Davies (1967) for South Wales. He assigns a score for every function on the basis of its frequency of distribution in the area in the following manner:

$$C = \frac{t}{T} \times 100$$

where

C = The score of function 't'

t = One unit of function 't'

T = Total number of units of function 't' in the area.

While determining the functional index of a centre, the relevant score for each function is to be multiplied by the number of functional units of that particular function.

In this way, the values of all the functional units, for all the functions existing at a centre may be obtained, by multiplying with their respective scores ( C-values ). Addition of all the values for each function gives the Relative Centrality Index. The same sixteen functions which were used for the Surplus Function Method were employed once again to determine the centrality scores. Since no attempt was made to substract the local consumption at a centre, the measure in essence expresses only the total functional availability and hence its aggregate importance.

Though a fair amount of correspondence was observed between the scores obtained by two methods, certain significant differences were, nonetheless evident. In the case of the Locational Index Method, the functional magnitude at a centre was directly used to derive centrality. No attempt was made to substract the local consumption at a place, this in many instances, led to an over estimation of centrality in the case of the industrial central places and an underestimation of administrative centres. Larger places on the other hand recorded proportionately lower scores than the one based on the surplus of functions. The surplus functional element in the larger central places is generally more in proportion to their own requirement. This is actually observed in the larger trade areas for similar goods for higher order central places. By not equating the functional magnitude with the population at a centre, a part of this surplus or excess of importance, which would otherwise belong to the larger centre, gets evenly distributed over the entire area. This has the net effect of reducing the centrality of the larger places, vis-a-vis, the smaller centres. This is further confirmed by the fact that centres of industry and other specialized functions, in the vicinity of Poona and elsewhere have all displayed higher centrality scores. The reverse is the case with the scores obtained by the Surplus Function Method. Lower scores obtained by the Surplus Function Method for such centres appear more realistic, as this limitation of their extra-local importance in relation to their size has actually been observed.

**Employment in Trade and Commerce as a measure of Centrality**

In the absence of functional data, which is always difficult to acquire, it is worth investigating if the census figures for employment in trade and commerce and other services ( District Census Hand-Book, Poona 1971 ) could not instead be used to measure centrality, giving essentially the same results. The method used here, is analogus to the one used by Godlund ( 1956 ). To calculate the Regional Mean Index of Centrality, he uses the relationship between the number of persons employed in retail trade and commerce, to the total population, with the help of the following equation :

$$C = \frac{TC}{P} \cdot 100$$

where

C = Regional Mean Index of centrality
TC = Persons employed in retail trade, commerce and other services
P = Total population of the Area

In a similar fashion, the centrality index for every central place can be determined. All the central places whose index exceeds the Regional Mean Index are supposed to have a service area for trade and commerce and other services. Higher indices being naturally associated with the more important central places.

On using employment in trade and other services for the same area, it was found that the centrality values for nearly seventy percent of the central places were well below the Regional Mean Index. In keeping with our basic assumption that only those central places whose centrality index exceeds the Regional Mean Index, have a service area, implies that the index is able to measure the central importance of only thirty percent

of the centres in the area, the rest have no service area at all. Apart from lack of applicability to the entire area, and an overestimation of centres of specialized functions, the small range in the value of the index between the largest and the smallest central place, fails to convey the wide disparity that actually exists between them, in terms of their centrality. The values obtained are not compatible, particularly when one is dealing with both, urban and rural central places, simultaneously. Incongruous results are obtained in several instances, for the index values in themselves are of little use as indicators of the relative centrality of a place in the area. For example, irrespective of size and importance, some of the smaller Tehsil-headquarters and market centres have a higher mean index of centrality than even the larger towns. This renders the task of classifying central places of similar importance even more difficult. The distribution of centrality scores based on the above three methods is given in Table IV.

**Conclusion**

The use of trade and commerce and other services for determining the index of centrality does not lend itself to the smaller service centres in the area. Nor is it uniformally applicable to both urban and rural central places. The scale factor must thus appear critical in limiting its application to essentially the larger urban centres. The Locational Index and the Surplus Function Method, both share one advantage in that they can be satisfactorily applied to all the eentral places in the area. Though the same functions were used in both the methods, a slight refinement in technique, in the case of the Surplus Function Method, led to more accurate assesment of centrality. The index was sensitive enough to express the greater importance of the administrative and commercial central places in the area, while at the same time relegating the industrial and other specialized centres to the lower rungs of the centrality scale. Also, the lower scores of industrial and other specialized centres are wholly commensurate with their restricted extra-local importance and large local populations. Therefore, in the case of the locational index, much higher scores were displayed by such centres. This exaggeration of centrality scores was caused due to the direct use of functional magnitude for expressing centrality. By not isolating the extra-local importance from the total importance, the Locational Index tends to smoothen over the finer differences of centrality values which figure more prominently in the case of the Surplus Function Method.

**Table IV**

**Centrality Scores based on the 3 methods**

Method I : Surplus Function Method
Method II : Locational Index
Method III : Employment based on trade and commerce and other services

| | I | II | III |
|---|---|---|---|
| 1. Lonavala | 625.25 | 85.64 | 13.03 |
| 2. Baramati | 475.00 | 88.16 | 14.63 |
| 3. Dehu Road | 286.00 | 43.29 | 20.29 |
| 4. Sirur | 160.03 | 58.74 | 13.64 |
| 5. Junnar | 152.41 | 69.89 | 12.13 |
| 6. Talegaon ( Dhab. ) | 144.86 | 47.45 | 9.78 |
| 7. Dhond | 100.42 | 76.00 | 10.65 |

| | I | II | III |
|---|---|---|---|
| 8. Bhor | 100.00 | 61.96 | 10.26 |
| 9. Narayangaon | 89.54 | 32.87 | 8.53 |
| 10. Indapur | 89.40 | 40.73 | 12.20 |
| 11. Manchar | 78.94 | 56.55 | 6.22 |
| 12. Nira | 76.60 | 28.86 | 11.65 |
| 13. Ghodegaon | 67.38 | 28.57 | 6.26 |
| 14. Chakan | 64.56 | 31.65 | 5.90 |
| 15. Bhigwan | 54.53 | 19.86 | 6.90 |
| 16. Uruli Kanchan | 49.30 | 26.00 | 9.11 |
| 17. Kamshet | 47.44 | 8.94 | 10.28 |
| 18. Paud | 47.42 | 10.92 | 10.46 |
| 19. Vadgaon | 47.30 | 15.93 | 10.56 |
| 20. Talegaon (Dham.) | 44.43 | 32.27 | 4.18 |
| 21. Velhe | 42.82 | 5.88 | 14.07 |
| 22. Otur | 40.66 | 23.13 | 3.90 |
| 23. Jejuri | 33.37 | 16.15 | 11.43 |
| 24. Numgaon K. | 25.78 | 12.54 | 2.72 |
| 25. Yewat | 24.01 | 18.46 | 4.70 |
| 26. Kedgaon | 23.52 | 9.88 | 4.15 |
| 27. Kalamb | 21.32 | 24.70 | 3.86 |
| 28. Fursungi | 20.20 | 5.33 | 3.50 |
| 29. Sansar | 20.19 | 6.90 | 18.50 |
| 30. Loni–Kalbhor | 20.05 | 8.95 | 5.25 |
| 31. Pabal | 18.23 | 6.38 | 2.93 |
| 32. Kuran | 15.41 | 5.54 | 15.46 |
| 33. Khed–Shivapur | 15.16 | 6.15 | 6.27 |
| 34. Belhe | 13.26 | 6.62 | 3.69 |
| 35. Walhe | 12.65 | 10.95 | 3.13 |
| 36. Vadgaon N. | 12.52 | 7.00 | 4.63 |
| 37. Nasrapur | 11.92 | 8.46 | 12.22 |
| 38. Ale | 11.92 | 6.70 | 3.20 |
| 39. Supe | 8.54 | 5.90 | 3.00 |
| 40. Theur | 8.32 | 5.22 | 3.58 |
| 41. Lohogaon | 6.46 | 6.40 | 27.17 |
| 42. Wada | 6.23 | 6.22 | 4.88 |
| 43. Awasari Kh. | 5.66 | 5.27 | 2.48 |
| 44. Malegaon Bk. | 5.38 | 12.15 | 2.56 |
| 45. Pandare | 4.90 | 7.19 | 1.67 |
| 46. Kadus | 4.24 | 5.41 | 2.90 |
| 47. Mulshi | 4.18 | 1.58 | 1.56 |
| 48. Manjari Bk. | 4.16 | 5.10 | 4.13 |
| 49. Sangavi | 3.94 | 3.91 | 1.95 |
| 50. Bavada | 3.78 | 6.96 | 1.70 |
| 51. Murrum | 3.78 | 6.09 | 1.64 |
| 52. Rajuri | 3.75 | 4.86 | 2.50 |

| | I | II | III |
|---|---|---|---|
| 53. Patas | 3.65 | 1.84 | 3.01 |
| 54. Kalas | 3.52 | 4.28 | 1.96 |
| 55. Koregaon Bhima | 3.25 | 3.60 | 3.75 |
| 56. Veer | 3.22 | 3.36 | 2.50 |
| 57. Sirsuphal | 3.15 | 2.58 | 2.06 |
| 58. Wagholi | 3.05 | 4.25 | 5.81 |
| 59. Malthan | 2.89 | 1.48 | 2.86 |
| 60. Takwe Bk. | 2.88 | 1.26 | 3.68 |
| 61. Pimpalwandi | 2.79 | 3.55 | 2.70 |
| 62. Kalamb | 2.74 | 2.38 | 2.86 |
| 63. Alandi | 2.74 | 1.65 | 9.90 |
| 64. Boripardhi | 2.66 | 6.38 | 4.48 |
| 65. Rajewadi | 2.61 | 3.56 | 1.67 |
| 66. Morgaon | 2.54 | 2.01 | 4.36 |
| 67. Dehu | 2.52 | 5.83 | 12.74 |
| 68. Charoli | 2.52 | 5.92 | 5.17 |
| 69. Nirdoshi | 2.51 | 0.85 | 1.33 |
| 70. Palasdeo | 2.50 | 2.51 | 2.53 |
| 71. Alandi (C) | 2.50 | 4.22 | 1.40 |
| 72. Ambegaon | 2.46 | 2.30 | 7.36 |
| 73. Chandkhed | 2.45 | 0.78 | 2.66 |
| 74. Shikrapur | 2.40 | 2.10 | 3.16 |
| 75. Bahul | 2.34 | 1.65 | 9.90 |
| 76. Kikawi | 2.32 | 1.80 | 3.64 |
| 77. Kolwan | 2.30 | 0.60 | 8.48 |
| 78. Kawathe | 2.16 | 1.78 | 2.30 |
| 79. Indori | 2.09 | 1.58 | 2.40 |
| 80. Vadgaon A. | 2.05 | 3.72 | 2.56 |
| 81. Dhamani | 2.02 | 2.05 | 2.70 |
| 82. Chikhali | 2.01 | 2.60 | 2.11 |
| 83. Kalas | 2.00 | 4.28 | 1.96 |
| 84. Shinoli | 1.94 | 1.39 | 2.65 |
| 85. Waffgaon | 1.93 | 2.71 | 2.58 |
| 86. Kale | 1.88 | 1.96 | 1.76 |
| 87. Nhavara | 1.79 | 2.37 | 3.86 |
| 88. Mahalung P. | 1.75 | 0.55 | 2.72 |
| 89. Pargaon | 1.71 | 1.56 | 2.00 |
| 90. Ranjangaon | 1.68 | 1.28 | 2.81 |
| 91. Ravangaon | 1.65 | 2.35 | 3.28 |
| 92. Loni Bhapkar | 1.64 | 1.74 | 2.27 |
| 93. Rahu | 1.56 | 1.97 | 1.73 |
| 94. Ambavade | 1.56 | 0.50 | 2.23 |
| 95. Kendur | 1.50 | 2.91 | 1.80 |
| 96. Shelgaon | 1.52 | 0.76 | 1.00 |
| 97. Murtt | 1.52 | 1.96 | 3.35 |

| | I | II | III |
|---|---|---|---|
| 98. Madh | 1.49 | 1.37 | 5.23 |
| 99. Awasari Kh. | 1.46 | 5.27 | 2.48 |
| 100. Pait | 1.43 | 1.30 | 1.71 |
| 101. Nangaon | 1.42 | 1.56 | 1.66 |
| 102. Kangaon | 1.41 | 1.34 | 0.75 |
| 103. Kanhoor | 1.42 | 1.72 | 1.86 |
| 104. Yenere | 1.32 | 1.31 | 1.63 |
| 105. Loni | 1.27 | 2.49 | 2.14 |
| 106. Peth | 1.25 | 3.21 | 3.07 |
| 107. Nhavi | 1.25 | 0.88 | 1.46 |
| 108. Parinche | 1 24 | 2.44 | 2.00 |
| 109. Muthe | 1.18 | 0.74 | 3.43 |
| 110. Karathi | 1.17 | 0.88 | 2.08 |
| 111. Bori ( BK. ) | 1.14 | 1.43 | 2.20 |
| 112. Warwand | 1.08 | 2.76 | 1.85 |
| 113. Man | 1.06 | 0.42 | 2.39 |
| 114. Umbraj | 1.04 | 1.80 | 1.64 |
| 115. Khanapur | 1.03 | 0.63 | 9.73 |
| 116. Garade | 1.00 | 1.55 | 1.63 |
| 117. Ane | 0.95 | 2.04 | 1.87 |
| 118. Korhale | 0-92 | 2.58 | 1.87 |
| 119. Sawargaon | 0.77 | 1.78 | 2.85 |
| 120. Mahalung | 0.76 | 1.85 | 1.35 |

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*Addresses of the authors*

Jayamala Diddee, Lecturer, Department of Geography, University of Poona, Pune 411007, India.

K. R. Dikshit, Professor and Head, Department of Geography, University of Poona, Pune 411007, India.