Interurban Distance in Indiana: An Evaluation of Techniques

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Many of the phenomena studied by human geographers are discrete areal units. We might cite factories, farmsteads, villages, cities, and even dots on dot maps as examples. Although these discrete units may at times be distributed in some regular pattern, more frequently they are spread across the map in random fashion.

The measurement of areal variations in the degree of concentration of these randomly distributed discrete objects is a basic problem of human geography. Barnes and Robinson have shown that one of the best measures of the degree of concentration (or dispersion, or density) is the distance between objects (1). They find that the average distance between objects in any given area can be determined by dividing the number of objects into the actual area, finding the square root of the resulting value, and multiplying this square root by the constant 1.11. Although their study was restricted to existing administrative areas, it is obvious that the technique is equally applicable to arbitrary areal units.

This study is primarily concerned with a comparison of techniques for deriving values of interurban distance in Indiana. All towns and urbanized areas of twenty-five hundred or more persons in 1950 are plotted on the base map, as are all places of similar size in a thirty mile wide strip of contiguous states (Fig. 1). Three techniques were used to measure interurban distance.

The hexagon method is based on the work of Barnes and Robinson, but introduces arbitrary areal units in place of existing administrative units, a modification of which most geographers would approve. The use of a hexagon in preference to any other geometric form is based on Mackay's findings (2). The base map was laid out with a five mile hexagonal grid of tick marks; a transparent hexagon with twenty mile sides was centered on each tick mark, consecutively, and the number of towns falling within the hexagon recorded (Fig. 2). Four towns are within the hexagon centered at A, and five within the one centered at B. When the area of the hexagon, 1,020 square miles, is divided by the number of towns and the square root of this result multiplied by 1.11, it is found that the average interurban distance for the hexagon centered on A is 18.8 miles, and 16.9 miles for the hexagon centered on B.

The sector method is based on the assumption of a more or less regular hexagonal distribution of towns, as hypothesized by Christaller (3). Three intersecting straight lines, spaced at an angular distance of sixty degrees, were drawn on a transparent overlay, together with concentric circles at two mile intervals (Fig. 2). The point of intersection was then placed on each town and the distance recorded to the closest town in each of three or six sectors; hence "three sector" and "six sector" techniques. The three closest different sector towns to our

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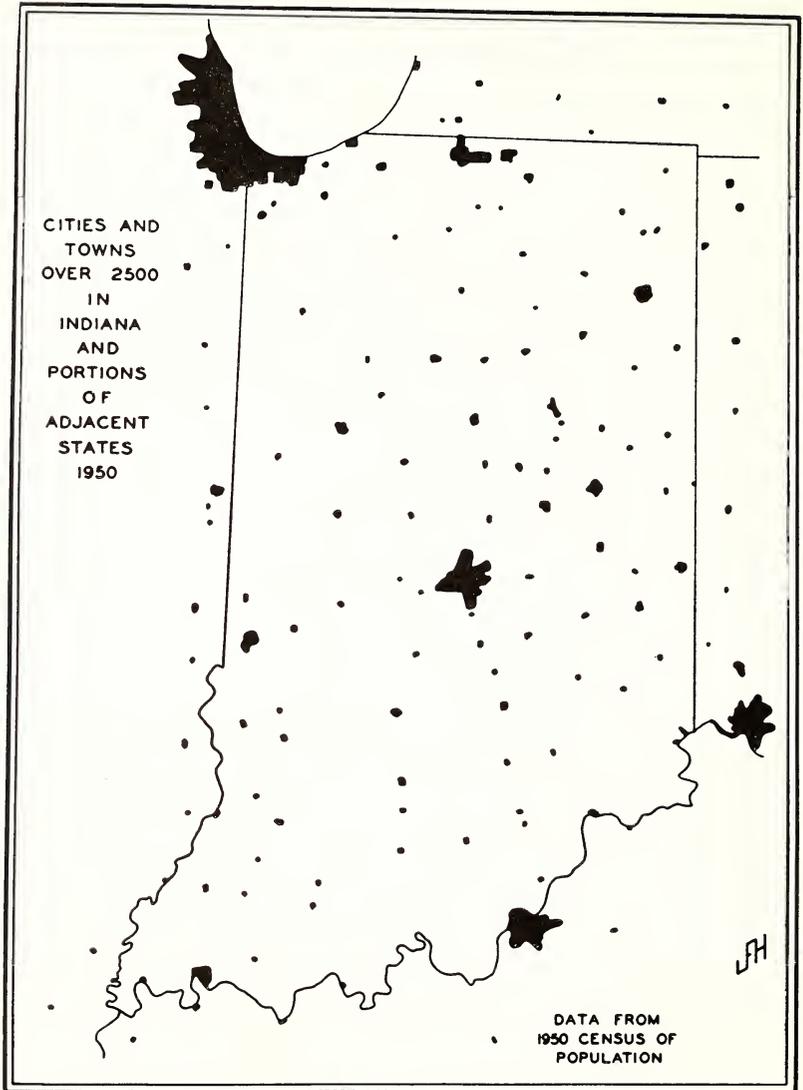STATES
1950

DATA FROM
1950 CENSUS OF
POPULATION

Figure 1.

example are 14, 17, and 17 miles, for an average distance of 16 miles by the three sector method; if the six sectors are used the average distance is 19 miles (Fig. 2). The three sector method actually measures the distance to the three closest towns which are separated by an angular distance of sixty degrees, whereas the six sector method measures the distance to the six closest towns with the same degree of angular separation.
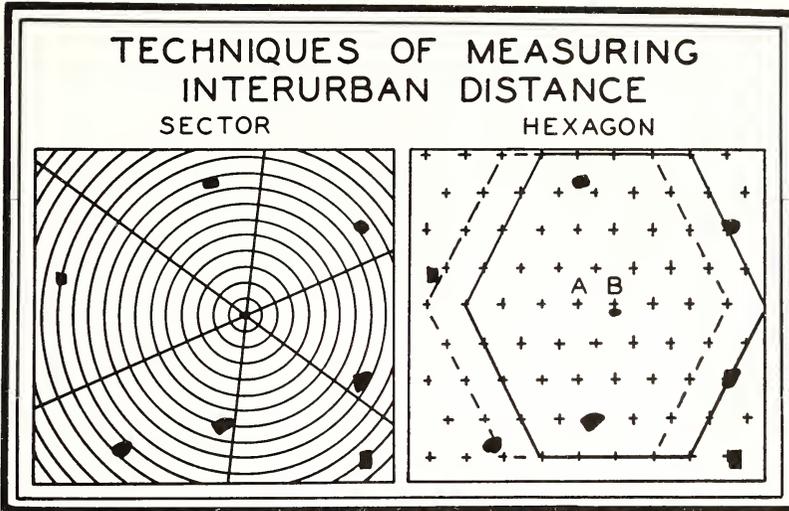
Figure 2.

The third method of measuring interurban distance is based on actual highway mileages. The distance from each town to the closest town on each state and federal highway was read from the official state highway map. The average interurban distance was computed, as in the sector method, by totalling these distances and deriving an arithmetic mean. Each of these three measures was used to determine "spot heights" for construction of conventional isopleth maps of interurban distance.

The most important fact made evident by comparing the four maps produced by these three methods is the discovery that each method produces a map showing the same general pattern of interurban distance, although there are minor variations in detail (Fig. 3). Distances determined by the three sector method, for instance, are necessarily lower than those determined by the six sector method, because the average distance to the three closest towns will have to be no more than equal to—and commonly is considerably lower than—the average distance to the six closest. It should be added that we found it impractical to attempt comparability of specific critical mileage values separating distance classes as measured by the different methods.

We should also emphasize the fact that our primary concern in this study is interurban distance, and not urbanization. The size and areal extent of towns are disregarded when all are weighted at unity, when Delphi and Brookville are made equals of Indianapolis and Gary. These techniques obviously are most significant in predominantly rural areas of discrete small towns, where interurban distance is also most significant, and least significant in metropolitan areas, where the concept of interurban distance is less meaningful.

Interurban distance, for instance, is greater around Indianapolis than in some other parts of the state (Fig. 3). All of these maps
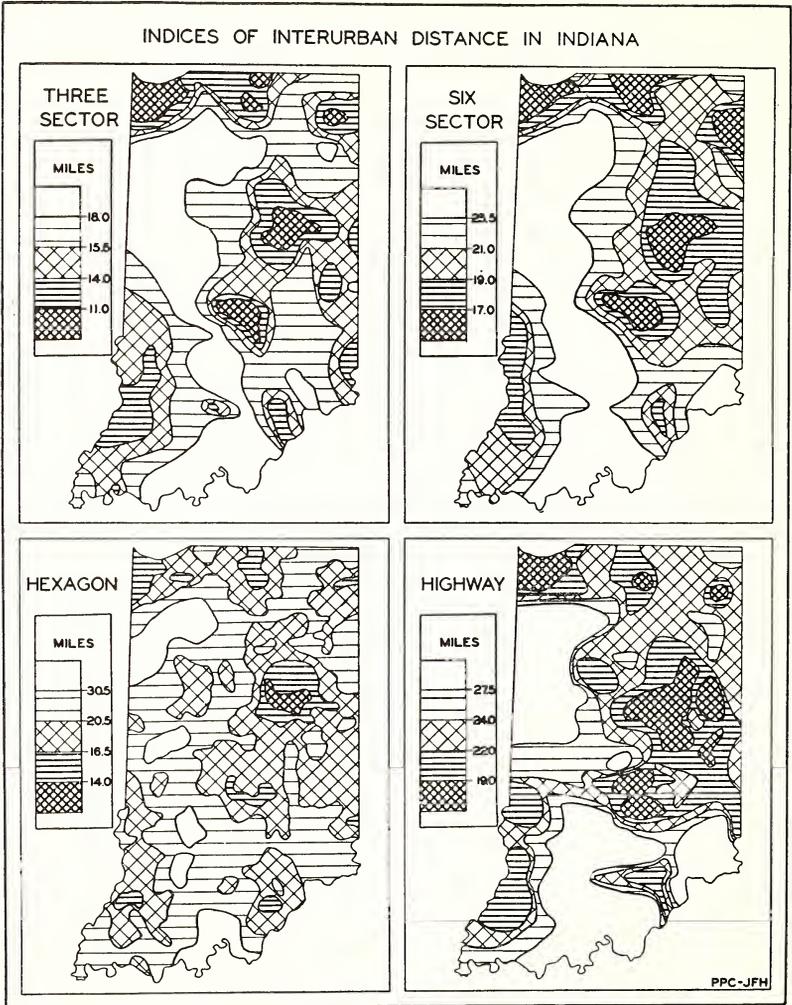
Figure 3.

show a minimum interurban distance in the east central part of Indiana, between Muncie and Marion, with another area of minimal distance south and west of Indianapolis. Interurban distances are also low in the northwestern corner of the state, near Chicago; in the South Bend-Elkhart area; north of Fort Wayne, in DeKalb County; east of Richmond, in Wayne County; in the Scottsburg Lowland, north of Louisville; and in the coal mining areas of southwestern Indiana. Conversely, there are two extensive areas of maximum interurban distance, one in the southeastern corner of the state and the other stretching in a broad belt to the west of a line from Chicago to Louisville.

The similarities of overall pattern on these four maps leads us to the conclusion that the best of the four techniques is the one which is most economical of time. This conclusion hands the palm to the three sector method of measuring interurban distance, although we would like to suggest that further experimentation with the hexagon method, both by increasing the grid spacing interval and the size of the measuring hexagon, might considerably enhance its speed without impairing the results obtained.

In particular, the hexagon method would appear to be of considerable utility as the number of items in the distribution increased, as, for instance, in converting a dot map to a density map, in preparing a map of interfarmstead distance for areas larger than county size, or in mapping interurban distance for the nation. These suggested applications indicate, of course, the fact that the techniques described in this study are applicable to any random distribution of discrete objects.

Before concluding, we cannot forebear calling your attention to striking areal co-variations between interurban distance and the importance of migration as an element in rural population change in Indiana in the decade 1940-50 (4). Significant in-migration corresponds with minimal interurban distance in the northwestern corner of the state, from Chicago to Elkhart; in the east central part of the state; and in the general vicinities of Fort Wayne and of Louisville (Fig. 4).
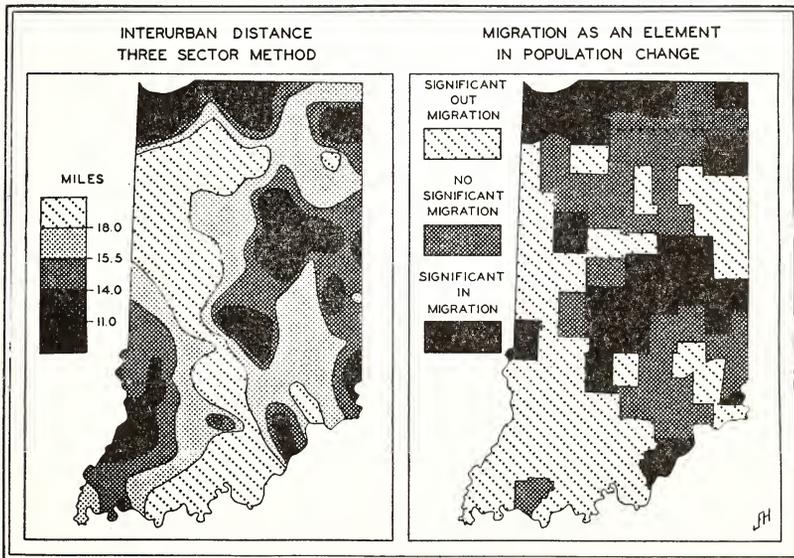

Figure 4.

Even more marked is the correspondence between areas of high interurban distance and significant out-migration. This is especially true of the area west of a line from Chicago to Louisville, but the same pattern holds in the southeastern part of the state as well. Furthermore,

interurban distances are somewhat higher than the state norm even in those counties which held their own migration-wise. But there are two exceptions; the areas of significant out-migration between Fort Wayne and Muncie and between Terre Haute and Vincennes have comparatively low interurban distances.

Once the relationship has been discovered by visual comparison of these maps, its mechanics are obvious: those people who live far from the nearest town are more likely to migrate than those who live close to one. But let us remind you of the man who made his million by placing the obvious bit of rubber on the end of the lead pencil. This relationship had not occurred to us before it was suggested by our comparison of the two maps, true enough, but neither had it been suggested in discussion of the senior author's paper at this meeting last year, and inasfar as we can ascertain it nowhere appears in print.

We should like to conclude, therefore, with the suggestion that preparation of interurban distance maps for other areas, and eventually for the entire country, might well call attention to other relationships which presently are not even suspected.

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