SOFTWARE FOR SPATIAL ANALYSIS ON A NETWORK

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This software is designed as an analytical toolbox for spatial analyses on a network. The software is implemented with an extension of ArcView8.X, and it will be open to public without charge in 2002. The software is developed under the project entitled by Spatial Information Science for Human and Social Sciences (SISforHSS) supported by the Ministry of Education and Science, Japan.

(1)**Potential Demand for Spatial Analysis on a Network**

Recently locational competition of retail stores in a densely inhabited region becomes very hard. For instance, in the central region of Tokyo (23 Wards; 621 squared km with 8 million inhabitants), almost five thousands convenience stores are competing their locations. A distinctive feature of this type of stores is small market areas. Because of this nature, marketing is concerned with microscopic geographical factors with a street network. Such marketing is called micro-marketing. GIS provide a powerful tool for micro-marketing, but a problem with that is poor analytical tools. The most traditional analytical tools are based upon the assumption that the market areas are homogeneous plane, and distance is measured in terms of the Euclidean distance. In a small area, however, irregular streets produce a heterogeneous plane and consumers access to stores through a street network. This suggests that there be great potential demand for analytical tools for micro-spatial analysis on a network where distance is measured in terms of the shortest-path distance.

(2)The Network Space

We suppose that the real world is represented by a network space formed by connected line segments, and that every geographical objects are assigned on the network (Figure 1). For instance, a store is assigned on a point on the network in terms of its access point, i.e. the gate or the entrance of the store. A house of a consumer is also assigned to a point on the network in the same manner. Thus the distributions of stores and consumers are represented by the distributions of points on the network. A line segment of the network may have attribute values, such as the width of a street, and a traffic volume.

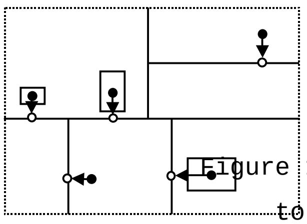

Figure 1: Assignment of (representative) points to the points on a network

(3)Functions of the Software

This software has the following functions.

i) Generate a point for a polygon

This function is to generate a representative point for a polygon representing a geographical object (such as a house) (see the black circles in Figure 1).

ii)Assign a point to a point on a network

This function is to assign a point that is not on a network to the nearest point on the network (see the white circles in Figure 1).

iii) Generate random points on a network

This function is to generate points on a network according to the Poisson point process on the network (i.e. a point being placed on a unit line segment on the network is the same regardless of the location of the segment on the network). This function may be used for Monte Carlo simulations.

iv) Generate a Voronoi diagram on a network

This function is to construct a Voronoi diagram generated by a set of points on a network (Okabe, Boots, Sugihara and Chiu, 2000).

v) Test by the cell count method

This function is to test randomness of points distributed on a network by use of the cell count method as an extension of the quadrat count method on a plane with Euclidean distance.

vi) Test by the nearest neighbor distance method

This function is to test randomness of points distributed on a network by use of the nearest neighbor distance method as an extension of the nearest distance neighbor distance method on a plane with Euclidean distance (Okabe, Yomono and Kitamuara, 1995).

vii) Test by the conditional nearest neighbor distance method

This function is to test if points (of Type A, say convenience stores) are independently and randomly distributed with respect to a set of fixed points (of Type B, say stations) (Okabe and Miki, 1984).

viii) Test by the K-function method

This function is to test randomness of points distributed on a network by use of the K-function method as an extension of the K-function method on a plane with Euclidean distance (Okabe and Yamada, 2001)

ix) Test by the cross K-function method

This function is to test if points (of Type A) are independently and randomly distributed with respect to a set of fixed points (of Type B) (Okabe and Yamada, 2001).

x) Estimate market areas using the Huff model

This function is to estimate the choice probability of choosing stores when consumers' behavior is described by the Huff model (Okabe and Kitamura, 1996).

xi) Estimate the demand for a store using the Huff model

This function is to estimate the demand of a store when consumers' behavior is described by the Huff model (Okabe and Okunuki, 2001).

(4)Implementation

Since the environment for developing programs with ArcView8.X is not ready at present, we have not yet developed a user-friendly interface, but we are now developing the fundamental programs with Visual Basic and Visual C++. Part of the outcome is shown in Figure 2, where the estimated demand for a store is indicated by colored marks.

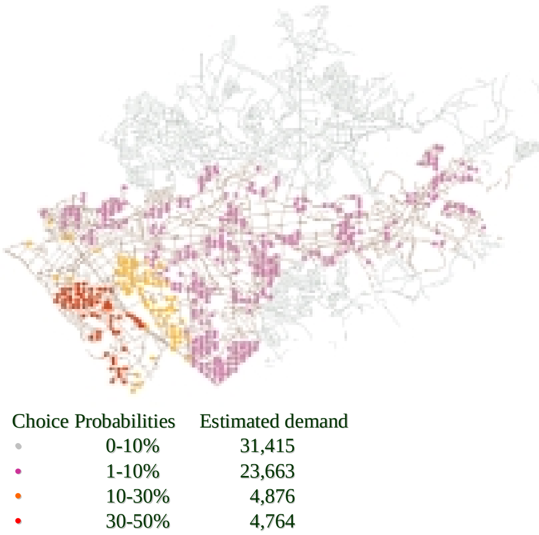

Figure 2: Demand estimation on a network with the Huff model

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