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A factorial ecology of Omaha: Using 1980 census data at block group scale

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A FACTORIAL ECOLOGY OF OMAHA:
USING 1980 CENSUS DATA AT BLOCK GROUP SCALE

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THESIS ACCEPTANCE

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ABSTRACT

This thesis is an urban factorial ecology of the Omaha/Douglas County area. The ecological unit used in the analysis is the Census Block Group. As a result, the data used are based on a more homogeneous areal unit, and the regionalization constructed yields social areas which more accurately display residential differentiation.

The input data consists of a matrix of 84 variables by 399 block groups. Through factor analysis, the matrix is reduced to a factor score profile matrix of 10 factors by 399 block groups. The first eight factors are interpreted into social dimensions.

From this factor structure, a regionalization is constructed for the Omaha/Douglas County area, consisting of twenty-eight social areas. These social areas are further grouped into an ecological model consisting of five concentric zones and four radial sectors.

The regionalization and model demonstrate a comparability in social dimensions and ecological structure between Omaha and other American cities. And, the social areas constructed are also comparable to the real residential districts of the Omaha/Douglas County area.

In addition, the automation of this study demonstrates a promising application potential of factorial ecology in urban planning and marketing analysis.

ACKNOWLEGEMENTS

This thesis could not have been accomplished without the help of many people. I would like to take this opportunity to express my thanks to them.

First, I must recognize the major role played by Dr. Charles Gildersleeve in directing the program in the Department of Geography-Geology, University of Nebraska at Omaha.

Second, I am indebted to Mr. Tim Himberger, the Data Base Coordinator at the Center for Applied Urban Research. He provided me with the computerized data from Summary Tape File 3 of the 1980 Census of Population and Housing.

Third, I am grateful to John P. Zipay, Real Estate Research Consultant, P. J. Morgan Company, and Dr. Michael Peterson of our department. Mr. Zipay's graduate course, Population and Development, introduced me to the idea of using census data at block group scale, and to the studies of Omaha. Dr. Peterson's graduate courses, GIS and Computer Mapping, and his personal advice helped me through the process of this thesis.

Finally, I would like to express my appreciation to Dr. David R. DiMartino. Dr. DiMartino has given me systematic instruction on urban geography through the period of my graduate study in this department. As advisor of this thesis, he is the person who has read every draft of the thesis, and helped me in every detail, from organizing the structure to correcting grammatical errors. Without his help, this thesis would not be possible.

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CHAPTER ONE
INTRODUCTION

The objective of this thesis is to apply the factorial ecology technique to Omaha, Nebraska's population characteristics in order to determine:

a) the appropriateness of the use of the technique,

b) the accuracy with which the results describe real ecological areas -- neighborhoods -- in Omaha,

c) the goodness with which the Omaha ecological structure fits the theoretical models, and

d) the degree to which the Omaha ecological structure resembles those of other American urban centers.

In addition, this thesis demonstrates the importance of the geographic (spatial) approach in urban factorial ecologies. Unlike such analyses conducted by ecologists and sociologists, this study deals with spatial issues: the scale of observation (areal extent) of input data, and the distribution of resulting social areas. Block group census data is used as the input data (rather than the more-traditional census tract data). It is hypothesized that the social areas derived can display residential differentiation more accurately due to the use of that smaller unit of analysis -- the block group. It is also hypothesized that the better "fit" between the ecological areas derived and real social areas (neighborhoods) of Omaha yields a technique more useful to applied studies, particularly urban planning.

THE NATURE OF URBAN FACTORIAL ECOLOGY

Urban factorial ecology is the study of urban residential differentiation from an ecological perspective. The data used are usually census data compiled for census-designated areal units. And, factor analysis is the core technique used for extracting "factors" and calculating "factor scores" for each individual areal unit from an input data matrix of n variables by m observations (areal units). Because this core technique is used, such studies are named "factorial" ecologies.

Urban factorial ecologies can be viewed as having three interrelated ecological elements: social dimensions, social space, and social areas. The social dimensions are the "attributes" resulting from factor analysis of the census data. Each dimension represents a group of correlated variables associated with social characteristics such as socioeconomic status, family status, dwelling patterns, ethnic origin, educational background, and occupation. Social space is a concept which deals with the patterns of social groupings in residential areas. Each pattern is a cluster of areal units with the same factor score profiles. Social areas are sub-regions of the city delineated in such a way that variations in factor score profiles within sub-regions are minimized while those between sub-regions are maximized. Such an analytical approach consists of a series of multivariate statistical procedures with the core technique of factor analysis, using aggregate census data based on the census designated areal units.

Most of the studies of urban factorial ecology have, by and large, succeeded in isolating three general social dimensions, using census data by census tract. Originally proposed in social area analysis, these dimensions are socioeconomic status (social rank), family status (urbanization), and ethnic status (segregation). By using two-way analysis of variance to test the spatial distribution patterns of the factor scores, it was found that the index which measures the socioeconomic status varies principally by sector; the index which measures the family status varies principally by concentric zone; and the index which isolates minority groups shows a tendency for those groups to cluster in a particular part of the city (that is, at the intersect of the zones and sectors)*. Therefore, the classic ecological models, Sectoral (Hoyt, 1933), Concentric Zone (Burgess, 1925), and ethnic segregation (Firey, 1945) can be integrated into this two-way factorial model. By using factor score profiles of the observations patterns of urban social space can be recognized, and, thereby, social areas can be delineated. Such analyses have been carried through many case studies. As a result, some general characteristics of the social structure of the Western City, especially the North American City, have been found through factorial comparisons.

<u>CRITICS:</u>

There have been critics of factorial ecology since its inception. These critics can be summarized into two categories: one focused on cultural critiques, and the other on technical critiques.

*: Anderson and Egeland, 1961.

Those who have criticized factorial ecologies on cultural grounds argue that such ecologies neglect the human and cultural aspects of the society in influencing residential differentiation. Recent critics show that social areas with similar ecological profiles do not necessarily yield similar social and attitudinal characteristics. For example, examination of the flows of telephone messages between districts in Minneapolis shows no apparent relationship between the patterns of calls and the region's social areas as defined by factorial ecology (Palm, 1973).

Those who criticize factorial ecologies on technical grounds focus on the validity and limitations of the analyses based on the aggregation of census data. The recent examples are Openshaw's (1984) and Gober's (1986) criticisms. Openshaw argues that the effects of the ecological fallacy are endemic to "areal census data", although their magnitude is perhaps not as large as might have been expected. He concluded that the principal effect of the spatial aggregation of census data on factor analysis is to create new factors by bringing together variables that were not strongly associated at the individual levels.

Gober (1986) investigated the variation in household structure at census tract level in twenty US cities between 1970 and 1980. She divided the household types into six categories and calculated an "entropy index" as the measure of the degree of dispersion for each census tract. The results showed that households differed from tract to tract in the US cities. That finding contrasted with what factorial ecologists would believe---that census tracts are homogeneous units.

DEFENDERS:

On the other hand, the pro-factorial ecology arguments have continued over the years. Those who try to defend these studies have focused their efforts in three areas: (a) clarification of the philosophy and research scope of the studies, (b) exploration of the implications and applications of the studies, and (c) improvement of the analytical techniques and refinement of the census data.

For example, Berry defined the philosophy of factorial ecology as "phenomenology". He said that "To understand the how and why of factorial ecology, the perspective of a phenomenological philosophy is required" (1971, p.214-16). Brindley and Raine pointed out that "social areas are essentially statistical phenomena. Their relationship to social reality -- their validity -- depends principally on the meaning of the social statistics with which the analysis begins. Without bearing this point in mind, any comparison of social areas with urban neighborhoods or communities which are more socially defined in terms of social networks, activity patterns and mental maps as well as social homogeneity will be misleading" (1979, p.280). Based on this point they discussed the potential for the use of factorial ecology in urban planning.

Patterson (1981, cited in Ley, 1983, p.87) conducted a factorial ecology of Vancouver using census data at smaller areal scales than the usual census tracts. In his study, 1237 "enumeration areas" (instead of 122 census tracts) are used as areal units, permitting a finer-grained analysis than would have been possible using the larger census tracts for the metropolitan area.

Urban marketing analysts have begun to use census block group, rather than census tract, data for urban marketing studies. Computer software packages are now available using data at that scale. One of the packages is called VISION, in which 117 demographic, socioeconomic and housing characteristics from the 260,000 U.S. block groups are used to identify 48 homogeneous market segments. By comparing any block group area to these 48 segments the marketing analysts can easily locate and quantify the prospects of the block group for a given market. A second package is called ClusterPlus Marketing System which identifies 47 unique lifestyle clusters using 1980 Census block groups. These clusters are groups of people living in areas with similar demographic characteristics...and having similar purchasing and behavior patterns. Knowing in which cluster a consumer lives provides a reasonable means for understanding and predicting how that consumer will behave in the marketplace.

From the discussion above, it is clear that factorial ecologies are, by nature, statistical analyses. They deal with social statistical characteristics. However, such statistical characteristics may suggest some deep-rooted economic functions and social mechanisms at work. In this sense, the philosophy of phenomenology may be applied to the studies. In addition, the improvement of the analytical techniques and the automation of the census data can further enhance the application potential of factorial ecologies in urban planning and marketing analysis.

THE CHARACTERISTICS OF THIS STUDY

SMALLER AREAL UNIT

This study uses the census block group (rather than census tract) as the areal unit for a factorial ecological study of Omaha. Using census data of smaller areal extent (block groups) allows the analysis of more homogeneous areal units to generate a finer grained regionalization of the city into social areas. The results will demonstrate the methodological strength of using block groups.

MAJOR FINDINGS

This study finds that the social dimensions interpreted are similar in factor structure to those constructed in other studies of American cities at the census tract scale*. The ecological model constructed in this study is also comparable to the generalized ecological model for the North American City which is comprised of a series of concentric zones and radial sectors (Appendix A-A Generalized Ecological Model).**(see next page footnotes) Moreover, many of the social areas designated in this study are comparable to those generally recognized real residential districts in Omaha, which confirms the advantage of using a finer-grained regionalization; that is, using smaller areal units -- block groups.

MAJOR ANALYTICAL PROCEDURES

The input data for this study consist of census block group data set in a matrix of 84 variables by 399 block groups. Through factor analysis the matrix is reduced to a factor score profile matrix of 10 factors by 399 block groups. The factors are interpreted as social dimensions. The 399 block groups are classified into eight clusters based on the 10 factor scores using cluster analysis, each cluster representing a community pattern. Those spatially adjacent block groups with the same cluster pattern form a homogeneous social area. Thus, a regionalization of twenty eight social areas is constructed. The social areas are further grouped into an ecological model consisting of five concentric zones and four radial sectors, with each of the social areas in an intersect of zones and sectors. The social area in the center is the Central Business District (CBD).

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*: Rees (1979, Chapter III, p.37-83) concluded that the American cities contains three types of social dimensions: (1) socioeconomic dimensions; (2) age and family structure dimensions; (3) a variety of different types of ethnic dimensions. He generalized these factorial dimensions based on his factor analysis of the population variables for thirteen selected urbanized areas in the U.S..

**: Rees (1970, Chapter 10, p.310) generalized this model for American cities.

AUTOMATION OF THE STUDY PROCESS

The block group variables used in this study are extracted from Summary Tape File 3 of the 1980 Census of Population and Housing (Bureau of The Census, Department of Commerce, 1982) (provided by Tim Himberger, data base coordinator of the Center for Applied Urban Research). The block group XY coordinate tape file is produced by Geographic Data Technology, Inc. (1985). The processes of data input, editing and analysis, and storage and transfer are conducted on UNO's VAX8650 computer. The 1985 SAS (Statistical Application System) statistical package is used for statistical analysis (1985). And, the Macintosh computer is used for mapping the results of the SAS analysis on the VAX computer, with the 1988 Macintosh graphic program MapMaker.

In the following chapters, Chapter Two is a brief review of the development of factorial ecology in the literature. Chapter Three describes the nature of the research area: its administrative divisions, historical evolution, physical framework, and some conceptions of the study area constructed in previous studies. Chapter Four concerns the methodology of this study. It describes the procedures used and the methodological strength of those procedures. Chapters Five and Six are the core of this study. Chapter Five describes the results of the factor analysis of the block group data. The factors are interpreted as social dimensions. Chapter Six focuses on the classification of the areas into social space and the division of Omaha into social areas. Finally, Chapter Seven is a discussion of the implications of those social statistical characteristics derived from the analysis.

CHAPTER TWO
LITERATURE REVIEW

Factorial ecology as an analytical technique results directly from attempts to validate the hypotheses implicit in the social area analysis developed by Shevky, Williams and Bell (Shevky and Bell, 1955). The three social dimensions in social area analysis--social rank, urbanization and segregation--were designated based on Wirth's theory about the increasing scale of society (Timms, 1971, p.125).

The rationale of the approach thus developed was attacked by Hawley and Duncan (1957) as an **ex post facto** rationalization of an **ad hoc** selection of census variables and indices. To test empirically whether a real relationship exists between these census variables and indices, factor analysis was applied to the data. Thus, an inductive approach was created with the core technique of factor analysis, along with an associated family of multivariate statistical techniques--that is, factorial ecology.

Bell (1955) first applied factor analysis to the six standard social area analysis variables which he and his collegues used in social area analysis. In the same way, Arsdol, Camilleri and Schmid (1958) used 10 large American cities as the testing areas of the technique. Both tests showed that the three dimensions used in social area analysis did represent a general social structure of American cities.

Anderson and Bean (1961) extended the variables beyond those used in social area analysis to 13 census tract variables in Toledo, Ohio. This analysis marked a step forward by which factor analysis was used to extract social dimensions underlying the input data sets rather than to confirm the validity of the previous designated indices of social area analysis. This was the beginning of factorial ecology, and the social dimensions are no longer limited to the three basic ones designed in the social area analysis. With the technique of factor analysis the researcher can extract all the potential social dimensions existant in the input data sets, and determine quantitatively which portion of the total variance can be explained by each of the dimensions.

Anderson and Egeland (1961) introduced analysis of variance for the first time into urban ecological studies. They conducted a test of Burgess' concentric zone and Hoyt's sector hypotheses of urban residential structure, using scores on the indices suggested by the social area analysis. But, Murdie (1969, p.158) was the first to use the scores from factor analysis instead of those from social area analysis, and to use all the tracts instead of a sample of tracts for the analysis of variance. Murdie designed a two-way factorial model comprised of six concentric zones and four radial sectors as the spatial structure for the analysis, and for the idealized social area model of metropolitan Toronto.

Rees (1970, p.377) introduced a two dimensional graph of social space differentiating socio-economic status vs. family status in his case study of Chicago. Each quadrant of the graph represented a pattern of the community types. By conducting a hierarchical cluster analysis to the observation units at "community area" and "municipality" scales based on the two dimensional factor scores, the observation units were grouped into eighteen clusters. Each has a position on the social space graph. Such classification of community types based on the two dimensions was, as Rees explained, intended to be consistent in concept with the social space divisions used in Shevky and his colleagues' social area analysis. Rees also pointed out the shortcomings of such classification because the social space dimensions should include all the dimensions resulting from factor analysis instead of just two dimensions. However, he did not conduct such a multi-dimension social space classification in his own study.

The rapid growth of factorial ecological studies in the literature led to the publication of a supplemental issue of Economic Geography devoted to a review and discussion of comparative factorial ecology (vol.47, No.2, June 1971). Berry (p.214-16), in his introductory article, discussed the philosophy and logic of factorial ecology. Rees' article (p.220-34) discussed an extended definition, survey, and critique of the field. Johnston's (p.314-23) and Meyer's (p.336-43) articles discussed some limitations in the technique.

So, factorial ecology has been recognized in urban social geography as one of the standard approaches to distinguish urban subareas and urban residential patterns. Since the mid-1970s, much attention in the literature on factorial ecologies has been turned to the aspects of its generality, limitations, and application potential

Herbert and Johnston in their introduction to Social Areas in Cities, Volume II pointed out that "researchers...have shown an unwillingness to restrict themselves to pattern description or to the analysis of aggregate statistics. More interesting questions now may be...answered by looking...at the individual level--at the key processes of social interaction, at the spatial effects of social inequalities and at the conditions which produce them"

(1976, p.1). Ley made similar comments: "If we accept that there is a world of urban experience much of which eludes ecological forms of thinking, then a new posture is required of the researcher...Although neither ecological variables nor ecological processes can ever be ignored, they provide only a partial view of the city as experienced" (1983, p.92). On the other hand, Brindley and Raine explored the application potential for urban planners and policy makers; they concluded: "in spite of its historical association with particular theories of the city, it has now become an essentially pragmatic, empirical method, readily available to planners" (1979, p.288).

Davies (1984; cited in Knox, 1987, p.125) developed a model of the developmental sequence of social structures. He suggested that, historically, four major dimensions of social differentiation--social rank, family status, ethnicity and migration status--have dominated cities everywhere, and that these are combined in different ways in different types of society to produce varying urban structure. He suggested that the general trend is, as the city evolves from feudal city to today's post-industrial city, that the intra-urban social structure evolves from a single axis structure to a structure of multi-axis complexity. His theory attempted to explain the differences in social structure between cities at different stages of societal change. Earlier, Abu-lughod (1969) summarized some basic conditions necessary for the classic dimensions of city structure to emerge. Both theories are useful in relating factorial ecology to a wider view of society and to build a body of theory around the generalized model of the Western city.

Knox (1987, p.120) reviewed some unsolved difficulties with factorial ecology. The first was the limitation of census data in the range of the variables available to describe the real social characteristics. The second is the representativeness of the subdivisions of census areal units as the spatial framework of the city. The third is the potential danger of overinterpretation of the results of factor analysis. In addition, he called for care in the selection of research areas; he noted that there are some differences in results between studies conducted on administratively defined cities and on functional urban areas. He agreed with a suggestion that the central city and suburban ecologies should be viewed as separate phenomena.

Ley's and Knox's works mentioned above are the latest comprehensive books published on urban social geography. Both discuss the place of factorial ecology in contemporary urban social geography. For example, in his chapter on spatial differentiation, Knox examined three approaches to the identification of urban subareas. These are concerned, respectively, with aspects of the built environment, the socio-economic environment, and the perceived environment (1987, p.99). Factorial ecology still represents a major approach in dealing with the socio-economic environment, even though some new studies with different perspectives are emerging, such as the "quality of life" studies, and studies of "deprivation", using other urban social indicators instead of those from census data.

All in all, factorial ecology is likely to remain a preferred approach in the search for high-level generalizations about urban residential structure through inter-city comparisons of residential topologies, particularly because of the convience the technique provides.

CHAPTER THREE
THE RESEARCH AREA

DESIGNATION OF RESEARCH AREA

The research area for this thesis is the portion of the Omaha-Council Bluffs SMSA found within Douglas County. This area is selected so as to include the "real city" of Omaha within the political jurisdiction of Douglas County. The corporate city of Omaha is a major part of the research area. However, the area of coverage extends well beyond the city limits to the north and northwest into the remainder of Douglas County (see Figure 2 and Appendix J).

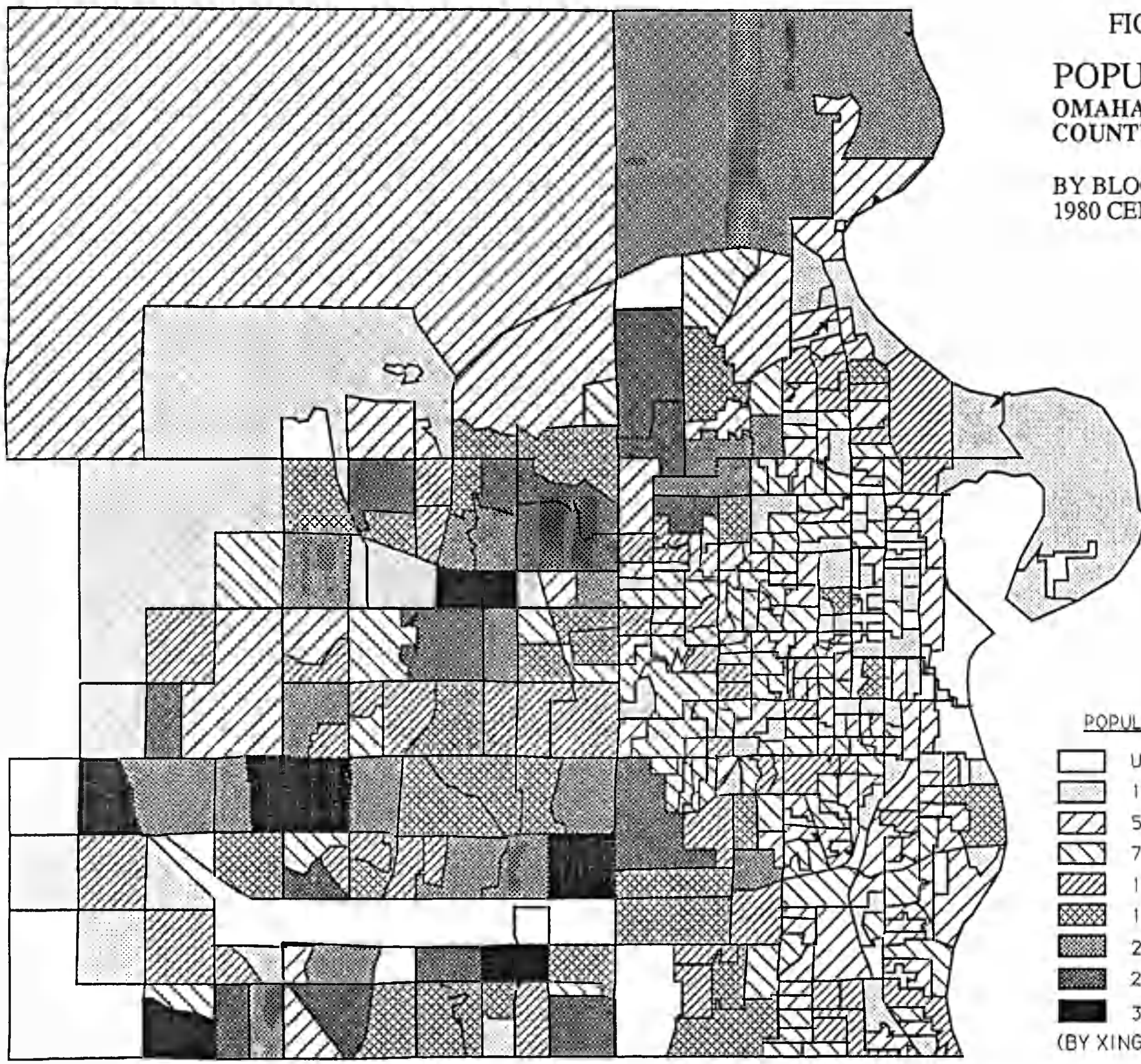
As of the 1980 census, the City of Omaha contained 314,255 people, representing 55 percent of the SMSA population, and the research area housed 384,864 people, representing about 80 percent of the total SMSA population (Figure 1).

Even though modern commuters and other economic activities have linked Omaha, Council Bluffs, Bellevue, Papillion and some other small centers of urban population into a single SMSA, the research area is administratively distinct, occupying the eastern part of Douglas County. Each of the urban centers has its own history of development. And each of the counties has its own development policies and local planning programs. Even though there have been comprehensive metropolitan area plans serving as a guide for the coordination of planning efforts of the individual

FIGURE 1

POPULATION
OMAHA/DOUGLAS
COUNTY AREA

BY BLOCK GROUP
1980 CENSUS



N

POPULATION

- UNDER 150
- 151 TO 500
- 501 TO 750
- 751 TO 1000
- 1001 TO 1500
- 1501 TO 2000
- 2001 TO 2500
- 2501 TO 3000
- 3001 TO 3884

(BY XINGLAI GE 1989)

governmental units, such coordination cannot determine the development of urban population centers in the SMSA because of political autonomy.

Over the years the City of Omaha has developed from a river front village to a large urban center (Figure 2). Overall, the city has undergone recent expansion in a west to southwest direction, although development along the river front initially witnessed a north-south growth thrust. As a result, the spatial patterns of residential differentiation in the City of Omaha today demonstrate a complex character which can be recognized with sectoral, concentric zone, and ethnic cluster models.

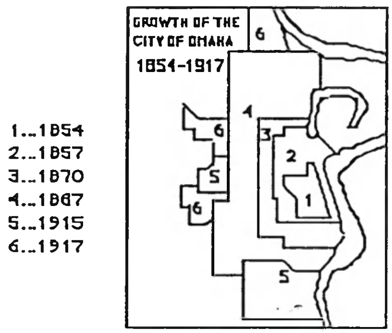
The development of urban elite districts entrenched a sectoral pattern in residential occupancy. The urban elite residential districts have been moving west along a sectoral strip from Capitol Hill, to West Farnam, to Happy Hollow, and to the Regency District and beyond, as wealthy residents (from the wealthiest of early pioneers to today's urban elite) have moved from the central city to the suburbs. The westward suburbanization displays this zonal pattern.

The population declined in most areas east of 42nd street in the decade of the 1960s. During the 1970s, the area of population loss extended to and beyond 72nd street. The western part of the city, particularly to the southwest, experienced rapid growth during the same period. The town of Millard, for example, which had fewer than four hundred residents in 1950, grew to over six thousand by 1970 (Baltensperger,1985, p.255).

FIGURE 2

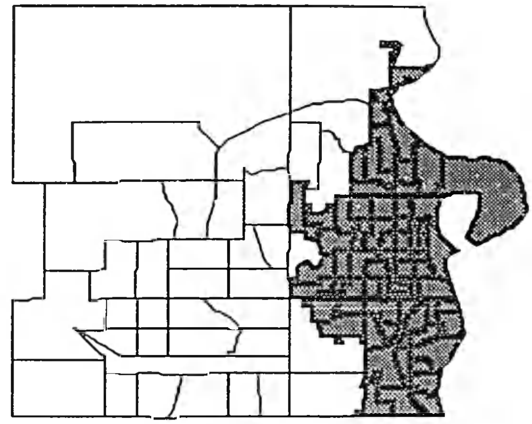
SPATIAL EXPANSION OF THE CITY OF OMAHA

1854 - 1917



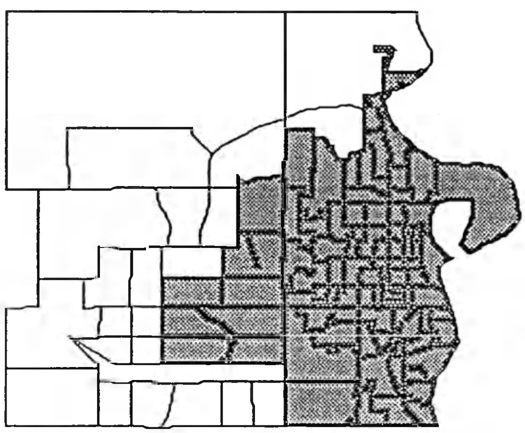
(REVISED FROM O. Q. PETERSON 1980)

1950 CENSUS AREA OF OMAHA (SHADED AREA)



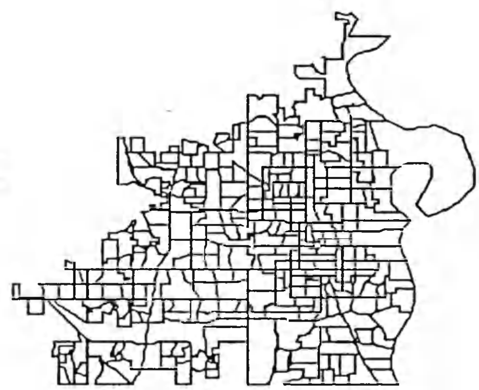
(KINOLAI CE 1989)

1960 CENSUS AREA OF OMAHA (SHADED AREA)



(KINOLAI CE 1989)

THE CITY OF OMAHA
(1988 ELECTION PRECINTS)



(DEPARTMENT OF GEOGRAPHY
UNIVERSITY OF NEBRASKA AT
OMAHA 1989)

NOTES: 1. The four maps have the same scale
2. The base map for 1950 and 1960 census maps is the census tract map of the 1980 Census. Some differences in census tract boundaries between each census dates are not displayed.

The ethnic residential districts demonstrated a cluster pattern historically. In Omaha there used to be two ethnic clusters -- in South Omaha and in the Near North Side. South Omaha was an "ethnic city" during early 20th century; its 26,000 residents in 1910 contained over 8,000 foreign-born (Peterson, 1980, p.63). The Near North Side, generally between 24th and 30th Streets, and between Ames and Dodge Streets, is where the Black community clusters today. The center of this community shifted from 14th and Dodge Streets to North 24th Street during the late Teens and early Twenties, and that area along 24th St. became the main business district for the Black community (Baltensperger, 1980, p.251).

Up to today, the morphological framework of the research area shows an east-west division along 72nd street. East of 72nd Street lies the older part of the city, within which there are many distinguished districts with unique ethnic , residential, commercial, and historical characteristics. Such districts, for example, are Downtown, Midtown, the Near North Side, Florence, South Omaha, Benson, Aksarben, Dundee, etc.

West of 72nd Street lies the area of the suburbs, and the diversification of these residential districts is less influenced by historical and cultural factors but more by economic and time factors. The housing in the eastern part of this area (near 72nd Street) developed earlier than that in the area further west. As a result, districts of inner suburbs, outer suburbs and urban fringe can be recognized

Therefore, there is a rationale for the designation of the research area as constructed. The research area includes the City of Omaha and its adjacent suburban areas within Douglas County. The research area has its own unique political, social, and historical background.

PREVIOUS DIVISIONS OF OMAHA FOR PLANS

There have been a number of local studies and plans which have divided the City of Omaha and the adjacent areas within Douglas County into various subareas. These subareas have been based on a range of factors, each suitable to the individual study's purposes.

One such plan divided the city into housing subareas (Housing and Community Development in the Nebraska-Iowa Riverfront Project Area, 1973). The division is based on an aggregation of census tracts, using a combination of Real Estate Zones and Neighborhood Planning Units to construct housing subareas. The subareas thus designated are supposed to be, as the report writes, "identifiable by the community as responsible and viable neighborhoods", and, "acceptable as areas with unique socioeconomic characteristics" (1973, p.3). Twenty-seven subareas are delineated for the whole SMSA area and twenty lie within the study area of this thesis (1973, p.9) (Figure 3).

Another regionalization of Omaha is the city planning districts designated in the city's new 1989 master plan prepared by the Omaha City Planning Department and the Mayor's Office of Economic and Policy Development. Twelve planning districts were created. The plan was intended to promote growth and the services that Omahans want in each of 12 planning districts throughout the city (Figure 4).

A third regionalization was constructed by Dean (1973, p.156) in his M.A. thesis presented to the Department of Sociology, University of Nebraska at Omaha. In his regionalization, Dean used 68 variables for 79 census tracts from the 1960 Census. Ten dimensions were constructed, and the 79 tracts were classified into 17 hierarchical clusters based on their factor scores. On the census tract map each of the tracts was marked with its pattern of clustering. As a result, those neighboring tracts with the same cluster patterns formed a homogeneous social area (Figure 5).

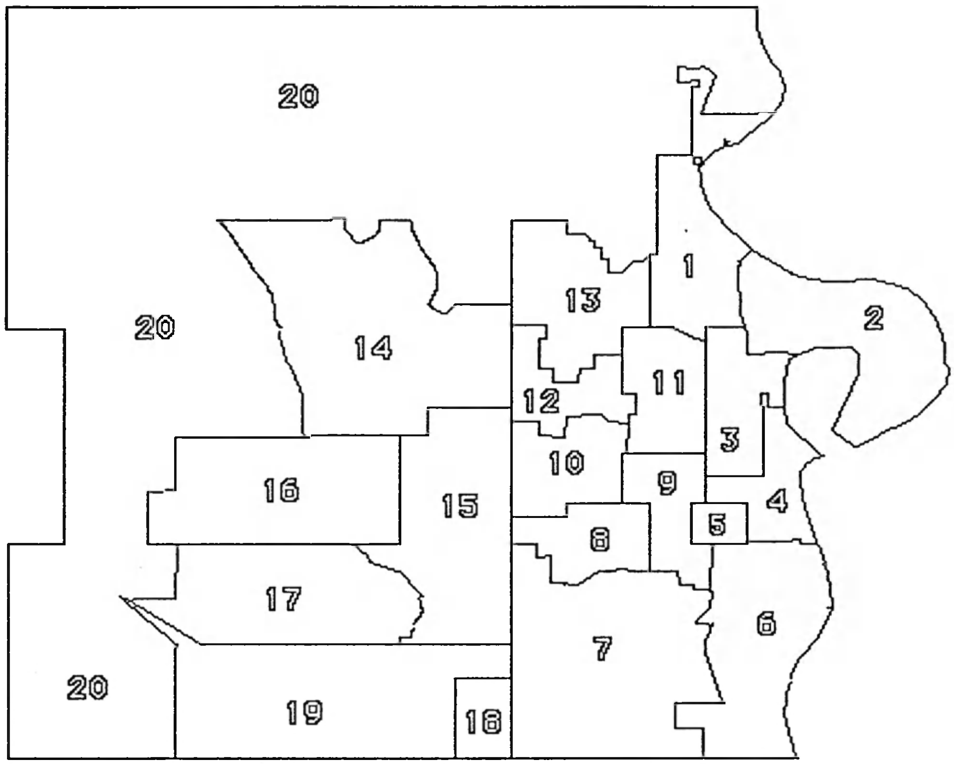
The first two regionalizations of the research area were constructed by urban planners and urban marketing analysts from Omaha, using field observation techniques. Their purposes, therefore, were pragmatic and the approaches were a "realistic combination" of residential districts. Without doubt, these regionalizations have served and are still serving the development of the city. They are also valuable references for understanding residential differentiation of the city.

The third regionalization mentioned above seems to be more objective but fails to identify realistic subareas accurately. The drawback which led to this failure was the use of the census tracts which are too big in areal size to define subareas accurately.

This study uses census block group data and the latest data processing and analytical techniques in an urban factorial ecology so that a finer-grained regionalization can be constructed with an objective approach. The field observation technique which is widely used in urban planning is important, but a more objective regionalization is also important. They must complement each other. Therefore, this study has application potential for urban planning and urban marketing analysis.

FIGURE 3

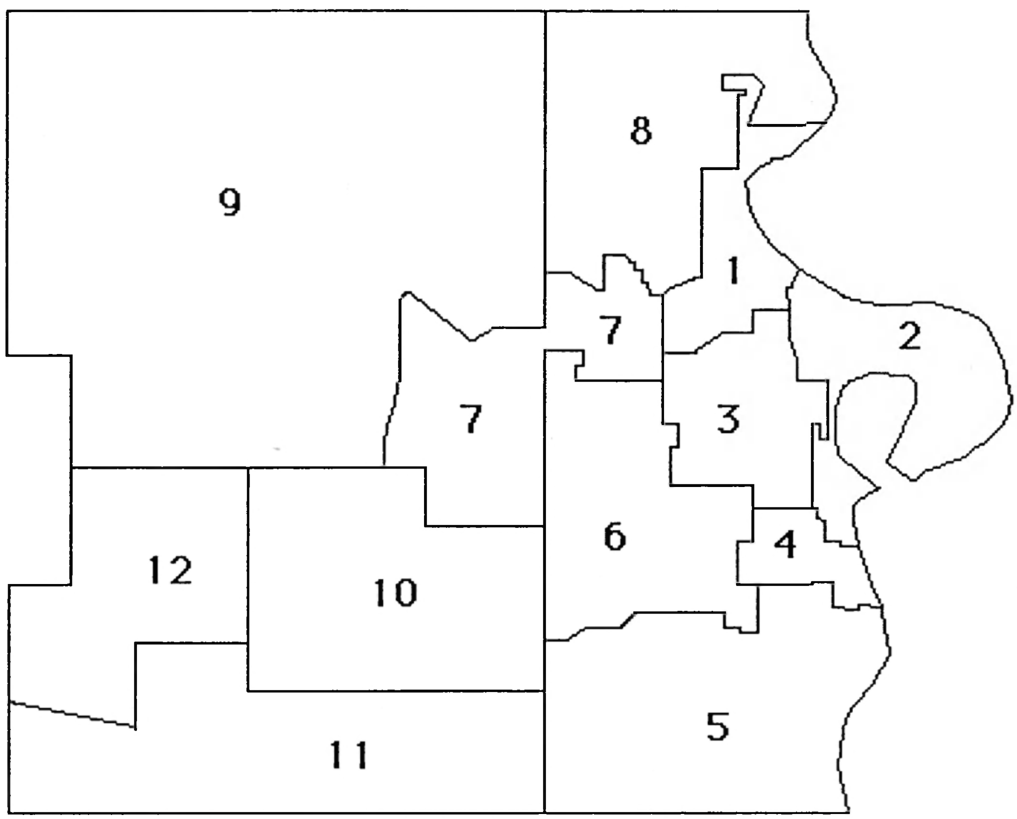
HOUSING SUB-AREAS IN THE RIVERFRONT DEVELOPMENT PROJECT 1973



1. FLORENCE-FORT
2. EAST OMAHA-CARTER LAKE
3. NORTH OMAHA COMMUNITY DEVELOPMENT
4. CBD-CREIGHTON
5. ST. MARY'S-PARK AVENUE
6. SOUTH OMAHA
7. AKSARBEN SOUTH
8. ELMWOOD PARK
9. CATHEDRAL-FIELD CLUB
10. FAIRACRES-DUNDEE
11. ADAMS-FONTENELLE PARK
12. BENSON
13. RUMMEL
14. KEYSTONE-WEST MAPLE
15. CROSSROADS-WESTSIDE
16. WESTROADS-BOYS TOWN
17. ROCKBROOK-BEL AIR
18. RALSTON
19. MILLARD-APPLEWOOD
20. PACIFIC HEIGHT-BENNINGTON

(Revised from: Housing and Community Development in the Nebraska-Iowa Riverfront Development Project Area, 1973)
Base map: census tract map of 1980 census

FIGURE 4
12 PLANNING DISTRICTS
OMAHA, 1989

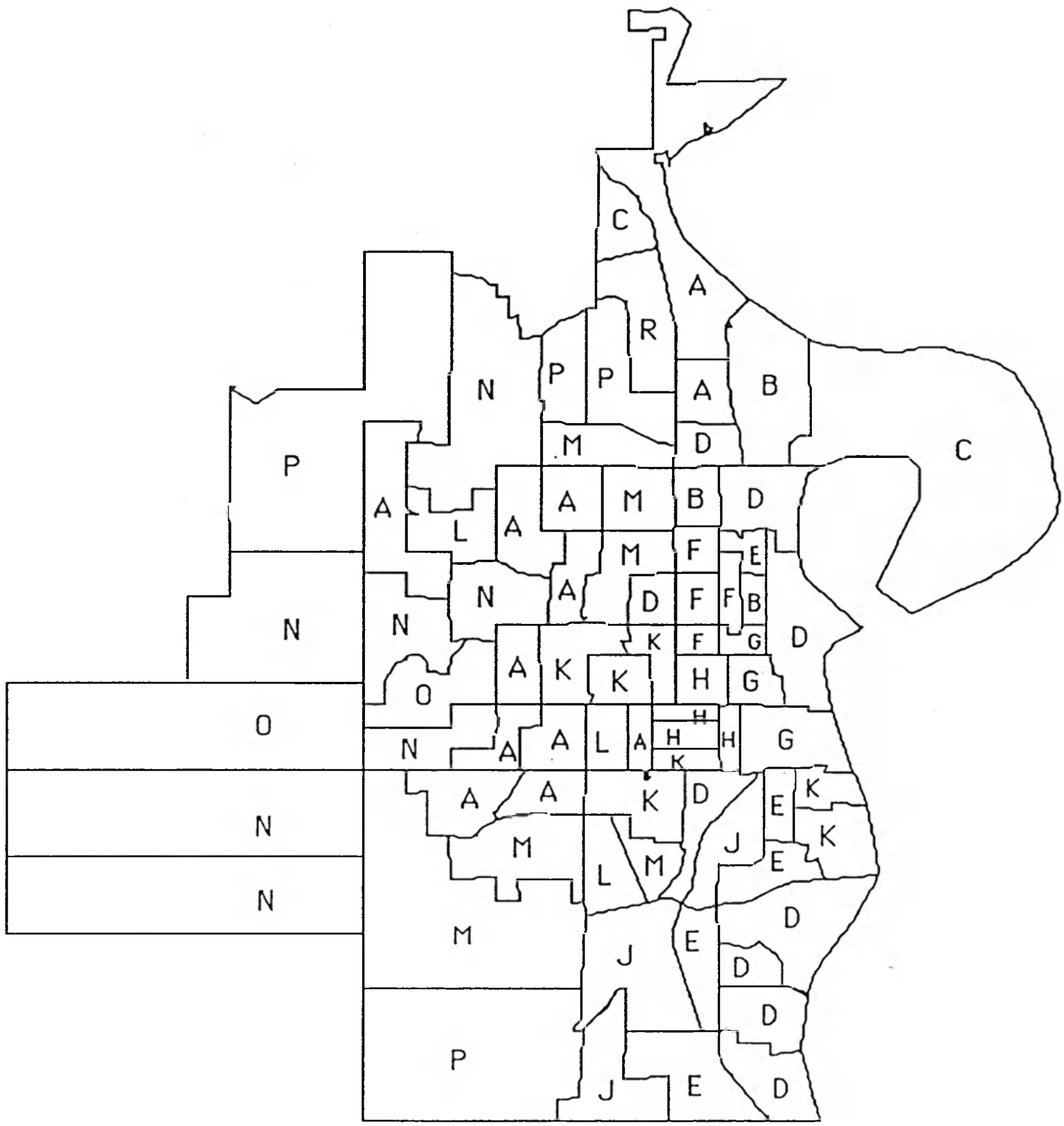


1. FLORENCE
2. EAST OMAHA
3. NORTH OMAHA
4. DOWNTOWN
5. SOUTH OMAHA
6. MIDTOWN
7. NORTHWEST
8. PONCA HILLS
9. NORTHWEST SUBURBAN
10. WEST OMAHA
11. SOUTHWEST
12. WEST SUBURBAN

(Revised from: Omaha World-Herald Metroextra, January 18, 1989)

FIGURE 5

SOCIAL AREAS OF OMAHA BY CENSUS TRACTS
USING 1960 CENSUS DATA



NOTE: Each letter is a plotting code for one cluster.
(Revised from: Dean, 1973)

CHAPTER FOUR
METHODOLOGY

AREAL UNIT OF ANALYSIS

The areal unit used in this study is the census-designated Block Group. A Block Group is an intermediate-sized areal unit between the Census Tract and the census Block. But the Block Group is the smallest areal unit of the census that has been digitized into standard XY coordinate files. In the research area there are 399 block groups. (The real number of block group sub-areas for mapping is 408 because some designated numbers of block groups have more than one designated subareas). The population size of the block groups ranges from 7 to 3884 (Figure 1, p.15). On average, a block group has 788 inhabitants.

SELECTION OF VARIABLES

Eighty-four variables are selected to describe the 399 block groups (Appendix B-Variable Code and Definition). The data base of the study thus consists of an 84 (variables) by 399 (block groups) matrix. The variables included deal with population composition, socioeconomic status, life stage and family status, ethnic status, housing, education-professional background, residential mobility, etc.

In terms of statistical measurement, the Kaiser's Measure of Sampling Adequacy (MSA) is used for deciding whether the input variables, both individual and as a whole, are appropriate for the factor model. The MSA is a summary of the size of the partial correlations relative to the ordinary correlations. Its value varies from a perfect score of +1.00 to as low as a minus value. Thus, the researcher is provided with a quantitative measurement of the applicability of factor analysis to the input data matrix, since it follows that when the data matrix represents a population and not a sample, what is being measured is not sampling adequacy, but its reciprocal--factor analytic applicability.

The overall Measure of Sampling Adequacy for the variable sets in this study is 0.79336. For individual MSA, only eight variables have values under 0.5, while forty-seven variables have values greater than 0.8 (Appendix C-The MSA Table). (In the SAS FACTOR procedure MSA values greater than 0.8 are considered "good" and under 0.5 are considered "poor"). Therefore, the input variables are appropriately included in the analysis as measured by the Measure of Sampling Adequacy.

ANALYTICAL PROCEDURES USED

All of the statistical analyses used in this study are performed with the SAS statistical package. Therefore, the exploration of the potential of the package for factorial ecologies is the major methodological concern in this study. Efforts have been focused on the selection of statistical procedures, the analytical options available in each individual procedure, and the format of outputs based on the specific needs of the research.

In addition to factor analysis, which extracts factors from the input variable matrix and computes factor scores on each of the factors for the areal units (that is, the factor score profile matrix of n factor scores by m areal units), a series of analytical techniques are used to deal with this factor score profile matrix. Among these analytical techniques are: two-way analysis of variance, one-way multivariate analysis of variance, cluster analysis (hierarchical and non-hierarchical), and discriminate analysis.

Accordingly, the SAS statistical procedures used are described as follows:

THE FACTOR PROCEDURE

The Factor procedure performs a principal factor analysis with oblique rotation for this study. The analytical results include a factor structure matrix, variance explained by each factor, final communality estimates, a factor score profile matrix, inter-factor correlations, the Kaiser's Measure of Sampling Adequacy, and a scree plot of eigenvalues .

In the procedure, by specifying PRIORS=SMC (squared multiple correlations are used for the prior communality estimates) a principal factor analysis is conducted. And, specifying ROTATE=PROMAX produces an orthgonal varimax prerotation followed by an oblique rotation. Other relevant outputs are produced by specifying the related analytical options. For examples, the MSA option produces the Kaiser's Measure of Sampling Adequacy, the SCREE option produces a scree plot of eigenvalues, and the SCORE option produces scoring coefficients. The OUTSTAT=FACT1 option saves the results in a file named FACT1.

A supplementary SAS procedure, the SCORE procedure is used to compute the factor score profile matrix, using the original input data and the scoring coefficients that were saved in FACT1. Then another SAS procedure, the PRINT procedure, is used to print out the factor score profile matrix, that is: 10 factor scores by 399 block groups. (Appendix D)

THE GLM PROCEDURE

There are two designs of the GLM procedure in this study. Those are: a two-way analysis of variance (Appendix E) and a one-way multivariate analysis of variance (Appendix F). Both are used for unbalanced analysis of variance for the factorial model of this study.

The two-way design with interaction is used to test whether the spatial variation of factor scores for each of the factors is characterized by zonal, sectoral, or cluster patterns.

In the design, CLASS statement specifies the two components in the factorial model: zones and sectors. MODEL statement specifies that three kinds of spatial variation patterns in the factorial model are tested: between zones, between sectors, and intercepts (Y=ZONES SECTORS ZONES*SECTORS). SS (sums of squares) options in the MODEL statement requests that the four types of SS be printed. Since the factorial model of this study is unbalanced with no missing values, Type III and Type IV estimable functions and associated tests are the same and applicable to the factorial model of this study. Therefore, the F values resulting from these two tests are used. Finally, the MEANS statement requests that the mean values by zones, sectors and intercepts be printed.

The one-way multivariate analysis of variance design is used to test whether the grouping of observations based on multiple variables has significant variance between groups rather than within groups.

In the design, CLASS statement specifies the groups for test (in this study, each group is a social area, and there are 24 social areas). MODEL statement specifies that each group for test has 10 variables (the 10 factor scores). MANOVA statement requests the GLM procedure enter a multivariate analytical mode using unbalanced data. H option in MANOVA statement specifies that the data matrices specified in the MODEL statement are used as hypothesis matrices. And SUMMARY option requests that analysis-of-variance tables for each variable be printed. Finally, the MEANS statement requests that the mean values on each of the 10 variables for the groups (social areas) be printed.

THE FASTCLUST PROCEDURE

The Fastclust procedure is used to cluster the 399 block groups based on their factor score profiles. With this procedure every block group is assigned to one and only one cluster. Therefore, this is a non-hierarchical clustering. This clustering of the block groups has two implications for the ecological analysis. First, each cluster represents one pattern of social space with a specific factor score profile. Second, social areas are formed by grouping those spatially adjacent block groups with the same cluster patterns.

The procedure (Appendix G) is designed to run the clustering analysis for three times to obtain good clusters from the large volume data matrix of this study (399 block group by 10 factor scores). The first run is a preliminary analysis, it classifies 20 clusters by specifying the MAXC=20 option. The cluster means for each of the 20 initial clusters are saved (by MEAN= option) as cluster seeds for the second-run analysis. Those cluster means from the initial clusters with less than 4 block groups are deleted (by DATA step with SET option), and the remaining cluster means are used as cluster seeds for a second-run clustering analysis. Those block groups which formed the low-frequency initial clusters are not used in the second-run analysis (by specifying STRICT= option). Eight clusters result from the second-run analysis. The third-run analysis is used to assign those block groups not used in the second-run analysis to the clusters so that all of the block groups are included in the clusters classified (by MAXITER= option).

THE CANDISC PROCEDURE

The Candisc procedure performs a canonical discriminant analysis using the output from the preceeding cluster analysis. The purpose of using this procedure in this study is to create a two-dimensional graph for displaying the separation of the eight multi-dimensional clusters classified in the preceding analysis.

In the procedure, the 10 variables (10 factor scores) for the clustering in the preceeding analysis are reduced to two canonical variables (by specifying NCAN= option) in such a way that the variance between the clusters is maximized while that within the clusters is minimized. And the procedure produces an output data set containing the scores on each of the two canonical variables for each block group (by specifying OUT= option). Then, the PLOT procedure plots a scatterplot of the block groups on this two-canonical-variables-axes graph to demonstrate the separation of the clusters classified (Appendix G).

THE CLUSTER PROCEDURE

The Cluster procedure performs a hierarchical cluster analysis to group the social areas into a hierarchical cluster tree based on their factor scores profiles. Each observation begins in a cluster by itself. The two closest clusters are merged to form a new cluster replacing the two old clusters. Merging of the two closest clusters is repeated until only one cluster is left. By tracing the clustering tree, the clustering distance between each pair of the social areas, and between each social area groups we can tell how far or close a social area, or a social area group, is from the others in terms of the factor score profiles.

In the procedure, the METHOD=SINGLE option specifies that the single linkage method is used for this analysis. To reduce chaining, some observations with extreme values must be omitted. The TRIM=10 option requests that 10 percent (the recommended value by the procedure designers) of the observations in the top range of the extreme values be trimmed. Therefore, 3 social areas are trimmed from the 24 social areas in this study. A supplementary SAS procedure, the TREE procedure, is used to plot out the tree diagram (Appendix H).

GRAPHIC OUTPUT

There are three kinds of graphic outputs in this study. The first kind is that illustrating the development and results of the analytical process. The second kind is that illustrating the researcher's interpretation of the results. The third kind is that showing areal distribution patterns by block group.

For the first kind, some output can be created directly by SAS analytical procedures in the form of printed output, and other output is created by additional SAS graphic procedures such as PLOT Procedure and TREE Procedure, using results from the analytical procedures. The second kind of output is the graphic illustration of the results drawn by the researcher to explain the implications of statistical analysis. The third kind of output is choropleth mapping by block groups.

The block group base map is created from the tape file of XY coordinates for block groups in Omaha (Geographic Data Technology, Inc., 1984). The Macintosh graphic program MapMaker (Select Micro Systems, Inc., 1988) is used to convert the XY coordinates into a block group boundary file, and to combine the boundary file with data files to create the map files of distribution patterns by block group. The MapMaker map files can be converted into MacDraw map files, and then into SuperPaint map files to improve the design styles of text, legend, and labelling.

METHODOLOGICAL STRENGTH OF THIS STUDY

The first strength of this study's methodology is that the use of the census block group data provides a finer-grained regionalization. Technically, grouping smaller areal units into social areas is similar to displaying a picture on an electronic screen with finer electronic cells. The more electronic cells used to form the picture, the clearer is the picture. There are only 103 census tracts in the research area. That number may not be adequate to define social areas. Whereas, 399 block groups may yield a better portrayal of the social areas.

In addition, census tracts may not be the appropriate areal unit to define social areas in terms of homogeneity. As the Riverfront Development Project Report acknowledged: "Although census tracts were established to identify homogeneous neighborhood groups, they have deteriorated in this neighborhood-identifying function with each succeeding census" (1973, p.8).

The second strength of the method is that the advantage of the SAS statistical package has yielded many meaningful statistical results from the analyses of the block group data sets used in this study. The SAS statistical package is powerful in dealing with large volume data sets and offers a variety of methodological options. In performing the analyses of this study, many methodological options in the procedures selected were tried before the final options were chosen so that the best results could be obtained.

The SAS User's Guide (1985 version, p.338) encourages users to try several options. For example, for factor analysis, "The choice among different rotations must be based on nonstatistical grounds. For most applications, the preferred rotation is that which is most easily interpretable" (SAS User's Guide, 1985, p.338). For cluster analysis, "you must ... decide whether the artificially generated clusters in the study resemble the clusters you suspect may exist in your data in terms of size, shape, and dispersion" (SAS User's Guide, 1985, p.65).

Finally, the computer mapping using the Macintosh computer, with the analytic results transferred from the VAX computer, has produced a variety of fine-quality block group maps. Many of actual residential districts and other linear features associated with some specific social characteristics are well displayed on the map.

The statistical results from SAS procedures on the VAX system are transferred to the Macintosh computer and entered into the Microsoft Excel application. Then MapMaker reads in the data sets from the Microsoft Excel application for choropleth mapping. As a result, the advantages from both systems are combined into the MapMaker maps through this linkage.

CHAPTER FIVE
SOCIAL DIMENSIONS

THE FACTORIAL PATTERN

The input data matrix of 84 variables by 399 observations (block groups) is analyzed by the SAS FACTOR procedure. Ten factors are retained for rotation; they explain about 84% of the total variance after the oblique rotation (Table 1). The correlations of the 84 variables with the 10 factors are shown in Appendix I (see footnote on next page). The first eight factors are interpreted into social dimensions, while the last two factors are left uninterpreted because of the relatively small proportion of total variance explained by them (based on their eigenvalues).

TABLE 1 FACTORS AND SOCIAL DIMENSIONS INTERPRETED

FACTORS	SOCIAL DIMENSION INTERPRETED	VARIANCE EXPLAINED
FACTOR 1	SUBURBAN AFFLUENT FAMILY STATUS	13.96
FACTOR 2	THE BLACK ETHNIC COMMUNITY	13.22
FACTOR 3	SUBURBAN ESTABLISHED FAMILY STATUS	10.91
FACTOR 4	HIGH SOCIOECONOMIC STATUS	10.69
FACTOR 5	RECENT GROWTH	7.79
FACTOR 6	MID-CITY WORKING FAMILY STATUS	6.90
FACTOR 7	ELDERLY AND LIVING ALONE	7.74
FACTOR 8	OLD HOUSING AND HISPANIC CLUSTERS	6.69
	SUBTOTAL OF VARIANCE EXPLAINED=	77.70 %
	RESIDUAL FACTORS	.
FACTOR 9	UNINTERPRETED	4.00
FACTOR 10	UNINTERPRETED	2.21
	TOTAL VARIANCE EXPLAINED=	83.91 %

The above factor pattern design is based on two criteria. The number of factors retained is based on the eigenvalues. The number of factors to be interpreted into social dimensions is based on the proportion of the total variance explained.

The scree plot of the eigenvalues (Figure 6) is used in this study to determine the number of factors to be retained. An eigenvalue is the sum of the squared loadings on the principal factors. It indicates how much variance is accounted for by each factor. On the plot, 84 eigenvalues for the maximum 84 factors form a dashed curve in the sequence of the factors. The point correspondent to the tenth factor is the break-point from where the eigenvalues of the remaining factors are much smaller. Therefore, the first ten factors are retained because they have much greater eigenvalues than the remaining factors.

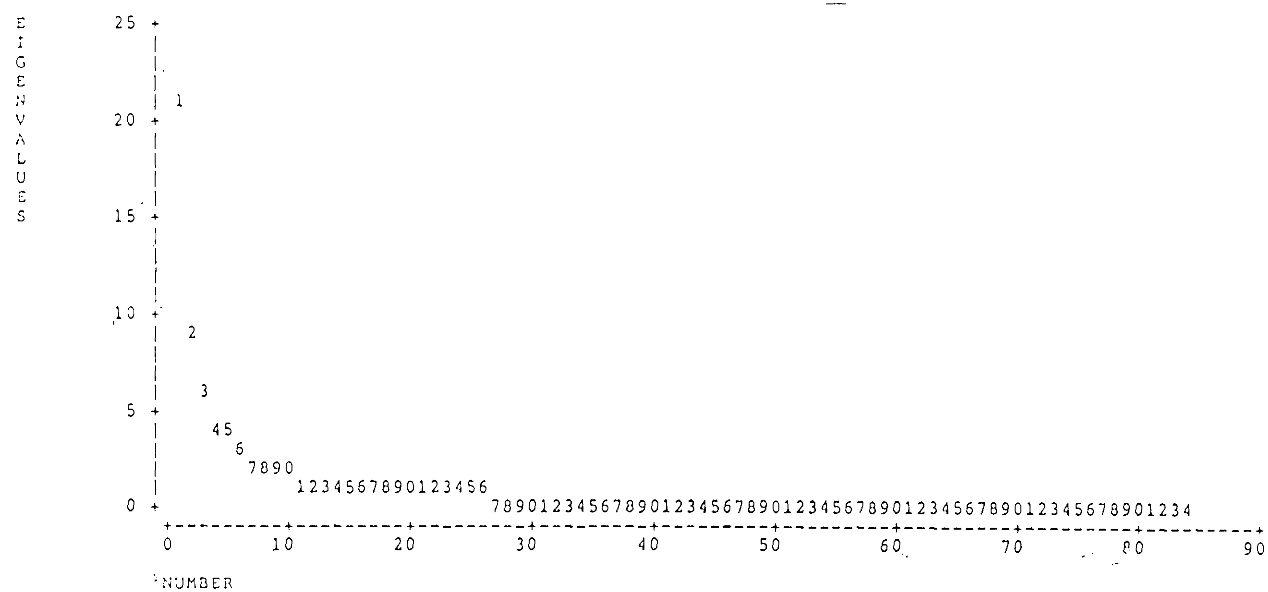
The determination of how many factors among those retained are interpreted into social dimensions depends on the proportions of the variance explained. Therefore, as the factors are arranged on the sequence of the proportions of the variance explained (Table 1), the factors on the "tail-end", which account for a minute proportion of the variance, are left uninterpreted.

A discussion of each of the factors thus isolated follows in this chapter.

Note: Appendix I shows the factor structure of this input data matrix, produced with the SAS Factor Procedure. Variables (in the first column) are arranged in such a way that those with highest loadings on Factor 1 (indicated by asterisks) are in the rows on the top of the column, and those on Factor 2 are in the next rows down the column, and so on.

FIGURE 6

SCREE PLOT OF THE EIGENVALUES



DESCRIPTION OF THE SOCIAL DIMENSIONS

DIMENSION 1: SUBURBAN AFFLUENT FAMILY STATUS

This social dimension isolates a group of variables associated with suburban married-couple family households, with high home and car ownership. Therefore, it is interpreted as "Suburban Affluent Family Status".

The most salient positive high-loading variables are "owner-occupied housing" (V54), "families/households ratio" (V13), "married-couple families" (V22), and "single-family dwelling" (V57) (Table 2). These tend to be non-central city characteristics. Such non-central city locations are indicated by the variables with high negative loadings: "units with 4 to 6 stories in structure" (V71), and "units with over 7 stories in structure" (V72). These two variables suggest that this dimension is the opposite of the areas with high-rise multi-story structures concentrated in the Mid-city and Downtown areas.

The factor score map for this dimension (Figure 7) demonstrates that there are two contrasting areas. The area with high positive scores is located near the western and southwestern fringe of the city, and the opposite area with high negative scores is located around the Downtown area. The map also shows that in the older city areas there are very few factor scores above positive 1.0, while most of the scores above positive 1.0 are located west of 72nd Street, or in the far northern part of the city east of 72nd Street. In other words, the high positive scores are located in the suburban areas.

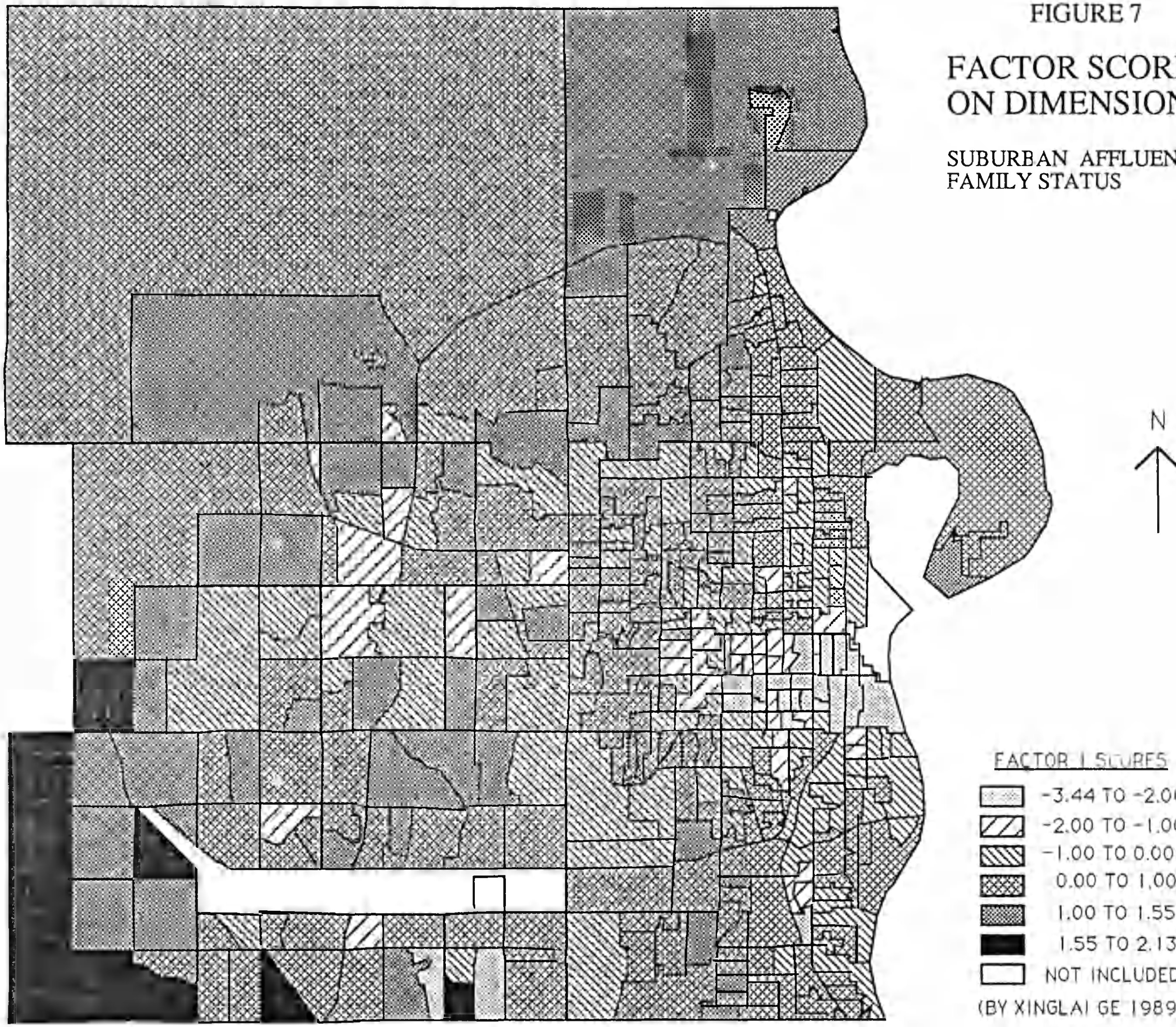
TABLE 2 FACTOR LOADINGS ON DIMENSION 1

VARIABLE CODE	VARIABLE DEFINITION	FACTOR LOADING
V54	% OWNER OCCUPIED HOUSING UNITS	92
V13	RATIO BETWEEN FAMILIES AND HOUSEHOLDS	90
V22	% MARRIED COUPLE FAMILIES	88
V57	% OF OWNER-OCCUPIED SINGLE-FAMILY DWELLING UNITS	75
V8	ROOMS PER UNIT	65
V30	% OF MARRIED COUPLE FAMILY HOUSEHOLDS WITHOUT OWN CHILDREN	58
V62A	% OF HOUSEHOLDS WITH TWO VEHICLES	57
V62	% OF HOUSEHOLDS WITH THREE OR MORE VEHICLES	55
V77	% OF OWNER-OCCUPIED HOUSING WITH ONE COMPLETE BATHROOM PLUS HALF BATH(S)	51
V27	% NON-FAMILY HOUSEHOLDS	-90
V55	% RENTER OCCUPIED HOUSING UNITS	-89
V56	% MULTI-FAMILY DWELLING UNITS	-88
V29	% ONE-PERSON HOUSHOLDS	-87
V63	% OF HOUSHOLD WITH ONE VEHICLE	-67
V64	% OF HOUSHOLDS WITHOUT VEHICLES	-58
V78	% SEPARATED OR DIVORCED	-57
V71	% OF UNITS WITH FOUR TO SIX STORIES IN STRUCTURE	-51
V50	% OF PERSONS BELOW POVERTY	-41
V72	% OF UNITS WITH OVER SEVEN STORIES IN STRUCTURE	-41
V33	% OF TENENTS HOUSEHOLDS MOVED INTO UNITS AFTER 1975	-34

FIGURE 7

FACTOR SCORES ON DIMENSION 1

SUBURBAN AFFLUENT FAMILY STATUS



DIMENSION 2: THE BLACK ETHNIC COMMUNITY

This dimension isolates a group of indicators typically associated with the Black ghetto areas (Table 3). The factor score map (Figure 8) shows that almost all of the high positive scores above 1.0 are concentrated around the Near North Side area where the Black community is located. Therefore, this dimension is interpreted as "Black Ethnic Community".

The most salient high-loading variables associated with this dimension are "families below poverty' (V51), "non-white population" (V15), "single-householder families" (V23), and the "Black population" (V14).

Other variables with high factor loadings further suggest that the community is characterized by poor housing (V73, V77, and V58), and deteriorated neighborhoods (V53). Family type is characterized by single parent families with own children (V24), and the separation and divorce rates are very high (V78). And, the socioeconomic status of the area is relatively low, characterized by relatively low family incomes (V42), lower paying occupations (V39), and high unemployment rates (V85).

The map indicates that the location of the core area of the community is between 42nd Street and 20th Street from west to east, and between Cumming Street and Ames Street from south to north. This core area is concentrated with block groups with factor scores above positive 2.0. Areas with positive factor scores between 1.0 and 2.0 extend from the core toward the northwest and north, which might indicate the direction of recent expansion of the Black ghetto. There is another isolated block group with a high positive factor score in the south-east Omaha area. This may be the beginning of a secondary core area.

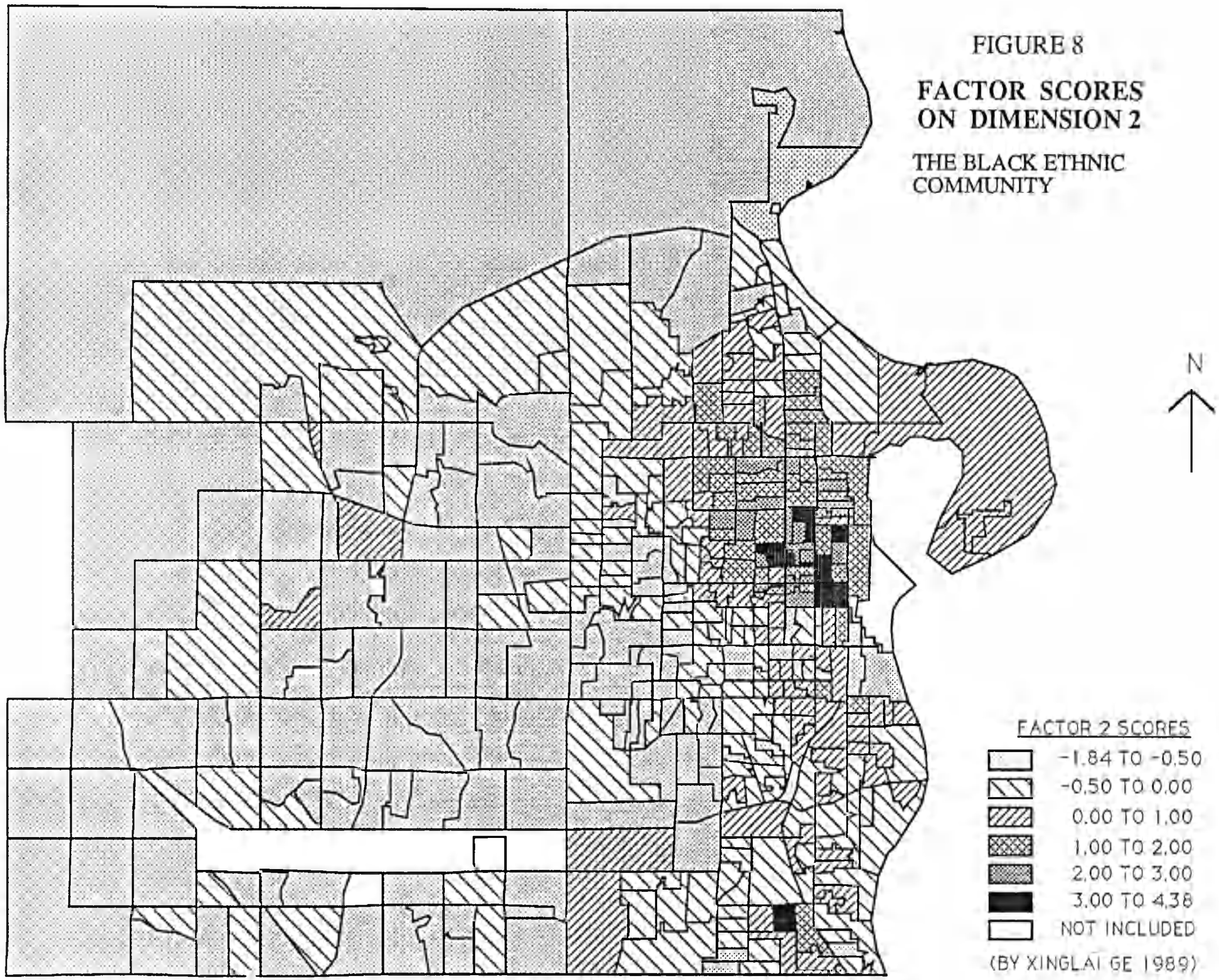
TABLE 3 FACTOR LOADINGS ON DIMENSION 2

VARIABLE CODE	VARIABLE DEFINITION	FACTOR LOADING
V51	% OF FAMILIES BELOW POVERTY	88
V15	% NON-WHITE	87
V23	% SINGLE-HOUSEHOLDER FAMILIES	87
V14	% BLACK	86
V49	% OF FAMILIES RECEIVING PUBLIC ASSISTANCE	85
V42	% WITH FAMILY INCOME UNDER 7,499	83
V24	% OF OWN CHILDREN IN SINGLE-PARENT HOUSEHOLDER FAMILIES	82
V50	% OF PERSONS BELOW POVERTY	81
V73	% OF UNITS WITHOUT AIR CONDITIONING	73
V39	% SERVICE OCCUPATION	61
V64	% OF HOUSEHOLDS WITHOUT VEHICLES	60
V87	% OF WORKERS WITH SOME UNEMPLOYMENT IN 1979	47
V63	% OF HOUSEHOLDS WITH ONE VEHICLE	47
V53	% OF HOUSING UNITS VACANT	45
V78	% SEPARATED OR DIVORCED	46
V85	UNEMPLOYMENT RATE	42
V6	MEDIAN FAMILY INCOME	-55
V52	PER CAPITA INCOME	-47
V45	% WITH FAMILY INCOME 25,000 - 34,999	-46
V22	% MARRIED-COUPLE FAMILIES	-42
V46	% WITH FAMILY INCOME 35,000 - 49,999	-40
V86	% OF FAMILIES WITH TWO OR MORE WORKERS	-40
V84	FEMALE WORKER PARTICIPATE RATE	-40
V58	MEAN VALUE OF OWNER-OCCUPIED NONCONDOMINIUM UNITS	-38
V77	% OF OWNER-OCCUPIED HOUSING WITH ONE COMPLETE BATHROOM PLUS HALF BATH	-33
V30	% OF MARRIED COUPLE FAMILY HOUSEHOLDS WITHOUT OWN CHILDREN	-32

FIGURE 8

FACTOR SCORES ON DIMENSION 2

THE BLACK ETHNIC COMMUNITY



DIMENSION 3: SUBURBAN ESTABLISHED FAMILY STATUS

The most salient high-loading variables associated with this dimension are those measuring the number of persons, families and housing units (variables No.1, No.2, No.7 and No.3) (Table 4). Therefore, areas with high factor scores on this dimension are the areas of relatively high number of population and housing units.

Another salient high-loading variable (V12) indicates that large number of children are born to the families in these areas. But by definition, the variable does not indicate whether these children are still living with their families or not. However, it does suggest that a high-fertility type of family exists in this kind of community.

Other variables with high factor loadings suggest that these areas contain housing units built relatively recently -- between 5 and 20 years old -- (newer than those in the older city, but older than those in the areas which are still undergoing development) (V67, V65), and that the dominant families in these areas are middle-income families with high-value housing units (V45, V58 and V73).

The factor score map (Figure 9) shows that areas with high factor scores above positive 1.0 are mostly outside the older (pre 1950) city (indicated in Figure 2) with the exception of one block group on the river front south of the downtown area, with positive score between 1.0 and 2.0. This exceptional block group is due to its population size. Figure 1, the Population map, on Page 15 indicates that this block group has the population size between 1501 to 2000, much larger than that of its vicinity block groups.

Factor scores on this dimension are sensitive to the population size because the variable indicating population size has the most salient factor-loading on the dimension (V1). On the whole, the dimension is associated with a group of inter-related characteristics of suburban established communities, and most of the high positive factor scores are concentrated in the suburban areas.

Therefore, this dimension is interpreted as "Suburban Established Family Status".

TABLE 4 FACTOR LOADINGS ON DIMENSION 3

VARIABLE CODE	VARIABLE DEFINITION	FACTOR LOADING
V1	NUMBER OF PERSONS	98
V2	NUMBER OF FAMILIES	97
V7	NUMBER OF HOUSING UNITS	94
V3	NUMBER OF HOUSEHOLDS	94
V58	MEAN VALUE OF OWNER-OCCUPIED NONCONDOMINIUM UNITS	86
V12	NUMBER OF CHILDREN EVER BORN TO WOMEN AGED 15 TO 44	85
V67	% OF STRUCTURES BUILT BETWEEN 1960 AND 1974	62
V45	% WITH FAMILY INCOME 25,000 TO 34,999	43
V65	% OF STRUCTURES BUILT BEFORE 1940	-54
V73	% OF UNITS WITHOUT AIR CONDITIONING	-48

FIGURE 9

FACTOR SCORES ON DIMENSION 3

SUBURBAN
ESTABLISHED
FAMILY STATUS

DIMENSION 4: HIGH SOCIOECONOMIC STATUS

The most salient high-loading variables on this dimension are "median family income" (V6), "four or more year college education" (V36), "family income over $50,000" (V47), "per capita income" (V52), and "managerial and professional occupation" (V37) (Table 5). These characteristics are particularly associated with the urban elites in the city. Therefore, this dimension is interpreted as "High Socioeconomic Status".

Other variables with high factor loadings indicating income levels are "family income of $35,000 - 49,999" (V46) with medium high positive loading, and "family income of $7,500 - 14,999" (V43) and "family income under $7,499" (V42) with negative loadings. With all these income-indicator variables, the factor scores on this dimension can be used to estimate socioeconomic status for each of the block groups. For example, the block groups with high positive scores should have more families with income over $50,000 and less families with income of $35,000 to 49,999, while those with medium high positive scores should have more families with income of $35,000 to 49,000 and less families with income over $50,000. This is because the variable representing income level of over $50,000 has much higher positive loading on the dimension than that representing income level of $35,000 to 49,999. And, the areas with negative scores are dominated by low income families because the variables representing low income levels have high negative loadings on this dimension.

The factor score map (Figure 10) shows that there are two areas of block groups with high positive factor scores from 2.0 to 3.0, and above positive 3.0. One is between West Dodge Road and West Center Street from north to south and between 84th Street to 130th Street from east to west. The other is around the Memorial Park and Happy Hollow street area.* These two areas should have many high-income families (over $50,000 incomes).

There are another two areas of block groups with medium high positive factor scores from 1.0 to 2.0. One is in the western part of the city between Blondo Street and Center Street. The other is in the northern part of the areas east of 72nd Street. These two areas should have many medium-high-income families ($35,000 to 49,000 incomes).

Almost all of the central city areas have factor scores below 0.0. These areas are areas with lower income families.

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*: One technical problem concerning this map is that there are three block groups with solid black shading at the west edge of the map. These three block groups in the block group designation of Omaha SMSA belong to a same block group code. Therefore in this mapping process they are assigned the same value. And the value comes from the upper block group polygon. The lower two block groups simply repeat the same value of the upper one, they do not have their own values.

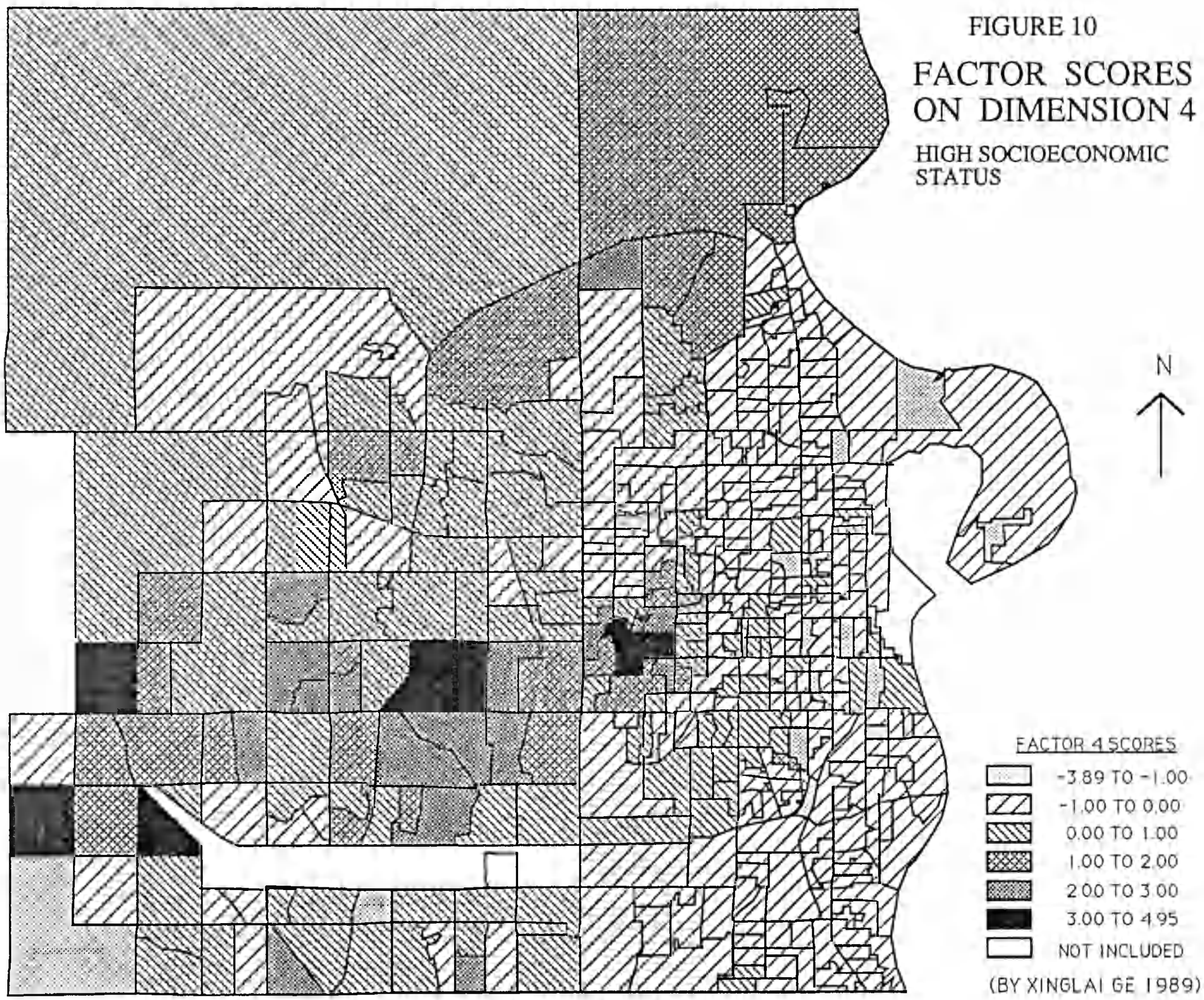
TABLE 5 FACTOR LOADINGS ON DIMENSION 4

VARIABLE CODE	VARIABLE DEFINITION	FACTOR LOADING
V6	MEDIAN FAMILY INCOME	83
V36	% WITH COLLEGE OF FOUR OR MORE YEARS	77
V47	% WITH FAMILY INCOME OVER 50,000	76
V52	PER CAPITA INCOME	76
V37	% IN MANAGERIAL AND PROFESSIONAL OCCUPATIONS	74
V11A	MEDIAN SELECTED MONTHLY OWNER COST WITH A MORTGAGE	64
V46	% WITH FAMILY INCOME 35,000 - 49,999	62
V11B	MEDIAN SELECTED MONTHLY OWNER COST NOT MORTGAGED	58
V74	% OF OWNER OCCUPIED HOUSING WITH FIVE OR MORE BEDROOMS	40
V43	% WITH FAMILY INCOME 7,500 - 14,999	-43
V41	% IN OPERATOR, FABRICATOR, AND LABORER OCCUPATIONS	-41
V42	% WITH FAMILY INCOME UNDER 7,499	-39

FIGURE 10

FACTOR SCORES ON DIMENSION 4

HIGH SOCIOECONOMIC STATUS



DIMENSION 5: RECENT GROWTH

This dimension isolates those areas which are still in the process of recent urbanization. The most salient high-loading variables are "households moved into units after 1975" (V33) and "structures built after 1975" (V68) (Table 6). Another salient high negative loading variable is "households moved into units before 1970" (V31), which further suggests that most of the residential growth has occurred during the previous 10 year census period. The other two high negative loading variables "structures built between 1940 to 1960" (V66) and "structures built before 1940" (V65) reinforce the newness of housing in the areas. Therefore, this dimension is specifically associated with recent urban development -- "Recent Growth".

In addition, the positive high-loading variable "persons in same county five years and over" (V69) suggests that this recent residential development is mainly from intra-city population movement, because this variable refers to the population who have been in the same county over five years.

Another group of high-loading variables suggest that the dimension is associated with a population of young or middle ages, indicated by the variable with positive loading "population aged 24 to 44" (V19), and by the variables with negative loadings "persons aged 45 to 64" (V20), "families with social security income" (V48), and "percent of widowed" (V79).

The factor score map (Figure 11) shows that areas with high positive scores between 2.0 to 3.0 and above 3.0 are spread along the western city limits, coinciding with the west edge of "Present Development Zone" designated in the "Omaha Urban Development Policy, 1986 edition"

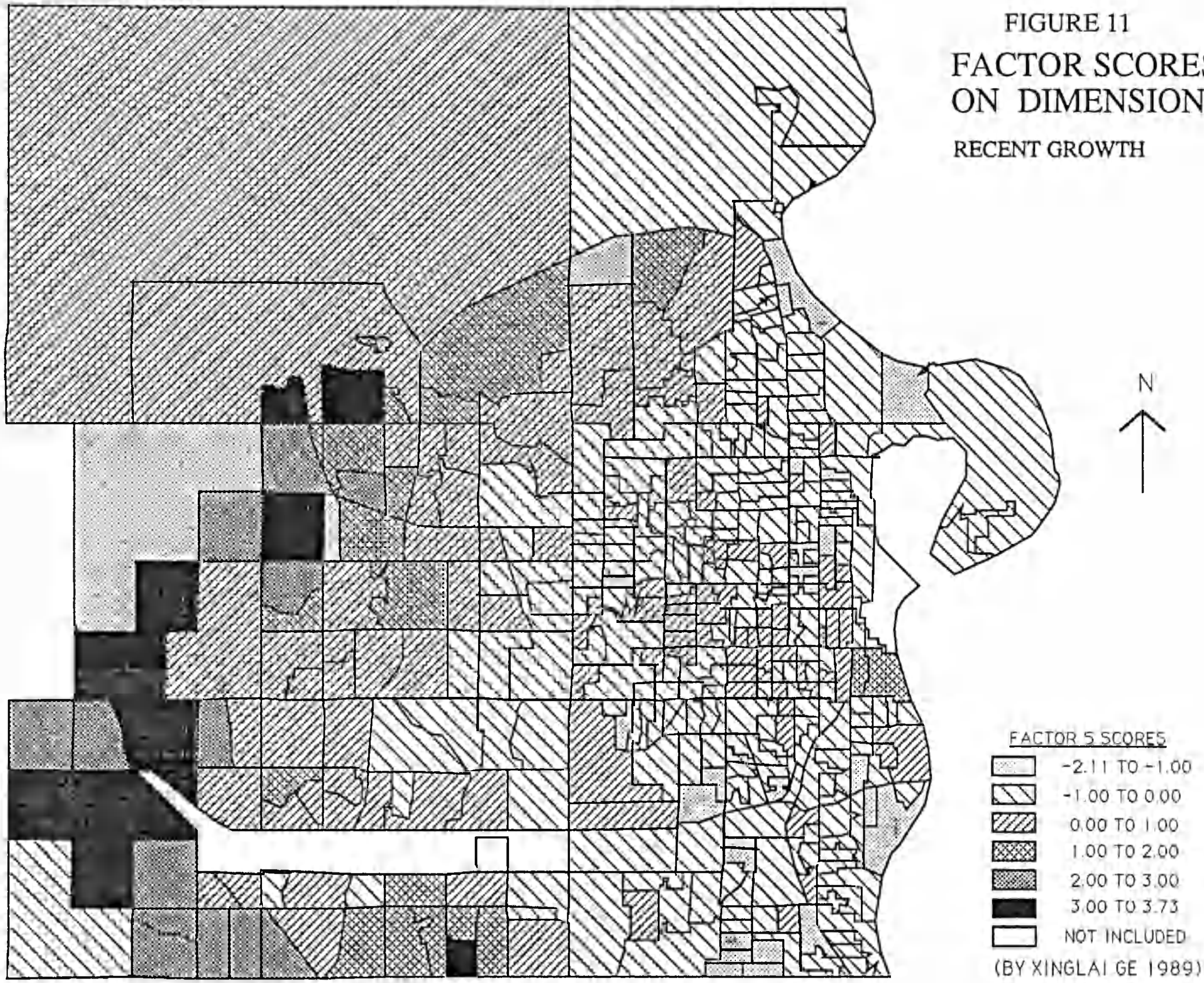
(Appendix J). As suggested by these high positive scores, it is only recently that most of the housing units have been built and most of the households have moved in to these areas. It can be inferred that the areas are undergoing a process in which agricultural or other vacant land is being converted into urban residential areas.

In the older city areas, there are no factor scores above positive 1.0 with the exception of the Downtown area where there are two block groups with positive scores between 1.0 and 2.0. This may indicate areas where Downtown redevelopment programs have occurred.

TABLE 6 FACTOR LOADINGS ON DIMENSION 5

VARIABLE CODE	VARIABLE DEFINITION	FACTOR LOADING
V33	% OF TENURE HOUSEHOLDS MOVED INTO UNITS AFTER 1975	8 2
V68	% OF STRUCTURES BUILT AFTER 1975	8 0
V19	% OF POPULATION AGED 24 - 44	6 8
V69	% OF PERSONS IN SAME COUNTY FIVE YEARS AND OVER	4 9
V31	% OF TENENTS HOUSEHOLDS MOVED INTO UNITS BEFORE 1970	- 8 1
V48	% OF FAMILIES WITH SOCIAL SECURITY INCOME	- 5 3
V66	% OF STRUCTURES BUILT BETWEEN 1940 - 1960	- 4 9
V20	% OF PERSONS AGED 45 - 64	- 4 9
V65	% OF STRUCTURES BUILT BEFORE 1940	- 4 7
V35	% WITH EIGHT YEAR ELEMENTARY SCHOOL EDUCATION	- 4 4
V79	% WIDOWED	- 3 6

FIGURE 11
FACTOR SCORES ON DIMENSION 5
RECENT GROWTH



DIMENSION 6: MID-CITY WORKING FAMILY STATUS

A group of variables with salient high-loadings on this dimension are "family income of $15,000 to 24,999" (V44), "four year high school education" (V34), "technical, sales, and administrative support occupation" (V38) and "female worker participation rate" (V84). These variables have positive loadings from 0.69 to 0.60. They reveal a specific relationship between female workers, family income level, educational background and occupation characterizing the research area. Two other variables with high positive loadings, "families with two or more workers" (V86) and "female laborers with own children under six year old" (V26) further suggest that this dimension is associated with working families characterized by high female worker participation rates but relatively lower family income (Table 7).

Rees once commented that female labor force participation is a complexly determined phenomenon in the American city; it should not be used as a simple indicator of family status (1979, p.66). It might be related to family status in certain cases while related to socioeconomic status in some other cases. In the case of this study, it seems that it is related to both. As Table 7 shows, this dimension has high loadings on variables related to socioeconomic status (V44, V34, V38), but also has high loadings on family-status-related variables (V86 and V26). In addition, Appendix H-Factor Structure shows that a family-status-related variable "ratio between families and households" (V13) also has a relative high correlation with the dimension, with positive 0.38. In this sense, this dimension should be a socioeconomic-related family status.

The factor score map (Figure 12) shows that the areas with the highest positive scores above 1.0 are scattered in discrete pockets from southwest to northeast approximately across the middle part of the city. Most of the positive scores between 0.5 and 1.0 are also concentrated in the middle parts of the city. The Downtown and the Near North Side (the Black community) areas are concentrated with high negative factor scores. High negative scores are also concentrated in the far western and southwestern parts of the research area.

Therefore, this dimension is interpreted as "Mid-City Working Family Status".

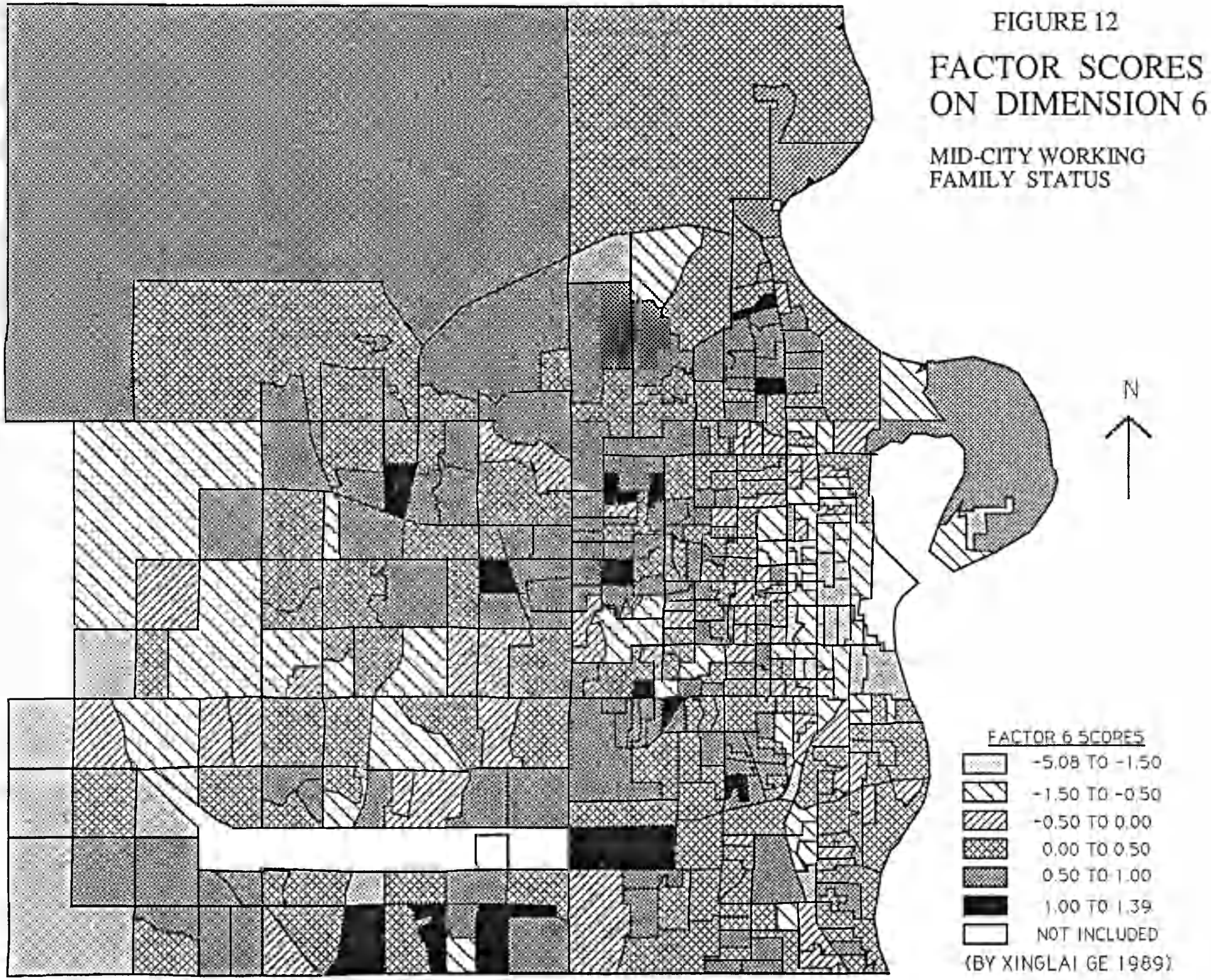
TABLE 7 FACTOR LOADINGS ON DIMENSION 6

VARIABLE CODE	VARIABLE DEFINITION	FACTOR LOADING
V44	% WITH FAMILY INCOME 15,000 - 24,999	69
V34	% WITH FOUR YEAR HIGH SCHOOL EDUCATION	66
V38	% IN TECHNICAL,SALES, AND ADMINISTRATIVE SUPPORT OCCUPATIONS	60
V84	FEMALE WORKER PARTICIPATION RATE	60
V70	% OF UNITS WITH 1 TO 3 STORIES IN STRUCTURE	57
V86	FAMILIES WITH TWO OR MORE WORKERS	55
V26	% OF FEMALE LABOR WITH OWN CHILDREN UNDER SIX YEAR OLD	48
V10	MEDIAN GROSS RENT	47
V9	PERSONS PER ROOM	-51

FIGURE 12

FACTOR SCORES ON DIMENSION 6

MID-CITY WORKING FAMILY STATUS



DIMENSION 7: ELDERLY AND LIVING ALONE

The most salient high-loading variables on this dimension are "persons aged over 65 and under 5" (V21), "percent of widowed" (V79), and "families with social security income" (V48). These variables have factor loadings above positive 0.8. They indicate that this dimension is associated with the elderly. Another three age-related variables with high negative loadings are "persons aged 5 to 17" (V18), "persons aged 25 to 44" (V19), and "number of children ever born to women aged 15 to 44" (V12). These three variables further suggest that this dimension is exclusive of youngsters (V18), persons at working age (V19), and women at child-bearing age (V12) (Table 8).

There are four variables with high positive factor loadings indicating the family types of those elderly. They are "one-person households" (V29) and "non-family households" (V27) with positive loadings, and "ratio between families and households" (V13) and "number of families" (V2) with negative loadings. Therefore, living alone (V79 and V29), or living with other non-family-members (V27) are the main family types for those elderly.

Some other variables with high loadings suggest that the location of areas with high factor scores on this dimension is around the Downtown area, which is characterized by high rise elderly homes. The variable "units with over 7 stories in structure" (V72) with positive loading 0.61 is an unique characteristics of the Downtown areas. The variables "structures built between 1960 to 1974 (V67) with negative loading 0.36 indicates that the areas with high factor scores on this dimension is non-suburban areas, because the suburbanization process started during the 1960s.

The factor scores on this dimension are useful for deciding the age characteristics for the residents in any part of the research area. The areas with high positive scores are concentrated with elderly because the variables indicating elderly have high positive factor loading on this dimension. On the other hand, the areas with high negative scores are areas with younger residents because the variables indicating youngsters have high negative factor loadings on this dimension. In other words, as the factor scores decrease from high positive to high negative, the average age of the residents in the areas decreases from elderly to the young.

The factor score map (Figure 13) shows that there are two areas with the highest positive scores (above 2.0). One is in and near the Downtown area and the other is in the Near North Side area. Otherwise few other areas have those high positive scores. On the other hand, the high negative scores are concentrated in the western and southwestern areas, and the far northern parts of the areas east of 72nd Street. Factor scores between 0.0 and positive 1.0 are concentrated in the mid-city areas and South Omaha areas. This factor score distribution pattern clearly indicates that the age of the residents decrease from east to west and southwest.

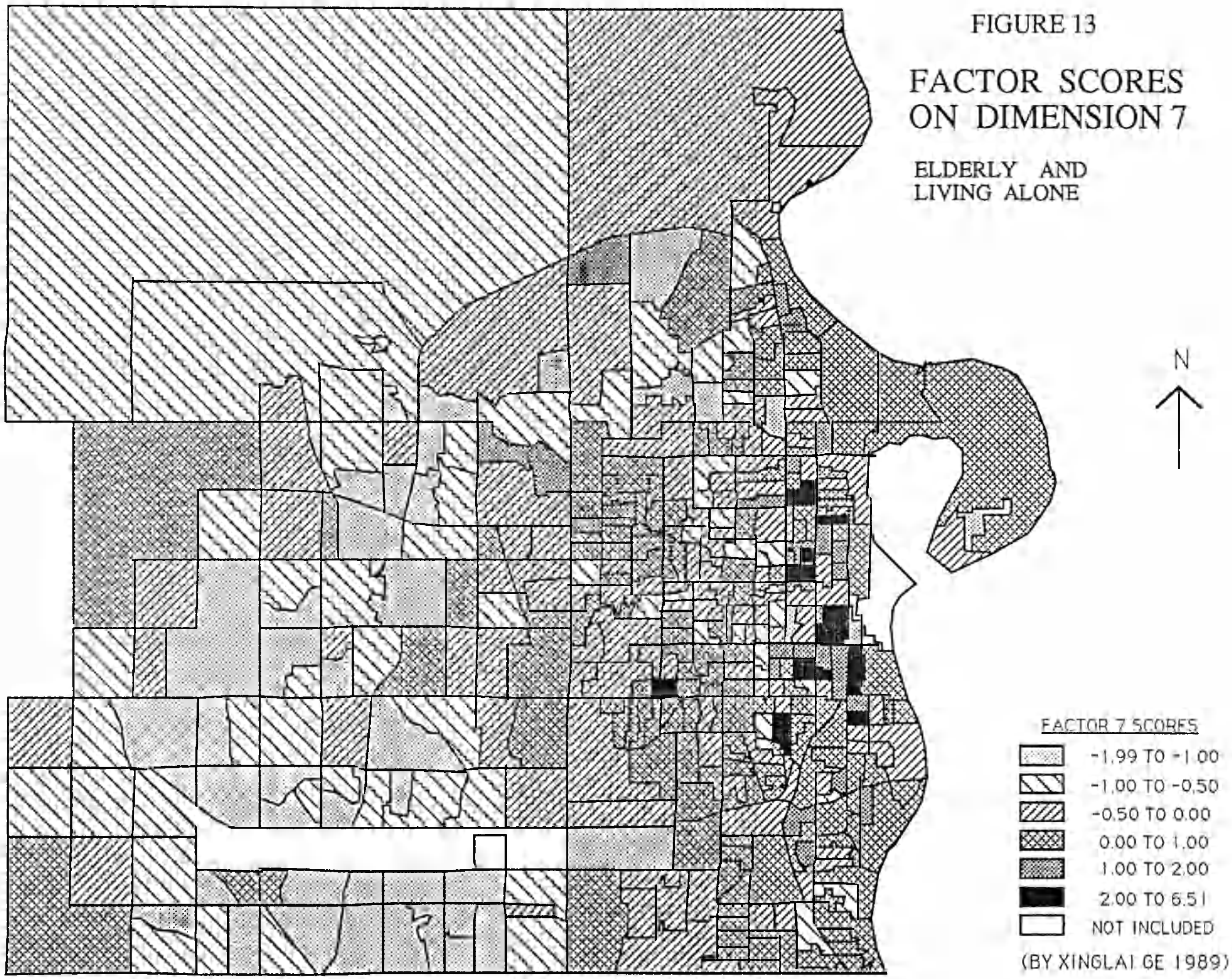
TABLE 8 FACTOR LOADINGS ON DIMENSION 7

VARIABLE CODE	VARIABLE DEFINITION	FACTOR LOADING
V21	% OF PERSONS AGED OVER 65 AND UNDER 5	8 2
V79	% WIDOWED	8 1
V48	% OF FAMILIES WITH SOCIAL SECURITY INCOME	8 1
V64	% OF HOUSEHOLDS WITH NO VEHICLES	6 2
V72	% OF UNITS WITH OVER 7 STORIES IN STRUCTURE	6 1
V29	% ONE-PERSON HOUSEHOLDS	5 3
V27	% NON-FAMILY HOUSEHOLDS	5 0
V63	% OF HOUSEHOLDS WITH ONE VEHICLE	4 7
V18	% OF PERSONS AGED 5 TO 17	- 4 7
V13	RATIO BETWEEN FAMILY AND HOUSEHOLD	- 4 1
V84	FEMALE WORKER PARTICIPATION RATE	- 4 0
V70	% OF UNITS WITH 1 TO 3 STORIES IN STRUCTURE	- 3 9
V11A	MEDIAN SELECTED MONTHLY OWNER COST, WITH A MORTGAGE	- 3 8
V12	NUMBER OF CHILDREN EVER BORN TO WOMEN AGED 15 TO 44	- 3 8
V67	% OF STRUCTURES BUILT BETWEEN 1960 TO 1974	- 3 6
V19	% OF PERSONS AGED 25 TO 44	- 3 4
V62A	% OF HOUSEHOLDS WITH TWO VEHICLES	- 3 3
V2	NUMBER OF FAMILIES	- 3 2

FIGURE 13

FACTOR SCORES ON DIMENSION 7

ELDERLY AND LIVING ALONE



DIMENSION 8: OLD HOUSING AND HISPANIC CLUSTER

The most salient high-loading variables on this dimension are "8 year elementary school education"(V35) and "structures built before 1940" (V65), with positive loadings 0.64 and 0.65 respectively. They indicate older housing areas and the residents with relatively little eduction. Another salient high-loading variable "people with Spanish origin" (V16) suggests that this dimension is associated with Hispanic ethnic population (Table 9).

There is a group of variables with high-loadings indicating the socio-economic status related to this dimension. These variables are "operator, fabricator, and laborer occupation" (V41), "family income of $7,500 to 14,999" (V43), and "precision production, craft, and repair occupation" (V40) with positive loadings, and "managerial and professional occupation" (V37) with a negative loading. Therefore, this dimension is also associated with the lower-income working class population.

Another variable with a positive loading of 0.32, "persons aged 45 to 64" (V36), suggests that the age characteristics associated with this dimension tends to be higher than other dimensions except dimension 7.

This dimension is interpreted as "Old Housing and Hispanic Cluster". Such interpretation implies that the two characteristics are related. However, it must be reminded that some areas characterized by old housing but with no population with Spanish origin may also have relative high factor scores on this dimension because the variable indicating the old housing has the highest loading (much higher than that of the variable indicating Spanish origin) on the dimension. Only the areas with the highest factor scores on this dimension are associated with the two characteristics.

The factor score map (Figure 14) shows that the areas with highest positive factor scores are concentrated in South Omaha area, where there is a concentration of about 70% of the block groups with scores over positive 1.0, and almost all block groups with over positive 2.0.

Most of the high negative scores are located west of the 72nd St. However, there are two block groups in the Downtown with high negative scores, this is because the Downtown area is not the real old-housing area due to the downtown redevelopment programs and because the Downtown area is associated with Dimension 7-Elderly and Living Alone.

Low positive factor scores are located in the areas east of the 72nd Street except South Omaha areas. These low positive scores in the older city areas tend to be scattered with other discrete pockets of negative scores, particularly in the areas between 72nd Street and 42nd Street. This indicates that the areas are the transition zone between the older city and the newer suburbs.

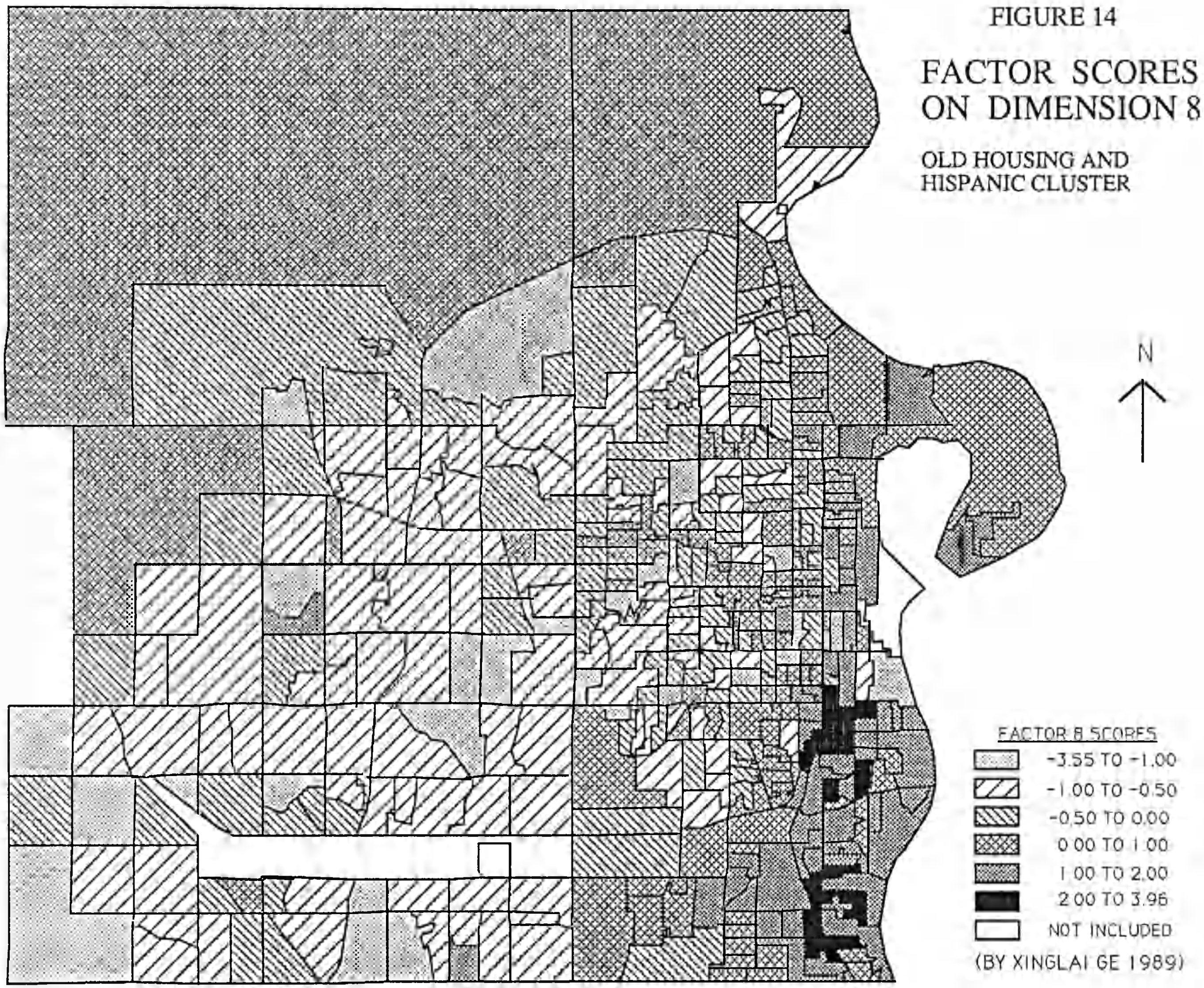
TABLE 9 FACTOR LOADINGS ON DIMENSION 8

VARIABLE CODE	VARIABLE DEFINITION	FACTOR LOADING
V65	% OF STUCTURES BUILT BEFORE 1940	6 5
V35	% WITH EIGHT YEAR ELEMENTARY SCHOOL EDUCATION	6 4
V16	% OF PEOPLE OF SPANISH ORIGIN	5 9
V17	% OF PERSONS 5 YEAR OLD SPEAKING A LANGUAGE OTHER THAN ENGLISH AT HOME	5 7
V41	% OF PERSONS WITH OPERATOR, FABRICATOR, AND LABORER OCCUPATIONS	5 5
V43	% WITH FAMILY INCOME OF 7,500 TO 14,999	5 1
V40	% OF PERSONS WITH PRECISION PRODUCTION, CRAFT, AND REPAIR OCCUPATIONS	3 8
V83	% OF PERSONS IN CARPOOL	3 5
V20	% OF PERSONS AGED 45 - 64	3 2
V36	% WITH FOUR OR MORE YEAR COLLEGE EDUCATION	- 4 8
V37	% OF PERSONS WITH MANAGERIAL AND PROFESSIONAL OCCUPATIONS	- 4 6

FIGURE 14

FACTOR SCORES
ON DIMENSION 8

OLD HOUSING AND
HISPANIC CLUSTER



SUMMARY OF THE SOCIAL DIMENSIONS

The description of the social dimensions above has revealed an overall social structure that emerged from a factor analysis of the census Block Group data for the Omaha area. A summary of these social dimensions is further discussed in this section so that the identity and differentiation in social structure between the Omaha area and other American cities can be recognized.

THE COMPARABILITY IN SOCIAL DIMENSIONS BETWEEN OMAHA AND OTHER AMERICAN CITIES

One dimension in this study -- Dimension 4-High Socioeconomic Status -- is based on socioeconomic status. The variables with high loadings on this dimension are those indicating income, occupation, and educational background which have been commonly recognized as typical socioeconomic-status indices. This finding confirms Rees' conclusion that socioeconomic status would emerge as a universal dimension in American cities (1979, p.80).

Second, four dimensions are interpreted as family status in this study. These are: Dimension 1-Suburban Affluent Family Status, Dimension 3-Suburban Established Family Status, Dimension 6-Mid-city Working Family Status, and Dimension 7-Elderly and Living Alone. For these dimensions, the variables with high-loadings include those indicating age, family types, child-bearing, female worker participation, and dwelling patterns which are often used as family-status indices for factorial ecological studies.

Rees confirmed that the patterns of family status found by Adams could be regarded as general patterns of family status found in the factorial ecological studies of American cities (1979, p.249). These patterns are:

I. Young, Footloose Cosmopolites
II. Blue Collar Working Class Families
III. Rising Young Families
IV. Mature Established Families
V. Aged Declining Families

It is interesting that the four family-status dimensions interpreted in this study are comparable to the factors recommended by Rees (from the second to the fifth patterns respectively; No.2 family status is correspondent to Dimension 6 in this study, No.3 to Dimension 1, No.4 to Dimension 3, and No.5 to Dimension 7).

Moreover, the general spatial patterns of family status described by Rees for American cities (1979, p.231-460) are also comparable to those displayed by the four family-status related dimensions in this study. As displayed in the factor score maps in the previous section, the four dimensions all show a spatial pattern of concentric variation. Dimension 7-Elderly and Living Alone, concentrates its highest positive scores in the center of the city. Dimension 6-Mid-city Working Family Status, concentrates its highest scores in a ring across the central city. Dimension 3-Suburban Established Family Status, concentrates its highest scores in a ring outside the central city. And, Dimension 1-Suburban Affluent Family Status, concentrates its highest scores in an outer suburban ring.

In addition, two ethnic-status dimensions are interpreted in this study. They are Dimension 2-the Black Ethnic Community, and Dimension 8-Old

Housing and Hispanic Cluster. For these two dimensions, the variables with high loadings include the ethnic indicators and a group of variables indicating the related socioeconomic status.

Rees examined the educational and income differentials between non-whites and whites, and between whites of Spanish surname and whites of non-Spanish surname for his 13 selected American cities (1979, p.354-73). His results clearly demonstrate that both minority groups are disadvantaged vis a vis Anglos. Such disadvantages are also clearly displayed by the two ethnic-status related dimensions in this study.

Finally, one dimension, Dimension 5-Recent Growth, is based on population mobility and age of housing in this study. The salient high-loading variables on this dimension indicate that the dimension is specifically associated with the recently-move-in households and recently-built housings.

The deviation between this dimension and the housing dimensions Rees generalized from his study of 13 selected American cities (1979, p.84-125) is that in Rees' study the housing dimensions are associated with a group of variables indicating housing values, housing conditions, housing types and size, tenure types, as well as housing age; while in this study the dimension is specifically associated with recently-built housing and recently-move-in residents instead of other housing and tenure characteristics. Therefore, the dimension in this study may suggest an ongoing process of recent urban development in the Omaha area, which has significant impacts on the spatial differentiation of the city.

It can be concluded that on the whole the social dimensions of the Omaha area are comparable to that of other American cities; on the other hand, some local characteristics can also be found in the dimensions of the Omaha area.

SOCIAL CLASS STRUCTURE SUGGESTED

The factor structure of this study demonstrates that the variables of socioeconomic-status are associated with different social dimensions to form different groups of income levels, educational background, and occupations as displayed in Table 10. This may suggest a social class structure for the Omaha area:

TABLE 10 SOCIAL CLASS STRUCTURE OF OMAHA

CLASS	INCOME	EDUCATION	OCCUPATION	DIMENSION .
CLASS 1	OVER 50,000	4 OR MORE YEAR EDUCATION	MANAGERIAL & PROFESSIONAL	DIMENSION 4 (TOP SCORES)*
CLASS 2	35,000 TO 49,999	4 OR MORE YEAR EDUCATION	MANAGERIAL & PROFESSIONAL	DIMENSION 4 (MID SCORES)**
CLASS 3	25,000 TO 34,999	- -	- -	DIMENSION 3
CLASS 4	15,000 TO 24,999	4 YEAR HIGH SCHOOL	TECHNICAL, SALES, ADMINISTRATEIVE SUPPORT	DIMENSION 6
CLASS 5	7,500 TO 14,999	8 YEAR ELEMENTARY SCHOOL	OPERATOR, FABRICATOR, LABORER	DIMENSION 8
CLASS 6	UNDER 7,500	- -	SERVICE	DIMENSION 2

* and **: see discussion on Page 49.

Table 10 also displays a comparability in social class structure between the Omaha area and other American cities. In general, the social class structure of the American cities consists of lower class, working class, middle class, and upper class (the criterion for each class varies in range from one city to the other). Table 10 indicates that, for the Omaha area, Class 1 is upper class, Class 5 is working class, Class 6 is lower class, while Class 2, Class 3 and Class 4 are different sub-levels of the middle class.

The next chapter turns to the analysis of the factor score profile matrix -- the matrix of 10 (factor scores) by 399 (block groups). Through that analysis, a series of spatial characteristics about the ecological structure of the Omaha area are revealed.

CHAPTER SIX
SOCIAL SPACE AND SOCIAL AREAS

FACTORIAL MODEL

A two-way factorial model is often used in factorial ecology to test whether the spatial distribution of factor scores on each individual factor has a zonal, sectoral, or cluster pattern that the researcher may have suspected. Analysis of variance is the technique used, and the result is a series of F-ratios as a quantitative measurement of the degree of variation between zones, between sectors, and between cells.

DESIGN OF THE MODEL

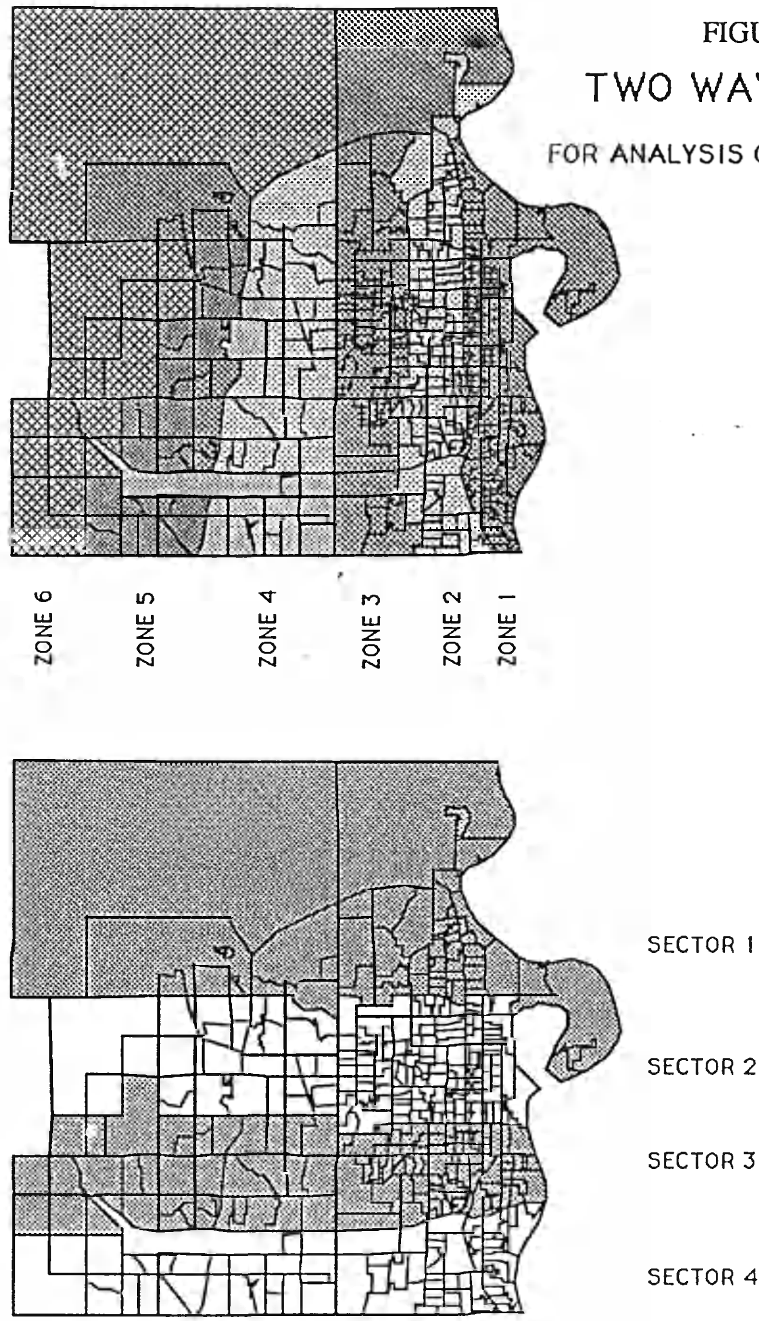
A two-way factorial model is presented here (Figure 15) as a preliminary test of the spatial variation patterns in the factor score distribution for the eight social dimensions. The model is composed of east-west sectors and north-south zones. The purpose of this test is to see whether, and to what degree, the factor scores on each of the eight social dimensions vary in either an east-to-west or north-to-south direction, or whether the high scores concentrate in some particular cells.

The six zones and four sectors in the model divide the research area into a total of twenty four cells. For each individual social dimension, the factor scores are re-formatted based on the two-way model (the arrangement of the data is displayed in Appendix E), and then analyzed with the SAS GLM procedure.

FIGURE 15

TWO WAY MODEL

FOR ANALYSIS OF VARIANCE



THE F-VAUES

The F-values resulting from the analysis (Table 11) show that: (a) the factor scores on Dimension 5-Recent Growth, vary predominantly by zones; (b) the factor scores on Dimension 4-High Socioeconomic Status, vary significantly both by zones and sectors; and, (c) the factor scores on the remaining dimensions also vary more significantly by zones than by sectors. In addition, the F-values for the intersects of zones and sectors in the model do not indicate cluster patterns. This contrasts with the fact that the factor scores on Dimension 2-the Black Ethnic Community are concentrated (as described in Chapter 4). The reason for this contradiction is that the area with high factor scores on Dimension 2 is much larger in size than one cell in this model. The F-value for the intersects can only show a significant cluster pattern when there is only one cell with a predominantly higher mean cell score than any other cells.

TABLE 11 F-VALUES FOR THE FACTORIAL MODEL

	VARIANCE RATIO (F VALUE)		
DIMENSION	BETWEEN ZONES	BETWEEN SECTORS	SECTORS*ZONES
DIMENSION 1	9.29(0.0001)	5.39(0.0012)	2.37(0.0029)
DIMENSION 2	23.64(0.0001)	9.74(0.0001)	4.63(0.0001)
DIMENSION 3	27.22(0.0001)	5.46(0.0011)	3.20(0.0001)
DIMENSION 4	21.97(0.0001)	19.98(0.0001)	4.28(0.0001)
DIMENSION 5	66.17(0.0)	0.73(0.5329)	5.18(0.0001)
DIMENSION 6	13.27(0.0001)	3.46(0.0164)	4.67(0.0001)
DIMENSION 7	20.33(0.0001)	1.28(0.2820)	1.34(0.1747)
DIMENSION 8	40.39(0.0001)	3.24(0.0221)	4.51(0.0001)

Note: In brackets are values of "PR>F".

THE MEAN FACTOR SCORES

In order to further illustrate the spatial distribution patterns hinted at in this factorial model, an examination of the mean factor score values by zones, sectors and cells follows.

For Dimension 4-High Socioeconomic Status, the mean factor scores by sector show that the Sector 3 has the highest value as compared to the other sectors (Table 12). This sector extends out from the Downtown to the south-western suburbs along which the Capitol Hill, West Farnam, Memorial Park-Happy Hollow, and the Regency Districts are located.

TABLE 12
MEAN FACTOR SCORES BY SECTORS FOR DIMENSION 4

SECTOR CODE	SECTOR MEANS
1	-0.1401
2	-0.1035
3	0.3470
4	-0.2617

For Dimension 2-the Black Community, there are two intersects with high mean factor scores by cell in the model (Table 13). These two cells are the intersect of Sector 2 and Zone 1, and that of Sector 2 and Zone 2. They are neighboring cells located in the Near North Side area. So, even though there are no high F-values for intersects, the mean factor scores by cell show that Dimension 2 concentrates its high score units on the two neighboring cells in this model (1,2 and 2,2).

TABLE 13
MEAN FACTOR SCORES BY CELLS FOR DIMENSION 2

CELL CODES ZONE	SECTOR	CELL MEANS
1	1	0.2189
1	2	1.4571
1	3	0.0877
1	4	-0.1135
2	1	0.2031
2	2	1.0010
2	3	-0.4224
2	4	0.0612
3	1	-0.4387
3	2	-0.3521
3	3	-0.6825
3	4	-0.0963
4	1	-0.5296
4	2	-0.6733
4	3	-0.7732
4	4	-0.8687
5	1	-0.4617
5	2	-0.5532
5	3	-0.6829
5	4	-0.5881
6	1	-0.5848
6	2	-0.7080
6	3	-0.8180
6	4	-0.8824

After plotting the zone mean scores on the two-axis coordinate graphs it can be seen that there are three kinds of zonal variation patterns. The first has a westward declining trend. Dimensions with this kind of zonal characteristics are central city oriented (Figure 16A). The second has a westward increasing trend. Dimensions with this kind of zonal characteristics are outer suburb oriented (Figure 17). The third has a peak value in the middle and declining both westward and eastward. Dimensions with this zonal characteristics are inner suburb oriented (Figure 16B).

FIGURE 16 A - MEAN ZONE SCORES
FOR CENTRAL CITY ORIENTED FACTORS

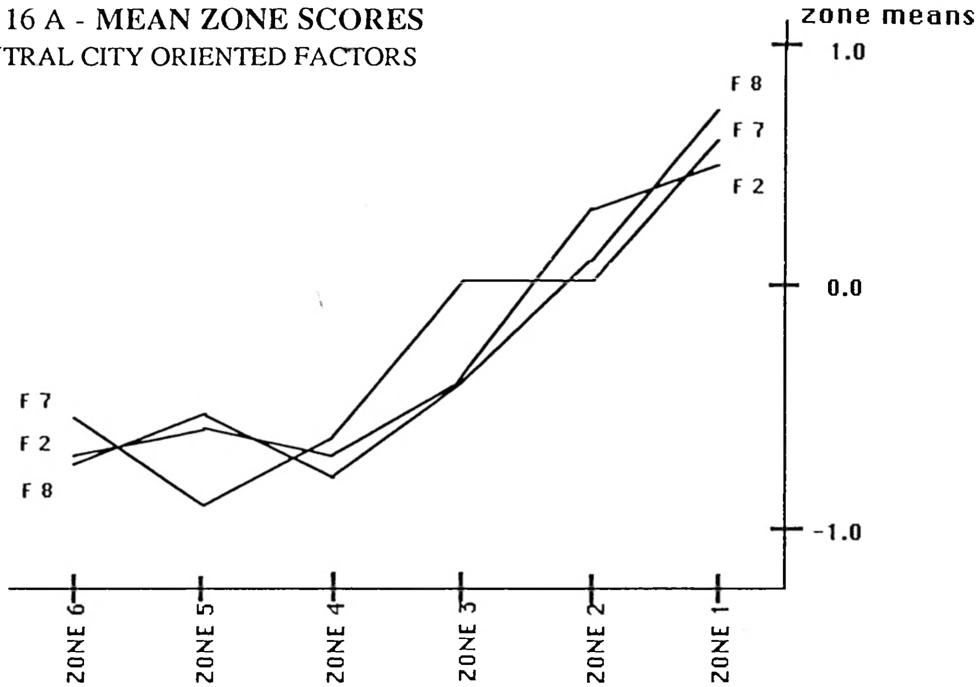


FIGURE 16 B - MEAN ZONE SCORES
FOR INNER SUBURBAN ORIENTED FACTORS

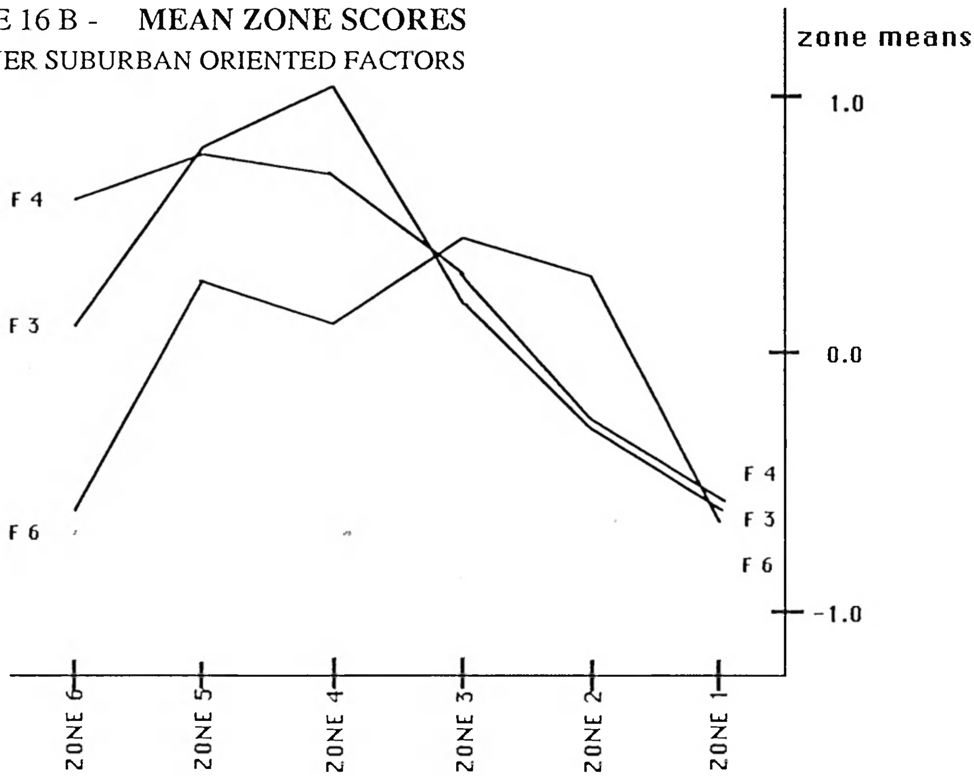
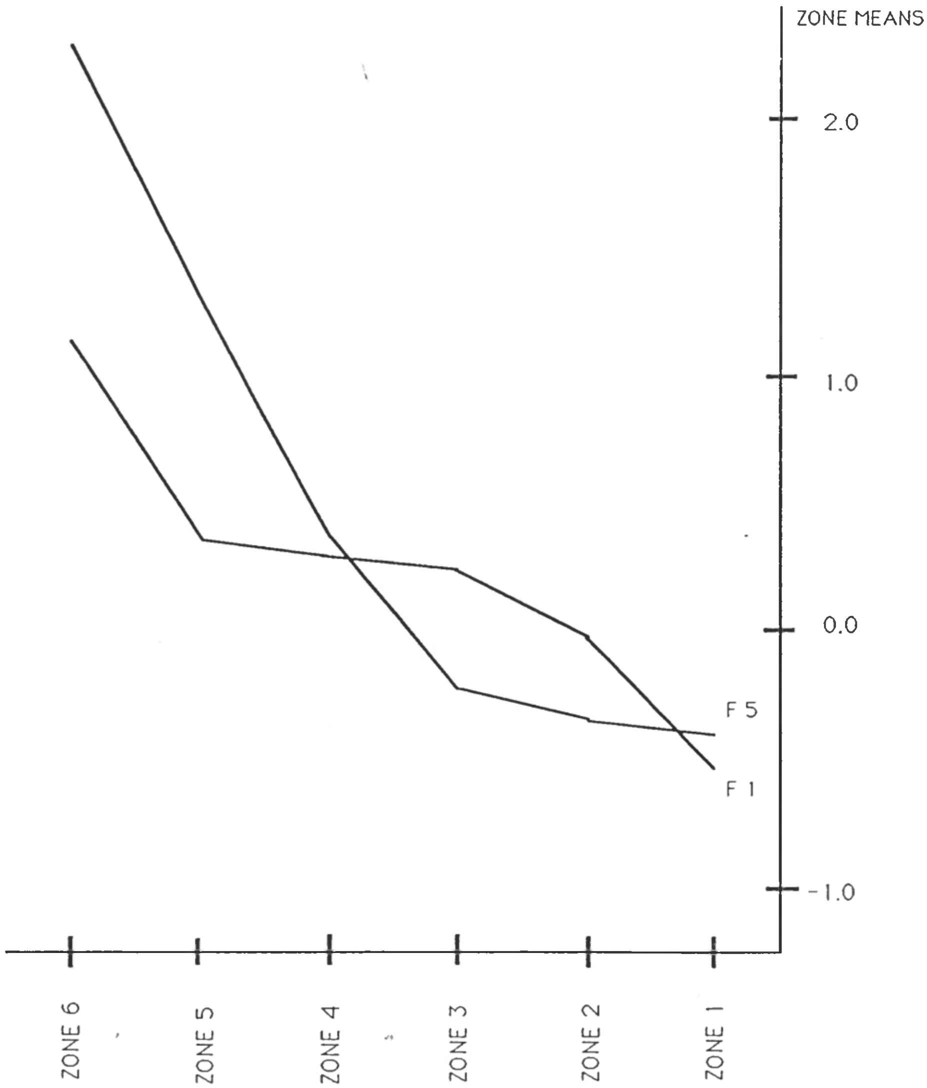


FIGURE 17

MEAN ZONE SCORES

FOR OUTER SUBURBAN ORIENTED FACTORS



THE CHARACTERISTICS OF THE RESIDENTIAL DIFFERENTIATION

With the factorial model, the analysis of variance for the eight social dimensions summarized the spatial patterns displayed in the previous individual factor score maps. The maps confirm that the spatial variation in the residential differentiation in the Omaha area is basically in an east-to-west direction, with the socioeconomic dimension exhibiting a sectoral pattern, and with concentrated ethnic residential districts.

The ethnic (Black and Hispanic) and the elderly residential districts with low socioeconomic status are located east of 48th and Saddle Creek Streets. In the factorial model, the areas compare to Zone 1 and Zone 2 where mean zone scores are above 0.0 on Dimension 2-the Black Ethnic Community, Dimension 8-Old Housing and Hispanic Cluster, and Dimension 7-Elderly and Living Alone, and the mean zone score on Dimension 4-High Socioeconomic Status is below 0.0 (Figure 16 A and B).

The blue collar working families tend to be established in a zone between 72nd Street and 48th and Saddle Creek Streets. In the factorial model the area compares to Zone 3 where the mean zone score on Dimension 6-Mid-City Working Family Status reaches its peak value.

Established suburban families and the urban elites are concentrated in the areas between 140th and 72nd Streets; these are the areas of Zone 4 and Zone 5 in the factorial model where the mean zone scores on Dimension 4-High Socioeconomic Status and Dimension 3-Suburban Established Family Status reach their peak values.

Young middle class families are found in the far western suburbs west of 140th Street. In the factorial model, these include the area of Zone 6 where the mean zone scores on Dimension 1-Suburban Affluent Family Status and Dimension 5-Recent Growth reach their peak values.

The sector located approximately between Dodge Street and Highway I-80 (Sector 3 in the factorial model) is where most of the residential districts with high socioeconomic status concentrated.

The Black community is concentrated approximately in the areas between Dodge and Ames Streets from south-to-north, and east of 48th and Saddle Creek Streets. In the model, this is the area of Cell (1,2) and Cell (2,2). The Hispanic population is concentrated in the South Omaha area. This area is located approximately south of Dodge Street and east of the Union Pacific railroad; that is, the areas of Cell (1,3) and Cell (1,4) in the model.

Overall, with the two-way factorial model, the analysis of variance can depict an outline of the spatial framework of residential differentiation in the City of Omaha as described above. Since the design of the factorial model is artificial, the zones, sectors and cells in the model are not the real areas formed by real residential districts. Rather, they serve as a tool to describe the spatial variation trends of the factor scores. The real residential zones and sectors in the research area must be recognized from an inductive approach rather than from such a "designed" model. Such an inductive approach is introduced in the following sections.

SOCIAL SPACE

THE IMPROVEMENT OF THE METHOD

Social space is a concept concerned with patterns of residential districts, or communities. In Shevky and Bell's social area analysis (1955), a logical division of social space was based on an index score matrix -- the resulting sixteen units were derived from four levels of social rank by four levels of urbanization. Rees (1970) developed this method using a two-axis graph (socioeconomic status vs. family status) to classify four patterns of social space, each occupying a quadrant of the graph. Thus, a generalized social area framework of the Chicago metropolis was constructed (Appendix K).

Such a method of classifying community patterns is based on the idea that a community pattern can be recognized according a few key criteria describing the characteristics of the population and housing in the community. The social dimensions in factorial ecologies represent different aspects of residential differentiation (as discussed in the previous factorial model), and they are the criteria for the classification.

The purpose of using only the two social dimensions -- socioeconomic status and family status -- for the classification of residential areas in Rees' study is to correspond to Shevky's concept of social space. However, such classification can only reveal how the communities differ from each other based on these two artificially-selected dimensions while the explanation of how the communities differ from each other in other dimensions is neglected. Therefore, a comprehensive classification of community patterns should be based on all of the dimensions that emerge from the factor analysis of the input data sets.

To avoid the shortcoming of using only two dimensions, the classification of community patterns in this study is based on the whole factor score profile matrix -- 10 factor scores by 399 block groups. A non-hierarchical cluster analysis is performed using the SAS FASTCLUST procedure.

As described in Chapter 3, the FASTCLUST procedure used in this study is characterized by the following traits: (1) the clusters are classified based on the factor scores on the 10 factors in the factor structure; (2) the clusters have relatively close number of units (block groups) to each other, (3) the units with extreme values are "assigned" to the clusters after the the cluster seeds (the core of the cluster in terms of the factor scores) have been chosen so that they do not influence the choosing of the cluster seeds; and, (4) the clusters are non-hierarchical, but, for each cluster, the analysis gives out the nearest cluster to it.

EIGHT SOCIAL-SPACE CLUSTERS AND THEIR CHARACTERISTICS

Eight clusters result from the analysis. Their statistical characteristics are summarized in Appendix L-Cluster Summary, and Appendix M-Cluster Means and Standard Deviation. The spatial distribution of these eight clusters is displayed on the block group map (Figure 18-Spatial Distribution of the Eight Clusters).

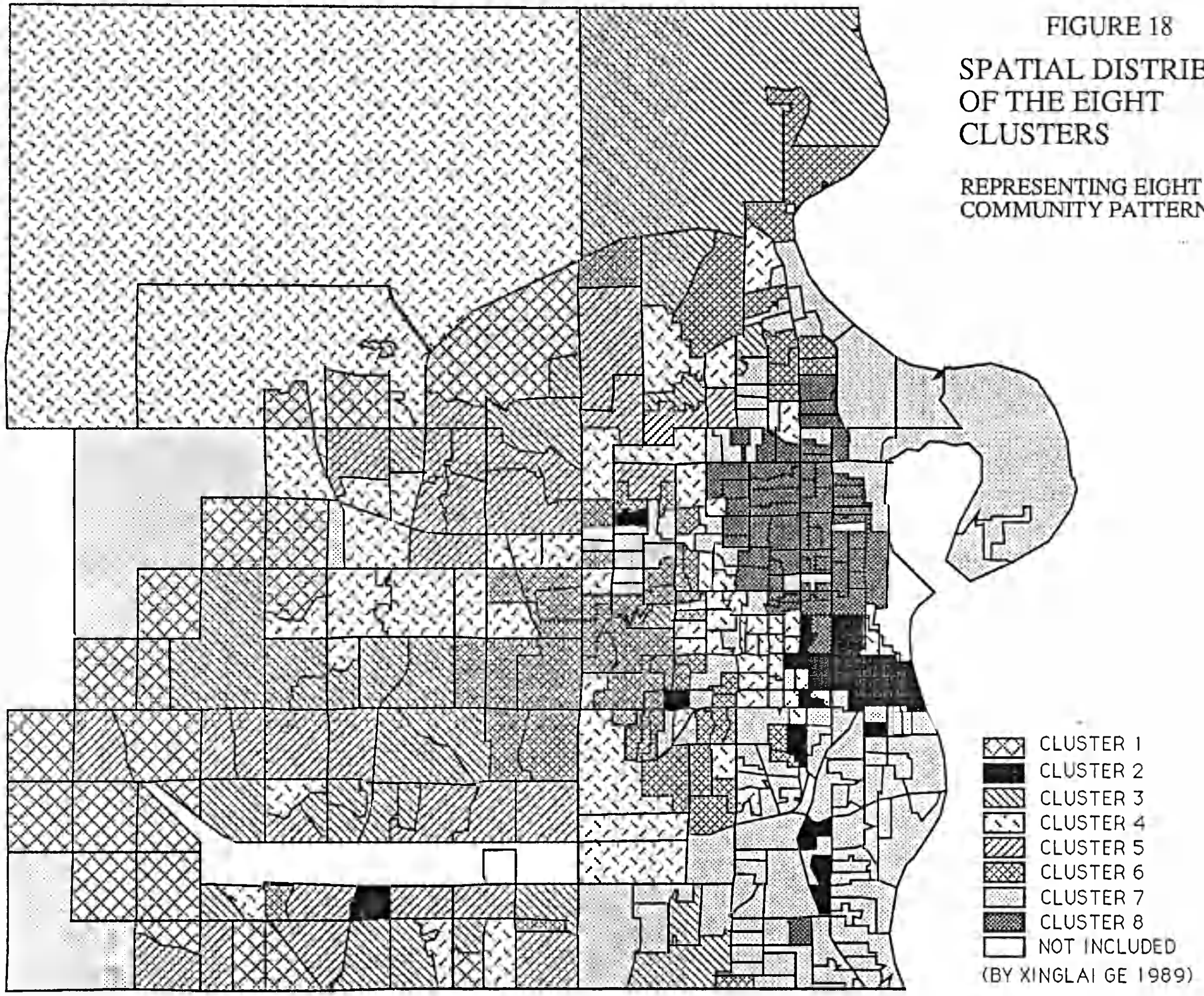


FIGURE 18

SPATIAL DISTRIBUTION OF THE EIGHT CLUSTERS

REPRESENTING EIGHT COMMUNITY PATTERNS

According to Appendix L and M, and the spatial distribution map of these clusters (Figure 18), the characteristics of each of the clusters are described as follows:

Cluster 1 has 19 block groups. This cluster has the highest positive cluster mean values on Dimension 1-Suburban Affluent Family Status and Dimension 5-Recent Growth as compared to the other clusters. The block groups of this cluster are spread along the western and northwestern city boundary. The nearest cluster to Cluster 1 is Cluster 3.

Cluster 2 has 26 block groups. This cluster has the highest positive cluster mean values on Dimension 7-Elderly and Living Alone, and negative values on Dimension 1-Suburban Affluent Family Status and Dimension 4-High Socioeconomic Status. The block groups of this cluster are concentrated around the Downtown area. There are a few isolated block groups of this pattern in the South Omaha, Benson, and Midtown areas, and one in the southwest Omaha area.

Cluster 3 has 30 block groups. This cluster has the highest cluster mean value on Dimension 4-High Socioeconomic Status. The block groups of this cluster are concentrated in the area from the Regency District extending westward along West Dodge Road to the Boys Town vicinity, and southward to the areas around Center Street from 132nd to 108th Streets. There are a few isolated block groups of this cluster located in the far northern and southern parts of the areas east of 72nd Street, the Memorial Park area, and along the northwestern city boundary. The nearest cluster to Cluster 3 is Cluster 5.

Cluster 5 has 30 block groups. This cluster has the highest cluster mean value on Dimension 3-Suburban Established Family Status. The block groups of this cluster are concentrated in several areas west of 72nd Street, and near the northern city boundary area east of 72nd Street. The nearest cluster to Cluster 5 is Cluster 3.

Cluster 8 has 55 block groups. This cluster has the highest cluster mean value on Dimension 2-The Black Community. All of the block groups of this cluster are concentrated in the Near North Side area with only one exception. There is only one isolated block group of this cluster located in South Omaha area. The nearest cluster to Cluster 8 is cluster 7.

Cluster 4 has 63, Cluster 6 has 59, and Cluster 7 has 117 block groups. These three clusters are characterized by no cluster mean values greater than either positive or negative 1.0. As a result, the characteristics of these three clusters may not be associated predominantly with a few social dimensions as are the other clusters. To interpret the characteristics of these three clusters, the cluster mean values on each of the eight social dimensions needed to be examined and compared with those of other clusters.

Cluster 4 has the highest positive cluster mean value on Dimension 6-Mid-City Working Family Status. But, this cluster mean value is only 0.48910. In addition, for cluster 4 this cluster mean value is also higher than those on the other dimensions. Cluster 4 also has a relative high positive cluster mean value on Dimension 5-Recent Growth, and a relative high negative value on Dimension 1-Suburban Affluent Family Status. The block groups of this cluster are concentrated in several areas including: the Midtown area, the Aksarben area, the areas between West Dodge Road and the west Maple Street around Westroads and Old Mill shopping centers, and the northwestern part of the research area which is the urban fringe of the Omaha SMSA. The nearest cluster to Cluster 4 is Cluster 6.

Cluster 6 has its highest positive cluster mean value on Dimension 4-High Socioeconomic Status, which is 0.75558. It has a relative high negative value on Dimension 5-Recent growth, which suggests that this cluster represent a relatively older residential districts. The block groups of this cluster are concentrated in the areas around the Memorial Park and the Happy Hollow Avenue, and in the North Omaha areas. The nearest cluster to Cluster 6 is Cluster 7.

Cluster 7 has its highest positive cluster mean value on Dimension 8-Old Housing and Hispanic Cluster, which is 0.81435, and highest negative value on Dimension 5-Recent Growth. The block groups of this cluster are concentrated in South Omaha areas, the Benson area, and the areas along the eastern city boundary on the river front. The nearest cluster to Cluster 7 is Cluster 6.

THE EIGHT COMMUNITY PATTERNS INTERPRETED

Based on the above description, eight clusters can be identified as eight community patterns and these are summarized in Table 14 below:

TABLE 14 EIGHT COMMUNITY PATTERNS INTERPRETED

CLUSTERS	COMMUNITY PATTERNS
CLUSTER1	OUTER SUBURBAN YOUNG FAMILY AND NEWLY-DEVELOPED COMMUNITY
CLUSTER2	ELDERLY AND LIVE-ALONE COMMUNITY
CLUSTER3	URBAN ELITE DISTRICTS
CLUSTER4	NOT-SO-ESTABLISHED WORKING FAMILY COMMUNITY
CLUSTER5	SUBURBAN ESTABLISHED COMMUNITY
CLUSTER6	OLDER MIDDLE CLASS RESIDENTIAL DISTRICTS
CLUSTER7	OLD HOUSING AND HISPANIC POPULATION DISTRICTS
CLUSTER8	THE BLACK COMMUNITY

GRAPHIC DISPLAY OF THE SOCIAL-SPACE CLUSTERS

To compare the difference between a two-dimensional classification and a multi-dimensional classification, these eight social space clusters are plotted onto a two-axis social space graph using Dimension 1 against Dimension 4 in this study (Figure 19). Each cluster is represented by an oval. The coordinates of the center of the oval are the mean scores on the two factors, respectively. The two diameters of the oval are the standard deviations of the cluster on the two factors, respectively. Therefore, the size of the oval represents the degree of concentration of the observations within the social space.

The graph displays two contrasting groups of social space patterns: one group on the upper-right quadrant of the graph, the other group on the lower-left quadrant of the graph. By looking at the cluster pattern map (Figure 18) it is easy to demonstrate that the patterns on the upper-right quadrant are all located in suburban areas while those on the lower-left quadrant are all located in the central city areas. The graph cannot clearly separate each of the ovals from the others in both the upper-right and lower-left quadrants. This is the limitation of the two dimensional classification because it cannot totally separate patterns which are classified based on multiple dimensions.

Multi-dimensional social space patterns can only be plotted on a two-dimensional graph by using a pair of canonic variables to reduce the number of the dimensions into two. A scatterplot graph produced by the SAS CANDISC procedure displays these eight clusters on such a two-dimensional graph (Figure 20). The drawback is that the two canonic variables do not directly indicate how they associate with the social dimensions.

FIGURE 19

TWO-DIMENSIONAL SOCIAL SPACE

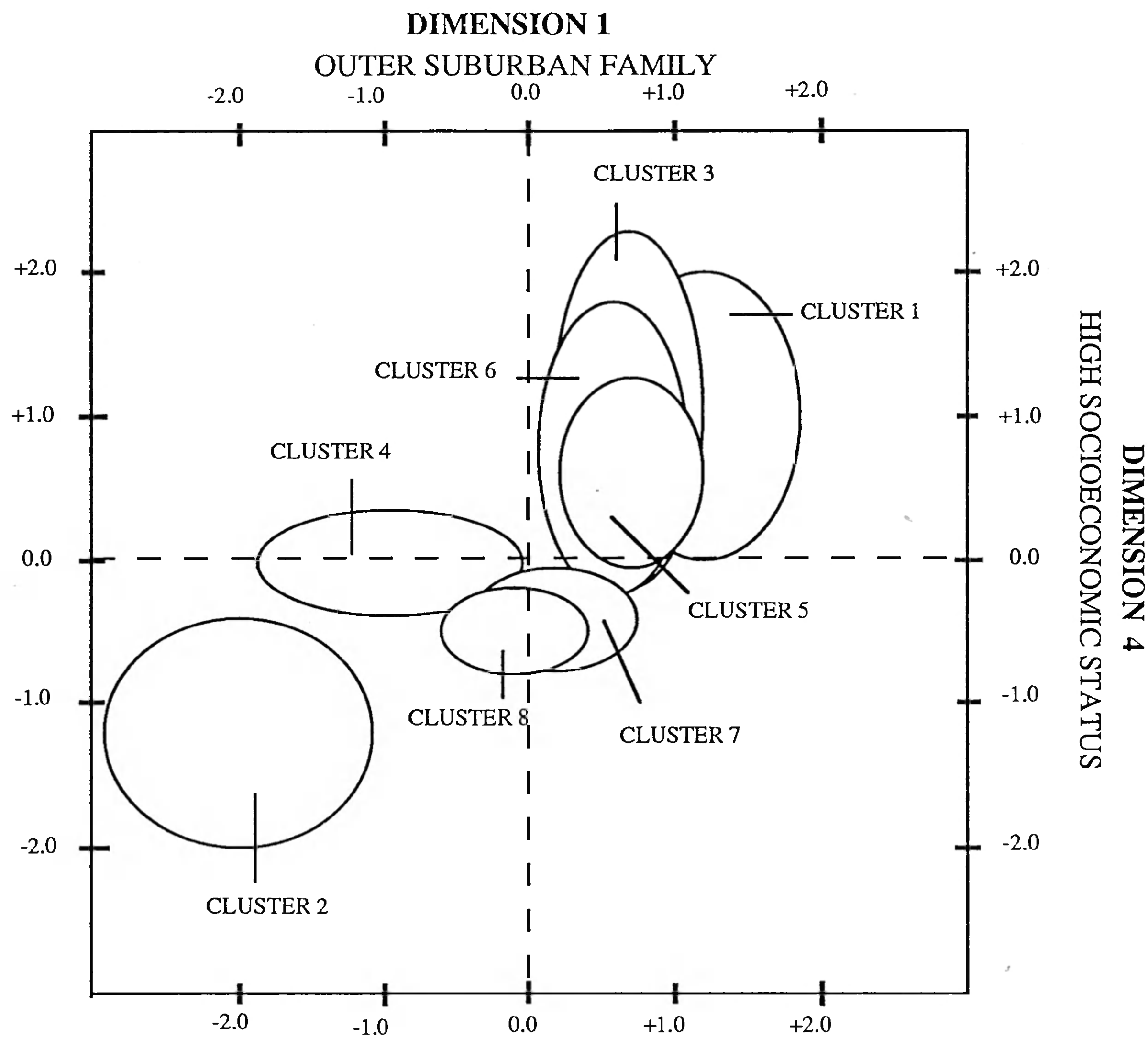
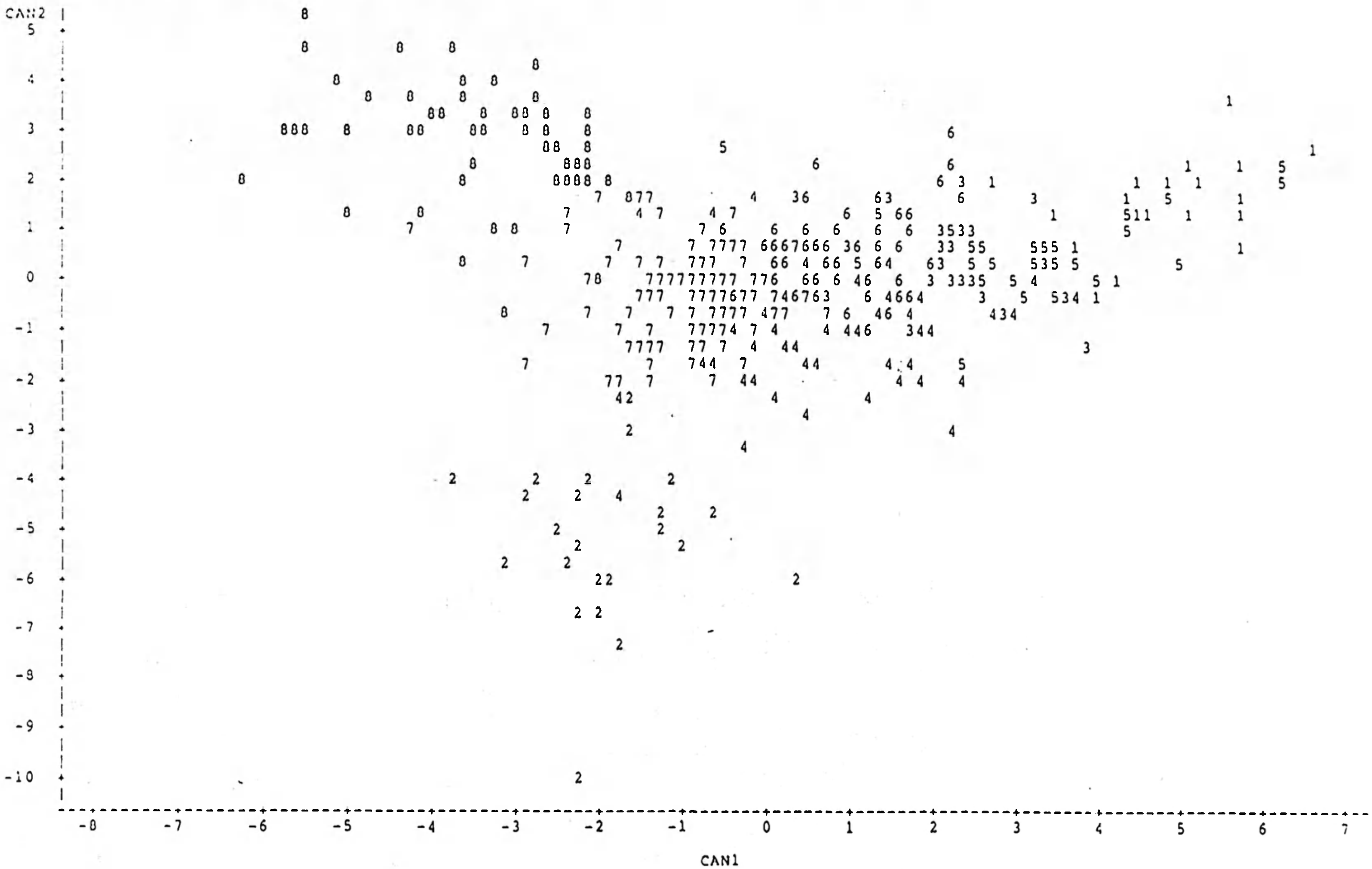


FIGURE 20

SCATTERPLOT OF THE SEPARATION OF THE EIGHT COMMUNITY PATTERNS

PLOT OF CAN2*CAN1   SYMBOL IS VALUE OF CLUSTER



NOTE: 86 OBS HIDDEN

SOCIAL AREAS

THE DIVISION OF THE SOCIAL AREAS

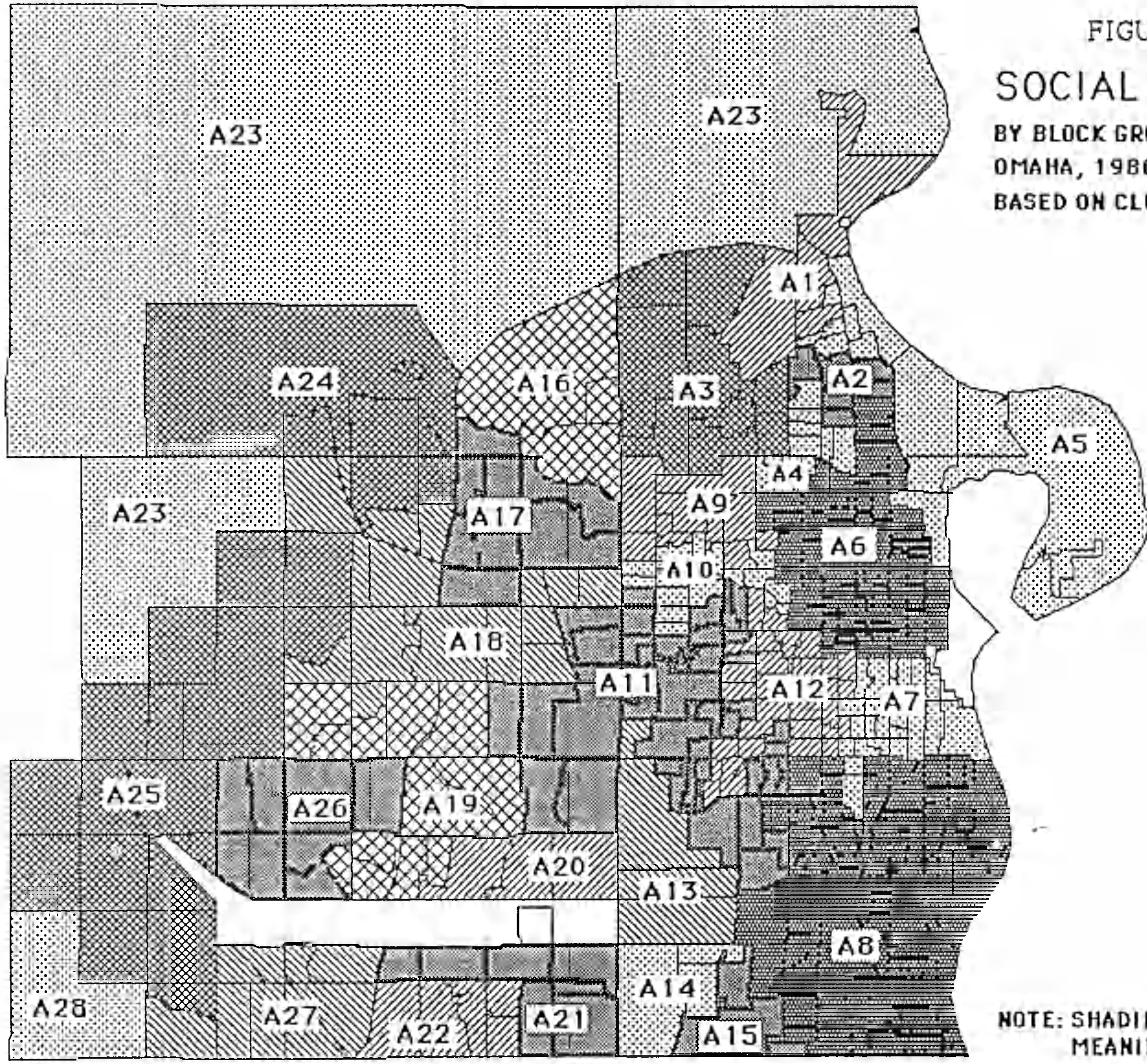
The division of the study area into the social areas in this study is refined and displayed on the map in Figure 21, using the social space cluster map developed in the previous section (Figure 18). Most of the social areas are designated by grouping those spatially adjacent block groups with like community characteristics. A few other social areas may contain the block groups with different community patterns, but most of these patterns are the nearest clusters to each other as described in the previous section. Twenty eight social areas are thus derived (Figure 21).

A one-way multivariate analysis of variance is used to test whether the division can yield a more significant variance of the factor scores between groups (social areas) than those within groups. The analysis is performed with the SAS GLM procedure, using the factor score profile matrix of 399 block groups by 10 factor scores, with each of the 399 block groups being designated to a particular social area. The results show that F-ratios (sum of squares between groups vs. that within groups) either for scores on the individual factors or the overall F approximation are significant at the 0.0 level or below (Table 14).

FIGURE 21

SOCIAL AREAS

BY BLOCK GROUP,
OMAHA, 1980 CENSUS
BASED ON CLUSTER PATTERNS



NOTE: SHADING HAS NO
MEANING IN PATTERNS

Table 15 indicates that the F-values for the 10 factors are all significant (the sum of the squares between groups is much larger than that within groups). Moreover, the F-values for the first eight factors which have been interpreted into social dimensions are higher than those of the last two factors which are left uninterpreted. Therefore, each of the twenty eight social areas can be considered to be relatively homogeneous in terms of those eight social dimensions.

TABLE 15 F-VALUES BASED THE DIVISION OF THE 28 SOCIAL AREAS

DEPENDENT VARIABLE	F-VALUE	PR > F
Factor 1	21.37	0.0
Factor 2	31.33	0.0
Factor 3	12.84	0.0001
Factor 4	11.79	0.0001
Factor 5	29.44	0.0
Factor 6	6.92	0.0001
Factor 7	7.53	0.0001
Factor 8	12.57	0.0001
Factor 9	5.67	0.0001
Factor 10	1.93	0.0042
F APPROXIMATION	10.88	0.0

RELATIONSHIP BETWEEN THE SOCIAL AREAS

Using the mean factor score profile matrix of 10 mean factor scores by 28 social areas (Table 16), which is computed by the GLM procedure, an hierarchical cluster analysis is performed with the SAS CLUSTER procedure. A tree diagram (Figure 22) and some related descriptive statistical features (Table 17) resulting from the analysis depict the relationship between these twenty eight social areas.

TABLE 16

MEAN FACTOR SCORE PROFILES
FOR THE TWENTY EIGHT SOCIAL AREAS

SOCIAL AREAS

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5
A1	0.8634	-0.6313	-0.53145	0.5509	0.41305
A2	0.7940	-0.0625	0.34458	-0.2463	-0.47485
A3	0.8735	-0.1285	0.60969	0.4373	0.11078
A4	0.3935	0.6230	-0.49884	-0.5690	-0.45623
A5	0.3079	0.0371	-0.75103	-0.6883	-0.70990
A6	-0.1278	1.8632	-0.61193	-0.5915	-0.50191
A7	-2.2727	-0.1737	-0.64027	-0.6304	0.21517
A8	0.0693	-0.0104	-0.38989	-0.4025	-0.58669
A9	0.0928	-0.0878	0.62266	-0.2224	-0.25996
A10	0.1648	-0.1931	-0.36891	-0.3467	-0.33120
A11	0.4627	-0.6237	0.28841	0.9879	-0.47121
A12	-1.1423	-0.2613	-0.19044	-0.0648	0.03249
A13	-0.3999	-0.4524	1.05518	-0.2023	0.23953
A14	0.3147	-0.1211	-0.09463	-0.6570	-0.46913
A15	0.8753	-0.3057	0.50560	-0.1042	-0.62913
A16	0.9005	-0.5394	0.05300	0.4780	0.88110
A17	0.4680	-0.7131	2.13711	0.5238	0.63412
A18	-0.6211	-0.5105	0.55521	0.2118	1.02217
A19	0.8195	-0.7842	0.80819	1.9969	0.21512
A20	0.7242	-0.7214	2.80770	0.9234	-0.08217
A21	-0.1386	-0.9480	0.51938	-0.3731	0.16538
A22	0.2682	-0.7261	0.58270	0.4985	1.94366
A23	0.8908	-0.6047	-0.27147	0.6043	-0.11663
A24	0.5698	-0.5812	-0.09113	0.2475	1.80081
A25	1.1187	-0.7918	0.29917	1.0248	2.79433
A26	0.2421	-0.5758	1.99747	0.8608	0.94387
A27	0.7224	-0.5713	1.16683	0.4303	1.42661
A28	1.7209	-1.1940	-0.85200	-1.9155	-0.42070

SOCIAL AREAS

	FACTOR6	FACTOR7	FACTOR8	FACTOR9	FACTOR10
A1	0.2576	-0.1668	-0.2262	0.4499	0.01435
A2	0.8039	0.0430	-0.2967	0.2068	0.29747
A3	0.1210	-0.5343	-0.4631	1.0528	0.01304
A4	0.5659	-0.1882	-0.0165	0.3176	-0.33367
A5	0.0109	0.1809	0.6222	0.4127	-0.65792
A6	-0.6464	0.2706	0.1362	-0.3442	0.21202
A7	-1.3517	1.5076	0.0522	0.2259	0.22477
A8	0.0309	0.2933	1.1915	-0.3811	-0.05127
A9	0.8842	0.0365	-0.6101	-0.2456	-0.52119
A10	0.6021	0.3635	0.0642	-0.1842	-0.32360
A11	0.3244	0.0884	-0.6250	-0.3176	-0.00742
A12	0.2975	0.1052	-0.1105	-0.4903	0.00118
A13	0.6786	-0.5816	-0.3457	0.1845	-0.30178
A14	0.4300	-0.0305	0.3580	-0.0574	-0.48703
A15	0.4680	-0.2331	0.1834	0.4573	-0.22460
A16	0.6016	-0.8080	-0.9365	1.2878	-0.01453
A17	0.4252	-0.6425	-0.6624	0.8653	0.31249
A18	0.5860	-0.5963	-0.4070	0.2741	-0.84710
A19	-0.2246	-0.9637	-0.6998	1.2100	0.02312
A20	0.2773	-0.7813	-0.6260	0.5591	0.31637
A21	-0.6567	-1.0684	-1.2516	-0.5268	-0.14006
A22	0.4413	-1.2070	-0.3396	0.8577	0.32448
A23	0.0502	-0.0827	0.1877	0.7222	-0.26447
A24	0.5100	-0.7557	-0.6513	0.7462	-0.21257
A25	-0.3109	-0.8177	-0.8915	-0.1429	1.04868
A26	0.2275	-1.0371	-0.6287	0.8033	0.30143
A27	0.3901	-0.7239	-0.4866	0.7051	0.21987
A28	-3.9184	0.0924	-1.1962	-3.9243	-0.04880

FIGURE 22

TREE DIAGRAM OF THE CLUSTERS OF SUB-AREAS

CODE NUMBER OF SUB-AREAS

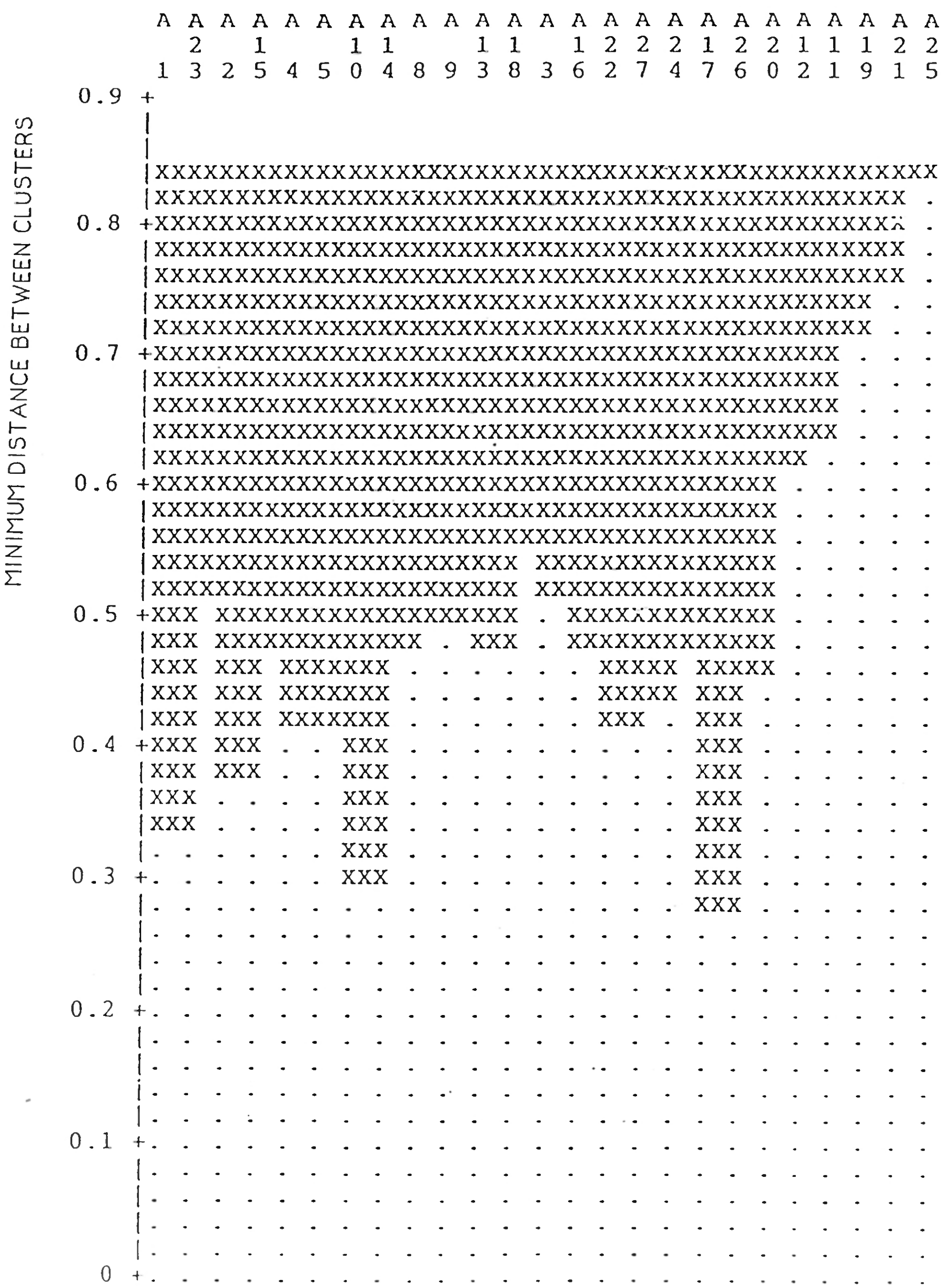


TABLE 17

STATISTICAL DESCRIPTION OF THE CLUSTERING OF THE TWENTY-EIGHT SOCIAL AREAS

EIGENVALUES OF THE COVARIANCE MATRIX

	EIGENVALUE	DIFFERENCE	PROPORTION	CUMULATIVE
1	1.71706	1.09190	0.495279	0.49528
2	0.62517	0.22528	0.180326	0.67560
3	0.39988	0.18234	0.115345	0.79095
4	0.21755	0.03089	0.062750	0.85370
5	0.18666	0.06241	0.053841	0.90754
6	0.12424	0.01156	0.035838	0.94338
7	0.11268	0.06917	0.032503	0.97588
8	0.04352	0.01620	0.012552	0.98843
9	0.02732	0.01454	0.007880	0.99631
10	0.01278	.	0.003687	1.00000

ROOT-MEAN-SQUARE TOTAL-SAMPLE STANDARD DEVIATION = 0.588801
MEAN DISTANCE BETWEEN OBSERVATIONS = 2.49994

NUMBER OF CLUSTERS	CLUSTERS JOINED		FREQUENCY OF NEW CLUSTER	NORMALIZED MINIMUM DISTANCE
24	A17	A26	2	0.282496
23	A10	A14	2	0.291781
22	A1	A23	2	0.340784
21	A2	A15	2	0.377473
20	A5	CL23	3	0.414455
19	A4	CL20	4	0.415488
18	A22	A27	2	0.426201
17	CL18	A24	3	0.448258
16	CL24	A20	3	0.460336
15	A13	A18	2	0.474027
14	CL21	CL19	6	0.481120
13	A16	CL17	4	0.482676
12	CL14	A8	7	0.488517
11	CL13	CL16	7	0.489913
10	A9	CL15	3	0.496384
9	CL12	CL10	10	0.505330
8	A3	CL11	8	0.515453
7	CL22	CL9	12	0.525701
6	CL7	CL8	20	0.551678
5	CL6	A12	21	0.612663
4	CL5	A11	22	0.647940
3	CL4	A19	23	0.726691
2	CL3	A21	24	0.761038
1	CL2	A25	25	0.834897

Based on Figure 22 and Table 17, in the early clustering stages, there are four pairs of social areas being linked. These are A17 and A26 at 0.28 (normalized minimum distance), A10 and A14 at 0.29, A1 and A23 at 0.34, and A2 and A15 at 0.37. Each of these pairs are the social areas with very similar factor score profiles.

Figure 22 and Table 17 indicate that these twenty-eight social areas can be grouped into seven clusters* plus with three social areas as "outliers"**.

The social areas arranged to the left of A3 (including A3) in Figure 22 form one cluster. These social areas are A1, A23, A2, A15, A4, A5, A10, A14, A8, A9, A13, A18, and A3. By comparing these social areas with the social area map (Figure 21), we can see that most of the social areas in this cluster are located east of 72nd Street, in the areas generally referred as the central city.

The social areas arranged between A16 and A20 (including these two) in Figure 22 form another cluster. These social areas are A16, A22, A27, A24, A17, A26, and A20. By comparing these social areas with the social area map (Figure 21), we can see that all of these social areas are located west of 72nd Street, in the areas generally referred as the suburbs.

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*: The clusters are formed at the clustering stage of 0.551678, the point at which the frequency of new cluster has a dramatic increase.

**: A clustering unit with extreme value is call an "outlier" in the SAS terminology.

For the social areas arranged to the right of A12 (including A12) in Figure 22, each of those form a single-element cluster. In addition, there are another three social areas being trimmed off as the outliers; these include the three social areas A6, A7, and A28.

All of these remaining social areas are those not similar to each other, each with its own unique factor score profile. Among these social areas, some are ethnic social areas (i.e. A6), some are urban elite districts (i.e. A19), some are social areas with particular social characteristics (i.e. the Downtown elderly district A7).

Overall, the relationship between these social areas demonstrates that 72nd Street is a significant boundary in differentiating the city of Omaha into subregions. The social areas located east of 72nd Street share some common characteristics associated with the central city, while the social areas located west of 72nd street share some common characteristics associated with the suburbs.

COMPARISIONS WITH OTHER SUBAREA DIVISIONS

There is a comparability of the social areas classified in this study with other generally recognized residential districts (either ethnic, historic, real estate, or contemporary community districts). By examining the location of the social areas on the social areas map (Figure 21, p.90), we can identify at least the following social areas with identifiable core districts:

A2	with	Florence
A6	with	the Black community
A7	with	Downtown
A8	with	South Omaha
A10	with	Benson
A11	with	Memorial Park and Happy Hollow
A12	with	Midtown
A13	with	Aksarben
A17	with	Keystone
A18	with	Westroads Shopping Center vicinity
A19	with	Regency
A20	with	Westgate
A21	with	Ralston
A27	with	Millard

Comparing the social areas in Figure 21 with the housing subareas in Figure 3 and the planning districts in Figure 4, it is also clear that there is, to a certain degree, a comparability in the overall spatial framework between the different divisions of those reports and this research.

The urban fringe identified in the Riverfront Development Projects (sub-area No.20 in Figure 3, p.21) is the same as the fringe social area identified in this study. In addition, the housing sub-areas east of 72nd Street in the Riverfront Project (Figure 3) are quite comparable to the social areas east of 72nd Street designated in this study (Figure 21, p.90).

The planning districts No.8 and No.9 designated in the city's master plan for 1989 (Figure 4, p.22) are comparable to the social area No.23 designated in this study (Figure 21). In addition, the No.1, No.2 No.3, No.4, and No.12 planning districts in the city plan (Figure 4) are comparable to the social areas A1, A5, A6, A7, and A25, respectively, designated by this study (Figure 21). Overall, the 1989 planning districts tend to be more generalized than the social area divisions derived by this study.

The social area divisions of this study have advantages over the Riverfront Development Project and the 1989 planning districts. These include:

(1) The subjectivity of the classification is reduced in this research because the social areas are designated based on their community patterns which are classified from the factor score profile matrix of 10 factor scores by 399 block groups. As a result, the social characteristics of the social areas thus designated are defined quantitatively.

(2) The social areas designated in this study are based on the grouping of Block Groups, while the other reports constructed subareas based on the grouping of the Census Tracts. As a result, the boundaries of the social areas designated by this study tend to be more irregular than the sub-areas designated in the other reports. The resulting irregularly shaped subareas are much closer to the real situation, while the other reports tend to oversimplify the areal extent of their subareas.

A SUGGESTED SOCIAL BUFFER

A social buffer is defined here as a transition zone between one residential district occupied predominantly by a social group, and a second residential district occupied by a different social group. By examining the mean factor score profiles of the social areas designated in this study, some social areas can be regarded as social buffers between two other social areas with opposite social characteristics. For example, the following segment of the mean factor scores (selected from Table 16, p.92) suggests that A4 is a social buffer between A3 and A6, because the factor scores of these social areas indicate that A6 is a Black community (with high positive score on Dimension 2-the Black Community), A3 is a White-dominated residential district (with negative score on Dimension 2), while A4 is a residential district with the social characteristics between those of A6 and A3 (Table 18).

TABLE 18 A SEGMENT OF MEAN SCORES SUGGESTING A SOCIAL BUFFER

AREA	DIMENSION 2	DIMENSION 3	DIMENSION 1	DIMENSION 4
A3	-0.1285	0.6097	0.8735	0.4373
A4	0.6230	-0.4988	0.3935	-0.5690
A6	1.8632	-0.6119	-0.1278	-0.5915

The segment of the mean factor scores (Table 18) indicates that for these three social areas, there is a gradation in mean factor scores on the selected social dimensions (Dimension 2-The Black community is an ethnic dimension; Dimension 3-Suburban Established Family Status and Dimension 1-Suburban Affluent Family Status are both family-status dimensions; and, Dimension 4-High Socioeconomic Status is a socioeconomic dimension). The

A3 and A6 areas have scores of opposite-sign on these selected social dimensions, while the social area A4 has values midway between those of the A3 and A6 areas. In addition, the social area A4 is located between the social areas A3 and A6. Therefore, A4 is a social buffer between the A6 and A3 areas.

GENERALIZED ECOLOGICAL MODEL

Based on the assumptions that (a) concentric zones and radial sectors exist in the research area, and (b) each of the social areas falls in one zone and one sector respectively, a generalized ecological model of the Omaha area can be offered. The twenty-eight social areas are arranged into the ecological model consisting of five zones and four sectors with the social area A7 at the center as the central business district (CBD) (Figure 23).

Such assumptions are derived from the frameworks first developed by Murdie (see Chaper 2) and then refined by Rees (see Appendix K). However, in Murdie's model the social areas are not completely fit into each zone and sector in the model, and in Rees' model the social areas are too generalized in terms of both spatial scale and the patterns describing the residential differentiation. Therefore, these two previous models are not accurate enough in describing the real residential differentiation in the research areas.

CONCEPTUALIZATION OF CONCENTRIC ZONES

The social areas can be grouped into five concentric zones around the CBD. The CBD is correspondent to the social area A7.

Away from the CBD, the first concentric zone covers the old city areas which are occupied by the social areas A5, A6, A12, and A8. As described in the previous section, the social areas of this zone are characterized by ethnic populations, old housing, low-socioeconomic status, and multi-unit dwelling patterns. This zone is named "Old City Ring".

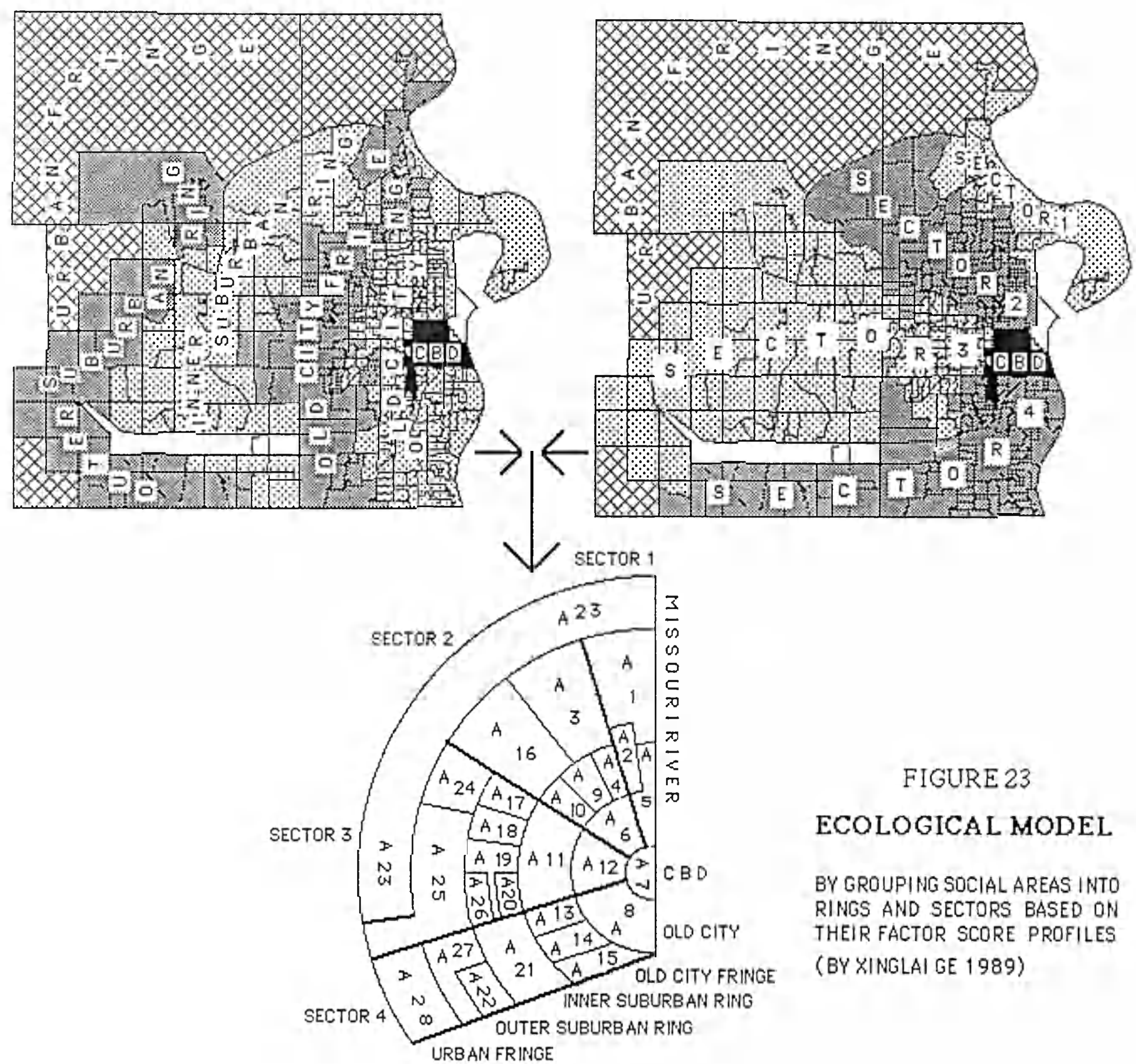


FIGURE 23

ECOLOGICAL MODEL

BY GROUPING SOCIAL AREAS INTO RINGS AND SECTORS BASED ON THEIR FACTOR SCORE PROFILES

(BY XINGLAI GE 1989)

The second zone is between the old city and the suburbs. The social areas in this zone are A1, A2, A4, A9, A10, A11, A13, A14, and A15. The characteristics of these social areas are more diversified than those in the first zone. Some of them have suburban characteristics while the others are closer to those in the "Old City Ring". Therefore, this zone is named "Old City Fringe".

Both the third and the fourth zones are suburban. Since the third zone is next to the Old City Fringe while the fourth zone is further out, the former is named "Inner Suburban Ring" and the latter is named "Outer Suburban Ring". The social areas in the "Inner Suburban Ring" are A3, A16, A17, A18, A19, A20, A26, and A21. These social areas are characterized by suburban established communities. The social areas in the "Outer Suburban Ring" are A24, A25, A22, and A27. These social areas are characterized by suburban newly-developed communities.

Outside the Outer Suburban zone is the outskirts of the city where the land use is dominated by agriculture (see Appendix J). Therefore, it is named "Urban Fringe". Two social areas fall in this zone; they are A23 and A28.

CONCEPTUALIZATION OF RADIAL SECTORS

Radial sectors can also be defined by grouping the social areas.

Radiating from the CBD, Sector 1 lies along the river front in the northeast part of the city. There are only two social areas designated in this sector; they are A1 and A5. The old Florence district occupies the north part of this sector.

Sector 2 starts from the Near North Side and extends toward the northwest to the area south of Highway I-680 and east of Military Avenue. The social areas in this sector are A6, A4, A9, A10, A3, and A16. The Black community is in this sector. There is also a trend for the Black ghetto to expand along this sector.

Sector 3 extends toward the west from the city center. The social areas in this sector are A12, A11, A17, A18, A19, A20, A26, A24, and A25. Dodge Street is the central axis of this sector, extending east to west.

Sector 4 extends along the southeastern and southern boundary of the city. It is separated from the other parts of the city by the Highway I-80 and the industrial tract in the western suburban area. The social areas in this sectors are A8, A13, A14, A15, A21, A22, A27, and A28. There are two contrasting social area groups in this sector. The social areas in the western part of this sector (west of 72nd Street) are characterized by newly-developed outer suburban young family communities with relatively high socioeconomic status, while the social areas in the eastern part of this sector are characterized by ethnic communities in the old housing areas with relatively low socioeconomic status.

Compared with Figure 23, it seems that Sector 3 and Sector 4 are not regularly-shaped. Sector 3 widens dramatically beyond 72nd Street. The western part of Sector 4 (west of 72nd Street) is more like Sector 3 in terms of their factor score profiles, while the eastern part of Sector 4 (occupied by the South Omaha area) is likely to extend further toward the south into Sarpy County. Therefore, it is possible to have some minor changes in grouping Sector 3 and Sector 4. But, by grouping the social areas constructed in this study can only yield four sectors radiating from the CBD, because there are only four social areas surrounding the social area A7 (CBD), these are social areas A5, A6, A12, and A8 (Figure 21).

QUANTITATIVE DESCRIPTION OF THE ZONES AND SECTORS

To demonstrate the characteristics of each of the individual zones and sectors with quantitative measurements, mean factor scores by zones and sectors are computed with the SAS GLM procedure, using the mean factor score profile matrix of 10 factor scores by 28 social areas from Table 16. Part of the result is shown in Table 19 below (only the first five dimensions are listed).

TABLE 19 MEAN FACTOR SCORES BY ZONES AND SECTORS FOR THE ECOLOGICAL MODEL (ON FIRST FIVE DIMENSIONS)

RINGS	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5
OLD CITY	-0.2232	0.4196	-0.4858	-0.4368	-0.4415
OLD CITY FRINGE	0.3957	-0.2061	0.1470	-0.0899	-0.2710
INNER SUBURBAN	0.4085	-0.6151	**1.1860**	0.6324	0.4863
OUTER SUBURBAN	0.6698	-0.6676	0.4894	0.5503	**1.9914**
URBAN FRINGE	**1.0984**	-0.7520	-0.4166	-0.0256	-0.1927
SECTORS					
SECTOR 1	0.7140	-0.3028	-0.3023	0.0551	-0.2221
SECTOR 2	0.4555	0.1332	-0.0665	-0.0300	-0.0963
SECTOR 3	0.3533	-0.6168	0.8340	0.7316	0.6773
SECTOR 4	0.4290	-0.5411	0.3116	-0.3407	0.2087

According to Table 19, there are three positive values above 1.0 for mean factor scores by zones. These are: 1.1860 on Dimension 3-Suburban Established Family Status for the Inner Suburban zone; 1.9914 on Dimension 5-Recent Growth for the Outer Suburban zone; and, 1.0984 on Dimension 1-Suburban Affluent Family Status for the Urban Fringe. Based on the characteristics related to these three dimensions, respectively, it can be inferred that the Inner Suburban zone is the place where the most of the established communities are located, the Outer Suburban zone is the place which has undergone recent growth, and the Urban Fringe is the zone where some isolated single-family-dwelling households with affluent families are located.

In addition, the highest mean zone score on Dimension 2-the Black Community is positive 0.4196 for the Old City zone, the other zones all have negative mean scores on this dimension. Therefore, the Old City zone is the only area where the Black population are concentrated.

The mean factor scores by sectors in Table 19 have no distinctive high values (above 1.0) compared with the mean factor scores by zones. This indicates that the differentiation between the sectors delimited in this study is not so distinctive as that between the zones delimited. One of the reasons may be the fact that actual urban development in the Omaha area and urban development policy has emphasized westward zonal expansion. This can be seen in the map of Omaha Urban Development Policy for 1986 (Appendix J). But, some differentiation between sectors can still be recognized from Table 19.

Sector 2 has the relative high mean factor score on Dimension 2-The Black Ethnic Community, which suggests that the Black population concentrate in this sector. Sector 3 has the relative high mean factor scores on Dimension 3-Suburban Established Family Status, Dimension 4-High socioeconomic Status, and Dimension 5-Recent Growth respectively, which suggests that this sector is the growing part of the city where most of the population and the urban elites are located, and where most of the urban development projects have taken place.

Overall, the ecological model demonstrates that there are five concentric zones and a CBD in the Omaha area. These zones can be recognized, as in most other American cities, equivalent to central city, central city fringe, inner suburbs, outer suburbs, and urban fringe. The model also demonstrates that there are at least four sectors radiating from the CBD, and these sectors vary in characteristics as in the case of other American cities.

Finally, the grouping of the social areas into the concentric zones is more accurate in depicting the east-to-west variation in residential differentiation, while the grouping of the social areas into sectors yields some irregularity in the configuration of the sectors. Some minor changes may be possible (for example, extending Sector 3 to include all of the social areas in the western suburbs), but the four-sector division seems to be the only possible solution by grouping the social areas constructed in this study

SUMMARY

An inductive approach is used in this chapter with the following steps:

(a) a preliminary test of the distribution patterns of the social dimensions;

(b) classification of community patterns on the multi-dimension social space performed with a non-hierarchical cluster analysis;

(c) division of social areas by grouping spatially adjacent block groups with the same community-pattern clusters; and,

(d) generalization of an ecological model consisting of concentric rings and radial sectors.

Eight cluster patterns, each representing a social space pattern (or community pattern) emerged from the multi-dimensional non-hierarchical cluster analysis. Based on these eight community patterns, the spatially adjacent block groups are grouped into twenty-eight homogeneous social areas across the research area. A mean factor score profile matrix is calculated for these twenty eight social areas, which is a matrix of 10 mean factor scores by 28 social areas. Finally, the twenty eight social areas are grouped into five concentric zones and four sectors with the social area A7 at the center as the CBD. As a result, a generalized ecological model is established.

The results confirm that the ecological structure of the research area is comparable to that posited by other research focused on North American cities.

The results also demonstrate the methodological strength of using block groups as the areal units of analysis, and suggest the possibility of conducting urban regionalizations with the assistance of statistical mapping processes, and describing urban sub-areas using quantitative statistical measurements.

CHAPTER SEVEN
SUMMARY AND CONCLUSIONS

This study has intended to prove that choosing the appropriate geographic (spatial) scale and the appropriate analysis technique can improve the accuracy and goodness of fit of the factorial ecology technique in describing and dispalying urban ecological structure and residential differentiation. The study made use of UNO's VAX computer to manipulate large volumes of census data, as well as the Macintosh computer for the census and related statistical mapping. The SAS statistical procedures are used for the related statistical analysis, and Macintosh graphic program MapMaker is used for the mapping. By linking the VAX with the Macintosh the advantages of the both computers are combined.

The use of the census Block Group data characterizes this study and through a series of statistical analyses of the census data generated from Block Group areal units yields a finer-grained urban regionalization.

The input data matrix of 399 block groups by 84 census variables is used for a principal factor analysis with oblique rotation. Ten factors are retained in the factor structure, from which eight social dimensions are interpreted. The 399 block groups are classified into eight clusters according their factor scores on the 10 factors, each of the eight clusters representing a community pattern. A social area division is constructed by grouping those spatially adjacent block groups with the same community patterns. Twenty eight social areas are thus designated. These twenty eight social areas are further grouped into an ecological model consisting of five concentric zones and four radial sectors with an additional CBD area in the center of the city.

The results demonstrate a comparability in the social dimensions interpreted and the ecological models generalized between the Omaha area and the other American cities.

In addition, many of the social areas designated in this study are comparable to those residential districts delimited by other studies of the Omaha area. This confirms the advantage of using smaller areal units for a finer-grained regionalization.

Based on the findings of this study, conclusions can be presented as follows.

(1) The similarity in ecological structures found by this study of the Omaha area conducted at block group scale to the findings for other American cities at census tract scale in previous factorial ecological studies demonstrates the general applicability of the ecological structure to American cities.

In spite of some variations in social dimensions from one study to the other, or from those using census tract data to those using block group data, the three basic dimensions -- socioeconomic status, age and family structure , and ethnicity -- are found to exist in studies conducted at both scales.

As a result, it is confirmed that the "inflating effect" due to the changing areal scales do not invalidate nor obscure the factorial ecological studies as a whole. The effect can only result in differences in the degree of generalization between studies conducted at different areal scales.

However, for those studies conducted on the urban areas of relatively smaller size (for example, in an urban area where the census tracts are too large to reflect the spatial variation), the use of smaller areal units (such as the Block Group) could be essential to adequate analysis.

(2) Another advantage of using the Block Group as the areal unit of analysis is that it can yield a much finer grained regionalization than those constructed with the Census Tract as the areal unit.

The social areas designated in this study constitute a much more complicated residential mosaic pattern than in any other previous regionalization conducted for the same research area. In addition, many social areas thus designated are comparable to those otherwise distinguished residential districts in the Omaha area.

It can be inferred that the social areas designated in this study can display the residential differentiation much more accurately due to the use of the smaller areal unit of analysis -- the Block Group.

(3) This study demonstrates that, with the use of the advanced analytical and mapping techniques and the automated census block group data, the application potential is promising for urban factorial ecological studies in urban planning and marketing analysis.

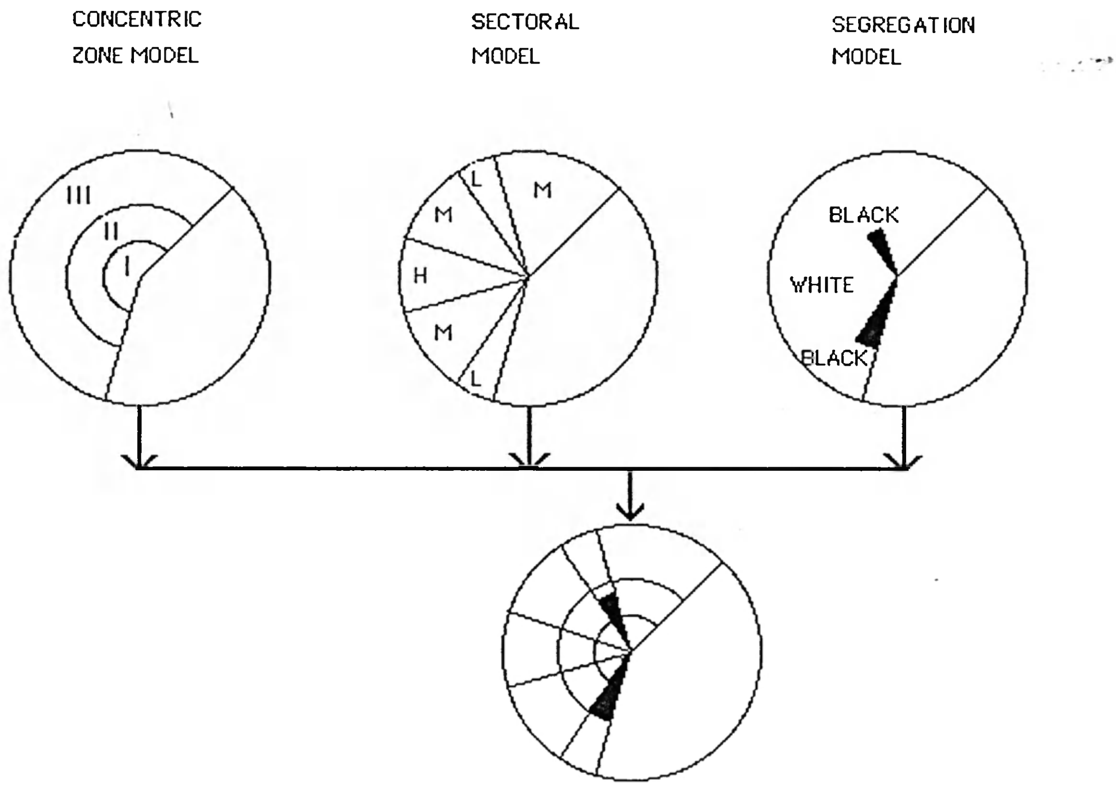
For example, as described in the previous chapter, the five concentric zones designated in the ecological model of this study are well coincident with the zones of development policy designated by Omaha planners (compare Figure 23 with Appendix J). There are two differences between the two designations: (1) the ecological model is generalized based on a series of objective analytical and mapping procedures while the zones of the development policy are, by and large, based on the field observation; and, (2) the ecological model is constructed with a computer software product format, subject to be updated with new and additional data; in other words, the model can be easily updated and reproduced. On the other hand, the map of the zones of development policy is a manual product, not subject to updating as easily. Therefore, the ecological model of this study can help to support, evaluate, and computerize the designation of official areas constructed by the planners, and can provide quantitative measurement and descriptions for the designation.

All in all, in spite of the limitations and some unsolved difficulties discussed in the literature, urban factorial ecology can further develop its theoretical and application potential in the future with the application of the geographic approach, including refinements in scales of observation (block group scale), and contemporary computer facilities and software packages. The theoretical potential lies in the study of generalized urban ecological structure through factorial comparisons. (The automation of the census data since the 1980 Census will provide much more convenience for this task) The application potential lies in its use for urban planning and urban marketing analysis.

APPENDICES

APPENDIX A

GENERALIZED ECOLOGICAL MODEL



COMBINED ECOLOGICAL MODEL

NOTE:

1. IN SECTORAL MODEL:
   - L: LOW SOCIO-ECONOMIC STATUS
   - M: MIDDLE SOCIO-ECONOMIC STATUS
   - H: HIGH SOCIO-ECONOMIC STATUS
2. IN CONCENTRIC ZONES MODEL:
   - I: CBD
   - II: INNER CITY ZONE
   - III: SUBURBAN ZONE

(P. H. REES 1970)

APPENDIX B
VARIABLE CODES AND DEFINITIONS

FIRST FILE:

1. GENERAL

1) NUMBER OF PERSONS
2) NUMBER OF FAMILIES
3) NUMBER OF HOUSEHOLDS
4) PERSONS PER HOUSEHOLD
5) PERSONS PER FAMILY
6) MEDIAN FAMILY INCOME
7) NUMBER OF HOUSING UNITS
8) ROOMS PER UNIT
9) PERSONS PER ROOM
10) MEDIAN GROSS RENT
11A) MEDIAN SELECTED MONTHLY OWNER COSTS, WITH A MORTGAGE
11B) MEDIAN SELECTED MONTHLY OWNER COST, NOT MORTGAGED
12) NUMBER OF CHILDREN EVER BORN TO WOMEN AGED 15 TO 44
13) RATIO BETWEEN FAMILIES AND HOUSEHOLDS (FAMILIES/HOUSEHOLDS)

2. ETHNIC

14) % OF BLACK
15) % OF NON-WHITE
16) % OF SPANISH ORIGIN
17) % OF PERSONS OVER 5 YEARS OLD SPEAKING A LANGUAGE OTHER THAN ENGLISH.

SECOND FILE:

1. AGE

18) % 5-17
19) % 25-44
20) % 45-64
21) % OVER 65 AND UNDER 5 (DEPENDENTS)

2. FAMILY

22) % MARRIED-COUPLE FAMILY
23) % SINGLE-HOUSEHOLDER FAMILY
24) % OF OWN CHILDREN IN SINGLE-PARENT HOUSEHOLDER FAMILY
25) % OF PERSONS IN SUBFAMILY
26) % OF FEMALE LABOR WITH OWN CHILDREN UNDER 6 YEARS

4. HOUSEHOLD

27) % NON-FAMILY HOUSEHOLDS
28) % OF HOUSEHOLDS WITH 6 OR MORE PERSONS
29) % ONE PERSON HOUSEHOLDS
30) % OF MARRIED-COUPLE FAMILY HOUSEHOLDS WITHOUT OWN CHILDREN

5.TENURE BY YEAR HOUSEHOLDER MOVED INTO UNIT

31) % BEFORE 1970
32) % 1970 - 1974
33) % AFTER 1975

THIRD FILE:

1. SCHOOL COMPLETED

34) % WITH 4-YEAR HIGH SCHOOL
35) % WITH 8-YEAR ELEMENTARY SCHOOL
36) % WITH COLLEGE 4 OR MORE YEARS

2. OCCUPATIONS

37) % IN MANAGERIAL AND PROFESSIONAL

38) % IN TECHNICAL, SALES, AND ADMINISTRATIVE SUPPORT

39) % IN SERVICE OCCUPATIONS

40) % IN PRECISION PRODUCTION, CRAFT, AND REPAIR

41) % IN OPERATORS, FABRICATORS, AND LABORERS

3. INCOME AND POVERTY

42) % WITH FAMILY INCOME UNDER 7,499

43) % WITH FAMILY INCOME 7,500 - 14,999

44) % WITH FAMILY INCOME 15,000 - 24,999

45) % WITH FAMILY INCOME 25,000 - 34,999

46) % WITH FAMILY INCOME 35,000 - 49,999

47) % WITH FAMILY INCOME OVER 50,000

48) % FAMILIES WITH SOCIAL SECURITY INCOME

49) % OF FAMILIES RECEIVING PUBLIC ASSISTANCE

50) % OF PERSONS BELOW POVERTY

51) % OF FAMILIES BELOW POVERTY

52) PER CAPITA INCOME

FOURTH FILE:

1. HOUSING

53) % HOUSING UNITS VACANT

54) % OWNER OCCUPIED HOUSING UNITS

55) % RENTER OCCUPIED HOUSING UNITS

56) % MULTI-FAMILY DWELLING UNITS

57) % OWNER-OCCUPIED SINGLE-FAMILY DWELLING UNITS

2. VALUE OF OWNER-OCCUPIED HOUSING UNITS

58) MEAN VALUE OF OWNER-OCCUPIED NONCONDOMINIUM UNITS

3. HOUSEHOLD VEHICLES

62A) % OF HOUSEHOLDS WITH TWO VEHICLES

62) % OF HOUSEHOLDS WITH THREE AND MORE VEHICLES

63) % OF HOUSEHOLDS WITH ONE VEHICLES

64) % OF HOUSEHOLDS WITH NO VEHICLES

4. YEAR STRUCTURE BUILT

65) % BEFORE 1940

66) % 1940 - 1960

67) % 1960 - 1974

68) % AFTER 1975

5.RESIDENCE IN 1975 AT SAME COUNTY LEVEL

69) % OF PERSONS IN SAME COUNTY 5 YEARS AND OVER

FIFTH FILE:

1. HOUSING

70) % OF UNITS WITH 1-3 STORIES IN STRUCTURE

71) % OF UNITS WITH 4-6 STORIES IN STRUCTURE

72 % OF UNITS WITH OVER 7 STORIES IN STRUCTURE

73) % OF UNITS WITHOUT AIR CONDITIONING

74) % OF OWNER OCCUPIED HOUSING WITH 5 OR MORE BEDROOM

75) % OF OWNER OCCUPIED HOUSING WITH 2 OR MORE COMPLETE BOTHROOMS

76) % OF OCCUPIED HOUSING UNITS LACKING CENTRAL HEATING SYSTEM

77) % OF OWNER OCCUPIED HOUSING WITH 1 COMPLETE BATHROOM PLUS HALF BOTH(S)

2. FAMILY & HOUSEHOLD

78) % SEPARATED OR DIVORCED

79) % WIDOWED

3. TRANSPORTATION

82) MEAN TRAVEL TIME TO WORK

83) % OF PERSONS IN CARPOOL

4. INCOME AND EMPLOYMENT

84) FEMALE WORKER PARTICIPATION RATE

85) UNEMPLOYMENT RATE

86) FAMILY WITH 2 OR MORE WORKERS

87) % OF WORKERS WITH SOME UNEMPLOYMENT IN 1979

APPENDIX C-THE MSA TABLE

KAISER'S MEASURE OF SAMPLING ADEQUACY: OVER-ALL MSA = 0.79336272

V1	V2	V3	V4	V5	V6
0.861253	0.876152	0.825882	0.672466	0.633439	0.879385
V7	V8	V9	V10	V11A	V11B
0.845868	0.884903	0.645902	0.862228	0.945818	0.937058
V12	V13	V14	V15	V16	V17
0.891751	0.979781	0.836704	0.844780	0.635206	0.703469
V22	V23	V24	V25	V26	V27
0.865641	0.780433	0.947022	0.798848	0.833276	0.825184
V28	V29	V30	V31	V32	V33
0.861708	0.951259	0.860607	0.680384	0.384397	0.664078
V39	V40	V41	V42	V43	V44
0.636064	0.308327	0.586438	0.840845	0.704097	0.469609
V45	V46	V47	V48	V49	V50
0.703524	0.658772	0.652678	0.911009	0.963023	0.887138
V51	V52	V18	V19	V20	V21
0.876201	0.883171	0.821928	0.811966	0.437446	0.679044
V55	V56	V57	V58	V62A	V62
0.714440	0.914585	0.839169	0.926123	0.812807	0.750646
V63	V64	V65	V66	V67	V68
0.844618	0.947427	0.726193	0.340125	0.661939	0.607350
V69	V34	V35	V36	V37	V38
0.768264	0.810811	0.916350	0.910528	0.666150	0.529731
V70	V71	V72	V73	V74	V75
0.577783	0.442352	0.467898	0.954622	0.773027	0.881775
V76	V77	V78	V79	V82	V83
0.237206	0.827994	0.860304	0.802693	0.745148	0.806631
V84	V85	V86	V87	V53	V54
0.913137	0.835511	0.890123	0.867432	0.791715	0.727205

APPENDIX D
FACTOR PROCEDURE
SAS PROCEDURE STATEMENTS FOR FACTOR ANALYSIS

```
FILENAME BGPOP51 'BGPOP51.DAT';
FILENAME BGPOP41 'BGPOP41.DAT';
FILENAME BGPOP31 'BGPOP31.DAT';
FILENAME BGPOP21 'BGPOP21.DAT';
FILENAME BGPOP11 'BGPOP11.DAT';
FILENAME FID 'FID.DAT';
DATA SOC;
        INFILE      BGPOP51;
        INPUT       V70 V71 V72 V73 V74 V75 V76 V77 V78 V79 V82
                    V83 V84 V85 V86 V87;
        INFILE      BGPOP41;
        INPUT       V53 V54 V55 V56 V57 V58 V62A V62 V63 V64 V65
                    V66 V67 V68 V69;
        INFILE      BGPOP31;
        INPUT       V34 V35 V36 V37 V38 V39 V40 V41 V42 V43 V44
                    V45 V46 V47 V48 V49 V50 V51 V52;
        INFILE BGPOP21;
        INPUT       V18 V19 V20 V21 V22 V23 V24 V25 V26 V27 V28
                    V29 V30 V31 V32 V33;
        INFILE      BGPOP11;
        INPUT       V1 V2 V3 V4 V5 V6 V7 V8 V9 V10 V11A V11B V12
                    V13 V14 V15 V16 V17;
        INFILE      FID;
        INPUT       FID $1-7;
        RUN;
PROC FACTOR DATA=SOC SCREE MINEIGEN=2.5 PRIORS=SMC
        ROTATE=PROMAX MSA ROUND REORDER SCORE OUTSTAT=FACT1;
PROC SCORE DATA=SOC SCORE=FACT1 OUT=SCORES;
PROC SORT;
        BY          FID;
PROC PRINT;
        VAR         FID FACTOR1 FACTOR2 FACTOR3 FACTOR4 FACTOR5
                    FACTOR6 FACTOR7 FACTOR8 FACTOR9 FACTOR10;
TITLE 1 C=WHITE 'FACTOR ANALYSIS OF CENSUS VARIABLES BYBLOCK
        GROUP';
TITLE 2 C=WHITE 'OMAHA, 1980 CENSUS';
```

APPENDIX E
GLM PROCEDURE
EXAMPLE OF SAS PROCEDURE STATEMENTS FOR TWO-WAY ANALYSIS OF VARIANCE

```
DATA VAL;
        INPUT ZONES SECTORS @;
        DO I= 1 TO 5;
        INPUT Y @;
        OUTPUT;
        END;
CARDS;
1 1      0.0058     -0.5515      1.6422      0.4787      0.2787
1 1      0.1835     -0.6294     -0.1404     -0.2515      0.1978
1 1     -0.1447     -0.0798     -1.2428      0.5815       ....
1 2     -0.1895      1.8433      0.7936      0.2985      0.3181
............
............
6 1     -0.6410       ....        ....        ....        ....
6 2      1.7553     -0.3416     -0.4152      1.0163       ....
6 3     -0.2263     -0.2880     -0.0446     -0.3485     -0.8622
6 3      0.0736       ....        ....        ....        ....
6 4     -0.0388     -1.7189       ....        ....        ....
PROC GLM;
        CLASS      ZONES SECTORS;
        MODEL      Y=ZONES SECTORS
                     ZONES*SECTORS / SS1 SS2 SS3 SS4;
        MEANS      ZONES SECTORS ZONES*SECTORS;
TITLE C=WHITE'TWO-WAY ANALYSIS OF VARIANCE FOR FACTOR8';
```

APPENDIX F
GLM PROCEDURE
SAS STATEMENTS FOR ONE-WAY MULTIVARIATE ANALYSIS OF VARIANCE

```
FILENAME MUV3 'MUV3.DAT';
FILENAME MUV4 'MUV4.DAT';
DATA SOR;
INFILE MUV3;
        INPUT       A F1 F2 F3 F4 F5;
INFILE MUV4;
        INPUT       A F6 F7 F8 F9 F10;
        RUN;
PROC GLM DATA=SOR;
        CLASS       A;
        MODEL       F1 F2 F3 F4 F5 F6 F7 F8 F9 F10=A;
        MANOVA      H=A/PRINTH PRINTE SUMMARY;
        MEANS       A;
TITLE1 C=WHITE'MULTIVARIATE ANALYSIS OF VARIANCE';
TITLE2 C=WHITE'ONE-WAY MODEL';
```

APPENDIX G
FASTCLUST PROCEDURE AND CANONICAL PROCEDURE
SAS PROCEDURE STATEMENTS FOR NON-HIERARCHICAL CLUSTER ANALYSIS AND CANONICAL DISCRIMINANT ANALYSIS

```
FILENAME SCORE1 'SCORE1.DAT';
FILENAME SCORE2 'SCORE2.DAT';
FILENAME FID 'FID.DAT';
DATA SOC;
      INFILE          SCORE1;
      INPUT           F1 F2 F3 F4 F5 F6 F7;
      INFILE          SCORE2;
      INPUT           F8 F9 F10;
      INFILE          FID;
      INPUT           FID $1-7;
      RUN;
PROC FASTCLUS DATA=SOC MEAN=MEAN1 MAXC=20 MAXITER=0
                      SUMMARY;
      VAR             F1 F2 F3 F4 F5 F6 F7 F8 F9 F10;
PROC PLOT DATA=MEAN1;
      PLOT _GAP_*_FREQ_='G' _RADIUS_*_FREQ_='R'/OVERLAY;
RUN;
DATA SEED; SET MEAN1;
      IF _FREQ_>4;
RUN;
PROC FASTCLUS DATA=SOC SEED=SEED MAXC=12 STRICT=5.0 OUT=OUT
      MEAN=MEAN2;
      VAR             F1 F2 F3 F4 F5 F6 F7 F8 F9 F10;
PROC CANDISC NCAN=2 ALL DATA=OUT OUT=CAN;
      VAR             F1 F2 F3 F4 F5 F6 F7 F8 F9 F10;
      CLASS           CLUSTER;
PROC PLOT;
      PLOT            CAN2*CAN1=CLUSTER;
RUN;
PROC FASTCLUS DATA=SOC SEED=MEAN2 MAXC=12 MAXITER=0 OUT=OUT;
      VAR             F1 F2 F3 F4 F5 F6 F7 F8 F9 F10;
PROC CANDISC NCAN=2 ALL DATA=OUT OUT=CAN;
      VAR             F1 F2 F3 F4 F5 F6 F7 F8 F9 F10;
      CLASS           CLUSTER;
PROC PLOT;
      PLOT            CAN2*CAN1=CLUSTER;
RUN;
PROC SORT;
      BY              CLUSTER;
PROC PRINT;
      BY              CLUSTER;
      VAR             FID CLUSTER;
```

APPENDIX H
CLUSTER PROCEDURE
SAS PROCEDURE STATEMENTS FOR HIERARCHICAL CLUSTER ANALYSIS

```
FILENAME CLU1 'CLU1.DAT';
FILENAME CLU2 'CLU2.DAT';
FILENAME CLU3 'CLU3.DAT';
DATA SOR;
INFILE CLU1;
        INPUT       AREA F1 F2 F3 F4 F5;
INFILE CLU2;
        INPUT       AREA F6 F7 F8;
INFILE CLU3;
        INPUT       AREA F9 F10;
        RUN;
PROC CLUSTER DATA=SOR METHOD=SINGLE TRIM=10 K=3;
        ID          AREA;
PROC TREE;
TITLE 'CLUSTER ANALYSIS OF 28 SUBAREAS';
TITLE2 'OMAHA BY BLOCK GROUP';
```

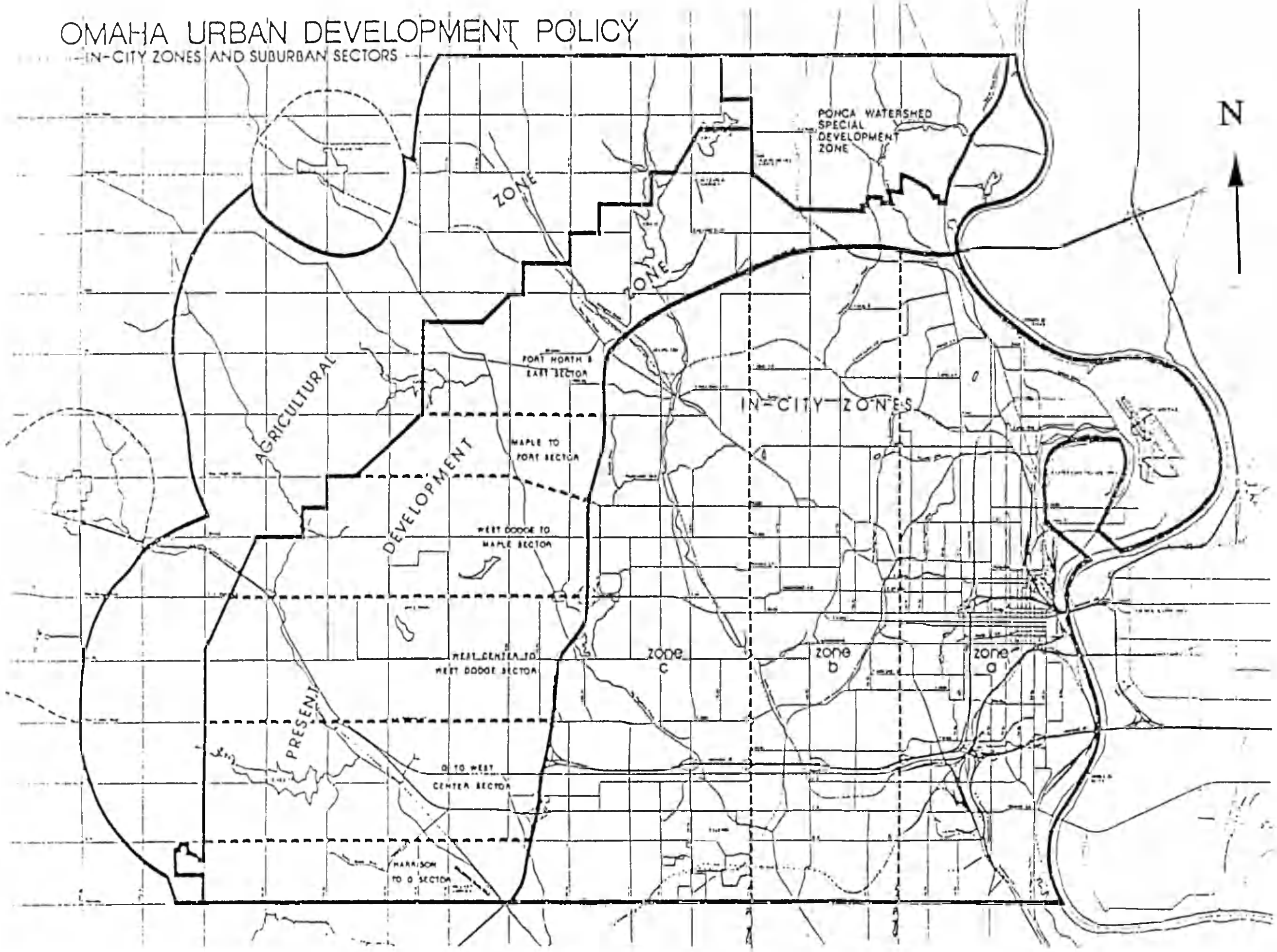
APPENDIX I-FACTOR STRUCTURE

FACTOR STRUCTURE (CORRELATIONS)

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6	FACTOR7	FACTOR8	FACTOR9	FACTOR10
V54	92 *	-20	18	37 *	-4	34 *	-16	-6	3	5
V13	90 *	2	28	36 *	10	38 *	-41 *	-2	11	13
V57	75 *	-7	17	19	-17	37 *	0	1	-17	4
V22	88 *	-42 *	36 *	50 *	23	34 *	-37 *	-12	13	11
V30	58 *	-32 *	11	32 *	-20	16	-2	1	-26	-11
V8	65 *	13	19	64 *	27	22	-24	9	-11	30
V62A	57 *	-32 *	40 *	46 *	42 *	29	-33 *	-29	25	4
V77	51 *	-33 *	24	19	-6	34 *	-5	-22	-3	-2
V75	48 *	-30	38 *	60 *	44 *	6	-23	-27	4	16
V78	-57 *	46 *	-28	-21	-7	-8	15	26	-8	-32 *
V71	-51 *	-3	1	-1	3	-15	28	3	-10	4
V63	-67 *	47 *	-37 *	-39 *	-33 *	-10	47 *	37 *	-50 *	-2
V29	-87 *	7	-24	-20	-11	-18	53 *	21	-25	-8
V27	-90 *	6	-24	-19	-7	-15	50 *	19	-24	-8
V55	-69 *	27	-14	-23	7	-15	22	19	-13	-1
V56	-88 *	-2	1	-8	20	-14	23	3	-5	-6
V14	-5	86 *	-23	-22	-21	-16	12	8	-13	10
V15	-7	87 *	-24	-24	-20	-18	13	15	-14	11
V24	-1	82 *	-10	-24	-12	1	-11	9	5	0
V23	-1	87 *	-18	-29	-25	6	-3	19	-4	1
V51	-21	88 *	-22	-31	-16	-24	20	28	-18	1
V49	-22	85 *	-23	-31	-18	-26	20	26	-11	2
V42	-29	83 *	-28	-39 *	-22	-25	25	33 *	-27	2
V50	-41 *	81 *	-29	-35 *	-19	-33 *	37 *	33 *	-22	7
V82	23	33 *	10	12	9	41 *	12	4	15	-5
V18	56 *	30	23	25	15	27	-47 *	-4	33 *	32 *
V73	-37 *	73 *	-48 *	-41 *	-30	-34 *	33 *	59 *	-32 *	3
V39	-17	61 *	-23	-30	-29	-12	27	44 *	-18	19
V64	-58 *	60 *	-35 *	-38 *	-20	-37 *	62 *	38 *	-22	10
V28	31	36 *	4	5	-10	11	-20	7	24	27
V87	-23	47 *	-4	-22	-6	25	3	28	-4	7
V53	-26	45 *	-26	-7	16	-27	17	30	-21	13
V85	-14	42 *	-23	-22	-16	-3	11	26	-1	-7
V25	7	26	-6	-13	-14	12	1	5	2	0
V7	2	-27	94 *	28	26	34 *	-18	-24	20	-3
V3	1	-27	94 *	29	26	33 *	-17	-24	19	-4
V1	24	-23	98 *	34 *	29	31	-29	-26	27	14
V2	36 *	-25	97 *	36 *	26	35 *	-32 *	-26	26	1
V12	36 *	-6	85 *	23	37 *	26	-38 *	-23	34 *	13
V58	49 *	-38 *	86 *	52 *	21	27	-29	-32	26	5
V67	5	-33 *	62 *	28	38 *	17	-36 *	-36 *	49 *	-6
V47	25	-27	24	76 *	9	-9	-17	-20	15	0
V52	5	-47 *	27	76 *	22	22	-9	-24	15	-20
V37	2	-45 *	31	74 *	40 *	6	-15	-46 *	15	7
V36	4	-47 *	41 *	77 *	45 *	10	-27	-48 *	15	20
V6	49 *	-55 *	42 *	83 *	31	25	-18	-34 *	24	18
V46	28	-40 *	23	62 *	27	-5	-5	-31	28	21
V74	18	1	4	40 *	-9	2	-5	5	-10	18
V11B	38 *	-16	52 *	58 *	-1	28	-14	-11	4	-1
V43	-24	38 *	-29	-43 *	-36 *	-3	28	51 *	-42 *	-7
V68	29	-26	14	27	80 *	-4	-21	-23	1	14
V33	-34 *	-9	18	15	82 *	12	-20	-14	0	4
V19	19	-25	38 *	34 *	68 *	54 *	-34 *	-24	19	5
V69	-17	9	6	7	49 *	29	-2	-4	12	-12
V11A	42 *	-34 *	46 *	64 *	52 *	37 *	-38 *	-21	10	4
V20	1	5	-8	21	-49 *	8	21	32 *	-12	-32 *
V66	16	16	-10	-4	-49 *	27	14	-10	-10	-20
V31	34 *	18	-23	-3	-81 *	11	33 *	33 *	-36 *	-5
V44	18	-22	13	-10	5	69 *	-15	3	13	-9
V34	31	-7	14	-7	1	66 *	-13	11	22	-12
V38	16	-28	34 *	30	17	60 *	-18	-23	-3	2
V26	13	-8	23	9	6	48 *	-11	-7	-1	11
V86	39 *	-40 *	39 *	42 *	36 *	55 *	-29	-18	16	36 *
V84	31	-40 *	36 *	53 *	42 *	60 *	-40 *	-11	25	-9
V10	15	-13	41 *	22	-3	47 *	-7	-9	-6	-10
V70	54 *	16	13	35 *	-4	57 *	-39 *	29	-30	-4
V83	3	34 *	-1	-14	-16	25	8	35 *	-16	9
V9	2	-4	-35 *	-9	4	-51 *	2	4	-41 *	2
V21	-26	17	-25	-13	-31	-3	82 *	29	-23	-16
V79	-31	25	-21	-20	-36 *	-12	81 *	22	-20	1
V72	-41 *	-4	-9	-15	12	-29	61 *	-11	28	14
V48	-30	35 *	-36 *	-33 *	-53 *	-24	81 *	45 *	-40 *	4
V16	-9	6	-11	-15	-5	3	2	59 *	-3	2
V17	-16	-2	-12	-7	-13	-2	19	57 *	-10	-5
V35	-26	55 *	-39 *	-38 *	-44 *	-26	53 *	64 *	-28	-8
V41	-3	49 *	-23	-41 *	-27	12	18	55 *	-5	-11
V40	14	9	-16	-19	-18	13	19	38 *	17	-26
V65	-29	40 *	-54 *	-26	-47 *	-16	41 *	65 *	-46 *	14
V76	-3	4	-1	-3	-3	-4	5	12	-4	-4
V32	18	3	22	16	-8	6	-7	2	46 *	12
V62	55 *	-26	23	44 *	8	26	-26	5	35 *	8
V5	-29	-2	-7	-6	8	-13	31	-4	4	60 *
V4	31	8	9	22	9	15	-25	0	13	64 *
V45	38 *	-46 *	43 *	38 *	39 *	27	-12	-39 *	14	29

NOTE: PRINTED VALUES ARE MULTIPLIED BY 100 AND ROUNDED TO THE NEAREST INTEGER VALUES GREATER THAN 0.316442 HAVE BEEN FLAGGED BY AN '*'

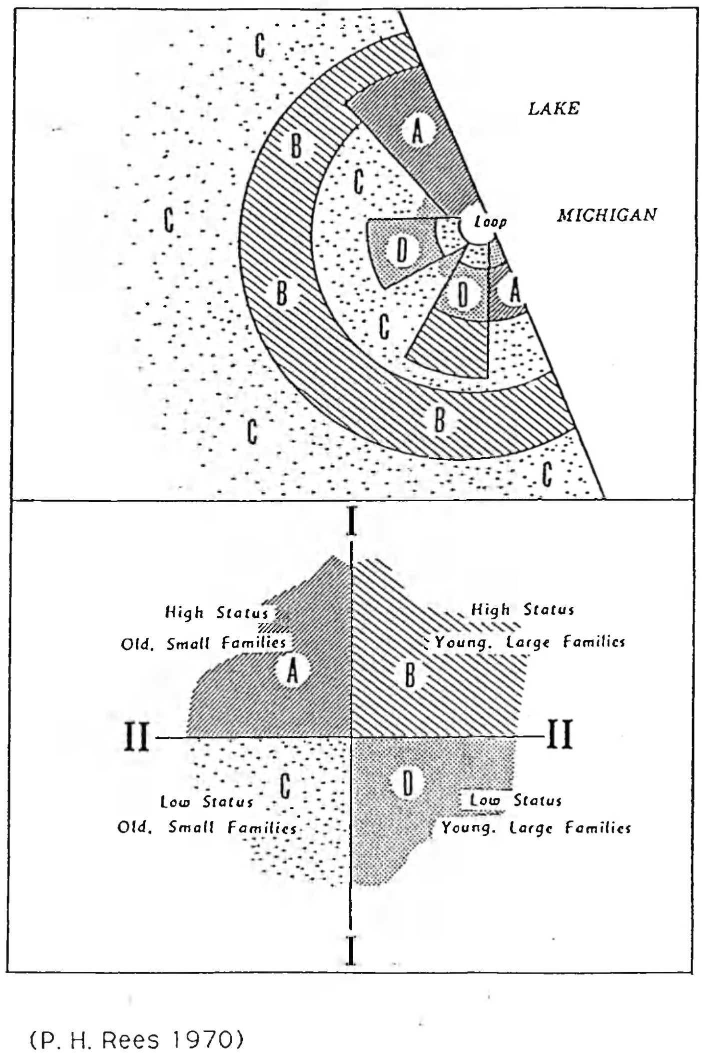
APPENDIX J



(Omaha City Planning Department 1987)

APPENDIX K

SOCIAL SPACE PATTERNS AND SOCIAL AREAS OF METROPOLITAN CHICAGO



(P. H. Rees 1970)

APPENDIX L

CLUSTER SUMMARY

CLUSTER NUMER	FREQUENCY	RMS STD DEVIATION	MAXIMUM DISTANCE FROM SEED TO OBSERVATION	NEAREST CLUSTER	CENTROID DISTANCE
1	19	0.8391	6.3562	3	3.0716
2	26	1.4231	8.1681	4	3.8378
3	30	0.7586	6.5390	5	2.0155
4	63	0.6248	5.3223	6	2.1458
5	30	0.5510	2.9383	3	2.0155
6	59	0.5929	4.3518	7	2.0889
7	117	0.6221	7.3264	6	2.0889
8	55	0.7602	9.5861	7	2.3182

STATISTICS FOR VARIABLES

VARIABLE	TOTAL STD	WITHIN STD	R-SQUARED	RSQ/(1-RSQ)
F1	0.9991545	0.6251340	0.6154307	1.6003113
F2	0.9973028	0.5150533	0.7379742	2.8164183
F3	0.9984084	0.6426882	0.5929217	1.4565298
F4	0.9929117	0.7508345	0.4382270	0.7800783
F5	0.9964408	0.5544732	0.6958052	2.2873675
F6	0.9882005	0.7830136	0.3832032	0.6212795
F7	0.9885996	0.7880806	0.3756989	0.6017911
F8	0.9846135	0.7943247	0.3606211	0.5640179
F9	0.9872533	0.8281392	0.3087372	0.4466279
F10	0.9749966	0.9309044	0.1044340	0.1166122
OVER-ALL	0.9908143	0.7319730	0.4638341	0.8650943

PSEUDO F STATISTIC = 48.32
APPROXIMATE EXPECTED OVER-ALL R-SQUARED = 0.33867
CUBIC CLUSTERING CRITERION = 28.646
WARNING: THE TWO ABOVE VALUES ARE INVALID FOR CORRELATED VARIABLES

APPENDIX M

CLUSTER MEANS

CLUSTER	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
1	1.16868	-0.80332	-0.02555	0.99534	2.97350	-0.09124	-0.72938	-0.76735	-0.10532	0.59232
2	-2.02456	-0.49797	-0.60813	-1.22834	0.10640	-2.01134	1.56308	-0.36707	0.91065	-0.22725
3	0.77827	-0.59380	0.56213	1.05302	0.36610	0.06316	-0.97363	-0.56638	1.27323	0.33348
4	-0.94012	-0.24933	0.10930	-0.02090	0.48803	0.48910	-0.46131	-0.25368	-0.01201	-0.41934
5	0.66939	-0.50677	2.37143	0.58385	0.79669	0.33109	-0.74812	-0.64005	0.78837	0.35644
6	0.57989	-0.60855	0.14962	0.75558	-0.48781	0.39587	0.12054	-0.54731	-0.24324	-0.07126
7	0.17486	0.00446	-0.46761	-0.44492	-0.60737	0.13314	0.29929	0.81435	-0.39819	-0.16082
8	-0.15347	2.04216	-0.55696	-0.49605	-0.45543	-0.50085	0.21462	0.24199	-0.39687	0.42537

CLUSTER STANDARD DEVIATIONS

CLUSTER	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
1	0.63693	0.33731	1.10569	1.05869	0.59125	1.28947	0.43787	0.73666	0.93677	0.74457
2	0.81804	0.80014	0.62624	1.31110	0.71086	1.55533	2.14474	1.98280	1.53996	1.73358
3	0.52353	0.30496	0.75436	1.27329	0.57787	0.64740	0.48595	0.37773	0.79081	1.19977
4	0.90023	0.41715	0.80519	0.41177	0.66931	0.41451	0.58443	0.56671	0.53645	0.72843
5	0.47212	0.45585	0.65515	0.73884	0.86586	0.29251	0.48817	0.14367	0.53887	0.49586
6	0.48065	0.27996	0.70368	1.03702	0.46351	0.58034	0.44132	0.45834	0.47337	0.67417
7	0.52911	0.46540	0.44305	0.37032	0.37601	0.80955	0.59914	0.80480	0.90734	0.64341
8	0.58112	0.82201	0.40949	0.32308	0.49483	0.72618	0.82233	0.70292	0.86257	1.34417

APPENDIX N
FORTRAN PROGRAM FOR CONVERTING STANDARD XY COORDINATES FILE INTO SAS MAP FILE

```
      DIMENSION X(1000), Y(1000)
      CHARACTER*86 LINE
      OPEN(UNIT=2, FILE='FILE2.FIX', STATUS='OLD')
      OPEN(UNIT=3, FILE='SAS.MAP', STATUS='NEW')
      DO 10 I=1, 26
      READ(2,'(A86)') LINE
10    CONTINUE
      READ(2,900) Xmin, Ymin, Xmax, Ymax
900   FORMAT(15X, 4(F10.6,2X))
      DO 20 I=1, 408
      READ(2,910) ISMSA, ISTATE, ICOUNTY, TRACT, IBLOCK, IPTS
910   FORMAT(20X, I4, 8X, I2, 9X, I3, 8X, F7.2, 14X, I1, 10X, I3)
      FRACTION=IBLOCK
      FRACTION=FRACTION/1000
      FID=TRACT+FRACTION
      READ(2, 911) NPOINTS
911   FORMAT(8X, I7)
      NUML=(NPOINTS+4)/5
      NC=1
      DO 50 N=1, NUML
      READ(2, 920) (X(IJ), Y(IJ), IJ=NC, NC+4)
      NC=NC + 5
50    CONTINUE
920   FORMAT(1X, 5(F10.6, 2X, F9.6, 2X))
      DO 105 M=1, NPOINTS
      WRITE(3, 999) ICOUNTY, TRACT, IBLOCK, FID, X(I), Y(I)
999   FORMAT(I7, F7.2, 2X, I1, 2X, F7.3, 2F10.5)
105   CONTINUE
20    CONTINUE
      STOP
      END
```

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