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A Statistical & Cartographic Analysis of the Size-Distribution of Retail Grocery Stores in Bowling Green, Kentucky

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A STATISTICAL AND CARTOGRAPHIC ANALYSIS OF THE SIZE-DISTRIBUTION OF RETAIL GROCERY STORES IN BOWLING GREEN, KENTUCKY

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OF THE

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Luke Drew Hall May 1975 65 pages

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The purpose of this study was to investigate the spatial distribution of retail grocery stores in Bowling Green, Kentucky using the formal element of store size as a controlling theme. This purpose was behaviorally accomplished through a cartographic analysis of the city wide arrangement and a statistical analysis measuring the degree and intensity of selected variables. A survey of pertinent literature was undertaken to discover locational trends and to uncover sixteen specific variables suggested to provide association with grocery store distribution. One general and six specific hypotheses were presented; all were rejected. The cartographic displays did, however, yield promising similarities to the arrangements suggested in the literature review with smaller stores to the city center and larger establishments locating to the outer city. Statistical analysis, which comprises of simple correlation and step-wise regression and correlation, also provided a number of statisically significant results. Simple correlation coefficients showed retail agglomeration, accessibility, hours open per week, and overcrowded housing to be significant. The regression model generated six variables considered to be important: retail agglomeration, accessibility, hours open per week, population 65 years plus, population density, and issuance of credit. A subordinate objective of this study was satisfied when it was found that the results

from Bowling Green generally agreed with findings of existing spatial studies from much larger urban centers. This study did not uncover any unusual conclusions concerning the distribution of retail grocery establishments, but it did present a new approach to their study.

CHAPTER I

SPATIAL AFFINITIES: THE RETAIL GROCERY IN THE URBAN ENVIRONMENT

Introduction

In the search for predictive laws explaining the spatial distribution of various phenomena, geographers have often been required to distinguish between the elements of form and function. In fact, for any scientific study to progress beyond the rudiments of identification and definition, these two elements must be considered. Form is a physically descriptive property such as size, shape, and number, while function refers to the use or activity associated with a phenomenon. Although separated for analytical purposes, in reality they are totally interrelated and inseparable.

The close interrelationship between form and function suggests that discovery of regularities in one element may coincide with regularities in the other. In the case of retailing, the form of the physical structure may be indicative of the original intended use or function of the building. Function in retailing has been identified as including sales methods, corporate policy, shopping area organization, type of goods, and frequency of use.[1] Ideally every change in function should result in an alteration in form such as building size or internal space arrangement. Investigation of aggregate formal elements (which are more

easily identified and preserved on the landscape) may be indicators of functional processes at work. Therefore, in the development of any system, function controls form. This study, however, reverses that association and surmises that analysis of existing forms will provide clues to functional systems. Once regularities in these two elements are established, the processes controlling spatial distribution can be reliably predicted using formal elements alone as indicators.

This study will isolate size, as an element of form, and employ it as a central factor in analyzing the spatial distribution of intraurban grocery stores. The ubiquity of these establishments in urban centers, compared to other retailing endeavors, makes food outlets an excellent topic for spatial studies concerned with city commercial structure. The investigation will be conducted within the corporate city limits of Bowling Green, Kentucky.

Purpose

The purpose of this study is to investigate the spatial distribution of retail grocery stores using the formal element of store size as a controlling theme. Previous geographic studies have employed similar approaches in studying food stores, but have used number and spacing as their elements of form.[2] The contribution of this work is the utilization of size as the determinant for the distribution of retail food establishments.

The specific objectives of this study are twofold. First, it is to assess the city wide arrangement of grocery stores based on size. This approach is included to discover the existence of regular patterns

in the size-distribution of stores. The second objective of the paper is to identify and measure selected variables associated with size-distribution. A survey of literature will be made to uncover information both on general distribution and specific variables which may be important in determining distribution.

Literature Survey

The survey of literature is divided into two sections. The first deals with size as a formal element in relation to grocery stores. The second involves the distribution of intraurban retail food establishments. At the close of the literature review, the operationalization and statement of the hypotheses will be presented.

Grocery Store Size

Size variation has been a common element in spatial studies concerned with retail trade. Reilly's familiar Law of Retail Gravitation employs size (population) to delimit the breaking point for retail trade between cities.[3] An adaption of Reilly's Law for intraurban retail trade substitutes square feet of selling area for city population.[4] Essentially store size is the determinant for a functional market area. Huff's probability theory for intraurban retail markets is based on square feet as a measure of area.[5] Independent studies dealing with grocery stores by Horton and Stafford have also used square food area as a variable.[6] The use of store size, expressed in square feet of selling area, in a spatial study is not novel, but the use of size as a controlling factor is, for it gives this study its identity.

Several studies have clustered grocery establishments into size

groupings and have studied only one group. Cooke and Radell have produced studies dealing with what they refer to as "corner stores" and "mom n' pop" stores, respectively. [7] Cooke defines his corner stores of metropolitan Victoria, as those having a square foot area of one thousand feet or less. [8] Radell's work in Boyle Heights, Los Angeles mentions that the small stores he studied have a median size of twelve hundred square feet. [9] Benine investigated a second size of facilities which he termed drive-in food stores which averaged twenty-four hundred square feet. [10] Grocery stores referred to in location research are much larger and are termed supermarkets. In order to establish standard terminology on the basis of size, the following system, appearing in Cooke, will be used: [11]

1) Neighborhood Store: less than 1,000 square feet
2) Convenience Store: 1,000 to 2,500 square feet
3) Large Food Market: 2,501 to 10,000 square feet
4) Supermarket: over 10,000 square feet

Note: All figures refer to selling area only, excluding storage space.

Since not all stores will conform to strict size categories, it seems appropriate to provide a description of each type.

The neighborhood store is the smallest type or facility and usually occurs isolated on residential street corners or small retail clusters. [12] Normally open longer hours (except for convenience stores) than larger markets, this type is often operated by a husband and wife team and caters to the patronage of walking customers. [13]

Convenience markets averaging twice the area of neighborhood stores, are located nearer to high volume traffic arteries, and are geared to

attract automobile customers.[14] Like neighborhood markets, they stay open longer hours, sometimes twenty-four hours a day with their greatest business during the evenings and weekends.[15] Similar product prices are higher in these stores than other types and they cater to the cash and carry consumers only.[16]

The large food market and the supermarket essentially serve the same food function. Their size difference is merely an attempt by proprietors, through time, to draw a greater number of customers by offering larger stores, a greater variety of goods, and usually lower prices.[17] Both sizes are frequented by single trip, high dollar expenditures of regular weekly buyers.

It seems clear that changes in grocery store size are directly related to its age. An administrator for a leading supermarket chain in Britain, McClelland has reported for his stores in 1963 that:[18]

> In 1955 the largest selling area in any branch was the same as it had been in 1921 - 800 square feet. In 1956 it was 1400. in 1958 2300, in 1959 3500, and in 1960 7000. The combined selling area of the first five new supermarkets is nearly 90 percent of that of all the fifty-eight shops of early 1957.

These statistics make it clear that through time a trend has developed toward building larger store structures. Applebaum supports this contention by stating that firms in the grocery business are attempting to capture greater shares of the market by constructing fewer, but larger retail food stores.[19] In support of smaller stores being older, Radell concludes his 1961 empirical study of small groceries by noting that neighborhood stores in Los Angeles were aged in appearance with a mean age of 37 years.[20] The relationship of store size to store age was tested quantitatively by Bishop and Brown in Ithaca, New York where building size was highly correlated ($r = .62$) to building

age.[21] According to these references, it would appear that locational variables associated with changes in store size would be the same aggregate factors relating to either new or old urban elements.

Grocery Store Location in Urban Centers

Geographic literature has provided definite clues as to distribution and location of retail food outlets within urban areas. The most notable difference between retail groceries and other retail businesses is their virtual absence from the central business district (CBD). Food stores are, according to Murphy and Vance, one of the several retail outlets found at the CBD's edge and along streets leading away from the city center, but rarely in the CBD.[22] As a low-order good, groceries do not necessarily need to pay the high cost of space in the CBD, because their location next to consumers is more important than their association with the central business district.

In an effort to locate in close proximity to its consumer, the placement of new food stores has kept pace with the continuing expansion of new residential areas of the city. As early as 1937, Proudfoot noted that Chicago's retail businesses were decentralizing with outward migration of that city's population.[23] This locational shift evolved to give retail stores the enjoyment of close contact with the "commodity-and-service-purchasing" population.[24] Close proximity of store and customer is essential, because as Berry has shown, the more frequently a consumer shops for a low-order good, such as food, the shorter the distance he is willing to travel.[25] For a food store to capture an area's trade, it must locate near its potential market. From Burgess' simple but basic model of urban growth, one would believe

that the expansion of newer residential zones takes place on the city's periphery.[26] If Burgess' model and the concept of close proximity are joined, it seems reasonable that grocery stores will locate on the existing city's limit. As each successive generation of establishments are built on the urban fringe, they could be assumed to form age rings with the older stores to the center.

Over the past fifty years, however, the increased use of the automobile has caused the term "close proximity" to be relative in terms of time. In older sections of urban centers, where outlets were designed to accommodate the walking customer, smaller stores are closely spaced as are other structures.[27] During the 1930's and 1940's as automobile travel became a common practice, retail stores began to locate near major traffic intersections.[28] This trend was doubly beneficial to retail business by making them more accessible to automobile traffic and by helping customers avoid the vehicular traffic congestion of the downtown. Further emphasis on traffic and continued expansion of urban residential sectors forced newer stores to seek easily accessible and untapped market locations along key radial transportation routes.[29] By this stage leading supermarket chains were well aware that close proximity did not mean absolute distance, but rather ease of accessibility. Applebaum and Cohen, both well known retail store locationalists, identify accessibility as including qualities such as size of road, road surface, traffic flow, noise, congestion, parking availability, and visibility.[30] It is now a well established principle that the reduction of factors interferring with automobile and human accessibility is a key element in the planning of shopping centers. In relation to this study, the perception of time-distance in this century should be reflected in structure spacing, with an increase in spacing correlated to

an increase of distance from the older central city. In addition, the increase in emphasis upon automobile traffic should be apparent in the construction of newer stores.

Along with perception of increased time-distance because of automobiles, retailing businesses have responded to greater consumer accessibility by agglomerating or clustering in shopping centers. When stores were built with walking as a major means of transport, individual shops were closely spaced and were often found isolated in residential areas. Radell reports that a concentration of small grocery stores in older East Los Angeles still rely on an eight hundred foot walking distance for ninety-five percent of their business. [31] The necessity of absolute proximity to the consumer was an essential factor in grocery store placement during the early twentieth century which caused stores to often position themselves in isolated locations. As the consumer was mobilized by the automobile, retail stores found it valuable to agglomerate in centers, as well as locating near major highways. Horton has shown that by concentrating retail businesses and offering a greater number of goods, more customers can be drawn from greater distances. [32] As a result of progressive stages in retail agglomeration or centrality, Garner has identified three levels of retail clustering in addition to the CBD. [33] They are (1) the neighborhood centers offering convenience goods to people living locally, (2) community centers providing goods demanded for several neighborhoods, and (3) regional centers supply goods for a major portion of the urban area. In addition to these groups, isolated stores may be included to reflect location of food outlets. Increase in retail agglomeration over time has been associated with an increase in physical store size.

Applebaum and Goldberg have suggested that the trend in grocery stores has been increased size, which has been aimed at building fewer stores serving greater market areas. [34] According to the historical development of retail clustering, it can be expected that newer, larger markets may be associated more strongly with retail agglomerations than older establishments.

The continual building of new supermarkets would indicate that the total number of food stores is on the rise, in fact this is not true. Applebaum and Goldberg have shown that from the fifteen year period 1948 to 1963 the total number of grocery stores has decreased 37 percent. [35] They attribute this apparent contradiction to the displacement of smaller food stores with much larger supermarkets which tripled in number in the same fifteen year period. In 1963, supermarkets as the largest class of food stores enjoyed nearly two-thirds of the entire food industry's business, while smaller neighborhood stores were constantly meeting their demise.[36] By 1967 only ten percent of the nations food business was done by independent, unafilliated stores. [37] Another study by Applebaum and Cohen contends that store size and market size are a balanced system, where increased store size produces increased market draw. [38] Therefore, the demise of the smaller stores has been necessary to keep a viable market-to-store balance.

Beginning in the early 1960's, a new small store has further infringed on the economic survival of the older neighborhood store. Commonly named the convenience market, its median size is about twice that of a neighborhood grocery. The location of these establishments are normally along heavily traveled highways within the city. [39] Its longer hours of business have given it customer appeal in relation to the

larger supermarkets which exhibit considerably shorter store hours.[40] The emergence of the smaller convenience market may cause complicating factors in assessing the spatial distribution of groceries based on a size analysis. Although its size is small, some of its attributes, such as accessibility, are dissimilar to existing neighborhood stores. It seems likely that neighborhood markets will not be entirely replaced by convenience, because both outlets retain a characteristic clientele.

The model so far established concerning the distribution of grocery store sizes throughout the city suggests that older smaller stores tend toward the city center, while larger and newer stores are to be found at the city's periphery. It may well be asked why this arrangement remains constant over time? Or why do larger stores not capture the inner city market area? Apparently economic laws are at work to hold this model relatively stable. One statement by Epstein in his study of geography and business follows that:

> Unless a business is unique (with a monopoly) or unless its image is overpowering in the market, association with deterioration of either business center or commodity, or with poor quality of life in its immediate trading area places constraints on moving up to or into the site area. Consumer mobility is so great today that alternate opportunities may have business driven away by undesirable environmental factors. There are many examples: cheap bars and derelicts discourage women shoppers and most night-shopping; contractors, trucking terminals, or fringe wholesaling will discourage patronage from all but the hardiest; and high crime will turn back even the most avid bargin hunter.[41]

According to Epstein, social deterioration, wholesaling districts, and high crime help turn away consumers. This is the apparent reason why newer stores shy away from inner cities, and while the existing older stores might stay to supply goods, they must cope with adverse social conditions. This pattern can be upset and has been in larger cities.

Bourne mentions that as buildings depreciate having ever lowering quality levels, there is a point where replacement of existing buildings become economically feasible.[42] Urban renewal would be a more contemporary term. Under these conditions it becomes, at least, possible for new grocery stores to locate in the central city. Although alterations are conceivable, the simple model of retail grocery pattern in the city inferred in the survey of literature, provides a starting point for predicting size-distribution patterns in urban centers.

The preceding two sections of the literature review have attempted to establish basic locational patterns and size characteristics of grocery stores within urban centers. These have been undertaken to uncover the general distribution of stores based on size. To discover patterns or regularities in distribution is not enough. To better understand the elements controlling these patterns, specific variables must be investigated so that their influence can be tested and measured.

Conceptualization and Presentation of Hypotheses

This section isolates specific operational factors which might be associated with differences in store size and cites literature in support of these factors. Although a total of sixteen variables are referenced, they have been condensed under four topical headings: 1) site and situation variables, 2) socio-economic variables, 3) age-population variables, and 4) store policy variables. Table 1 contains a list of all specific variables used in the study.

TABLE 1

LIST OF VARIABLES

Variable Label	Variable Name
Y	Store size measured in square feet of selling area for each store
X_1	Population density for each enumeration district (E.D.)
X_2	Percent population aged 18 to 24 years in each E.D.
X_3	Percent population aged 65 and over in each E.D.
X_4	Percent black population in each E.D.
X_5	Percent of houses with 1.01 or more persons per room in E.D. (overcrowding)
X_6	Aggregate dollar rent density in each E.D.
X_7	Aggregate dollar value density of owner occupied houses in each E.D.
X_8	Housing density in each E.D.
X_9	Number of retail businesses surrounding each grocery store (agglomeration)
X_{10}	Average daily traffic flow nearest each grocery store (accessibility)
X_{11}	Number of grocery stores sited in each E.D. (store frequency)
X_{12}	Distance from central business district to each store
X_{13}	Distance to 1st nearest neighbor grocery store for each store
X_{14}	Distance to 2nd nearest neighbor grocery store for each store
X_{15}	Hours open per week for each store
X_{16}	Does store issue credit? (binary: yes or no)

Factors of Site and Situation

Factors of store site and situation were chosen on the basis of their applicability to urban groceries as they have evolved as retail businesses. Six variables were selected to reflect the discussion of location changes in the literature survey. The two most obvious choices were an accessibility variable and an agglomeration variable. Accessibility has been operationally expressed many times as a count of vehicular traffic, although it is considered to involve a greater number of less easily expressed qualities.[43] Since accessibility has been such an important factor in the location of newer, larger food stores, it is suggested to be positively associated with store size.

Another of the more common factors accompanying the development of newer shopping centers has been the trend toward retail agglomeration. The newer, larger groceries have been consistently positioned in shopping centers offering an increasing number of other retail shops. Retail agglomeration near food outlets could be surmised to be positively associated with changes in store size.

The next four physical site features actually reflect relative location. They are: grocery store frequency, distance from the CBD, distance to first nearest neighbor, and distance to the second nearest neighbor. Distance from the CBD is an approach to determining whether the building of newer, larger stores has, in fact, kept pace with the city's peripheral residential sectors. It seems likely that the placement of convenience markets may disturb this correlation. Nonetheless, distance to the first and second neighbor are both aimed at identifying the effect of relative time-distance perception and enlarged market

captured by stores over time. With the automobile gradually replacing walking as the dominant transportation mode, the spacing of stores should be increased over time. This theoretical spacing may be complicated, because the location of newer shopping centers has been irregular, with a bunching along major transportation routes, according to Cohen and Lewis.[44] A consistent relationship may be upset, but generally all three of these variables should display a positive association to store size.

Socio-Economic Factors

Socio-economic factors corresponding to grocery store location are based on the association of store age to the surrounding residential age. Neale has shown that a direct correlation does exist between socio-economic levels of an area and the spacing and density of grocery stores, but does not identify specific elements.[45] According to the filtering mechanism, buildings and whole neighborhoods move downward through quality levels until the inner rings of the city contain the delapidated buildings and consequently, the less wealthy people.[46] It seems reasonable to assume, therefore, that purchasing power varies over space. Whereas, the outer city displays the larger food stores and the more wealthy population, the inner city largely exhibits limited income groups. Getis has studied uneven distribution of consumption expenditures in relation to grocery store placement.[47] By doing so, he supports its use here as a guiding force affecting socio-economic factors. In an attempt to measure the association of uneven consumer incomes and grocery store size, five variables have been chosen. They

are: percent black populations, aggregate dollar rent, aggregate dollar value of owner occupied houses, overcrowding (1.01 or more persons per room), and housing density.

Black population concentrations have been concluded by Pred to "mirror extremely low standard of living" which have been associated with independent groceries.[48] This contention as well as a later comment by Cohen, that the corner store has existed longer in black areas than elsewhere in the city, tend to indicate that a negative association would be expected between black population and store size.[49]

Dollar value of housing and dollar rent are meant to reflect potential consumer incomes, since raw income figures are not available. Dollar value of housing may correspond to the income distribution since it takes into account only owner occupied units. The density of housing value is based on the premise that central city homes are older and valued lower. Dollar rent was chosen to reflect the anticipated higher number of rented units in the central city. The figures may be misleading, however, because more units may be rented in the central city, but the rent per unit may be low. This factor may be offset in that the fewer rented units anticipated in the outer city will likely rent for a higher dollar value. Regardless of the complications, aggregate dollar rent would theoretically be negatively associated with store size.

Berry, Simmons, and Tennant have stated that the most obvious influence on population density in the city center is that older city buildings have smaller lots.[50] This suggests that housing density will be negatively associated with store size. In addition to housing density, overcrowding was included to reflect the low economic level of central cities and the known greater population density of the city center.

Overcrowding could be expected to be also negatively associated with the distribution of grocery store size.

Age-Population Factors

As has been discussed, the accessibility of the consumer plays an important role in the type of store he will frequent. Those people with automobiles and higher disposable incomes have extended perception of time and distance. They are more able to travel where they please and, consequently, buy where they please. Directly opposed to these higher income population are those who are limited in disposable income, and thus are restricted as to their money allocated to retail goods. This ceiling on disposable income limits the expenditures on accessibility. It is assumed that this will allow restricted income areas to support more closely spaced food stores. The restricted effective market area will, in turn, force stores to occupy less area to balance the market size, to store size system mentioned by Applebaum and Cohen. [51] To portray this condition, three variables were established: population density, population aged 18 to 24, and population 65 and above. Population density was chosen to reflect the fact that smaller stores still operate in older sections of cities and older city areas as characteristics of smaller lots and higher population density. [52] These higher densities increase the opportunity of customer attraction for stores in that area. [53] The simple association of grocery store size to population density is, of course, complicated by the emergence of the smaller convenience markets located throughout the city. Density should, though, provide some positive associations to store size.

The selection of specific population groups is based on their

limited accessibility and so there is an economic possibility of an entrepreneur catering to these groups. Persons sixty-five years of age and above were thought to be limited in automobile transportation (accessibility) either through limiting economies or physical disabilities. The higher density of older persons near the city has been a well established principle in urban models such as Burgess'.[54] The inclusion of persons 18 to 24 in the limited accessibility group is due to the location of a university in the study area. Horton maintains that the placement of non-retail institutions such as educational ones, increases the opportunity of attracting increased numbers of customers to firms offering low-order goods.[55] This, coupled with the notion that college students generally have limited budgets and rely heavily upon walking as a means of transportation, suggests that smaller closely spaced grocery stores might situate nearby to capture this trade. The three aforementioned age-population factors are considered to be related with smaller stores, thus negatively associated with store size.

Factors of Store Policy

Store policy factors are not strictly locational, but they exert a force on the attraction of clientele. Applebaum and Cohen have reported that the physical facilities, merchandising, and promotional skills of a store affects the potential business.[56] In an effect to account for variations of store policy, provide operational variables, and still keep them relevant to the grocery business, two variables were chosen in this area: the total hours open per week and whether a store offers credit. Both variables have appeared previously in food

store studies. Bonine's quantitative study of convenience markets in Austin, Texas revealed hours open for business each week to be the most significant variable accounting for profits.[57] Radell has noted the considerably longer business hours of neighborhood stores when compared to larger stores.[58] Issuance of credit was included because it was found by Radell to be a common practice of neighborhood stores in his study area.[59] Credit issuance has not been a common practice for larger grocery stores, except for credit cards. Convenience stores, with cash and carry policies, may disturb the issuance of credit, but it should remain a common practice of the smaller neighborhood stores. Since these two variables are attached to smaller stores, they will likely be negatively associated with changes in size. From the review of literature, the following hypotheses can be stated.

Hypotheses

General Hypotheses: The spatial distribution of intraurban retail grocery establishments, based on store size, will display regularities in arrangement as suggested in geographic literature and the following specific hypotheses will provide a high degree of explanation for factors controlling that pattern.

Specific Hypotheses:

(1) Store size is positively associated with accessibility, retail agglomeration, distance from the CBD, distance to the second nearest grocery store, and distance to the first nearest grocery store.

(2) Store size is negatively associated with store frequency.

(3) Store size is positively associated with dollar housing density.

(4) Store size is negatively associated with dollar rent density, housing density, percent overcrowding, and percent black population.

(5) Store size is negatively associated with the percent population 18 to 24 years of age, percent of population 65 years and over, and population density.

(6) Store size is negatively associated with the variables of hours open and issuance of credit.

Summary of Chapter

This chapter has concerned itself with the location of retail grocery stores in the urban landscape. It was developed according to four basic sections. The first was an introduction including the purpose and objectives of the study. The second portion dealt with the presentation of literature citing the general distribution of food store sizes and several of the controlling forces. A third section investigated previous works suggesting specific factors related to the distribution of stores. This chapter closed with a set of operational hypotheses to be tested employing store size as the determinant of distribution.

NOTES

[1]Saul B. Cohen and George K. Lewis, "Form and Function in the Geography of Retailing," Economic Geography, XLIII (1967), 1-42.

[2]Stafford has dealt with grocery store distribution by using store number as a controlling theme and Neale has studied the number and spacing. For reference see bibliography.

[3]William J. Reilly, The Law of Retail Gravitation (2nd edition, Pilsbury Publishers, N.Y., 1953).

[4]Frank Strohkarch and Katherine Phelps, "The Mechanics of Constructing a Market Area Map," Journal of Marketing, XII (April 1948), 493-496, as cited by David Huff, "A Probability Analysis of Shopping Center Trading Areas," Land Economics, XXXIX (February 1963), 83.

[5]David Huff, "A Probability Analysis of Shopping Center Trading Areas," Land Economics, XXXIX (February 1963), 90.

[6]Although the controlling element of these studies was not size, they have used square feet of selling area as a measure of store size (the independent variable) in regression analysis. See bibliography for full references.

[7]Both Cooke and Radell have analyzed the smallest and oldest grocery store in urban centers. Radell studied only a single neighborhood in Los Angeles, while Cooke studied all small food stores in metropolitan Victoria, Edmonton, Canada. Both mention the same type of store, but have given it different names. For reference see bibliography.

[8]Norman A. Cooke, "Small Food Stores in Metropolitan Victoria" (Unpublished Masters Thesis, The University of Alberta, Edmonton, Canada, 1969), p. 102-103.

[9]David R. Radell, "Mom n' Pop" Grocery Stores in the Boyle Heights Section of Los Angeles, California: A study of Site and Situation, (Unpublished Masters Thesis, Los Angeles State College, Los Angeles 1961), 28.

[10]Micheal E. Benine, "Spatial and Functional Pattern of a Single Class of Retail Establishment: An Analysis of Location of the Drive-in grocery in Austin, Texas, (Unpublished Masters Thesis, University of Texas, Austin, Texas, 1966).

[11]Cooke, "Small Food Stores," p. 102-103.

[12]Malcolm Proudfoot, "City Retail Structure," Economic Geography, XIII (1937), 427-428.

[13]Radell, "Mom n' Pop" Grocery Stores, p. 43 and p. 73.

[14]"Stores That Are Open When You Need Them," Financial World, XXXIX (June 6, 1973), p. 11.

[15]Bonine, The Spatial and Functional Pattern of a Single Class of Retail Establishment, pp. 77-78.

[16]"Stores That are Open," p. 11.

[17]William Applebaum, "Can Store Location Research Be Science?," Economic Geography, XLI, 1965, p. 236.

[18]W.G. McClelland, Studies in Retailing, 1963, cited in "The Shopping Centers of Tyneside Urban Region and Large Scale Grocery Retailing," Economic Geography, XLII, 1966, p. 53.

[19]Applebaum, "Can Store Location Survive," p. 236.

[20]Radell, "Mom n' Pop" Grocery Stores, p. 70.

[21]W.E. Bishop and E.H. Brown, "Analysis of Spatial Shopping Behavior," Journal of Retailing, XLV (1969), 27.

[22]R.E. Murphy and J.E. Vance, Jr., "Delimiting the C.B.D.", Economic Geography, XXX (1954), 201.

[23]Malcolm Proudfoot, "The Outlying Business Centers of Chicago," Journal of Land and Public Utility Economics, XIII (1937) 69.

[24]Ibid., p. 60.

[25]Brian J.L. Berry, Geography of Market Centers and Retail Distribution (Prentice-Hall, Inc., Inglewood Cliffs, N.J., 1967) p. 19-24.

[26]Ernest W. Burgess, "The Growth of the City: An Introduction to a Research Project," (in The City, Robert E. Park, Ernest W. Burgess, and Roderick D. McKenzie, University of Chicago Press, Chicago, 1925) p. 50-51.

[27]Malcolm Proudfoot, "City Retail Structure," Economic Geography, XIII (1937), 427.

[28]"Form and Function," p. 12.

[29]Ibid.

[30]S.B. Cohen and W. Applebaum, "Evaluating Store Site and Determinating Store Rents," Economic Geography, XXXIV (1960), 3.

[31]Radell, "'Mom n' Pop' Grocery Stores," p. 73.

[32]Frank E. Horton, "Location Factors as Determinants of Consumer Attraction to Retail Firms," Annals of the Association of American Geographers, LXIII (1968), 800-801.

[33]B.J. Garner, "Model of Urban Geography and Settlement Location" Socio-Economic Models in Geography, ed. by Richard Chorley and Peter Haggett (London: Methuen, 1968), 347-348.

[34]Applebaum, "Can Store Location," p. 263.

[35]William Applebaum and Ray A. Goldgerg, Brand Strategy in United States Food Marketing: Perspective on Food Manufacturer's and Distributors' Brands in the United States (Division of Research, Graduate School of Business Administration, Harvard University, Mass., 1967) 22.

[36]Ibid.

[37]Ibid., pp. 4-5.

[38]Cohen and Applebaum, "Evaluating Store Site," p. 28.

[39]"Stores That Are Open," p. 11.

[40]Ibid.

[41]B.J. Epstein, "Geography and the Business of Retail Site Evaluation and Selection," Economic Geography, XLVII (1971), 195.

[42]Larry S. Bourne, "Physical Adjustment Processes and Land Use Succession: A Conceptual Review and Central City Example," Economic Geography, XLVII (1971), 3.

[43]See page 7 of text and footnote 30 for qualities of accessibility and reference.

[44]Cohen and Lewis, "Form and Function," p. 3.

[45]Charles A. Neale, "A Hypothesis About the Relationship Between the Socio-Economic Status of Census Tracts and the Distributional Characteristics of Retail Grocery Outlets in Those Tracts" (Unpublished Masters Thesis, University of Cincinnati, Cincinnati, Ohio, 1968).

[46]Homer Hoyt, The Structure and Growth of Residential Neighborhoods in American Cities (Federal Housing Administration, Washington, D.C., 1939).

[47]Arthur Getis, "The Determination of the Location of Retail Activities with the Use of a Map Transformation," Economic Geography, XXXIX (1963), 14.

[48]Allan Pred, "Business Thoroughfares as Expressions of Urban Negro Culture," Economic Geography, XXXIX (1963), 233.

[49]Cohen and Lewis, "Form and Function," p. 12.

[50]Brian J.L. Berry, J.W. Simmons, and R.J. Tennant, "Urban Population Densities: Structure and Change," Geographical Review, LIII (1963), 396.

[51]Cohen and Applebaum, "Evaluating Store Site," p. 28.

[52]Berry, Simmons, and Tennant, "Urban Population Densities," p. 396.

[53]Horton, "Locational Factors," 792.

[54]Burgess, "The Growth of the City," p. 50-51.

[55]Horton, "Locational Factors," p. 792.

[56]Cohen and Applebaum, "Evaluating Store Site," p. 23.

[57]Bonine, "The Spatial and Functional Pattern of a Single Class of Retail Establishment," pp. 77-78.

[58]Radell, "'Mom n' Pop' Grocery Stores," p. 40.

[59]Ibid., p. 41.

CHAPTER II

THE SETTING AND RESEARCH DESIGN

This chapter directs its attention toward the behavioral steps contributing to the testing of the hypotheses. Four areas will be discussed: the setting of the study, the methodology, the basic statistical unit, and the collection of data. Since the overall research approach is normative, utilizing aggregate data, the validity of any and all conclusions is controlled by the elements contributing to these evaluative statements.

The Setting

Bowling Green, Kentucky provides the setting for this study (see Map III). As the largest urban center in south central Kentucky, Bowling Green gives political, economic, social, and educational guidance to the surrounding area. Its position as the county seat of Warren County and headquarters for the ten county Barren River Area Development District allow this city of 36,000 residents a strong local political influence. The existence of interstate Highway 65 and heavily traveled railways demonstrate its central position on major transportation routes connecting Northern and Southern United States trade regions. Industrial sites in and around the city accent its importance in labor and produc-

tion. Numerous restaurants, motels, and the Beech Bend amusement park provide key social attractions. The presence of Western Kentucky University in the heart of the city adds further to its regional importance.

The selection of Bowling Green as a study area lies in its small size and urban growth pattern. Previous studies dealing with city-wide grocery store location have been undertaken in urban centers over one hundred thousand population and other studies have used only sectors of larger metropoitan areas.[1] No geographic study has been found which directs itself toward the analysis of the entire population or retail food outlets within a single small-sized city. This investigation may then either substantiate or refute findings obtained from larger urban areas. Urban growth in Bowling Green has been such that all four size classifications of grocery stores are represented in the city. A preliminary examination of operating food stores in Bowling Green revealed that eight are classified as neighborhood type, nineteen as convenience stores, thirteen as large markets, and nine as supermarkets.[2] It must be noted that the store numbers above are based on numerical breaking points. Using strict size break downs is somewhat misleading, because some classic neighborhood stores, according to store definitions, were above the one thousand square foot cut off point. As a result, they were counted as convenience markets. Nevertheless, the study area displays a wide range of grocery store size with all size groups represented. The smallest grocery was four hundred square feet and the largest just under twenty-five thousand square feet.[3] An investigation of retail grocery stores using Bowling Green,

Kentucky as the study area should help uncover the similarities or dissimilarities between this smaller urban area and those in larger cities.

Research Design

In the quest for a specific research design, it was concluded that a combination of cartographic analysis, simple correlation, and step-wise regression and correlation would best serve the needs of this study.[4] Cartographic displays may aid in exposing general trends in the arrangement of stores. Correlation and regression are capable of statistically measuring the association between store size and variables relating to location.

Methodology

Simple and step-wise correlation and regression analysis has been employed commonly as a tool in the measuring of functional relationships in almost every subfield of geography.[5] Stafford and Horton have employed this type of methodology in their analysis of grocery store location in Iowa City and Waco, Texas.[6] The purpose of regression is to predict variations in Y (in this case, store size), when values of X (locational factors) are known. The simple linear regression model is usually stated as $Y = a + bX$, where Y is the dependent variable, b is the slope of the regression line, a is the Y-axis intercept, and X is the known value.[7] The graphing of the correlation between two variables (X and Y) normally creates a scattered appearance, but by subjecting the data to the bivariate model above, the values for an "average" or best fit regression line are available. Along this line,

predictions may be made as to the average change in Y for changes in X.

Cartographic analysis is included to provide an approach capable of displaying an overview of grocery store size patterns in the study area. Two maps are included to aid in the analysis: one to show the relative location of stores and a second to illustrate an aggregate view of store size arrangement. The third map provides selected reference points in the study areas. These cartographic presentations are intended to help bridge the gap between the theoretical literature survey and the detailed statistical analysis.

Statistical Units

Three United States Bureau of the Census statistical units were available for this study: census blocks, enumeration districts, and census tracts. It was determined that for the purposes of this investigation statistical units should be large enough to show aggregate locational traits without amplifying exceptional features, yet be small enough to indicate a considerable degree of individual neighborhood characteristics on a city scale. The great number of census blocks seemed incapable of providing sufficient combined neighborhood traits, while the five census tracts grouped the city into areas with too much averaging of data. On this basis, enumeration districts or E.D.'s were chosen. In support of this choice, it was discovered that Horton, in a study on consumer attraction to grocery and drug stores, employed a similar unit called a serial zone.[8] He mentions that these zones averaged just less than ten city blocks. E.D.'s in Bowling Green serve a similar function with an average of about fourteen blocks per district.

Enumeration districts were thus preferred over other available alternatives, were confirmed in literature, and consequently established as the basic statistical unit for the study.

Map I has been prepared to illustrate the placement of enumeration districts and their identifying numbering system. Since E.D.'s cover the entirety of Warren County, Bowling Green shows only a portion of the County system. Within the corporate city limits, districts begin at 14-A and run through 43-B, with only numbers 14 and 43 divided into A and B designations. Districts 14-A, 21, 27, 40, and 43-B are broken into multiple areas as shown on the map. This index with E.D. number and placement will prove helpful for identifying statistical units by numbers during the analysis in Chapter III.

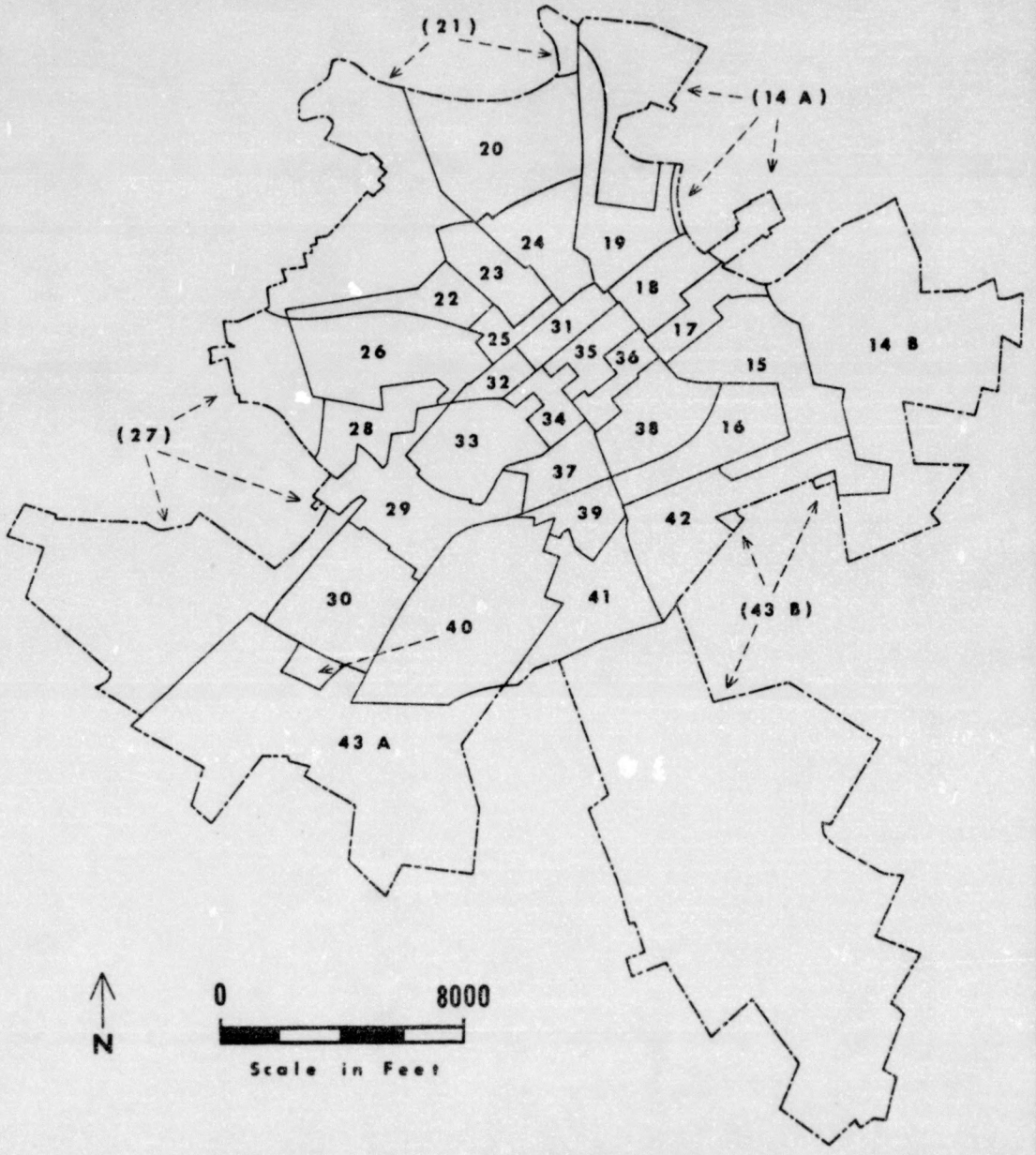
The only drawback seen in the use of E.D.'s was the disparity in comparative areas. Data for each district would be handled in the regression as if they were equal in areal extent. A dot-grid measurement of each districts area revealed that area varied from approximately 0.71 acres in number 32 to 36.51 acres in 43-B.[9] A list of computed acreage is found in the Appendix A. In an effort to correct for this anticipated discrepancy, census data were either changed to percentages or densities per acre.

Collection and Arrangement of Data

Since a relationship between the size of grocery stores and locational factors is assumed, data collection was pursued in two areas to account for a total of sixteen independent variables and one dependent variable (see Table 1 in Chapter I). The first area was physical data applying to each store and the second was data applying to the stores

ENUMERATION DISTRICTS

Bowling Green, Kentucky 1970



Each numbered area is one enumeration district as delimited by the U.S. Bureau of Census for 1970.

4.11

MAP I

surrounding urban landscape. Data concerning the store were collected by means of an interview with a manager, owner, or employee of each of the 50 operating retail outlets. Information relating to the stores' location required three sources; the United States Census, the Kentucky Department of Transportation, and distances derived from a census base map of Bowling Green. Although sources were dated from 1967 to 1975, the study was not seen to be unreasonably weakened for they represent the most practical and complete data assemblage possible. The remainder of this section deals with the specifics of this study's data collection.

Selection of stores for the study was limited to those listed in Carson's 1974 Bowling Green City Directory (see Appendix B for list).[10] Among those listed, certain omissions were necessary. Five stores were found to lie outside the corporate city limits, providing complications because they were included in county E.D.'s. Three were out of business during the data collection period and three were new food outlets not included in the directory. The total number of operating establishments available for analysis was 50. Although food items are sold from liquor stores, gasoline service stations, and thrift shops, these stores were not considered for the study because their primary function was not grocery retailing. On the other hand, the stock in larger groceries ventured into hardware and toiletries. Before being included in the study, all stores listed in the directory were visited by the author to verify their primary food character.

The questionnaire circulated to each store contained four questions (for original see Appendix C). Questions related to total hours open per week, number of square feet of selling area, issuance of credit,

and number of retail stores surrounding their structure. Questions were asked orally and answers were recorded in written form. The majority of floor areas were calculated by pacing the dimensions of the store's selling area. Rarely did a manager or owner know the square foot area of his store without consulting records and no local government agency has such data on file. Agglomeration of surrounding structures included stores on the same side of the block, directly across the street, on the facing side of the block and across the street diagonally. Agglomeration figures for shopping centers included the above criteria as well as all retail stores in the center. This information was established as characteristics for each of the fifty stores selected for the study.

Census data provided values for eight of the sixteen independent variables. Raw figures were retrieved from Frankfort, Kentucky, where they are recorded on computer tape according to enumeration districts. Because of the size variation in statistical units (previously mentioned), these variables required standardization to avoid spatial bias. Four variables were calculated into percentages and the remainder were reworked to reflect densities. Values changed to percentages of the total population in each E.D. included percent population 18-24 years of age, population 65 or more years of age, black population, and overcrowding (1.01 or more persons per room). The remaining values were altered to reflect densities per acre (see appendix for acre areas). Densities were calculated according to each E.D. for total dollar monthly rent and housing density. These standardized values were attached to each store within their district and thus were considered to be a portion of the location variables for that retail grocery store.

Accessibility variables were collected from the Kentucky Department of Transportation.[11] Since accessibility involves many qualities, it required a single numerical designation to be included in the regression analysis. It was defined as vehicular flow or average daily traffic over a twenty-four hour period at a point nearest the store and on the same street.[12] This system provided a relative measure of traffic flow for all but four stores. To avoid missing data, these four were estimated using the author's judgement and rounding figures from roads considered to display similar traffic conditions. Traffic flow data were from 1969 to 1973 and furnished by the Department of Transportation. Although the use of average daily traffic counts is not a true measure of accessibility, it provides a relative and available resource for this study.

The working base map was a 1970 census map acquired from Bowling Green's Block Statistics publication, compiled by the United States Bureau of the Census.[13] Corporate city limits and street names were elicited from this map. Scale was measured to be true and store locations and enumeration districts were recorded. Statistical units were delimited as they appeared on a xerox copy of Frankfort, Kentucky's master. All information gathered and arranged on the census map was later transferred and reduced to page size for inclusion in this paper. This base map also serves as a tool for deriving the measurements for the variables of distance from CBD, distance to first neighboring food store, and distance to the second nearest food store. Each measurement was accomplished for all fifty stores by the use of straight line distances.

Chapter Summary

Chapter II has covered the selection of the study area, the research design and specific collection of data. The study area Bowling Green, Kentucky was chosen because of its smaller size and suitability of all grocery store sizes. The research design established enumeration districts as the basic statistical unit and the analytic tools were designated as cartographic displays and step-wise regression. Also, presented were a table listing the variables for this study and a map showing the placement of statistical units in the study area.

NOTES

[1]Stafford analyzed grocery stores in Des Moines, Iowa; Neale studied groceries in Cincinnati, Ohio; Bishop and Brown in Waco, Texas; Cooke in Victoria, Canada; and Radell in the Boyle Heights district of Los Angeles. See bibliography for full references.

[2]Figures derived from the author's data on size of operating retail food stores in Bowling Green. Classification according to size and corresponding titles appear in Chapter I.

[3]Based on author's determination of store size which was found by pacing the dimensions of each retail food establishment.

[4]The step-wise regression model used in this study is a programmed computer tape package titled: Statistical Package for the Social Sciences (SPSS), by Nie, Bent, and Hull (New York: McGraw-Hill, 1970). Usage was made possible through the University of Kentucky via the computer terminal at Western Kentucky University.

[5]Bryn Greer-Wooten, A Bibliography of Statistical Applications in Geography: Commission on College Geography, Technical Paper No. 9 (Washington, D.C., Association of American Geographers, 1972), p. 70.

[6]Howard Andrew Stafford, "Analysis of Grocery Store Locations in Des Moines, Iowa, 1958" (Unpublished Ph.D. dissertation, University of Iowa, 1960); and Frank Horton, "Location Factors as Determinants of Consumer Attraction to Retail Firms," Annals of the Association of American Geographers, LXIII (1968), pp. 787-801.

[7]Greer-Wootten, A Bibliography of Statistical Applications, p. 67.

[8]Horton, "Location Factors," p. 794.

[9]Areas calculated by using a 64 dot per square inch grid and converting to acreages.

[10]Carson Directory Company, Bowling Green City Directory (Taylor, Michigan: Carson Directory Company Publishers, 1974), section 1, pp. 132-133.

[11]All traffic flow information was obtained through the Kentucky Department of Transportation. Data was dated from 1969 to 1973.

[12]According to the Kentucky Department of Transportation all traffic counts are based on a twenty-four hour data collection period and called Average Daily Traffic (ADT).

[13]United States Bureau of the Census, Census of Housing: 1970 Block Statistics Final Report HC (3) -96, Selected Areas in Kentucky (Washington, D.C.: Government Printing Office, 1971).

CHAPTER III

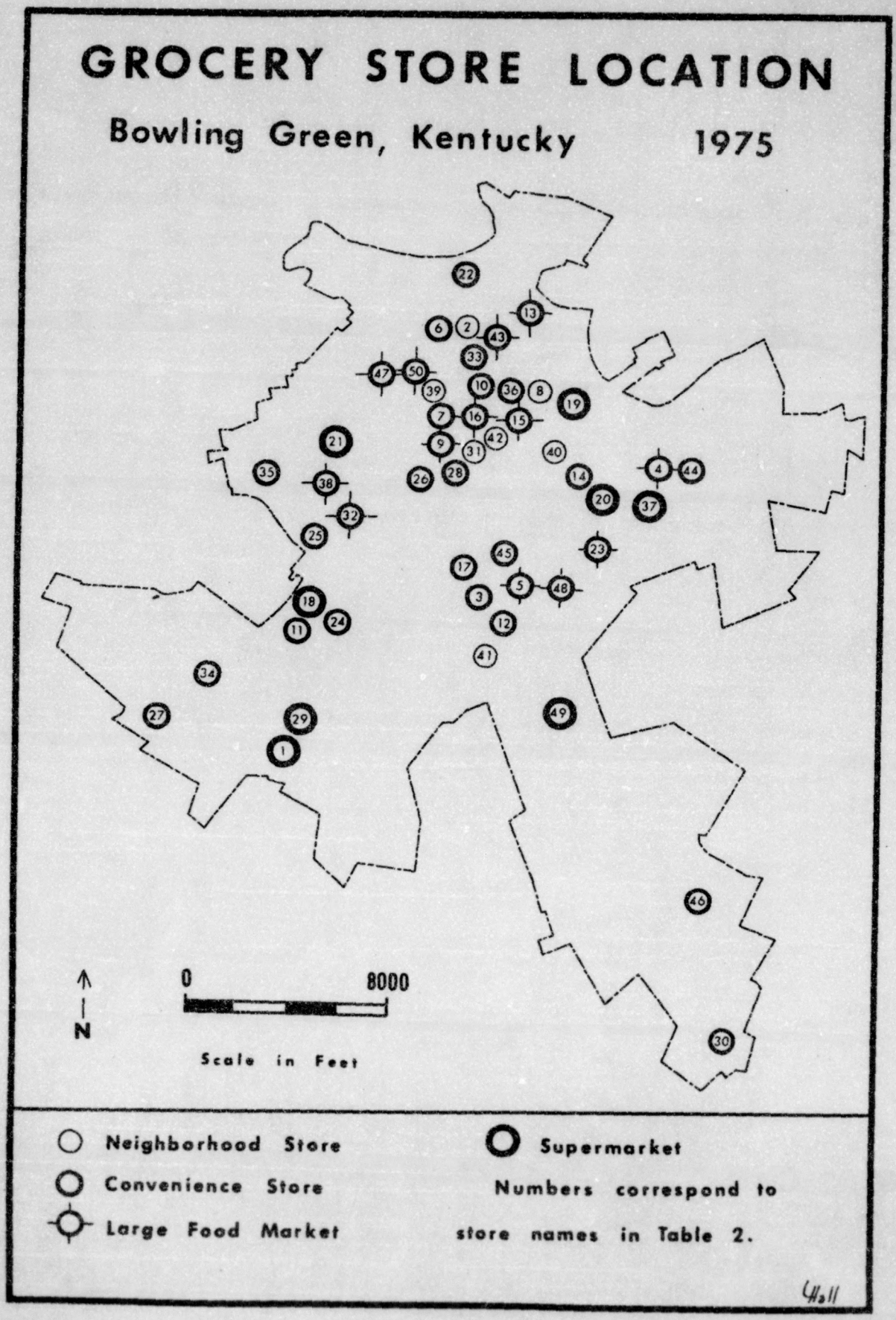
INTRAURBAN GROCERY STORES: AN ANALYSIS OF SPATIAL DISTRIBUTION

This chapter analyzes the spatial distribution of all operating retail food establishments in Bowling Green, Kentucky according to the store size. Three areas will be discussed: the cartographic, the specific hypotheses, and the general hypothesis as stated in Chapter I. The visual cartographic displays (see Maps II and IV) are undertaken to determine the existence of regularities in the arrangement of stores' city wide. This is an attempt to compare the distribution suggested by the literature survey with the existing pattern in the study area. The second portion of this investigation deals with the specific hypotheses. Each of the six hypotheses will be analyzed according to the simple correlation results (see Table 3 for r values). The final section of the analysis concerns the validity of the general hypothesis. Its acceptance or rejection will be determined by several factors including the simple and step-wise correlation values (Table 4), the specific hypotheses, and the cartographic displays. These three sectons of the investigation will complete the analysis of spatial distribution for grocery stores in the study area.

Cartographic Analysis

Relative location of the city's fifty outlets appears on Map II, Location of Grocery Stores. Circled numbers correspond to store names in Table 2. The distribution of stores is scattered with only three considered to fall near the CBD's edge. Comparison with Map III (Study Area Reference Map) indicates that major transportation routes create the most powerful clustering effect upon stores. Centrally located establishments situated near U.S. Highway 31-W, Center Street, and West Main Street. The most obvious secondary clustering takes place along the outlying radial transportation routes such as Russellville Road, Cemetery Road, Scottsville Road, Old Morgantown Road, and Richardsville Road. This map indicates that major transportation routes have exerted a powerful attraction on the location of retail food outlets in Bowling Green.

In an effort to translate the city wide distribution of stores into a form based on store size alone, Map IV was constructed. It depicts the mean size of grocery stores per enumeration district. The number of outlets situated in each district appears numerically within that statistical unit. From a total of thirty-one E.D.'s, twenty-four were found to display stores. Forty percent (ten) of the E.D.'s exhibited only a single grocery concern. The mean value of these units reflects the square foot area of just one store. The remaining sixty percent had multiple establishments to a maximum of five per district. For these stores, the mean was calculated as a simple average. Numerical breaking points for the average values follow the classification system mentioned in Chapter I.


GROCERY STORE LOCATION
Bowling Green, Kentucky 1975
N
0
8000
Scale in Feet
Neighborhood Store
Convenience Store
Large Food Market
Supermarket
Numbers correspond to store names in Table 2.
Hall

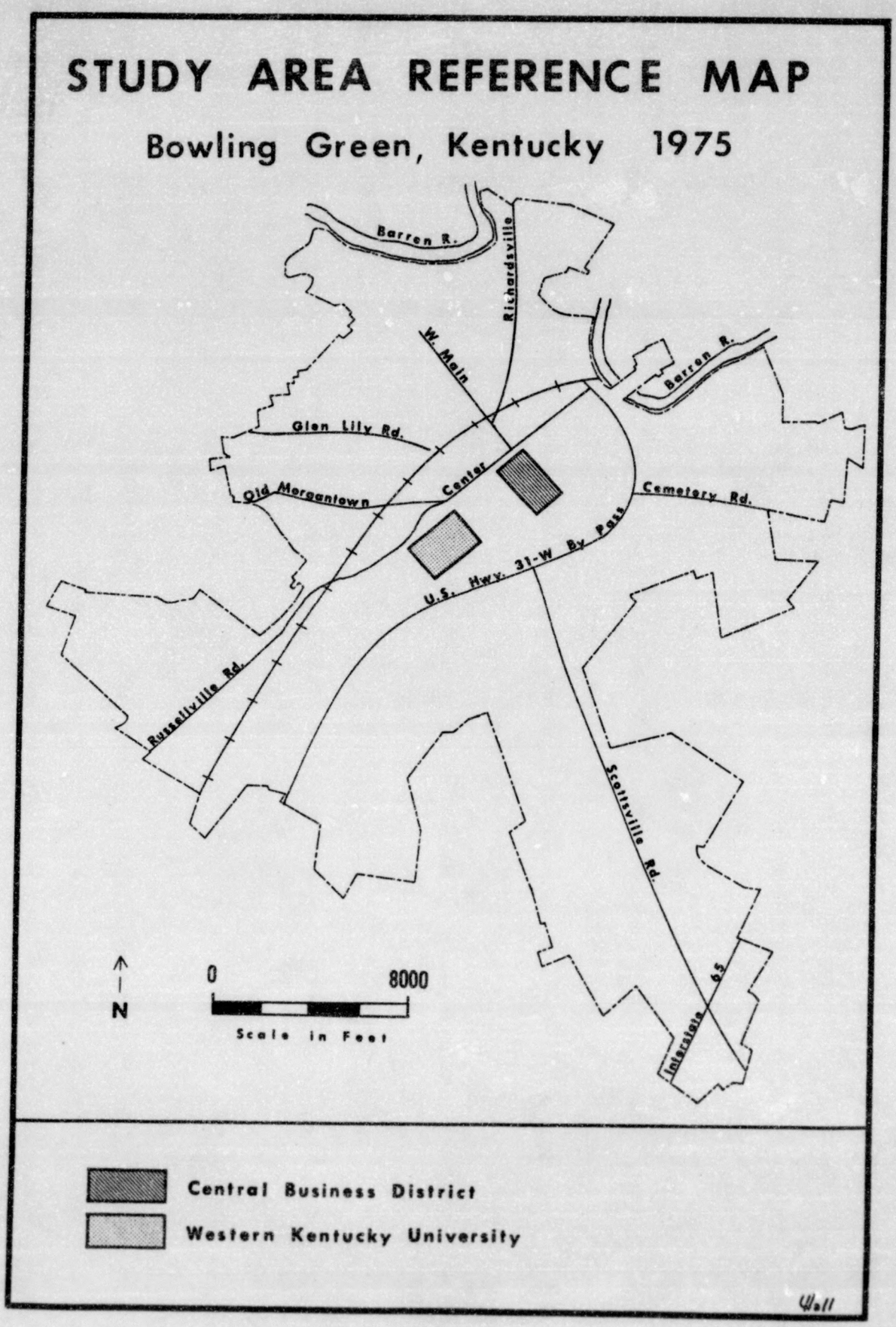
MAP II

TABLE 2

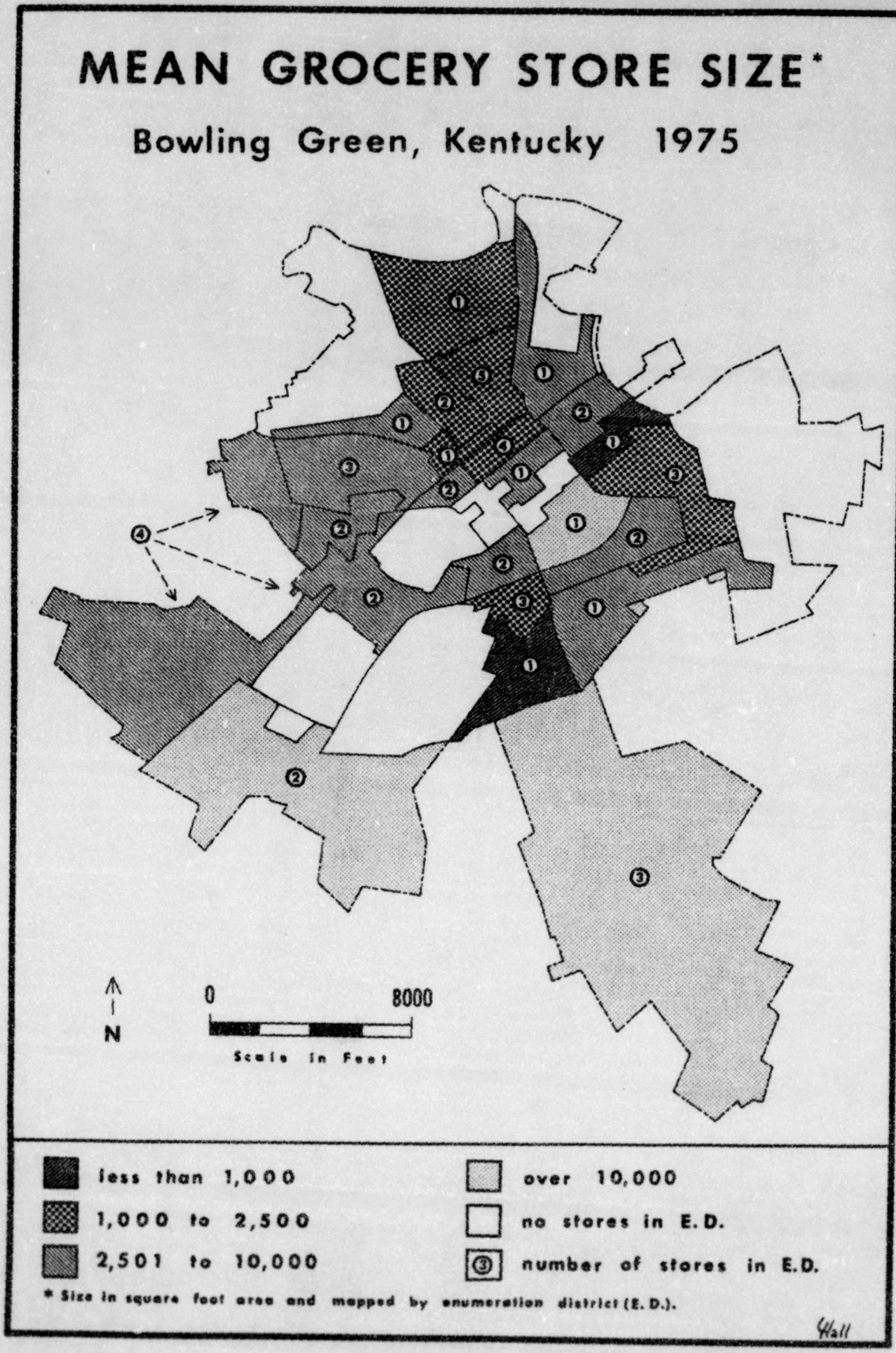
LIST OF STORES USED IN STUDY

(NOTE: Store numbers correpsond to locations on Map III.)

1. A & P Food Store
2. Barry Street Market
3. Campbell's Kwik Market (Laurel Av.)
4. " " " (Fairview Av.)
5. " " " (Broadway)
6. Chumney's Grocery
7. Clay Street Minit Market
8. J. S. Cole & Son
9. D & F Super Market
10. Dudley's Market
11. Fast Way Market
12. Fourteenth Street Food Market
13. Garrett's Big Star
14. Green Tree Market
15. Houchins Market Number 1
16. " " " 12
17. " " " 3
18. " " " 32
19. " " " 34
20. " " " 6
21. " " "(Glen Lily Rd.)
22. Hunt's Market
23. Jiffy Market
24. Jiffy Market Number 3
25. Jiffy Mart Number Two
26. Jr. Food Number 1
27. " " " 2
28. " " " 3
29. Kroger Company
30. Market Center
31. Minton Grocery
32. Moore Bros. I.G.A. Market
33. Oliver's Food Market
34. Pac-A-Sac Market
35. Page And Son Market
36. Raymer & McConnell Grocery
37. Reeves Food Center #1
38. " " " #2
39. Girtha Richard's Grocery
40. Sidden's Cash Market
41. Smallhouse Road Market
42. Super City Market
43. Tucker's Minit Market (Gordon)
44. " " " (Fairview)
45. " " " (Laurel)
46. " " " (Shive Ln.)
47. West End Super Market
48. William's Food Mart
49. Winn Dixie
50. Woodford Street Market


STUDY AREA REFERENCE MAP
Bowling Green, Kentucky 1975
Barren R.
Richardsville
W. Main
Barren R.
Glen Lily Rd.
Old Morgantown
Center
Cemetery Rd.
U.S. Hwy. 31-W By Pass
Russellville Rd.
Scottsville Rd.
Interstate 65
N
0
8000
Scale in Feet
Central Business District
Western Kentucky University

MAP III


MEAN GROCERY STORE SIZE*
Bowling Green, Kentucky 1975
N
0
8000
Scale in Feet
less than 1,000
1,000 to 2,500
2,501 to 10,000
over 10,000
no stores in E.D.
number of stores in E.D.
* Size in square foot area and mapped by enumeration district (E.D.).
Hall

MAP IV

Map IV, Mean Grocery Store Size, generally represents the city arrangement of outlets suggested in the literature survey. The greatest number and concentration of smaller establishments lie to the city center, while the enumeration districts containing larger stores occupy the outer city. The map shows E.D.'s 20, 23, 24, 25, and 31 to display thirteen smaller stores with a mean size between 1,000 and 2,500 square foot area (refer back to Map I in Chapter II for E.D. numbers). This is clearly the greatest concentration and number of smaller stores in the city and is situated in the older central city. A visual examination of this section of Bowling Green, by the author, disclosed that it displays deteriorated housing and closely spaced buildings. Although these stores did not have a mean size of under 1,000 square feet, as mentioned by Cooke's categories (in Chapter I), the majority were older structures of neighborhood type. The placement and distribution of smaller groceries confirms the findings of the literature survey.

Enumeration districts with mean store areas from 2,501 to 10,000 square feet are, for the most part, clustered around the central core of small stores located in the West Main and Richardsville Road area. Although the literature suggests larger groceries will distribute themselves in age rings from the city center, there is not a continuous circular zone in the case of Bowling Green. This is likely due to the Barren River which has acted as a physical barrier to city growth in general to the east and north (see Map II for river location). Excluding the complicating effects of the heavily traveled U.S. 31-W By Pass which has spurred a considerable linear concentration of retail businesses, a second incomplete ring of stores 2,501 to 10,000 square is recognizable to the west, south, and east. Residential quality in this second ring is better than the 1,000 to 2,500 group near West Main Street, but houses probably still average thirty to forty years old here. This generalization does not hold for E.D.'s 42 and 27, where 42 is nearer

subdivisions and commercial developments.

A third size group of over 10,000 square feet is only evidenced in E. D. 43-A and 43-B. These are lying to the fringe of the city as the literature contended, but their fragmented development could hardly be considered strong support. Taken as part of the entire growth of the city, however, these three areas of progressively larger mean grocery store size categories do exhibit an approximation of the city wide pattern presented in the literature survey.

The orderly arrangement of size does have several obvious exceptions. They may well stem from the existance of U.S. 31-W which bisects the center of these abnormalities in the model. Enumeration districts 15, 17, 38, 39, and 41 complicate the development of the 2,501 to 10,000 size food outlets. With the exception of 17 and 41 which contain isolated neighborhood stores under 1,000 square feet, the confusion is caused by seven convenience markets situated on U.S. 31-W, Scottsville Road, and Cemetery Road. As it had been suspected these newer small stores decreased the mean size of E.D.'s 15 and 39, thus disrupting the model. Barring those enumeration districts mentioned above, patterns of store size city wide do generally adhere to the findings of existing studies.

Analysis of the Specific Hypotheses

Simple Correlation Coefficients (Table 3) provides the basis for accepting or rejecting each of the six specific hypothesis. It shows the statistical correlation between store size (Y) and each of the sixteen independent variables (X). The validity of variables is judged by its probability level. Those displaying a probability reading of 95 percent or 99 percent were run to determine if the generated correlation values

should be statistically accepted or if they should be attributed to a chance occurrence. Correlations falling below these two levels are commonly attributed to chance. Each hypothesis will be discussed separately.

Table 3

SIMPLE CORRELATION COEFFICIENTS

Variable	r Value	Variable	r Value
X_1 (population density)	-.183	X_9 (agglomeration)	+.420**
X_2 (population 18-24)	-.086	X_{10} (accessibility)	+.404**
X_3 (population 65 +)	-.155	X_{11} (store frequency)	-.182
X_4 (black population)	-.136	X_{12} (CBD distance)	+.205
X_5 (overcrowding)	-.345*	X_{13} (1st neighbor)	+.071
X_6 ($ rent density)	-.123	X_{14} (2nd neighbor)	+.171
X_7 ($ housing density)	+.007	X_{15} (hours open)	-.325*
X_8 (housing density)	-.172	X_{16} (issue credit)	-.154

**Significant at the 99th percent probability level

*Significant at the 95th percent probability level

Source for levels: F.C. Mills, Statistical Methods, 1955

Hypothesis 1: Store size is positively associated with accessibility, retail agglomeration, distance from the CBD, distance to first nearest grocery store, and distance to second nearest grocery store.

An inspection of Table 3 reveals that all five elements from this hypothesis do exhibit positive associations. Only agglomeration (X_9) and accessibility (X_{10}), however, were found to be statistically significant. With simple correlation values of .420 and .404, these two command the greatest correlation to store size. Taking into consideration the strong reference to retail agglomeration and accessibility in the literature, this outcome could have been anticipated. The strength of the remaining three elements in hypothesis 1 (X_{12}, X_{13}, and X_{14}) were thought to have been greater. The effects of relative proximity upon distribution through time has evidently not been a strong factor on an aggregate basis. These correlation values of .205, .071, and.171 may be due to the wide spacing of smaller convenient markets along Scottsville, U.S. 31-W By Pass and Cemetery Road. Complication may also have grown from the close spacing of the larger Kroger and A&P stores. On the basis of these findings hypothesis 1 must be conditionally rejected, since two elements were statistically significant while three were not.

Hypothesis 2: Store size is negatively associated with store frequency.

The store frequency variable (X_{11}) was operationally expressed as the number of grocery stores in each enumeration district. It differs from the nearest neighbor measures in that it accounts for areal store concentrations rather than linear distance. Store frequency was found to be negatively associated (-.182) with store size (Table 2). This suggests that where stores are smaller, they tend to be more closely spaced. Analysis of Map IV verifies this fact by showing a greater

number of stores when the store size is smaller, (except for E.D. 15 and 41). This especially holds true in the West Main and Richardsville Road area. Although the correlation was not as strong as was anticipated, it may have been complicated by the close proximity of the two large shopping centers with supermarkets over 10,000 square feet on the southern stretch of U.S. 31-W By Pass. Since the correlation value was not significant, hypothesis 2 is rejected.

Hypothesis 3: Store size is positively associated with dollar housing density.

Dollar density of owner occupied houses (X_7) was designed to be a surrogate value for income by measuring the value of homes. Its low simple r (.007) indicates that this correlation is probably due entirely to chance occurrence and no regularities exist between store size and dollar housing density. This correlation generally contradicts the literature. It is entirely possible, though, that the inclusion of this variable was unwise, for it measured opposing forces. By standardizing the value according to area, the higher-cost demand of the central city was compared by acre with the supposedly more expensive peripheral residential sector. A previous run without standardizing showed that dollar value of houses displayed a significant correlation with store size (.350). This high value was in support of literature, but it was felt that standardizing was a more objective expression based on size difference of E.D.'s. By undertaking this step, however, the high value of city center building was overlooked as a compensating force. Hypothesis 3 is rejected, although the evidence leading to its rejection is questionable.

Hypothesis 4: Store size is negatively associated with dollar rent density, housing density, percent overcrowding and percent black.

This group of four variables was suspected to be negatively associated with store size and that suspicion was supported by the simple correlation coefficients (Table 2). Overcrowding (X_5) had an unexpectedly high r value (-.345) which was found to be significant at the 95% level. The other three variables, dollar rent density (X_6), housing density (X_8), and percent black (X_4) displayed correlations ranging from -.172 to -.123 and were not significant. This suggests the existance of a relationship not handled in previous literature. On the basis of these values hypothesis 4 is conditionally rejected.

Hypothesis 5: Store size is negatively associated with the percent of population 18 to 24 years of age, percent of population 65 years and over, and population density.

The three variables mentioned in hypothesis 5 are all negatively associated with store size, but none show a significant correlation. Population density (X_1) exhibited the highest value (-.183), and may well be related to the overcrowding (X_5) in the central city. The influence of Western Kentucky University as measured by population 18-24 years of age (X_2) is negligable (-.086). The placement of population of persons 65 and above (X_3) near smaller grocery stores was greater than expected (-.155), but did not rank significantly. According to the values of its three elements, Hypothesis 5 was rejected.

Hypothesis 6: Store size is negatively associated with the variables of hours open and issuance of credit.

The testing of hours open (X_{15}) and credit (X_{16}) was introduced to measure the correlation of store policy to store size. As was suggested in the literature both were negatively associated with values of -.325 and -.154, respectively. Hours open was found significant. Based on these results, hypothesis 6 is conditionally rejected.

Analysis of the General Hypothesis

General Hypothesis: The spatial distribution of intraurban grocery establishments, based on store size, will display regularities in arrangement as suggested in geographic literature and the following specific hypotheses will provide a high degree of explanation for factors controlling that pattern.

The acceptance or rejection of the general hypothesis depends on three factors: the specific hypotheses, the cartographic displays, and the step-wise regression and correlation results (Table 4). Analysis of the specific hypotheses indicates that all were rejected, but nonetheless four variables did show significant or highly significant correlation to changes in size. They were retail agglomeration, accessibility, hours open, and overcrowding. The other twelve variables were statistically insignificant as explainers of grocery store size. The cartographic analysis suggested that Bowling Green generally adheres to the literatures contentions with smaller businesses to the city center and larger establishments situated progressively toward the urban fringe. Disruptions in the models were seen as physical barriers (Barren River) limited city growth to the north and east causing fragmentation of size rings and the U.S. 31-W By Pass retail concentration

through the city. The use of maps and simple correlation values as explainers of the spatial distribution of grocery store sizes has met with only limited success. It has revealed an approximation of the literature's visual model and only four significant variables.

At this point in the analysis it is appropriate to assess the combined intensity of all the variables together in explaining the spatial distribution of grocery stores. Separately, some variables have had more association with changes in store size than have others. In order to interpret the total explaining power of the sixteen variables, according to standard measures, the step-wise regression model was utilized. In addition to assessing the total variation, this model also designates the amount of contribution of each individual variable. In order to present the aggregate or combined effect of all sixteen variables, Table 4 was established. It shows four values derived from the statistical regression model. Multiple R (Mult. R) indicates the combined correlation of each successive step in the regression process combined so that step 16 reflects the multiple correlation of all sixteen variables. R^2 displays the combined explained variation of all steps to a maximum of 49.4 percent. Column number three shows the percent explained variation of each variable taken individually and is derived from R^2. The F-value is a measure of significance for each step. All F-values are significant at the 95th or 99th percent level.

Only six values displayed adequate competence as explainers. They are agglomeration (X_9), hours open (X_{15}), accessibility (X_{10}), population 65 + (X_3), store frequency (X_{11}), and population density (X_1). Since variables enter according to their importance to the dependent

TABLE 4

REGRESSION VALUES IN ORDER OF ENTRY

Variable	Mult. R	R^2	% Explained Variation	F Value**
X_9 (agglomeration)	.420	17.7	17.7	10.32
X_{15}(hours open)	.508	25.8	8.1	8.18
X_{10}(accessibility)	.608	37.0	11.2	9.02
X_3 (population 65 +)	.654	42.8	5.8	8.42
X_{11}(store frequency)	.667	44.5	1.7	7.08
X_1 (population den.)	.683	46.7	2.2	6.29
X_{16}(issue credit)	.689	47.5	0.8	5.43
X_4 (black population)	.693	48.0	0.5	4.74
X_{13}(1st neighbor)	.694	48.2	0.2	4.14
X_{12}(CBD distance)	.698	48.7	0.5	3.70
X_{14}(2nd neighbor)	.700	49.0	0.3	3.32
X_2 (population 18-24)	.701	49.1	0.1	2.98
X_6 ($rent density)	.701	49.2	0.1	2.68
X_5 (overcrowding)	.701	49.2	0.0	2.42 *
X_7 ($housing density)	.702	49.4	0.2	2.21 *
X_8 (housing density)	.703	49.4	0.0	2.01 *

** All values significant at the 99th percent level unless marked

* Significant at the 95th percent level

Source for levels: F.C. Mills, Statistical Methods, 1955

variable (Y), these occupy the first six positions. Their combined multiple correlation (.683) makes up nearly all of the total R. R^2 indicates that the first six variables to enter in the regression equation account for 46 per cent of the entire variation (49.4 per cent). Independently, retail agglomeration and accessibility are the highest explainers with 17.7 per cent and 11.2 per cent attributed to each, respectively. Again the strong reference in existing literature confirms the significance. Hours open and store frequency would also be expected to rank high according to previous studies. Although no direct association has yet been established for population density to grocery stores, its ranking can well be understood when comparing the distribution of stores with city population arrangements. The high explained variation of population 65 and over (5.82) is an unexpected outcome, with a ranking above store frequency and population density. The purpose of this study is not to explain the causes behind this unforeseen occurrence, but this relationship could well be further investigated in another study. In relation to the entire variable set the first six entries provide the most notiable association to grocery store size distribution.

It is interesting to compare the ranking of overcrowding (X_5) in the regression model in Table 4. It was statistically significant in the simple correlation (Table 3), but provides almost no contribution to the regression values. In an attempt to uncover the cause, a close inspection was made of the entire correlation matrix. Here it was found that overcrowding was highly correlated to black population (r = .610), indicating that black population and overcrowding measure similar

conditions. Once the regression had accounted for that condition by ranking X_4, it no longer needed to record it again. Thus overcrowding was entered low in the regression model.

The remainder of the variables account for an insignificant amount of explanation. According to the data set the last ten variables to enter the regression model provided 2.7 per cent of the total explained variation and .020 of the multiple correlation. On this basis, they must be considered to be insignificantly associated with changes in store sizes.

When all sixteen variables are taken together, they account for 49.4 per cent of the total explained variation and .703 of the R. The total explaining power of the variable set is acceptable, although not satisfactory. It was hoped that a greater amount could be recorded.

At this point in the analysis, it only remains to judge the validity of the general hypothesis for the data analysis has been accomplished. The cartographic displays revealed an encouraging, but doubtful approximation of the patterns in previous literature. Simple correlation identified four significant variables, one of which was contested in the regression results. When subjected to the regression model, six important variables were indicated. On the basis of the study's three areas of analysis, the general hypothesis must be conditionally rejected. Full rejection is restricted by the promising results stemming from the maps and the combined regression values.

A subordinate interest of this investigation involved the small size of the study area. It was not known whether Bowling Green, with a population of about 36,000, would exhibit store characteristics

similar to those urban centers cited in the literature which all had populations in excess of 100,000. The general application of previous studies would indicate that city size will not affect the processes and distribution of retail food establishments.

Chapter Summary

Chapter III has presented the results and an analysis of the cartographic diplays, the simple correlation, and the step-wise regression and correlation in an effect to discover the pattern and controlling elements of grocery stores spatial distribution. Mapping of the study areas size patterns revealed an approximate support of the literature survey. All six specific hypothesis were rejected, although two variables were found to be statistically significant and two highly significant. Analysis of the regression values showed that all sixteen variables tested accounted for 49.4 per cent explains variation with most of that accounted for by the first six to enter. The elements of the general hypothesis were reviewed and a conditional rejection was concluded.

CHAPTER IV

SUMMARY AND CONCLUSION

The purpose of this study was to investigate the spatial distribution of intraurban retail grocery stores using the formal element of store size as a controlling theme. Two objectives were presented to fulfill that purpose. They were to assess the city wide arrangement of food establishments and to identify and measure selected variables controlling that arrangement. A survey of literature suggested a simple model for intraurban store patterns and sixteen operational variables. Based on the literatures findings, one general hypothesis and six specific hypotheses were formulated.

The study area was designated as Bowling Green, Kentucky. The selection of this site was based on two factors. The first was its small size. No study was found that dealt with the entire population of retail grocery stores in a single small urban center. It was thought that this investigation could either substantiate or refute findings derived from larger urban areas. A second factor was the suitable showing of four size groups of stores within the study area. This would allow representation of each size in the analysis and thus reduce bias due to overloading any one size group.

The purpose and objectives of the study were accomplished through a combination of cartographic displays, simple correlation, and stepwise regression and correlation. The basic statistical unit utilized

was the enumeration district (E.D.) covering about fourteen city blocks each. Data sources included the United States Bureau of the Census, the Kentucky Department of Transportation, and a personal interview with each of the fifty food establishments. Store size was designated as the dependent variable and calculated by pacing the dimensions of the stores selling area. The data set was subjected to the regression model to determine the intensity of association between specific variables and two maps were prepared to illustrate location and arrangement of outlets.

Analysis of the data was undertaken in three areas: the cartographic illustrations, the simple correlation coefficients, and the regression values. The map was concluded to support the literature, but did not adequately confirm it. All six specific hypotheses, based on simple correlation values, were rejected, but four variables did exhibit statistically significant associations. The general hypothesis, drawing its success from all the preceding analysis plus the regression values, was conditionally rejected. Formal rejection was controlled by the promising, but unsatisfactory results of the maps and regression rankings. In addition, it must be decided that the conclusions of the literature survey, stemming from studies of urban centers over 100,000 population, are applicable to smaller urban areas such as Bowling Green, Kentucky.

Weaknesses of the Study

The most obvious weakness of this study is the association between form and function using only size as an element of form. Although the

use of a single formal element does provide another approach to investigating intraurban retail structure, a more logical indicator of function might be a combination of formal elements. However, this paper did expose similar significant variables using size, as others have using spacing or number alone. On even a larger scale, it has not been clearly determined what the relationships between form and function are in retailing. If they are valid approaches in geography, what are acceptable methods of utilization? And to what retailing enterprises can they reliably be applied? If, and when, these questions can be properly answered, one must then discover how form and function are related to processes controlling spatial distribution, and finally to prediction.

It was hoped that better availability and suitability of data could be accomplished. Collection of the dependent variable, through pacing the stores dimensions, gave a relative measure of size, but not an exact one. Both the city planners and the city building codes office were contacted and neither could provide data on floor areas of retail establishments. Whether more accurate measurements would have changed the study's outcome is unknown, but it would certainly have improved the data set. A second difficulty in information collection was the inability to use income figures. Although they are collected by the Bureau of Census, they are of little use to intraurban studies. Such data are available only in anonymous form, making it useless to the researcher wishing to attach it to a point in space. The surrogate variables used in this paper were not seen to properly reflect income data. These weaknesses had to be dealt with in a practical manner,

though, if the study was to be undertaken at all.

Further Research

Upon completion of this investigation, several areas of further research merit consideration. Studies attempting to measure the affect of variables on the spatial distribution of retail establishments have commonly found site factors such as accessibility or agglomeration to be significant. The importance of these have become well established. More emphasis needs to be placed on socio-economic elements. The unexpected association of population sixty-five and above to store size is an example. Perhaps by uncovering such relationships, retail businesses can be suited more closely to the consumers by merely considering locational factors. Understanding of conditions such as these may allow consumer and business both to profit by altering simple formal elements of size, number, and spacing. The goal of science is normally considered to be prediction, perhaps though, it is possible to fulfill humanitarian needs in that same search.

APPENDIX A

Areas of Enumeration Districts Used in Study

Enumeration District Numbers	Area in Acres*
15	4.41
16	3.17
17	1.53
18	2.15
19	3.17
20	6.05
22	1.74
23	2.05
24	2.66
25	0.92
26	5.12
27	13.94
28	1.94
29	4.61
31	1.33
32	0.71
35	1.53
37	1.64
38	2.66
39	1.43
41	3.48
42	5.84

43A	15.89
43B	36.51

Source: author

*Calculated by use of the dot grid method (64 dots per square inch on a 1:2000 scale map).

APPENDIX B

NOTE: The following list is from Carson's City Directory (under "Groceries and Meats - Retail"). Numbered stores were used in the study; some were deleted for the stated reasons. Listings with an asterisk(*) were new stores not included in the Directory, but used in the study.

A&P Food Stores (Br) 2403 Nashville Rd. - 1

Barry Street Market 701 Barry St. - 2

Campbell's Kwik Market 1516 Laurel Ave - 3

Campbell's Kwik Market 245 Louisville Rd. - out of city limits

Campbell's Kwik Market 1010 Fairview Ave. - 4

Campbell's Market No. 2 1105 Broadway St. - 5

Chumney's Grocery 600 W. Main St. - 6

Clay Street Minit Mart 1175 Clay St. - 7

Cole J S & Son 423 College St. - 8

Commissary The 1215 Laurel Ave. - out of business

Country Corner Louisville Rd. - out of city limits

D & F Super Market Inc, 1232 Adams St. - 9

Dudley's Market 108 W. Main St. - 10

Elder's Country Store 2725 Nashville Rd. - out of city limits

Fast Way Market 2016 Russellville Rd. - 11

Fast Way Market No. 2 1220 Broadway St. - out of business

Fourteenth Street Food Market 1127 E. 14th Ave. - 12

Garrett's Big Star 510 Gordon Ave. - 13

Green Tree Market 900 Fairview Ave. - 14

Guy's Market 514 Pearl St. - out of business

Houchens Market No. 1 817 College St. - 15

Houchens Market No. 12 103 E. Main St. - 16

Houchens Market No. 3 1615 Laurel Ave. - 17

Houchens Market No. 32 1901 Russellville Rd. - 18

Houchens Market No. 34 348 College St. - 19

Houchens Market No. 6 709 Laurel Ave. - 20

*Houchens Glen Lily Rd. - 21

Hunts Market 835 Boat Landing Rd. - 22

Jiffy Market 231 By-Pass - 23

Jiffy Market No. 3 1803 Robinson La. - 24

*New Morgantown Rd. Jiffy Market - 25

Jiffy Mart No. 2 2911 Nashville Rd. - out of city limits

Jr. Food Stores Inc, Store No. 1, 1403 Adams St. - 26

Jr. Food Stores Inc, US 68 and Woodmont Dr. - 27

Jr. Food Stores Inc, 1305 Center St. - 28

Kroger Co. 2353 Nashville Rd. - 29

Market Basket 2804 Nashville Rd. - out of city limits

Market Center 3909 Scottsville Rd. - 30

Minton Grocery 115 E. 10th Ave. - 31

Moore Bros. IGA Market 206 W. Morgantown Rd. - 32

Oliver's Food Market 327 Church - 33

Pac-A-Sac 2317 Russellville Rd. - 34

Page and Son Market 817 W. Morgantown Rd. - 35

Raymer & McConnell Grocery 707 Kentucky St. - 36

Reeves Food Centers Store No. 1, 408 Fairview Plaza - 37

Reeves No. 2 393 Old Morgantown Rd. - 38

Richards Grocery 1021 Payne St. - 39

Siddens Cash Market 600 Fairview Ave. - 40

Smallhouse Rd. Market 1418 Smallhouse Rd. - 41

Super City Market 207 E. Main St. - 42

Tucker's Minit Market 221 Gordon Ave. - 43

Tucker's Minit Market 1120 Fairview Ave. - 44

Tucker's Minit Market 1337 Laurel Ave. - 45

*Tucker's Minit Market Shive Ln. - 46

West End Super Market, 418 Woodford St. - 47

Williams Food Mart 1136 Nutwood Ave. - 48

Winn Dixie 1751 Scottsville Rd. - 49

Woodford Street Market 501 Woodford St. - 50

APPENDIX C

Questionnaire

Name of Store:

Address:

1) How many hours per week is your store open?

   a) Monday thru Friday _____

   b) Saturday _____

   c) Sunday _____

   d) Total _____

2) What is the total number of square feet of selling area in your store?

   a) Estimated by owner _____

   b) Estimated by interviewer _____

   c) Known _____

3) Does your store issue credit?

   a) Limited (only to a few) _____ (yes)

   b) Controlled (to all qualified) _____ (yes)

   c) None _____ (no)

4) Retail agglomeration (done by interviewer) : visual count of total number of retail outlets:

   a) On the same side of block _____

   b) Diagonally or straight across street _____

   c) In the same structure _____

   d) Total _____

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