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A Systems-Behavioral Approach to the Geographic Problem of Locating Outdoor Recreation Facilities

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A SYSTEMS-BEHAVIORAL APPROACH TO

THE GEOGRAPHIC PROBLEM OF LOCATING

OUTDOOR RECREATION FACILITIES

By

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I would also like to thank the Planning and Recreation Departments of the City of Windsor for their kind assistance and all the many other people directly or indirectly connected with the final presentation of this paper.

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CHAPTER 1

INTRODUCTION

"The type of Geography which admits the importance of quantification and the appropriateness of statistical methodology, but always as servants and not as masters, would appear to be the best answer the profession can furnish to the embarrassing questions which have arisen during the current debate in academic circles regarding geography's right to be included in the curricula of institutions of higher learning."

____ William Warntz

As a geographer interested in the problems of location and behavioral models relating to man's reaction to space, my purpose in this paper is to establish a quantitative approach to the analysis of a specific location problem as applied within the field of recreation analysis.

With regard to the analysis of recreation behavior, many areas of human behavior need to be considered for the investigation and understanding of outdoor recreation habits extend far beyond the realm of any one specialized field. Much of the research yielding important insights might not at first appear to be geographically important since it is carried on by economists, sociologists, demographers, political scientists and so on. Moreover, one of the most important contributions that could be made but appears to have been neglected to a large degree is the geographic problem of determining the proper location of recreation facilities.

Performance in the past seems to have made it clear that the process of planning by spurts and sudden crisis can achieve little. We need new tools and techniques not only to cope with new problems, but to expand and deepen our knowledge of recreation as a systematic form of behavior. In this way it might be possible to develop effective behavioral models for recreation; thus helping recreation planners to decide when to act, where to act and how to act in response to a particular stimulus. Consequently, I have defined in a general "systems" framework, those terms within which the essential characteristics of a recreation problem can be identified and features of a solution explored. The development of this systems approach is followed by a behavioral model designed to combine the relevant variables of the system into a meaningful and useful instrument to be used in the planning and location of outdoor recreation facilities. The model in its final form is specifically designed for estimating the optimum location of the outdoor swimming pool.

Although the approach taken relies heavily upon methods used in analyzing the optimum location of retail outlets, it differs in its application by the consideration of a "double universe". The meaning and significance of this double universe appears to be an important improvement over the approach taken by some marketing geographers and shall be discussed at further length later in the paper.

Finally, it might be noted that in many cases, exact pertinent consideration of the variables involved in recreation planning are merely touched upon briefly, not because they are trivial, but because they may perhaps deserve serious examination in their own right which would be beyond the scope of this paper. Consequently, I have relied heavily upon those authors who have recently contributed to a series of articles published by the Outdoor Recreation Resources Review Commission, Washington, D.C. and in particular, Perloff and Wingo whose appreciation of systems theory has contributed immeasurably to the "system" I have designed for recreation planning.

CHAPTER 11

THE ESTABLISHING OF A "SYSTEMS" FRAMEWORK FOR THE PLANNING OF OUTDOOR RECREATION FACILITIES

In an attempt to understand the problems inherent in recreation planning it might first be advisable to classify and place in perspective those elements that appear to be relevant to the analysis of a particular recreation problem. One approach is through the analysis of systems theory which deals with sets of objects or factors, these objects or factors being the parts or components of the system. Any recreation activity or group of activities can be viewed as a system with sub-systems being a part of larger systems.

The value of general systems theory is that it shows a concern for theoretical formulation and model building, and the use of probabalistic rather than deterministic solutions. [1]All the difficulties involved in an analysis of recreation perhaps argues for the need for a new planning framework--- a system which brings into perspective the recreation of urban populations, the evolving needs and demands, and the requirements and potentialities involved in supplying these needs.

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1 Perloff and Wingo enter into a discussion of the application of systems theory and recreation in their article <u>Trends in American Living and Outdoor Recreation</u>, Outdoor Recreation Resources Review Commission study report no. 22 (Washington, 1962) pp. 81-100.

Two steps then, need to be taken: first to investigate the nature of the elements of the system -populations, recreation activities, and the facilities for these activities, and second to explore the interactions between them.

A Population Groups as Elements:

The first step is to disaggregate the population into groups which are reasonably homogenous. These outdoor recreation groups are the basic units of the system, and are so drawn as to exhaust the population. The population is broken down by age, sex, education and socio-economic status. Under these conditions, any changes in the group behavior is then achieved by the process of assigning the members of a population to the outdoor recreation groups through estimates:

(a) of the characteristics of new population increments and

(b) of the probabilities that individuals will shift among the outdoor recreation classes in the interim (changes in age, education and socio-economic status).

1 Age

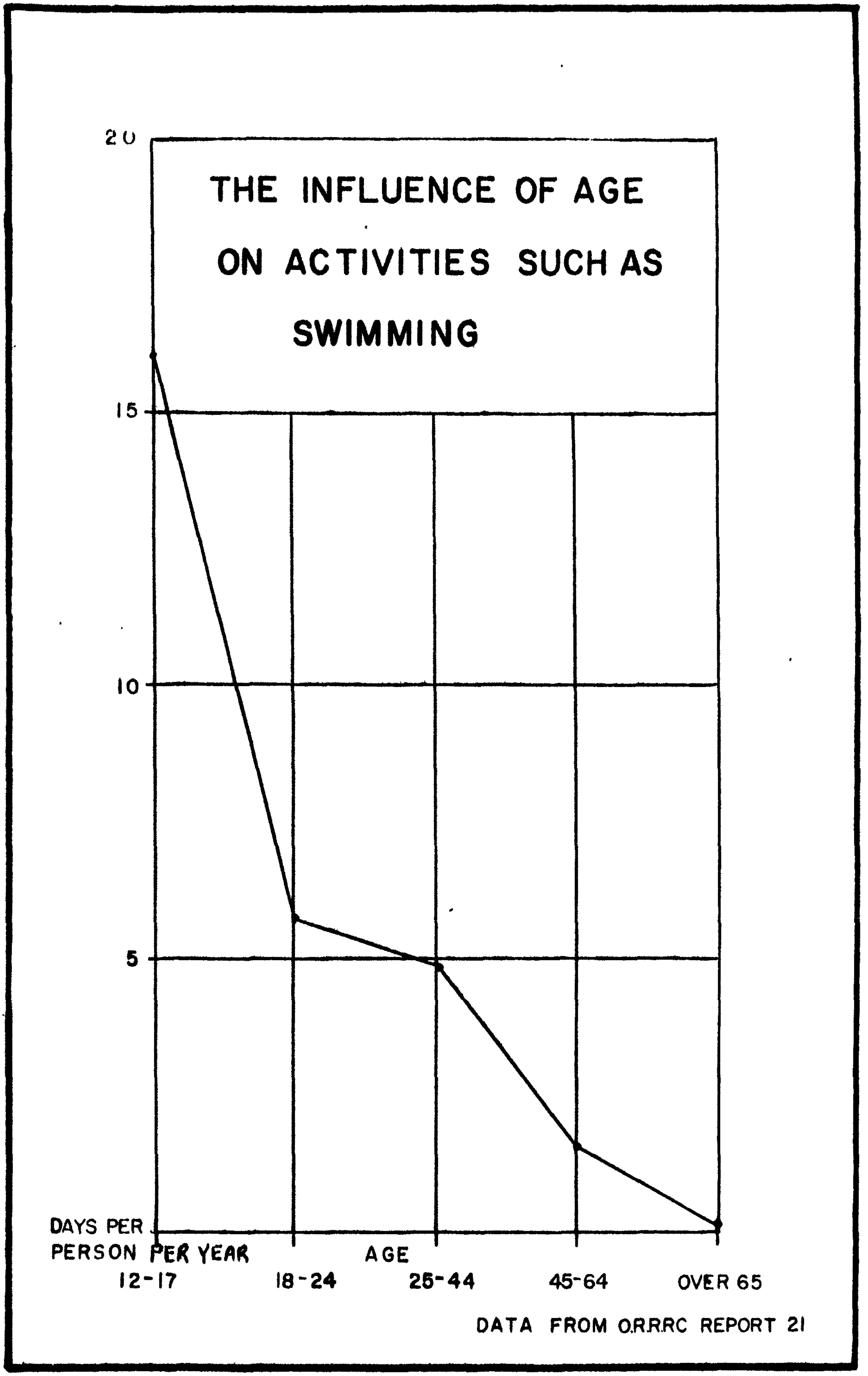
One's age or position in the life cycle has a substantial influence on what outdoor recreation activities he is likely to engage in. Young single persons are predisposed toward more active and more challenging activities while elderly retired couples frequently seek reasonably passive but gregarious recreation activity. In this sense, where one stands in the life cycle has an important effect in setting out the bounds within which recreation behavior is likely to take place. As an example, an activity such as swimming greatly decreases with age as shown in the accompanying graph, and thus there is a specific age group that swimming as a form of recreation activity is most appealing to. Any shift in the age structure of the population will cause a net change in the popularity of swimming.

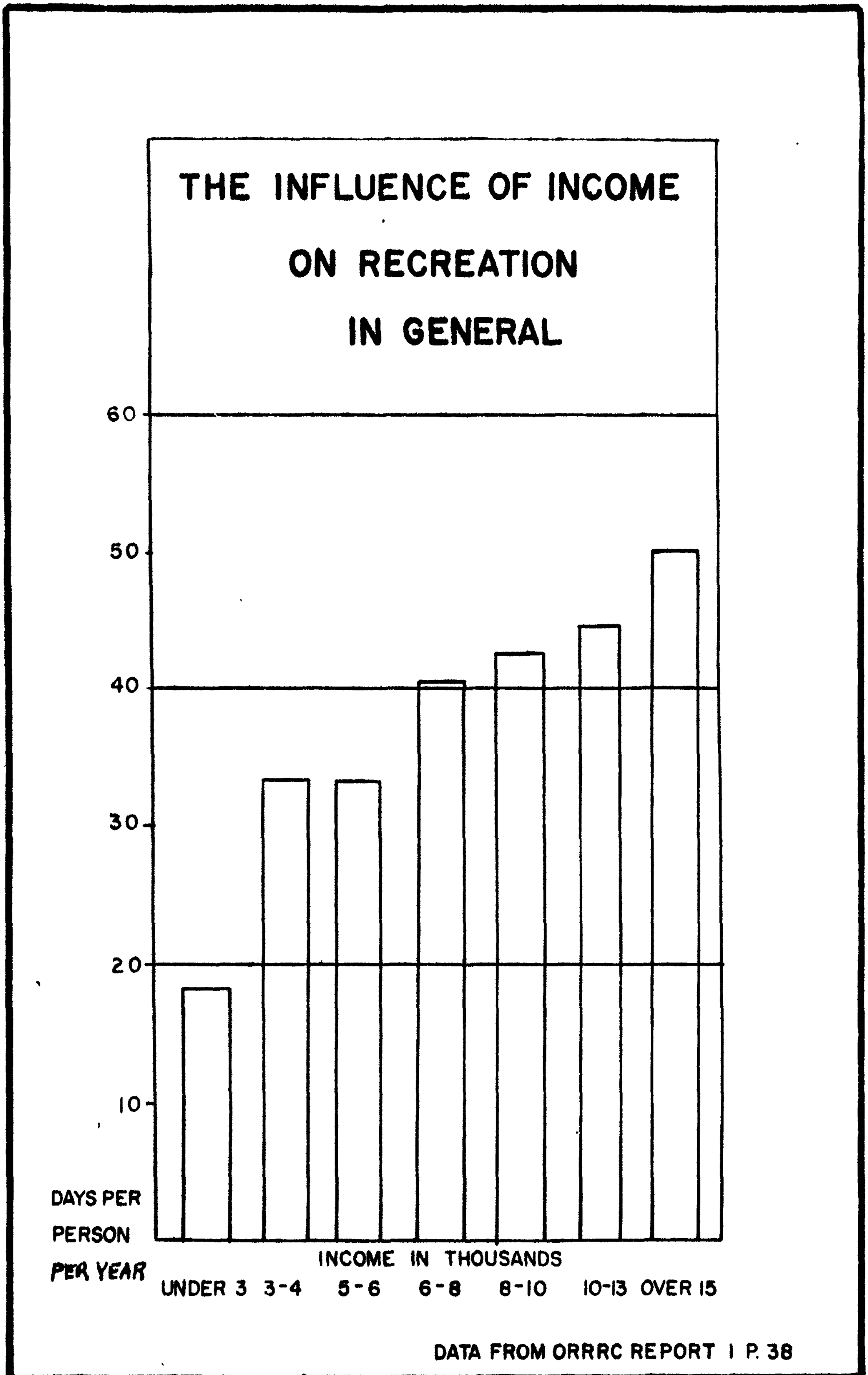
2 Sex

The recreation proponsities of males and females differ to the extent that males prefer more active and challenging recreations than do females who are in most cases more predisposed towards passive and social recreations.

3 Socio-economic Status

Socio-economic status, meaning wealth and position in the community, is equally obvious as a variable in how people make decisions about their use of leisure time. This variable has a number of dimensions—rich people can simply afford more expensive forms of recreation than the less affluent. There is also a class effect—certain recreations have prestige associations which influence recreation behavior. The influence of income on recreation in general can be seen by examination of the accompanying chart. The number of recreation days per person greatly increases


THE INFLUENCE OF AGE
ON ACTIVITIES SUCH AS
SWIMMING
20
15
10
5
DAYS PER
PERSON PER YEAR
AGE
12-17
18-24
25-44
45-64
OVER 65
DATA FROM O.R.R.R.C. REPORT 21


THE INFLUENCE OF INCOME
ON RECREATION
IN GENERAL
60
50
40
30
20
10
DAYS PER
PERSON
PER YEAR
INCOME IN THOUSANDS
UNDER 3
3-4
5-6
6-8
8-10
10-13
OVER 15
DATA FROM ORRRC REPORT 1 P. 38

with income. This effect is gradually changing however, with the average worker getting continually increasing wages and more vacation days every year. The forty hour work week will soon be a thing of the past.

4 Education and Cultural Background:

Education is closely bound up with socio-economic status and ethnic origin. People of different cultures and different incomes prefer different recreations. By way of example, polo and soccer are activities pursued in some European and Latin American countries but followed only negligibly in North America. Where a large immigrant population is present their recreation patterns and habits are readily apparent and must be accounted for.[2]

B Activities as Elements:

The type of activity under consideration often determines who participates, when, where, and how much. Whether it is an active, passive, group or family activity, it has the role in the system of linking the demand side of the population to the supply side consisting of any of the facilities which policy provides. It is in the understanding of the demands of the population that the type of activity needed is recognized. The supply side of the system is balanced off with the type of facility provided.

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2 For a more detailed discussion of the effects of age, socio-economic status, sex and education on recreation behavior refer to Perloff and Wingo, Urban Growth and the Planning of Outdoor Recreation, in O.R.R.R.C. study report no. 22 (Washington, 1962) pp 85-87.

C Facilities as Elements:

Facilities for outdoor recreation have several key characteristics which influence the manner in which the system operates.

1 Specialized Facilities

A facility may be highly specialized in use so that one, or at best a few facilities permit several activities to be enjoyed concurrently by different users.

2 Multiple Purpose Facilities

A facility might be multiple purpose in the sense that it is arranged to permit a number of specialized and unspecialized activities to be carried out simultaneously.

3 Size of the Facility

Whatever the resource endowment of the facility, simple size or area has an important relationship to capacity for most activities. Whatever the facility, whether it be a local swimming pool or a regional park, the physical size of the facility in question often determines how many people will participate.

4 The Accessibility Factor

The accessibility of a recreation facility often determines the utility or frequency of patronage. The farther away a facility is from the user group, the less the frequency of patronage is likely to be. How often does a person go to a nearby regional park instead of a park like Banff in Alberta? Of course a lot depends on the recreation experience to be enjoyed but physical distance or accessibility can be viewed in terms of the time and money costs associated with travel. This is particularly true in terms of travelling to duplicate alternative recreation sites. Physical distance thus becomes a friction factor in terms of usage or utility.

5 The Competition of Duplicate Facilities

The competition of similar facilities is an important consideration when attempting to balance off the supply side of the problem. In an attempt to analyze consumer behaviour one must consider all potential facilities simultaneously. Given several comparable facilities all other things being equal, the recreationist will use the nearer more frequently— or to the exclusion of— the more remote.[3] Although this relationship seems quite simple, it is one of the most important factors to consider in the establishment of a recreation system for future planning.

D The Geographic Location Factor

The location factor is bound up with all the elements of the system previously discussed. Location in its broadest sense has a special set of effects depending on the level of interest. At the regional level, uniquely local patterns in the use of leisure are

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3 ibid.

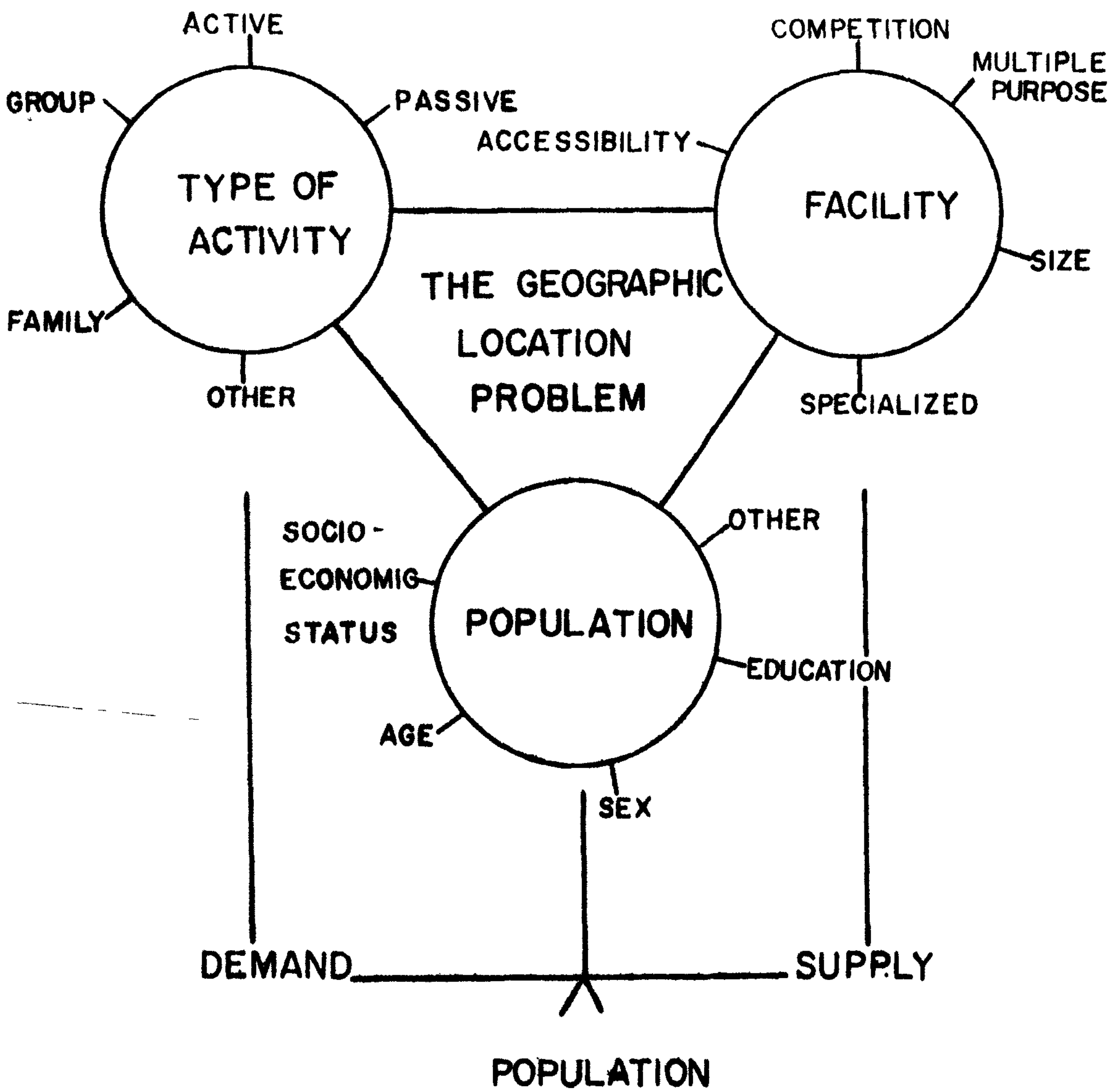
perhaps apparent. At another level, the influence of location results from conditions of accessibility or distance. Location related to the distance concept determines the time, money and inconvenience costs of gaining access to facilities depending on what population group you are dealing with. In effect, location determines the impact of competition, the friction of distance on the habits of the consumer, and the decision to develop additional facilities.

Although location does not fit the role of an input, it is so critical a factor affecting the ability of a facility to produce services valued by a recreation clientele that it should perhaps lie at the center of the system. Location affects the performance of a facility because distance influences the recreation decisions of the consumers.

A systems analysis approach to a problem requires a focus on the relationships which connect the elements of the system together and which are pathways by which changes are communicated among the elements. If the problem is seen to be one of relating a set of demand conditions to a set of supply conditions, these interactions stand in the place of the market. In the accompanying diagramatic expression of the system developed for recreation, interdependence is directly apparent in the complex array of outdoor recreation demands, activities and facilities.

All outdoor recreation facilities are tied together whereby changes tend to have impacts on many or all of the factors in the system. The facilities turn out specific products at given locations. Further, the system includes a set of consumers with propensities to engage in certain kinds of recreation, budgets in both time and money, knowledge

DIAGRAMATIC EXPRESSION OF THE SYSTEM



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of alternatives, and an inclination to act rationally to maximize their net satisfactions.

It is the behavior of consumers which powers the system, the consumer being at the fulcrum of supply and demand.

The Effect of Changes Within the System:

If in the short run one facility is expanded, this expansion will set in motion a wavelike set of impacts. In the first instance, those facilities for which it is an easy substitute will experience a reduction in the intensity with which they are used. This impact will be spread throughout the system of facilities until an equilibrium is achieved in which new patterns of attendance are once again established. In the same manner, changes are transmitted throughout the system when the activities or populations experience changes. The system is thus seen as an expression of varying conditions, each condition having an effect on the other and revolving around the problem of geographic location. Now that the key elements of the system have been identified it is now possible to establish a method or model for planning such that the kinds and levels of performance that are needed might be achieved. It might however, be advisable to first explore the behavioral approach to recreation planning in the light of present marketing methods, and trends in the business world.

CHAPTER III

THE BEHAVIORAL APPROACH TO RECREATION PLANNING IN THE LIGHT OF METHODS PRESENTLY USED BY MARKETING ANALYSTS

Having identified the relevant variables in recreation planning and having placed them in a workable framework in order to demonstrate their inter relationships, the next step is to develop a meaningful expression of the system as applied to the recreationist's behavioral pattern. Behavioral patterns have been closely studied by market analysts in their attempts to demonstrate the importance of location in the travel patterns of shoppers. As such, they have made significant contributions to the understanding of the behavioral approach to other forms of planning. The gravity model approach is a case in point.

The Gravity Model Concept:

One of the first to formally apply a behavioral approach to marketing was William J. Reilly. Using Newton's law that "the attraction between two masses is directly proportional to the products of their masses and inversely proportional to the squares of the distance between them", he attempted to apply the concept toward determining the relative retail pulling power of two competing cities on an intervening area. His hypothesis was that, "two cities attract retail trade from an intermediate town in the vicinity of the breaking point approximately in direct proportion to the population of the two cities and in inverse proportion to the square of the distance from the two cities to the intermediate town."[4] Reilly's study was published in 1929 and has come to be known as "The Law of Retail Gravitation". Since then a number of empirical studies have been conducted using his basic model particularly in the field of marketing research.[5]

The shortcomings of many of the behavioral models based on the gravity concept of Reilly was that he had never intended to quantify the movements of persons as market research analysts have attempted to do. However, the concept itself is well worth exploring for on the demand side of recreation, the counterpart of accessibility can be viewed as a so called "gravity model" in which is incorporated the tendency of demand for a service to vary inversely from its distance to the consumer.

The Model of Huff:

A second contribution to the understanding of location related to behavioral patterns was the model developed by D. L. Huff, designed to establish the optimum location of shopping centres. The basic form of his model is more applicable to the understanding of planning for recreation facilities because:

1. The prime interest of the planner is the maximum satisfaction of the consumer who lends himself to behavioral studies and patterns.

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4 Reilly, W. J., The Law of Retail Gravitation, New York, 1931, p.4.

5 For a straightforward and clear explanation of the gravity model concept read the article by P. D. Converse, New Laws of Retail Gravitation, Journal of Marketing, vol. 14, 1949.

2. It must equip the system with a feed back to allow for changes in the components of the system. In other words the model must be easily adapted to changing conditions in the system through time.

3. It must make full use of the internal dependencies of the system whereby when one input changes the other inputs also change in response to the original stimulus.

4. The model must be simple, easily interpreted, reasonably accurate, and readily adaptable to a variety of recreation problems, particularly with regard to the location problem.

5. Finally, the model must be an imitation or simulation of real world processes so that the predictive abilities afforded by the basic model can be extended even further by incorporating additional variables.[6]

Inputs of The Basic Model

Thus far, only the distance factor has been mentioned as one variable that can be adapted to a gravity model concept. In developing a basic model of consumer reaction to space, the model must also estimate the likelihood of a consumer patronizing a particular recreation facility by taking into consideration all potential facilities simultaneously. In other words, when a recreationist is faced with the alternative of similar recreation facilities, the decision to go to one particular facility is a result of the consideration of all the facilities in question. This input represents the

6 Ibid p.5

competition factor which must be considered in any marketing approach. Finally, the model must include an expression of the physical size of the facility in question as size is a determinant of potential utility in terms of how many people can actually make use of it. Many of the other inputs of the system can be included in the basic model depending on the type of recreation under investigation. However, the elements of size, distance and competition represent the primary inputs of the basic model. Again, depending on the level of interest, additional variables can be included.

The Basic Gravity Model For Recreation Planning:

Huff's basic hypothesis is: "The value of a shopping center to a consumer is inversely related to the effort and expense involved in getting from the consumer's point of origin to a given shopping center"[7] This basic relationship for purposes of recreation analysis might be stated: "The utility of a recreation facility or the value of the facility to the consumer is directly proportional to its size, inversely proportional to the distance from the consumer's travel base and inversely proportional to the competition of similar recreation facilities". Expressed mathematically, it takes the form:

$$P(eij) = \frac{\left(\frac{Si}{Dij} \right)}{\sum_{j=1}^{n=1} \left(\frac{Si}{Dij} \right)}$$

7 Huff, D. L., A Probabilistic Analysis of Shopping Center Trade Areas, Land Economics, Vol. 39, 1963, p.86

where:

$P(cij)$ = the probability of a consumer at a given point of origin i travelling to a given facility j

Sj = the size of the facility devoted to a particular class or type of recreation

Dij = the travel time or physical distance that is involved in getting from the consumer's travel base i to the facility under analysis j. (Travel time can be associated with cost or the expense and inconvenience that is perceived to be involved in travelling to various recreation sites).

$\sum_{j=1}^{n=1} \left(\frac{Sj}{Dij} \right)$ = an expression of the alternatives that a recreationist has in his decision to travel to one particular facility instead of perhaps several others that are similar. It represents the competition factor either in terms of multiple purpose or single recreation type classes.

For purposes of illustration, let us assume that a recreationist is equal distance from two swimming pools that are comparable in size with all other factors being equal. The probability of him going to either facility should be 50%.

Thus:

$P(cij) = ?$

Sj = 5000 square feet in both cases

Dij = 1 mile in both cases

j = 2 swimming facilities

Substituting In The Equation:

$$Pcij = \frac{\frac{5000}{1}}{\frac{5000}{1}+\frac{5000}{1}} = .50 \text{ or } 50\%$$

Although this model as it exists does estimate the correct probability under the circumstances described, it's main shortcomings perhaps lay in the misconception of the "single universe" concept which assumes conditions to be constant throughout the study area. It is very unlikely that the relationships described hold true with each subsequent unit of distance. As such it is likely that the impact of distance creates what might be called a "core" user group and a "peripheral" user group which represents a double universe concept. The relationships described in the equation might hold true in the core user group but might change with the impact of greater distances in the peripheral user group. If this is true, separate equations must be developed for each universe with additional variables included to account for any changes that might occur. This appears to be the basic shortcoming of the Huff type model and it is quite likely that swimming pools as well as shopping centers have a somewhat definable "core" of patrons and a "peripheral" market area that cannot be assumed to exist under the same conditions. With this in mind, the final model must be altered to take into consideration differing conditions if they exist. Two different sets of conditions require two equations if the model is to be realistic in its assumptions.

However, this basic type of gravity model can be developed into a reliable model for recreation area analysis partly because it contains the three main features of the system: the inputs of size distance and competition. It brings supply and demand together and the effects are brought out by the consumer and his propensity to use a particular recreation facility.

Because people are seen as possessing characteristics which are associated with their recreation behavior, the populations of the "system" can be broken down into groups, homogenous in large degree and exhibiting consistent recreation habits. Depending on the type of recreation facility under investigation, the populations can be classified. For example, the demand at any one moment for a recreation type classified by age can be found by summing the recreation propensities of this particular age group.

One important advantage of the model is that it should estimate the "likelihood" of a consumer using alternative recreation facilities in terms of demand gradients (probability values) radiating outwards from the facility under investigation. By adding up all of the consumer demand potentials geographically, a surface potential demand on a local, regional or national landscape is possible. The demand map can then be re-adjusted to incorporate a number of additional features of the system allowing for reliable predictions for allocations of consumer demand, location of facilities, the size of facilities and so on.

Operating as a system, changes in demand should become a function of all the other variables which directly or indirectly are a part of the basic model. These changes can be analyzed and different classes of activities planned ahead of time to cope with these future estimates.

Application of the systems approach and the behavioral approach to a specific recreation problem shall be analyzed in the next chapter in the hope that the accuracy and performance of the method shall serve as an index to its potential value as an instrument for future recreation planning and analysis.

CHAPTER IV

APPLICATION OF THE SYSTEMS BEHAVIORAL APPROACH TO A SPECIFIC RECREATION PROBLEM

The model thus far developed is incapable of estimating the total number of people that might be expected to attend a given outdoor recreation facility partly because of the limited number of variables that have been incorporated into the model. The next step is to analyze an existing system of recreation facilities in an attempt to identify from the "system" already developed, other relevant variables.

To accomplish this, I have chosen an existing system of outdoor swimming pools in the city of Windsor partly because the necessary information was readily available and partly because of my associated experience in this type of recreation activity. It was necessary to assume that one particular swimming pool (Lanspeary), was the subject pool under analysis in the hope that the information gained would be relevant in the final development of the behavioral model. Finally, it is hoped that the end result will be an accurate account of the number of people that would use the pool during an average week without referring to the actual attendance data until necessary for comparison of results. Its usefulness as a location model is bound up by its ability to predict attendance at a specific location in terms of the many variables that might be involved. If this is accomplished the approach used shall have more than justified itself.

The Approach

Step 1:

Selection of the Necessary Variables from the System

The first necessary step in any recreation problem is to define the relevant variables so that an accurate analysis might take place. The various interactions of these variables are readily apparent by examination of the diagramatic expression of the system. The following factors were chosen from the elements:

A Activities as Elements

The type of activity under analysis is swimming. This represents the demand side of the system.

B Populations as Elements

The population that takes part in this type of activity is basically determined by:

1 age - Having worked with the recreation department in the city of Windsor it is known through experience that the largest user group is probably between the ages of 6 and 19.

2 sex - There appeared to be no difference between a male or female tendency to use this type of recreation facility.

3 education and socio-economic status - At first glance these variables did not appear to influence a person's tendency to make use of a swimming pool. However, in order to be sure, socio-economic status was taken into consideration through the analysis of an "income" effect.

C Facilities as Elements

The relevant variables to be considered in the supply side of the system are:

1. The competition of duplicate recreation facilities.
2. The accessibility of the subject swimming pool under analysis (distance factor).
3. The size of the subject swimming pool.

The facility is specialized and used only for the purpose of swimming.

Step 2:

Testing The Variables Using Multiple Correlation Analysis

In order to be sure that the correct variables were chosen from the system, a multiple correlation analysis of the chosen variables was undertaken. The following procedure was followed:

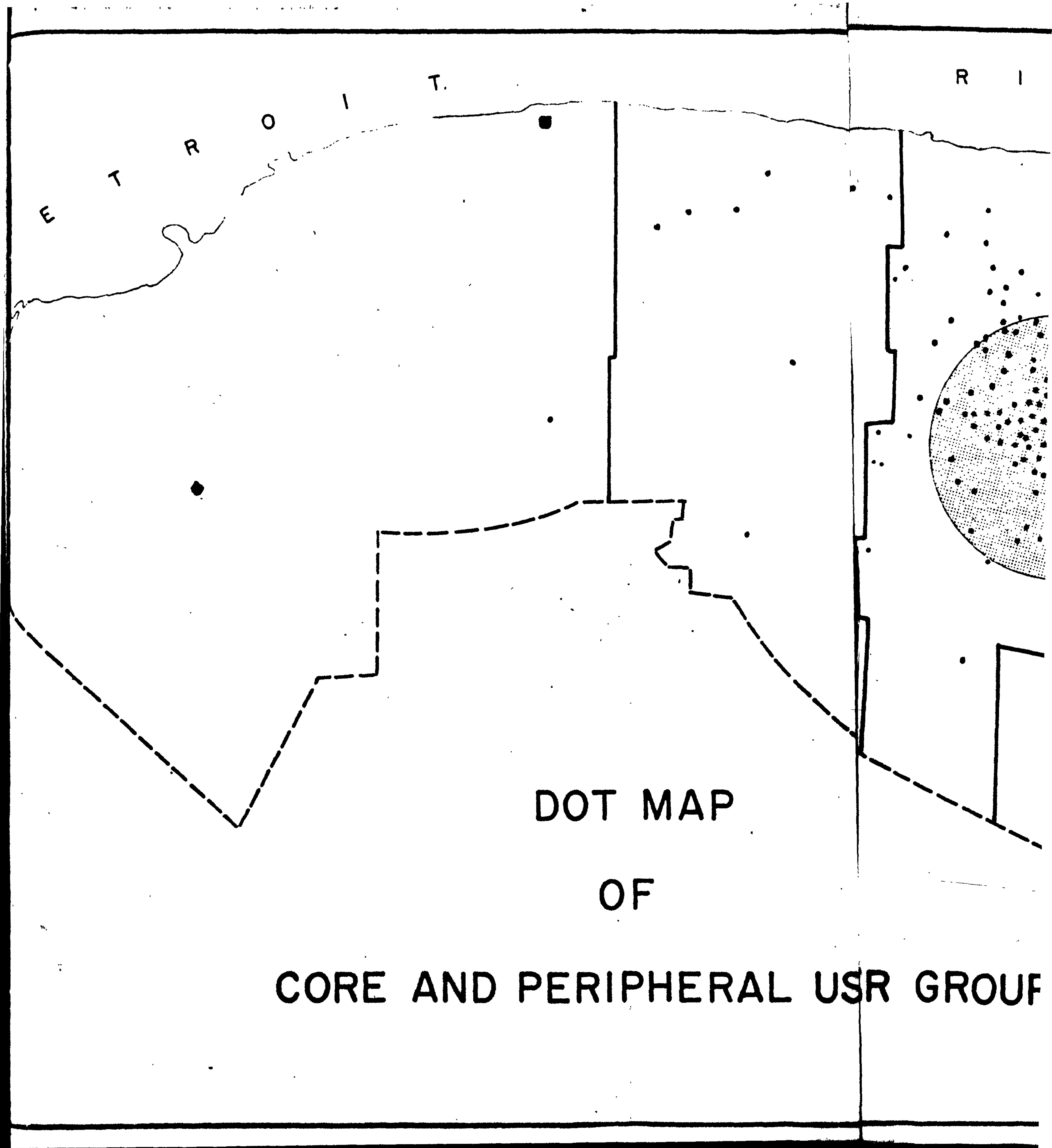
1. Selection of An Effective Sample Group —

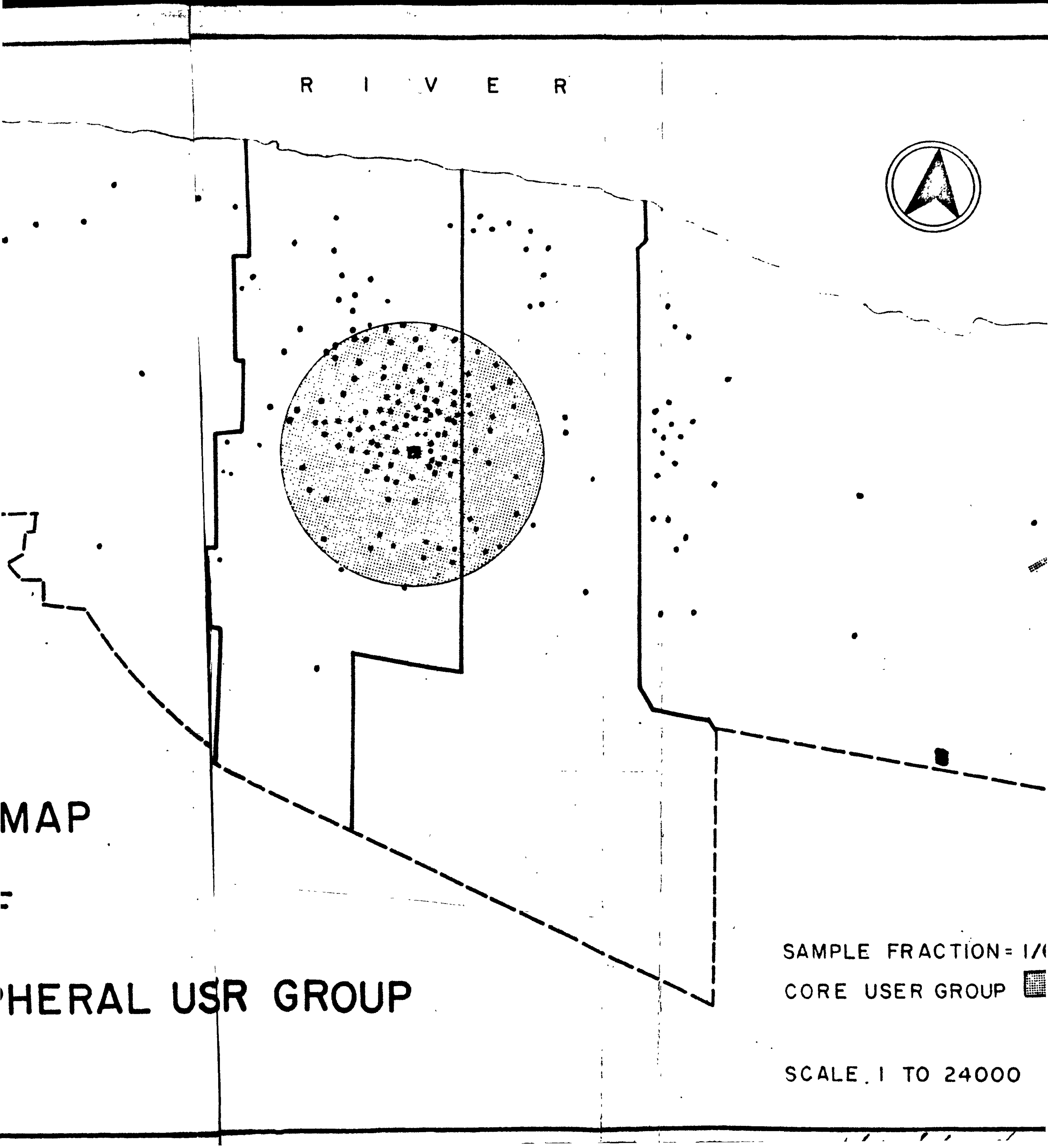
During the period of July 18-25 every sixth person was interviewed to determine where they lived, their age and how often they used the subject pool. The address of each user was plotted on a base map with a scale of 1 to 8000 and the distance was measured to give an accurate estimate of this variable. Straight-line distance was used because of the impossibility of establishing what the actual routes of the users might have been.

Upon plotting the location of each user it was interesting to note that approximately 57 per cent of the user group was within 2500 feet from the facility with the remainder coming from various areas of the city. This indicated the probable existence of the core and peripheral user group previously discussed and the necessity of following a "double universe" approach. The total number of interviews taken was 202 with a sample fraction of 1/6. The following dot map is a 2/3 reduction of the original base map.

2. Consideration of the Income Effect -

To take into account a potential income effect, the base map previously developed was placed over a municipal census tract map showing income by census districts for the year 1965. It was found that the greatest usage was enjoyed by the lower income groups. By referring to the accompanying map it can be seen that there were no users in the census district with the highest income and relatively few users in the districts of income 5,038 dollars and 5,169 dollars. However in the district with the lowest income of 3,790 dollars there was a large user group even


E T R O I T.
R I
DOT MAP
OF
CORE AND PERIPHERAL USR GROUF


R I V E R
MAP
HERAL USR GROUP
SAMPLE FRACTION = 1/
CORE USER GROUP
SCALE. 1 TO 24000

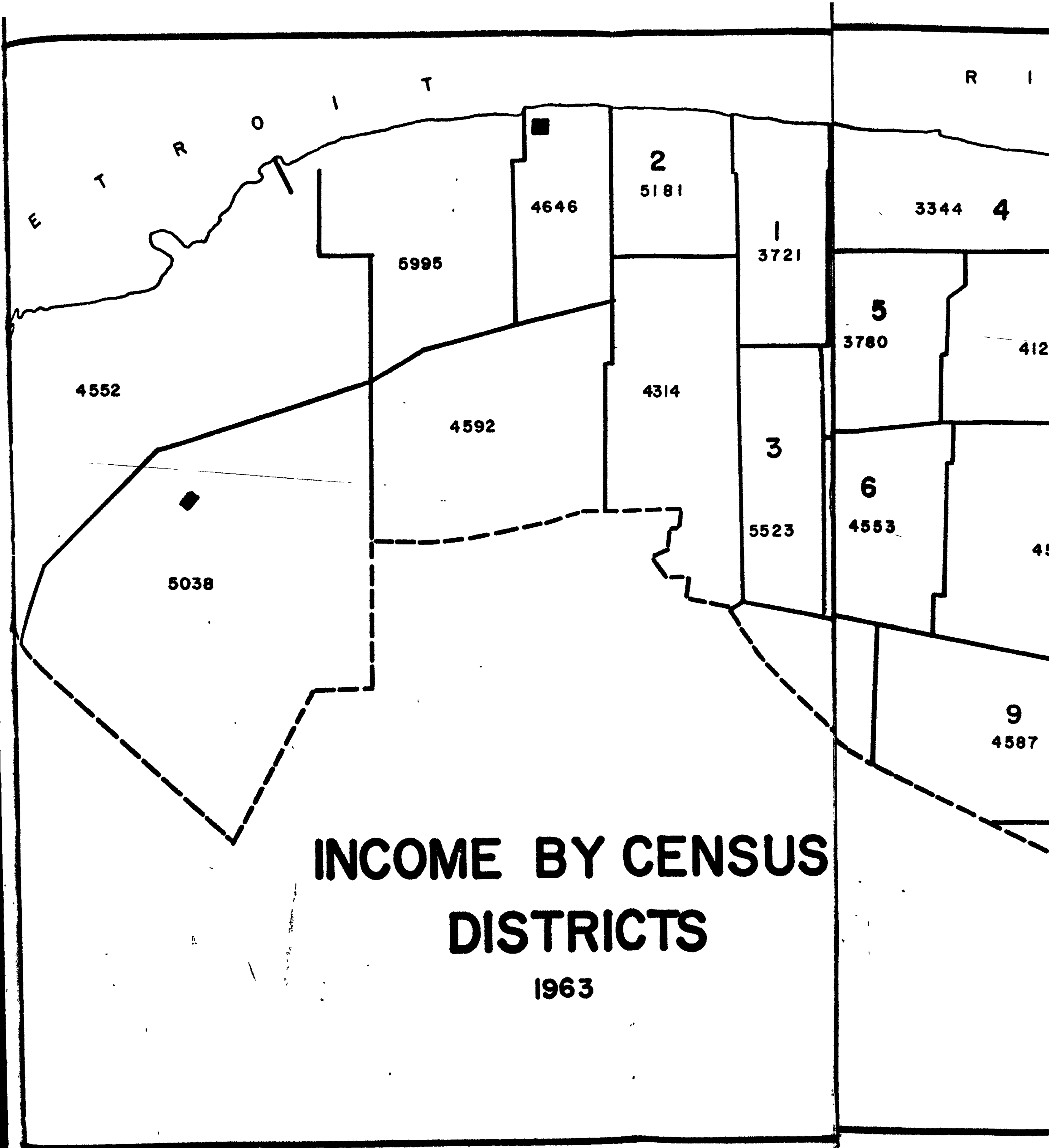
though they were a greater distance from the swimming pool than the higher income groups.

There is a problem in assuming an income effect in that individuals sampled could be low income individuals of average income groups within the census tract under analysis. However, it is quite possible that families with higher incomes have more alternatives for recreation and enjoy a greater variety particularly in the form of summer vacation trips. The effect of this variable will be estimated in the correlation analysis.

The data collected by the 202 interviews appeared to provide a meaningful base by which a statistical comparison could be made between the effect of distance, the effect of income and the effect of age on the frequency of patronage.

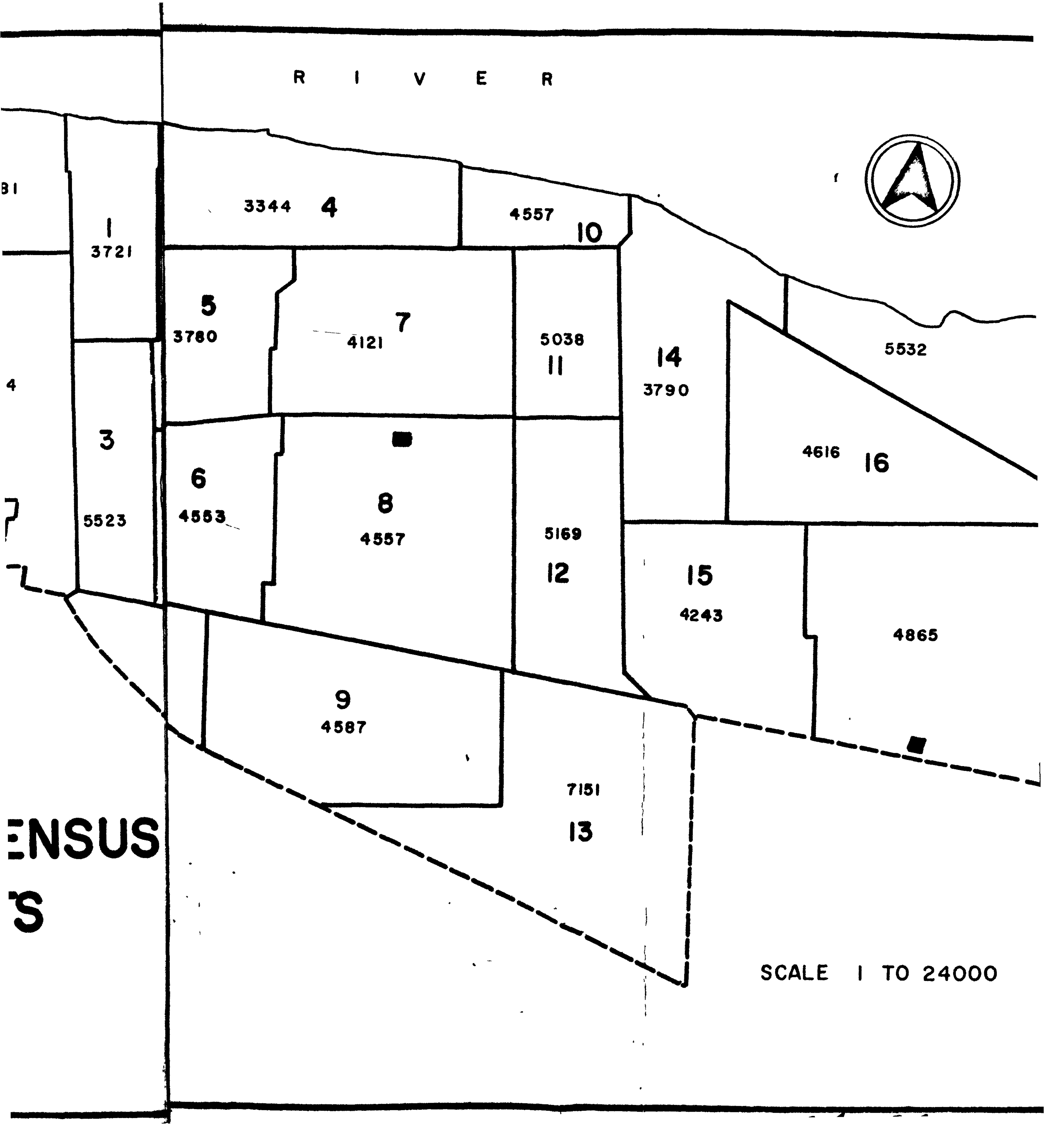
3. The Multiple Correlation Analysis —

With the variables selected the next necessary step was to determine whether the correct variables had been chosen and to estimate their degree of association. A trained recreation planner who is well aware



INCOME BY CENSUS DISTRICTS

1963



R I V E R
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of the recreation scene and knows that he has selected the relevant variables could quite possibly eliminate this stage of the analysis.

The 202 interviews and resulting tables were broken down into 16 categories corresponding to the sixteen census districts used in the income analysis. These 16 units were chosen because they were the only units that provided detailed income data which was necessary to complete the analysis. The following symbols were used:

X1 = frequency of patronage.

X2 = the average distance in feet that the population of the statistical unit in question had to travel to make use of the facility.

X3 = the average income in dollars.

X4 = the number of persons between the ages of 6 and 19 that make use of the swimming pool. (It was found from the sample that approximately 95% of the people that made use of this swimming pool were within this age group.)

Table 1 is the table developed from the raw data and upon close examination it can be seen that the frequency of patronage is largely dependent upon the distance factor. The income effect is not readily apparent but the number of people between the ages of 6 and 19 in each statistical unit does show a strong relationship.

THE DATA FOR CALCULATING THE SUMS

SQUARES AND PRODUCTS OF THE SIXTEEN

CENSUS DISTRICTS

TABLE 1

Unit	Frequency	Average Distance	Average Income	Numbers-Age
	X1	X2	X3	X4
1	3.	7600.	3721.	896.
2	4.	6100.	5181.	426.
3	2.	6800.	5523.	437.
4	11.	5500.	3344.	1007.
5	26.	4000.	3780.	1159.
6	7.	4000.	4533.	835.
7	69.	2000.	4121.	1534.
8	46.	2500.	4557.	1234.
9	1.	5200.	4587.	1146.
10	0.	5500.	4557.	294.
11	7.	3600.	5038.	695.
12	5.	4000.	5169.	620.
13	0.	8000.	7151.	938.
14	16.	5500.	3790.	757.
15	4.	7200.	4243.	893.
16	1.	9000.	4616.	981.
Total	202.	86500.	73911.	13852.
Mean	12.62	5406.25	4619.43	865.75

Table 2 provides the computations of the squares products and sums for measures of relationship between the frequency of patronage and the three independent variables for the sixteen census districts. The data was tabulated by a 1620 computer and the following results were recorded:

(a) Explained Variation	=	4323.3329
(b) Unexplained Variation	=	1226.4171
(c) Standard Error of Estimate	=	9.4419
(d) Coefficient of Determination	=	.7429
(e) Coefficient of Correlation	=	.8616

The distance factor accounted for approximately 52 per cent of the variation, the income effect accounted for approximately 5 per cent of the variation and the number of people within the specified age group accounted for 25 per cent of the variation. The remainder represents the unexplained variation.

The correlation coefficient was tested to see whether or not a chance occurrence of significant magnitude had occurred as a result of a poor sample size or errors made in the data analyzed. It was found that the percentage probability that the coefficient of .8616 could have occurred by chance was less than 0.1 per cent. Thus, the analysis and the variables chosen were highly significant.

To summarize:

1. Age - The greater the number of people between the ages of 6 and 19, the greater the frequency of patronage.

2. Distance - The closer the user is to the swimming pool the more frequently he is likely to use it.

TABLE II

	X1*X1	X1*X2	X1*X3	X1*X4	X2*X2	X2*X3	X2*X4	X3*X3	X3*X4	X4*X4
1	9.	22.800	11.163	2.688	57.760	28.2796	6.8096	13.8458	3.3340	.8028
2	16.	24.400	20.724	1.704	37.210	31.6041	2.5986	26.8427	2.2071	.1814
3	4.	13.600	11.046	.874	46.240	37.5564	2.9716	30.5035	2.4135	.1909
4	121.	60.500	36.784	11.077	30.250	18.3920	5.5385	11.1823	3.3674	1.0140
5	676.	104.000	98.280	30.134	16.000	15.1200	4.6360	14.2884	4.3810	1.3432
6	49.	28.000	31.731	5.845	16.000	18.1320	3.3400	20.5480	3.7850	.6972
7	4761.	138.000	284.349	105.846	4.000	8.2420	3.0680	16.9826	6.3216	2.3531
8	2116.	115.000	209.622	56.764	6.250	11.3925	3.0850	20.7662	5.6233	1.5227
9	1.	5.200	4.587	1.146	27.040	23.8524	5.9592	21.0405	5.2567	1.3133
10	0.	0.000	0.000	0.000	30.250	25.0635	1.6170	20.7662	1.3397	.0864
11	49.	25.200	35.266	4.865	12.960	18.1368	2.5020	25.3814	3.5014	.4830
12	25.	20.000	25.845	3.100	16.000	20.6760	2.4800	26.7185	3.2047	.3844
13	0.	0.000	0.000	0.000	64.000	57.2080	7.5040	51.1368	6.7076	.8798
14	256.	88.000	60.640	12.112	30.250	20.8450	4.1635	14.3641	2.8690	.5730
15	16.	28.800	16.972	3.572	51.840	30.5496	6.4296	18.0030	3.7889	.7974
16	1.	9.000	4.616	.981	81.000	41.5440	8.8290	21.3074	4.5282	.9623
Total	8100.	682.50	851.62	240.70	527.05	406.593	71.531	353.678	62.629	13.585

There is also a peripheral and core user group each of which is to be recognized by separate equations in the final model.

3. the income effect - The lower the income of a user, the greater is his tendency to use the facility.

In addition, it is accepted that the frequency of patronage should be directly proportional to the size of the facility and inversely proportional to the competition of similar facilities as assumed by the basic gravity model approach.[8]

Step 3:

Establishment of Functional Statistical Units

Divide the study area into small statistical units (a grid). The standard census districts used in the multiple correlation analysis were found to be too general and too large. The greater the number of statistical units in the grid, the more refined is the analysis. Consequently, 250 sub wards of the municipality were used. The income, numbers and ages of the population residing in each of the units was then recorded.

Step 4:

The Size, Competition and Distance Factors

Determine the size and location of all the competing swimming pools within the study area. There are three additional swimming pools other than Lanspeary. Atkinson pool is situated in the north-west part of the

8 Huff, D. L. A Probabalistic Analysis of Shopping Center Trade Areas, Land Economics, Vol. 39, 1963 pp. 87-89

city, Prince Road in the extreme west end, Herman in the south-east and Lanspeary in the center. The size of each pool was expressed in terms of square footage of swimming area. The distance of each statistical unit from each swimming pool was calculated in feet.

Step 5:

Establishing the Surface Demand-Potential Map for Swimming

The basic gravity model takes the form:[9]

$$P(cij) = \frac{\left(\frac{Sj}{Dij}\right)}{\sum_{j=1}^{n=1}\left(\frac{Sj}{Dj}\right)}$$

or:

> "the probability of a consumer at statistical unit i travelling to swimming pool j P(cij), is directly proportional to the size of swimming pool j (sj), inversely proportional to the distance of statistical unit i to swimming pool j (Dij), and inversely proportional to the competition".

The swimming pool under analysis in this case was Lanspeary (j). The number of pools was four. The model was applied to each of the 250 statistical units using a 1620 computer system and Fortran statements.

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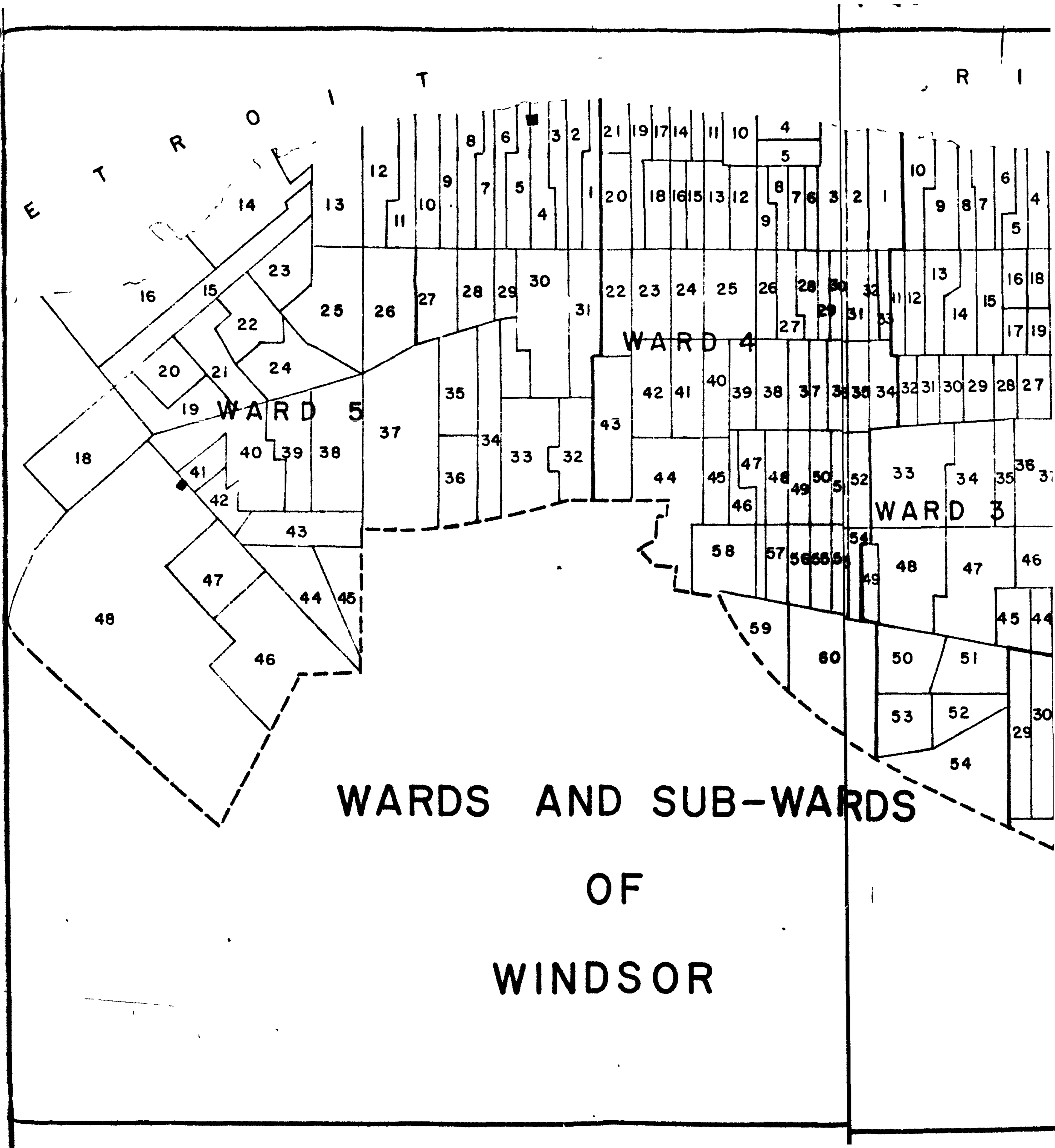
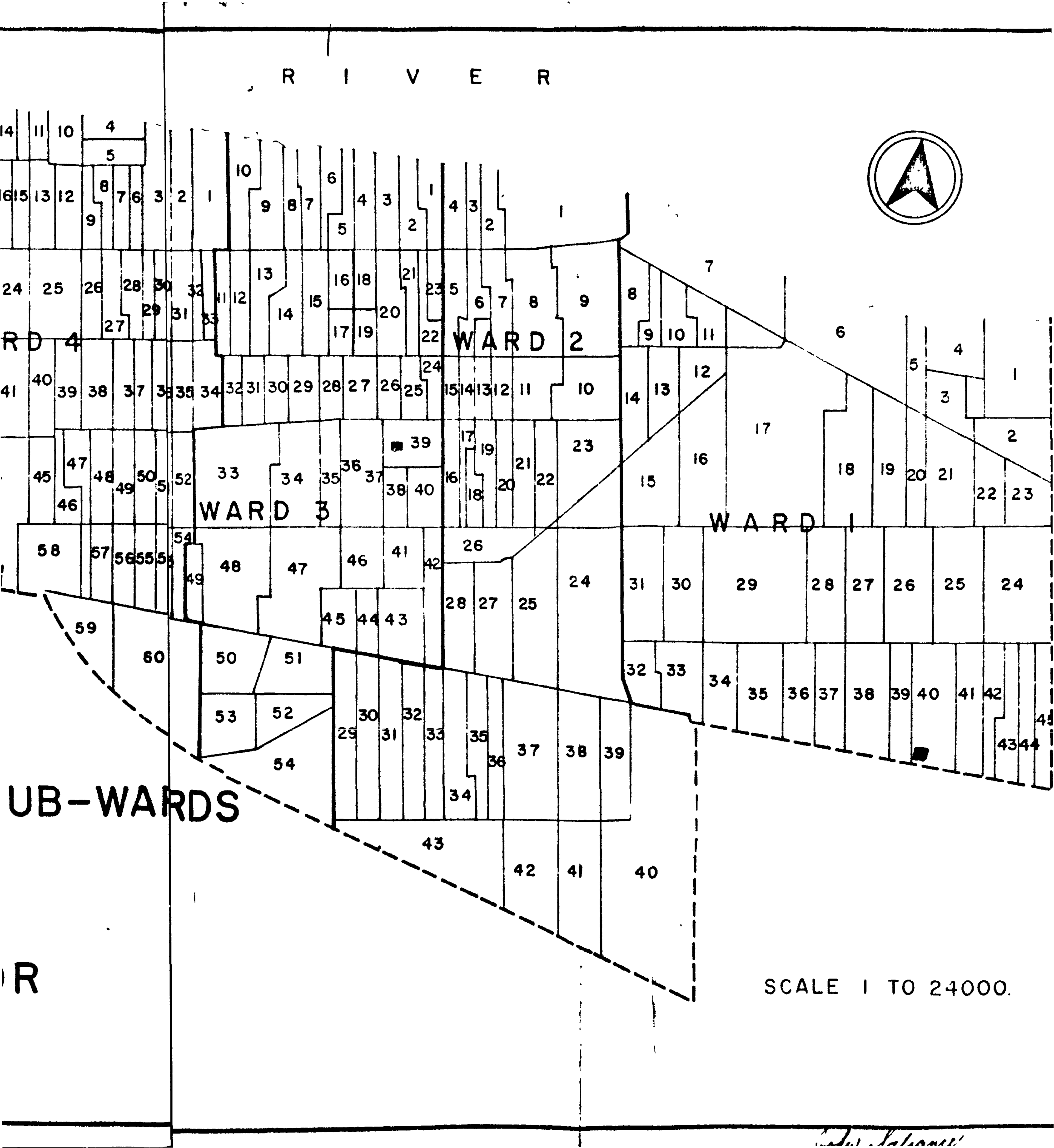
9 Ibid p.87



WARDS AND SUB-WARDS OF WINDSOR


R I V E R
RD 4
WARD 3
WARD 2
WARD 1
UB-WARDS
R
SCALE 1 TO 24000.

The appropriate values were then plotted in the center of each statistical unit and isolines of probability were drawn up to give a geographic representation of the surface demand potential as shown in the following map. It is interesting to note in the accompanying map that the isolines form irregulat patterns around the subject pool. The further away the isolines are from the center, the greater the spacing is to the next succeeding line. This can probably be accounted for by the distance factor. The isolines also appear to "sweep" away from the other swimming pools towards Lanspeary which is likely due to their own drawing power or the competition factor. The most important thing to note is that the 70 per cent probability line is very closely associated with the core user group established in the original sampling. Outside this core the probability values assume more extreme and irregular patterns. Finally, it is important to observe that there are no rigid boundary lines between market areas, a concept that many recreation planners have relied upon in the past.

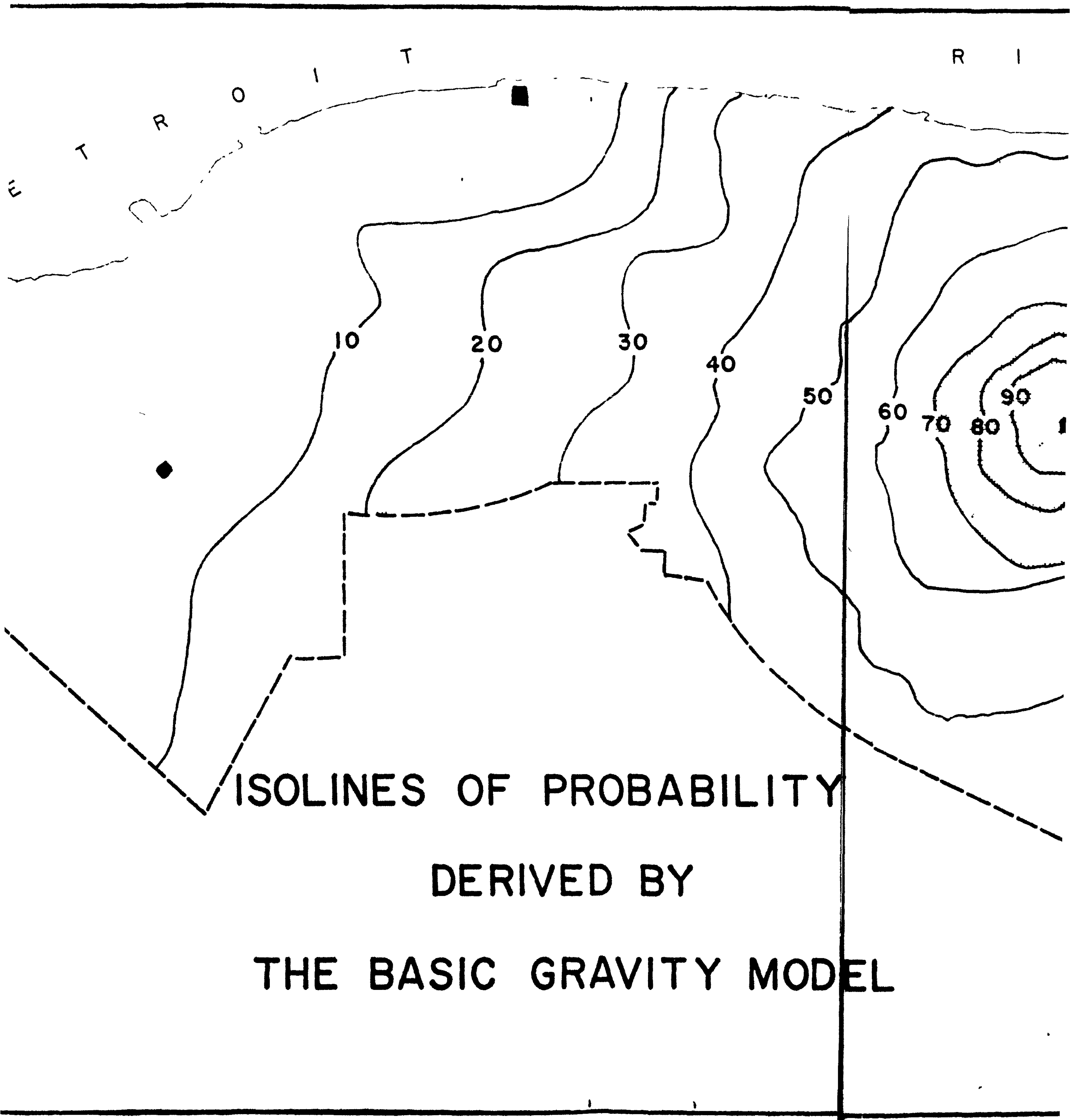
Step 6:

Accounting for Irregularities in the Pattern of Demand
by the Inclusion of Additional Variables

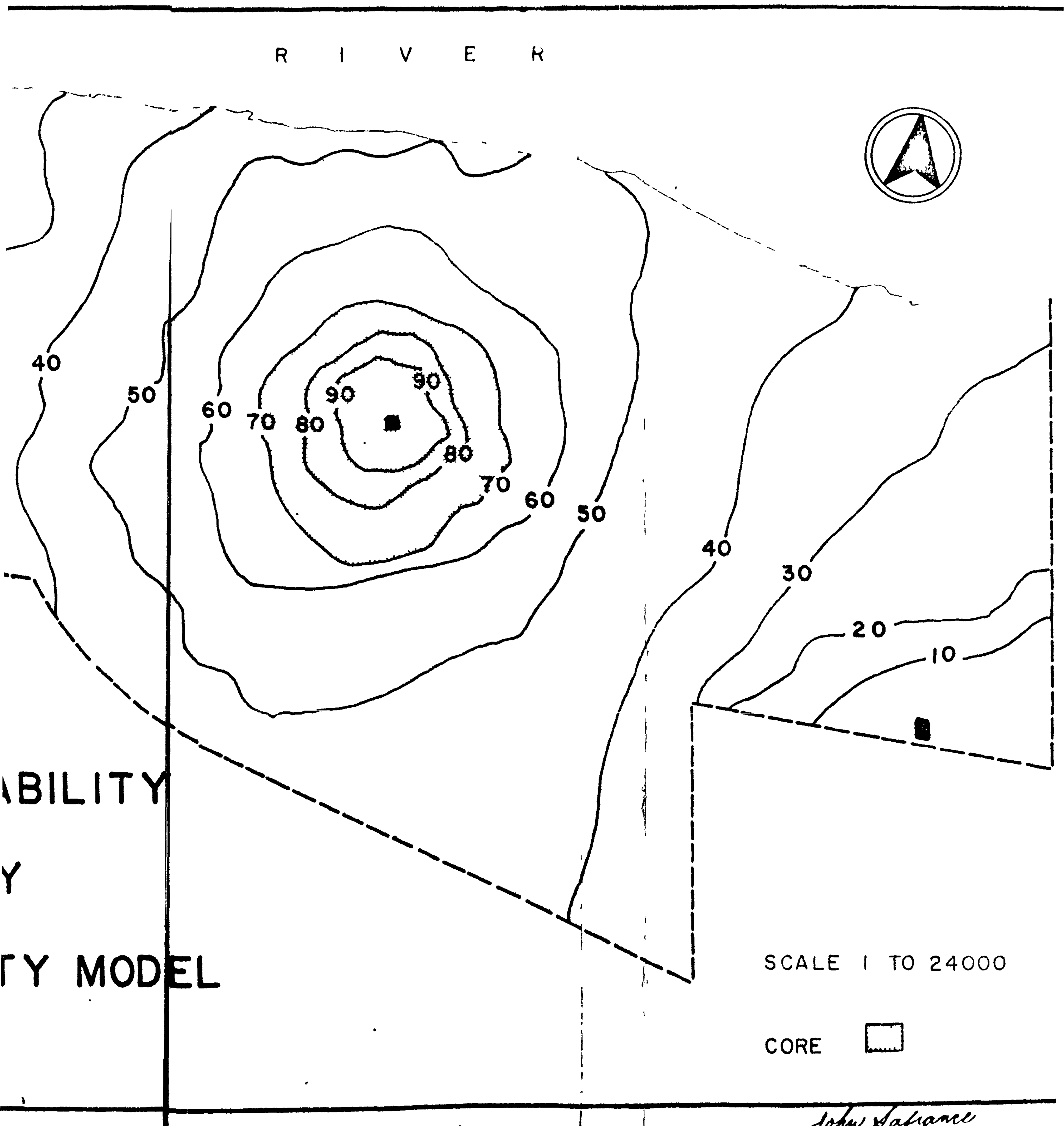
At this point in the analysis, the irregularities of the surface demand potential and any other variables that are relevant to the recreation problem must be accounted for.

1 The core user group -

With regard to the recreation situation under investigation, it had been established that there was an irregular pattern between the core user group and the outside user group. The core user group appeared to satisfy the conditions set forth in the basic equation as shown by



ISOLINES OF PROBABILITY
DERIVED BY
THE BASIC GRAVITY MODEL


RIVER
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ABILITY
Y
TY MODEL
SCALE 1 TO 24000
CORE

the previous demand potential map. To find the total attendance of this core group during an average week, multiply each probability value in each statistical unit by the number of people in the user group. The resultant value is then multiplied by the average weekly attendance of the core user group. To illustrate:

$$j = (P.S.Fn)$$

where:

j = the total attendance of swimming pool j inside 2500 feet.

P = the probability values obtained by the basic equation.

S = the total number of people between the ages of 6 and 19 in each statistical unit inside 2500 feet

Fn = the average weekly attendance inside 2500 feet

The model applied in this form estimated the core user group to be approximately 54% of the total user population which was quite close to the figure established in the original sample.

2 The Peripheral User Group -

The peripheral user group does not appear to satisfy the conditions set forth in the core user group and to use the same equation without introducing additional variables would be an unrealistic situation. The following additional variables were included:

1. The income effect -

The rate of patronage was observed to be inversely proportional to the income for the population outside 2500 feet. In other words, low income groups had a greater tendency to use the facility than high income groups. As a result, the final value for a statistical unit outside the core user group was multiplied by the average income of all the statistical units divided by the actual income of the statistical unit under investigation. This approach had the tendency to either increase or decrease the attendance. For example; if the average income of all the units was 4000 dollars, and the average income of the statistical unit under analysis was 3000 dollars, the final attendance figure would be increased by approximately 1/3.

$$\left(\frac{4000}{3000} \text{ X final no. of probable users}\right)$$

2 Establishing a K Value -

Some constant had to be developed to take into account the remaining variation. By trial and error, a constant was applied to the outside equation in the hopes that the final answer would be close to the desired result. The value for K that came closest to estimating the total peripheral attendance was 2.755. The outside equation thus took the form:

$$j = K(P.S.Fk.Inc)$$

where:

j = the total attendance outside 2500 feet at swimming pool j.

K = some constant to be estimated by trial and error.

P = the probability values obtained by the basic equation.

n = the total number of people be-
tween the ages of 6 and 19 in
each statistical unit outside
2500 feet.

Fk = the average weekly attendance
of the peripheral user group.

Inc = the income effect (average in-
come divided by the actual
income

Step 7:

Estimating the Total Average Weekly Attendance

After having accounted for irregularities in the surface demand potential by the consideration of additional variables, the next step was to estimate the total average weekly attendance. This was found by application of the behavioral model in its final form. In this instance, the total expected attendance is found by summing the core and peripheral user demand. The equation thus took the form:

$$j = (P.S.Fn) + K(P.S.Fk.Inc)$$

where:

j = the total expected attendance at
swimming pool j

For computer purposes, the equation takes the form:

$$(cij) = \left(\frac{\left(\frac{Si}{Dij}\right)}{\sum\limits_{j=21}^{n=4} \left(\frac{Si}{Dij}\right)} .S.Fn \right) + K \left(\frac{\left(\frac{Si}{Dij}\right)}{\sum\limits_{j=229}^{n=4} \left(\frac{Si}{Dij}\right)} .S.Fk.Inc \right) \quad 10$$

where:

(cij) = the total expected attendance for consumers of origin i travelling to swimming pool j.

The number of statistical units within the core user group was 21 and the number of units in the peripheral user group was 229. The computer model as it exists calculated a total average weekly attendance of 3,039 for Lanspeary pool while the actual average weekly attendance based on the past five years was 2,798. The model thus calculated the average weekly attendance with greater than 92 per cent accuracy or within 8 per cent of the actual attendance.

In an attempt to further establish the accuracy of the model's predictive capabilities, it was applied to Atkinson pool in the north-west part of the city using the same constant developed for Lanspeary. The attendance for Atkinson was estimated to be 2,288 while the actual attendance was an average of 2,473. Again this estimate was greater than ninety-two percent accurate and within 8 per cent of calculating the actual average weekly attendance.

It is possible the model could be even more accurate by incorporating additional relevant variables. However, the model should not

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10 Note: All the symbols used in this equation are as previously defined.

contain so many variables that it becomes unmanageable in terms of practical application. The model in its present form was able to estimate with a high degree of accuracy the attendance of Lanspeary and Atkinson pools in less than one minute using a 1620 computer. This perhaps attests to its reliability and efficiency as a planning instrument.

The model as it exists is capable of:

1 Estimating present and future demands for swimming by taking into account changes in the characteristics of the population. In this way future planning can be a meaningful concept.

2 The model can determine the proper location of a swimming pool in terms of the greatest user satisfaction. The best alternative for location is where the facility will receive the greatest attendance thus fulfilling the supply side of the problem.

3 It makes full use of the internal dependencies of the system whereby when one input changes, the other inputs also change in response to the original stimulus. The model is thus easily adapted to a variety of conditions that are susceptible to changes through time.

4 The model is simple, easily interpreted, accurate, and readily adaptable to a variety of recreation problems; particularly with regard to the location problem where supply and demand achieve reality.

5 The model is capable of determining the proper size a facility should be at a specific location. This is accomplished by having the size variable the only unknown in the equation.

To summarize, the analysis should proceed through the following stages:

1 Identification of the problem and selection of the necessary variables relevant to a solution by examination of the system and its interactions.

2 Testing the variables chosen using a multiple correlation analysis.

3 Division of the study area into a grid of functional statistical units.

4 Establishing the surface demand potential for each of the recreation facilities under investigation using the basic gravity model.

5 Accounting for the irregularities in the pattern of demand by the inclusion of additional variables.

6 Summing up total demand for the recreation facility under analysis and determining whether they are properly located, if more are needed, where they should be located and what trends are presently taking place so that accurate future planning might take place.

CHAPTER V

CONCLUSION

Although the model has been developed for the analysis of swimming pools in the city of Windsor, the basic inputs should be similar to conditions that might exist in other cities. These inputs can be tested by applying the model in its existing form and if the desired results do not vary by any great degree, the model is suitable for application. However, if the model does not function with the desired degree of accuracy it may be necessary to examine any other variables that might be relevant to the new study area. If no new variables are readily apparent, all that might have to be changed is the value for the constant. This adjustment might compensate for any slight changes in the variables that might have been necessary.

The Approach And Its Usefulness:

The emphasis of the analysis is on the populations that make use of the facility. This represents the demand side of the problem. Only through the analysis of this demand can the supply side of the problem be fulfilled. This is accomplished by locating the required facilities in those areas that will most adequately fulfill the demand. The demands of populations change through time and by analysis of the "system", these changes can be noted. Only when the inter relationships of all the variables are understood, is it possible to develop a model capable of demonstrating these inter relationships. It is hoped that the "system" developed in this paper has provided some insight into this aspect of recreation planning.

Although the usefulness and accuracy of the approach has been demonstrated by the analysis of only one particular type of recreation activity, it is hoped that this single demonstration represents an indication of its potential use as a reliable instrument for the analysis of a variety of recreation - location problems. It is likely that the basic gravity model approach is suitable to the regional as well as the urban or local environment. However, before attempting such an analysis it would be necessary to examine closely the different conditions that might exist. An interesting application might be the analysis of regional parks to determine if the variables in planning for this type of recreation facility exist under the same conditions as those for local swimming pools. It is likely that some changes would have to be made although the relationships of size, distance and competition would probably remain the same. Such a model might be developed to establish the best alternatives for the location of additional regional parks, how large they should be, what facilities should be included and what the expected attendance is likely to be.

The Implications of The "Double Universe" Approach:

The model in its basic form eliminates rigid boundary lines in terms of "market" areas and substitutes probability lines, radiating outward from the facility under examination. This approach gives a "best" estimate of the expected attendance — a concept presently being accepted as a realistic improvement over the methods employed by some marketing and location experts. I have altered this approach in my analysis such that there is a double universe concept — a concept that treats separately a "core", and a "peripheral" market area. Both groups are treated as "probable" markets for recreation facilities with special treatment of each universe to compensate for any differences that might exist between them. There is no definite boundary line between each universe although some decision must be made by the analyst to separate them. This decision is based upon a sample distribution of the populations that make use of the facility and in this way a realistic simulation of real world conditions can be established. It is hoped that this has been an important contribution to the understanding and treatment of market areas in location analysis in general.

The Quantitative Approach And The Geographer

It might be noted that the dangers involved in model building and the quantitative approach, lay in the possibility of over simplifying problems in order to keep the analysis in workable form. It is hoped that this has not been the case for the model I have developed. Even though quantitative analysis makes no pretense at accounting for some factors and does not include intangible and human values, it may offer more evidence than personal judgement in a decision making situation. When criteria and values are valid and when models are good predictors, decisions based on them are justified. On the other hand, when criteria and values are vague, and when quantitative aspects of the model can only account for a small portion of the problem, decisions must rely heavily upon judgement and experience.

Although no apologies are necessary for the approaches geographers have taken in the past, there appears to be an increasing reliance upon the use of quantitative analysis and models designed to aid the geographer in his research. This perhaps represents one of the most exciting developments within the field of Geography and shall continue to be welcomed by any geographer who understands these advances in the light they deserve. This is particularly true of the location geographer. However, it must be understood that such techniques still remain the servants and not the masters of the decision making process.

APPENDIX I

DATA

sj = the size of Lanspeary pool in square footage of swimming area.

Dij = distance of statistical unit i to swimming pool j (Lanspeary).

sk = size of Herman swimming pool in square footage of swimming area.

DIK = distance of statistical unit i to swimming pool K (Herman)

SL = size of Atkinson swimming pool in square footage of swimming.

DIL = distance of statistical unit i to swimming pool L (Atkinson)

SM = size of Prince Road swimming pool in square footage of swimming area.

DIM = distance of statistical unit i to swimming pool M

WARD 1

	SJ	DIJ	SK	DIK	SL	DIL	SM	DIM	AGE GROUP					INCOM
1	5000.	12000.	3900.	7000.	4968.	23000.	3500.	29000.	16	44	14	10	27	5532
2	5000.	12000.	3900.	5500.	4968.	23000.	3500.	29000.	24	48	9	10	36	5532
3	5000.	11000.	3900.	6500.	4968.	24000.	3500.	28500.	20	22	8	12	39	5532
4	5000.	11500.	3900.	7500.	4968.	22000.	3500.	29000.	28	37	6	4	31	5532
5	5000.	10000.	3900.	6500.	4968.	21000.	3500.	27500.	13	34	9	10	42	5532
6	5000.	8500.	3900.	8000.	4968.	19500.	3500.	26000.	7	25	9	7	34	5532
7	5000.	7200.	3900.	9500.	4968.	16000.	3500.	24000.	22	38	7	7	24	3790
8	5000.	5500.	3900.	9500.	4968.	15600.	3500.	23500.	9	22	2	7	16	3790
9	5000.	6000.	3900.	8700.	4968.	15800.	3500.	23700.	17	31	5	5	20	3790
10	5000.	6200.	3900.	8700.	4968.	15900.	3500.	24000.	14	36	3	4	20	3790
11	5000.	6500.	3900.	8600.	4968.	16000.	3500.	24100.	20	31	5	6	32	3790
12	5000.	6100.	3900.	7500.	4968.	16100.	3500.	24000.	18	21	6	6	22	3790
13	5000.	5600.	3900.	7500.	4968.	16000.	3500.	23600.	13	26	8	7	33	3790
14	5000.	5100.	3900.	7700.	4968.	16000.	3500.	23000.	10	24	4	3	21	3790
15	5000.	5500.	3900.	6700.	4968.	17000.	3500.	23000.	11	33	6	5	16	3790
16	5000.	6100.	3900.	6200.	4968.	17200.	3500.	24000.	11	24	9	7	20	3790
17	5000.	8000.	3900.	6200.	4968.	19000.	3500.	25000.	20	51	6	8	38	4616
18	5000.	8600.	3900.	5200.	4968.	20000.	3500.	26000.	24	40	12	11	39	4616
19	5000.	9200.	3900.	4800.	4968.	20400.	3500.	26200.	26	45	7	8	32	4616
20	5000.	9600.	3900.	4900.	4968.	20800.	3500.	27000.	21	53	13	21	65	4616
21	5000.	10400.	3900.	4500.	4968.	21500.	3500.	27500.	14	44	11	11	51	4616
22	5000.	11000.	3900.	4600.	4968.	22400.	3500.	28000.	16	54	12	16	69	4616
23	5000.	12200.	3900.	4500.	4968.	23600.	3500.	28500.	28	50	12	8	45	4616
24	5000.	12500.	3900.	3500.	4968.	24000.	3500.	28500.	53	100	18	33	100	4869
25	5000.	11500.	3900.	3000.	4968.	23800.	3500.	28000.	34	79	20	21	72	4869
26	3000.	10500.	3900.	2800.	4968.	23600.	3500.	27500.	23	61	19	16	65	4869
27	5000.	9600.	3900.	3000.	4968.	22500.	3500.	26500.	23	45	12	11	28	4869
28	5000.	8900.	3900.	3400.	4968.	21500.	3500.	25500.	26	60	18	18	57	4869
29	5000.	7000.	3900.	4700.	4968.	20000.	3500.	24000.	17	31	6	6	26	4242
30	5000.	6200.	3900.	5300.	4968.	18500.	3500.	22800.	10	20	1	2	18	4242
31	5000.	5600.	3900.	5700.	4968.	18000.	3500.	22400.	10	28	6	5	26	4242
32	5000.	6600.	3900.	5400.	4968.	19000.	3500.	22400.	18	34	6	9	26	4242
33	5000.	7100.	3900.	4600.	4968.	19800.	3500.	22600.	13	26	2	4	22	4242
34	5000.	7600.	3900.	4000.	4968.	20200.	3500.	23000.	28	47	9	11	44	4242
35	5000.	8200.	3900.	3300.	4968.	21000.	3500.	23700.	17	20	7	6	33	4242
36	5000.	9200.	3900.	2200.	4968.	22000.	3500.	24200.	37	97	24	30	92	4242
37	5000.	9600.	3900.	1900.	4968.	22200.	3500.	24200.	42	90	20	20	75	4869
38	5000.	10100.	3900.	1400.	4968.	22600.	3500.	25500.	24	43	7	10	49	4869
39	5000.	10600.	3900.	1000.	4968.	23000.	3500.	25700.	22	52	13	24	61	4869
40	5000.	11100.	3900.	1000.	4968.	23800.	3500.	25800.	13	25	2	6	17	4869
41	5000.	11500.	3900.	1100.	4968.	24000.	3500.	27000.	18	64	18	20	58	4869
42	5000.	11900.	3900.	1200.	4968.	24500.	3500.	27200.	34	88	25	22	84	4869
43	5000.	12500.	3900.	1000.	4968.	25000.	3500.	27800.	28	68	20	23	66	4869
44	5000.	12600.	3900.	1500.	4968.	25200.	3500.	28000.	21	47	14	10	40	4869
45	5000.	13000.	3900.	2000.	4968.	26000.	3500.	28500.	33	63	18	26	56	4869

WARD 2

	SJ	DIJ	SK	DIK	SL	DIL	SM	DIM	AGE GROUP					INCO
1	5000.	5500.	3900.	12000.	4968.	14500.	3500.	21000.	10	22	8	9	25	455
2	5000.	5000.	3900.	13000.	4968.	13000.	3500.	19500.	11	19	8	6	17	455
3	5000.	4600.	3900.	13200.	4968.	12800.	3500.	19200.	17	20	6	7	27	455
4	5000.	3500.	3900.	14000.	4968.	12200.	3500.	19000.	19	27	10	2	24	455
5	5000.	3700.	3900.	13000.	4968.	12000.	3500.	19000.	19	26	5	9	22	455
6	5000.	3800.	3900.	12000.	4968.	13000.	3500.	19200.	18	35	6	5	30	455
7	5000.	4000.	3900.	11900.	4968.	13200.	3500.	19400.	11	37	11	12	18	503
8	5000.	4500.	3900.	11000.	4968.	13800.	3500.	20000.	20	43	13	9	31	503
9	5000.	5100.	3900.	10500.	4968.	14200.	3500.	21000.	18	31	7	2	27	503
10	5000.	4500.	3900.	9200.	4968.	15500.	3500.	21000.	15	19	5	7	27	503
11	5000.	3000.	3900.	9500.	4968.	14500.	3500.	20000.	24	60	14	13	48	503
12	5000.	2600.	3900.	10500.	4968.	13500.	3500.	19000.	18	34	4	8	31	503
13	5000.	2600.	3900.	10600.	4968.	13000.	3500.	18800.	15	42	3	12	26	503
14	5000.	2000.	3900.	11000.	4968.	13000.	3500.	18600.	19	35	5	6	28	412
15	5000.	1600.	3900.	10000.	4968.	12800.	3500.	18400.	15	24	6	7	35	412
16	5000.	1000.	3900.	10000.	4968.	14000.	3500.	18100.	8	20	6	1	16	455
17	5000.	1200.	3900.	9800.	4968.	14400.	3500.	18200.	9	24	7	6	16	455
18	5000.	2000.	3900.	9600.	4968.	14600.	3500.	18200.	8	12	1	2	12	455
19	5000.	2600.	3900.	9600.	4968.	14800.	3500.	18400.	12	22	6	4	20	516
20	5000.	2600.	3900.	9500.	4968.	15400.	3500.	18600.	9	26	10	5	19	516
21	5000.	2800.	3900.	9000.	4968.	16200.	3500.	18900.	20	43	8	14	34	516
22	5000.	3200.	3900.	8200.	4968.	17000.	3500.	20300.	21	35	6	20	36	516
23	5000.	4000.	3900.	8000.	4968.	17000.	3500.	21000.	18	35	7	6	21	516
24	5000.	5200.	3900.	6600.	4968.	17800.	3500.	20400.	17	25	10	5	41	516
25	5000.	4200.	3900.	8000.	4968.	17000.	3500.	19200.	9	33	9	6	19	516
26	5000.	2600.	3900.	9200.	4968.	15400.	3500.	19000.	35	51	10	10	37	516
27	5000.	4200.	3900.	8500.	4968.	16600.	3500.	18800.	7	16	4	2	22	455
28	5000.	4000.	3900.	9000.	4968.	16200.	3500.	18400.	5	23	5	0	26	455
29	5000.	5500.	3900.	11000.	4968.	15500.	3500.	16500.	20	45	8	9	45	458
30	5000.	5500.	3900.	10800.	4968.	15700.	3500.	17000.	13	39	8	9	38	458
31	5000.	5500.	3900.	10600.	4968.	16000.	3500.	17400.	15	40	3	16	47	458
32	5000.	5500.	3900.	10000.	4968.	16300.	3500.	17600.	18	52	5	14	26	458
33	5000.	5700.	3900.	9400.	4968.	17000.	3500.	17800.	21	34	22	7	31	458
34	5000.	6400.	3900.	8600.	4968.	17200.	3500.	18000.	4	33	11	11	29	458
35	5000.	6000.	3900.	8200.	4968.	17400.	3500.	18600.	17	28	7	5	30	458
36	5000.	6200.	3900.	8000.	4968.	18000.	3500.	21000.	12	24	7	4	22	715
37	5000.	6400.	3900.	7400.	4968.	18200.	3500.	21000.	12	31	4	8	31	715
38	5000.	6800.	3900.	6800.	4968.	19000.	3500.	21400.	11	37	11	7	56	715
39	5000.	7000.	3900.	6200.	4968.	19000.	3500.	21800.	8	27	6	7	24	715
40	0.	0.	0.	0.	0.	0.	0.	0.	0	0	0	0	0	[illegible]
41	5000.	8600.	3900.	7500.	4968.	20000.	3500.	21800.	31	55	15	17	54	715
42	5000.	8200.	3900.	8000.	4968.	19800.	3500.	20500.	26	51	9	8	47	715
43	5000.	8200.	3900.	8600.	4968.	19000.	3500.	19000.	21	40	11	10	32	715

WARD 3

	SJ	DIJ	SK	DIK	SL	DIL	SM	DIM	AGE GROUP					INCOM
1	5000.	5000.	3900.	14000.	4968.	12000.	3500.	18500.	24	27	10	13	27	3348
2	5000.	4500.	3900.	14200.	4968.	11800.	3500.	18200.	13	34	7	7	33	3349
3	5000.	4800.	3900.	14200.	4968.	11500.	3500.	18100.	18	27	11	7	33	3349
4	5000.	4500.	3900.	14400.	4968.	10500.	3500.	17800.	21	28	6	7	27	3349
5	5000.	4500.	3900.	14800.	4968.	10500.	3500.	17200.	21	41	8	11	38	3349
6	5000.	5200.	3900.	15500.	4968.	10200.	3500.	17100.	25	29	6	4	10	3349
7	5000.	5500.	3900.	16200.	4968.	9400.	3500.	16800.	17	21	5	4	15	3349
8	5000.	5000.	3900.	16000.	4968.	9200.	3500.	16200.	18	27	7	6	18	3349
9	5000.	5000.	3900.	16400.	4968.	9200.	3500.	16000.	13	17	2	7	21	3349
0	5000.	5500.	3900.	16600.	4968.	8800.	3500.	15800.	6	12	4	2	13	3349
1	5000.	4200.	3900.	16000.	4968.	8800.	3500.	14400.	19	38	8	12	39	3780
2	5000.	3800.	3900.	15600.	4968.	9000.	3500.	14600.	16	32	7	6	20	3780
3	5000.	3600.	3900.	15800.	4968.	9600.	3500.	15000.	22	40	3	12	37	3780
4	5000.	3200.	3900.	14800.	4968.	10200.	3500.	15200.	15	43	6	5	35	3780
5	5000.	2800.	3900.	14000.	4968.	10000.	3500.	15600.	13	35	11	4	39	4121
6	5000.	3200.	3900.	14200.	4968.	10800.	3500.	16200.	18	33	4	5	23	4121
7	5000.	3200.	3900.	14000.	4968.	11200.	3500.	16200.	19	35	5	8	22	4121
8	5000.	3200.	3900.	14000.	4968.	11200.	3500.	16600.	11	24	8	3	14	4121
9	5000.	2600.	3900.	13500.	4968.	11500.	3500.	16600.	25	17	6	7	21	4121
0	5000.	2600.	3900.	13200.	4968.	12400.	3500.	16800.	22	33	9	4	34	4121
1	5000.	2700.	3900.	12500.	4968.	12400.	3500.	17000.	17	32	6	8	27	4121
2	5000.	3000.	3900.	12000.	4968.	14000.	3500.	17200.	19	31	5	6	20	4121
3	5000.	3400.	3900.	13000.	4968.	13000.	3500.	17400.	16	32	15	10	30	4121
4	5000.	1000.	3900.	11000.	4968.	15000.	3500.	18000.	9	21	3	2	17	4121
5	5000.	400.	3900.	11800.	4968.	13000.	3500.	17800.	18	40	6	5	37	4121
6	5000.	200.	3900.	12000.	4968.	12000.	3500.	17400.	24	20	2	4	21	4121
7	5000.	200.	3900.	12400.	4968.	12000.	3500.	17000.	14	24	6	10	24	4121
8	5000.	1000.	3900.	13000.	4968.	11500.	3500.	16000.	25	28	6	5	37	4121
9	5000.	1400.	3900.	13500.	4968.	11200.	3500.	15500.	11	20	6	7	23	4121
0	5000.	2000.	3900.	14000.	4968.	11000.	3500.	15200.	9	26	3	3	22	3780
1	5000.	2600.	3900.	14200.	4968.	10500.	3500.	15000.	12	19	5	4	30	3780
2	5000.	2800.	3900.	14500.	4968.	10500.	3500.	14200.	31	52	9	12	32	3780
3	5000.	2700.	3900.	14000.	4968.	11000.	3500.	14000.	13	31	8	5	31	3780
4	5000.	1500.	3900.	12500.	4968.	12500.	3500.	15500.	26	41	5	14	43	4557
5	5000.	1000.	3900.	12600.	4968.	12600.	3500.	15700.	12	18	5	5	20	4557
6	5000.	600.	3900.	13000.	4968.	13000.	3500.	15800.	6	24	5	5	24	4557
7	5000.	200.	3900.	13200.	4968.	13200.	3500.	16200.	9	21	2	4	13	4557
8	5000.	200.	3900.	13000.	4968.	13400.	3500.	17000.	6	19	3	2	16	4557
9	5000.	200.	3900.	13000.	4968.	13500.	3500.	17000.	8	21	3	3	22	4557
0	5000.	400.	3900.	12900.	4968.	13100.	3500.	17100.	17	40	8	8	21	4557
1	5000.	1500.	3900.	10600.	4968.	14000.	3500.	17000.	15	27	5	8	14	4557
2	5000.	3400.	3900.	9200.	4968.	15500.	3500.	16200.	15	21	6	6	22	4557
3	5000.	3200.	3900.	10200.	4968.	15200.	3500.	17200.	13	27	7	7	33	4557
4	5000.	3500.	3900.	10800.	4968.	14500.	3500.	17200.	11	22	2	4	19	4557
5	5000.	3500.	3900.	11500.	4968.	14000.	3500.	17000.	16	20	5	6	33	4557
6	5000.	2700.	3900.	11600.	4968.	13500.	3500.	16500.	14	29	3	10	15	4557
7	5000.	3000.	3900.	12100.	4968.	13000.	3500.	16800.	16	27	8	9	23	4533
8	5000.	3600.	3900.	13000.	4968.	12500.	3500.	15800.	14	24	6	3	22	4533
9	5000.	4500.	3900.	14000.	4968.	11500.	3500.	14600.	6	20	4	7	36	4533
0	5000.	5000.	3900.	13000.	4968.	13800.	3500.	14500.	19	28	12	11	28	4587
1	5000.	4800.	3900.	12000.	4968.	14500.	3500.	14900.	19	20	8	2	20	4587
2	5000.	5400.	3900.	12000.	4968.	14800.	3500.	14900.	17	18	4	4	21	4587
3	5000.	6000.	3900.	13000.	4968.	14500.	3500.	14200.	10	23	5	9	32	4587
4	5000.	6500.	3900.	11800.	4968.	15500.	3500.	15000.	19	27	9	4	30	4587

WARD 4

	SJ	DIJ	SK	DIK	SL	DIL	SM	DIM	AGE GROUP					INCO
1	5000.	5700.	3900.	17000.	4968.	8000.	3500.	15000.	40	71	9	8	42	334
2	5000.	6200.	3900.	17200.	4968.	7800.	3500.	14800.	1	4	1	1	3	334
3	5000.	6400.	3900.	17800.	4968.	7400.	3500.	14200.	2	2	0	2	2	334'
4	5000.	7800.	3900.	18900.	4968.	6500.	3500.	14000.	0	2	1	0	2	373
5	5000.	7200.	3900.	18800.	4968.	6500.	3500.	14000.	0	0	0	0	0	373
6	5000.	6500.	3900.	18400.	4968.	6800.	3500.	14000.	3	5	1	1	16	373
7	5000.	7000.	3900.	18600.	4968.	6200.	3500.	13800.	10	13	2	3	10	373
8	5000.	7200.	3900.	18600.	4968.	6000.	3500.	13400.	8	11	4	3	7	373
9	5000.	5800.	3900.	18800.	4968.	7500.	3500.	13000.	11	26	4	7	13	373
0	5000.	8200.	3900.	19000.	4968.	5500.	3500.	13200.	9	15	3	2	7	373
1	5000.	9000.	3900.	20000.	4968.	4600.	3500.	12000.	10	22	5	2	26	426
2	5000.	7600.	3900.	18500.	4968.	5400.	3500.	11200.	13	17	5	12	40	372
3	5000.	8400.	3900.	18500.	4968.	4600.	3500.	11500.	19	37	12	11	39	426
4	5000.	9500.	3900.	20000.	4968.	3800.	3500.	11500.	11	33	3	8	32	426.
5	5000.	9400.	3900.	19200.	4968.	3600.	3500.	10800.	24	40	6	6	46	426.
6	5000.	9500.	3900.	19400.	4968.	3500.	3500.	10500.	12	18	3	0	21	426:
7	5000.	10400.	3900.	21000.	4968.	2000.	3500.	11000.	8	17	3	3	8	426:
8	5000.	9800.	3900.	21200.	4968.	2400.	3500.	10000.	7	29	3	8	31	426:
9	5000.	11000.	3900.	22200.	4968.	1400.	3500.	10800.	15	23	7	4	19	426:
0	5000.	10400.	3900.	21400.	4968.	2000.	3500.	9500.	8	19	2	3	15	426:
1	5000.	11000.	3900.	23000.	4968.	1000.	3500.	10500.	13	31	5	6	24	464(
2	5000.	9000.	3900.	20500.	4968.	4500.	3500.	8500.	15	37	11	10	39	4314
3	5000.	5200.	3900.	20200.	4968.	4500.	3500.	9000.	14	38	12	11	29	4314
4	5000.	8000.	3900.	20000.	4968.	5200.	3500.	9500.	16	14	4	4	11	4314
5	5000.	7000.	3900.	19000.	4968.	6000.	3500.	10500.	15	26	6	11	24	4314
6	3000.	6600.	3900.	18500.	4968.	6400.	3500.	11200.	14	30	8	5	18	4314
7	5000.	6400.	3900.	18000.	4968.	6600.	3500.	11500.	19	37	5	3	31	3721
8	5000.	6000.	3900.	18000.	4968.	7000.	3500.	11600.	18	26	5	5	22	3721
9	5000.	5800.	3900.	17600.	4968.	7400.	3500.	12000.	29	31	9	6	29	3721
0	5000.	5800.	3900.	17200.	4968.	7500.	3500.	12500.	4	9	2	2	3	3721
1	5000.	5200.	3900.	17000.	4968.	7800.	3500.	13000.	1	12	2	0	7	3721
2	5000.	4800.	3900.	16800.	4968.	8200.	3500.	13200.	6	11	5	3	20	3780
3	5000.	4400.	3900.	16200.	4968.	8600.	3500.	14000.	5	6	1	4	6	3780
4	5000.	3500.	3900.	15400.	4968.	9800.	3500.	13500.	14	33	5	20	26	3780
5	5000.	4000.	3900.	15600.	4968.	9200.	3500.	13400.	13	29	4	5	89	3780
6	5000.	4800.	3900.	15800.	4968.	8600.	3500.	12500.	4	17	3	6	22	5182
7	5000.	5000.	3900.	16200.	4968.	8400.	3500.	12000.	12	30	6	11	22	5182
8	5000.	5500.	3900.	16500.	4968.	8000.	3500.	11500.	10	14	4	2	18	5182
9	5000.	5800.	3900.	17000.	4968.	7800.	3500.	11000.	4	31	7	6	34	5182
0	5000.	6500.	3900.	18000.	4968.	7400.	3500.	10400.	11	29	3	6	26	5182
1	5000.	7500.	3900.	19000.	4968.	6600.	3500.	9400.	11	24	9	3	22	4314
2	5000.	8400.	3900.	19400.	4968.	6700.	3500.	8600.	17	46	10	13	33	4314
3	5000.	7000.	3900.	20000.	4968.	6600.	3500.	7800.	28	36	8	8	39	4314
4	5000.	7800.	3900.	19000.	4968.	7800.	3500.	8800.	35	49	9	13	50	4314
5	5000.	6500.	3900.	17600.	4968.	8800.	3500.	10200.	14	19	6	3	28	4314
6	5000.	5400.	3900.	14500.	4968.	9600.	3500.	11000.	18	33	6	13	32	5523
7	5000.	5500.	3900.	14600.	4968.	8600.	3500.	11200.	14	36	12	3	46	5182
8	5000.	4800.	3900.	14800.	4968.	9600.	3500.	12000.	28	30	7	7	15	5182
9	5000.	4500.	3900.	14600.	4968.	10000.	3500.	12500.	3	5	5	1	8	5182
0	5000.	4400.	3900.	14400.	4968.	9600.	3500.	12900.	0	2	1	1	8	5182
1	5000.	4200.	3900.	14200.	4968.	9800.	3500.	13100.	9	9	3	6	24	4533
2	5000.	3800.	3900.	14000.	4968.	10000.	3500.	13500.	6	29	6	6	23	4533
3	5000.	4600.	3900.	14500.	4968.	11800.	3500.	14000.	9	25	3	4	19	4533
4	5000.	4800.	3900.	14600.	4968.	11500.	3500.	13000.	3	5	3	5	10	4533
5	5000.	5000.	3900.	15000.	4968.	11200.	3500.	12700.	6	13	1	3	12	5523
6	5000.	5600.	3900.	15600.	4968.	11000.	3500.	12000.	22	48	13	11	40	5523
7	5000.	6200.	3900.	16200.	4968.	10500.	3500.	11200.	11	37	6	6	32	5523
8	5000.	6800.	3900.	17000.	4968.	10000.	3500.	10400.	15	24	2	7	21	5523
9	5000.	6600.	3900.	16000.	4968.	11500.	3500.	11500.	18	31	3	4	34	5523
0	5000.	6400.	3900.	15000.	4968.	12500.	3500.	12500.	13	38	4	5	37	5523

WARD 5

	SJ	DIJ	SK	DIK	SL	DIL	SM	DIM	AGE GROUP					INCOM
1	5000.	10600.	3900.	20500.	4968.	400.	3500.	9000.	15	36	6	2	32	4646
2	5000.	11200.	3900.	21500.	4968.	1000.	3500.	9800.	25	28	5	8	19	4646
3	5000.	11500.	3900.	21700.	4968.	500.	3500.	8400.	17	25	5	7	28	4646
4	5000.	11200.	3900.	22200.	4968.	400.	3500.	8500.	25	37	8	11	35	4646
5	5000.	11400.	3900.	22500.	4968.	400.	3500.	8100.	27	38	4	8	39	4646
6	5000.	11600.	3900.	22700.	4968.	400.	3500.	8000.	13	27	9	6	28	4640
7	5000.	12000.	3900.	24000.	4968.	1000.	3500.	8000.	19	47	12	11	32	4646
8	5000.	12200.	3900.	23000.	4968.	1500.	3500.	7500.	9	25	8	5	15	4640
9	5000.	12500.	3900.	24000.	4968.	1500.	3500.	7800.	14	39	6	7	32	5995
10	5000.	13000.	3900.	24200.	4968.	1600.	3500.	7600.	10	22	10	0	22	5995
11	5000.	13500.	3900.	24800.	4968.	1600.	3500.	7500.	26	42	3	12	45	5995
12	5000.	14000.	3900.	25500.	4968.	2200.	3500.	7000.	18	24	10	10	23	5995
13	5000.	15000.	3900.	26500.	4968.	3500.	3500.	6200.	25	38	6	7	40	5995
14	5000.	16500.	3900.	28000.	4968.	5000.	3500.	5500.	25	38	8	3	29	4532
15	5000.	17600.	3900.	28200.	4968.	6400.	3500.	4000.	20	37	9	12	34	4532
16	5000.	18000.	3900.	29500.	4968.	7200.	3500.	14500.	23	40	4	5	32	4532
17	5000.	26500.	3900.	32000.	4968.	9000.	3500.	14600.	11	23	6	7	13	4532
18	5000.	18500.	3900.	27500.	4968.	9500.	3500.	2400.	23	33	10	5	33	4532
19	5000.	17500.	3900.	26500.	4968.	8000.	3500.	2500.	21	47	10	15	36	4532
20	3000.	17800.	3900.	26500.	4968.	7200.	3500.	3000.	15	24	5	9	26	4532
21	5000.	17200.	3900.	27500.	4968.	6200.	3500.	3500.	33	67	11	25	59	4532
22	5000.	16000.	3900.	28000.	4968.	5500.	3500.	4200.	26	52	13	12	42	4532
23	5000.	15200.	3900.	28500.	4968.	4500.	3500.	5000.	10	26	4	5	24	453
24	5000.	15000.	3900.	27500.	4968.	5500.	3500.	3800.	10	24	5	5	27	453
25	5000.	14400.	3900.	26500.	4968.	4200.	3500.	4800.	25	34	11	5	37	453
26	5000.	13500.	3900.	24500.	4968.	3800.	3500.	5600.	17	34	4	6	33	599
27	5000.	12200.	3900.	23800.	4968.	3500.	3500.	6200.	13	37	6	12	34	599
28	5000.	11500.	3900.	22800.	4968.	3400.	3500.	7000.	19	18	8	7	23	464
29	5000.	10800.	3900.	22000.	4968.	4800.	3500.	6500.	56	29	8	7	40	459
30	5000.	10500.	3900.	21000.	4968.	4000.	3500.	7400.	16	34	3	7	45	459
31	5000.	10000.	3900.	21000.	4968.	4200.	3500.	7600.	26	31	7	12	31	459
32	5000.	9800.	3900.	21100.	4968.	6200.	3500.	7000.	21	36	5	12	26	459
33	5000.	10600.	3900.	21300.	4968.	7200.	3500.	6200.	27	50	18	16	46	459
34	5000.	11000.	3900.	21600.	4968.	6000.	3500.	5800.	20	45	18	19	67	459
35	5000.	11800.	3900.	22000.	4968.	5000.	3500.	5400.	74	132	20	18	46	459
36	5000.	11600.	3900.	21800.	4968.	7000.	3500.	5000.	82	127	43	20	83	459
37	5000.	13200.	3900.	23000.	4968.	6500.	3500.	3800.	17	49	14	15	220	459
38	5000.	14000.	3900.	24500.	4968.	7000.	3500.	2800.	32	78	18	19	77	503
39	5000.	14800.	3900.	24800.	4968.	6800.	3500.	2500.	18	33	11	9	35	503
40	5000.	16200.	3900.	26000.	4968.	7800.	3500.	1800.	107	137	46	28	82	503
41	5000.	16400.	3900.	26000.	4968.	8500.	3500.	800.	22	44	13	9	55	503
42	5000.	16000.	3900.	26000.	4968.	9000.	3500.	800.	12	14	6	5	30	503
43	5000.	15000.	3900.	25500.	4968.	8600.	3500.	1500.	20	26	8	10	28	503
44	5000.	15000.	3900.	25500.	4968.	9400.	3500.	2200.	26	44	14	10	48	503
45	5000.	14200.	3900.	25500.	4968.	9000.	3500.	2600.	5	13	3	1	17	503
46	5000.	15500.	3900.	26000.	4968.	11000.	3500.	3200.	106	129	48	38	125	503
47	5000.	16000.	3900.	26200.	4968.	10000.	3500.	2000.	11	36	4	6	22	503
48	5000.	18500.	3900.	29000.	4968.	12000.	3500.	2600.	30	80	14	10	49	503

APPENDIX II

AVERAGE WEEKLY ATTENDANCE EXPECTED AT LANSPEARY POOL

S = the total number of people in each statistical unit.

P = the probability value for each statistical unit using the basic gravity model.

S*P = the probable number of visitors from each statistical unit that are likely to go swimming at Lanspeary.

S*P*FN = the average expected weekly attendance for each statistical unit inside 2500 feet (core user group).

S*P*FK = the average expected weekly attendance for each statistical unit outside 2500 feet (peripheral user group).

Inc = the final expected attendance for the peripheral user group for each statistical unit (the peripheral user group).

	S	P	S*P	S*P*FN	S*P*FK	*INC	WARD 1
1	111.	.317945	35.29		3.129	2.600	
2	127.	.284910	36.18		3.208	2.666	
3	101.	.328345	33.16		2.940	2.443	
4	106.	.334116	35.41		3.140	2.609	
5	108.	.341566	36.88		3.271	2.718	
6	82.	.401492	32.92		2.919	2.425	
7	98.	.444784	43.58		3.865	4.687	
8	56.	.508720	28.48		2.526	3.063	
9	78.	.477905	37.27		3.305	4.009	
10	77.	.470779	36.25		3.214	3.898	
11	94.	.458299	43.08		3.820	4.633	
12	73.	.456876	33.35		2.957	3.586	
13	87.	.477039	41.50		3.680	4.463	
14	62.	.502878	31.17		2.764	3.353	
15	71.	.469671	33.34		2.957	3.586	
16	71.	.435214	30.90		2.740	3.323	
17	123.	.377528	46.43		4.117	4.100	
18	126.	.339122	42.72		3.789	3.773	
19	118.	.313588	37.00		3.281	3.267	
20	173.	.309058	53.46		4.741	4.721	
21	131.	.281847	36.92		3.274	3.260	
22	167.	.275622	46.02		4.081	4.064	
23	143.	.254585	36.40		3.228	3.214	
24	304.	.216908	65.94		5.847	5.524	
25	226.	.210189	47.50		4.212	3.980	
26	184.	.215780	39.70		3.520	3.326	
27	119.	.239605	28.51		2.528	2.388	
28	179.	.270461	48.41		4.292	4.056	
29	86.	.368510	31.69		2.810	3.045	
30	51.	.410543	20.93		1.856	2.011	
31	75.	.444358	33.32		2.955	3.202	
32	93.	.399244	37.12		3.292	3.567	
33	67.	.359697	24.09		2.137	2.315	
34	139.	.323925	45.02		3.992	4.326	
35	83.	.280241	23.26		2.062	2.235	
36	280.	.202288	56.64		5.022	5.442	
37	247.	.177041	43.72		3.877	3.663	
38	133.	.136083	18.09		1.604	1.516	
39	172.	.099853	17.17		1.522	1.438	
40	63.	.095945	6.04		.536	.506	
41	178.	.100717	17.92		1.589	1.502	
42	253.	.104999	26.56		2.355	2.225	
43	205.	.086493	17.73		1.572	1.485	
44	132.	.119562	15.78		1.399	1.322	
45	196.	.145220	28.46		2.523	2.384	
	5848.			0.00	138.46	141.94	

	S	P	S*P	S*P*FN	S*P*FK	*INC	WARD 2
1	74.	.521453	38.58		3.421	3.451	
2	61.	.537160	32.76		2.905	2.930	
3	77.	.556606	42.85		3.800	3.833	
4	82.	.621505	50.96		4.519	4.558	
5	81.	.600717	48.65		4.314	4.352	
6	94.	.596666	56.08		4.973	5.016	
7	89.	.585615	52.11		4.621	4.216	
8	116.	.555373	64.42		5.712	5.212	
9	85.	.524737	44.60		3.955	3.608	
10	73.	.549454	40.11		3.556	3.245	
11	159.	.642306	102.12		9.056	8.262	
12	95.	.675542	64.17		5.690	5.192	
13	98.	.672563	65.91		5.844	5.332	
14	93.	.729954	67.88	58.831			
15	87.	.763434	66.41	57.560			
16	51.	.842002	42.94	37.214			
17	62.	.816683	50.63	43.881			
18	35.	.726991	25.44	22.051			
19	64.	.673530	43.10		3.822	3.399	
20	69.	.676098	46.65		4.136	3.678	
21	119.	.658716	78.38		6.950	6.181	
22	118.	.624311	73.66		6.532	5.809	
23	87.	.569112	49.51		4.390	3.904	
24	98.	.480021	47.04		4.171	3.709	
25	76.	.553065	42.03		3.727	3.314	
26	143.	.673865	96.36		8.544	7.598	
27	51.	.557666	28.44		2.522	2.543	
28	59.	.573337	33.82		2.999	3.025	
29	127.	.506098	64.27		5.699	5.711	
30	107.	.507158	54.26		4.812	4.822	
31	121.	.508251	61.49		5.453	5.464	
32	115.	.504282	57.99		5.142	5.153	
33	115.	.492541	56.64		5.022	5.033	
34	88.	.454738	40.01		3.548	3.556	
35	87.	.467473	40.67		3.606	3.614	
36	69.	.464380	32.04		2.841	1.826	
37	86.	.446962	38.43		3.408	2.191	
38	122.	.424082	51.73		4.587	2.949	
39	72.	.404616	29.13		2.583	1.660	
40	0.	0.000000	0.00	0.000			
41	172.	.384941	66.21		5.871	3.774	
42	141.	.401446	56.60		5.019	3.226	
43	114.	.404098	46.06		4.085	2.625	
	3932.			219.53	171.85	153.98	

WARD 3

	S	P	S*P	S*P*FN	S*P*FK	*INC
1	101.	.531417	53.67		4.759	6.534
2	94.	.555810	52.24		4.632	6.358
3	96.	.536475	51.50		4.566	6.268
4	89.	.541551	48.19		4.273	5.866
5	119.	.541673	64.45		5.715	7.845
6	74.	.504774	37.35		3.312	4.546
7	62.	.481848	29.87		2.649	3.636
8	76.	.500050	38.00		3.369	4.625
9	60.	.500862	30.05		2.664	3.657
10	37.	.471008	17.42		1.545	2.121
11	116.	.531029	61.59		5.462	6.642
12	81.	.558125	45.20		4.008	4.874
13	114.	.581963	66.34		5.883	7.154
14	104.	.614350	63.89		5.665	6.889
15	102.	.641087	65.39		5.798	6.467
16	83.	.621718	51.60		4.575	5.104
17	89.	.624827	55.60		4.931	5.500
18	60.	.626130	37.56		3.331	3.715
19	76.	.673627	51.19		4.539	5.063
20	102.	.680130	69.37		6.151	6.861
21	90.	.668447	60.16		5.334	5.950
22	81.	.653591	52.94		4.694	5.236
23	103.	.624747	64.34		5.706	6.364
24	52.	.850312	44.21	38.318		
25	106.	.932189	98.81	85.633		
26	71.	.963756	68.42	59.300		
27	78.	.963970	75.18	65.161		
28	101.	.840230	84.86	73.544		
29	67.	.788447	52.82	45.780		
30	63.	.722445	45.51	39.443		
31	70.	.662170	46.35		4.110	4.998
32	136.	.643662	87.53		7.762	9.439
33	88.	.653888	57.54		5.102	6.205
34	129.	.780899	100.73	87.300		
35	60.	.843634	50.61	43.866		
36	64.	.902168	57.73	50.037		
37	49.	.965703	47.31	41.008		
38	46.	.966122	44.44	38.514		
39	57.	.966225	55.07	47.729		
40	94.	.933794	87.77	76.069		
41	69.	.782105	53.96	46.767		
42	70.	.604914	42.34		3.754	3.787
43	87.	.631266	54.92		4.870	4.912
44	58.	.611600	35.47		3.145	3.172
45	80.	.613531	49.08		4.352	4.390
46	71.	.668978	47.49		4.211	4.248
47	83.	.646128	53.62		4.755	4.822
48	69.	.601811	41.52		3.682	3.733
49	73.	.539005	39.34		3.489	3.538
50	98.	.525933	51.54		4.570	4.580
51	69.	.535785	36.96		3.278	3.285
52	64.	.508331	32.53		2.884	2.890
53	79.	.483811	38.22		3.389	3.396
54	89.	.465188	41.40		3.671	3.679
	4399.			838.47	170.60	198.36

WARD 4

	S	P	S*P	S*P*FN	S*P*FK	*INC
1	170.	.447333	76.04		6.743	9.255
2	10.	.422977	4.22		.375	.514
3	8.	.407286	3.25		.288	.396
4	5.	.344325	1.72		.152	.188
5	0.	.362407	0.00		0.000	0.000
6	26.	.392109	10.19		.904	1.113
7	38.	.360955	13.71		1.216	1.498
8	33.	.348386	11.49		1.019	1.256
9	61.	.430787	26.27		2.330	2.870
10	36.	.307422	11.06		.981	1.209
11	65.	.261780	17.01		1.508	1.626
12	87.	.313103	27.24		2.415	2.983
13	118.	.271748	32.06		2.843	3.066
14	87.	.225593	19.62		1.740	1.876
15	122.	.218077	26.60		2.359	2.543
16	54.	.212214	11.45		1.016	1.095
17	39.	.138603	5.40		.479	.516
18	78.	.163833	12.77		1.133	1.221
19	68.	.100945	6.86		.608	.656
20	47.	.136759	6.42		.569	.614
21	79.	.076710	6.06		.537	.531
22	112.	.245651	27.51		2.439	2.599
23	104.	.363187	37.77		3.349	3.568
24	49.	.291537	14.28		1.266	1.349
25	82.	.343261	28.14		2.495	2.659
26	75.	.368267	27.62		2.449	2.609
27	95.	.380171	36.11		3.202	3.956
28	76.	.404248	30.72		2.724	3.365
29	104.	.421204	43.80		3.884	4.798
30	20.	.424410	8.48		.752	.929
31	22.	.458507	10.08		.894	1.104
32	45.	.485667	21.85		1.937	2.356
33	22.	.515409	11.33		1.005	1.222
34	98.	.583562	57.18		5.071	6.166
35	140.	.543196	76.04		6.743	8.200
36	52.	.485359	25.23		2.238	1.985
37	81.	.470846	38.13		3.381	2.999
38	48.	.439004	21.07		1.868	1.657
39	82.	.421223	34.54		3.062	2.716
40	75.	.385813	28.93		2.565	2.276
41	69.	.333834	23.03		2.042	2.176
42	119.	.306076	36.42		3.229	3.441
43	119.	.338405	40.27		3.570	3.804
44	156.	.340800	53.16		4.714	5.023
45	70.	.405177	28.36		2.515	2.679
46	102.	.455992	46.51		4.124	3.432
47	111.	.439941	48.83		4.330	3.841
48	87.	.492665	42.86		3.800	3.371
49	22.	.515588	11.34		1.005	.892
50	12.	.517466	6.20		.550	.488
51	51.	.531643	27.11		2.404	2.438
52	70.	.559810	39.18		3.474	3.523
53	60.	.536255	32.17		2.853	2.893
54	26.	.518236	13.47		1.194	1.211
55	35.	.505264	17.68		1.568	1.305
56	134.	.473372	63.43		5.624	4.681
57	92.	.440002	40.48		3.589	2.987
58	69.	.408941	28.21		2.502	2.082
59	90.	.435971	39.23		3.479	2.895
60	97.	.454561	44.09		3.909	3.254
	4204.			0.00	[illegible]	[illegible]

	S	P	S*P	S*P*FN	S*P*FK	*INC
1	91.	.0350 6	3.18		.282	.279
2	85.	.074992	6.37		.565	.559
3	82.	.039644	3.25		.288	.285
4	116.	.033182	3.84		.341	.337
5	116.	.032575	3.77		.335	.331
6	83.	.032022	2.65		.235	.233
7	121.	.069622	8.42		.747	.739
8	62.	.094040	5.83		.517	.511
9	98.	.092523	9.06		.804	.616
0	64.	.093550	5.98		.530	.407
1	128.	.090349	11.56		1.025	.786
2	85.	.109275	9.28		.823	.631
3	116.	.135256	15.68		1.391	1.066
4	103.	.146230	15.06		1.335	1.354
5	112.	.137001	15.34		1.360	1.380
6	104.	.207086	21.53		1.909	1.937
7	60.	.171171	10.27		.910	.923
8	104.	.112924	11.74		1.041	1.056
9	129.	.116433	15.01		1.331	1.350
20	79.	.122945	9.71		.861	.873
21	195.	.130135	25.37		2.250	2.282
22	145.	.142798	20.70		1.836	1.862
23	69.	.144924	9.99		.886	.899
24	71.	.144960	10.29		.912	.925
25	112.	.144290	16.16		1.433	1.453
26	94.	.150439	14.14		1.253	.961
27	102.	.160239	16.34		1.449	1.111
28	75.	.169373	12.70		1.126	1.114
29	140.	.209135	29.27		2.596	2.598
30	105.	.200342	21.03		1.865	1.867
31	107.	.214675	22.97		2.036	2.038
32	100.	.255571	25.55		2.266	2.268
33	157.	.247051	38.78		3.439	3.442
34	169.	.219953	37.17		3.296	3.299
35	290.	.188932	54.79		4.858	4.863
36	355.	.213420	75.76		6.718	6.725
37	315.	.169577	53.41		4.736	4.741
38	224.	.144239	32.30		2.865	2.614
39	106.	.128666	13.63		1.209	1.103
40	400.	.101526	40.61		3.601	3.285
41	143.	.056309	8.05		.714	.651
42	67.	.057983	3.88		.344	.314
43	92.	.098117	9.02		.800	.730
44	142.	.127924	18.16		1.610	1.469
45	39.	.146517	5.71		.506	.462
46	446.	.159854	71.29		6.322	5.768
47	79.	.115392	9.11		.808	.737
48	183.	.124841	22.84		2.025	1.848
	6460.			0.00	80.41	77.10

APPENDIX III

AVERAGE WEEKLY ATTENDANCE

AT ATKINSON SWIMMING POOL

S = the total number of people in user group in each statistical unit.

P = probability value for each statistical unit using the basic gravity model.

S*P = the probable number of visitors from each statistical unit that are likely to go swimming at Atkinson.

S*P*FN = the average expected attendance for each statistical unit inside 2500 feet (core user group).

S*P*FK = the average expected attendance for each statistical unit outside 2500 feet (peripheral user group).

Inc = the final expected attendance for the peripheral user group for each statistical unit (the income effect).

	S	P	S*P	S*P*FN	S*P*FK	*INC	WARD 1
1	111.	.164822	18.29		1.622	1.348	
2	127.	.147697	18.75		1.663	1.382	
3	101.	.149528	15.10		1.339	1.112	
4	106.	.173534	18.39		1.631	1.355	
5	108.	.161609	17.45		1.547	1.286	
6	82.	.173889	14.25		1.264	1.050	
7	98.	.198872	19.48		1.728	2.096	
8	56.	.178208	9.97		.884	1.073	
9	78.	.180321	14.06		1.247	1.512	
10	77.	.182399	14.04		1.245	1.510	
11	94.	.184992	17.38		1.541	1.870	
12	73.	.171994	12.55		1.113	1.350	
13	87.	.165895	14.43		1.279	1.552	
14	62.	.159266	9.87		.875	1.062	
15	71.	.150979	10.71		.950	1.152	
16	71.	.153361	10.88		.965	1.171	
17	123.	.157941	19.42		1.722	1.715	
18	126.	.144889	18.25		1.618	1.612	
19	118.	.140517	16.58		1.470	1.464	
20	173.	.141729	24.51		2.174	2.165	
21	131.	.135462	17.74		1.573	1.567	
22	167.	.134484	22.45		1.991	1.983	
23	143.	.130765	18.69		1.658	1.651	
24	304.	.112250	34.12		3.025	2.859	
25	226.	.100912	22.80		2.022	1.910	
26	184.	.095389	17.55		1.556	1.470	
27	119.	.101577	12.08		1.071	1.012	
28	179.	.111241	19.91		1.765	1.668	
29	86.	.128153	11.02		.977	1.059	
30	51.	.136707	6.97		.618	.669	
31	75.	.137360	10.30		.913	.989	
32	93.	.137797	12.81		1.136	1.231	
33	67.	.128156	8.58		.761	.825	
34	139.	.121092	16.83		1.492	1.617	
35	83.	.108727	9.02		.800	.867	
36	280.	.084051	23.53		2.086	2.261	
37	247.	.076068	18.78		1.666	1.574	
38	133.	.060426	8.03		.712	.673	
39	172.	.045725	7.86		.697	.658	
40	63.	.044461	2.80		.248	.234	
41	178.	.047951	8.53		.756	.715	
42	253.	.050673	12.82		1.136	1.074	
43	205.	.042970	8.80		.781	.738	
44	132.	.059398	7.84		.695	.656	
45	196.	.072145	14.14		1.253	1.184	
	5848.			0.00	59.28	59.99	

	S	P	S*P	S*P*FN	S*P*FK	*INC	WARD 2
1	74.	.196526	14.54		1.289	1.300	
2	61.	.205277	12.52		1.110	1.120	
3	77.	.198750	15.30		1.357	1.368	
4	82.	.177159	14.52		1.288	1.299	
5	81.	.184035	14.90		1.321	1.333	
6	94.	.173293	16.28		1.444	1.457	
7	89.	.176323	15.69		1.391	1.269	
8	116.	.179940	20.87		1.850	1.688	
9	85.	.187256	15.91		1.411	1.287	
10	73.	.158498	11.57		1.026	.936	
11	159.	.132040	20.99		1.861	1.698	
12	95.	.129271	12.28		1.089	.993	
13	98.	.133651	13.09		1.161	1.059	
14	93.	.111581	10.37		.920	1.026	
15	87.	.094818	8.24		.731	.815	
16	51.	.059758	3.04		.270	.272	
17	62.	.067621	4.19		.371	.375	
18	35.	.098950	3.46		.307	.309	
19	64.	.117565	7.52		.667	.593	
20	69.	.113416	7.82		.693	.617	
21	119.	.113123	13.46		1.193	1.061	
22	118.	.116765	13.77		1.221	1.086	
23	87.	.133051	11.57		1.026	.912	
24	98.	.139333	13.65		1.210	1.076	
25	76.	.135765	10.31		.914	.813	
26	143.	.113041	16.16		1.433	1.274	
27	51.	.140193	7.14		.634	.639	
28	59.	.140658	8.29		.735	.742	
29	127.	.178433	22.66		2.009	2.013	
30	107.	.176530	18.88		1.674	1.678	
31	121.	.173593	21.00		1.862	1.866	
32	115.	.169067	19.44		1.724	1.727	
33	115.	.164089	18.87		1.673	1.676	
34	88.	.168122	14.79		1.311	1.314	
35	87.	.160166	13.93		1.235	1.238	
36	69.	.158929	10.96		.972	.625	
37	86.	.156167	13.43		1.190	.765	
38	122.	.150805	18.39		1.631	1.048	
39	72.	.148115	10.66		.945	.607	
40	0.	0.000000	0.00	0.000			
41	172.	.164465	28.28		2.508	1.612	
42	141.	.165191	23.29		2.065	1.327	
43	114.	.173284	19.75		1.751	1.126	
	3932.			0.00	52.49	47.06	

WARD 3

	S	P	S*P	S*P*FN	S*P*FK	*INC
1	101.	.220006	22.22		1.970	2.705
2	94.	.210604	19.79		1.755	2.409
3	96.	.222487	21.35		1.893	2.599
4	89.	.230608	20.52		1.819	2.498
5	119.	.230660	27.44		2.434	3.340
6	74.	.255688	18.92		1.677	2.302
7	62.	.280127	17.36		1.540	2.113
8	76.	.270027	20.52		1.819	2.497
9	60.	.270465	16.22		1.439	1.975
10	37.	.292496	10.82		.959	1.317
11	116.	.251823	29.21		2.590	3.150
12	81.	.234144	18.96		1.681	2.045
13	114.	.216839	24.71		2.192	2.665
14	104.	.191503	19.91		1.766	2.147
15	102.	.178355	18.19		1.613	1.799
16	83.	.183033	15.19		1.347	1.502
17	89.	.177379	15.78		1.399	1.561
18	60.	.177749	10.66		.945	1.054
19	76.	.151323	11.50		1.019	1.137
20	102.	.141695	14.45		1.281	1.429
21	90.	.144617	13.01		1.154	1.287
22	81.	.139159	11.27		.999	1.114
23	103.	.162349	16.72		1.482	1.653
24	52.	.056324	2.92		.259	.289
25	106.	.028499	3.02		.267	.298
26	71.	.015959	1.13		.100	.112
27	78.	.015963	1.24		.110	.123
28	101.	.072595	7.33		.650	.725
29	67.	.097925	6.56		.581	.648
30	63.	.130512	8.22		.729	.886
31	70.	.162916	11.40		1.011	1.229
32	136.	.170544	23.19		2.056	2.501
33	88.	.159472	14.03		1.244	1.513
34	129.	.093108	12.01		1.065	1.074
35	60.	.066526	3.99		.353	.357
36	64.	.041372	2.64		.234	.236
37	49.	.014538	.71		.063	.063
38	46.	.014327	.65		.058	.058
39	57.	.014222	.81		.071	.072
40	94.	.028330	2.66		.236	.238
41	69.	.083260	5.74		.509	.513
42	70.	.131841	9.22		.818	.825
43	87.	.132047	11.48		1.018	1.027
44	58.	.146682	8.50		.754	.760
45	80.	.152401	12.19		1.081	1.090
46	71.	.132939	9.43		.836	.844
47	83.	.148152	12.29		1.090	1.105
48	69.	.172212	11.88		1.053	1.068
49	73.	.209565	15.29		1.356	1.375
50	98.	.189336	18.55		1.645	1.648
51	69.	.176228	12.15		1.078	1.080
52	64.	.184285	11.79		1.045	1.048
53	79.	.198916	15.71		1.393	1.396
54	89.	.193830	17.25		1.529	1.532
	4399.			0.00	61.09	72.06

WARD 4

	S	P	S*P	S*P*FN	S*P*FK	*INC
1	170.	.316685	53.83		4.773	6.552
2	10.	.334061	3.34		.296	.406
3	8.	.349993	2.79		.248	.340
4	5.	.410546	2.05		.182	.224
5	0.	.398866	0.00		0.000	0.000
6	26.	.372411	9.68		.858	1.057
7	38.	.404921	15.38		1.364	1.681
8	33.	.415388	13.70		1.215	1.497
9	61.	.331010	20.19		1.790	2.205
10	36.	.455406	16.39		1.453	1.791
11	65.	.508900	33.07		2.933	3.162
12	87.	.437843	38.09		3.377	4.172
13	118.	.493061	58.18		5.159	5.563
14	87.	.560373	48.75		4.323	4.661
15	122.	.565779	69.02		6.120	6.599
16	54.	.572325	30.90		2.740	2.955
17	39.	.716125	27.92	24.203		
18	78.	.664704	51.84	44.931		
19	68.	.788069	53.58	46.441		
20	47.	.706598	33.21	28.780		
21	79.	.838418	66.23	57.401		
22	112.	.488157	54.67		4.848	5.165
23	104.	.416997	43.36		3.845	4.097
24	49.	.445648	21.83		1.936	2.063
25	82.	.397908	32.62		2.893	3.082
26	75.	.377344	28.30		2.509	2.674
27	95.	.366292	34.79		3.085	3.811
28	76.	.344281	26.16		2.320	2.866
29	104.	.328020	34.11		3.025	3.736
30	20.	.326110	6.52		.578	.714
31	22.	.303715	6.68		.592	.731
32	45.	.282473	12.71		1.127	1.370
33	22.	.262010	5.76		.511	.621
34	98.	.207081	20.29		1.799	2.188
35	140.	.234660	32.85		2.913	3.542
36	52.	.269164	13.99		1.241	1.100
37	81.	.278471	22.55		2.000	1.774
38	48.	.299883	14.39		1.276	1.132
39	82.	.311212	25.51		2.262	2.007
40	75.	.336721	25.25		2.239	1.986
41	69.	.376929	26.00		2.306	2.457
42	119.	.381281	45.37		4.023	4.287
43	119.	.356619	42.43		3.763	4.009
44	156.	.338619	52.82		4.684	4.991
45	70.	.297363	20.81		1.845	1.966
46	102.	.254854	25.99		2.305	1.918
47	111.	.279557	31.03		2.751	2.440
48	87.	.244756	21.29		1.888	1.674
49	22.	.230529	5.07		.449	.398
50	12.	.235654	2.82		.250	.222
51	51.	.226388	11.54		1.023	1.038
52	70.	.211366	14.79		1.312	1.330
53	60.	.207710	12.46		1.105	1.120
54	26.	.214923	5.58		.495	.502
55	35.	.224120	7.84		.695	.578
56	134.	.239447	32.08		2.845	2.368
57	92.	.258148	23.74		2.105	1.752
58	69.	.276300	19.06		1.690	1.407
59	90.	.248608	22.37		1.984	1.651
60	97.	.231245	22.43		1.989	1.655

WARD 5

	S	P	S*P	S*P*FN	S*P*FK	*INC
1	91.	.921992	83.90	72.711		
2	85.	.834541	70.93	61.475		
3	82.	.905976	74.29	64.381		
4	116.	.923154	107.08	92.803		
5	116.	.922458	107.00	92.733		
6	83.	.922710	76.58	66.370		
7	121.	.830121	100.44	87.048		
8	62.	.759969	47.11	40.833		
9	98.	.766096	75.07	65.064		
10	64.	.755235	48.33	41.888		
11	128.	.757447	96.95	84.022		
12	85.	.690941	58.73	50.897		
13	116.	.575962	66.81		5.924	4.542
14	103.	.479471	49.38		4.379	4.441
15	112.	.374341	41.92		3.717	3.770
16	104.	.514403	53.49		4.743	4.811
17	60.	.500780	30.04		2.664	2.702
18	104.	.218498	22.72		2.015	2.043
19	129.	.253068	32.64		2.894	2.936
20	79.	.302004	23.85		2.115	2.145
21	195.	.358710	69.94		6.202	6.291
22	145.	.412756	59.84		5.307	5.382
23	69.	.486388	33.56		2.976	3.018
24	71.	.392816	27.88		2.473	2.508
25	112.	.491543	55.05		4.881	4.951
26	94.	.531035	49.91		4.426	3.393
27	102.	.554974	56.60		5.019	3.848
28	75.	.569213	42.69		3.785	3.745
29	140.	.467543	65.45		5.804	5.810
30	105.	.522534	54.86		4.865	4.870
31	107.	.507860	54.34		4.818	4.823
32	100.	.401381	40.13		3.559	3.562
33	157.	.361386	56.73		5.031	5.036
34	169.	.400667	67.71		6.004	6.010
35	290.	.443027	128.47		11.392	11.404
36	355.	.351404	124.74		11.062	11.073
37	315.	.342169	107.78		9.557	9.567
38	224.	.286632	64.20		5.693	5.194
39	106.	.278246	29.49		2.615	2.386
40	400.	.209513	83.80		7.431	6.780
41	143.	.107948	15.43		1.368	1.248
42	67.	.102421	6.86		.608	.555
43	92.	.170040	15.64		1.387	1.265
44	142.	.202829	28.80		2.553	2.330
45	39.	.229693	8.95		.794	.724
46	446.	.223807	99.81		8.851	8.076
47	79.	.183445	14.49		1.285	1.172
48	183.	.191232	34.99		3.103	2.831
	6460.			820.22	161.31	155.26

BIBLIOGRAPHY

Adams, T. Design of Residential Areas Howard City Planning Studies, London: Humphrey Milford Oxford University Press, 1934.

Applebaum, W. J. Marketing by the Case Method. Economic Geography Vol. XXVII, 1961

Boss, I. D. F. Design for Decision. The MacMillan Co., New York, N. Y., 1959.

Butler, G. D. Standards for Playgrounds Playfields and Indoor Recreation Facilities. New York: The National Recreation Association, 1963.

—————— Recreation Area Standards. New York: The National Recreation Association, 1963.

Clawson, M. Methods of Measuring the Demand for and Value of Recreation. Resources for the Future, reprint no. X, Feb., 1959.

Cohen, S. B. Location Research Programming for Voluntary Food Chains. Economic Geography Vol. XXXVII 1961.

Converse, P. D. New Laws of Retail Gravitation. Journal of Marketing. Vol. XIV 1949.

Epstein, B. I. Evaluation of an Established Planned Shopping Center. Economic Geography Vo. XXXVII 1961.

Gregory, S. Statistical Methods and the Geographer. London: Cambridge University Press, 1963.

Huff, D. L. A Probabalistic Analysis of Shopping Center Trade Areas. Land Economics Vol. XXXIV 1963.

Kaplan, M. Leisure In America. New York: John Wiley and Sons Inc. 1960.

Kostka, J. Neighbourhood Planning. The Appraisal Institute of Canada Inc., 1957.

Madow, P. Recreation in America. New York: The H. Wilson Co. 1965.

Municipal Census Data for the City of Windsor Windsor: Windsor City Hall, 1965.

Outdoor Recreation for America (Report to the President and to the Congress. By the Outdoor Recreation Resources Review Commission) Vol. I, V, XV, XIX, XX, XXI, XXII, XXIV, XXV, XXVI, XXVII. Washington, D. C. 1962.

Sessons, H. D. New Bases for Recreation Planning. Journal of American Institute of Planners Vol. XXX, 1964.

Wolfe, R. I. Recreation Travel: The New Migration. The Canadian Geographer Vol. XX 1966.