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A REGIONAL ANALYSIS OF RECREATIONAL BOATING PARTICIPATION IN THE STATE OF MICHIGAN

By

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ABSTRACT

A REGIONAL ANALYSIS OF RECREATIONAL BOATING PARTICIPATION IN THE STATE OF MICHIGAN

By

Paul Raymond Fiske

This study was designed to investigate regional variation in recreational boating participation rates in five regions within the State of Michigan. Each study region consisted of multi-county units, delineated as Michigan Planning and Development Regions, or recreation sub-planning regions. Two of the regions utilized consisted of Standard Metropolitan Statistical Areas (SMSA's): Detroit, Lansing, and the Monroe County portion of the Toledo, Ohio SMSA. Two of the study regions were multi-county units located in the northern portion of Michigan's Lower Peninsula; and the final region (Marquette-Iron Mountain) is located in the Upper Peninsula.

A detailed questionnaire was prepared and mailed to a sample of 21,764 Michigan registered boat owners. This questionnaire was designed to collect information in six principal categories: (1) information concerning sampled watercraft (e.g., length, horsepower); (2) place of storage of watercraft during the boating season; (3) transportation of watercraft during the study year; (4) use of recreational watercraft during the study year (calendar 1968); (5) number of

(registered and unregistered) watercraft owned by respondents; and (6) socio-economic characteristics of sampled watercraft owners.

Individual variation in boating participation was analyzed by estimating a least squares equation for each of the five independent study regions, and for the total (State of Michigan) sample. Regional variation in population participation in boating activities was analyzed by an aggregate participation model.

Considerable variation in the rate of recreational boating participation was found to exist among sampled registered watercraft owners in the State of Michigan. The estimated number of total boating activity occasions varied considerably among counties. The highest rates of boating participation were found to exist in non-metropolitan areas of the State.

Among socio-economic variables analyzed in this study, family size, occupation of family head, and age of family head were significantly correlated with individual boating participation in one or more study regions. Boating participation increased positively with family size in two of the study regions delineated. A significant (and positive) correlation was also noted for the statewide equation. This finding indicates that boating tends to be a family activity; and that the highest rates of boating participation tend to exist among larger families who own registered watercraft.

Significant relationships were found to exist between registered boat owner's occupational class and boating participation rate in four of the five study regions examined. In Region 1--Detroit, the professional occupation had a significant (but negative) effect upon boating participation. In Region 6--Lansing, none of the occupational classes used were significantly correlated with boating participation. In Region 7C--Saginaw Bay, boat owners employed as service workers had a significant (and positive) effect upon boating participation. Other factory workers was the only occupational class which had a significant relationship with boating participation rate in Region 12A--Marquette-Iron Mountain. This occupational class had a positive effect on the dependent variable.

Age of family head was significantly correlated with boating participation in three of the five study regions examined: Region 1--Detroit, Region 10--Traverse Bay, and Region 12A--Marquette-Iron Mountain. In Region 10, age of family head was positively correlated with boating participation. However, there was a negative correlation between age and boating participation in both the Detroit and Marquette-Iron Mountain Regions. While significant correlations existed between family income of respondents and boating participation, these findings should be regarded as inconclusive since the data collected on family income was inadequate to provide a basis for a rigorous test of this relationship.

In addition to (independent) variables relating to socio-economic characteristics of sampled watercraft owners (or their immediate families), the modified user-characteristic model contained variables concerning the specifications of sampled watercraft. Place-of-storage of watercraft (during the boating season) was found to be significantly correlated with boating participation in three of the five study regions utilized, as well as in the total (statewide) automobile driving distance from a county seat to the closest point of boating access on a Great Lake increases, boating participation by the population of that county would decrease.

Surface water acreage was positively correlated with boating participation in the "bottom thirty" counties of origin, i.e., among the bottom thirty counties of origin, the aggregate boating participation rate would be expected to increase directly with the relative availability of boatable surface water acreage. A positive relationship was also found to exist between a county's boating participation rate and the number of public boat-launching sites within the county. Supply variables are thus found to be important as explanatory variables, and represent policy tools which are available to public administrators.

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Finally, I wish to gratefully acknowledge the assistance of my wife, Jan. Without her assistance and untiring support, it would not have been possible for me to complete this study. My two sons, Scott and Steven, also demonstrated much patience and understanding over an extended period of time, when they did not receive the usual amount of attention and guidance from their father.

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CHAPTER I

INTRODUCTION AND BACKGROUND

Introduction

> When we elect to watch the play of human motives that are ordinary--that are sometimes mean and dismal and ignoble--our impulse is not the philosopher's impulse, knowledge for the sake of knowledge, but rather the physiologist's knowledge for the healing that knowledge may help to bring. Wonder . . . is the beginning of philosophy. It is not wonder, but rather the social enthusiasm which revolts from the sordidness of mean streets and the joylessness of withered lives, that is the beginning of economic science. Here, if in no other field, Comte's great phrase holds good: "It is for the heart to suggest our problems; it is for the intellect to solve them. . . .[1]

Outdoor recreation constitutes an area of increasing importance in public resource policy. A majority of Americans currently participate in some form of outdoor recreation at public or private facilities. Visitation rates at national parks and forests, and at state, county, and local facilities have climbed steadily for decades. Extensive recreation facilities have been provided by the various levels of government (federal, state, and local), and by the private sector. In response to increasing levels of use of available facilities by campers, swimming enthusiasts, boaters, and other recreationists, public agencies have embarked upon extensive land acquisition programs in order to "keep ahead" of increased participation.

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[1]Cf. A. C. Pigou, The Economics of Welfare (4th ed.; New York: St. Martin's Press, 1962), pp. 4-5.

In the United States, most people do participate in some form of outdoor recreation. In 1960, for example, it was estimated that Americans engaged in one or more outdoor recreation activities on 4.4 billion separate occasions; and further, that 90 per cent of all Americans participated one or more times.[1] A 1968 study places the aggregate level of consumer spending on outdoor recreation at $83 billion in the United States. It was further estimated in the same study that the average annual rate of increase in consumer spending on recreation equipment between 1964 and 1968 was about $6 billion per year.[2] Outdoor recreation has, indeed, become big business.

The Problem Setting

Virtually every report, paper, or article written on the topic of outdoor recreation during the past several years speaks of ever-increasing demand. For many years, Americans have been expanding their level of participation. This has been true in both a relative and absolute sense. While many improvements are needed in the statistical information relating to the rate and level of demand, the available

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[1]Outdoor Recreation Resources Review Commission, Outdoor Recreation For America (Washington: U.S. Government Printing Office, 1962), pp. 4-5; As used hereafter, ORRRC refers to the U. S., Outdoor Recreation Resources Review Commission, created by Congressional Act of June 28, 1958 (Public Law 85-470, 72 Stat. 238). The Commission was established to determine (1) ". . . the recreation wants and needs of the American People now and . . . in the years 1976 and 2000;" (2) ". . . the recreation resources of the Nation available to fill those needs;" and (3) "What policies and programs should be recommended to insure that the needs of the present and future are adequately and efficiently met?"

[2]Expenditure categories included camper trailers, boats, camping equipment, fishing, hunting, vacation trips, and "other amusements." See, "$80 Billion For Leisure," U. S. News and World Report, Vol. 70, No. 13 (September 15, 1969), pp. 58-61.

information at hand appears clear: a large majority of Americans, when afforded the physical opportunity, and given free choice, are willing to devote certain portions of their time and incomes to outdoor recreation activities.

Mass participation in recreation (as a leisure time activity) is, for the most part, a uniquely American phenomenon. In past times, and even today in many parts of the world, very few countries have experienced leisure on a scale such as is enjoyed by the people of the United States. History reveals that most people down through the ages have had to labor so hard during their lifetime in order to produce the bear necessities of life--food, clothing, and shelter--that little time was ever left over for spare time (leisure) activities.[1] Under these circumstances, only the most wealthy or priviledged classes ever had much leisure.

In the United States, a number of social and economic (as well as political) conditions have changed in order to make recreation activities a more attainable goal for the average American. Most scholars agree that the principal factors contributing to widespread participation in outdoor recreation consist of: (1) higher population levels; (2) increased productivity per man hour of labor, (3) changes in the amount and timing of available leisure, e.g., shorter work weeks, more paid holidays, longer paid vacations; (4) increased

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[1]There is, of course, room for genuine debate concerning the actual extent of leisure time available to most people. Some researchers have advanced convincing arguments that most Americans are really without much discretionary leisure or "choosing" time. More will be said about this factor in Chapter II.

concentration of population in cities and urban areas, coupled with urban expansion and sprawl; (5) widespread ownership of automobiles; (6) improved all-weather highways, and the availability of cheaper air travel; (7) increasing consumers' real incomes; (8) changed attitudes towards leisure and recreation; and (9) mass advertizing and marketing promotion practices.[1]

Much of the current interest in outdoor recreation can actually be traced, in large measure, to very early land policies during the nation's formative years. Even in colonial times, interest was shown in conserving certain land and water resources for public benefit. One of the earliest public interventions having implications for outdoor recreation was the Great Ponds Act, Passed by the Massachusetts Bay Colony in 1641. This act reserved about two thousand bodies of water, exceeding ten acres in size, and totalling some 90,000 acres, decreeing that they ". . . were to remain as a public resource forever open to the public for 'fishing and fowling.'"

The common or "Green," so typical of many New England Towns even today, had its origin in the early colonial period. One of the earliest and most noteworthy of these municipal areas was the Boston Common, established in 1634. This area has been reserved for public use by Boston citizens for more than three hundred years. Another milestone in the history of municipal parks occurred in 1853 when the

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[1]See, for example, Marion Clawson, Methods of Measuring the Demand For and Value of Outdoor Recreation, Reprint No. 10 (Washington: Resources for the Future, Inc., 1959), p. 1; also, Raleigh Barlowe and Milton H. Steinmueller, "Trends in Outdoor Recreation," A Place to Live; 1963 Yearbook of Agriculture (Washington: U. S. Department of Agriculture, 1963), pp. 299-301.

City of New York began acquiring land for Central Park--the first area acquired by a municipality exclusively for public recreation.

The Congress of the United States established an important preccedent early in the 19th Century when it passed an act in 1832, reserving four sections of land in the Quachita Mountains of Arkansas ". . . for the future disposal of the United States." This reservation was made to preserve the hot mineral springs of the area from ". . . indescriminate exploitation and abuse by private interests." Following this initial step, Congress established the Yosemite Grant in 1864. The Yosemite Valley, and the nearby grove of "Mariposa Big Trees" were reserved from the public domain and entrusted to the State of California ". . . upon the express conditions that the premises shall be held for public use, resort and recreation; shall be inalienable for all time. . . ." Later (in 1872), Congress established Yellowstone National Park--the first national park in the world.

It should also be noted that commercial recreation assumed some importance quite early in the 19th Century. As early as 1820, hotels and accommodations for tourists were available at Franconia Notch in the White Mountains of New Hampshire. By 1825, a hotel and resort area was also well established in the Catskills of New York State as well.[1] For the most part, however, outdoor recreation has largely remained a public matter in the United States. As Clawson notes:

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[1]The preceeding historical narrative is based upon several references: Frank E. Smith, The Politics of Conservation (New York: Pantheon Books, 1966); C. Frank Brockman, Recreational Use of Wild Lands (New York: McGraw-Hill Book Company, Inc., 1959); John Ise, Our National Park Policy; A Critical History (Baltimore: The Johns Hopkins Press, 1961).

> Most outdoor recreation in the United States takes place on publicly owned and provided areas, including water bodies open to the public. Some individuals own their own outdoor recreation places, but in most instances these people also use public areas. Hunting, fishing, camping, picnicing, hiking, and other extensive land use activities are largely upon public lands and waters.
>
> There are several reasons for the dominance of the publicly owned areas. For one thing, the minimum adequate area for most outdoor recreation activities is simply too large and too expensive for any but the richest people to have as their own; for another, such areas normally have ample capacity for far more people than the members of a single family. It is not only the costs of owning such areas, but also the costs of minimum upkeep and service, that may be decisive. For many kinds of outdoor activities, supervision or instruction is also needed, and this, too, can usually be provided most economically on a larger scale than the single family.
>
> At any rate, public provision of outdoor recreation areas is a widely accepted aspect of American life. The role of private lands and waters may be larger in the future . . . but outdoor recreation seems likely to continue to be carried out largely on publicly provided areas.[1]

In addition to early reservations of land for municipal and national parks, large acreages were withdrawn from the public domain[2] around the end of the 19th Century. Withdrawals were made for forest reserves, water power and reservoir sites, national monuments, military reservations, bird and game sanctuaries, and a host of other uses. While much of the land (and water) area reserved was not withdrawn

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[1]Marion Clawson, Land and Water For Recreation (Chicago: Rand-McNally and Company, 1963), pp. 10-11.

[2]The public domain is here defined to include all lands that were at any time owned by the United States and subject to sale or other transfer of ownership under the laws of the federal government. The national domain consists of the total area of land and water under the jurisdiction of the United States. The federal government has, or has had, both ownership in and jurisdiction over the public domain, while it exercises only jurisdiction over the national domain. See, E. Louise Peffer, The Closing of the Public Domain (Stanford, California: The Stanford University Press, 1951), pp. 8-31.

exclusively for outdoor recreation uses, much of the acreage has, over the years, come to have tremendous significance as a physical supply base for recreational activities. National Forest reserves were actually authorized as early as 1817;[1] however, the power vested in the President of the United States by Congress was never officially invoked until the Hot Springs Reservation in 1832. More explicit authorization was to come much later in a Congressional act in 1891. There is strong evidence to suggest that the Congress did not recognize the full significance of the legislation passed, however.

The portion of the bill dealing with forest reserves was included in the legislation at the last minute as an obscure "rider." For the most part, the bill dealt with routine land matters; however, the attached rider specified that:

> The President of the United States . . . may set apart and reserve any part of the public lands wholly or in part covered with timber . . . as public reservations.[2]

Several presidents made use of this authority. During 1897, President Cleveland created thirteen new forest reserves, totalling about 21.4 million acres. This acreage, when added to previously established reserves, made a total of nearly 39 million acres.[3] Initial

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[1]The United States Constitution places control over publicly owned lands in the hands of Congress. However, in 1817 Congress began the practice of delegating to the President the authority ". . . from time to time, to withdraw certain lands from entry to serve particular functions." Peffer, op. cit., pp. 14-15.

[2]Cf. Outdoor Recreation Resources Review Commission, Federal Agencies and Outdoor Recreation, ORRRC Study Report 13 (Washington: U.S. Government Printing Office, 1962), p. 20.

[3]Peffer, op. cit., p. 17.

withdrawals were made by President Harrison beginning in 1891. However, by far the most impressive acreage was reserved by President Theodore Roosevelt after the turn of the century: in two years (1905 and 1906) he withdrew more than 63 million acres of public land; and altogether, created more than 148 million acres of forest reserves. The Congress, finally aware of the full significance of the powers which it had granted, took swift action to strip the president of these prerogatives. According to two scholars:

> These withdrawals aroused so much opposition that an act was passed prohibiting additional withdrawals in many states without specific congressional approval. Roosevelt signed the bill, but first--rumor says on the same day--he established twenty-one additional forests.[1]

By 1923, there were about 161.3 million acres of land which had been withdrawn as forest reserves (which by this time were known as National Forests). In addition, power site reserves totalled nearly 2.5 million acres; national parks reserves amounted to about 7.2 million acres; national monuments about 1.1 million acres; military reservations 1.5 million acres; and bird and game sanctuaries about 0.4 million acres.[2]

As of 1960, it was estimated that about 12 per cent of the total land area of the United States was contained in 25,000 designated

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[1]Marion Clawson and Burnell Held, The Federal Lands, Their Use and Management (Baltimore: The Johns Hopkins Press, 1957), p. 167.

[2]Including all other reserve categories, about 272.3 million acres (more than a fifth of the original public domain) had been reserved by 1923. By way of comparison, the original public domain was estimated to total about 1.4 billion acres. The present land area of the United States (excluding Alaska) is placed at roughly 1.9 billion acres. See, E. Louise Peffer, op. cit., p. 8; Benjamin A. Hibbard, A History of the Public Land Policies (New York: The MacMillan Company, 1924), pp. 529-537; and Marion Clawson, Burnell Held, and Charles H. Stoddard, Land For the Future (Baltimore: The Johns Hopkins Press, 1960), p. 43.

public recreation areas. Most of this acreage, and a majority of the recreation areas, is located within the forty-eight contiguous states. Outdoor recreation is also premitted on much of the remaining public domain land--873 million acres administered by the Bureau of Land Management.[1]

At the time of the ORRRC inventory in 1960, over four-fifths of the designated land area for outdoor recreation was federally owned and managed. Most of the acreage was administered by the so-called land-managing agencies: the National Park Service, the Forest Service, and the Bureau of Sport Fisheries and Wildlife. Another group of federal agencies fall under the category of water management: the Corps of Engineers, the Bureau of Reclamation, the Tennessee Valley Authority, and the Federal Power Commission. A large number of other agencies, bureaus, and departments play less direct or periferal roles in administering outdoor recreation programs and/or facilities, e.g., the Soil Conservation Service, the Bureau of Indian Affairs, the Department of Housing and Urban Development, the U. S. Coast Guard, etc. One of the major recommendations of the Outdoor Recreation Resources Review Commission, following its national study, was that a Bureau of Outdoor Recreation be established at the federal level, within the U. S. Department of Interior.

A Bureau of Outdoor Recreation was established in 1964, and it is now charged with overall responsibility for coordinating various

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[1]Outdoor Recreation Resources Review Commission, Public Outdoor Recreation Areas--Acreage, Use, Potential, ORRRC Study Report 1 (Washington: U.S. Government Printing Office, 1962), p. 1.

programs of the federal agencies. In addition, the Bureau has responsibility for providing assistance to other levels of government (state, county, local).

In addition to providing public programs, land, and facilities for use by the recreating public, the Federal Government has initiated financial assistance to private landowners in order to encourage the establishment of commercial recreation facilities. The U. S. Department of Agriculture has been assigned responsibilities for assisting in the development of resources presently in agricultural uses, and in rural areas. The Food and Agriculture Act of 1962 provides this authority.[1] Several agencies within the Department of Agriculture have been given responsibilities for implementing the provisions of this legislation. The Soil Conservation Service has been designated as the chief planning agency of the department. The Farmers' Home Administration and the Federal Land Bank have been authorized to grant loans to rural land owners for the department of recreation facilities in certain instances, i.e., when design and construction standards, among other things, appear adequate. The Agricultural Stabilization and Conservation Service (ASCS) also has been given authority to make incentive payments to private land owners in order to encourage the transfer of certain lands out of agriculture and into recreation uses.

At the federal level, agency efforts in administering programs and facilities demanded by the recreating public have often been

[1] U. S., Congress, Food and Agriculture Act of 1962, Public Law 87-703, 87th Congress, H.R. 12391, September 27, 1962, pp. 1-2.

frustrated by a lack of uniform standards, policies, and criteria. Commenting on this problem, the ORRRC observed that:

> In 1960 there were some 425 to 450 million recreational visits to government managed, financed, or licensed facilities, but no agency of the Federal Government was established to provide recreation for the public. The U. S. Army Corps of Engineers was concerned with aids to navigation and flood control--yet it entertained 106 million visitors in 1960. The Forest Service was established to conserve the forests, but it played host to 92.5 million visitors. Even the national park service was not formed to provide recreation in the usual sense, but to preserve unique or exceptional scenic areas. Recreation has been an incidental, and almost accidental, byproduct of the "primary" purposes of federal agencies. Lack of anything resembling a national recreation policy is therefore at the root of most of the recreation problems of the federal government. But the recreationists exist even if a policy does not.[1]

In addition to federal facilities, state, county, and municipal governments have acquired and developed significant land areas for outdoor recreation. In 1960, it was estimated that state agencies owned and administered 20,429 individual recreation areas, totalling about 32.1 million acres. County and other local units of government operated an estimated 2,560 park and recreation areas, comprising a total land area of 3.5 million acres.[2]

Much has been learned about the magnitude of participation in outdoor recreation. While available literature has succeeded in focusing attention on outdoor recreation, there is a general lack of quantitative research in the field. Although most studies have documented the fact that recreation participation has been generally increasing for a number of years, they generally do not attempt to analyze precisely the underlying factors thought to be related to

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[1] ORRRC Study Report 13, op. cit., p. 1.

[2] ORRRC Study Report 1, op. cit., pp. 8-9.

levels of participation in particular recreation activities. The present study will concern itself with participation in a specific outdoor recreation activity--recreational boating. It will be designed to identify specific variables believed to be associated with individual and aggregate participation in boating in the state of Michigan, and to measure the influence of these factors upon participation rates.

Study Objectives

(1) The first objective is to obtain an estimate of the total level of recreational boating undertaken in Michigan during 1968; its distribution in various geographic regions in the state, and among various segments of the population. This objective will involve two parts, dealing with (a) boating activities in Michigan by residents of other states or (Canadian) Provinces, and (b) recreational boating undertaken in other states or (Canadian) Provinces by Michigan residents.

(2) The second objective is to identify specific socio-economic, demographic, and environmental factors believed to be associated with recreational boating activities; to isolate these factors and measure the extent of their influence upon individual and aggregate levels of boating activity during a given time period. A multiple-regression model will be utilized for statistical analysis.

(3) The final objective is to suggest policy guidelines which will be relevant to the problems of administering public and private boating facilities in the State of Michigan.

Assumptions and Limitations

(1) The first major assumption is that the household is the decision-making unit concerned with consumption goods and services

such as a recreational boating trip. As such, it is faced with the problem of allocating its finite income between recreational boating trips and other goods and services in a way that maximizes total satisfactions.

(2) It is assumed that households which have purchased powered watercraft, and have registered them with the Michigan Secretary of State, constitute the major recreational boating population of the state.

(3) It is assumed that a mail questionnaire mailed to a sample of the registered watercraft owners in the State of Michigan will be representative of the total universe of recreational watercraft users in the state.

(4) This study assumes that watercraft owners can adequately recall the magnitude and location (Michigan County) of recreational boating activity undertaken during the previous boating season when asked to complete a mail questionnaire at the conclusion of the boating season (one calendar year).

(5) Each recreational boating trip taken presents the consumer with a set of time and money costs. This study assumes, however, that fixed costs are unimportant in the decision to make a boating trip as the study is limited to a population which has already purchased recreational boating equipment. Further, for purposes of the analysis, variable travel and on-site costs (made up of such items as gasoline, food, highway tolls, user fees, lodging) are held constant. However, distance travelled and travel time will be explicitly introduced in the statistical analysis.

(6) Watercraft owners will vary in the total amount of recreational boating activity undertaken during any given year. Each household will be affected by (a) location with respect to boating opportunities (supply); (b) tastes and preferences; (c) personal circumstances such as health, family income, and leisure time available; (d) the amount of money, time, and bother associated with going boating; (e) alternative outlets for time and money budgets.

(7) Recreational boat owners are indifferent as between different boating activities undertaken (e.g., fishing, cruising for pleasure). That is, it is assumed for the purpose of this study that the marginal rate of substitution between, say, a day spent fishing and a day of waterskiing is unity.

(8) The quality of the recreation experience is important in determining where one goes boating. That is to say, boaters are able to differentiate the "product" produced at a particular lake, stream, or pond from that obtainable at an alternative site, and these perceptions are important in boaters' decisions.

(9) It is assumed that either zero or nominal[1] prices are charged for the use of public boating marinas, public launching sites, and other recreational boating facilities in Michigan which are maintained and operated by the various levels of government (state, federal and local). Further, it is assumed that prices charged for comparable facilities and services at commercial boating marinas

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[1]A nominal price is defined, in this instance, as one which is not sufficient to cover construction, operation, maintenance, and depreciation costs of the facility over its useful economic life.

are not significantly different from those charged at public facilities.

Study Hypotheses

(1) The level of participation in recreational boating by a household is not significantly influenced by:

(a) Family income

(b) Family size

(c) Occupation of household head

(d) Age of household head

(e) Educational level of household head

(f) Place of storage of watercraft (during boating season)

(g) Number of watercraft owned

(h) Length of sampled watercraft

(i) Horsepower rating of watercraft motor

(j) Type of power system of watercraft

(k) Transportation of watercraft

(2) The rate of participation in recreational boating by a regional (county) population is not significantly influenced by:

(a) Travel distance

(b) Aggregate disposable income

(c) Per cent of households with incomes under \$3,000

(d) Per cent of households with incomes over \$10,000

(e) Population density

(f) Distance from a Great Lake

(g) Per cent of population composed of minority races

(h) Location with respect to an SMSA

(i) Number of commercial and public campgrounds in county

(j) Surface water acreage of county

(k) Number of public boat launching sites in county

(l) Number of hotels, motels, tourist courts, and camps in county

(m) Number of amusement and recreation service firms in county

(n) Number of registered recreational watercraft in county

(o) Occupations of county residents

Methodology

This study is designed to estimate regional variation in individual and aggregate participation rates in recreational boating in the State of Michigan. Least squares techniques will be used to estimate a linear equation for five Michigan Planning and Development Regions, as well as for the statewide sample. In addition, a second model will be used to investigate factors associated with aggregate boating participation rates of regional (county) populations. The investigation will also focus upon estimating the total amount of recreational boating undertaken in Michigan during calendar year 1968; its distribution in various geographic regions in the state, and among various segments of the population.

A sample of 21,764 registered watercraft owners was drawn from boat registration records maintained by the Michigan Department of State, Vehicle and Watercraft Registration Division. Approximately 10 per cent of all registered Michigan watercraft greater than 20 feet in length were selected from each county; and 5 per cent of the registered watercraft 20 feet or less in length were selected in a systematic sampling procedure.

A detailed questionnaire was mailed to the 21,764 boat owners selected in the final sample.[1] Follow-up post card reminders were mailed to survey non-respondents in three control counties: Ingham, Grand Traverse, and Leelanau. In addition, personal interviews were conducted among survey non-respondents in these three control counties.

Background of This Study and Data Sources

The data used in this study were collected in a survey of Michigan registered boat owners by the Recreation Research and Planning Unit, Department of Parks and Recreation Resources, Michigan State University. The data were collected originally by the Recreation Research and Planning Unit under a contract grant from the Waterways Division, Michigan Department of Natural Resources, in order to investigate problems of: (1) inventorying and analyzing current rates of watercraft use on a statewide basis; and (2) with developing quantitative projection techniques for forecasting future levels of recreational boating in various geographic regions of the state.

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[1]The survey questionnaire is exhibited in Appendix A.

CHAPTER II

THE NATURE OF THE DEMAND FOR OUTDOOR RECREATION

The preliminary chapter was largely devoted to a discussion of the historical roots of outdoor recreation in the United States. Two underlying themes were woven into (or implied in) the narrative: (1) Aggregate levels of participation in outdoor recreation activities--such as camping, picnicking, biking, swimming, hunting, fishing, boating, etc.--have been increasing over time; and (2) much of the required supply base for extensive activities such as recreation have been provided by means of public action through the political process.

In the present chapter, the focus will shift. Emphasis will be given to the factors which help to explain the nature and significance of demand; and which are associated with consumer behavior.

The Theory of Consumer Demand

Consumer behavior is concerned with the purchasing decisions of households. Thus a study of consumer demand attempts to isolate those variables which help to explain household consumption of goods and services. In this respect, participation in an outdoor recreation activity (say, boating) is not viewed as being different from any other economic choice problem facing the consumer to allocate certain portions of his income if he wishes to participate. Thus, the household is viewed as the major decision unit which decides how much outdoor recreation to buy at alternative prices, given the level of household income, the prices of alternative goods and services, etc.

There appear to be three conditions which force the individual consuming unit (the household) to make choices concerning the various quantities of goods and services which it consumes: (1) each consuming unit has a limited (finite) income; (2) each consuming unit has varied and unlimited (infinite) wants to be satisfied; and (3) each good or service to be consumed to satisfy a want may be acquired only at a (nonzero) price.[1] Given these three conditions, it becomes clear that the household cannot purchase unlimited quantities of goods and services. It must, therefore, select certain combinations from among all of those available (at nonzero prices). Further, it is assumed that, on the basis of available knowledge, most households will attempt to purchase a combination of goods and services which maximizes the total satisfactions of the members of that household group.

Within the mainstream of economic theory, there exists a body of generalized propositions relating to consumer behavior; the actions of individuals and households in their efforts to maximize satisfactions (utility). One of the earliest theories advanced to explain why consumers demand certain goods and services was that of Alfred Marshall:

> If a person has a thing which he can put to several uses, he will distribute it among these uses in such a way that it has the same marginal utility in all. For if it had a greater

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[1]Willard W. Cochrane and Carolyn S. Bell, The Economics of Consumption (New York: McGraw-Hill Book Company, 1956), p. 79.

> marginal utility in one use than another, he would gain by taking away some of it from the second use and applying it to the first .
>
> . . . .
>
> But when commodities have become very numerous and highly specialized, there is an urgent need for the free use of money, or general purchasing power; for that alone can be applied easily in an unlimited variety of purchases. And in a money-economy, good management is shown by so adjusting the margins of suspense on each line of expenditure that the marginal utility of a shillings worth of goods on each line shall be the same. And this result each one will attain by constantly watching to see whether there is anything on which he is spending so much that he would gain by taking a little away from that line of expenditure and putting it on some other line.[1]

This concept of demand, it should be noted, assumes that the rational consumer will seek to maximize utilities. As a number of later theorists have pointed out, Marshall--together with a group of earlier economists such as Jevons (1871) and Walras (1874)--assumed that utilities were independent, were a measurable quality of any commodity, and were additive. A later economist, building upon earlier work by Pareto and Edgeworth, challenged Marshall's assumptions concerning cardinal measurement of utility:

> Marshall's argument, therefore, proceeds from the notion of maximizing total utility, by way of the law of diminishing marginal utility, to the conclusion that the marginal utilities of commodities bought must be proportional to their prices.
>
> But now what is this "utility" which the consumer maximizes? And what is the exact basis for the law of diminishing marginal utility? Marshall leaves one uncomfortable on these subjects.[2]

Vilfredo Pareto is credited with originating the underlying foundation of the modern theory of consumer demand. Pareto departed

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[1]Alfred Marshall, Principles of Economics (8th ed.; London: MacMillan and Co., Limited, 1947), pp. 117-118.

[2]John R. Hicks, Value and Capital (2nd ed.; Oxford: The Clarendon Press, 1946), p. 12.

from the traditional subjective value theory, and did away with the assumptions of independent and additive utility. Further, he removed the major obstacle--the assumption of cardinally measurable utility. Pareto's contribution was to show that consumer tastes and preferences could be analyzed by means of indifference curves which require only ordinal measurement--the rank ordering of budgets.[1]

An indifference curve is a locus of points, or combination of goods each of which yields the same level of total satisfactions, and toward which the consumer is indifferent. It effectively portrays the choice problem facing the consumer, i.e., it forces the consumer to "give up" certain quantities of one good in order to obtain additional units of other goods, given a fixed budget constraint.[2] In order to construct an indifference curve, all that is required is to have the consumer rank order the various combinations (quantities) of two goods which he would be willing to purchase under a given budget level. The rank ordering of combinations of two goods (say x and y) can now be used to establish the boundaries of an indifference curve.

An indifference curve usually slopes downward to the right. That this is most often the case, can be illustrated by considering an example. Consider again the case of two goods (x and y), with units of good y on the vertical axis and units of good x on the horizontal

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[1]C. E. Ferguson, Microeconomic Theory (3rd ed.; Homewood, Illinois: Richard D. Irwin, Inc., 1972), p. 24.

[2]This principle serves as a basis for the concept of the marginal rate of substitution of one good for another. The marginal rate of substitution of, say, good x for good y (MRS_{xy}) is defined as the amount of y the consumer is just willing to give up in order to get an additional unit of x.

axis. An indifference curve is provided which shows the various combinations of the two goods which would be purchased under prevailing market prices and the individual consumers budget. If the indifference curve in such a diagram were perfectly horizontal, this would mean that the consumer was indifferent between combinations of the two goods (x and y), both of which contain the same amount of y, but one of which contains more units of good x. In order for this to occur, the consumer would have to be receiving enough units of good x to be saturated with it. The same relationship would hold true (in reverse) if the indifference curve were perfectly vertical in the diagram, i.e., the consumer would have to be receiving enough units of good y to be saturated with it.

The usual case, then, is one in which the indifference curve slopes downward to the right. In this situation, the consumer must give up units of one commodity, and this loss is compensated for by taking additional units of the other commodity in order for him to maintain constant satisfactions.[1] Indifference curves also are usually convex to the origin of the indifference map.[2]

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[1] Ibid., pp. 41-45.

[2] The curvature of an indifference curve is closely related to the degree of complementarity and substitutability between two commodities. The indifference curves for perfect substitutes, for example, would be downward-sloping straight lines. Indifference curves for two goods which are good complements, on the other hand, tend to approximate right-angle axes, with the origin of the two axes, showing a narrow range of substitutability between the two goods. Perfect substitutes may be regarded as the same commodity for all practical purposes. Complementarity and substitutability have considerable significance regarding consumer purchasing decisions. John R. Hicks, op. cit., pp. 42-51. For a more recent treatment, see J. R. Hicks, A Revision of Demand Theory (Oxford: The Clarendon Press, 1956).

Indifference curves are important tools in economic analysis. They may be utilized to obtain an individual consumer's demand curve for a particular good, and the consumer's income-consumption curve.

An income-consumption curve shows the relationship between the equilibrium combinations of two goods purchased at varying levels of money income with prices held constant. As a consumer's level of money income increases, his budget line[1] shifts, to points of tangency on successively higher indifference curves, defining new equilibrium combinations of goods. A line drawn connecting these equilibrium points is called an income-consumption curve. The income-consumption curve slopes upward to the right (positively) with "normal" goods. Engel Curves may be constructed directly from income-consumption curves, and are highly important in the study of household expenditure patterns. Such curves relate the amount of any good purchased to the consumer's level of income. The income elasticity of demand[2] may be related to the slope or curvature of an Engel curve.

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[1]The budget line is simply the individual consumer's budget restraint. In the two goods case (x and y), a consumer's opportunity factors consist of his level of income at a point in time, and the prices of goods x and y at a fixed point in time. The total units of good x which can be purchased at any one time is obtained by dividing the consumer's income (I.) by the unit price of good x (Px.). Likewise, the maximum number of units of good y which the consumer can purchase is I./Py. The budget line joins these two extreme points. Indifference curves show the consumers preferences for various combinations of the two goods, while the budget line shows the consumers "opportunity factor," i.e., it shows what it is possible for him to do. See, Richard H. Leftwich, The Price System and Resource Allocation (3rd ed.; New York: Holt, Rinehart and Winston, 1966), pp. 72-75.

[2]The income elasticity of demand is ". . . the proportional change in the consumption of a commodity, divided by the proportional change in income." Ferguson, op. cit., p. 47.

Engel's Law was formulated in nineteenth-century Belgium in an empirical study of the relationship between household incomes and expenditures on food. The law states that the proportion of the family income spent on food declines as income rises. Later researchers, expanding upon many implied relationships exhibited in the data collected by Engel, generally have attributed to him four basic propositions; namely, "As income increases:

1. The percentage of the income spent for food decreases.

2. The percentage of income spent for rent, fuel, and light remains the same.

3. The percentage of the income spent for clothing remains about the same.

4. The percentage of the income spent for sundries (items such as education, care of health, comfort, and recreation) increased rapidly.[1]

Over the years, many empirical studies have been made which have, in general, tended to support Engel's laws. Studies made in the 1950's, however, resulted in some modification in the four propositions stated above. A reformulation of these generalizations was made in order to reflect more current study results:

> As the income of families increases, the DOLLARS they spend for each important category of expenditure also rises, but the PERCENTAGES of total income spent for the various categories change in the following ways:
>
> 1. The percentage spent for food decreases.
>
> 2. The percentage spent for housing and household operation remains about constant.

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[1] Charles S. Wyand, The Economics of Consumption (New York: The Macmillan Company, 1938), pp. 220-21.

3. The percentage spent for clothing, transportation, recreation, health and education increases, as does the percentage saved.[1]

Most studies based upon the propositions of Engel's laws have been of the "static" variety, utilizing cross-section income distributions, and have assumed constant tastes. In order for the laws to be useful in prediction, however, ". . . they must also apply to changes in income from one time period to another."[2] A national study of leisure spending patterns of consumers was undertaken in 1963 by Dr. George Fisk[3] of the University of Pennsylvania. Using time-series data, Fisk traced the relationship between national leisure spending behavior and aggregate disposable personal income. For the period 1929-60, it was found that total measured leisure expenditures of consumers increased at approximately the same rate as aggregate disposable personal income, and slightly more rapidly than personal consumption expenditures. According to Fisk, "The impression conveyed by marketing periodicals that expenditures for leisure are rising 'explosively' stems from the redistribution of total measured leisure, which has produced rapid expenditures for items such as foreign travel, boats, toys, TV sets, and books."[4] Fisk's contention is that changes in tastes and preferences over time, resulting in expenditure

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[1]Benjamin S. Loeb, "The use of Engel's Laws as A Basis for Predicting Consumer Expenditures," <u>Journal of Marketing</u>, Vol. 20, No. 1 (July, 1955), p. 21.

[2]<u>Ibid</u>.

[3]George Fisk, <u>Leisure Spending Behavior</u> (Philadelphia: University of Pennsylvania Press, 1963).

[4]<u>Ibid</u>., p. 80.

redistribution to other leisure goods and services, have usually been mistaken for changes in the total (aggregate) level of leisure spending as a whole.

Within the expenditure categories included under total measured leisure,[1] computed per capita time series income elasticities indicated that foreign travel, pleasure boats, sporting goods, and durable and non-durable toys captured ". . . an increasing share of per capita expenditure increases relative to per capita increases in income." Expenditures for leisure (TML) projected to 1965 (in 1958 dollars) also indicated that average propensities to consume will remain relatively unchanged at about 8 or 9 per cent of per capita disposable personal income.

Engel's law is of considerable interest in this present study. The relationship between family income and level of participation in recreational boating will be explored further as a sub-hypothesis of the dissertation.

Growth in Outdoor Recreation Demand

In order to explore what is meant by the demand for outdoor recreation, it will be helpful at this point to return once again to indifference curves as a beginning point. It was noted, previously, that indifference curves may be used to determine an individual consumer's income-consumption curve, which allow construction of Engel

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[1]Total measured leisure (TML) spending was the sum of the outlays for recreation, reading, alcoholic beverages, and foreign travel (when available). Ibid., p. 7.

Curves. Indifference curves may be utilized, within a micro-static framework, to derive an individual consumer's demand curve for a specific commodity.

Whereas income-consumption curves trace out the changes in purchasing behavior of consumers when money income varies (relative prices of goods remaining constant); the consumer demand curve for a specific commodity relates quantities of that good purchased to market price (money income and prices of all other goods held constant). The demand curve can be derived from a price-consumption curve.[1] By plotting all points from the price-consumption curve (e.g., the number of units of a good purchased at observed market prices, where market price is given by the slope of the budget line), a demand curve can be traced out. The shape of the demand curve so constructed indicates a highly important principle--the law of demand: a demand curve nearly always slopes downward (negatively) to the right, so that with price plotted on the vertical axis and quantity on the horizontal axis the quantity of a good purchased per unit time varies inversely with price. As the price of a good rises, the corresponding quantity taken declines; or alternatively, as the price decreases, the amount rises.[2]

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[1]A price-consumption curve traces out the equilibrium quantities of two goods purchased when price ratios change (money income remaining constant). The curve connects the points of tangency between the budget line and individual indifference curves, created by changes in the market price ratio. Ferguson, loc. cit., pp. 49-51.

[2]An important exception to the law of demand is the so-called "Giffen good." In this special case, the quantity of the good demanded varies directly with price.

Up to this point we have considered demand only in terms of one consumer or household. Under real world conditions, however, the demand for any given commodity is the aggregate amount purchased by large numbers of households. The transition from individual demand curves to market demand curves is accomplished by summing the quantities demanded by each consumer at the various possible prices horizontally.

The term "demand," then, has a very specialized meaning. It represents a schedule which shows the various amounts of a product which consumers are willing and able to purchase at each specific price in a set of possible prices during some specified period of time. In an economic sense, it is often desirable to consider "effective demand;" the amount of a good or service which consumers are willing and able to purchase (pay for), versus the mere longing or want for certain products or services.

What causes a demand schedule to change? By definition, a theoretical demand curve involves a number of assumptions. Several "determinants" of demand must remain constant or fixed in order for one to define the location of a demand curve. The basic determinants of demand consist of: (1) the tastes or preferences of consumers, (2) the money income of consumers, (3) the prices of related goods, (4) consumer expectations with respect to future prices and incomes, and (5) the number of consumers in the market.[1] A change in any one of these determinants, since it will affect the data in the demand

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[1]C. R. McConnell, Elementary Economics; Principles, Problems, and Policies (New York: McGraw-Hill Book Company, 1960), p. 64.

schedule, will necessarily shift the location of the demand curve. A shift in the position of the demand curve (right or left) is regarded as a change in demand. A change in the demand schedule or curve, however, is different from a change in the "quantity demanded." A change in the quantity demanded is associated with movement from one point to another on a fixed demand curve. Such movement along the demand curve results from a change in the price of the commodity concerned.

The static assumptions of theoretical demand curves, as we have noted above, postulate fixed tastes and preferences of consumers. Tastes and preferences consist of a set of non-price variables which are difficult to measure and quantify. In the present study, considerable emphasis will be placed upon tastes and preferences as they relate to the demand for recreational boating.[1]

In Chapter I, several factors were cited as contributing to higher levels of participation in outdoor recreation (see page 3). One of the most important aspects of outdoor recreation demand centers around the relationship between recreation and the consumer's leisure time. It has been pointed out by many writers that Americans have generally held to a "work ethic" in times past; rejecting idleness or play and holding to strong social customs and mores favoring hard work

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[1]Sociological studies have shown, for example, that various elements of socio-economic status are correlated with the tastes and behavior of consumers. Measurable elements include occupation, education, family composition, age, place of residence, sex, and income. Since demand is, in part, a function of tastes and preferences of consumers, and tastes and preferences in turn are related to socio-economic factors, demand can be viewed as a partial function of such variables. See R. Havinghurst and K. Feigenbaum, American Journal of Sociology, Vol. 64 (January, 1959), pp. 397-411.

as a virtue. That the work ethic has been a strong force motivating peoples' behavior through the years is clear. The classical economists had some strong values and beliefs regarding work and leisure:

> . . . the consumption . . . of productive labourers is not all of it productive consumption. There is unproductive consumption by productive consumers. What they consume in keeping up or improving their health, strength and capacities of work, or in rearing other productive laborers to succeed them, is productive consumption. But consumption on pleasures or luxuries, whether by the idle or by the industrious, since production is neither its object nor is any way advanced by it, must be reckoned unproductive: with a reservation perhaps of a certain quantum of enjoyment which may be classed among necessaries, since anything short of it would not be consistent with the greatest efficiency of labour. That alone is productive consumption, which goes to maintain and increase the productive powers of the community. . . .[1]

Leisure may be considered as the time left over for use by the individual beyond that required for sleep, necessary personal chores and work. In this sense, one might think of "discretionary leisure" in the same way we think of discretionary personal income--a residual left over to the individual which may be used in a manner of his own choosing.

Recreation and leisure are highly correlated, although not synonymous. According to Clawson, leisure is ". . . all time beyond existence and subsistence time."[2] A consumer may choose to devote certain amounts of his leisure to outdoor recreation, as one major form of leisure time activity. It is clear that "time" is a scarce resource in an economic sense. One cannot accumulate a stock of time,

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[1]Cf. John Stuart Mill, Principles of Political Economy, ed. by Sir W. J. Ashley (New York: Augustus M. Kelly, 1961), pp. 51-52.

[2]Marion Clawson, Land and Water for Recreation, loc. cit., pp. 1-2.

however, as one might accumulate a stock of capital. One's leisure time budget may be completely filled or it may be overcommitted, with no residual amount available for recreation activities. As Linder puts it, there is a certain demand and a certain supply of time, and ". . . the demand by individuals is usually sufficiently high in relation to the supply to make time a scarce commodity. . . ."[1]

It has been estimated that the annual national time budget by the year 2,000 will total about 2,907 billion hours. Of this total estimated time, 1,794 billion hours may be taken up by work, school, housekeeping, personal care, and sleep. The remaining 1,113 billion hours could be available for leisure time activities (including outdoor recreation). This total would exceed the leisure hours available to Americans in 1950 by approximately two and one-half times. As nearly as can be determined from available data, approximately one half of the increase in projected leisure hours for the year 2,000 would result due to higher population. The remaining increase, however, would result from more leisure hours becoming available per capita.[2]

As nearly as can be determined, about 3 to 4 per cent of all leisure time (composed principally of leisure hours available daily, on weekends, for vacations and to the retired) is devoted to outdoor recreation activities. Thus, outdoor recreation is not seen to be the

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[1]Linder goes on to suggest that there is no reasonable analysis of time in the economic literature. Economists, he feels, typically assume consumption is an instantaneous act, having no temporal consequences. Time in working life is, however, treated as a scarce resource. See, Steffan B. Linder, The Harried Leisure Class (New York: Columbia University Press, 1970), pp. 1-8.

[2]Clawson, op. cit., p. 5.

major area of leisure time allocation for most of the population. One of the reasons which may contribute to this rather modest time allocation is that nearly 40 per cent of the estimated time available comes as daily leisure--after work or after school closes--and it is not sufficient to allow people to drive any distance to a recreation area or facility. Moreover, much of this daily leisure comes during periods of the year when climates do not permit participation in many kinds of recreation activities.

When daily leisure is excluded it appears that outdoor recreation occupies about 7 per cent of the aggregate leisure time available. It should be noted, however, that the percentage of all available leisure time taken up by outdoor recreation has increased rapidly over the last several decades; and, on the basis of available trends, will continue to increase in the future. In the future, retired, vacation, and weekend leisure probably will account for most of the increases in the leisure hours available on both an aggregate and per capita basis, particularly if future reductions in the length of the average workweek take place, resulting in a three-day weekend rather than reduced daily work hours.[1]

The average work week has been reduced considerably in the United States. In 1850, the average work week was about 69.8 hours. It declined to 60.2 hours in 1900, 44.0 hours in 1940, and 39.5 hours in 1960. By 1976 and 2000, the average work week is expected to drop

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[1] Ibid., p. 7.

to 36.6 hours and 30.5 hours, respectively.[1] Paid holidays are expected to increase: in 1960, the average worker received 6.3 paid holidays; by the years 1976 and 2000, it is expected that average paid holidays will increase to 8.5 and 10.1 days, respectively. Average paid vacation will also undergo change. In 1960, the average worker received 2.0 weeks of paid vacation time; by the years 1976 and 2000, the average paid vacation is projected to increase to 2.8 weeks and 3.9 weeks, respectively.[2]

The changing amounts and timing of leisure can have differential effects on various segments of the population. That is, available statistical information does not segment or classify the population in very fine divisions. The most that can be said about expected changes in leisure time is that the "average" worker will probably experience an increase in leisure. Specific population segments, such as those who own recreational watercraft, are thus "buried," insofar as they are only one group of people whose leisure time availability is computed (along with that for all other people) in a national aggregate account.

The Outdoor Recreation Resources Review Commission studies indicated that participation in seventeen different outdoor recreation activities amounted to about 4.4 billion separate "activity occasions" during the summer of 1960. ORRRC further estimated that, by the years

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[1] Outdoor Recreation Resources Review Commission, Projections to the Years 1976 and 2000: Economic Growth Population, Labor Force and Leisure, and Transportation, ORRRC Study Report 23 (Washington: U.S. Government Printing Office, 1962), p. 181.

[2] Ibid., pp. 68-71.

1976 and 2000, total participation could well expand to 6.9 billion and 12.4 billion activity occasions. A number of interesting population characteristics appear to be associated with participation: age, income, education, family size, occupation, and place of residence were all found to have significant effects upon both the amount and type of outdoor recreation in which people participate.[1]

Age was found to be highly important in influencing the type of outdoor activity engaged in. Studies indicated that as age increases, there is a decline in the most active recreation activities--bicycling, hiking, horseback riding, water skiing, and camping. Except for walking or driving for pleasure and fishing, however, participation in most outdoor recreation activities was found to decline with advancing age.

Income was very influential in influencing rates of participation, particularly those recreation activities requiring substantial outlays of money for recreational equipment--boating, water skiing, camping, horseback riding, etc. It was found that higher income groups most often participated in such activities. ORRRC also found that ". . . in general, participation tends to go up as income does." Participation rates were found to rise steadily between $3,000 family income and the $7,500-$10,000 class; beyond this level declining slightly. The association between income and recreation activity was very pronounced for metropolitan area residents.

Participation rates were found to increase directly with education levels, particularly for such activities as swimming,

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[1]Outdoor Recreation for America, loc. cit., pp. 27-32.

playing games, sightseeing, walking, and driving for pleasure. No consistent correlation was found between education and other forms of recreation activity.

ORRRC found that families tend to participate in outdoor recreation together. Approximately 60 per cent of the family heads surveyed (or their wives) indicated that the entire family participated in two of the same kinds of activities together.

A number of ORRRC studies indicated that occupation has considerable influence upon participation. However, the published study indicated that occupation was probably most influential with respect to levels of income and the amount of paid vacation associated with a particular job or position. However, professional people were found to enjoy the most recreation, and farm workers the least. Managers and proprietors participated at a rate which was less than the average for all occupations. Generally, the self employed (and their wives) also showed lower levels of participation than others.

Suburban residents and rural non-farm people were shown to have higher levels of recreation activity than city residents. Country residents tended to do more camping, fishing, and hunting, while city residents emphasized sightseeing, pleasure driving, picnicking and swimming most. People residing in rural areas, in general, showed the highest participation rates. Location and access to recreation areas and facilities appeared to be important factors in the higher levels of participation exhibited by country residents.

In a more recent study, Gillespie and Brewer carried out a household survey in the St. Louis Metropolitan Area to ". . . determine the quantity of recreation demanded by that population in relation to socioeconomic characteristics."[1] In this study, an econometric model was developed, using days of participation in "water-oriented outdoor recreation" as the dependent variable, and selected socioeconomic characteristics of the St. Louis (SMSA) population as independent variables. Water-oriented outdoor recreation was defined to include fourteen separate recreation activities, i.e., swimming, water skiing, ice skating, camping, picnicking, boating, boat fishing, hunting, sight-seeing, nature walks, golfing, hiking, and "others."

The effect of price (transport cost) on participation levels was assumed constant for purposes of the study. The SMSA population was treated as if it originated at a single point in space, where the structure of transport costs faced by all households in order to engage in recreation activities in a "vast rural mountainous area" adjacent to the metropolitan area was the same.

Continuous variables included in the model were annual family income, age of the head of household, education of the head of household, age squared, education squared, and the product of income and age. Dummy ("zero-one") variables were used in order to assess the effects of qualitative variables (occupation, sex, and race) upon participation rates.

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[1]Glenn A. Gillespie and Durward Brewer, "Effects of Nonprice Variables Upon Participation in Water-Oriented Outdoor Recreation," American Journal of Agricultural Economics, Vol. 50, No. 1 (February, 1968), pp. 82-90.

The coefficient of multiple determination (R^2) for the model was 0.62.[1] However, some variables were retained in the model which lacked significance at the .05 level (income, age, age squared, and sex of household head). The researchers claim generality of application of the model, stating that ". . . it may be used for predictive purposes for a population of a metropolitan area by use of the mean values of the socioeconomic characteristics of the population, multiplied by the number of families of that population." This explicit statement appears to be open to challenge. Coefficients between socioeconomic variables and recreation participation, it would appear, are implicitly assumed to remain constant over time. Clawson notes, for example, that "my best, but extremely rough, estimates of past changes in recreation use suggests that such coefficients have changed greatly in the past; and this at least suggests that they may change significantly in the future."[2]

Mueller and Gurin did a national study of outdoor recreation participation rates in 1959 and 1960, involving a cross-section of household heads and their spouses.[3] A total of 2,750 home interviews

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[1]The coefficient of multiple determination gives the percentage of the variance in the dependent variable explained by (or associated with) changes in the independent variables.

[2]Marion Clawson, "Effects of Nonprice Variables Upon Participation in Water-Oriented Outdoor Recreation: Comment," American Journal of Agricultural Economics, Vol. 50, No. 4 (November, 1968), p. 1039.

[3]Eva Mueller and Gerald Gurin, Participation in Outdoor Recreation: Factors Affecting Demand Among American Adults, ORRRC Study Report 20 (Washington: U.S. Government Printing Office, 1962).

were completed. Respondents were asked "how do you usually spend most of your leisure time, both indoors and outdoors, in the evenings, in your time off and on weekends?" Persons interviewed usually gave a spontaneous response, citing particular activities which were of interest to them.

In order to focus on participation in outdoor recreation activities, each respondent was later given a printed card, listing eleven outdoor activities: (1) outdoor swimming or going to a beach, (2) boating and canoeing, (3) fishing, (4) hunting, (5) skiing and winter sports, (6) hiking, (7) driving for sight-seeing and relaxation, (8) nature or bird walks, (9) picnics, (10) camping, and (11) horseback riding. Respondents were then asked whether they had engaged in this activity "not at all," "once or twice," "three or four times," or "more often," in the last year. Each person interviewed was also instructed to reply with respect to his own activities rather than those of the family as a whole.

Most of the findings of the study were presented by use of an "activity scale," constructed from the sequence of questions above. Each respondent was given a score of 1 for each of the above 11 activities engaged in four times or less, and a score of 2 for each activity engaged in more than four times in the past year. For the 11 activities studied, scores could thus range from 0 to 22. In addition to these ratings, a respondent was awarded an additional score of two for an activity which was mentioned spontaneously (before the activity card was presented); and an additional score of four was added if he spontaneously mentioned two or more of the 11 activities. Thus, the activity scale could range from 0 to 26.

The survey revealed that 38 per cent of all respondents participated in fishing during the previous year; 28 per cent had participated in boating and canoeing; 17 per cent in hunting; 19 per cent in hiking; 15 per cent in camping; 14 per cent engaged in nature study or bird walks; 7 per cent went horseback riding; 6 per cent engaged in skiing and other winter sports; 45 per cent participated in outdoor swimming or going to the beach; 66 per cent went on picnics; and 71 per cent went automobile riding for sight-seeing and relaxation.

Using the outdoor recreating "activity scale" as the dependent variable, Mueller and Gurin utilized a multiple classification analysis (a multiple regression technique) to determine the net influence of nine socioeconomic-demographic characteristics of the national sample of households. The independent variables included income, education, occupation, length of paid vacation, race, age, life cycle stage, region, and place of residence. The analysis was made separately for men and women. The nine socioeconomic-demographic characteristics explained about 28 per cent of the variation in the activity scale for men, and 29 per cent for women. For the total sample, the proportion of total variance in the activity scale explained by the independent variables was about 30 per cent.

The researchers conclude that ". . . it is clear that factors other than socioeconomic characteristics are major determinants of outdoor recreational activity. Such things as time available, the goals and interests which the individual seeks to promote in his leisure time, the leisure time preferences of other family members and friends, physiological factors, recreational experience in childhood, interest in such competing activities as golf and tennis or availability of facilities come to mind readily."[1]

The Outdoor Recreation Commodity

As was pointed out in the preliminary chapter, outdoor recreation has been produced historically by both the public and private sectors of the economy. According to some scholars, public production and public control of recreation resources has been more prevalent in the United States than private production. Existing data on the relative importance of public and private resources is, however, decidedly fragmentary.

The merits of public vs. private provision of recreation facilities and services will not be debated in this section. Rather, emphasis will be placed upon identifying some of the characteristics and peculiarities of the outdoor recreation commodity.

One of the peculiar attributes of outdoor recreation is that recreation areas and facilities are dispersed geographically over space. This means that the consumer must travel to the resource in order to participate in a particular recreation activity. Transfer costs, then, become an important item in the consumers family budget, to the extent that members of the household participate in outdoor recreation. As Kalter and Gosse point out:

> Usually the total disutility associated with the purchase of a good or service is approximated by the market price of that good or service. All other costs in terms of money, time, and bother are neglected as being of small magnitude relative to the purchase

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[1] *Ibid.*, pp. 26-27.

price. These latter costs can be called "transfer costs" and include any cost associated with the process of exchange.

The market prices or entrance fees for many of the most popular recreational activities are very low or even non-existent. Some public recreational sites are entirely supported by general tax funds while others charge only a small fee, often just for parking. Many private landowners permit free use of their land for recreational purposes. In the case of many forms of recreation, therefore, the transfer costs cannot be ignored because they outweigh the market price of the activity.[1]

One of the principal characteristics of outdoor recreation product, then, revolves around the nature of the pricing policy pursued on public areas. Many outdoor recreation facilities, it should be noted, are provided by the private sector (e.g., camping, golf courses, shooting preserves), and recreation services on such areas have been sold on the market in accordance with pricing rules which are not unlike the rules adopted in the sale of products from any other (private) investment project. However, in the case of the recreation facilities and services provided by the public sector, pricing policies have presumably not been in accordance with such rules, resulting in much outdoor recreation being provided to consumers at zero (or nominal) prices.[2] According to the National Ad Hoc Water Resources Council, for example:

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[1]Robert J. Kalter and Lois E. Gosse, "Recreation Demand Functions and the Identification Problem," Journal of Leisure Research, Vol. 2, No. 1 (Winter 1970), p. 47.

[2]For example, a recent survey of state legislation in 12 Northeastern States indicated that virtually no defined criteria was contained in laws authorizing state agencies to charge user fees for public campground use. Agency heads were simply authorized to charge such fees as they deemed "appropriate" and "reasonable" under a general grant of discretionary authority: R. S. Bond, M. I. Bevins, and P. R. Fiske, "Public Campground Policy in the Northeast," Unpublished

The recreational services of public water and related land resource developments are currently provided to the users free of charge or for a nominal fee, usually covering only a part of the cost. Thus, although it is known that there is a large and growing demand for these services, there is, in the formal sense, no well-established market for them and few data are available on market prices that reflect the value of the service provided by public projects. Under the circumstances, it becomes necessary to derive simulated market prices.[1]

The essential provision of Supplement No. 1 is that, in the absence of formal market pricing for outdoor recreation services, ". . . desirable uniformity in the treatment of recreation in the planning of projects and programs and in cost allocations will be accomplished through the application of unit values that reflect the concensus judgment of qualified technicians."[2] Supplement No. 1, then, would have a panel of experts which would (1) estimate the number of users for a particular recreation site, and (2) choose an acceptable price which, when multiplied by the estimated number of users, would give a figure which could be regarded as total tangible benefits (in dollar terms).

Supplement No. 1 implies that a single non-varying price is acceptable for evaluating the benefits generated by existing public

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Manuscript for a Regional Bulletin to be printed by the Massachusetts Agricultural Experiment Station Under Regional Project NEM-42, Economic Analysis of the Campground Market in the Northeast, March, 1973.

[1]Ad Hoc Water Resources Council, Evaluation Standards for Primary Outdoor Recreation Benefits, Supplement No. 1, June 4, 1964. Supplement to U.S., Congress, Policies, Standards and Procedures in the Formulation, Evaluation and Review of Plans for Use and Development of Water and Related Land Resources, Senate Document 97, 87th Congress, 2nd Session, October 29, 1962, p. 5 (in supplement).

[2]Ibid., p. 5.

recreation facilities, expansions contemplated for existing facilities and finite-sized new recreation areas. A further implication of this policy is that the price elasticity for each public recreation facility is infinite, i.e., that the demand curve is horizontal. According to this rationale, consumers are presumed to demand more of what already is provided at the existing price level.

Cicchetti, Seneca, and Davidson point out that the directives of Supplement No. 1 are inappropriate for such a complex problem as estimating the benefits of public recreation projects.[1] They point out that under normal expectations the demand curve for specific outdoor recreation activities within a given region would be downward sloping. Further, given a downward sloping demand curve, one introduces the problem of how to handle the estimation of recreation benefits in cases where the demand for a particular recreation activity is inelastic. They point out that policy makers faced with the problem of providing alternative recreation areas at different scale (supply) levels, would find "market" price inappropriate as the figure to be used in estimating tangible benefits which would accrue to the alternative projects.

If the equilibrium price defined where a downward sloping demand curve and an upward sloping supply curve were used, how would one handle the problem of a case where supply was increased? For example, if a larger supply was contemplated (i.e., a downward shift

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[1] Charles J. Cicchetti, Joseph J. Seneca, and Paul Davidson, The Demand and Supply of Outdoor Recreation (New Brunswick, New Jersey: Bureau of Economic Research, Rutgers University, June 1969), pp. 6-13.

in the supply curve, other things held constant), the intersection of the new supply curve and the old demand curve would result in a lower market price. The quantity of recreation presumed to be taken at this lower price would, accordingly, increase with the accompanying movement along the demand curve. However, as Cicchetti, et al., point out "If the demand curve is downward sloping . . . a crucial factor in comparing the benefits (at the alternative supply levels) is the price elasticity of this schedule." If, for example, both the "market" prices (say P_1 and P_2) fall in the inelastic portion of the demand curve, the benefits as measured by Supplement No. 1 procedures would give a result such that the tangible benefits generated by using P_1 (the higher price with smaller quantity) would be higher than the benefits calculated by use of P_2 (the lower price and higher quantity consumed), even though we would have a larger number of users at the larger scale of development.

Another issue which is closely related to the question of project evaluation is the aspect of reimbursement policy. In the literature, the practice of divorcing economic evaluation of resource development projects from considerations concerning reimbursement of project costs has come to be known as "the evaluation--reimbursement dichotomy."

Outdoor recreation has been practically a free good in the past, stemming largely from public policy decisions. Such policies, according to several scholars, have led to "premature excess demand" for outdoor recreation resources. As Stoevener and Brown note:

> . . . to insist upon compensation has important efficiency implications in itself. The good or service, when made available below cost, will be demanded not only by those able to pay the compensation but also by all those who value it more highly than the price at which it is actually obtainable to them. This

means an increase in use of the good or service, an increase in the use of other imputs with which the former is combined in production, an increase in the product produced by it, and corresponding decreases in the production of goods from which the factors of production have been withdrawn.[1]

Generally, decision making in the field of outdoor recreation has proceeded on the basis of insisting that recreation services be provided free (or nearly so), and that such practice could be justified on the basis of the meritorious nature of recreation in general. That is, in certain circumstances it may be argued that it would be inappropriate to insist upon recovery of project costs by means of compensation provided by project beneficiaries. The burden of this argument rests on the thesis that public investment projects for outdoor recreation resources have income distributive effects.[2] Even on purely intuitive grounds, it appears that recreation resource development projects do have some income distributive effects. However, in the case of outdoor recreation projects of a resource-based character (i.e., those located some distance from population centers, and which require that project

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[1]Herbert H. Stoevener and William G. Brown, "Analytical Issues in Demand Analysis for Outdoor Recreation," in Journal of Farm Economics, Vol. 49, No. 5 (December, 1967), p. 1298.

[2]Income redistribution is thought of technically as a conscious public policy directed toward relaxing the budget constraint faced by specific disadvantaged individuals or groups. Or, in other cases, ". . . as making provision for some items, catering to what are referred to as 'merit wants,' to enter into the consumption patterns of individuals whose incomes are inadequate for this purpose. Subsidization of producer goods and services via reimbursement policies, . . . has the effect of redistributing several stages removed from the point of intended impact with the consequent diffusion of redistributive effects among many individuals and groups not qualified on Welfare grounds." See, John V. Krutilla, "Is Public Intervention in Water Resources Development Conducive to Economic Efficiency?" Natural Resources Journal, Vol. 6, No. 1 (January, 1966), pp. 68-69.

beneficiaries necessarily incur significant transfer costs), predominantly higher-income groups would be the market segment catered to.[1]

A conscious public policy built upon a rationale of justifying the construction of outdoor recreation projects solely on the basis of income distributive effects does not appear warranted. While recreation projects do have such effects, ". . . their effectiveness must be questioned when they are employed as tools primarily for this purpose. This is true especially of outdoor recreation developments which cater predominantly to upper income groups.[2] By the same token, recreation developments located in low-income areas such as the urban ghetto may contribute toward a more equal income distribution.

Outdoor recreation areas represent a diverse set of characteristics. Public areas are administered by a large number of state, federal and municipal agencies. In addition, there are large numbers of private areas and facilities. All of these areas differ in terms of physical characteristics, chief uses, facilities provided, location with respect to users, etc. However, as Marion Clawson points out, many of these areas exhibit similarities which permit classification into fewer groups, thereby facilitating understanding and analysis. Clawson has suggested a three-fold classification of outdoor recreation areas, distinguished primarily upon the basis of economic

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[1]That is, relatively higher levels of family income would be required ordinarily before consumers would have adequate resources to (a) purchase recreational equipment, and (b) cover the transfer costs involved in travelling from home to the recreation area if they are to enjoy certain kinds of outdoor recreation activities (e.g., boating, camping, snow skiing).

[2]Stoevener and Brown, op. cit., p. 1297.

similarities: (1) resource-based areas, (2) user-oriented areas, and (3) intermediate areas:

1. Resource-based areas are characterized by their outstanding physical attributes. Major areas in this class would include national parks, national forests, some state parks, and some private lands such as large timberland ownerships, seashores, and major lakeshores. Such areas are usually located at considerable distances from major concentrations of population. Therefore, for most people, a visit to a resource-based area involves considerable travel, and thus both time and money in moderately large amounts. Visits to resource-based areas are those normally undertaken during extended vacation periods. Most resource-based areas are quite large in size, usually encompassing several thousand acres of land and/or water area.

2. User-Oriented areas lie at the other end of the scale for the most part. They consist chiefly of parks and playgrounds administered by city, county, or other local governmental units. Some private recreation service firms also fall in this category, such as golf courses, amusement parks and the like. Their most important characteristic is their closeness and ready accessibility to users. Travel distance (and therefore travel time and costs) are at a minimum for such areas. User-oriented areas are visited after school by children, after work by adults, and during the day by many mothers and small children. The use of these areas, then, is closely correlated with the free (or discretionary leisure) time available each day.

3. Intermediate areas lie between the other two types of areas geographically and in terms of use. They generally lie within

a range of 1-2 hours driving time from major concentrations of population. Visits to such areas typically involves all-day outings and weekend use. Less travel time and expense is involved in individual visits to intermediate areas than for trips to resource-based facilities. Federal reservoirs, state parks and private facilities fall into this area. Camping, picnicking, hiking, swimming, hunting, and fishing are usually the dominant activities undertaken at intermediate areas.[1]

Much of the participation in outdoor recreation tends to fall into a pattern such as that described in the classification system described above. In practice, however, there tends to be some overlap in use patterns at the various types of areas. The amount and timing of available leisure does appear to be closely related to where one participates in outdoor recreation. A change in the length of the average work week from five to four days, for example, would have the potential of altering present patterns of outdoor recreation. Shorter work weeks, together with higher real incomes and improvements in travel facilities, might mean an increased demand for recreation services and facilities at intermediate recreation areas, for example. Likewise, longer paid vacations might mean more time devoted to outdoor recreation during fall, winter, and spring periods rather than during the summer months, with consequent shifts in demand for various kinds of outdoor recreation resources. There is also the distinct possibility that increases in the amount of leisure time available will result in the pursuit of other types of cultural and educational activities, with

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[1]Clawson, Held, and Stoddard, _Land for the Future_, _loc_. _cit_., p. 126.

correspondingly less time and resources being devoted to outdoor recreation activities.

Public, Private and Mixed Goods

Exchange in the market place depends upon the existence of exclusive title among property owners to those goods which are to be exchanged. A consumer who wishes to obtain a particular commodity from a private supplier must ordinarily meet the terms of exchange set by that owner. An exclusion principle thus usually comes into play for those commodities which are exchanged on the private market. Consumers may be prevented from acquiring ownership rights or the right to use and enjoy many types of goods and services unless they are willing to pay the stipulated market price demanded by the owner or supplier.

Market exchange performs an important function in the economy. Among other things, the process of exchange provides a mechanism of communication between producer and consumer. A market bid by a consumer reveals his preference for particular goods and services and indicates to resource owners what types of commodities should be produced under prevailing cost conditions.

In recent years, considerable attention has been given in the theoretical literature to special resource allocation problems created by public provision of certain goods and services. A pure public (or social) good may be thought of as being at nearly a polar opposite from a private good. Much of the literature places heavy emphasis upon the non-market demand aspects of certain goods, and upon their "equal consumption" attributes. According to Musgrave, social wants are:

> . . . those wants satisfied by services that must be consumed in equal amounts by all. People who do not pay for the services cannot be excluded from the benefits that result; and since they cannot be excluded from the benefits, they will not engage in voluntary payments. Hence, the market cannot satisfy such wants. Budgetary provision is needed if they are to be satisfied at all. Determination of the required budget plan is complicated by two factors. . . . A primary difficulty arises because true preferences are unknown. A second difficulty arises because there is no single most efficient solution to the satisfaction of social wants or to the problem of supplying services that are consumed in equal amounts by all.[1]

The usual examples cited as public goods include such things as national defense, the judiciary system, police and fire protection, and public roads. Unlike most goods, national defense cannot be "consumed" in different quantities by different individuals. A person residing in California is as well protected as one who lives in Michigan. Put another way, the good provided is not finely divisible. National defense could not be sold in different quantities to different people. This leads to another major distinction to be made about public goods; another of their peculiar attributes is that they are "jointly supplied."

The rationale for considering outdoor recreation activities which utilize natural resources at a public park as public goods is due primarily to this jointness in supply characteristic. Maintaining adequate water quality at a public beach for one person at the same time provides clean water for other people. Once the cost of purifying the water has been covered, the additional cost of supplying clean water to other users is zero. As Cicchetti puts it:

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[1] Richard A. Musgrave, The Theory of Public Finance (New York: McGraw-Hill Book Company, Inc., 1959), p. 9.

> Outdoor recreation is a public good not because of the demand side of the market but because of the fact that a facility or natural resource is either provided or not in large indivisible lumps either as a pure public good or as a mixed good. Once provided up to the point of crowding or deterioration for future generations, the . . . cost of supplying user space or an additional visitor day is zero.[1]

The theoretical literature stresses for the most part that a pure public good is largely a polar case which is not often found in the real world; and that many goods and services, even though publicly provided, are actually mixed goods. We have already noted, for example, that outdoor recreation facilities, even though constructed with public funds, involve private costs. Even though public facilities are constructed and made available to public use at zero or nominal prices, it is significant that high user (or transfer) costs must be incurred by recreationists in order to transport themselves from their place of residence to the recreation facility. Transfer costs are usually highest for resource-based areas which are located some distance away from population centers. Outdoor recreation, then, usually involves both public and private components, and may be thought of as a mixed good.

Individuals may thus exhibit a private demand for camping in the Porcupine Mountains, reflected by a willingness to pay the transfer costs associated with travel to the campground. We may think of this as a private component of the recreation good. The fact that public funds were used to reserve the natural resources of the Porcupine Mountains area for public use serves as a public component of the

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[1]Charles J. Cicchetti, et al., op. cit., p. 32.

recreational camping good. The area is either provided or not, in a large lump, and the facility is thus "jointly supplied" to all who care to use it.

While it is true that the natural resources of the Porcupine Mountains area, in a wholistic sense, are not readily divisible, this may be treating the problem too simplistically. Special facilities constructed for the use of the public are divisible, and compensation may be required of those people who utilize the services made available (e.g., campsites, boat marinas, bathhouses, lockers, etc.). Even public ownership and control of nonproduced resources ("nature products") does not, in itself, preclude the possibility of defining certain divisible scarcities which may be rationed among users. According to Bator, the problem does not exist because of public ownership but rather because of institutional arrangements, difficulty in product identification, and the feasibility of keeping track of "what is consumed," and who consumes it. Tangible values and ownership title to certain factors are simply not assigned. In Bator's words:

> This is an . . . ownership externality. It is essentially an unpaid factor case. Nonappropriation, divorce of scarcity from effective ownership, is <u>the</u> binding consideration. Certain "goods" (or "bads") with determinate . . . values are simply not attributed. It is irrelevant here whether this is because the lake where people fish happens to be in the public domain, or because "keeping book" on who produces, and who gets what, may be impossible, clumsy, or costly in terms of resources. For whatever legal or feasibility reasons, certain variables which have positive or negative . . . value are not assigned axes.[1]

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[1]Francis M. Bator, "The Anatomy of Market Failure," The Quarterly Journal of Economics, Vol. LXXII, No. 3 (August, 1958), pp. 364-65.

Problems of Measuring Demand

Much of the theoretical work underlying techniques for measuring the demand for outdoor recreation has been contributed by Dr. Marion Clawson. In a paper presented at the University of Wisconsin on January 13, 1959, Clawson set forth some important principles underlying construction of economic demand curves for attendance at a single recreation site.[1] Using attendance data for Yosemite National Park in California, demand curves were approximated for California visitors, and out-of-state visitors. In estimating the demand curve for a particular recreation area, a two-stage procedure was employed: (1) construction of one curve for the total recreation experience, and (2) derivation of a demand curve for the recreation opportunity *per se*. The curve for the total recreation experience is based upon actual attendance figures for large numbers of people; and the curve for the recreation opportunity is derived from the first.

Throughout this chapter, emphasis has been placed upon the importance of transfer (or user) costs in discussing the demand for outdoor recreation. Any discussion of the outdoor recreation experience, then, cannot logically be limited to the actual on-site activity engaged in. If the definition of user costs is restricted to those incurred while the recreationist is at the site, the cost of the recreation experience would be slight, i.e., entrance or user fees at the site may be zero or very low in relation to the cost of the whole recreation experience. Actually, there is a "threshhold cost"

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[1]Marion Clawson, *Methods of Measuring the Demand for and Value of Outdoor Recreation*, *loc. cit.*, 36 pages.

which must be paid before one can enjoy an activity day of recreation. If one wishes to spend a day boating, for example, he must first purchase a boat, perhaps a trailer to transport it to a lake or pond, and also pay a registration fee if it is a powered watercraft. In addition, transportation costs (gasoline, highway tolls, food and lodging en route, etc.) must be paid, usually on a roundtrip basis. There may also be a launch or boat storage fee at the destination. Thus, the cost of the whole recreation experience is composed of an aggregate "package" of costs.

Clawson divides the whole recreation experience into five distinct phases: (1) anticipation, (2) travel to the actual site, (3) on-site experiences and activities, (4) travel back home, and (5) recollection.[1] Much discussion about outdoor recreation is confined to the on-site experience. This phase is presumably why a family goes to the bother of making a trip to a public or private campground. However, the on-site experience ". . . may be less than half of the total, whether measured by time involved, expense incurred, or total satisfaction gained."[2] Viewed in this way, then, the whole recreation experience consists of a set or package of satisfactions (or dissatisfactions) obtained through the various phases of a recreation trip. The sum of the satisfactions realized from the various phases of the experience would have to be balanced against the sum of the

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[1]Marion Clawson and Jack L. Knetsch, Economics of Outdoor Recreation (Baltimore: The Johns Hopkins Press, 1966), pp. 33-35.

[2]*Ibid.*, p. 34.

costs incurred in order to determine whether or not one would be willing to repeat any or all of the whole experience.

In constructing a demand curve for Yosemite National Park, Clawson assumes that the family is the unit which decides which recreation area it will visit. Even though family members may engage in different activities while at the park, it is assumed that an individual trip is jointly planned. Further, he assumes that members of the family realize satisfactions (or dissatisfactions) in the form of anticipation before the trip begins, from the actual on-site experience, and through recollections about the whole trip after returning home.

A demand curve based upon the concept of the whole recreation experience is assumed to be like the demand curve for other services and commodities. It is applied to large numbers of people, rather than to individuals. That is, any one person may have an individual demand curve which is extreme in some form, but a large group of people will together provide a more measurable and predictable reaction to an outdoor recreation opportunity. Moreover, it is assumed that if a demand curve for a large group of people can be constructed, ". . . then it is probable that another large group chosen more or less at random but with similar characteristics to the first group, will respond in similar fashion to costs and other characteristics of the recreation experience."[1]

Using attendance data from Yosemite National Park, Clawson separated the visits by point of origin of the visitors, and divided them into distance zones based upon one-way milage from the park. In

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[1] Clawson, op. cit., p. 15.

figuring distance zones, California residents were kept separate from visitors originating in other states. The total number of visitors from each distance zone was then divided by the population in that zone in order to obtain the estimated number of visits per 100,000 population. An estimated cost per visit was then calculated, using an average cost of $9.00 per day plus 10 cents per mile for car for double one-way distance (divided by four on assumption of 4 passengers per car). The number of visits per 100,000 population and the estimated cost per visit were then plotted, and demand curves were approximated for California residents and out-of-state visitors.

Calculation of the average cost per visit was based upon a major assumption--that travel to Yosemite Park was the chief purpose of the trip, and that it should, therefore, bear the costs of travel from home to the park as well as within the park. Despite the assumptions made about costs per trip, the approximated demand curves appeared to be much more price-elastic for distance zones closest to the park (where estimated costs per visit were lowest) than for the most distant zones on the eastern seaboard.

Building upon the Clawson technique, Brown, Singh, and Castle undertook a study involving economic evaluation of the Oregon salmon and steelhead sport fishery in 1964.[1] The researchers point out that there are some real limitations associated with the Clawson method of estimating demand. They point out that more than the monetary cost of

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[1]William G. Brown, Ajmer Singh, and Emery N. Castle, An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery, Technical Bulletin 78 (Corvallis, Oregon: Agricultural Experiment Station, Oregon State University, 1964), 47 pages.

the visit is involved in determining the number of visits per 100,000 population of various distance zones. The cost of the trip in time "would be one effect that could shift the demand curve to the right or to the left depending upon whether the visitor regards the travel time as pleasant or onerous."[1] Also, distance could be expected to shift the demand curve to the left for another reason: "The greater the distance a zone is from a particular recreation site, the greater are the number and appeal of available substitutes for that particular site, because other sites become relatively cheaper in time and money."[2]

The Oregon salmon-steelhead study employed the use of mail questionnaires. Based upon estimated cost per respondent and an estimated 50 per cent return, it was planned that 6,000 questionnaires be mailed. However, because response was greater than the expected 50 per cent rate, only 5,751 questionnaires were actually mailed. The researchers attempted to reduce error from memory bias by mailing questionnaires to anglers at the end of each month during the year 1962. Questions relating to expenditures made on fishing trips were thus answered on a monthly basis by respondents. Angler expenditures were obtained on a "per angler--family basis," rather than on a "per angler" basis. About 80 per cent of the questionnaires actually mailed were completed and returned by respondents.

Sport fishermen selected in the sample were divided into distance zones for the analysis. Using information from the returned mail questionnaires, average variable costs per angling day was

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[1] <u>Ibid</u>., p. 9.

[2] <u>Ibid</u>.

computed for each distance zone. Anglers were also asked to supply information on average miles per trip. An average miles per steelhead-salmon fishing trip figure was then computed for each distance zone. A significant relationship was found between number of fishing days taken per unit of population for each distance zone and average variable cost per day of fishing. Days of fishing taken was also found to have a significant relationship with average family income, and average miles per trip taken.

In 1967, Cole undertook a study of outdoor recreation preferences of households within the Philadelphia--Baltimore--Washington Metropolitan region.[1] The study was based upon 1963-64 household participation rates in pleasure riding, picnicking, walking, swimming, boating, camping, fishing, hunting, golfing, horseback riding, ice skating, snow skiing, tobogganning, and vacation and weekend trips. A mail questionnaire was used in the study. The questionnaire was mailed to a sample of 2,000 households in the study area by National Family Opinion, an independent polling firm. The completed questionnaires were returned to National Family Opinion as well. A total of 1,718 usable questionnaires were completed and returned by respondents.

Multiple regression analysis was used in the study, relating household participation in various outdoor recreation activities to: (1) socio-economic characteristics of respondents, (2) distance travelled to participate, (3) time required to participate, and (4) admission fees

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[1]Gerald L. Cole, "Toward the Measurement of Demand for Outdoor Recreation in the Philadelphia--Baltimore--Washington Metropolitan Region with Implications for Agricultural Resource Use" (unpublished Ph.D. dissertation, Michigan State University, 1967).

charged. In general, the coefficient of multiple determination was less than 0.50 for individual activities. Rates of participation in recreational boating were found to be positively correlated with both distance travelled and time required to reach a body of water where the boating activity took place. Within the sample area, there were no natural lakes. Suitable boating water was thus thought to be limited to the Atlantic Ocean, the Delaware and Cheasapeake Bays, and tributary rivers emptying into the bays or oceans. Participants indicated that they drove an average of 100 miles to reach water suitable for botaing. Publicly-owned mill ponds within the region restricted outboard motor size to 5 horsepower or less.

Participation in recreational boating was also found to be positively correlated with automobile ownership and household income of respondents. Automobile ownership and income level, as well as travel time and distance travelled, were also positively correlated.

Much of the empirical work undertaken in the past has concentrated heavily in two major areas: (1) prediction of participation rates of households based upon socioeconomic-demographic characteristics, and (2) construction of economic demand curves based upon estimated transfer costs between the zone of origin of participants and destination recreation areas. More recently, considerable attention has been placed upon the importance of supply variables in explaining variation in recreation participation rates. A number of researchers have pointed out the need for taking account of supply factors facing recreationists. According to Knetsch:

> Recreation demand studies, to be useful for planning purposes must consider the effect of both supply and demand factors on

> recreation use or participation. Use data in the form of population segment participation rates or visits to recreation areas must be obtained, but the interpretation should consider that both demand and supply variables explain or determine these rates. That is, the emphasis should be placed on determining and explaining patterns of use which emerge, given an availability of opportunities and the characteristics of the using population.[1]

One of the difficulties in utilizing socioeconomic factors such as family income, education level, average work week, family size, etc., to explain observed patterns of participation in outdoor recreation activities is that projections of future levels of use depend heavily upon the availability of recreation facilities (supply). Indeed, concentration upon projected increases in socioeconomic factors overlooks the fact that the required supply of recreation facilities ". . . may not be growing at the same rate--and in fact may not be growing."[2]

It has already been emphasized that outdoor recreation areas are dispersed geographically over space: and that the recreationist must travel to the point of supply in order to participate. The location of a household, then, with respect to a supply point may have an important influence upon the kind of recreation activities engaged in. This would appear particularly true if one accepts the "learning by doing" hypothesis. According to this proposition, outdoor recreation may be a good which is ". . . not demanded until supplied."[3]

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[1] Jack L. Knetsch, "Assessing the Demand for Outdoor Recreation," Journal of Leisure Research, Vol. 1, No. 1 (Winter 1969), p. 87.

[2] Cicchetti, Seneca, and Davidson, op. cit., pp. 38-39.

[3] Ibid., p. 33.

This suggests that people may acquire a taste for a particular outdoor recreation activity through "want creation," induced as a result of constructing recreation facilities.

A number of empirical studies mentioned in this chapter emphasize the difficulties involved in attempting to measure recreation demand. Such difficulties appear to arise for several reasons: public provision of areas and facilities, zero prices, and geographical dispersion of facilities and natural resources over space, giving rise to high transfer costs. The theory of consumer demand is not easily applied directly to such a market. Besides these problems, there is an even more fundamental consideration facing the researcher interested in empirical study of outdoor recreation demand: <u>the identification problem</u>.

The identification problem consists of difficulty in interpreting observations in the marketplace for any particular good, as quantities and prices in a supply-demand diagram trace out points of equilibrium between both the supply and demand curve. Traditionally, the identification problem has been most closely associated with interpretation of time series data, as supply and demand curves show the existing market conditions at only a given point in time; and existing market conditions may be expected to change. Indeed, ". . . the supply and demand curves which accurately represent the market situation of to-day will not represent that of a week hence. The curves which represent the average or aggregate of conditions this month will not hold true for the corresponding month next year."[1]

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[1]E. J. Working, "What do 'Statistical Demand' Curves Show?" <u>Quarterly Journal of Economics</u>, Vol. 41 (February, 1927), p. 217.

In analyzing time series data on attendance at a public park, a public boating marina, or other outdoor recreation facility, for example, an administrator or planner is faced with the problem of resolving the question as to whether changes in levels of use of the area reflect demand responses or supply responses, or both.

As Klein points out, what is observed in the market for any particular good at a moment in time is simultaneous solution of a system of three equations: (1) a demand function, where price equals a function of quantity demanded plus error, (2) a supply function, where price equals a function of quantity supplied plus error, and (3) a market clearing function, where supply equals demand plus error.[1] In cases where there is considerable variation in both the supply and demand function over time, estimation becomes difficult. There is no assurance that a demand pattern exists in such a situation--there may be a "mongrel" function. Some researchers hold the view that there is considerable variability in both the supply and demand functions in the outdoor recreation market:

> . . . it is widely assumed that price is not an explanatory variable in the supply function for most recreation services and that such a function is vertical in nature for any given time period because of its public provision. The relative shifts in the supply and demand curves over time are unknown. Thus, the essential elements required to trace the structural demand function are missing. Assuming that shifts over time in the supply function due to changes in public policy help in tracing the demand relationship is not sufficient if shifts in the demand relationship itself are unknown.[2]

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[1]Lawrence R. Klein, An Introduction to Econometrics (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1962), p. 10.

[2]Kalter and Gosse, *op. cit.*, pp. 47-48.

The present study will be cognizant of these problems in relation to empirical investigation of recreational boating. Reference to the "learning by doing phenomenon" has already been made. A person who is taken for a boat ride and "learns" something about operating a watercraft may, for example, then exhibit a demand for boating, assuming the experience was pleasurable. He may not have acquired any desire to go boating at all had he not learned by doing. In order for one to learn about boating, an accessible supply of boatable water would have to exist. Recreational boating participation may, then, be correlated with supply factors.

Recreational Boating--A Case Study

In 1960, it was estimated that 22 per cent of the United State's population 12 years of age and over engaged in boating one or more times. On a national basis, this represented a per capita rate of 1.22 occasions for the 3-month period June-August,[1] and all indicators point to the fact that recreational boating has grown very rapidly in popularity over the past several decades.

The popularity of recreational boating has also been readily apparent in the State of Michigan during the past several years. At the end of calendar year 1965, Michigan had a total of 398,902 registered watercraft, and ". . . at least another 100,000 rowboats and

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[1]Outdoor Recreation Resources Review Commission, National Recreation Survey, ORRRC Study Report 19 (Washington: U.S. Government Printing Office, 1962), p. 24.

other craft that do not require registration."[1] Beginning in 1958, all people owning and operating powered watercraft in the state were required to register them with the Michigan Secretary of State. A total of 217,533 watercraft were registered in the first year. By 1968, the number had risen to 438,017.[2] Table 1 shows the change in boat registrations, by length class, between 1965 and 1968.

Accompanying this steady growth in the size of the Michigan recreational boating fleet, there has been a substantial expenditure of public funds by the State of Michigan, the federal government, and local communities on the construction of public boat marinas. Virtually

TABLE 1.--Numbers of Registered Watercraft in Michigan, by Size Class, for Selected Years.

	Registered Watercraft Less than 20 Feet Total Length		Registered Watercraft 20 Feet or Greater Total Length		Total All Watercraft	
Year	No.	Per Cent	No.	Per Cent	No.	Per Cent
1965	337,763	94.8	21,139	5.2	398,902	100
1968	413,949	94.6	24,068	5.4	438,017	100

Source: Michigan Department of State, Vehicle and Watercraft Records Division.

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[1]Michael Chubb, Outdoor Recreation Planning in Michigan by a Systems Analysis Approach; Part III, The Parctical Application of Program RECSYS and SYMAP, Technical Report No. 12 (Lansing, Michigan; Michigan Department of Conservation, December 1967), pp. 11-12.

[2]Division of Vehicle and Watercraft Records, "Size and Type of Registered boats in Michigan Counties," Unpublished Report, Michigan Secretary of State's Office, December 31, 1968.

all of these public expenditures have been made for the construction of "Harbors of Refuge" on the Great Lakes (including Lake Michigan, Superior, Huron, Erie, Lake St. Clair, and connecting waters).[1] This Great Lakes marina development program has been undertaken largely by the Michigan State Waterways Commission. Table 2 gives a tabular summary of expenditures on the marina development program between 1964 and 1970.

TABLE 2.--Expenditures for the Michigan Waterways Commission Marina Construction Program, 1964-1970.

Biennium	Waterways Commission Expenditures	Federal Sources	Local Expenditures	Total All Sources
1964-1966	$1,708,505	$ 811,397	$ 195,664	$2,716,747
1966-1968	2,781,988	3,281,051	490,236	6,552,094
1968-1970	4,884,381	1,199,548	1,502,726	7,586,655
TOTALS	$9,374,874	$5,291,966	$2,188,626	$16,855,496

Source: Waterways Division, Michigan Department of Natural Resources.

As watercraft ownership and use has grown in popularity in Michigan, so to has interest in research on boating participation. A number of past studies have contributed to existing knowledge in this area. A 1965 survey, sponsored by the Michigan Waterways commission,

[1]Substantial expenditures of public funds have also been made for acquisition and development of public access sites and boat launching facilities on inland lakes and streams in the state. These expenditures have been made by a number of different state and federal agencies for the purpose of providing boating opportunities for the public. In addition, there are a number of commercial boat marinas throughout the state. A complete inventory of all such facilities is beyond the scope of this study, however.

estimated that approximately 16 million boat-use periods were generated by recreationists during the calendar year.[1] Most past research on recreational boating in Michigan has dealt with problems of (1) inventory and analyzing current levels of watercraft use on a statewide basis, and (2) with developing quantitative projection techniques for forecasting future levels of recreational boating in various geographic regions of the state. Past research has placed heavy emphasis upon systems science and systems analysis. Systems models have been developed in order to forecast future boating participation by means of origins and destinations of Michigan boaters. By utilizing collected survey data on boating use, component parameters of the model are "tuned" so that they will forecast boating use within a base year with acceptable accuracy. Component parameters are then changed in order to reflect expected conditions during a target year sometime in the future. Levels of boating participation are then predicted for each county in the state.[2]

While these past studies have contributed significantly to existing knowledge about current and expected levels of boating activity in the state, they have not dealt to any degree with factors associated with variations in individual and aggregate levels of boating

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[1]Michigan Department of Conservation, Waterways Division, Transportation Predictive Procedures: Recreational Boating and Commercial Shipping (Lansing, Michigan: Michigan Department of Commerce, 1967).

[2]See, D. M. Milstein and L. M. Reid, et al., Michigan Outdoor Recreation Demand Study; Volume II, Activities Reports, Technical Report No. 6 (Lansing, Michigan: Michigan Department of Commerce, 1966); J. B. Ellis, Outdoor Recreation Planning in Michigan by a Systems Analysis Approach, Part II, Technical Report No. 7 (Lansing, Michigan: Michigan Department of Conservation, 1966); also, Chubb, op. cit.

participation. The present study will examine the effects of specific variables upon individual and aggregate boating participation rates in several geographic regions of Michigan.

CHAPTER III

DATA COLLECTION PROCEDURES

The principal objective in this chapter will be to outline the research methods utilized in conducting this study. First, emphasis will be given to identification and description of the study area. Next, sampling procedures will be outlined. Finally, emphasis will be given to describing the procedures followed in preparing and distributing the mail questionnaire, and with data coding and processing.

The Study Area

In conducting this investigation, the sample area consisted of the entire state of Michigan. Data were collected from recreational watercraft owners in all 83 counties, as well as, from a sample of registered boat owners residing in other states. The principal objective of this study is to analyze regional differences in boating participation in the state. However, a second objective was to estimate the total volume of recreational boating undertaken in the state by Michigan residents.

Very little empirical research of this nature has been conducted in the past. The studies undertaken by Cole, Brewer and Gillespie cited in Chapter II were intensive investigations of factors associated with variation in recreation activity undertaken by largely urban populations in the Baltimore-Washington-Philadelphia region and the St. Louis, Missouri metropolitan area. This study differs from these two investigations in that it will explore the relationship between recreation participation rates for a single outdoor activity (boating) and specific variables over several regions. A series of five regions were selected for this study.[1]

The five regions selected for intensive investigation were chosen as a result of examination of previous empirical research. Studies conducted by the Outdoor Recreation Resources Review Commission suggest, for example, that recreation activities engaged in by rural non-farm residents differ from those pursued by urban residents. In those studies, rural people were found to have higher overall levels of recreation activity than city residents. Location and access to recreation areas and facilities appeared to be important in the higher overall levels of participation exhibited by rural residents.[2] The five regions selected for study were also selected on the basis of their location with respect to population centers (metropolitan areas) of the state, and the nature of the water resources and facilities

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[1]The only other study located which examined socio-economic characteristics and preferences of Michigan residents for recreational boating was one undertaken as a part of the Michigan Outdoor Recreation Demand Study. In that study, socioeconomic characteristics and preferences of respondents to a mail survey were analyzed for the 10 top counties of origin. The 10 top origin counties were ranked according to the number of usable questionnaires returned by respondents. The counties chosen also led the state in terms of the number of resident boat registrations. The 10 counties in the order ranked were Wayne, Oakland, Kent, Genessee, Macomb, Ingham, Kalamazoo, Calhoun, Jackson, Saginaw. See, John L. Needy, "Boating," in Michigan Outdoor Recreation Demand Study; Vol. II, Activities Reports, Technical Report No. 6 (Lansing, Michigan: Michigan Department of Conservation, 1966), pp. 10.24-10.32.

[2]Outdoor Recreation For America, loc. cit., pp. 27-32.

available to the residents of each region. For example, two of the regions selected contain one or more Standard Metropolitan Statistical Areas,[1] and both regions may be considered as major population centers. One of these regions borders directly on a Great Lake, while the other is situated in the center of the state with relatively little indigenous surface water area available for boating by the resident population. The other three regions selected for analysis are located in more rural portions of the state, and are typified by a more scattered pattern of settlement, different employment situations, and a relatively close access to surface water and boating facilities for recreational watercraft use.

The five regions selected as study areas for this investigation include: (1) Region 1-Detroit, (2) Region 6-Lansing, (3) Region 7c-Roscommon, (4) Region 10-Traverse City, and (5) Region 12A-Marquette. The counties included in the five selected regions are shown below:

(1) Region 1	Counties
	Wayne
	Monroe
	Washtenaw
	Livingston
	Oakland
	Macomb
	St. Clair

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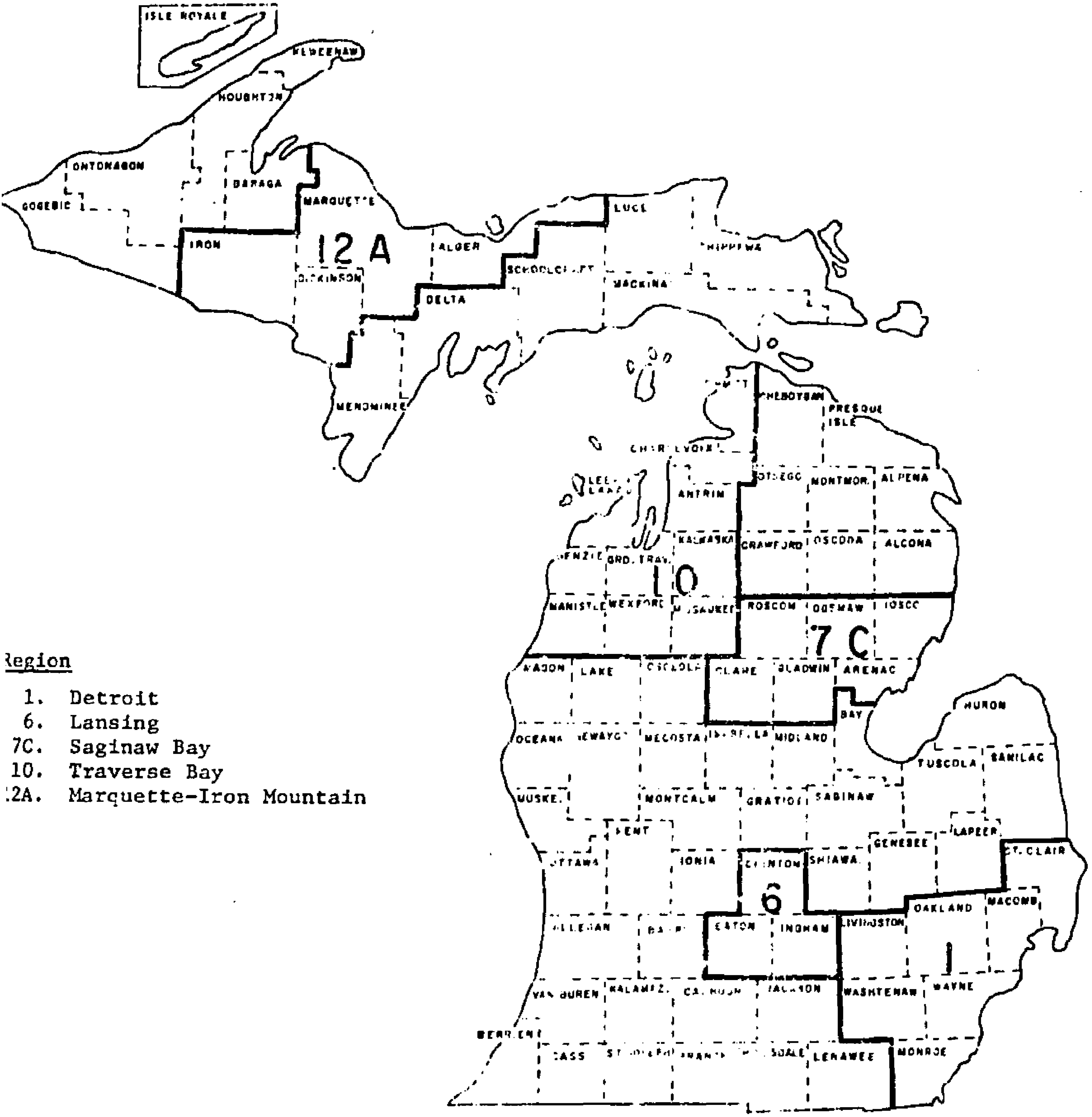
[1]A Standard Metropolitan Statistical Area (SMSA) is defined as a county or a group of contiguous counties which contains at least one city of 50,000 inhabitants or more; or "twin cities" with a combined population of at least 50,000. In addition, contiguous counties are included in an SMSA if they are essentially metropolitan in character, and are socially and economically integrated with the central city. See, U.S. Department of Commerce, Bureau of the Census, <u>U.S. Census of Population: 1960; Vol. I, Characteristics of the Population</u>, Part 24, Michigan (Washington: U.S. Government Printing Office, 1960), pp. XVII and XVIII.

(2) Region 6	Ingham Eaton Clinton
(3) Region 7c	Roscommon Ogemaw Iosco Clare Gladwin Arenac
(4) Region 10	Manistee Wexford Missaukee Benzie Grand Traverse Kalkaska Leelanau Antrim Charlevoix Emmet
(5) Region 12A	Iron Dickinson Marquette Alger

These five regions were selected from the official Michigan Planning and Development Regions, designated by the Executive Office of the Governor in February of 1968. Three of the regions selected are actually so called "recreation sub-plan regions," designated by the Michigan Office of Planning Coordination. Figure 1 shows the location of the selected study regions in the state.

The regions selected show considerable variation in socio-economic characteristics. Between 1960 and 1970, for example, two of the counties in Region 1 showed an overall population increase of more than 50 per cent (Livingston and Macomb). These counties are located in the immediate area surrounding the city of Detroit. High levels of population growth in the outlying counties of the region



Region

1. Detroit
6. Lansing
7C. Saginaw Bay
10. Traverse Bay
12A. Marquette-Iron Mountain

Figure 1.--Michigan Planning and Development and Recreation Sub-Plan Regions Utilized as Study Areas.

Source: Adapted from Official Map Delineating Michigan State Planning and Development Regions, February 1968.

suggest a continuation of suburban growth in the metropolitan region. By way of contrast, Wayne County (containing the City of Detroit), showed relatively little change in population between 1960 and 1970--a net increase of 0.1 per cent.

Region 6, consisting of the Lansing Standard Metropolitan Statistical Area (SMSA), showed a rate of population increase which was well above the state average. The two suburban counties of the region--Eaton and Clinton--showed the highest rates of population increase with 38.7 and 27.7 per cent, respectively. Ingham county (containing the cities of Lansing and East Lansing) showed a population increase of 23.5 per cent.

Three counties in Region 7C showed relatively high levels of population increase during the past 10-year period. In fact, Iosco county, with an overall population increase of 50.9 per cent ranked as the third fastest growing county in the state. Clare county showed a population increase of 43.3 per cent, and Roscommon county, with a net increase of 37.4 per cent, were among the top 10 "growth" counties between 1960 and 1970. Overall, this region showed the most rapid rate of population growth of all study areas examined. Houghton Lake and the City of Tawas on Lake Huron are both recreation resort centers. There is a considerable acreage of public land in this region, administered by state and federal agencies.

Region 10 showed a much more modest rate of population change than the other three regions. Manistee, Wexford, Missaukee, and Benzie counties showed a rate of population increase which was considerably lower than the state average of 13.5 per cent during the past 10 years.

Overall, the region's rate of population change was about 14 per cent between 1960 and 1970. Like region 7C, region 10 may be characterized as a resort-type area. A considerable amount of public land is open for outdoor recreation use on Manistee National Forest. State Parks and State Forest Campgrounds are also abundant in this region. Like Region 7C, Region 10 is close enough to many population centers in the state to be considered a week-end use area. Public and private campgrounds, boating facilities on Lake Michigan and inland lakes and streams, make this one of the states most attractive regions for outdoor recreation activities of all kinds.

Region 12A is located in Michigan's Upper Peninsula. It is a region which, with the exception of Marquette county, declined in population between 1960 and 1970. The four counties of this region are at about the mid-point geographically in the Upper Peninsula as one travels from east to west. The region has excellent access to two great lakes (Superior and Michigan), as well as excellent inland water resources for boating. Also, public recreation facilities are available in the region on both state and national forest areas. By and large, this region was selected because of its relative isolation from the population centers of the state. The driving distance involved is believed to preclude much recreational use in this area other than by the resident population over much of the year. Extended vacation trips are also made to this area by both Michigan residents and non-residents.

Pertinent population characteristics for the five study regions are included in Tables 3, 4, 5, and 6. Table 3 summarizes the population

TABLE 3.--Population of Regional Study Areas and the State of Michigan, and Percentage Change: 1960-1970.

Region and County	April 1, 1960	April 1, 1970	Percentage Change 1960-1970
REGION 1			
Wayne	2,666,297	2,669,604	0.1
Monroe	101,120	118,479	17.2
Washtenaw	172,440	234,103	35.8
Livingston	38,233	58,967	54.2
Oakland	690,259	907,871	31.5
Macomb	405,804	625,309	54.1
St. Clair	107,201	120,175	12.1
Totals	4,181,354	4,734,508	13.2
REGION 6			
Ingham	211,296	261,039	23.5
Eaton	49,684	68,892	38.7
Clinton	37,969	48,492	27.7
Totals	298,949	378,423	26.6
REGION 7C			
Roscommon	7,200	9,892	37.4
Ogemaw	9,680	11,903	23.0
Iosco	16,505	24,905	50.9
Clare	11,647	16,695	43.3
Gladwin	10,769	13,471	25.1
Arenac	9,860	11,149	13.1
Totals	65,661	88,015	34.0
REGION 10			
Manistee	19,042	20,094	5.5
Wexford	18,466	19,717	6.8
Missaukee	6,784	7,126	5.0
Benzie	7,834	8,593	9.7
Gd. Traverse	33,490	39,175	17.0
Kalkaska	4,382	5,272	20.3
Leelanau	9,321	10,872	16.6
Antrim	10,373	12,612	21.6
Charlevoix	13,421	16,541	23.2
Emmet	15,904	18,331	15.3
Totals	139,017	158,333	13.9
REGION 12A			
Iron	17,184	13,813	-19.6
Dickinson	23,917	23,753	- 0.7
Marquette	56,154	64,686	15.2
Alger	9,250	8,568	- 7.4
Totals	106,505	110,820	4.1
THE STATE	7,823,194	8,879,862	13.5

Source: Michigan Statistical Abstract, Ninth ed., 1972, Table I-5, pp. 33-36.

TABLE 4.--Median Family Income, and Per Cent of Families in Selected Income Classes, for Regional Study Areas and the State of Michigan: 1960 and 1970.

Region and County	1970			1960		
		Per Cent of Families With Income -			Per Cent of Families With Income -	
	Median Family Income (dolls.)	Less than Poverty Level[1]	$15,000 or More	Median Family Income (dolls.)	Under $3,000	$10,000 & Over
REGION 1						
Wayne	11,351	8.1	28.7	6,597	15.3	20.4
Monroe	11,398	5.7	25.4	5,892	15.5	12.6
Washtenaw	12,294	5.1	34.8	6,890	12.1	23.9
Livingston	11,551	5.1	29.2	5,775	18.3	13.0
Oakland	13,826	3.8	43.3	7,576	9.2	28.8
Macomb	13,110	3.6	36.1	7,091	9.4	20.2
St. Clair	10,125	8.5	20.8	5,546	20.5	11.2
REGION 6						
Ingham	11,193	6.5	27.5	6,393	12.8	18.2
Eaton	11,423	5.4	27.9	5,821	17.6	12.7
Clinton	11,014	5.2	23.0	5,636	18.7	11.3
REGION 7C						
Roscommon	6,895	14.7	13.1	4,477	33.3	8.8
Ogemaw	6,545	18.8	8.3	3,874	38.6	6.9
Iosco	7,165	13.3	8.9	4,602	26.5	7.2
Clare	7,547	15.4	10.0	4,400	33.7	4.7
Gladwin	8,157	10.7	10.2	4,481	32.7	4.9
Arenac	8,320	12.2	12.1	4,237	33.7	8.2

TABLE 4.--Continued.

Region and County	1970			1960		
		Per Cent of Families With Income -			Per Cent of Families With Income -	
	Median Family Income (dolls.)	Less than Poverty Level[1]	$15,000 or More	Median Family Income (dolls.)	Under $3,000	$10,000 $ Over
REGION 10						
Manistee	8,365	11.8	10.7	5,112	21.1	7.3
Wexford	8,024	12.4	9.6	4,865	24.9	7.8
Missaukee	6,820	17.6	7.6	3,678	37.9	6.1
Benzie	7,760	11.2	12.1	4,563	28.3	4.1
Gd. Traverse	9,542	7.3	18.1	5,259	20.6	11.0
Kalkaska	6,686	18.5	7.2	3,876	35.5	2.6
Leelanau	8,278	11.3	13.1	4,139	33.5	7.2
Antrim	8,043	9.9	11.7	4,002	34.2	6.5
Charlevoix	8,535	10.7	12.8	4,502	27.1	6.3
Emmet	8,610	10.3	16.4	4,694	26.7	5.5
REGION 12A						
Iron	7,443	10.6	6.0	5,043	25.5	6.2
Dickinson	8,316	10.2	10.2	4,770	26.5	6.3
Marquette	8,562	8.7	11.3	5,022	19.2	6.8
Alger	8,014	11.1	7.3	5,028	27.5	5.9
THE STATE	11,032	7.3	26.7	6,256	15.7	17.4

[1]The "poverty" definition is based upon an index of poverty income cutoff levels, adjusted by family size, sex of family head, number of children under 18 years of age, and farm and non-farm residence. Poverty income cutoffs are revised annually to allow for changes in cost of living reflected in the consumer price index. In 1969, the average poverty threshhold for a nonfarm family of four headed by a male was $3,745.

Source: U.S. Census of Population: 1960 and 1970, PC (1) C24, Table 44, p. 243, and PC (1) - C, Table 36, p. 185.

TABLE 5.--Percentage Distribution of Population by Residence Class for Regional Areas and the State of Michigan, 1960 and 1970.

Region or County	1960 Per Cent of Population Which Was -			1970 Per Cent of Population Which Was -		
	Urban[1]	Rural nonfarm	Rural Farm	Urban[1]	Rural nonfarm	Rural Farm
REGION 1						
Wayne	97.5	2.4	0.1	98.2	1.7	0.1
Monroe	27.7	61.1	11.2	35.0	52.4	12.6
Washtenaw	70.4	24.3	5.3	78.3	17.4	4.3
Livingston	12.7	72.1	15.2	10.9	77.2	11.9
Oakland	88.2	11.1	0.7	90.0	9.0	1.0
Macomb	87.4	10.9	1.7	92.2	6.8	1.0
St. Clair	49.5	41.5	9.0	53.9	48.6	5.3
REGION 6						
Ingham	82.1	13.8	4.1	85.6	11.4	3.0
Eaton	38.8	40.2	21.0	42.5	44.4	13.1
Clinton	21.9	50.3	27.8	21.3	57.9	20.8
REGION 7C						
Roscommon	0.0	96.5	3.5	0.0	84.2	15.8
Ogemaw	0.0	74.4	25.6	0.0	83.8	16.2
Iosco	0.0	91.3	8.7	41.9	50.7	7.4
Clare	0.0	86.1	13.9	16.2	68.8	15.0
Gladwin	0.0	68.7	31.3	0.0	83.2	16.8
Arenac	0.0	72.0	28.0	0.0	85.1	14.9
REGION 10						
Manistee	56.3	45.9	10.4	38.5	53.4	8.1
Wexford	54.8	37.1	8.1	50.8	44.5	4.7

TABLE 5.--Continued.

Region or County	1960 Per Cent of Population Which Was -			1970 Per Cent of Population Which Was -		
	Urban[1]	Rural nonfarm	Rural Farm	Urban[1]	Rural nonfarm	Rural Farm
Missaukee	0.0	61.6	38.4	0.0	73.1	26.9
Benzie	0.0	87.0	13.0	0.0	88.2	11.8
Gd. Traverse	55.1	35.3	9.6	46.1	46.1	7.8
Kalkaska	0.0	80.5	19.5	0.0	96.7	3.3
Leelanau	0.0	71.3	28.7	0.0	71.1	28.9
Antrim	0.0	80.7	19.3	0.0	85.2	14.8
Charlevoix	41.2	43.5	15.2	40.4	52.9	6.7
Emmet	38.6	47.2	14.2	34.1	57.1	8.8
REGION 12A						
Iron	21.9	72.6	5.5	19.4	77.1	3.5
Dickinson	73.4	23.3	3.3	71.2	26.5	2.3
Marquette	62.0	36.5	1.5	65.3	32.3	2.3
Alger	45.7	44.1	10.2	44.3	49.0	6.7
THE STATE	73.4	21.0	5.6	73.9	21.7	4.4

[1]Computed as a residual. The urban population consists of all persons living in: (a) places of 2,500 inhabitants or more incorporated as cities, villages, bouroughs, and towns . . . , but excluding persons living in rural portions of extended cities; (b) unincorporated places of 2,500 inhabitants or more; and (c) other territory, incorporated or unincorporated, included in urbanized areas. Population not classified as urban is rural.

Source: U.S. Census of Population: 1960 and 1970, PC (1) - C24, Table 43, p. 242; PC (1) - C, Table 35, p. 184.

TABLE 6.--Selected Employment Characteristics of Employed Persons for Regional Study Areas and the State of Michigan, 1960 and 1970.

Region and County	1960			1970		
	Per Cent in Manufacturing Industries	Per Cent in White Collar Occupations[1]	Per Cent Working Outside County of Residence	Per Cent in Manufacutring Industries	Per Cent in White Collar Occupations[1]	Per Cent Working Outside County of Residence
REGION 1						
Wayne	39.8	41.8	6.3	37.5	44.4	14.5
Monroe	43.1	31.8	35.2	41.7	34.8	46.8
Washtenaw	23.3	50.5	9.1	23.1	56.3	12.1
Livingston	31.7	35.3	30.7	34.5	41.8	41.1
Oakland	41.2	49.4	39.8	34.1	57.8	33.4
Macomb	46.6	41.2	47.6	42.3	47.2	42.4
St. Clair	33.0	36.8	13.1	35.6	39.9	20.7
REGION 6						
Ingham	24.5	49.4	5.0	21.4	55.0	8.7
Eaton	33.6	42.0	42.8	34.3	45.1	54.9
Clinton	31.4	30.0	47.7	31.4	39.4	60.5
REGION 7C						
Roscommon	11.4	47.5	11.1	15.2	45.6	11.0
Ogemaw	21.5	31.7	10.7	20.4	35.8	15.3
Iosco	17.1	40.7	3.5	14.3	45.2	7.2
Clare	30.1	32.0	18.2	28.2	37.8	25.0
Gladwin	26.7	32.9	31.8	40.4	33.5	39.1
Arenac	23.5	30.7	23.5	33.9	29.5	32.9

TABLE 6.--Continued.

Region and County	1960			1970		
	Per Cent in Manufacturing Industries	Per Cent in White Collar Occupations[1]	Per Cent Working Outside County of Residence	Per Cent in Manufacturing Industries	Per Cent in White Collar Occupations[1]	Per Cent Working Outside County of Residence
REGION 10						
Manistee	37.0	33.0	5.9	39.5	33.5	7.9
Wexford	29.9	39.3	8.4	30.4	42.3	5.4
Missaukee	18.8	27.7	24.9	22.0	35.4	38.6
Benzie	20.3	32.9	13.6	20.9	35.1	16.6
Gd. Traverse	19.0	43.2	4.6	17.7	49.8	5.1
Kalkaska	29.5	36.4	25.2	27.2	38.7	35.2
Leelanau	17.2	33.6	38.0	15.9	39.5	37.2
Antrim	30.3	29.7	15.7	40.6	32.7	19.7
Charlevoix	27.0	33.5	11.3	31.5	38.6	14.5
Emmet	13.2	42.0	5.5	15.5	45.7	7.6
REGION 12A						
Iron	5.5	33.1	4.5	8.9	40.8	15.2
Dickinson	27.2	39.1	10.3	21.8	43.3	10.0
Marquette	14.3	36.4	2.4	6.3	44.8	4.6
Alger	35.3	33.4	8.0	35.8	33.9	9.0
THE STATE	38.0	40.1	13.9	35.9	44.9	19.0

[1]Includes Professional, Managerial (except farm), clerical, and sales workers.

Source: U.S. Census of Population: 1960 and 1970, PC (1) - C24, Table 44, p. 243; PC (1) - C, Table 36, p. 185.

change for all five study areas between 1960 and 1970. Table 4 shows median family incomes for counties within the study regions, as well as a distribution of the percentage of families in low and high income classes. Table 5 gives a percentage distribution of regional populations by class of residence (urban, rural non-farm, and rural farm) for 1960 and 1970. Finally, Table 6 cites selected employment characteristics of the populations in the various study regions.

The Sample Design

There were two major objectives for this study: (1) to estimate the total volume of recreational boating undertaken in the state by Michigan residents, and its geographical distribution; and (2) to examine regional variations in recreational boating participation patterns. In approaching these two major objectives, one major assumption was made; namely, that the major recreational boating population in the state consists of households which have registered powered watercraft with the Michigan Secretary of State as required by state statute. This assumption was made after considering the major components of the system.

The Sample Universe

There appear to be at least four major segments in the Michigan recreational boating system. That is, recreational boating activity is believed to be generated by four sub-populations: (1) recreational boating undertaken in the state by registered boat owners who are Michigan residents; (2) recreational boating undertaken by Michigan residents who own unregistered watercraft (rowboats, canoes, unpowered sailboats and other craft); (3) boating done in Michigan by residents of other states who have powered watercraft registered with the Michigan Secretary of State; and (4) boating done in Michigan by non-residents who transport unregistered watercraft into the state.

In 1968, there were 438,017 watercraft registered in the records of the Division of Vehicle and Watercraft Records, Michigan Department of State. Of this total, an estimated 426,057 were owned by residents of Michigan. Another 11,960 watercraft were registered by residents of other states.[1] This population was considered as the sample universe for this study. While it was recognized that this delimitation meant that there would be "leakages" of unknown magnitude resulting from ignoring the other three components in the system, it was felt that registered watercraft owners accounted for most of the recreational boating in the state. Also, it appeared extremely difficult to obtain an adequate sample of watercraft users in the other elements of the system.

The Sample Unit

The sample unit selected for this study consisted of individual watercraft. In order to estimate boating use, it was felt that use data should be gathered for specific sampled watercraft. Accordingly, respondents to the recreational boating survey were requested to estimate the number of occasions of use for a single watercraft, identified by its Michigan registration number.

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[1]Unpublished records, Division of Vehicle and Watercraft Records, Michigan Department of State, 1968.

The Sample Frame

The sample frame consisted of a computer tape listing of all 438,017 registered boat owners in the state of Michigan. A copy of this tape was furnished on a loan basis by the Michigan Secretary of State's Office. The contents of this tape were transferred onto computer tapes at the Michigan State Computer Laboratory.

Drawing of Sample

A stratified random sampling procedure was used in this study. A review of previous research of recreational boating was first made. A 1965 survey completed by Arthur D. Little, Inc., for the Waterways Division, Michigan Department of Conservation[1] also employed as stratified sampling procedure. The 1965 survey stratified registered watercraft into two length classes: (1) watercraft 20 feet and less total length, and (2) watercraft greater than 20 feet total length. A total of 398,902 recreational watercraft were registered in the state at the time of the 1965 survey: 377,763 in the 20 feet or less class, and 21,139 in the over 20 feet class.

According to the 1965 survey, watercraft were stratified into these two length classes because ". . . completely random sampling would not give . . . a good response from the boats over 20 feet." However, the researchers note also that sample size ". . . was largely determined by the funds available. . . ."[2] Mail questionnaires were finally mailed to owners of 2.5 per cent of the registered watercraft 20 feet

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[1] _Transportation Predictive Procedures_, _loc_. _cit_., 1966.

[2] _Ibid_., p. 24.

or under, and to the owners of 20 per cent of the boats over 20 feet. A total of 9,444 questionnaires were mailed to owners of the smaller watercraft, and 4,226 to owners of larger watercraft for a grand total of 13,670. A total of 3,643 usable responses were received from owners of watercraft in the 20 feet or less class, and 1,575 returns were received from boat owners in the over 20 feet class. Overall, returns to the mailed questionnaire average about 38.2 per cent.

In the present study, an attempt was made to secure data from the 1965 survey on boating participation rates in order to analyze variance in boat use as a basis for determining sample size. However, given time limitations and scarce research funds, such analysis could not be completed in time for the survey. In the 1965 survey, 13,670 questionnaires were mailed, and 5,218 usable responses were received (a 38.2 per cent return). The present study was undertaken with the assumption that a similar rate of response could be obtained in 1968.

Based upon the response received in 1965, it was decided to try to secure about 8,800 usable responses in the 1968 survey. Watercraft were again stratified into two length classes: 20 feet or less, and greater than 20 feet. In 1968, there were 413,949 registered watercraft in the 20 feet and under length category, and 24,068 registered craft in the over 20 feet class. In order to obtain approximately 8,800 usable responses, a decision was made to sample 5 per cent of the watercraft in the 20 feet and less class, and 10 per cent of the watercraft in the over 20 feet class. Thus the sample size was determined by multiplying these factors by the number of registered boats in the two length classes:

.05 (413,949)	=	20,697
.10 (24,068)	=	2,406
Total Sample		23,103

A systematic sampling procedure was used in actually drawing the sample. The sample was drawn through use of the CDC 3600 computer at Michigan State University. A computer tape containing the entire list of registered watercraft owners in the state was utilized. In order to draw the desired number of sample watercraft from each length class, a sampling interval was computed. The computer was then programmed to select every twentieth watercraft 20 feet or less in length, and every tenth watercraft over 20 feet in length for each county. Computer programming errors reduced the number of watercraft finally selected to 21,764. Names and addresses of owners of the registered boats selected were printed on self-adhesive address labels. Each label contained the name and address of the watercraft owner, the registration number of the boat selected, and the length of the boat.

The Mail Questionnaire

Early in the study, a decision was made to develop a self-administered mail questionnaire for use in the collection of data on recreational boating participation in the state. Initial drafts of the questionnaire were prepared in early October, 1968.[1] After a first draft of the instrument had been prepared, the questionnaire was subjected to a series of revisions and pre-tests. A series of meetings were held with staff of the Waterways Division and Recreation

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[1]The questionnaire used in this study is exhibited in Appendix A.

Resource Planning Division, Michigan Department of Natural Resources. Several drafts of the questionnaire were prepared during these consultations.

Following this series of revisions, the questionnaire was mimeographed, and was pretested under a cover letter through distribution to 50 known registered boat owners among the staffs of the Michigan Department of Natural Resources, the Natural Resources Division, Michigan State University, and St. Lawrence Hospital, Lansing, Michigan. The pre-test disclosed several ambiguous questions, and a final draft of the questionnaire was prepared, incorporating changes suggested by pre-test versions of the instrument completed and returned by respondents.

A final draft of the questionnaire was prepared at this stage. The first page of the questionnaire consisted of a cover letter written by the Director of the Waterways Division, Michigan Department of Natural Resources. On the reverse side of the cover letter, an outline map of Michigan was provided showing county boundaries, and principal highway routes in the state. The map was provided in order to assist respondents with answering questions pertaining to the county location of recreational boating undertaken. The cover letter, which also gave the mailing address of respondents, was perforated at the margin so that persons completing the questionnaire could tear off the first page in order to insure an anonymous response.

There were six principal categories of questions included in the mail questionnaire: (1) information on specifications and type of watercraft sampled; (2) place of storage of watercraft during boating season; (3) transportation of watercraft during study year; (4) use of recreational watercraft during study year--calendar 1968; (5) number of (registered and unregistered) watercraft owned by respondents; and (6) family characteristics of respondents.

An instructions block was printed at the top of page 3. These instructions requested respondents to answer questions 1-13 for the specific watercraft drawn in the sample. That is, respondents were asked to provide information asked for in these questions for the watercraft bearing the Michigan registration number printed in the address label on the cover letter.

Mailing Procedures

The questionnaire, in final form, was printed and folded by the University Printing Service, Michigan State University. In order to facilitate the mailing, self-adhesive address labels, printed by the Michigan State University Computer Center at the time of sampling, were affixed to the cover letter of the questionnaire. Approximately 80 per cent of the address labels did not have postal zip codes printed on them. Since postal zip codes are required by the United States Postal Service for bulk mailing, all missing zip codes had to be checked in a zip-code directory and posted on labels by hand.

Self-adhesive address labels were attached to the latter of transmital in a pre-marked box at the upper left-hand corner of the page. Folded questionnaires were then placed in window envelopes bearing the return address of the Michigan Waterways Commission. A postage-free return envelope was also included with each mailed questionnaire. The questionnaire was mailed during the last two weeks of April, 1969.

Response to the Questionnaire

Completed questionnaires were returned to the Waterways Commission Office in Lansing. The returned questionnaires were picked up at the Commission offices by staff of the Recreation Research and Planning Unit at Michigan State University.

A total of 6,800 questionnaires were completed and returned by sampled watercraft owners. Of this total, 250 responses had to be discarded because of a decreased owner, incomplete information provided, or sale or disposal of the sampled watercraft during the study year. A total of 5,647 questionnaires were retained for statistical analysis. Table 7 shows the distribution of returned questionnaires by boat-length class.

A detailed breakdown of numbers of questionnaires used for statistical analysis is given in the Appendix section for each Michigan County.[1]

Non-Respondent Interviews

A large sample size (23,103) was established for this study as it was anticipated that no follow-up procedures would be employed. One technique for increasing the rate of response on mail surveys is to send out a series of reminders to non-respondents on predetermined dates following the initial mailing of the survey questionnaire.

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[1]See Appendix B.

TABLE 7.--Number of Questionnaires Mailed, and Number of Responses Retained for Statistical Analysis, by Boat-Length Class.

Boat Length Class	Number of Michigan Registered Watercraft December 1968	Number of Questionnaires Mailed April-May 1969	Number of Questionnaires Retained for Analysis	
			Number	Per Cent of Total Registered
20 Feet or Less	413,949	19,468	5,049	1.22
20 Feet or Above	24,068	2,296	598	2.49
Totals	438,017	21,764	5,647	1.29

Source: Michigan Secretary of State, "Size and Type of Registered Boats in Michigan Counties," Unpublished Report, 1968.

Insufficient research funds were available for this purpose during the study. However, an attempt was made to assess the reliability of responses obtained in the returned questionnaires. Accordingly, a series of respondent and non-respondent interviews were conducted following mailing of the survey instrument.

Follow-up procedures were employed in three pre-selected control counties in Michigan: Ingham, Grand Traverse, and Leelanau. Initial mail questionnaires sent to registered boat owners in these three counties were coded on the last page, including the name and address of the sampled boat owner, and the Michigan registration number of the sampled watercraft. A master check-list of all sampled watercraft in the three control counties was prepared. As completed questionnaires were returned, they were compared with this master checklist. Thus, survey non-respondents could be identified following the cut-off date established for return of the questionnaire.

In order to assess the effects of a mail follow-up on the rate of response obtained, two follow-up post cards were also sent to sampled watercraft owners in the three counties. The first reminder was mailed on June 1, 1969, and the second on June 15, 1969. Overall, the response to the mail questionnaire was 26 per cent for the entire sample. A somewhat higher rate of response was obtained in the three control counties, however. Table 8 summarizes the rate of response to the mail survey realized in the three control counties.

TABLE 8.--Questionnaires Mailed and Returned, and Percentage Response for Survey Control Counties.

Survey County	Number Registered Watercraft December 1968	Number of Questionnaires Mailed April-May 1969	Number of Questionnaires Completed and Returned	Per Cent Response
Ingham	13,351	638	216	33.9
Grand Traverse	4,845	226	64	28.3
Leelanau	1,897	89	35	39.3
Totals	20,093	953	315	33.1

Source: "Size and Type of Registered Boats in Michigan Counties," 1968.

In the three test counties, all sampled watercraft owners who had not returned completed questionnaires six weeks following the initial mailing were classified as non-respondents. All non-respondents in these three counties were listed on a checklist and assigned a number. A checklist was also developed for all mail survey respondents. Using a table of random numbers, 200 names were chosen from the respondent and non-respondent checklists for follow-up interviews. A total of 50 survey respondents were chosen in this fashion (25 from Ingham County, and 25 from Grand Traverse and Leelanau counties combined). The same procedure was utilized in selecting non-respondents: a total of 150 names were drawn from the non-respondent checklist (75 from Ingham county, and 75 from Grand Traverse and Leelanau counties combined). A larger number of non-respondents than respondents was selected for interview as it was felt that the possibility of having significant differences in information provided in the survey between respondents and non-respondents was a problem which should be investigated.

Personal interviews were conducted among a total of 85 survey non-respondents and 35 respondents during July and August of 1969. The interview schedule used consisted of the mail questionnaire in the same form as was distributed in the initial mailing. A total of 13 respondent and 34 non-respondent interviews were completed in Ingham county. In Grand Traverse and Leelanau counties (combined), a total of 22 respondent and 51 non-respondent interviews were conducted. All interviews were completed by staff of the Recreation Research and Planning Unit, Department of Park and Recreation Resources, Michigan State University.

Information collected in this series of interviews was coded and key punched. These data were subjected to statistical testing in order to determine if significant differences existed between information provided by survey non-respondents and respondents. On the basis of a chi square analysis completed in 1970, it was concluded that (in the three test counties):

1. There is no significant difference in the educational level of respondents and non-respondents to the 1968 recreational boating survey.
2. There is no significant difference in family incomes of respondents and non-respondents.
3. There is no significant difference in the amount of recreational participation by respondents and non-respondents to the 1968 boating survey.
4. There appears to be no real difference in the geographical distribution of recreational participation by respondents and non-respondents ". . . although a small sample size prevents the drawing of a final conclusion in this regard."[1]

Data Processing and Coding

A total 5,647 questionnaires returned by respondents were retained for statistical analysis. Information from the questionnaires was transferred directly onto specially printed optical scan forms, prepared in consultation with the Evaluation Services Office, Michigan

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[1]Allison Jean Igo, "An Analysis of the Validity of Mail Surveys for Use in Recreation Research" (unpublished Masters Thesis, Michigan State University, 1971), p. 91.

State University.[1] After coding was completed, optical scan sheets were processed by University Evaluation Services. IBM punch cards were produced directly from the optical scan forms. A complete printout of entries made on punch cards was obtained for each county in the state. Printout information was cross referenced to the original questionnaires for each county in order to correct coding errors. The corrected IBM punch cards were then processed at the Michigan State University Computer Laboratory. The data from all cards was transferred to magnetic computer tapes for statistical analysis.

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[1]Optical scan sheets utilized in this study are exhibited in Appendix C.

CHAPTER IV

RESULTS OF THE INVESTIGATION

This chapter is devoted to an analysis and presentation of selected data and information collected in the 1968 survey of registered boat owners in Michigan. Frequency of boating participation information was provided by each respondent to the survey in questions 10 and 12 in the mail questionnaire.[1] Sampled watercraft owners were asked to provide estimates of the number of boat days (activity occasions) spent on: (a) Great Lakes and connecting waters, and (b) inland lakes and streams during the previous boating season, and the Michigan county where such boating activity occurred.

Geographical Distribution of Boating Participation

In question 10, watercraft owners were asked to ". . . name the three Great Lakes or connecting waters counties where this boat was used during the past boating season." Respondents were instructed to count each part day spent boating as a full day. Total boating days as provided by respondents, then, is actually an estimate of the number of boating activity occasions. The preceeding question (number 9) defined Great Lakes and connecting waters. For purposes of the study, Great Lakes and connecting waters were defined to include Lake Huron, Lake Erie, Lake Superior, Lake Michigan, Lake St. Clair, the St. Mary's

[1]See Appendix A.

River, the St. Clair River, and the Detroit River. To assist respondents in naming the Michigan county where boating activity was undertaken, a map was provided in the questionnaire on page 2. The map showed the boundaries of all Michigan counties, and the principal highways in the state.

Question 12 requested boating participation information for activity undertaken on inland lakes and streams in the state. Specifically, respondents were asked to ". . . name the three Michigan counties where this boat was used most on inland lakes and streams during the past boating season. Give the number of days that this boat was actually in the water under power or sail in each of these counties." To assist respondents in answering the question, one line in the boxes provided in both questions 10 and 12 was reserved as an example.

Based upon information obtained in questions 10 and 12, total boating activity estimates were made for each county in Michigan. Boating activity estimates were made for origin and destination counties. An origin county is defined as the county where the sampled watercraft owner makes his permanent residence. Destination counties, on the other hand, are those counties where recreational boating activity actually took place. Thus, estimates of recreational boating for an origin county consists of all boating activity generated by the sampled watercraft owners who resided in that county at the time of the survey. Recreational boating at destination counties consists of estimated activity occasions undertaken by sampled watercraft owners from a particular county in all other counties of the state. Table 9 gives a tabular summary of estimated total boating activity occasions for each Michigan

TABLE 9.--Estimated Population, Boat Days, Sample Size, and Calculated Boat-Use Periods Per 1,000 Population, by Michigan Origin County, 1968.

County	(1) Total Population[a] 12/31/68 (000)	(2) Estimated Total Boat Days 1968 Season	(2÷1) No. Boat Days Per 1,000 Pop.	Sample Size
1-Alcona	5.6	16,120	2,878.57	N= 18
2-Alger	8.0	30,517	3,814.62	N= 9
3-Allegan	60.0	114,676	1,911.26	N= 57
4-Alpena	30.4	108,641	3,573.71	N= 39
5-Antrim	9.8	87,800	8,959.18	N= 36
6-Arenac	9.5	12,037	1,267.05	N= 10
7-Baraga	7.7	28,376	3,685.19	N= 11
8-Barry	31.4	135,501	4,315.31	N= 57
9-Bay	114.7	137,510	1,198.86	N= 71
10-Benzie	7.5	40,793	5,439.06	N= 18
11-Berrien	169.4	222,569	1,313.86	N=114
12-Branch	35.7	113,403	3,176.55	N= 62
13-Calhoun	146.0	270,077	1,849.84	N=106
14-Cass	37.8	172,364	4,559.89	N= 66
15-Charlevoix	16.0	59,186	3,699.12	N= 34
16-Cheboygan	14.4	78,298	5,437.36	N= 28
17-Chippewa	35.3	98,731	2,796.91	N= 26
18-Clare	12.9	17,263	1,338.21	N= 21
19-Clinton	45.1	63,264	1,402.74	N= 33
20-Crawford	5.7	17,358	3,045.26	N= 6
21-Delta	33.2	57,657	1,736.65	N= 34
22-Dickinson	23.9	44,603	1,866.23	N= 25
23-Eaton	58.5	89,204	1,524.85	N= 62
24-Emmet	16.8	76,978	4,582.02	N= 38
25-Gennessee	442.4	590,340	1,334.40	N=317
26-Gladwin	10.6	21,511	2,029.33	N= 16
27-Gogebic	19.8	25,892	1,307.67	N= 21

TABLE 9.--Continued.

County	(1) Total Population[a] 12/31/68 (000)	(2) Estimated Total Boat Days 1968 Season	(2÷1) No. Boat Days Per 1,000 Pop.	Sample Size
28-Gd. Traverse	38.3	186,758	4,876.18	N= 64
29-Gratiot	38.9	56,709	1,457.81	N= 16
30-Hillsdale	35.0	98,342	2,809.77	N= 29
31-Houghton	33.0	64,972	1,968.84	N= 35
32-Huron	34.0	22,844	671.88	N= 18
33-Ingham	254.1	360,760	1,419.75	N=222
34-Ionia	44.6	55,056	1,234.43	N= 38
35-Iosco	22.7	74,966	3,302.46	N= 25
36-Iron	14.1	41,389	2,935.39	N= 22
37-Isabella	37.7	31,754	842.28	N= 30
38-Jackson	141.0	256,302	1,817.74	N=121
39-Kalamazoo	190.6	211,641	1,110.39	N=170
40-Kalkaska	4.9	-0-[b]	-0-[b]	N= 5
41-Kent	406.7	686,210	1,687.26	N=270
42-Keewenaw	2.2	2,194	997.27	N= 4
43-Lake	4.5	4,559	1,013.11	N= 11
44-Lapeer	49.4	31,318	633.96	N= 28
45-Leelanau	9.8	48,400	4,938.77	N= 35
46-Lenawee	81.5	135,996	1,668.66	N= 63
47-Livingston	46.6	98,301	2,109.46	N= 57
48-Luce	6.9	12,432	1,801.73	N= 11
49-Mackinac	9.6	61,726	6,429.79	N= 29
50-Macomb	596.3	724,501	1,214.99	N=231
51-Manistee	19.5	71,766	3,680.30	N= 17
52-Marquette	62.9	102,553	1,630.41	N= 51
53-Mason	21.8	52,267	2,397.56	N= 23
54-Mecosta	23.6	40,443	1,713.68	N= 25
55-Menominee	22.9	25,622	1,118.86	N= 14
56-Midland	59.6	90,369	1,516.25	N= 60

TABLE 9.--Continued.

County	(1) Total Population[a] 12/31/68 (000)	(2) Estimated Total Boat Days 1968 Season	(2÷1) No. Boat Days Per 1,000 Pop.	Sample Size
57-Missaukee	6.0	7,386	1,231.00	N= 8
58-Monroe	114.7	172,138	1,500.76	N= 60
59-Montcalm	41.0	73,933	1,803.24	N= 41
60-Montmorency	4.4	24,609	5,592.95	N= 13
61-Muskegon	157.3	291,770	1,854.86	N=118
62-Newyago	25.8	75,895	2,941.66	N= 36
63-Oakland	851.2	1,069,379	1,256.31	N=489
64-Oceana	16.4	29,445	1,795.42	N= 17
65-Ogemaw	9.4	38,112	4,054.46	N= 23
66-Ontonagon	10.7	14,279	1,334.48	N= 22
67-Osceola	14.5	4,154	286.48	N= 21
68-Oscoda	4.0	7,155	1,788.75	N= 6
69-Otsego	9.3	17,319	1,862.25	N= 10
70-Ottawa	117.1	242,003	2,066.63	N=123
71-Presque Isle	12.1	39,953	3,301.90	N= 14
72-Roscommon	8.0	81,295	10,161.87	N= 41
73-Saginaw	218.3	220,352	1,009.39	N=155
74-Sanilac	33.9	25,337	747.40	N= 18
75-Schoolcraft	7.6	18,688	2,458.94	N= 13
76-Shiawassee	61.1	68,310	1,118.00	N= 50
77-St. Clair	115.7	228,174	1,972.11	N= 83
78-St. Joseph	45.3	159,337	3,517.37	N= 84
79-Tuscola	47.3	30,587	646.65	N= 30
80-Van Buren	55.3	121,711	2,200.92	N= 59
81-Washtenaw	210.8	178,273	845.69	N=125
82-Wayne	2,727.3	2,023,200	741.83	N=638
83-Wexford	18.6	43,219	2,323.60	N= 23
TOTALS	8,663.9	11,686,832	---	5,379
MEAN	104.38	140,805.20	2,403.10	64.81

[a]"Sales Management," Survey of Buying Power, Vol. 102, No. 12 (June 10, 1969), Section D, pp. 88-95.

[b]The 5 respondents to the survey from Kalkaska County all indicated that no boating was done during 1968 with sampled watercraft.

county, as well as an estimated rate of boating participation per 1,000 county population for the study year (1968).

In preparing these estimates, the data provided by respondents in questions 10 and 12 was utilized. The total boat days figures in the left hand column were first totalled for each destination county cited by respondents from a particular county of origin (residence). This operation was completed by means of a computer program developed at the Michigan State University Computer Laboratory. An origin-destination matrix was produced from this operation, consisting of aggregated estimates of boating activity undertaken by all sampled watercraft owners in destination counties. The 83 x 83 matrix thus produced was used as a basis for obtaining total boating activity estimates for each county in the state.

Sample data in the origin-destination matrix were expanded to give an estimate of total boating activity undertaken. Expansion factors were calculated for each county based upon the ratio between the total number of registered watercraft per county and the actual number of sample watercraft owners who responded to the mail survey in 1968.[1] Boating activity occasions by sampled watercraft owners in the origin-destination matrix were next multiplied by the calculated expansion factor for the county involved.[2]

The data in Table 9 indicate that, on the basis of information supplied by respondents to this survey, the greatest amount of total

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[1]Expansion factors calculated for each county are shown in Appendix C.

[2]A matrix showing expanded boating activity days by Michigan origin and destination counties is shown in Appendix D.

boating activity was generated in counties where total population was highest, and where the number of total registered watercraft owners resided. Considerable variation appears to exist among counties of the state, however. The top 10 origin counties in the state (on the basis of total boating activity generated) were: Wayne, Oakland, Macomb, Kent, Gennesee, Ingham, Muskegon, Calhoun, Jackson and Ottawa. While these counties rank high in terms of estimated total boating activity, population participation rates appear to be somewhat lower.

In Wayne County, for example, expanded total boating activity occasions totalled more than 2 million boat days for 1968. However, the estimated boating participation rate for the county population was computed at only 741.8 boat days per 1,000 county population. By way of contrast, a number of counties in the northern portion of the Lower Peninsula, while generating a relatively small volume of total boating activity, at the same time exhibit high boating participation rates. In Montmorency county, for example, there was an estimated population of 4.4 thousand persons in 1968 (see Table 9), and the recreational boating survey results indicate that during the survey year Montmorency county residents had a boating participation rate of 5.5 thousand activity occasions per 1,000 county population. Mackinac, Antrim, Roscommon, Leelanau, Grand Traverse, Benzie, Cass, Cheboygan, Emmet, Ogemaw, and Barry counties also show relatively high levels of boating participation. Each of these counties had an estimated boating participation rate greater than 4,000 occasions per 1,000 county population for the study year.

Analytical Procedures

In analyzing the regional variation in recreational boating participation in Michigan, least squares techniques were used to estimate two types of equations. Equation type 1 is designed to analyze individual variation in boating participation within five planning and development regions, and the state of Michigan as a whole. Equation type 2 examines variation in the rate of boating participation by county populations. The second type of equation will be estimated for the State of Michigan as a whole, and for the thirty Michigan counties showing: (a) the highest aggregate levels of total boating activity, and (b) the lowest aggregate levels of total boating activity. In addition, boating participation will be analyzed by using frequency data on socio-economic characteristics of boat owners, characteristics of owned watercraft, place of storage of watercraft during the boating season, and transportation of watercraft.

Modified User-Characteristics Model

As was pointed out in Chapter II, a number of studies have shown that the demand for most goods and services is related to the tastes and preference of consumers. Demand for outdoor recreation, for example, has been shown to be a partial function of socioeconomic status, including occupation, education, family composition, age, sex, place of residence, and income. Certain socioeconomic characteristics of watercraft owners were obtained in the 1968 survey.

Questions 15-20 (pages 6 and 7) in the mail questionnaire solicited information from respondents on socioeconomic status. In addition to these factors, information was obtained from respondents on number of watercraft owned, power system of watercraft, horsepower of motor(s) used, place of storage of watercraft during the boating season, and transportation of watercraft: questions 1, 2, 4, 6, and 14 in the mail questionnaire. Also, information on watercraft length was available for each sampled boat from the records supplied by the Michigan Secretary of State's Office. The specific form of the model to be estimated is as follows:[1]

$$y_j = a + b_1 s_{1j} + b_2 x_{2j} + \ldots + b_{38} x_{38j} + u_j$$

where: $i = 1, 2, \ldots 38$
$j = 1, 2, \ldots N$

and: y_j is the jth observation of the dependent variable.

x_{ij} is the jth observation of the ith independent variable.

a is the constant term

b_i is the coefficient of the ith independent variable

u_j is the jth observation of a random error term, where ($j = 1, 2, \ldots N$). The u_j are assumed to be independent, and come from a normal distribution with zero mean and uniform variance

Model Specification

The dependent variable (y_j) is the number of recreation boating activity occasions (boat days) undertaken by sampled watercraft users during calendar year 1968. The number of boating activity occasions

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[1]The general form of the regression model specified here closely follows that outlined in L. V. Manderscheid, An Introduction to Statistical Hypothesis Testing, Ag. Econ, Mimeo. 867--Revised (East Lansing, Michigan: Department of Agricultural Economics, Michigan State University, February, 1964), pp. 17-23.

for each sampled watercraft was obtained from questions 10 and 12 in the mail questionnaire.

The independent variables (x_i) are specified in detail as follows:

Power system of watercraft (x_1-x_4).--Relate to the type of power system employed in each sampled watercraft. These variables were entered as "zero-one" (dummy) variables. The variable x_1 refers to a watercraft having an outboard motor; x_2 was a sampled watercraft which was a sailboat with motor; x_3 denotes a watercraft having an inboard motor; and x_4 was a classification assigned to a watercraft having an inboard motor with outboard drive. Each sampled watercraft was thus placed in one of these classifications. Each of the four variables was assigned a value of one whenever a sampled watercraft fell into that particular classification; otherwise, a value of zero was assigned.

Horsepower rating of watercraft (x_5).--Each respondent to the mail survey was asked to give the horsepower rating of the primary motor used on the sampled watercraft. Horsepower rating was then entered as a continuous variable.

Place of storage of watercraft (x_6 - x_{11}).--Each sampled watercraft owner was asked to give the usual place of storage of his watercraft during the boating season. Respondents were asked to check one of several response categories (see question 4 in the questionnaire). The response categories were:

x_6 At my permanent home, which is not on a lake or river.
x_7 At waterfrontage located at my permanent home lot.

x_8 At a commercial marina-berth.
x_9 At a summer cottage.
x_{10} At a publicly owned marina.
x_{11} At a boat or yacht club.

The place of storage classifications were entered as "zero-one" variables. A value of one was assigned for a particular variable when respondents checked that classification category and zero otherwise.

Boat Transportation (x_{12}).--Each respondent was asked to indicate whether or not he transported his watercraft ". . . from your house or other location to particular launching sites during the past boating season (calendar year 1968)." In a later question (number 7) watercraft owners were also requested to indicate the total number of times that the sampled watercraft was transported ". . . from the place of storage or mooring to the place of use." Response to this latter question proved to be less than adequate, as many respondents left it blank. Thus, variable x_{12} was entered as either zero or one. If a respondent indicated (yes) that the watercraft was transported during the past boating season, a value of one was entered, and zero otherwise.

Number of boats owned (x_{13}).--This variable was designed to measure the effect of multiple boat ownership upon the amount of recreational boating participation undertaken. In question 14 in the mail survey, respondents were requested to give the number of other registered and unregistered boats owned ". . . by you, and by the members of your immediate family residing with you." The value assigned this variable for each individual boat owner was obtained through a summation of the number of boats listed in question 14 (including the watercraft drawn in the sample).

Boat Length (x_{14}).--Boat length was the specified hull length of each sampled watercraft given in the list of Michigan registered watercraft owners, obtained from the Michigan Secretary of State's Office. For each individual observation, the value of this variable was entered as the specified raw boat-hull length.

Age of Family Head (x_{16}).[1]--Respondents to the boating survey were asked "what is the age . . . of the head of your family?" in question number 16 of the mail questionnaire. Individual observations for the variable were taken from this question, and were the age in years specified for the family head, irrespective of sex. It should be noted that because of the late mailing date (April, 1969) the information on age supplied in this question was subject to some change. That is, "age of family head" could have been interpreted to mean age at the time the questionnaire was received by registered boat owners. On the other hand, since the entire calendar year (1968) was included in the survey, age of household head would reasonably be expected to vary within that span of time. Thus, it is not clear "which age" respondents actually gave in this question: age at the time the questionnaire was received, age at the end of the calendar year, or age at some other point between January 1, 1968, and December 31, 1968.

Age Squared (x_{17}).--The measure used for this variable was obtained from question 16 in the mail questionnaire, and consisted of the age of the household head squared (x_{16}^2). It should be noted, however, that this variable is subject to measurement error of unknown

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[1]Variable x_{15} does not appear in this sequence of independent variables since it was the dependent variable (boat days), described at the beginning of this section.

magnitude resulting from possible misinterpretation of the question relating to age in the questionnaire.

Family Size (x_{18}).--This variable was entered in order to measure the effect of family size of watercraft owners upon the level of recreational boating participation. The measure used for the variable was obtained from questions 16 and 17, in the survey instrument. Each sampled watercraft owner was asked to give the age and sex of ". . . each member of your family residing with you (excluding the head of household)," in question 17. The measure used consisted of a summation of all family members listed in question 17, including the head of household listed in question 16. This variable may also be biased due to the length of time involved. Respondent's family size could easily have changed, and may have been larger (or smaller) at the time the questionnaire was received and completed than it would have been had the survey been restricted to a more compact time horizon.

Occupation of Family Head (x_{19}-x_{35}).--The measure for this variable was obtained from question 18 in the mail questionnaire. Each respondent was asked "What is the occupation of the head of your family? (please indicate the type of job that you hold, not the organization for which you work)." A series of eighteen occupational classes were established, and each response given was assigned to one of these categories.[1] All occupational classes were treated as "zero-one"

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[1]Occupation classes used follow closely the classification system developed by the U.S. Bureau of the Census. One of the occupational classes ("other employment") was later suppressed in order to obtain a determinate solution in the computer analysis. Thus, seventeen occupational classes were actually utilized in the regression equation.

variables. Whenever an individual response to question 18 resulted in a person being assigned to a particular occupational class, that class was assigned a value of one for that observation, and all other classes zero. The seventeen occupational classes used were as follows:

x_{19} - Professional	x_{28} - Farm Laborers
x_{20} - Farm Managers	x_{29} - Laborers
x_{21} - Managers and Officials	x_{30} - Student
x_{22} - Clerical Workers	x_{31} - Housewife
x_{23} - Sales Workers	x_{32} - Retired
x_{24} - Craftsmen	x_{33} - Military
x_{25} - Operatives	x_{34} - Unemployed
x_{26} - Household Workers	x_{35} - Other factory
x_{27} - Service Workers	

Family Income (x_{36}).--The value used for this variable was obtained for each individual observation from question 19 in the mail questionnaire. Each respondent was asked in this question to ". . . estimate your total family income for 1968 by checking the box (opposite the appropriate income class) below." A series of seven income classes were provided: total family income (1) under $3,000 annually, (2) $3,000 to $5,999 annually, (3) $6,000 to $7,999 annually, (4) $8,000 to $9,999 annually, (5) $10,000 to $14,999 annually, (6) $15,000 to $24,999 annually, and (7) $25,000 and above. This *a priori* ordering of income classes poses real difficulty in choosing an appropriate value for the family income variable.

The procedure followed was to develop a weighting system for the seven income classes. A value of 1 was assigned to income class one where the dollar interval ranged between 0 and $2,999. Similarly, a value of 2 was assigned to income class two since the within-class interval remained $2,999. However, income class <u>three</u> had a within-class interval of only $1,999. Therefore, a value of only 2.66 was assigned to this class. A similar procedure was followed with the remaining income classes (class <u>four</u>--3.32, class <u>five</u>--4.97, class <u>six</u>--8.27, and class <u>seven</u>--11.57). The weighting assigned to class <u>seven</u> required an additional assumption: since this income class was "open-ended" ($25,000 and above), it was arbitrarily decided to weight this class in proportion to the within-class interval of the preceeding class--$9,999.

It should be noted that the procedure of rank-ordering family income into seven classes in the mail questionnaire introduced a source of statistical bias. Such a procedure has the effect of constraining the incomes of respondents into a linear ordering when in fact this may not be the case, i.e., participation in recreational boating may not be related linearly with family income. The seven rank-ordered income classes force this implicit assumption, however.

The family income variable is introduced as a test of the hypothesis that there is no significant influence of income upon recreational boating participation. A rigorous test of this hypothesis would demand that raw family income values be used as the measure for this variable. This would allow the data to determine the relationship.[1]

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[1] Some empirical work has shown, for example, that there may be a curvilinear relationship between recreation participation and family income, i.e., family income appears positively correlated with increasing levels of participation up to some "threshhold" level of income, beyond which further participation declines. That is, the commodity in question (recreation participation) is treated as an "inferior good," where less of the commodity is taken at higher levels of family income (assuming no change in prices). See, for example, <u>Outdoor Recreation for America</u>, <u>loc</u>. <u>cit</u>., pp. 27-32.

Furthermore, as Stevens notes:

> . . . the customary procedure of assigning a value . . . by interpolating linearly within a class interval is, in all strictness, wholly out of bounds. Likewise, it is not strictly proper to determine the mid-point of a class interval by linear interpolation, because the linearity of an ordinal scale is precisely the property which is open to question.
>
> . . . .
>
> (Also). . . it is proper to point out that means and standard deviations computed on an ordinal scale are in error to the extent that the successive intervals on the scale are unequal in size.[1]

The implicit assumptions inherent in the procedure of ranking family income a priori into income classes (with unequal intervals), together with the assigning of discrete weights to each of the seven income classes based upon linear interpolation within each class, serves to invalidate the statistical test of this hypothesis. The procedure followed implies a priori knowledge about the distribution of actual incomes of respondents which was not in fact knowable.

Family Income Squared (x_{37}).--The measure used for this variable was obtained by squaring family income (x_{36}) for each individual observation. This variable was introduced in the statistical model in order to test the hypothesis that the change in the dependent variable (boating activity occasions) is associated with non-linear changes in family income. Because of the procedures outlined above in entering the family income variable, however, entering squared values (discrete weights) which were calculated for the seven income classes does not represent a valid test of the hypothesized relationship.

The Product of Family Income and Age (x_{38}).--The measure used for this variable was the cross product between Family Income (x_{36})

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[1]S. S. Stevens, "On the Theory of Scales of Measurement," Science, Vol. 103, No. 2684 (June, 1946), p. 679.

and Age of Family Head (x_{16}). Past empirical work has indicated that family income and age of participants are primary variables influencing participation in certain outdoor recreation activities. Further, some studies have shown that such variables are significantly interrelated.[1] Changes in family income may have different effects upon recreation participation at different income and age levels of participants. Limitations in both the income and age variables (x_{36} and x_{16}) have already been discussed above. Interpretation of regression results will have to be made cautiously, recognizing these explicit limitations.

Education of Family Head (x_{38}).--The measure used for this variable was taken directly from respondent replies to question 20 in the mail questionnaire. Question 20 asked respondents to ". . . indicate the total years of education completed by the head of your family." While actual years of education completed was the measure used for this variable, there appear to be at least three possible sources of bias inherent in the wording and structure of this question. First, there was no opportunity for a respondent to answer this question if he had received zero years of formal education. To the extent that a significant number of respondents fell in this category, the resulting distribution of education attainment for respondents is skewed, i.e., a computed population mean would be of greater magnitude conceivably as a result of counting only those respondents who had a non-zero response to the question.

[1]See, Brewer and Gillespie, loc. cit., pp. 85-86, and Outdoor Recreation for America, loc. cit., pp. 27-32.

Secondly, question 20 was structured ambiguously over the high bound of the range considered. Seventeen boxes were provided in this question--years of education completed could thus range between 1 and 17 years. However, an eighteenth box was provided which respondents could check if years of education completed was greater than 17. Almost all respondents checking this box wrote in the actual number of years completed (above 17). These figures were thus accepted as the measure for the education variable for a specific observation. Where no response was given, other than a check, the observation was dropped from the analysis.

Finally, the wording of the question may not have been clear to respondents. There is a possibility that some respondents counted non-formal education (such as non-credit short courses, in-service training, etc.) in arriving at their response. There may also have been confusion on the part of some respondents as to which time (during the calendar year) should be used as a point of reference in responding to the education question.

Computational Procedures

In testing study hypothesis one, the regression equation specified above was estimated by utilizing a stepwise deletion procedure.[1] The statistical analysis was performed at the Michigan State University Computer Laboratory on a CDC-3600 computer.

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[1]See, Mary E. Rafter and William L. Ruble, Stepwise Deletion of Variables from a Least Squares Equation, STAT Series Description No. 8--LSDEL (East Lansing, Michigan: Agricultural Experiment Station, Michigan State University, November 1969), pp. 12-13.

The stepwise deletion routine utilized proceeds by printing least squares coefficients and related statistics with all beginning independent variables (36) in the equation. A new least squares equation is then estimated, following deletion of one (independent) variable. A second variable is then deleted, and the equation is again re-calculated. Independent variables continue to be deleted in this fashion until a variable selected as a candidate for deletion meets one or more specified stopping criteria.

Alternative stopping criteria may be used in the stepwise deletion program available. Only a single criterion was utilized for this problem, however: MINSIG = .05--deletion of variables from the specified equation one at a time, recalculating the least squares equation each time a (independent) variable was deleted until the significance level α of the computed regression coefficient of the candidate for deletion was $\overline{<}$ .05.

In order to obtain a determinate solution to the problem, one further procedure was followed with respect to handling the dummy variables in the initial equation. Zero-one values were used to represent the effects of certain independent variables upon recreational boating participation, e.g., power system of sampled watercraft (x_1-x_4), place of storage of watercraft during the boating season (x_6-x_{11}), and occupation of family head (x_{19}-x_{35}). In each case, a value of either zero or one was assigned to the variables within each set of classes. A sampled watercraft either had an outboard motor, or it did not. A sampled watercraft was either stored at a commercial boat marina during the boating season, or it was not. Likewise, the head of the family either had an occupation which could be classified as professional, or he (or she) did not.

Initial runs of the model did not give a determinate solution, i.e., regression coefficients and other least squares statistics "would not compute." The LSDEL routine is automatically programmed to compute an intercept term. As Johnston points out, however, if one attempts to estimate the intercept term where only dummy independent variables are used, the estimation procedure may break down " . . . since the appropriate matrix cannot be inverted."[1]

For example, consider a case where two qualitative classes of observations are involved in which individual observations of the two classes are "pooled." It would be possible to insert two dummy variables into the equation in order to obtain estimates of the class effects, such that:

$$y = a_0 + a_1 D_1 + a_2 D_2 + bx + u$$

where D_1 = 1 if an observation falls in class 1; 0 if in class 2.

D_2 = 1 if an observation falls in class 2; 0 if in class 1.

As Leistritz[2] points out, however, the above equation cannot be estimated, since the dummy variables D_1 and D_2 and the constant term have a perfect linear relationship ($D_1 + D_2$ = constant). In order to obtain determinate estimates of the parameters in the above equation,

[1]J. Johnston, Econometric Methods (New York: McGraw-Hill Book Company, Inc., 1963), p. 222.

[2]F. Larry Leistritz, The Use of Dummy Variables in Regression Analysis, Ag. Econ. Misc. Report No. 13 (Fargo, North Dakota: Agricultural Experiment Station, August 1973), p. 2.

additional constraints have to be imposed upon the a_j. One recommended procedure is to set one of the $a_j = 0$, thus dropping one of the dummy variables from the equation so that:

$$y = a_o + a_2 D_2 + bx + u$$

if a_1 is set equal to zero. In the new equation, a_o becomes the intercept term for observations of class 1, and $(a_o + a_2)$ becomes the intercept term for the observations of class 2.[1]

The above procedure was followed in order to obtain a determinate solution to the problem, except that observations within the three classes involved were not "pooled." For example, in question 4 in the mail questionnaire, respondents were asked where they stored the sampled watercraft during the boating season. There were seven response categories in this question--respondents were requested to check a single box opposite one of these seven categories. The seventh category was listed as "other." This category was dropped from the equation, and zero (0) or one (1) values were entered for the remaining six categories.

The same procedure was followed with the remaining two classes of qualitative variables: occupation of family head, and power system of sampled watercraft. In the case of the power system of watercraft class, an "other" category was dropped from the equation and zero (0) or one (1) values were entered for the remaining four categories. Likewise, an eighteenth category under the occupation class ("other")

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[1] _Ibid._, p. 3.

was dropped from the equation, leaving seventeen categories for which zero (0) or one (1) entries were entered in the equation estimated. As a result of incorporating zero-one values into the regression equation, a simple covariance model is thus obtained (ANOCOVA). Such a model involves regression on both categorical and numerical variables.

Aggregate Participation Model

Hypothesis 2 relates to the rate of recreational boating participation by regional (county) populations. In testing the stated hypothesis, least squares techniques were again utilized to estimate a linear equation which measures the effects of specified (independent) variables upon the rate of recreational boating participation by county populations. The model parameters were estimated for the State of Michigan as a whole; and for (a) thirty Michigan counties which were estimated to generate the highest levels of total (aggregate) boating activity during 1968; and (b) thirty Michigan Counties which were estimated to generate the lowest levels of total (aggregate) boating activity during 1968. The specific form of the equation is as follows:

$$Y_j = a + b_1 X_{1j} + b_2 X_{2j} + \ldots + b_{26} X_{26j} + u_j$$

where: $i = 1, 2, \ldots 26$
$j = 1, 2, \ldots n$

and: Y_j is the jth observation of the dependent variable.

X_{ij} is the jth observation of the ith independent variable.

a is the constant term.

b_i is the coefficient of the ith independent variable.

u_j is the jth observation of a random error term, where ($j = 1, 2, \ldots n$). The u_j are assumed to be independent, and come from a normal distribution with zero mean and uniform variance σ^2.

Model Specification

The dependent variable (Y_j) is the estimated number of boat days (activity occasions) per 1,000 county population during the calendar year 1968. The measure used was calculated separately for each Michigan county, based upon information obtained from the 1968 survey of registered Michigan watercraft owners. Estimates of total recreational boating activity occasions were first calculated for the 83 Michigan counties. This estimate was then divided by the estimated total county population on December 31, 1968, in order to obtain a boating participation rate per 1,000 population (see Table 9).

Travel Distance (X_2).--The measure used for this variable was the weighted average one-way travel distance (in miles) calculated for all 83 Michigan counties on the basis of results obtained from the 1968 survey of Michigan registered watercraft owners. The specific value calculated for each county was obtained from the data presented in the county origin-destination matrix exhibited in Appendix D. These tables show the estimated boating activity occasions generated by origin county (county of residence of sampled watercraft owners), the distribution of these activity occasions by destination counties (county where boating activity took place), and the percentage of estimated total boating activity generated by an origin county which was undertaken in each Michigan destination county.[1]

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[1]An origin county also was treated as a destination county since much of the boating activity generated takes place within the county of

One major assumption was made in order to calculate an estimated average travel distance for the boating trips made by the residents of a particular origin county; namely, that the number of boating trips taken by registered watercraft owners between an origin county and a destination county was directly proportional to the percentage of total boating activity occasions estimated for the destination county during the survey year. Information on the actual number of recreational boating trips taken by sampled boat owners was not obtained in the survey instrument. In calculating the estimated average travel distance for each origin county, the percentage of total boating activity occasions for a destination county was treated as a weight. One-way travel distance (in miles) between origin and destination counties was obtained from the Michigan State Highway Department, and consisted of the shortest calculated highway driving distance between the centers of population for origin and destination counties.[1]

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residence of boat owners. For each Michigan origin county, there were, therefore, 83 possible counties of destination within the State.

[1]The highway driving distances used are referred to as "skim distances." In obtaining this measure, a computer program was used to examine all possible combinations of highway routes between centers of population in origin and destination counties. A stopping criteria was used such that absolute highway travel distance (in miles) was minimized by the program. It should be noted that this measure does not necessarily minimize highway driving <u>time</u> between origin-destination counties. It is conceivable that alternate travel routes could be selected which, although exhibiting greater absolute highway mileage, may involve less driving time, particularly if the combination of travel routes selected included limited-access expressways. Richard Esch, "Highway Skim Distance," Unpublished data, Highway Planning Division, Michigan Department of State Highways, Lansing, Michigan, June 1973.

Computation of the weighted average (one-way) travel distance for each origin county involved (1) determining weights for each distination county--calculated from the origin-destination matrix, and consisting of the percentage of boating activity occasions which took place in a particular destination county. This percentage was treated as a proxy for the number of actual boating trips taken between origin-destination counties by registered boatowners. (2) Multiplying the calculated weight by the one-way highway driving distance, obtained from State Highway Department Skim distance tables for each origin-destination county combination. (3) Summing these totals and dividing the resulting figure by the sum of the weights used for all combinations of origin-destination counties. The mathematical procedure followed is also shown in Appendix D.

Aggregate Disposible Income (x_3).--The measure used for this variable was obtained from Sales Management, Inc.,[1] and consists of the Net Effective Buying Income (EBI) in thousands of dollars for each Michigan county in 1968. This measure corresponds closely to "disposable personal income" per county. It consists of estimates of what individuals receive in wages, salaries, and commissions; proprietor's income, rental income from real property, dividends and interest from securities and savings, social security benefits, pension, and welfare payments. In addition to these sums, allowance is made (where relevant)

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[1]"Sales Management," Survey of Buying Power, Vol. 102, No. 12 (June 10, 1969), Section D, pp. 88-95. Copyright by Sales Management, Inc., June 10, 1969. Reproduced by written permission of Sales Management, Inc., August, 1973. Further reproduction of these data in any form may be made only upon written request to Sales Management, Inc., 630 Third Ave., New York, N.Y. 10017.

for including imputed rentals for owner-occupied homes, and an imputed value for fuel and food raised and consumed on farms.

After arriving at total personal income, an allowance is made for direct taxes--federal, state, and local. The estimate for direct taxes, when subtracted from total personal income leaves a residual called Effective Buying Income (EBI).

Households with less than $3,000 Annual Cash Income (x_4).--Consists of the percentage of households with net cash incomes in the range of $0 - $2,999 for the calendar year 1968, by Michigan County. The values for this variable were also obtained from Sales Management, Inc.[1]

Households with greater than $10,000 Annual Cash Income (x_5).--The value used for this variable consisted of the percentage of households with net cash incomes which were equal to or greater than $10,000 for the calendar year 1968, by Michigan county.[2]

County Population Density (x_6).--Consisted of the estimated number of persons per square mile for each Michigan County. Values were calculated by dividing the total land area of each county (in square miles) by the estimated 1968 county population.[3]

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[1] Ibid.

[2] Ibid.

[3] County Land Areas were obtained from Michigan Statistical Abstract (Sixth ed.; East Lansing, Michigan: Bureau of Business and Economic Research, Graduate School of Business Administration, Michigan State University, 1966), Table II-1, p. 73. The 1968 county population estimates were obtained from Sales Management, Survey of Buying Power, op. cit., Section D, pp. 88-95.

Distance from a Great Lake (x_7).--The measure used for this variable was the shortest one-way highway distance (in miles) between the county seat in each Michigan county, and the closest point of boating access on a Michigan Great Lake. Distances were scaled on a Michigan Highway map. Great Lakes were defined to include Lakes Huron, Erie, Superior and Michigan; Lake St. Clair, the St. Mary's River, and the Detroit River. This variable is not a measure of "time-distance" in the sense that a variety of travel routes were used in estimating the road mileage between counties and Great Lakes. The measure used is a physical proximity parameter. In some cases, the estimated highway mileage consisted largely of highway routes which were limited-access expressways; while in other cases, the most direct (shortest) combination of highway travel routes were principally secondary roads.[1]

Proportion of Minority Races in Population (x_8).--Specific county values for this variable were obtained from the U.S. Census of Population.[2] Utilizing census data, the percentage of minority races in the total county population was computed. The procedure followed consisted of summing the total number of persons in each classified minority race (Indian, Japanese, Chinese, Filipino, Negro, and all other), and dividing this total by the estimated 1970 population. It should be noted that the percentage of minority races was calculated

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[1]Map measurements were taken from Rand McNally Road Atlas; Supplement to the 104th Edition of the Rand McNally Commercial Atlas and Marketing Guide (Chicago: Rand-McNally & Company, 1968), p. 54.

[2]U.S. Department of Commerce, Bureau of the Census, 1970 Census of Population; General Population Characteristics, PC (1)-B24 Michigan (Washington: U.S. Government Printing Office, 1970), Table 34, pp. 178-180.

for 1970. Survey data on boating participation, however, was collected for calendar 1968. This means that the values calculated for this variable are biased in unknown directions to the extent that the proportion of minority races in county populations shifted over various points in time between April 1, 1970, and the study year (calendar 1968). For purposes of this study, it is assumed that the percentage of minority races in each county which existed as of April 1, 1970, held constant during the study year (1968). Since comparable county data could not be obtained for the boater survey year (1968), it was decided to test the relationship between county boating participation rates and racial composition of the population using the 1970 data.

Distance from an SMSA--Size-Distance (x_9).--This variable constitutes a hypothesis about the effect of urban areas upon the rate of recreational boating participation by regional (county) populations. The size-distance variable is introduced in the equation as a test of the "opportunity theory." Participation in various forms of non-urban recreation (such as recreational boating) is theorized to depend upon resource availability. Urban residents,[1] theoretically,

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[1]Urban residents are here defined to mean all persons living in (a) places of 2,500 inhabitants or more incorporated as cities, villages, boroughs, and towns, but excluding those persons living in the rural portions of extended cities; (b) unincorporated places of 2,500 inhabitants or more; and (c) other territory, incorporated or unincorporated, included in urbanized areas. Urbanized area can be characterized as the "physical city," as distinguished from the "legal city" and the metropolitan community. The boundaries of metropolitan areas (SMSA's) are determined by political lines, while those of urbanized areas are determined by the pattern of urban land use. Standard Metropolitan Statistical Areas (SMSA's) were defined more explicitly in Chapter III. Also, see U.S. Department of Commerce, Bureau of the Census, 1970 Census of Population; Volume 1, Characteristics of the Population, Part A, Number of Inhabitants (Washington: U.S. Government Printing Office, 1970), pp. X-XIV.

have less physical opportunity to participate in resource-oriented activities (such as boating) because of the urbanized nature of their living environment. If the theory holds, both the population of the urban area and the physical size of the area taken up by the urban land uses (such as industrial areas, business and commercial structures, highways, schools, cemetaries, residential subdivisions, etc.) may interact to influence recreation participation rates of regional populations.[1] Where one lives--in relation to urban areas--may limit the amount of recreational boating undertaken.

The values for this variable were calculated for all 83 Michigan counties. The procedure followed involved setting up a series of scale values, based upon each county's location with respect to an SMSA. SMSA counties[2] were assigned a value of one for each 100,000 population. SMSA counties containing populations between 50,000 and 100,000 were assigned a value of 0.5. Based upon the population criteria used, no county could be assigned a value greater than 27--that assigned to Wayne County.[3]

In assigning individual county values, a distance decay principle was followed. Distances were measured from the center of the central city in an SMSA to the county line which is farthest from the SMSA.

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[1]See, for example, John C. Hendee, "Rural-Urban Differences Reflected in Outdoor Recreation Participation," Journal of Leisure Research, Vol. 1, No. 4 (Fall, 1969), pp. 335-36.

[2]Those counties in which there was located a Standard Metropolitan Statistical Area (SMSA) during 1968.

[3]1968 population levels for SMSA counties were obtained from Sales Management, Survey of Buying Power, op. cit., Section D, pp. 88-95.

Counties located less than 50 miles from the central city of an SMSA were assigned a value of four less than the value calculated for the SMSA county. Counties located in a distance zone between 50 and 100 miles of an SMSA were assigned values which were four less than the value assigned to counties located within the 50-mile zone, etc. Using this rating scheme, counties located at a distance of 300 miles or more from an SMSA were assigned a value of zero.[1]

In some cases, particular counties had a potential of being assigned two values since they were located within the influence zone of two SMSA's. In such cases, the county in question was always assigned the higher of the two alternative values. In cases where two SMSA counties were located within a zone of mutual influence, the value derived for the SMSA county in question was assigned on the basis of its own calculated value plus the value for the influencing SMSA. The value assigned in all cases, however, was never larger than the value of the influencing SMSA. It should be noted that alternative population and distance values might be used for this variable.

Public and Private Campsites (x_{10}).--The value used for this variable consisted of the total number of individual campsites (at both public and commercial areas) which had the services of constructed boat-launching facilities within the campground. Separate values were obtained for each county in the state. There were five categories of campgrounds included in the inventory: (1) state forest campgrounds, (2) state park campgrounds, (3) national forest campgrounds, (4) county

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[1]This rating method follows closely that developed in W. K. Bryant, "An Analysis of Inter-community Income Differentials in Agriculture in the United States" (unpublished Ph.D. dissertation, Michigan State University, 1963), pp. 72-73.

and municipal campgrounds, and (5) commercial campgrounds. Only campgrounds which actually provided boat-launching facilities during 1968 were selected.[1]

Surface Water Acreage (x_{11}).--The surface water acreage was inventoried for each county in the state. Values entered for each county consisted of the total area (in acres) contained in selected surface water bodies: (1) natural lakes and ponds, (2) natural lakes with a dam, (3) artificial lakes, (4) artificial ponds, (5) hydroelectric reservoirs, (6) small lakes, and (7) flood control reservoirs. Only water bodies covering at least 4 acres were included in the tabulations for each county. Many surface water areas were excluded from the inventory on the assumption that much of the water acreage involved would not be suitable for power watercraft use. Categories excluded were municipal water supply reservoirs, fish and wildlife floodings, mill ponds, gravel pit or quarry ponds, fish hatchery ponds, underwater borrow pits, recharge basins, settling ponds, beaver ponds, sewage disposal basins, fishbreeding ponds, tailings ponds, brine storage basins, swamps, marshes, canals, bogs, rivers and streams, and Great Lakes.[2]

As noted above, no inland rivers and streams were included in the water acreage summary. Furthermore, certain of the excluded water

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[1]The inventory of public and private campsites was made for the State of Michigan from Statistical information contained in Woodhall's Trailering Parks and Campgrounds (Highland Park, Illinois: Woodall Publishing Company, 1968), pp. 325-346.

[2]Acreage figures were obtained from C. R. Humphrys and R. F. Green, Michigan Lake Inventory Bulletins 1-83 (East Lansing, Michigan: Michigan State University, Department of Resource Development, 1962).

areas listed above may, in fact, be highly desirable as recreational boating areas. To the extent that desirable boating areas were excluded from the inventory, this variable may not be adequately specified to portray actual water resource availability. Also, a different result might be obtained by changing the minimum acreage restraint (4 acres) used in obtaining individual county values for this variable.

Public Boat-Launching Sites (x_{12}).--Values used for this variable were obtained from tabulations on the number of publicly constructed boat-launching sites available on inland lakes and ponds and Great Lakes during 1968 for each Michigan county. Individual county values were obtained from tabulations of public access sites prepared by the Michigan Department of Natural Resources, Waterways Commission. Public access site tabulations are broken into five general categories: (1) Waterways Division, (2) State Parks, (3) Recreation Areas, (4) State Forests, and (5) Game Areas.[1]

Public access sites are summarized by region and county. The value used for each county involved a summation of access sites included under each of the five administrative categories. An adjustment was made in the resulting value, however, in order to allow for public access sites (boat-launching facilities) already entered in the public and private campsites variable (x_{10}). Cross-tabulations were made for each county, and public access (boat-launching) sites counted as being present in public or commercial campgrounds were deducted from the value

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[1] Michigan State Waterways Commission: Biennial Report--1968-1970 (Lansing, Michigan: Michigan Department of Natural Resources, Waterways Commission, 1970), pp. 16-17.

for each county entered under the public boat-launching site variable. Thus, the value used reflects, insofar as possible, only constructed public access sites for each Michigan county in 1968 which are not located at a public or private campground facility.

Hotels, Motels, and Tourist Courts (x_{13}).--This variable constitutes a test of the statistical relationship between recreational boating participation and the number of commercial lodging facilities present in a county (other than campground facilities). Facilities included in the county parameter values were commercial motels, hotels, tourist homes, trailer parks, and sporting and recreational camps present and in operation as of July 1, 1967.[1]

To the extent that the number of commercial establishments counted under these categories increased (or decreased) between July, 1967, and various time periods during the survey year (1968), the values entered do not reflect an accurate specification of the variable being tested. However, more precise data for 1968 was not available for use in this study, and the values entered are assumed to hold constant during calendar 1968.

Amusement, Recreation Services (x_{14}).--This variable is entered in order to test the statistical relationship between recreational boating participation and the availability of substitute leisure time amusement and recreation services available within a county. Values entered for each county represent an aggregate estimate of all commercial

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[1]U.S. Department of Commerce, Bureau of the Census, Census of Business, 1967; Vol. V, Selected Services--Area Statistics, Part II, Michigan (Washington: U.S. Government Printing Office, 1970), Table 3, pp. 8-12.

amusement and recreation service firms (except motion pictures) which were in operation within each Michigan county as of July 1, 1967.[1] The aggregate number of firms was composed of:

a. Producers, orchestras, entertainers.
b. Bands, actors, other entertainers.
c. Dance bands, orchestras (except symphony).
d. Symphony orchestras, other classical groups.
e. Entertainers (radio, TV), except classical.
f. Theatrical producers and services.
g. Bowling alleys, billard, pool establishments.
h. Dance halls, studios, and schools.
i. Commercial sports--baseball, football clubs, etc., promoters, racetrack operations, including racing stables.
j. Public golf courses.
k. Skating rinks.
l. Amusement parks (including kiddie-theme parks).
m. Coin-operated amusement devices.
n. Concession operators of amusement devices, rides, carnivals, circuses, and fairs.
o. Other commercial recreation and amusement.

Individual county values were not available for specific types of recreation-amusement service firms listed above--only aggregate county totals. There may have been increases (or decreases) in the total number of recreation-amusement service firms between July of 1967 and particular points in time during the study year (1968). Values are assumed to hold constant during the study year, however.

Occupations of County Population (x_{15}-x_{20}; x_{23}-x_{27}; x_{29}).[2]--The values entered for these variables consisted of the percentage of

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[1] Ibid.

[2] Variables x_{21}-x_{23} do not appear in this sequence as the intervening columns were utilized as data control cards in the computer card deck. Variable x_{28} appeared as a separate variable and is described following the occupation variables.

a county's employed labor force accounted for by 12 occupation classes. The percentages were calculated for each occupation class, based upon statistical data presented in the U.S. Census of Population.[1] Percentages were entered for each Michigan county (83) for the following occupation classes:

x_{15} Professional, Technical and Kindred Workers.
x_{16} Managers and Administrators (except farm).
x_{17} Sales workers.
x_{18} Clerical and Kindred Workers.
x_{19} Craftsmen, Foremen and kindred workers.
x_{20} Operatives (except transport).
x_{23} Laborer (except farm).
x_{24} Farmers and farm managers.
x_{25} Farm laborers and farm foremen.
x_{26} Service workers (except private household).
x_{27} Private household workers.
x_{29} Transport equipment operatives.

Registered Watercraft in County (x_{28}).--The value used for this variable consisted of the number of registered watercraft per 1,000 county population during 1968. The value was calculated for each Michigan county by dividing total number of registered watercraft by the estimated 1968 county population.[2]

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[1]U.S. Department of Commerce, Bureau of Census, 1970 Census of Population; General Social and Economic Characteristics, PC (1)-C24 (Washington: U.S. Government Printing Office, 1970), Table 122, pp. 558-564.

[2]The total number of registered watercraft per county was obtained from Division of Vehicle and Watercraft Records, "Size and Type of Registered Boats in Michigan Counties," Unpublished Report, Michigan Secretary of State's Office, December 31, 1968. County population data was obtained from Sales Management, Survey of Buying Power, loc. cit., Section D, pp. 88-95.

For purposes of this study, it was assumed that the number of registered watercraft in each Michigan County was uniform during each month of the calendar year (1968), and coincided with yearly summary statistics compiled as of December, 1968. A similar assumption had to be made concerning the population of Michigan counties at various points in time during the calendar year. To the extent that these two assumptions are not met, values calculated for each county may be biased in unknown directions, depending upon (a) the rate of aggregate population change--increases or declines--from one time period to another during the calendar year, and (b) increases or declines in the total number of registered watercraft owned by boat owners in each county.

Computational Procedures

In testing study hypothesis two, the equation specified above was estimated by utilizing the stepwise deletion program outlined for equation number one. The statistical analysis was completed at the Michigan State University Computer Laboratory on a CDC-3600 computer.

As before, only a single stopping criterion was utilized in the program used to calculate least squares statistics: MINSIG = .05--deletion of variables from the specified equation one at a time, recalculating the least squares equation each time a (independent) variable was deleted until the significance probability of the computed regression coefficient of the candidate for deletion was $\leq .05$. Only continuous variables were included in the model.

Data Analysis--Results

The remainder of this chapter will be devoted to a presentation of the principal findings of the study. The first section will involve a summary of regional variation in recreational boating activities by registered Michigan watercraft owners, utilizing the five study regions identified in Chapter II. The second section will be devoted to a summary of the observed effects of specific variables (specified in model number 2) upon recreational boating participation rates exhibited by county populations. Results of the statistical analysis of estimated county population participation rates will be presented for the State of Michigan as a whole, and separately for (a) the thirty Michigan counties which had the highest estimated aggregate boating participation levels during 1968, and (b) thirty Michigan counties which exhibited the lowest estimated aggregate boating participation levels during 1968.[1]

Modified User Characteristics Model

Linear regression was used to determine the effects of specific socioeconomic characteristics of a sample of registered watercraft owners (and their immediate families) upon the number of boat days (activity occasions) undertaken during the calendar year 1968. In addition to these variables, the model specified contained variables relating to place of storage of watercraft, type of power system of sampled watercraft, length of sampled watercraft, horsepower of primary

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[1]In this case, all 83 Michigan counties were ranked according to the total estimated number of boating activity occasions calculated for the study year. All counties were ranked based upon total boat days computations, made in Table 9 (see page 97). From this rank-ordered list, the top thirty counties were selected, as were the bottom thirty. Model two could not be estimated separately for the five study regions identified due to a lack of sufficient degrees of freedom (the number of observations minus the number of constants fitted in the equation minus one--N-K-1). In the case of Region 6--Lansing, for example, there were only three observations, and twenty-six independent variables.

motor used on sampled watercraft, transportation of watercraft, and number of (registered and unregistered) watercraft owned by sampled watercraft owners. Regression results will be presented in this section for the five selected study regions, as well as for the State of Michigan as a whole.

Region 1--Detroit

Region 1 contains all (or portions of) three Standard Metropolitan Statistical Areas: Detroit, Ann Arbor, and the Monroe County portion of the Toledo, Ohio, SMSA. There are seven counties contained in this region, including Wayne, Monroe, Washtenaw, Livingston, Oakland, Macomb, and St. Clair.

The computer program utilized for this study, as noted previously, consisted of a stepwise deletion procedure. Independent variables were deleted from the initial equation one at a time in successive iterations until all candidate variables remaining met a specified stopping criterion. In order to be retained in the final equation, the significance probability of the computed regression coefficient of an (independent) variable had to be $\leq .05$.

The income variables (x_{36}, x_{37}, and the cross-product of income and age--x_{38}) were not found to be statistically significant in this region. However, this result should be weighed cautiously as these variables may have been entered incorrectly in the statistical analysis. Frequency data suggest, for example, that the weighting procedure assigned to the family income classes utilized in the survey instrument (question 19, page 6) represents a source of statistical bias, and does not properly reflect the actual income distribution of respondents from this region. The actual distribution of family income, by class, among sampled watercraft owners from region 1 is given in Table 10.

TABLE 10.--Income Class Distribution of Sampled Watercraft Owners from Region 1, 1968.

Income Class*	No. of Sampled Boat Owners	Per Cent
Under $3,000	33	3.12
$ 3,000 - $ 5,999	54	5.11
$ 6,000 - $ 7,999	93	8.80
$ 8,000 - $ 9,999	142	13.43
$10,000 - $14,999	375	35.48
$15,000 - $24,999	255	24.13
$25,000 and Over	105	9.93
TOTALS	1,057	100.00

*Income classes shown here are the same as those utilized in the mail questionnaire (question 19, page 6).

In order to obtain additional insight into the relationship between family income and frequency of boating participation, two additional tables have been prepared. An inspection of the distribution of family incomes among respondents in Table 10 above shows that the income variable was incorrectly specified in the regression equation.[1] Tables 12 and 13 show the relationship between family income, by class, and frequency of boating participation by sampled watercraft owners in

[1]The weighting procedure utilized implicitly assumes *a priori* that a constant income distribution exists among sampled watercraft owners in all study regions.

TABLE 11.--Frequency of Boating on Great Lakes by Number and Percentage of Respondents in Selected Income Classes, Region 1, 1968.

Income Class*	0-10 Occasions		11-21 Occasions		22-32 Occasions		33-43 Occasions		44-54 Occasions		55-65 Occasions	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Under $3,000	29	87.88	3	9.09	0	0.00	0	0.00	1	3.03	0	0.00
$ 3,000 - $ 5,999	41	75.93	5	9.26	5	9.26	2	3.70	1	1.85	0	0.00
$ 6,000 - $ 7,999	70	75.27	8	8.60	6	6.45	4	4.30	2	2.15	2	2.15
$ 8,000 - $ 9,999	113	79.58	10	7.04	6	4.23	4	2.82	2	1.41	3	2.12
$10,000 - $14,999	266	70.93	37	9.87	29	7.73	17	4.53	10	2.67	5	1.33
$15,000 - $24,999	178	69.80	22	8.63	22	8.63	8	3.14	10	3.92	6	2.35
$25,000 and Over	63	60.00	10	9.52	10	9.52	8	7.62	4	3.81	5	4.76
TOTALS	760	71.90	95	8.99	78	7.38	43	4.07	30	2.84	21	1.99

Income Class*	66-76		77-87		88-98		99-109		Totals	
Under $3,000	0	0.00	0	0.00	0	0.00	0	0.00	33	100.00
$ 3,000 - $ 5,999	0	0.00	0	0.00	0	0.00	0	0.00	54	100.00
$ 6,000 - $ 7,999	0	0.00	0	0.00	1	1.08	0	0.00	93	100.00
$ 8,000 - $ 9,999	1	0.70	1	0.70	1	0.70	1	0.70	142	100.00
$10,000 - $14,999	5	1.33	4	1.07	1	0.27	1	0.27	375	100.00
$15,000 - $24,999	3	1.18	4	1.57	1	0.39	1	0.39	255	100.00
$25,000 and Over	3	2.86	2	1.91	0	0.00	0	0.00	105	100.00
TOTALS	12	1.13	11	1.04	4	0.38	3	0.28	1057	100.00

*Income classes follow those used in the mail questionnaire (page 6, question 19).

TABLE 12.--Frequency of Boating on Inland Lakes and Streams by Number of Respondents in Selected Income Classes, Region 1, 1968.

Income Class*	0-10 Occasions		11-21 Occasions		22-32 Occasions		33-43 Occasions		44-54 Occasions		55-65 Occasions	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Under $3,000	21	63.64	5	15.15	2	6.06	0	0.00	0	0.00	2	6.06
$ 3,000 - $ 5,999	33	61.11	12	22.22	2	3.71	0	0.00	3	5.55	1	1.85
$ 6,000 - $ 7,999	53	56.99	17	18.28	9	9.68	5	5.37	1	1.07	3	3.23
$ 8,000 - $ 9,999	79	55.63	20	14.09	18	12.68	8	5.63	7	4.92	3	2.11
$10,000 - $14,999	202	53.87	81	21.60	40	10.67	23	6.13	10	2.67	9	2.40
$15,000 - $24,999	137	53.73	42	16.47	23	9.02	15	5.88	10	3.92	9	3.53
$25,000 and Over	69	65.72	12	11.43	6	5.71	3	2.86	5	4.76	4	3.81
TOTALS	594	56.20	189	17.88	100	9.46	54	5.11	36	3.41	31	2.93

Income Class*	66-76		77-87		88-98		99-109		Totals	
Under $3,000	0	0.00	0	0.00	2	6.06	1	3.03	33	100.00
$ 3,000 - $ 5,999	0	0.00	0	0.00	2	3.71	1	1.85	54	100.00
$ 6,000 - $ 7,999	0	0.00	2	2.15	3	3.23	0	0.00	93	100.00
$ 8,000 - $ 9,999	2	1.41	2	1.41	1	0.70	2	1.41	142	100.00
$10,000 - $14,999	1	0.27	3	0.80	2	0.53	4	1.06	375	100.00
$15,000 - $24,999	3	1.18	3	1.18	6	2.35	7	2.74	255	100.00
$25,000 and Over	1	0.95	1	0.95	4	3.81	0	0.00	105	100.00
TOTALS	7	0.66	11	1.04	20	1.89	15	1.42	1057	100.00

*Income classes follow those used in the mail questionnaire (page 6, question 19).

Region 1 on (a) Great Lakes and connecting waters, and (b) inland lakes and streams.

A summary of least squares statistics for the Detroit Region is presented in Appendix F. Regression coefficients presented in that table are for the initial equation estimated, with all independent variables retained in the model. However, as noted previously, the computer program utilized consisted of a stepwise deletion procedure, whereby candidate independent variables were deleted from the initial equation in successive iterations until all remaining variables met a specified stopping criterion. Table 13 presents selected least squares statistics for all independent variables retained in the final regression equation for this region.

Table 13 shows that one of the "place of storage" variables (x_6) was retained in the final regression equation. Registered boat owners included in the sample who stored their watercraft at their place of residence during the boating season, as a group, boated less than other respondents during the study year. This variable had a negative effect upon boating participation, and was highly significant statistically. Number of boats owned (by sampled watercraft owners) was positively correlated with boating activity. Boat length was also positively correlated with boating activity. For the sample of registered watercraft from this region, the number of boating activity occasions (boat days) is expected to increase with boat length. This suggests that higher overall boating participation rates may be expected among watercraft owners who own the largest watercraft.

TABLE 13.--Statistics from the Final Regression Equation for Region 1, Detroit.

Variable		Regression Coefficients[a]	Standard Errors of Regression Coefficients	Level of Significance[b]	Mean
Intercept	(a)	27.116661	6.76109		
Storage of Watercraft at Permanent Home (not on a lake or river)	(X_6)	-12.051651	2.100010	<.0005	.40019
Number of Boats Owned	(X_{13})	3.069490	1.060438	.004	1.59603
Boat Length	(X_{14})	0.958455	0.186614	<.0005	15.92999
Age of Family Head	(X_{16})	-0.346322	0.088178	<.0005	48.27247
Family Size	(X_{18})	1.335662	0.553897	.015	3.60833
Occupation of Family Head--Professional	(X_{19})	-5.249418	2.314773	.022	.20341

$R = .3409$[c] $R^2 = .1163$[d] $S_{yx} = 29.6016$[e]

[a]Values which appear in this column for X_{13}, X_{14}, X_{16}, and X_{18} are for continuous variables, and show the estimated effect of these variables on the slope of the regression line. Values for X_6 and X_{19} assume equal slope coefficients for both zero-one variables. These latter values give the estimated net effect of the two variables on the intercept.

[b]For 1,050 degrees of freedom.

[c]Multiple correlation coefficient.

[d]Coefficient of multiple determination.

[e]Standard error of estimate.

Age of family head, as in the initial equation, was negatively correlated with recreational boating participation, and this result was highly significant statistically. Family size was again also positively related with boating participation. In the final equation, one of the occupation variables (x_{19}) was also retained. For the sample of watercraft owners from this region, boat owners classified as holding professional occupations appear to participate in boating activity significantly less than boat owners holding other occupations. The interpretation of this finding would be that the net effect of the professional occupations classification (x_{19}) would be to change the level of the intercept negatively by an estimated 5.2 boat days (activity occasions).

Since all dummy variables included in the initial equation were deleted in the final iteration (except for x_6 and x_{19}); it should be noted that the combined net effects of the deleted categorical variables--including those dropped in order to obtain a determinate solution--are contained in the intercept term shown in Table 13. Also, intercorrelations between variables retained in the final equation and those deleted in the computer program would make the regression coefficients of independent variables shown in Table 13 less reliable. Where the dependent variable is influenced by the combined effects of intercorrelated independent variables, part of the effect of the deleted variable is contained in the coefficient of the variable retained in the equation. If the regression model is to be used for prediction, a decision has to be made as to whether or not both intercorrelated independent variables should be retained in the equation, even though one of the variables may lack statistical significance. A correlation matrix was obtained for all independent variables included in the regression equation estimated for the State of Michigan as a whole, and results of this analysis will be presented later in this section.

Region 6--Lansing

This region is located in the south-central portion of Michigan, and consists of the Lansing Standard Metropolitan Statistical Area (SMSA). There are three counties contained within this region: Ingham, Eaton, and Clinton.

The income variables (x_{36}, x_{37}, and the cross-product of income and age--x_{38}) were not statistically significant at the .05 level in this region. In view of the procedure used in assigning weights to the various income classes supplied respondents, however, further examination will be undertaken with regard to the relationship between family income and boating participation. Table 14 shows the actual distribution of reported family income among respondents in the Lansing Region, by class.

Table 14 shows that the weighting procedure followed in specifying the income variables did not adequately reflect differences in income distributions between survey respondents from the various study regions identified. Given the nature of the income classes supplied respondents in the mail questionnaire, an alternative procedure for specifying the income variable in the regression model would be to treat it as a dummy variable, assigning zero (0) or one (1) values to the various income classes. This would have permitted the data to determine the relationship.

TABLE 14.--Income Class Distribution of Sampled Watercraft Owners, Region 6, 1968.

Income Class*	No. of Sampled Boat Owners	Per Cent
Under $3,000	4	1.53
$ 3,000 - $ 5,999	19	7.25
$ 6,000 - $ 7,999	22	8.40
$ 8,000 - $ 9,999	46	17.56
$10,000 - $14,999	103	39.31
$15,000 - $24,999	55	20.99
$25,000 and Over	13	4.96
TOTALS	262	100.00

*Income classes follow those used in the mail questionnaire (question 19, page 6).

In order to further examine the relationship between family income and boating participation, two additional tables have been prepared. Table 15 shows the relationship between respondent income class, and frequency of boating participation on Michigan Great Lakes. Table 16 has been prepared to show the relationship between respondent income class and frequency of boating participation on Michigan Inland Lakes and Streams for the Lansing Region. It should be noted that it would be possible to obtain additional insights into the variation in boating participation among respondents from the various study regions by estimating the regression equation separately from (a) respondents boating on inland lakes and streams, and (b) Great Lakes and connecting waters.

On the basis of the data presented in Tables 15 and 16, it appears that frequency of boating participation tends to be greater

TABLE 15.--Frequency of Boating on Great Lakes by Number and Percentage of Respondents in Selected Income Classes, Region 6, 1968.

Income Class*	0-10 Occasions		11-21 Occasions		22-32 Occasions		33-43 Occasions		44-54 Occasions		55-65 Occasions	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Under $3,000	4	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
$ 3,000 - $ 5,999	18	94.74	0	0.00	0	0.00	0	0.00	0	0.00	1	5.26
$ 6,000 - $ 7,999	21	95.45	0	0.00	1	4.55	0	0.00	0	0.00	0	0.00
$ 8,000 - $ 9,999	36	78.26	3	6.52	3	6.52	0	0.00	2	4.35	0	0.00
$10,000 - $14,999	91	88.35	5	4.86	2	1.94	0	0.00	3	2.91	1	0.97
$15,000 - $24,999	44	80.00	1	1.82	4	7.27	4	7.27	0	0.00	1	1.82
$25,000 and Over	13	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTALS	227	86.64	9	3.44	10	3.82	4	1.53	5	1.91	3	1.14

Income Class*	66-76		77-87		88-98		Totals	
Under $3,000	0	0.00	0	0.00	0	0.00	4	100.00
$ 3,000 - $ 5,999	0	0.00	0	0.00	0	0.00	19	100.00
$ 6,000 - $ 7,999	0	0.00	0	0.00	0	0.00	22	100.00
$ 8,000 - $ 9,999	2	4.35	0	0.00	0	0.00	46	100.00
$10,000 - $14,999	0	0.00	1	0.97	0	0.00	103	100.00
$15,000 - $24,999	0	0.00	0	0.00	1	1.82	55	100.00
$25,000 and Over	0	0.00	0	0.00	0	0.00	13	100.00
TOTALS	2	0.76	1	0.38	1	0.38	262	100.00

*Income classes follow those used in the mail questionnaire (page 6, question 19).

TABLE 16.--Frequency of Boating on Inland Lakes and Streams, by Number and Percentage of Respondents in Selected Income Classes, Region 6, 1968.

Income Class*	0-10 Occasions		11-21 Occasions		22-32 Occasions		33-43 Occasions		44-54 Occasions		55-65 Occasions	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Under $3,000	2	50.00	0	0.00	0	0.00	0	0.00	1	25.00	0	0.00
$ 3,000 - $ 5,999	7	36.84	6	31.58	3	15.79	2	10.53	0	0.00	1	5.26
$ 6,000 - $ 7,999	14	63.63	0	0.00	2	9.09	1	4.55	1	4.55	2	9.09
$ 8,000 - $ 9,999	17	36.95	8	17.39	4	8.70	4	8.70	2	4.35	6	13.04
$10,000 - $14,999	33	32.04	16	15.54	12	11.65	16	15.54	9	8.73	11	10.68
$15,000 - $24,999	24	43.64	8	14.54	12	21.81	1	1.82	2	3.64	5	9.09
$25,000 and Over	4	30.77	1	7.69	0	0.00	3	23.08	1	7.69	2	15.39
TOTALS	101	38.55	39	14.89	33	12.60	27	10.30	16	6.11	27	10.30

Income Class*	66-76		77-87		88-98		99-109		Totals	
Under $3,000	0	0.00	1	25.00	0	0.00	0	0.00	4	100.00
$ 3,000 - $ 5,999	0	0.00	0	0.00	0	0.00	0	0.00	19	100.00
$ 6,000 - $ 7,999	0	0.00	2	9.09	0	0.00	0	0.00	22	100.00
$ 8,000 - $ 9,999	1	2.17	2	4.35	2	4.35	0	0.00	46	100.00
$10,000 - $14,999	3	2.91	1	0.97	0	0.00	2	1.94	103	100.00
$15,000 - $24,999	1	1.82	1	1.82	1	1.82	0	0.00	55	100.00
$25,000 and Over	0	0.00	1	7.69	1	7.69	0	0.00	13	100.00
TOTALS	5	1.91	8	3.05	4	1.53	2	0.76	262	100.00

*Income classes follow those used in the mail questionnaire (page 6, question 19).

on inland lakes and streams than on great lakes among respondents from the Lansing Region. Only 38.55 per cent of all respondents indicated that they went boating on 0-10 occasions on inland lakes and streams; while more than 86 per cent of all respondents indicated that they boated on 10 or less occasions on Michigan Great Lakes. Also, the relationship between family income and frequency of boating participation on Michigan Great Lakes tends to be positive only within a given range, increasing with family income up through the $15,000 - $24,999 class and declining thereafter.

In addition to the regression results presented in Appendix F, selected statistics will also be presented here for the final equation estimated. Table 17 gives selected least squares statistics from the final regression equation. The place of storage variables (x_6 and x_7) were retained in the final equation, and were highly significant. The net effect of these two classes of variables upon boating participation was highly negative in both cases. Sampled watercraft owners who indicated that they stored their watercraft at their permanent residence during the boating season, as a class, boated significantly less than watercraft owners who reported storing their boats at other locations. Multiple boat ownership was also positively associated with boating participation in the final equation estimated for this region. Just as in the Detroit Region, higher boating participation rates appear to be associated with sampled watercraft owners from the Lansing Region who reported owning more than one registered (or unregistered) watercraft.

TABLE 17.--Statistics from the Final Regression Equation for Region 6, Lansing.

Variable		Regression Coefficients[a]	Standard Error of Regression Coefficients	Level of Significance[b]	Mean
Intercept	(a)	35.459359	7.56418		
Storage of Watercraft at Permanent Home (not on a lake or river)	(X_6)	-15.278457	4.904263	.002	.38550
Storage of watercraft at waterfrontage located at Permanent home lot	(X_7)	-34.831689	10.317919	.001	.04580
Number of Boats Owned	(X_{13})	13.016858	2.487568	<.0005	1.71374
Income Squared	(X_{37})	0.425664	0.145531	.004	33.54481
Income times age	(X_{38})	-0.110237	0.036135	.003	253.26649

$R = .4615$[c] $R^2 = .2130$[d] $S_{yx} = 34.2789$[e]

[a]Values which appear in this column for X_{13}, X_{37}, and X_{38} give estimated effects on the slope of the regression line. Values for X_6 and X_7 assume equal slope coefficients. These latter values give the estimated effects of the two variables on the intercept.

[b]With 256 degrees of freedom.

[c]Multiple correlation coefficient.

[d]Coefficient of multiple determination.

[e]Standard error of estimate.

Income squared (x_{37}) and the cross-product of income and age (x_{38}) were also retained in the final regression equation, and were highly significant. However, the significance of this finding should be considered cautiously since the values used for these variables in the regression model appear to be biased. In order to test the relationship between boating participation and family income, zero-one values might be inserted in the regression equation for the various income classes used in the survey instrument.

Region 7C--Saginaw Bay

The Saginaw Bay Region is located in the north central portion of Michigan's Lower Peninsula. It extends from the center of the state on the western edge to the Lake Huron Shoreline on the eastern side. This region contains abundant inland lakes and streams in the eastern and central portions, centering on the Houghton Lake area, and borders upon one of the Great Lakes in Arenac and Iosco counties. A total of six counties are contained within this region: Roscommon, Ogemaw, Iosco, Clare, Gladwin, and Arenac (see Figure 1, Chapter III).

For this region, selected statistics from the initial regression equation are summarized in Appendix F. None of the computed regression coefficients for the variables contained in the initial equation had significance probabilities of .05 per cent or less.

Another interesting finding in this region relates to the income distribution among sampled watercraft owners. A much larger proportion of respondents from region 7C appear to be grouped in the lower range of income classes examined than in the previous two regions. For example, 60 per cent of all respondents from region 7C reported 1968 family incomes of less than $8,000 in 1968. Moreover, 12.50 per cent reported incomes of less than $3,000; and 29.17 per cent reported annual incomes between $3,000 - $5,999. These findings contrast with those for regions 1 and 6. In region 6, only 17.16 per cent of all respondents reported annual incomes of less than $8,000 during 1968. In region 1, a similar proportion appeared to exist--an estimated 17.02 per cent of those responding to the survey reported family incomes of less than $8,000. The actual income distribution of respondents for Region 7C is given in Table 18.

TABLE 18.--Income Class Distribution of Sampled Watercraft Owners from Region 7C, 1968.

Income Class*	No. of Sampled Boat Owners	Per Cent
Under $3,000	15	12.50
$ 3,000 - $ 5,999	35	29.17
$ 6,000 - $ 7,999	22	18.33
$ 8,000 - $ 9,999	16	13.33
$10,000 - $14,999	21	17.50
$15,000 - $24,999	8	6.67
$25,000 and Above	3	2.50
TOTALS	120	100.00

*Income classes follow those used in the mail questionnaire (question 19, page 6).

The median family income for respondents from Region 7C is estimated to be approximately $6,908.44. This statistic was computed from the data presented in Table 18 above, and represents an approximation of the actual median. It is interpolated based upon the (implicit) assumption that individual values within the median class ($6,000 - $7,999) are evenly distributed over that interval. Given the manner in which income data was reported by respondents in the mail questionnaire, the true median cannot be determined from the distribution shown in Table 18. Actual (ungrouped) data on family income would have to be used in order to determine the true median.[1]

Following a similar procedure, median family income was calculated for respondents from the Detroit and Lansing Regions as well. The grouped data on family income in Tables 10 and 14 were utilized. For the study year (1968), the median family income of respondents from the Detroit Region was estimated to be approximately $12,753.11, and $11,940.59 for respondents from the Lansing Region. Based upon these estimates, median family income appears to be clearly higher among respondents from the Detroit and Lansing Regions than that calculated for the Saginaw Bay Region.

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[1]An estimate of median family income was calculated for all respondents from Region 7C by using an interpolation formula:

$$Md = L + \frac{i(n/2 - F)}{f}$$

where: Md = the median,
L = the lower limit of the median class,
i = the width of the median class,
f = the frequency for the median class,
F = the cummulative frequency for all classes below the median class,
n = the total number of values of X (the sum of all frequencies).

See, W. A. Spurr, L. S. Kellogg, and J. H. Smith, Business and Economic Statistics (Rev. edition; Homewood, Illinois: Richard D. Irwin, Inc., 1961), pp. 187-88.

Caution should be exercised when considering these statistics. While it is possible to compute a median value from an open-ended frequency distribution, the mean value cannot be determined if the end values are unknown. Also, the median calculated value, as noted previously, should be regarded as only an approximation of the true median because of the uneven distribution of values within the median class itself, i.e., more than one-half of the original values may lie on one side of the interpolated median. Per cent values shown in Tables 10, 14, and 18 were treated as ordinary frequencies, and were so utilized in the interpolation formula used in calculating median values for each distribution of regional family income.

Further examination of the relationship between family income and boating participation for the Saginaw Bay Region may be made by referring to Tables 19 and 20. Table 19 shows the distribution of boating activity occasions by family income class for boating participation on Michigan Great Lakes (and connecting waters). Table 20 shows the relationship between family income class and frequency of boating participation on Michigan Inland Lakes and Streams for the Saginaw Bay Region.

Generally, frequency of boating participation is shown to have considerable variation among respondents from this region. While annual boating participation tends to be higher on Michigan Lakes and Streams, no clear pattern appears to exist. For example, an estimated 11.67 per cent of all respondents indicated that they boated on Inland Lakes and Streams on 11 - 21 occasions; while only 5.83 per cent of all respondents indicated boating on Great Lakes on 11 - 21 occasions.

TABLE 19.--Frequency of Boating on Great Lakes by Numbers of Respondents in Selected Income Classes, Region 7C, 1968.

Income Class*	0-10 Occasions No.	0-10 Occasions %	11-21 Occasions No.	11-21 Occasions %	22-32 Occasions No.	22-32 Occasions %	33-43 Occasions No.	33-43 Occasions %	44-54 No.	44-54 %	55-65 No.	55-65 %	Totals No.	Totals %
Under $3,000	13	86.66	1	6.67	0	0.00	0	0.00	0	0.00	1	6.67	15	100.00
$ 3,000 - $ 5,999	32	91.43	3	8.57	0	0.00	0	0.00	0	0.00	0	0.00	35	100.00
$ 6,000 - $ 7,999	21	95.45	1	4.55	0	0.00	0	0.00	0	0.00	0	0.00	22	100.00
$ 8,000 - $ 9,999	14	81.50	1	6.25	1	6.25	0	0.00	0	0.00	0	0.00	16	100.00
$10,000 - $14,999	18	85.72	1	4.76	0	0.00	1	4.76	0	0.00	1	4.76	21	100.00
$15,000 - $24,999	7	87.50	0	0.00	1	12.50	0	0.00	0	0.00	0	0.00	8	100.00
$25,000 and Over	3	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	3	100.00
TOTALS	108	90.00	7	5.83	2	1.67	1	0.83	0	0.00	2	1.67	120	100.00

*Income classes follow those used in the mail questionnaire (question 19, page 6).

TABLE 20.--Frequency of Boating on Inland Lakes and Streams by Number of Respondents in Selected Income Classes, Region 7C, 1968.

Income Class*	0-10 Occasions No.	0-10 Occasions %	11-21 Occasions No.	11-21 Occasions %	22-32 Occasions No.	22-32 Occasions %	33-43 Occasions No.	33-43 Occasions %	44-54 Occasions No.	44-54 Occasions %	55-65 Occasions No.	55-65 Occasions %
Under $3,000	11	73.33	2	13.33	1	6.67	0	0.00	0	0.00	1	6.67
$ 3,000 - $ 5,999	22	62.86	2	5.71	4	11.43	1	2.86	0	0.00	3	8.51
$ 6,000 - $ 7,999	11	50.00	3	13.64	2	9.09	0	0.00	1	4.54	3	13.64
$ 8,000 - $ 9,999	10	62.50	2	12.50	2	12.50	0	0.00	0	0.00	1	6.25
$10,000 - $14,999	7	33.33	3	14.29	3	14.29	3	14.29	2	9.52	2	9.52
$15,000 - $24,999	3	37.50	2	25.00	0	0.00	2	25.00	0	0.00	1	12.50
$25,000 and Over	1	33.34	0	0.00	0	0.00	1	33.33	0	0.00	0	0.00
TOTALS	65	54.17	14	11.67	12	10.00	7	5.83	3	2.50	11	9.17

Income Class*	66-76 No.	66-76 %	77-87 No.	77-87 %	88-98 No.	88-98 %	99-109 No.	99-109 %	Totals No.	Totals %
Under $3,000	0	0.00	0	0.00	0	0.00	0	0.00	15	100.00
$ 3,000 - $ 5,999	0	0.00	0	0.00	1	2.86	2	5.71	35	100.00
$ 6,000 - $ 7,999	1	4.55	0	0.00	0	0.00	1	4.54	22	100.00
$ 8,000 - $ 9,999	0	0.00	0	0.00	1	6.25	0	0.00	16	100.00
$10,000 - $14,999	0	0.00	0	0.00	0	0.00	1	4.76	21	100.00
$15,000 - $24,999	0	0.00	0	0.00	0	0.00	0	0.00	8	100.00
$25,000 and Over	0	0.00	0	0.00	1	33.33	0	0.00	3	100.00
TOTALS	1	0.83	0	0.00	3	2.50	4	3.33	120	100.00

*Income classes follow those used in the mail questionnaire (question 19, page 6).

Similarly, 10.00 per cent of respondents reported boating on Inland Lakes and Streams between 22 - 32 occasions, while only 1.67 per cent of the respondents from this region reported going boating on 22 - 32 occasions.

Selected statistics from the final regression equation estimated for Region 7C are shown in Table 21. Only two of the independent variables were retained in the model after the specified stopping criterion was met: family size of registered boat owner (x_{18}), and occupation of family head--service worker (x_{27}).

The standard error of estimate (S_{yx}) is the standard deviation of the observed values of the dependent variable around the regression line. If the observed values are scattered widely around the regression line, estimated values of the dependent variable based upon the estimating line will not be very accurate. Table 21 shows that the standard error of estimate in the Saginaw Bay equation is 26.93. For an individual forecast of y (boat days), one could say that the true value of y would lie within $\pm$ 26.93 boat days with two chances out of three of being correct. In this region (as well as all others) the standard error of estimate is quite large. Thus, predicted values of y will not be very accurate using this model.

Also, a very small percentage of the total variance in the dependent variable is explained by this model in Region 7C. The computed coefficient of multiple determination is only .1208, indicating that approximately 12 per cent of the total variance in the dependent variable is explained by the independent variables retained in the final equation.

TABLE 21.--Statistics from the Final Regression Equation for Region 7C, Saginaw Bay.

Variable		Regression Coefficients[a]	Standard Error of Regression Coefficients	Level of Significance[b]	Mean
Intercept	(a)	9.693997	5.267375		
Family Size	(X_{18})	4.832810	1.649592	.004	2.825
Occupation of Family Head--Service Worker	(X_{27})	35.349367	13.716022	.001	.0333

$R = .3475$[c] $R^2 = .1208$[d] $S_{yx} = 26.9332$[e]

[a]The value which appears in this column for X_{18} gives the estimated effect of the variable upon the slope of the regression line. The value for X_{27} assumes a constant slope coefficient. This latter value gives the estimated net effect of the variable on the intercept value.

[b]With 117 degrees of freedom.

[c]Multiple correlation coefficient.

[d]Coefficient of multiple determination.

[e]Standard error of estimate.

Region 10--Traverse Bay

The Traverse Bay Region is located in the Northwest portion of Michigan's lower peninsula. The area is bounded along its westerly edge by the shoreline of Lake Michigan. Substantial public recreation facilities are located in this area in the form of state forests and parks, and the Manistee National Forest. Sleeping Bear Dunes, which has been investigated as a possible National Recreation Area, is also located within this region. There are ten counties contained within this region: Manistee, Wexford, Missaukee, Benzie, Grand Traverse, Kalkaska, Leelanau, Antrim, Charlevoix, and Emmet. Statistics from the initial regression equation are summarized for this region in Appendix F.

The income variables (x_{36}, x_{37}, and x_{38}) were significantly correlated with boating participation in this region. However, this result should be discounted in view of the limitations noted in the specification of these variables. The distribution of total family income among respondents from this region is shown in Table 22 below.

Table 22 shows that 41.41 per cent of all respondents from Region 10 had family incomes which were less than $8,000 annually during 1968. Nearly 9 per cent of all respondents reported incomes less than $3,000, and 14.84 per cent reported having incomes between $3,000 - $5,999. These findings should be considered cautiously, of course, since only about 26 per cent of the total number of questionnaires mailed were actually completed and utilized in the statistical analysis. Somewhat higher response rates were obtained from respondents in the three follow-up control counties (Ingham, Grand Traverse, and Leelanau), but the high

TABLE 22.--Income Class Distribution of Sampled Watercraft Owners, Region 10, 1968.

Income Class*	No. of Sampled Boat Owners	Per Cent
Under $3,000	23	8.99
$ 3,000 - $ 5,999	38	14.84
$ 6,000 - $ 7,999	45	17.58
$ 8,000 - $ 9,999	42	16.40
$10,000 - $14,999	53	20.70
$15,000 - $24,999	36	14.07
$25,000 and Over	19	7.42
TOTALS	256	100.00

*Family income classes are the same as those utilized in the mail questionnaire (question 19, page 6).

rate of non-response raises questions concerning the validity of the income distributions shown in this study.

The estimated median family income for respondents from Region 10 is $9,047.04. This result contrasts with approximate median incomes of $6,908.44 for Region 7C, $12,753.11 for Region 1, and $11,940.59 for Region 6. The relationship between respondent incomes and boating participation for the Traverse Bay Region is further examined in Tables 23 and 24. These tables indicate that frequency of boating participation for all respondents was greater on Michigan inland lakes and streams than on Great Lakes.

For example, an estimated 17.58 per cent of all respondents indicated boating on Michigan inland lakes and streams on 11 - 21 occasions, while only 7.81 per cent of respondents indicated boating on Michigan Great Lakes on 11 - 21 occasions. The data in these tables

TABLE 23.--Frequency of Boating on Great Lakes by Number and Percentage of Respondents in Selected Income Classes, Region 10, 1968.

Income Class*	0-10 Occasions		11-21 Occasions		22-32 Occasions		33-43 Occasions		44-54 Occasions		55-65 Occasions	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Under $3,000	22	95.65	0	0.00	0	0.00	1	4.35	0	0.00	0	0.00
$ 3,000 - $ 5,999	35	92.11	2	5.26	0	0.00	0	0.00	1	2.63	0	0.00
$ 6,000 - $ 7,999	35	77.78	3	6.67	2	4.44	3	6.67	0	0.00	1	2.22
$ 8,000 - $ 9,999	34	80.95	4	9.53	2	4.76	0	0.00	0	0.00	1	2.38
$10,000 - $14,999	42	79.25	3	5.66	4	7.55	2	3.77	2	3.77	0	0.00
$15,000 - $24,999	26	72.22	6	16.67	2	5.55	1	2.78	1	2.78	0	0.00
$25,000 and Over	13	68.43	2	10.53	0	0.00	1	5.26	1	5.26	0	0.00
TOTALS	207	80.86	20	7.81	10	3.91	8	3.13	5	1.95	2	0.78

	66-76		77-87		88-98		Totals	
Under $3,000	0	0.00	0	0.00	0	0.00	23	100.00
$ 3,000 - $ 5,999	0	0.00	0	0.00	0	0.00	38	100.00
$ 6,000 - $ 7,999	0	0.00	0	0.00	1	2.22	45	100.00
$ 8,000 - $ 9,999	0	0.00	0	0.00	1	2.38	42	100.00
$10,000 - $14,999	0	0.00	0	0.00	0	0.00	53	100.00
$15,000 - $24,999	0	0.00	0	0.00	0	0.00	36	100.00
$25,000 and Over	1	5.26	0	0.00	1	5.26	19	100.00
TOTALS	1	0.39	0	0.00	3	1.17	256	100.00

*Income classes follow those used in the mail questionnaire (page 6, question 19).

TABLE 24.--Frequency of Boating on Inland Lakes and Streams by Number and Percentage of Respondents in Selected Income Classes, Region 10, 1968.

	0-10 Occasions		11-21 Occasions		22-32 Occasions		33-43 Occasions		44-54 Occasions		55-65 Occasions	
Income Class*	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Under $3,000	13	56.52	3	13.04	3	13.04	1	4.35	0	0.00	1	4.35
$ 3,000 - $ 5,999	15	39.47	8	21.05	3	7.90	0	0.00	1	2.63	3	7.90
$ 6,000 - $ 7,999	22	48.89	13	28.89	3	6.67	2	4.44	3	6.67	1	2.22
$ 8,000 - $ 9,999	23	54.76	4	9.53	4	9.53	2	4.76	1	2.38	3	7.14
$10,000 - $14,999	23	43.40	8	15.09	10	18.87	5	9.43	2	3.77	1	1.89
$15,000 - $24,999	16	44.44	8	22.22	4	11.11	1	2.78	1	2.78	3	8.33
$25,000 and Over	10	52.64	1	5.26	2	10.53	1	5.26	1	5.26	1	5.26
TOTALS	122	47.66	45	17.58	29	11.33	12	4.69	9	3.51	13	5.08

	66-76		77-87		88-98		99-109		Totals	
Under $3,000	0	0.00	0	0.00	2	8.70	0	0.00	23	100.00
$ 3,000 - $ 5,999	2	5.26	0	0.00	2	5.26	4	10.53	38	100.00
$ 6,000 - $ 7,999	0	0.00	0	0.00	0	0.00	1	2.22	45	100.00
$ 8,000 - $ 9,999	1	2.38	0	0.00	3	7.14	1	2.38	42	100.00
$10,000 - $14,999	0	0.00	0	0.00	3	5.66	1	1.89	53	100.00
$15,000 - $24,999	1	2.78	1	2.78	0	0.00	1	2.78	36	100.00
$25,000 and Over	0	0.00	1	5.26	2	10.53	0	0.00	19	100.00
TOTALS	4	1.56	2	0.78	12	4.69	8	3.12	256	100.00

*Income classes follow those used in the mail questionnaire (page 6, question 19).

also suggest that frequency of boating participation may have a non-linear relationship with family income--increasing up to a threshhold level of income and declining thereafter.

Statistics for the final regression equation are summarized for the Traverse Bay Region in Table 25. The horsepower rating of the primary watercraft engine used (x_5) was positively correlated with boating participation in Region 10. This finding suggests that higher levels of boating participation exist in this region among watercraft owners having larger engines. It may also indicate that relatively higher rates of boating participation exist on Michigan Great Lakes where large watercraft engines are more easily accommodated. Storage of watercraft variables (x_7 and x_8) also had a positive net effect upon boating participation. Watercraft owners who stored sampled watercraft at their permanent residence, which was located on waterfrontage, as a class, had a positive effect on boating participation. Sampled boat owners from this region who stored their watercraft at a commercial marina during the boating season (x_8) also had a positive effect upon boating participation.

Multiple boat ownership (x_{13}) also was positively correlated with boating participation, and this result was significant at the .001 level of probability. Age of household head squared was negatively correlated with boating participation. This indicates that there is a non-linear relationship between age and boating participation. The income variables (x_{36}, x_{37}, and x_{38}) were all significantly correlated with boating participation in this region. However, there appears to be a strong likelihood that this result is biased. Further examination

TABLE 25.--Statistics from the Final Regression Equation for Region 10, Traverse Bay.

Variable		Regression Coefficients[a]	Standard Error of Regression Coefficients	Level of Significance[b]	Mean
Intercept	(a)	59.996111	12.607039		
Horsepower of Primary Watercraft Engine	(X_5)	0.103405	0.045264	.023	32.28906
Storage of Watercraft at Residence located on waterfrontage	(X_7)	11.463108	4.392955	.010	0.27734
Storage of Watercraft at Commercial Marina during Boating Season	(X_8)	20.754596	7.472134	.006	0.08594
Number of Boats Owned	(X_{13})	6.105275	1.738332	.001	1.85156
Age Squared	(X_{17})	-0.009359	0.002508	<.0005	3052.99219
Family Income	(X_{36})	-15.251885	4.479506	.001	4.44961
Income Squared	(X_{37})	0.499931	0.229369	.030	28.40261
Income Times Age	(X_{38})	0.148740	0.052964	<.0005	231.85996

$R = .4271$[c] $R^2 = .1824$[d] $S_{yx} = 29.6514$[e]

[a]Values in this column for X_5, X_{13}, X_{17}, X_{36}, X_{37}, and X_{38} give the estimated effects of the individual variables on the slope of the regression line. Values for variables X_7 and X_8 assume equal slope coefficients for each categorical class. These latter values give the estimated net change in intercept attributable to specific zero-one variables in the two classes considered.

[b]With 222 degrees of freedom.

[c]Multiple correlation coefficient.

[d]Coefficient of multiple determination.

[e]Standard error of estimate.

of the relationship between family income and boating participation has been undertaken in Tables 22, 23, and 24 in this section.

Region 12A--Marquette-Iron Mountain

The Marquette-Iron Mountain Region is located in Michigan's Upper Peninsula. It bisects the Upper Peninsula--extending from the Lake Superior shoreline on its northerly edge to Lake Michigan on its southerly side. Four counties are wholly contained within this region: Iron, Dickinson, Marquette, and Alger.

Regression results from the initial equation are summarized for this region in Appendix F.

No significant relationship appears to exist between the family income variables (x_{36}, x_{37}, and x_{38}) and boating participation. The actual distribution of family income among respondents from Region 12A is shown in Table 26 below.

The computed median family income for the 119 respondents from Region 12A is approximately $9,046.53. This figure can be compared with similar statistics computed for other Michigan Study Regions: Region 1--$12,753.11, Region 6--$11,940.59, Region 7C--$6,908.44, and Region 10--$9,047.04.

For Region 12A respondents, nearly 59 per cent had reported family incomes of less than $10,000 annually. A total of 27.72 per cent of all respondents reported incomes of less than $6,000 annually; and 12.60 per cent indicated receiving annual incomes of less than $3,000 annually.

Data relating to frequency of boating indicate that respondents from Region 12A participated more often in boating activities on inland

TABLE 26.--Income Class Distribution of Sampled Watercraft Owners, Region 12A, 1968.

Income Class*	No. of Sampled Boat Owners	Per Cent
Under $3,000	15	12.60
$ 3,000 - $ 5,999	18	15.12
$ 6,000 - $ 7,999	15	12.60
$ 8,000 - $ 9,999	22	18.49
$10,000 - $14,999	33	27.74
$15,000 - $24,999	11	9.25
$25,000 and Over	5	4.20
TOTALS	119	100.00

*Income classes follow those used in the mail questionnaire (question 19, page 6).

lakes and streams that upon Michigan Great Lakes or connecting waters. For example, Table 27 shows that approximately 8 per cent of all respondents participated in boating on Great Lakes on 11 - 21 occasions. However, Table 28 indicates that about 19 per cent of all respondents participated in boating in inland lakes and streams on 11 - 21 occasions. Moreover, nearly 6 per cent of all respondents reported boating on Great Lakes on 22 - 32 occasions; while nearly 12 per cent of the respondents reporting indicated that they went boating on inland lakes and streams on 22 - 32 occasions. For detailed information on frequency of boating participation and family income, see Tables 27 and 28.

Table 29 summarizes statistics from the final least squares equation for the Marquette-Iron Mountain Region (12A). Only three independent variables met the specified stopping criterion in the LSDEL Program utilized. Multiple boat ownership (x_{13}) was again highly

TABLE 27.--Frequency of Boating on Great Lakes by Number and Percentage of Respondents in Selected Income Classes, Region 12A, 1968.

Income Class*	0-10 Occasions		11-21 Occasions		22-32 Occasions		33-43 Occasions	
	No.	%	No.	%	No.	%	No.	%
Under $3,000	14	93.33	1	6.67	0	0.00	0	0.00
$ 3,000 - $ 5,999	15	83.33	0	0.00	0	0.00	1	5.56
$ 6,000 - $ 7,999	9	60.00	3	20.00	1	6.67	0	0.00
$ 8,000 - $ 9,999	15	68.18	2	9.09	3	13.63	1	4.55
$10,000 - $14,999	26	78.79	1	3.03	2	6.06	2	6.06
$15,000 - $24,999	7	63.64	3	27.27	1	9.09	0	0.00
$25,000 and Over	5	100.00	0	0.00	0	0.00	0	0.00
TOTALS	91	76.47	10	8.41	7	5.88	4	3.36
	44-54		55-65		66-76		Totals	
Under $3,000	0	0.00	0	0.00	0	0.00	15	100.00
$ 3,000 - $ 5,999	1	5.55	1	5.56	0	0.00	18	100.00
$ 6,000 - $ 7,999	1	6.66	1	6.67	0	0.00	15	100.00
$ 8,000 - $ 9,999	0	0.00	0	0.00	1	4.55	22	100.00
$10,000 - $14,999	0	0.00	2	6.06	0	0.00	33	100.00
$15,000 - $24,999	0	0.00	0	0.00	0	0.00	11	100.00
$25,000 and Over	0	0.00	0	0.00	0	0.00	5	100.00
TOTALS	2	1.68	4	3.36	1	0.84	119	100.00

*Income classes follow those used in the mail questionnaire (page 6, question 19).

TABLE 28.--Frequency of Boating on Inland Lakes and Streams by Number and Percentage of Respondents in Selected Income Classes, Region 12A, 1968.

	0-10 Occasions		11-21 Occasions		22-32 Occasions		33-43 Occasions		44-54 Occasions		55-65 Occasions	
Income Class*	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Under $3,000	7	46.66	5	33.33	0	0.00	0	0.00	0	0.00	1	6.67
$ 3,000 - $ 5,999	11	61.11	3	16.66	2	11.11	1	5.56	0	0.00	1	5.56
$ 6,000 - $ 7,999	9	60.00	2	13.33	1	6.67	0	0.00	1	6.67	0	0.00
$ 8,000 - $ 9,999	11	50.00	5	22.73	1	4.54	3	13.64	0	0.00	0	0.00
$10,000 - $14,999	17	51.52	6	18.18	5	15.15	1	3.03	1	3.03	2	6.06
$15,000 - $24,999	4	36.37	2	18.18	2	18.18	2	18.18	0	0.00	0	0.00
$25,000 and Over	1	20.00	0	0.00	3	60.00	1	20.00	0	0.00	0	0.00
TOTALS	60	50.42	23	19.33	14	11.77	8	6.72	2	1.68	4	3.36

	66-76		77-87		88-98		99-109		Totals	
Under $3,000	2	13.33	0	0.00	0	0.00	0	0.00	15	100.00
$ 3,000 - $ 5,999	0	0.00	0	0.00	0	0.00	0	0.00	18	100.00
$ 6,000 - $ 7,999	1	6.66	0	0.00	1	6.67	0	0.00	15	100.00
$ 8,000 - $ 9,999	0	0.00	0	0.00	1	4.55	1	4.54	22	100.00
$10,000 - $14,999	0	0.00	0	0.00	1	3.03	0	0.00	33	100.00
$15,000 - $24,999	0	0.00	0	0.00	1	9.09	0	0.00	11	100.00
$25,000 and Over	0	0.00	0	0.00	0	0.00	0	0.00	5	100.00
TOTALS	3	2.52	0	0.00	4	3.36	1	0.84	119	100.00

*Income classes follow those used in the mail questionnaire (page 6, question 19).

TABLE 29.--Statistics from the Final Regression Equation for Region 12A, Marquette-Iron Mountain.

Variable		Regression Coefficients[a]	Standard Error of Regression Coefficients	Level of Significance[b]	Mean
Intercept	(a)	44.829237	12.922069		
Number of Boats Owned	(X_{13})	11.278031	2.887559	<.0005	1.67227
Age of Family Head	(X_{16})	-0.697643	0.240251	.004	50.84034
Occupation of Family Head, Other Factory Worker	(X_{35})	64.837219	31.831160	.044	.00840

$R = .4143$[c] $R^2 = .1716$[d] $S_{yx} = 31.3994$[e]

[a]Values in this column for X_{13} and X_{16} give the estimated effects of the two variables on the slope of the regression line. However, the value for X_{35} assumes a constant slope coefficient, and gives the estimated net change in intercept attributable to a zero-one variable.

[b]With 115 degrees of freedom.

[c]Multiple correlation coefficient.

[d]Coefficient of multiple determination.

[e]Standard error of estimate.

important in this region, and was positively correlated with boating participation. Age of family head (x_{16}) was negatively correlated with boating participation in the Marquette-Iron Mountain Region.

Occupation of family head (x_{35}) had a highly positive effect upon the dependent variable. Other factory workers, as a class, did significantly more boating than boat owners in other occupational classes.

The State of Michigan

In addition to estimating parameters in the regression equation separately for five Michigan Planning and Development Regions, the regression model was also estimated separately for the State of Michigan as a whole. That is, observations were combined from all 83 Michigan Counties. Selected statistics for the initial regression equation estimated are summarized in Appendix F.

The income variables (x_{36}, x_{37}, and x_{38}) were not significantly correlated with boating activity occasions. This may have been a result of improperly specifying family income in the regression model, however. The actual distribution of family income among respondents to the survey is shown in Table 30.

The computed median family income for all survey respondents is approximately $10,840.06. For the entire sample, 29.17 per cent of all respondents reported family incomes of less than $8,000.00 annually. A total of 10.32 per cent of the respondents had family incomes of $3,000 - $5,999, and 5.25 per cent reported family incomes of less than $3,000. About 55 per cent of all survey respondents had family incomes of $10,000 or above during the survey year (1968).

TABLE 30.--Income Class Distribution of Sampled Watercraft Owners, State of Michigan, 1968.

Income Class*	No. of Sampled Boat Owners	Per Cent
Under $3,000	230	5.25
$ 3,000 - $ 5,999	452	10.32
$ 6,000 - $ 7,999	595	13.60
$ 8,000 - $ 9,999	681	15.55
$10,000 - $14,999	1,376	31.42
$15,000 - $24,999	725	16.57
$25,000 and Over	319	7.29
TOTALS	4,378	100.00

*Income classes follow those utilized in the mail questionnaire (question 19, page 6).

A comparison of computed median family incomes may be made on a regional basis by referring to Table 31. This table gives a tabular summary of median incomes by study region, and the State. Only two study regions (Detroit and Lansing) had computed median family incomes which were greater than the State of Michigan statistic.

In view of the constraints imposed by collection of data on family income in the survey instrument, the statistical analysis has been supplemented by the inclusion of frequency count tables in the data analysis chapter. This practice has been followed consistently for all study regions identified. Similar tables have also been prepared for the State of Michigan as a whole. Tables 32 and 33 provide frequency of boating data by income classes of respondents for Great Lakes and Inland lakes and streams boating, respectively.

TABLE 31.--A Comparison of Median Family Income of Respondents, by Study Region, 1968.

Area	Computed Median Family Income 1968 (Dollars)	Sample Size (N)
The State of Michigan	10,840.06	4,378
Region 1--Detroit	12,753.11	1,057
Region 6--Lansing	11,940.59	262
Region 7C--Saginaw Bay	6,908.44	120
Region 10--Traverse Bay	9,047.04	256
Region 12A--Marquette-Iron Mountain	9,046.53	119

As was the case in individual study regions, frequency of boating (number of occasions) tends to be higher on inland lakes and streams areas than on Great Lakes. For example, about 17 per cent of all respondents indicated that they boated on inland lakes and streams on 11 - 21 occasions in 1968; while only about 7 per cent of survey respondents indicated going boating on Great Lakes on 11 - 21 occasions during the study year. Likewise, about 12 per cent of all respondents reported boating on inland lakes and streams on 22 - 32 occasions; while only about 5 per cent of the respondents reported going boating on Great Lakes between 22 - 32 occasions during the study year.

Table 34 summarizes selected statistics from the final regression equation for the total (State of Michigan) sample. All of the "type of power system" variables (x_1-x_4) met the specified stopping criterion in the LSDEL program. All coefficients had significance probabilities $\leq .05$, and thus were retained in the final equation. All four variables had positive effects upon the dependent variable, and calculated a_j values

TABLE 32.--Frequency of Boating on Great Lakes by Number of Respondents in Selected Income Classes, State of Michigan, 1968.

	0-10 Occasions		11-21 Occasions		22-32 Occasions		33-43 Occasions		44-54 Occasions		55-65 Occasions	
Income Class*	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Under $3,000	203	88.26	15	6.52	3	1.30	2	0.87	2	0.87	3	1.30
$ 3,000 - $ 5,999	398	88.05	24	5.30	14	3.10	4	0.89	4	0.89	4	0.89
$ 6,000 - $ 7,999	502	84.37	34	5.71	27	4.54	10	1.68	5	0.84	10	1.68
$ 8,000 - $ 9,999	568	83.41	54	7.93	23	3.38	8	1.17	10	1.47	8	1.17
$10,000 - $14,999	1127	81.90	85	6.18	61	4.43	35	2.54	24	1.75	19	1.38
$15,000 - $24,999	550	75.86	55	7.59	54	7.45	24	3.31	16	2.21	12	1.66
$25,000 and Over	218	68.34	26	8.15	27	8.46	18	5.64	11	3.45	8	2.51
TOTALS	3566	81.45	293	6.69	209	4.78	101	2.31	72	1.64	64	1.46

	66-76		77-87		88-98		99-109		Totals	
Under $3,000	1	0.44	0	0.00	0	0.00	1	0.44	230	100.00
$ 3,000 - $ 5,999	1	0.22	0	0.00	1	0.22	2	0.44	452	100.00
$ 6,000 - $ 7,999	1	0.17	1	0.17	3	0.50	2	0.34	595	100.00
$ 8,000 - $ 9,999	4	0.59	2	0.29	3	0.44	1	0.15	681	100.00
$10,000 - $14,999	12	0.87	7	0.51	2	0.15	4	0.29	1376	100.00
$15,000 - $24,999	3	0.41	5	0.69	3	0.41	3	0.41	725	100.00
$25,000 and Over	5	1.56	2	0.63	2	0.63	2	0.63	319	100.00
TOTALS	27	0.62	17	0.39	14	0.32	15	0.34	4378	100.00

*Income classes follow those utilized in the mail questionnaire (page 6, question 19).

TABLE 33.--Frequency of Boating on Inland Lakes and Streams by Number of Respondents in Selected Income Classes, State of Michigan, 1968.

Income Class*	0-10 Occasions No.	0-10 Occasions %	11-21 Occasions No.	11-21 Occasions %	22-32 Occasions No.	22-32 Occasions %	33-43 Occasions No.	33-43 Occasions %	44-54 Occasions No.	44-54 Occasions %	55-65 Occasions No.	55-65 Occasions %
Under $3,000	151	65.65	27	11.74	22	9.57	3	1.30	4	1.74	8	3.48
$ 3,000 - $ 5,999	251	55.53	87	19.25	44	9.73	17	3.76	7	1.55	16	3.54
$ 6,000 - $ 7,999	309	51.93	109	18.32	77	12.94	29	4.87	21	3.53	17	2.86
$ 8,000 - $ 9,999	332	48.75	118	17.33	92	13.51	43	6.31	27	3.96	28	4.11
$10,000 - $14,999	634	46.08	260	18.90	195	14.17	102	7.41	52	3.78	50	3.63
$15,000 - $24,999	352	48.55	119	16.41	88	12.14	37	5.10	25	3.45	40	5.52
$25,000 and Over	172	53.92	33	10.34	29	9.09	20	6.27	17	5.33	8	2.51
TOTALS	2201	50.27	753	17.20	547	12.49	251	5.73	153	3.50	167	3.82

Income Class*	66-76 No.	66-76 %	77-87 No.	77-87 %	88-98 No.	88-98 %	99-109 No.	99-109 %	Totals No.	Totals %
Under $3,000	3	1.30	2	0.87	6	2.61	4	1.74	230	100.00
$ 3,000 - $ 5,999	5	1.11	2	0.44	7	1.55	16	3.54	452	100.00
$ 6,000 - $ 7,999	4	0.67	6	1.01	10	1.68	13	2.19	595	100.00
$ 8,000 - $ 9,999	6	0.88	14	2.06	11	1.62	10	1.47	681	100.00
$10,000 - $14,999	19	1.38	8	0.58	26	1.89	30	2.18	1376	100.00
$15,000 - $24,999	11	1.52	9	1.24	20	2.76	24	3.31	725	100.00
$25,000 and Over	2	0.63	10	3.13	16	5.02	12	3.76	319	100.00
TOTALS	50	1.14	51	1.17	96	2.19	109	2.49	4378	100.00

*Income classes follow those utilized in the mail questionnaire (page 6, question 19).

TABLE 34.--Statistics from the Final Regression Equation for the State of Michigan.

Variable		Regression Coefficients[a]	Standard Error of Regression Coefficients	Level of Significance[b]	Mean
Intercept	(a)	12.049114	4.227445		
Type 1-1(outboard motor)	(X_1)	6.711649	2.994954	.024	0.87124
Type 2-1(sailboat with motor)	(X_2)	11.429399	4.864498	.018	0.01494
Type 3-1(inboard motor)	(X_3)	8.587497	3.803828	.023	0.05838
Type 4-1(inboard-outboard motor)	(X_4)	10.655542	3.991207	.008	0.03236
Horsepower of Primary Engine	(X_5)	0.048449	0.012616	<.0005	34.29418
Storage at Premanent Residence (not on lake or river)	(X_6)	-11.721026	1.161063	<.0005	0.40371
Transportation of Watercraft	(X_{12})	3.464273	1.108551	.002	0.54899
Number of Boats Owned	(X_{13})	4.140232	0.477337	<.0005	1.69314
Boat length	(X_{14})	0.485870	0.146603	.001	14.99004
Age Squared	(X_{17})	-0.002774	0.000505	<.0005	2651.97307
Family Size	(X_{18})	1.037961	0.296420	.001	3.36999
		$R = .3237$[c]	$R^2 = .1048$[d]	$S_{yx} = 29.7148$[e]	

[a]Values which appear in this column for $(X_1\text{-}X_4)$, X_6, and X_{12} assume equal slope coefficients. These values give the estimated net effect of the categorical values listed on the intercept term. Values for X_5, X_{13}, X_{14}, X_{17}, and X_{18} give estimated effects on the slope of the regression line.

[b]For 4406 degrees of freedom.

[c]Multiple correlation coefficient.

[d]Coefficient of multiple determination.

[e]Standard error of estimate.

showed little variation. This finding suggests two things: (1) following the assumptions underlying this study, the "type of power system" variables could be "pooled" without sacrificing much sensitivity; and (2) the study could have been conceptualized differently, i.e., perhaps these variables would have shown more sensitivity if the model variables were estimated separately for Great Lakes Boating and Inland Lakes and Streams Boating. Type of power system may be a more important factor in explaining boating participation as size of water surface area varies, and when boat launching facilities (of varying size and sophistication) are provided at ponds, lakes, and streams which are located at varying distances from the user population.

In the State of Michigan equation, horsepower of watercraft had a positive effect upon boating participation. This finding implies that larger watercraft engines are used relatively more than smaller watercraft in the state. One of the "place of storage" variables (x_6) was retained in the final equation. Watercraft owners who stored their (sampled) watercraft at their home residence during the boating season, as a class, boated significantly less than boat owners who stored their (sampled) watercraft at other locations. The effect of this variable on the dependent variable was negative. Boat transportation (x_{12}) was important in explaining variation in the dependent variable, and its effect was positive. However, the wording of the relevant question(s) in the mail questionnaire may have been such that many respondents gave a positive response to the question(s) when, in fact, they only transported their watercraft once or twice during the boating season.

Multiple boat ownership (x_{13}) was also retained in the model through the final iteration. For the sample as a whole, this variable had a positive effect upon boating participation. Many of the sampled watercraft owners had more than one (registered or unregistered) boat. The statistical analysis indicates that sample watercraft owners having more than one boat are those who did the most boating during the study year (1968). Likewise, Age Squared (x_{17}) had a negative effect upon boating participation. This suggests that age of boat owner has a curvilinear relationship with the dependent variable (boating activity occasions). Family Size (x_{18}) also was retained in the final iteration of the State of Michigan equation. Family size was shown to have a positive effect upon boating participation. Within the relevant range of family size considered, this variable indicates that boating activity occasions increase linearly with increasing family size.

As noted previously in this chapter, intercorrelations between deleted independent variables, and significant variables retained in the final equation become important if the model is to be used for forecasting. In order to determine where intercorrelations exist between independent variables, a correlation matrix was obtained for use in interpreting the results obtained in the State of Michigan Equation. It should be noted that the variables specified in the model did not change in the State Equation.

Horsepower of watercraft (x_5) was negatively correlated with type 1-1 (x_1). This finding indicates that sampled watercraft having outboard motors were not usually those with the greatest horsepower ratings. However, horsepower of watercraft (x_5) was positively correlated with power system type 3-1 (watercraft having inboard motors). Horsepower rating (x_5) was also positively correlated with type of power system type 4-1 (inboard motor with outboard drive).

There appears to be a strong positive correlation between place of storage of watercraft and type of power system 1-1 (outboard motor), particularly x_6--storage of watercraft at permanent residence during boating season. A strong positive correlation exists also between place of storage--commercial marina (x_8) and boat type. Strong positive intercorrelation is indicated between commercial marina storage (x_8) and watercraft type 3-1 (inboard motor). Also, commercial marina storage (x_8) is negatively correlated with power system type 1-1 (outboard motor). There is a strong positive correlation between commercial marina storage (x_8) and horsepower rating (x_5) of watercraft as well.

A positive correlation is exhibited between place of storage--yacht club (x_{11}) and power system type 2-1 (sailboat with motor). Boat length (x_{14}) is negatively correlated with type of power system 1-1 (outboard motor). However, it is positively correlated with type of power system 3-1 (inboard motor). Boat length is also positively correlated with horsepower rating of watercraft (x_5). A correlation matrix is exhibited in Appendix E.

Aggregate Participation Model

Study hypothesis number 2 concerns the aggregate rate of recreational boating participation by regional (county) populations in the State of Michigan. It hypothesizes that the rate of boating participation is a linear function of factors such as: (1) travel distance, (2) disposable income of boat owners, (3) the proportion of minority races in the population, (4) population density of the region being studied, (5) distance from and population of nearest Standard Metropolitan Statistical Area (SMSA), (6) distance of county from a Great Lake, (7) number of commercial and public campgrounds in county, (8) surface water acreage of county, (9) number of public boat-launching sites in county, (10) the number of hotels, motels, tourist courts, and camps in county, (11) the number of substitute amusement-recreation service firms in county, (12) number of registered watercraft in county, and (13) occupations of county residents.[1]

The aggregate participation model will be estimated for the State of Michigan as a whole; and for (a) thirty Michigan counties which were estimated to generate the highest levels of total (aggregate) boating activity during 1968; and (b) thirty Michigan counties which were estimated to generate the lowest levels of total (aggregate) boating activity during 1968.[2]

There are definite limitations involved in making inferences about a population estimator obtained by using grouped data. The aggregate participation model used grouped data for both the dependent

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[1]In contrast to the procedure followed in the modified user characteristics model, occupation variables were entered as percentages in the aggregate participation model. Twelve occupational classes were utilized, following the categories used in the 1970 Census of Population. The percentage of a county's employed labor force represented by specific occupational classes was the value entered for all twelve occupations.

[2]As explained previously, it was not possible to estimate model parameters for the same five study regions used in testing hypothesis 1 due to a lack of sufficient degrees of freedom.

and independent variables. As Prais and Houthakker have observed, however:

> . . . the correlation coefficient obtained from grouped observations is not a satisfactory estimator of the correlation coefficient in the population; for while a satisfactory estimate can be obtained of the residual variance, it is not possible to obtain an estimate of the original variance on the basis of grouped data. . . . Correlation coefficients based on grouped data can thus only be used for comparative purposes.[1]

County parameters were used in the aggregate participation model. That is, the dependent variable consisted of an aggregate boating participation rate per 1,000 county population. This value was calculated for each county in the State of Michigan, based upon information obtained from the 1968 boating survey. Likewise, values for most of the independent variables were obtained by using census figures (or tabulating) in order to obtain aggregate county estimates.

The State of Michigan

Least squares estimators obtained from the initial State of Michigan equation are shown in Appendix F. Statistics from the final (State of Michigan) regression equation are shown in Table 35 below.

In the final equation, high income was positively correlated with boating participation. The measure used for this variable was the county percentage of families having an annual cash income of $10,000 or more. Percentage of minority races within a county population (x_8) was negatively correlated with boating participation.

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[1]S. J. Prais and H. S. Houtakker, The Analysis of Family Budgets (London: Cambridge University Press, 1955), p. 61.

TABLE 35.--Statistics from the Final Regression Equation, State of Michigan.

Variable		Regression Coefficients	Standard Errors of Regression Coefficients	Level of Significance[a]	Mean
Intercept	(a)	8,583.984432	2,316.674253		
High Cash Income	(X_5)	48.336752	16.456685	.004	23.48193
Percentage of Minority Races	(X_8)	-48.042538	21.730985	.030	2.96663
Surface Water Acreage	(X_{11})	0.047606	0.012992	<.0005	9,594.77952
Occupation--Professional	(X_{15})	-200.578147	58.885271	.001	12.13711
Occupation--Sales Workers	(X_{17})	-354.804368	91.255020	<.0005	6.07036
Occupation--Craftsmen	(X_{19})	-122.747538	54.046498	.026	15.84217
Occupation--Operatives	(X_{20})	-84.168886	33.744618	.015	17.27205
Occupation--Laborers	(X_{23})	-171.785598	59.403892	.005	5.07807
Occupation--Farm Laborers	(X_{25})	-228.265170	107.814722	.038	1.19783
Occupation--Household Workers	(X_{27})	-585.192097	199.322457	.004	1.15084
No. Registered Watercraft per 1,000 county population	(X_{28})	23.078423	2.246925	<.0005	94.26867

$R = .9082$[b] $R^2 = .8249$[c] $S_{yx} = 794.7133$[d]

[a]With 71 degrees of freedom.

[b]Multiple correlation coefficient.

[c]Coefficient of multiple determination.

[d]Standard error of estimate.

Ceteris paribus, the higher the proportion of minority races in a county population, the lower the aggregate participation rate in boating which will be generated by that county.

Total county surface water acreage (x_{11}), as defined in this study, was positively correlated with the aggregate boating participation rate shown by that county. The relative availability of boatable surface water resources in a county does appear to have a positive (but small) association with boating participation. However, boat launching facilities; substitute leisure time amusement-recreation services; hotels, motels, tourist courts, and camps; and public and commercial campgrounds did not appear to have a significant influence upon the rate of boating participation shown by county populations.

Occupations of county labor force significantly influenced the rate of boating participation in the State of Michigan equation: Professional occupations (x_{15}), sales workers (x_{17}), craftsmen (x_{19}), operatives (x_{20}), laborers (x_{23}), farm laborers (x_{25}), and household workers (x_{27}), were all negatively correlated with county boating participation rates. The measure used for this variable was the percentage of a county's employed labor force represented by various occupation categories.

Number of registered watercraft per 1,000 county population was positively and significantly correlated with the aggregate boating participation rate. Ceteris paribus, the higher the incidence of registered watercraft ownership shown by a county population, the higher will be that county's boating participation rate.

Several of the independent variables which were deleted from the final regression equation appear to be highly correlated with some of those variables retained. The "high income" variable (x_5), for example, exhibited a positive correlation with variable x_2--travel distance, which was deleted from the final equation. Part of the effect of the deleted variable (x_2) is thus retained in the equation. The high income variable (x_5) was also positively correlated with aggregate disposible income (x_3). These intercorrelations among the independent variables make the computed regression coefficients less reliable estimators if the model is utilized as a forecasting tool. A strongly negative association was also present between the "high income" variable (x_5) and the "low income" variable (x_4). However, x_4 was not retained in the final regression equation. A correlation matrix is exhibited in Appendix E.

Top 30 Origin Counties

The aggregate participation model could not be estimated for the five study regions identified in Chapter III because of a lack of sufficient degrees of freedom. A decision was made, therefore, to estimate the equation for the "top" and "bottom" thirty counties of origin of the state.

In performing this operation, a rank-ordered list was first prepared. All 83 counties were ranked according to the total estimated (aggregate) number of boating activity occasions generated during the study year (1968). This population variable is not the same as that used for the dependent variable in the regression model. The dependent variable consisted of the estimated number of aggregate boating activity occasions per 1,000 county population (see Table 9, page 97). On the basis of the list of rank-ordered counties, the following 30 counties were selected as the top origin areas in the State of Michigan:[1]

(82) Wayne	(81) Washtenaw
(63) Oakland	(14) Cass
(50) Macomb	(58) Monroe
(41) Kent	(78) St. Joseph
(25) Genessee	(08) Barry
(33) Ingham	(09) Bay
(61) Muskegon	(46) Lenawee
(13) Calhoun	(80) Van Buren
(38) Jackson	(12) Branch
(70) Ottawa	(03) Allegan
(77) St. Clair	(04) Alpena
(11) Berrien	(52) Marquette
(39) Kalamazoo	(17) Chippewa
(73) Saginaw	(30) Hillsdale
(28) Grand Traverse	(47) Livingston

Statistics from the initial regression equation are shown in Appendix F. Variables which were retained in the final regression equation following satisfaction of the specified stopping criterion are shown in Table 36 below.

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[1]Numbers which appear in parentheses before each county are county identification numbers. Individual counties are arrayed in order of descending rank as origin areas in the State of Michigan during 1968.

TABLE 36.--Statistics from the Final Regression Equation, Top 30 Michigan Counties of Origin.

Variable		Regression Coefficients	Standard Errors of Regression Coefficients	Level of Significance[a]	Mean
Intercept	(a)	544.646554	302.367966		
No. of Registered Watercraft per 1,000 county population	(X_{28})	20.917046	3.587544	<.0005	74.90000

R = .7405[b] R^2 = .5483[c] S_{yx} = 759.3992[d]

[a]With 28 degrees of freedom.

[b]Multiple correlation coefficient.

[c]Coefficient of multiple determination.

[d]Standard error of estimate.

The only variable retained in the final equation was number of registered watercraft per 1,000 county population (x_{28}). There was a strong positive correlation between boating participation rate and the incidence of registered watercraft ownership per county, as might be expected.

Bottom 30 Counties of Origin

A rank-ordered list was also prepared in order to determine the "bottom" 30 counties of origin in Michigan. Counties were again ranked on the basis of the aggregate number of boating activity occasions generated by each county during the study year (1968). On the basis of this operation, the following list of counties were selected as the "bottom thirty." As noted previously, the numbers in parentheses which precede each county refer to the county's identification number. Counties are ranked in order of ascending rank as origin areas in the State of Michigan.

(40) Kalkaska	(60) Montmorency
(43) Lake	(07) Baraga
(67) Osceola	(74) Sanilac
(68) Oscoda	(55) Menominee
(57) Missaukee	(27) Gogebic
(58) Arenac	(65) Ogemaw
(48) Luce	(79) Tuscola
(01) Alcona	(02) Alger
(66) Ontonagon	(37) Isabella
(69) Otsego	(44) Lapeer

(18) Clare	(71) Presque Isle
(20) Crawford	(64) Oceana
(75) Schoolcraft	(54) Mecosta
(32) Huron	(10) Benzie
(26) Gladwin	(36) Iron

Least squares estimators from the initial regression equation for the "bottom thirty" counties are shown in Appendix F. Table 37 shows the results obtained following satisfaction of the computer program stopping criterion.

Both "high income" (x_5) and "low income" (x_4) variables were highly significant in the final iteration. Both variables had a positive effect upon boating activity occasions for this group of 30 counties. There was also a strong intercorrelation between the high income and low income variables. Distance from a Michigan Great Lake (x_7) was negatively correlated with boating activity occasions in the final equation. Proportion of minority races (x_8) was also retained in the final regression equation, and was negatively correlated with boating participation rate for this group of counties. Public and private campsites (x_{10}) was negatively correlated with boating participation rate. _Ceteris paribus_, as the number of public and private campsites (having boat-launching facilities) increases within a county, the rate of boating participation decreases.

Surface water acreage of county (x_{11}) was positively correlated with boating participation rate. As the acreage of boatable surface water increases (among this group of counties) so too does the boating participation rate. Number of public boat-launching sites in county

TABLE 37.--Statistics from Final Regression Equation, Bottom 30 Countries of Origin.

Variable		Regression Coefficients	Standard Errors of Regression Coefficients	Level of Significance[a]	Mean
Intercept	(a)	-11,207.498550	11,509.851132		
Households with Less than $3,000 annual cash income	(X_4)	195.639884	58.355302	.008	25.46667
Households with Greater than $10,000 annual cash income	(X_5)	174.447884	30.039930	<.0005	18.86667
Distance from a Great Lake	(X_7)	-38.689514	6.293840	<.0005	28.80000
Proportion of minority races in county population	(X_8)	-316.976168	33.883101	<.0005	1.80800
Public and private campsites in county	(X_{10})	-2.484757	0.517980	.001	353.20000
Surface water acreage of county	(X_{11})	0.144861	0.022212	<.0005	8,527.08000
Public boat-launching sites in county	(X_{12})	48.438188	16.527460	.017	9.53333
Occupation-Professional, Technical & Kindred workers	(X_{15})	-1,296.822480	141.400906	<.0005	11.42800
Occupation-Managers and Administrators (except farm)	(X_{16})	-409.845991	71.360625	<.0005	7.03333
Occupation-Sales workers	(X_{17})	-1,051.257845	165.594912	<.0005	5.61633
Occupation-Clerical and Kindred workers	(X_{18})	-484.560733	98.638268	.001	11.60367

TABLE 37.--Continued.

Variable		Regression Coefficients	Standard Errors of Regression Coefficients	Level of Significance[a]	Mean
Occupation-Craftsmen, Foremen & Kindred Workers	(X_{19})	-884.884763	131.142229	<.0005	15.96567
Occupation-Operatives (except transport)	(X_{20})	-737.767922	103.394451	<.0005	17.10800
Occupation-Laborer (except farm)	(X_{23})	-810.847255	115.097971	<.0005	6.04533
Occupation-Farmers and Farm Managers	(X_{24})	-403.454656	132.045609	.014	3.90567
Occupation-Farm Laborers and Farm Foremen	(X_{25})	-856.514299	127.076978	<.0005	1.61567
Occupation-Service Workers (except private household)	(X_{26})	-464.648508	133.533825	.007	13.67333
Occupation-Private Household Workers	(X_{27})	-2,201.197764	189.162799	<.0005	1.17433
No. of Registered Water-craft per 1,000 County Population	(X_{28})	12.695381	3.343728	.004	97.40000
Lccupation-Transport Equipment Operatives	(X_{29})	-1,127.762766	161.627179	<.0005	4.47767
		$R = .9922$[b]	$R^2 = .9845$[c]	$S_{yx} = 319.650$[d]	

[a]With 8 degrees of freedom.

[b]Multiple correlation coefficient.

[c]Coefficient of multiple determination.

[d]Standard error of estimate.

(x_{12}) was strongly positive in its effect upon boating participation rate. For the "bottom thirty" counties, the population's boating participation rate would be expected to increase with the construction of additional boat launching facilities.

The occupation variables were all highly negative in their effect upon boating participation rate for the "bottom thirty" counties. Professional, technical, and kindred workers (x_{15}); managers and administrators--except farm (x_{16}); sales workers (x_{17}); clerical and kindred workers (x_{18}); craftsmen, foremen, and kindred workers (x_{19}); operatives--except transport (x_{20}); laborers--except farm (x_{23}); farmers and farm managers (x_{24}); farm laborers and farm foremen (x_{25}); service workers--except private household (x_{26}); private household workers (x_{27}); and transport equipment operatives (x_{29}) all were negatively correlated with boating participation rate.

Number of registered watercraft per 1,000 county population (x_{28}) was positively correlated with boating participation rate in the "bottom thirty" counties. Ceteris paribus, as the number of registered watercraft per 1,000 population increases in a county, so too will that county's aggregate participation rate in boating.

Out-of-State Boating

The first major objective of this study was to ". . . obtain an estimate of the total level of recreational boating undertaken in Michigan during 1968; its distribution in various geographic regions in the state . . . ." There were two sub-parts involved in this objective: (a) to estimate boating activities undertaken in Michigan by residents of other states or (Canadian) Provinces, and (b) recreational boating undertaken in other states or (Canadian) Provinces by Michigan residents. It was not possible to fulfill these two sub-objectives.

First, it was not possible to obtain estimates of total boating activity which was undertaken in Michigan by sampled non-residents since there was no way of computing expansion factors. Residents of other states who registered their watercraft with the Michigan Secretary of State Department were included in the original sample involved. However, while it was possible to determine the origin state and obtain an estimate of the total number of powered watercraft owned by non-residents coming from other states. It was, therefore, impossible to calculate expansion factors for out-of-state origin counties without undertaking an additional survey of appropriate state agencies in a number of other states and Canadian Provinces. This type of research seems better suited to a regional (inter-state) approach with better funding than the present study.

The second sub-objective was to obtain an estimate of the total amount of boating which was undertaken in other states or Canadian Provinces by registered Michigan watercraft owners. Due to funding limitations in the study, this information was not coded, and was thus not available for use in this dissertation. Conceptually, one approach to making such estimates would be to determine: (a) the number of activity occasions, and (b) the state or province of out-of-state boating activity undertaken by sampled Michigan watercraft owners. It would then be possible to determine the ratio between the number of sampled watercraft (which were used out-of-state during the study period) and the total number of registered watercraft in each county of Michigan. It would then be possible to determine expansion factors for each Michigan county, and to use these factors in estimating total boating activity occasions for each destination state or Canadian Province. This is another study which might be best approached as an international consortium.

CHAPTER V

SUMMARY, CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS FOR FURTHER RESEARCH

This chapter will be divided into four parts: (1) a summary of principal study findings; (2) conclusions suggested by the data analysis; (3) limitations of the research methods employed; and (4) recommendations for further research.

Summary

Modified User Characteristics Model

Study hypothesis number one states that the level of participation in recreational boating by a household unit is not significantly influenced by:

(a) Family income

(b) Family size

(c) Occupation of household head

(d) Age of household head

(e) Education level of household head

(f) Place of storage of watercraft (during boating season)

(g) Number of watercraft owned

(h) Length of sampled watercraft

(i) Horsepower rating of watercraft motor

(j) Type of power system of watercraft

(k) Transportation of sampled watercraft

Family Income

Ordinary least squares was utilized to test the relationship between boating participation and family income of sampled watercraft owners. The results of the statistical analysis is inconclusive with respect to this variable. While significant relationships were noted in several study regions, this result must be discounted since the income variables (x_{36}, x_{37}, and x_{38}) were subject to statistical bias stemming from the procedure followed in model specification. In order to adequately test the hypothesized relationship with the data collected in this study, dummy variables would have to be utilized. An alternative approach (and one most basic to the conceptualization of this study) would have been to alter the procedure utilized in gathering data in the field. Raw (ungrouped) family income values might have been obtained from sampled respondents through household interviews.

On the basis of the contingency tables constructed for the study regions, a weak relationship appears to exist between family income and frequency of boating. However, an open-ended frequency distribution on family income (with unequal intervals between classes) was utilized in the tables presented.

Family Size

Significant relationships between frequency of boating participation and family size were found to exist in two study regions, as well as for the total sample. The stated study hypothesis is thus rejected for family size on the basis of this sample of registered watercraft owners. Within the range of values obtained, boating participation tends to increase positively with family size.

Occupation of Household Head

Occupation of household head had a significant effect upon boating participation in four of the five study regions examined. In Region 1, the "professional" occupation (x_{19}) had a significant (but negative) effect upon boating participation. In Region 7C, service workers (x_{27}) had a significant effect upon boating participation. Other factory workers (x_{35}) was the only occupation variable which was significant in Region 12--Marquette-Iron Mountain. The hypothesized relationship is thus rejected for these three regions.

The hypothesis is accepted for Region 10--Traverse Bay, Region 6--Lansing, and for the state of Michigan equation on the basis of this sample. None of the occupation classes exhibited a significant influence upon boating participation in these three equations. The hypothesis is rejected, however, for Region 1--Detroit, Region 7C--Saginaw Bay, and Region 12--Marquette-Iron Mountain.

Age of Family Head

Age of family head was significantly correlated with boating participation in three study regions: Region 1--Detroit, Region 10--Traverse Bay, and Region 12A--Marquette-Iron Mountain. In Region 10, age of family head was positively correlated with boating participation. However, the computed regression coefficients had negative signs in both Region 1 and Region 12A. The hypothesized relationship is rejected for Regions 1, 10 and 12A; and accepted for Regions 6 and 7C, and for the State of Michigan.

Age of family head squared was significantly correlated with boating participation in Region 10 and for the State of Michigan. In both cases, the computed regression coefficients had negative signs. For these two regions, age may have a non-linear relationship with boating participation.

Educational Level of Household Head

The study hypothesis is accepted for this variable. No significant relationship was found between education of household head and boating participation in any of the study regions examined. Further study of this relationship should be undertaken, however, as the education variable was subjected to possible bias due to the wording of the question relating to education in the survey instrument. First, the wording and structure of the survey question (question 20) was such that a respondent had no way of answering if he had received zero years of education, i.e., no box was provided. Also, the question was structured ambiguously over the high bound of the range considered. Years of education completed could range between one and seventeen years, as seventeen boxes were provided. However, an eighteenth box was provided for the use of respondents whose education exceeded seventeen years. Finally, there is a possibility that respondents may have been confused about the wording of the survey question. Non-credit short courses, and in-service training could have been counted in arriving at a response to the question as worded.

Place of Storage of Watercraft

Respondents were asked where they usually stored sampled watercraft during the boating season (question 4). There were seven "place of storage" categories provided:

1. At my permanent home, which is not on a lake or river.
2. At waterfrontage located at my permanent home lot.
3. At a commercial marina-berth.
4. At a summer cottage.
5. At a publicly-owned marina.
6. At a boat or yacht club.
7. Other (specify).

Category seven was suppressed in order to obtain a determinate solution to the problem. However, six of the categories were retained in the model. Category one (RESIDS) was statistically significant at less than .0005 in Region 1. The calculated coefficient had a negative sign. Both category one (RESIDS) and category two (WATFRNT) were statistically significant in Region 6. The calculated coefficients for both categories had negative signs, however.

In Region 10, two of the categorical classes were significantly correlated with boating participation: COMMAR (x_8), and WATFRNT (x_7). In the State of Michigan Equation, one categorical class (RESIDS) was statistically significant. The calculated coefficient again had a negative sign. The interpretation of these results is that the significant categorical classes would have a negative effect upon the intercept in the equation. The stated study hypothesis relating to this class of variables is rejected in part. Place of storage did have a significant influence upon boating participation in three of the five study regions, as well as in the State of Michigan Equation.

Number of Watercraft Owned

Multiple boat ownership was positively correlated with boating participation in four of the five study regions, as well as in the State of Michigan Equation. The calculated regression coefficients all had positive signs except for region 7C--Saginaw Bay. However, the multiple-boat ownership variable lacked significance in the equation estimated for that region. The statistical analysis indicates that number of boats owned by sampled watercraft owners is highly significant as an indicator of boating participation, and the study hypothesis is thus rejected.

Length of Sampled Watercraft

Boat length (x_{14}) was positively (and significantly) correlated with boating participation in Region 1. For this region, owning larger watercraft was strongly associated with boating participation. This variable was also positively correlated with participation in the State of Michigan Equation. However, the variable lacked statistical significance in all other study regions. The study hypothesis is rejected in part. It is rejected for Region 1, and for the State of Michigan as a whole, but it is accepted for the four other delineated study regions. It is possible that other study regions could be identified within the state where boat length assumed greater importance in view of the fact that it was statistically significant in the State of Michigan Equation.

Horsepower Rating of Watercraft Motor

Horsepower of sampled watercraft motor was significantly correlated with boating participation in only the State of Michigan Equation. It lacked statistical significance in all other study regions. It is conceivable that this variable would have a greater influence upon boating participation in some other region within the state, however. For the state as a whole, the interpretation of this finding would be that boating participation tends to increase positively with larger and more powerful watercraft. Since powered watercraft require more sophisticated launching, maintenance, and storage facilities than non-power watercraft, it is likely that demands for marina facilities will be received from watercraft owners having the largest watercraft engines.

The study hypothesis is rejected for the State of Michigan as a whole, but accepted for the five study regions. Further research of this nature should concentrate on verifying or rejecting this finding, and should perhaps concentrate upon testing the observed relationship in additional study regions.

Type of Power System of Watercraft

There were five classes of variables relating to power system of sampled watercraft in the initial modified user-characteristics model:

1. Watercraft with outboard motor
2. Sailboat with motor

3. Watercraft with inboard motor
4. Watercraft with inboard-outboard motor
5. Other (write in)

Variable x_5 was suppressed in the final equation in order to obtain a determinate solution. Dummy (zero-one) values were entered for classes 1-4. In the State of Michigan Equation, all four classes were significant at less than the .05 level. In all cases, the power system variables had a positive effect upon the dependent variable. The hypothesis is rejected in part. Type of power system was significantly correlated with boating participation in the state of Michigan equation. However, a different selection of study regions might result in additional areas of the state where these classes of variables significantly influenced boating participation.

Transportation of Sampled Watercraft

Sampled boat owners were asked whether or not they transported their watercraft ". . . from your house or other location to particular launching sites during the past boating season (calendar year 1968)." Since a yes or no answer was obtained, boat transportation was entered as a "zero-one" variable. Boat transportation was positively correlated with boating participation in the State of Michigan Equation at the .002 level. However, it was not significant in any of the five delineated study regions. In fact, it had a negative sign in some instances. The hypothesis is rejected for the State of Michigan as a whole, but accepted for the five study regions examined. Because of its significance in the State of Michigan Equation, it may be possible to estimate the equation for other regions where boat transportation would be more important as an explanatory variable.

It may also be relevant to obtain a better response to the transportation questions by utilizing personal interviews, and by interviewing during the actual boating season.

Aggregate Participation Model

Study hypothesis number two states that the rate of participation in recreational boating by a regional population is not significantly influenced by:

(a) Travel distance

(b) Aggregate disposable income

(c) Percent of households with incomes under $3,000

(d) Percent of households with incomes over $10,000

(e) Population density

(f) Distance from a Great Lake

(g) Percent of population composed of minority races

(h) Location with respect to an SMSA

(i) Number of commercial and public campgrounds in county

(j) Surface water acreage of county

(k) Number of public boat launching sites in county

(l) Number of hotels, motels, tourist courts, and camps in county

(m) Number of amusement and recreation service firms in county

(n) Number of registered recreational watercraft in county

(o) Occupations of county residents

Travel Distance

The measure used for this variable was the estimated weighted average one-way travel distance between origin and destination counties in the State of Michigan. Information on the actual number of boating trips taken by sampled watercraft owners was not obtained in the survey instrument; thus, a major assumption had to be made in order to calculate an average one-way travel distance for each Michigan County. An assumption was made that the number of boating trips taken by registered watercraft owners between individual origin and destination counties was directly proportional to the percentage of total boating activity occasions estimated for the destination county during the survey year.

No significant relationship was found between travel distance and the rate of boating participation undertaken by county populations. The hypothesized relationship is thus accepted for this variable. An alternative formulation might have resulted in a significant relationship. Determination of the actual number of boating trips taken by sampled watercraft owners (as opposed to the number of activity occasions) might represent a more realistic formulation of this variable.

Aggregate Disposable Income

The measure used for this variable corresponds closely with "disposable personal income" per county. It consisted of the net Effective Buying Income (EBI) in thousands of dollars for each Michigan County in 1968. There was no significant relationship between this variable and county boating participation rate. The hypothesized relationship is accepted.

Percent of Households with Incomes
under $3,000

This variable consisted of the percentage of households with net cash incomes of less than $3,000 for the calendar year 1968, by Michigan County. The low income variable (x_4) was positively correlated with the dependent variable (county boating participation rate) among the "bottom thirty" Michigan origin counties; and the computed regression coefficient was significant at the .008 level of probability. There was no significant relationship between this factor and the dependent variable in either the Statewide or "top thirty" origin counties equations. The hypothesis concerning this variable is thus rejected in part, and accepted for the State of Michigan and "top thirty" origin counties equations.

Percent of Households with Incomes
over $10,000

The value used for this variable consisted of the percentage of households within a county which had net cash incomes which were equal to or greater than $10,000 for the calendar year 1968. The high income variable (x_5) was significant in both the State of Michigan and the "bottom thirty" counties of origin equations. In both instances, the high income variable was positively correlated with the dependent variable. The study hypothesis concerning the relationship between high income and the dependent variable is rejected for the

State of Michigan and "bottom thirty" origin counties equations, but is accepted for the "top thirty" origin counties equation.

Population Density

This variable consisted of the estimated number of persons per square mile for each Michigan County. No significant relationship was found between population density (x_6) and the dependent variable. A positive relationship was noted in both the State of Michigan and "top thirty" counties of origin equations, while a negative correlation was found in the "bottom thirty" origin counties equation. However, the calculated significance probabilities of the regression coefficients was greater than .05 in all cases. The study hypothesis is accepted for this variable.

Distance from a Great Lake

The measure used for this variable was the shortest one-way highway distance (in miles) between the county seat in each Michigan county, and the closest point of boating access on a Michigan Great Lake. The distance from a Great Lake variable (x_7) was found to be strongly negative in its influence upon boating participation in the "bottom thirty" counties of origin equation. In that equation, the calculated significance probability of the regression coefficient was significant at less than the .0005 level. A positive relationship existed between distance from a Great Lake (x_7) and the dependent variable in both the State of Michigan and "top thirty" counties of origin equations. However, the computed regression coefficients lacked significance. The hypothesis is rejected for the "bottom thirty" origin counties, and accepted for the State of Michigan and "top thirty" origin counties equations.

Proportion of Minority Races in Population

The measure used for this variable consisted of the total number of persons in each classified minority race in a county (Indian, Japanese, Chinese, Filipino, Negro, and all other) divided by the total estimated 1970 population. Parameter values calculated for this variable may be biased in unknown directions since 1970 census data were used; while the survey data on boating participation was collected during 1968. An assumption was made, however, that the percentage of minority races which existed in each Michigan County held constant between the survey year (calendar 1968) and April 1, 1970.

The minority races variable (x_8) was highly significant in the State of Michigan Equation and the "bottom thirty" origin counties equations. In both cases, there was a negative correlation between the percentage of minority races and the dependent variable. In both equations, the computed significance probability of the regression coefficients was less than .0005. The study hypothesis is rejected, therefore, for these two regions, and accepted for the "top thirty" origin counties equation.

Distance from an SMSA--Size-Distance

The measure used for this variable consisted of a series of scale values, based upon each Michigan county's location with respect to an SMSA. Both population and distance were used as criteria.

After assigning scale values to all SMSA counties in the state, a distance decay principle was followed in determining scale values for all other counties in the State. Counties located less than 50 miles from the central city of an SMSA were assigned a value which was four less than the value calculated for the SMSA county, etc.

The size distance variable (x_9) lacked significance in all three equations: the State of Michigan, the "top thirty" origin counties, and the "bottom thirty" origin counties. The study hypothesis is thus accepted for this variable. It should be noted that arbitrary restraints were used in specifying this variable. Alternative approaches might be used in formulating this variable which might lead to a different result.

Number of Commercial and Public Campgrounds

The value used for this variable consisted of the number of individual campsites (at both commercial and public areas) which had the services of constructed boat-launching facilities within the campground. Only campgrounds which actually provided boat-launching facilities during 1968 were selected for inclusion in the county totals.

This variable was significant at the .001 level in the "bottom thirty" origin counties equation. The computed regression coefficient was negatively correlated with the county boating participation rate. The hypothesized relationship is thus rejected for the "bottom thirty" origin counties; and accepted for the State of Michigan and "top thirty" origin counties equations.

Surface Water Acreage of County

Values entered for this variable consisted of the total surface water area (in acres) contained in each county in selected surface water categories: (1) natural lakes and ponds, (2) natural lakes with a dam, (3) artificial lakes, (4) artificial ponds, (5) hydroelectric reservoirs, (6) small lakes, and (7) flood control reservoirs. Only water bodies containing at least four acres were included in the tabulations for each county.

Surface water acreage (x_{11}) was positively correlated with boating participation in all three equations. The computed regression coefficient was significant at less than .0005 in the State of Michigan and "bottom thirty" origin counties equations. Surface water was not significant at the .05 level in the "top thirty" origin counties initial equation, and was not retained in the final iteration. The hypothesized relationship is, therefore, rejected for this variable in part.

Public Boat-Launching Sites

The measure used for this variable consisted of the number of publicly-constructed boat-launching sites on inland lakes and ponds and Great Lakes during 1968 for each Michigan county. Values represent, insofar as possible, only constructed public-access sites during 1968 which were not located at a public or private campground facility.

This variable was negatively correlated with the aggregate boating participation rate in both the State of Michigan and "top thirty" origin counties equations. However, in both cases, the regression coefficient lacked significance. The computed regression coefficient was significant at the .017 level in the "bottom thirty" origin counties equation; and the coefficient had a positive effect upon the dependent variable. The hypothesized relationship is thus accepted for the State of Michigan and "top thirty" origin counties equations; but it is rejected for the "bottom thirty" counties equation.

Number of Hotels, Motels, Tourist Courts, and Camps

The value entered for this variable was the aggregate number of commercial motels, hotels, tourist homes, trailer parks, and sporting and recreational camps present and in operation in each Michigan county as of July 1, 1967. Precise data was not available for calendar year 1968; and values entered were assumed to hold constant during the study year.

There was a negative correlation between this variable (x_{13}) and the aggregate rate of boating participation. However, the computed regression coefficient lacked significance in all three equations estimated. The study hypothesis related to this variable is accepted.

Number of Amusement and Recreation Service firms

This variable was entered in order to test the hypothesized statistical relationship between aggregate boating participation rates and the availability of substitute leisure time amusement and recreation service firms in operation within Michigan Counties. No precise data were available for this variable during 1968; and values entered consisted of the number of commercial amusement-recreation service firms which were in operation as of April 1, 1967.

The computed regression coefficients for this variable (x_{14}) lacked significance in all three equations estimated. The hypothesized relationship is thus accepted in this instance.

Number of Registered Watercraft per County

The value used for this variable (x_{28}) consisted of the total number of registered watercraft per 1,000 county population for each Michigan county during 1968.

The computed regression coefficients were highly significant in all three equations estimated: they were significant at less than the .0005 level in the State of Michigan and "top thirty" origin counties equations; and the coefficient computed was significant at the .004 level in the "bottom thirty" origin counties equation. In all cases, the variable was positively correlated with the dependent variable. The hypothesized relationship is rejected for this variable.

Occupations of County Residents

The values entered for these variables consisted of the percentage of a county's employed labor force accounted for by twelve occupational classes. Percentages were calculated separately for each occupational class, based upon data presented in the 1970 Census of Population. Precise data on these variables were not available for 1968, and calculated percentages were assumed to hold constant between 1970 and the study year.

In the State of Michigan Equation, seven of the computed regression coefficients were significant at less than the .05 level: Professional, technical and kindred workers (x_{15}); sales workers (x_{17}); craftsmen, foremen and kindred workers (x_{19}); operatives--except transport (x_{20}); laborer--except farm (x_{23}); farm laborers and farm foremen (x_{25}); and private household workers (x_{27}). In all cases, the regression coefficients had negative signs.

None of the regression coefficients were statistically significant in the "top thirty" origin counties equation. However, all twelve occupational classes had significant regression coefficients (at less than the .05 level) in the "bottom thirty" counties equation. As was the case in the State of Michigan Equation, the computed regression coefficients were all negatively correlated with the dependent variable in the "bottom thirty" counties equation. The hypothesized relationship is rejected for the State of Michigan and "bottom thirty" counties, but is accepted for the "top thirty" origin counties.

Conclusions

Considerable variation in the rate of recreational boating participation was found to exist among sampled registered watercraft owners in the State of Michigan. Excluding Kalkaska County (where the rate of participation was estimated to be zero), the estimated number of activity occasions ranged from a high of 10,161 boat days per 1,000 population in Roscommon County to a low of 286 boat days per 1,000 population in Osceola County. The highest rates of boating participation were found to exist in non-metropolitan areas of the state.

While significant relationships were noted between family income of respondents and boating participation, these results should be regarded as inconclusive since the data collected on family income were inadequate to provide a basis for a rigorous test of this relationship. Contingency tables between family income and boating participation suggest that a non-linear relationship exists. Further research will be required in order to test the relationship between these variables more satisfactorily.

Among socio-economic variables analyzed in this study, family size, occupation of family head, and age of family head were significantly correlated with boating participation in one or more study regions. Boating participation increased positively with family size in two of the study regions examined. A positive relationship was also noted for the Statewide sample. This finding indicates that boating tends to be a family activity; and that the highest rates of boating participation tend to exist among larger families who own registered watercraft.

Significant relationships were found between occupational class and boating participation in four of the study regions examined. Occupation appears to be correlated with boating participation most closely in the metropolitan regions of the state. This may be due to the fact that certain occupations (which are most common in urban regions) have more leisure time. Occupation may well be intercorrelated with family income to a substantial degree. Because of the manner in which the income variables were specified, however, no conclusive finding is possible in this study.

Age of family head was significantly correlated with boating participation in three of the study regions examined. However, computed regression coefficients had negative signs in two of these regions (Region 1 and Region 12A). In Region 10, age of family head was positively correlated with boating participation. Previous research has shown that age is intercorrelated with family income, i.e., boating participation varies at different combinations of income and age. Limitations in the income variable did not permit a definitive finding on this relationship in the present study, however. Age of family head squared did exhibit a significant influence upon boating participation in two of the study regions examined (the statewide sample and the Region 10 area). In both cases, the regression coefficients had negative signs, suggesting that the relationship between age of family head and boating participation is curvilinear.

In addition to variables pertaining to socio-economic characteristics of the sampled watercraft owners (or their immediate families) the modified user-characteristics model contained independent variables which related to sampled watercraft. Certain place-of-storage variables were significantly correlated with the dependent variable (boating participation). Place-of-storage of watercraft at home residence during the boating season was negatively correlated with boating participation in the two metropolitan study regions (Region 1 and Region 10). This finding suggests that registered watercraft owners who store their watercraft at home during the boating season, and transport it on individual boating trips, as a class, participate less than boat owners who store their watercraft at other locations in these two regions. A similar result was noted when the equation was estimated for the total (statewide) sample. In Region 10 (one of the resort areas of the state) place-of-storage variables were also important. In the Traverse Bay Region, place-of-storage at a commercial boat marina, or at permanent residence (located on waterfrontage) were both positively correlated with boating participation. Boat owners in these two categorical classes were found to participate significantly more than boat owners who stored their watercraft at other locations during the boating season.

Multiple boat ownership appears, on the basis of this study, to be strongly associated with boating participation. In four of the five study regions examined, as well as in the State of Michigan Equation, multiple boat ownership was significantly correlated with participation. Ceteris paribus, as the number of watercraft owned increases (within the relevant range examined), so too does boating participation. In regions where the incidence of multiple boat ownership is high, individual participation in boating should also be high among that segment of the population which owns registered watercraft.

Boat length was variable in its effect upon boating participation. This variable was significant in Region 1, as well as the State of Michigan Equation. However, it lacked significance in all other study regions. This factor assumes importance, however, in public policy concerning the construction of public boat marinas and other facilities, since larger watercraft usually require more elaborate care and handling equipment than smaller boats. Therefore, this variable, while not statistically significant in four of the study regions, may be more important then a strict interpretation of study results may indicate. First, Region 1 (containing the City of Detroit and Wayne County) generates more total boating activity occasions than any other region in the state. Also, this variable was significant in the total (statewide) sample. The dilemma faced here, though, is related to the identification problem, i.e., is a high level of boating participation the result of demand factors or supply factors in the destination counties? There is no easy answer readily available to this question since both supply and demand factors should logically be considered when analyzing boating participation.

Closely related to the discussion above is another study finding concerning watercraft characteristics. Horsepower rating of watercraft motor was significantly correlated with boating participation in only the State of Michigan (statewide) Equation. Ceteris paribus, for the statewide sample as a whole, boating participation tends to increase with greater horsepower ratings of sampled watercraft motors. One may ask whether or not this finding is the result of boating participation being induced by the construction of public and private boat marina facilities? It is extremely doubtful that the larger horsepower engines would be as readily purchased were it not for public and private docking facilities provided which are capable of accommodating larger watercraft.

The type-of-power-system classes were extremely variable in their effect upon boating participation. In Region 1--Detroit, sampled watercraft owners who reported owning boats with outboard motors, as a class, exhibited a significant influence upon the dependent variable. In Region 6--Lansing, sampled watercraft owners having sailboats with motors, as a class, exhibited a significant influence upon boating participation. In the State of Michigan Equation, all four categorical classes were significantly correlated with the dependent variable. The implications of this finding are unclear. While this class of variables was significant in explaining part of the variation in the dependent variable, little was gained, apparently, by entering sub-class effects in the regression equation.

The effects of transportation upon watercraft use are not clear as a result of this analysis. Because of the nature of the wording and structure of the questions on transportation in the survey instrument, this factor was entered as a dummy (zero-one) variable. Moreover, the transportation variable exhibited a significant influence upon boating participation in the State of Michigan Equation. However, one is still left unclear about the implications for public policy, given this result. It would be more important to know "how many" individual boating trips were taken by respondents, and to what destinations. Given such information, one would be in a better position to assign costs to each trip, and to construct economic demand curves. Cross-section data could thus be used to construct a market demand curve for an individual study region. Variation in transfer costs between origin regions and destination counties would ensure variability in the price of boating trips even though cross-sectional data were used.

Computed R^2 values were quite low for the various study regions utilized; ranging from a low value of .1048 in the State of Michigan Equation to a high of .2130 in Region 6--Lansing. These results indicate that the selected socio-economic factors, together with watercraft characteristic variables represent only a partial explanation of the variation found to exist in boating participation rates reported by sampled watercraft owners. Furthermore, in order to use such variables as an aid to forecasting boating participation rates of registered watercraft owners, an additional assumption has to be made: it would be necessary to assume that the class effects of the various categorical variables used (the aj) are additive. It is not clear that such is the case. Combining watercraft characteristics with socio-economic effects does not appear to be wholly justifiable. Also, variation in the socio-economic factors used in the model (and therefore the computed regression coefficients) may be expected to take place over time, raising serious questions concerning the validity of forecasting future boating participation rates with the coefficients obtained in this study.

In the aggregate participation model, a conscious effort was directed at the inclusion of "supply" variables in the statistical equation. In this equation, aggregate boating participation rates of county populations were specified as a function of socio-economic factors, supply factors, complementary boating facilities, and substitute leisure time activities. Relatively high R^2 values were obtained for this model in each region where the equation was estimated. However, this statistic is an unsatisfactory estimator of the coefficient of multiple determination in the county populations concerned, since it was computed using grouped data.

In the "top thirty" origin counties equation, number of registered watercraft per 1,000 county population was significantly correlated with boating participation. This single variable was retained in the final regression equation, and explained more than 54 percent of the variation in the dependent variable. No other variables were retained in the model. Surface water acreage, and complementary boating facilities variables, were deleted from the equation in the final iteration. These factors are thus judged to be relatively unimportant in explaining variations in boating participation rates in the top origin counties of the state. Since the model was estimated separately for the "top thirty" origin counties of the state, it must be concluded that other factors account for variation in boating participation rates in these counties.

In the "bottom thirty" origin counties equation, a very high R^2 value was obtained. Independent variables retained in the final equation accounted for an estimated 98 percent of the variation in the dependent variable. All twelve of the occupation variables were retained in the final iteration. Both income variables were also retained. In the thirty counties where boating participation rates were lowest, both high income (households with annual incomes of $10,000 and above) and low income (households with annual incomes less than $3,000) were important in explaining variation in boating participation. A county's location with respect to a Great Lake (mileage) was negatively correlated with boating participation. A one-unit increase in the travel distance to a Great Lake would be accompanied by a negative effect upon the aggregate boating participation rate of that county. Likewise, the number of public and private campsites (with access to boat launching facilities) was negatively correlated with boating participation in the "bottom thirty" origin counties. *Ceteris paribus*, as the number of such campsites increases within a county, boating participation would be expected to decrease on the basis of this study. This may be a result of over-crowding and over-use at water areas serviced by public and private campsites having boat-launching facilities.

Surface water acreage was positively correlated with boating participation in the "bottom thirty" origin counties equation. *Ceteris paribus*, among the lowest aggregate boating participation counties, the participation rate would be expected to increase directly with the availability of surface water acreage. Closely related to this variable, was the finding regarding the public boat-launching site variable. A positive correlation was found to exist between a county's boating participation rate and the number of public boat-launching sites in that county. Among the "bottom thirty" counties of origin, boating participation may be expected to increase directly with the number of constructed public boat-launching sites provided. This seems to indicate that boat-launching facilities represent a definite policy variable which can be used by public natural resources administrators. It would be extremely difficult to alter socio-economic characteristics over time. However, boat-launching facilities represent a valid tool which may have income distributive effects if constructed in close proximity to those segments of the population which one wishes to provide recreation benefits as a matter of public policy. Additions to the boatable surface water acreage of a county might represent another valuable policy tool. Artificial lakes and ponds, when constructed in close proximity to the population to receive primary recreation benefits, can also be regarded as an income distributive policy. Development of existing natural surface water resources may or may not serve the same purpose, since transfer costs may be prohibitive to many segments of the potential boating population.

Limitations

One of the primary limitations of this study is related to the methods used in preparing and distributing the survey questionnaire. In all likelihood, significant memory bias was introduced in the survey data collected since respondents were requested to recall specific details about boating undertaken over a period of time equivalent to one calendar year (1968). Further, the survey instrument was not distributed until April and May of 1969. It is probable that many respondents had begun boating during the calendar year 1969 at the time the survey instrument for this study was received. It is highly probable that the activity occasions data gathered is biased in unknown directions.

Another question may be raised regarding the response rate obtained to the mail survey. Approximately 30 percent of the questionnaires mailed were actually completed and returned by respondents. Thus questions may be raised about the rate of boating participation exhibited by survey non-respondents. A post card follow-up was undertaken in three control counties, resulting in a slightly higher response to the survey. Also, follow-up interviews were completed among non-respondents in these three counties (Ingham, Leelanau, and Grand Traverse). However, follow-up interviews were not completed until July of 1969. An independent analysis of survey respondents was undertaken in a companion study. No significant differences were found between survey respondents and non-respondents, but the late date of the follow-up interviews make these results highly suspect.

Another limitation involves the sampling plan for this study. Further research in this area should be directed toward reducing the sample size. The data collected in this study should provide a basis for calculating an adequate sample size. The systematic random sample drawn in this study has the effect of clustering the sample in the large urban counties where the greatest number of registered watercraft exist.

The time horizon used in this study as a basis for collecting data on boating activity severely limits the usefulness of the survey. Registered boat owners were asked to supply boating use information for one calendar year. A shorter time period would be preferable. Compressing the base period to peak use periods during the summer months (June, July, or August) would simplify the data collection process since respondents would be in a better position to answer specific questions about boating activity undertaken. By reducing the sample size, sampling from a select group of study regions, and reducing the time horizon base period, the data collected should be much more useful. Personal interviews would be a better data collection procedure.

The data used as measures for independent variables had sources of statistical bias, stemming largely from the fact that they were collected at points of time other than the study base period (1968). Also, the dependent variable (boating activity occasions) suffered from the same difficulty in both of the statistical models used. It was necessary to assume, for example, that the number of boating activity occasions was constant during all points in time during the study year, and that the number of registered watercraft in the State of Michigan was invariant during the study year, i.e., the number of registered watercraft at the end of the calendar year was constant during 1968.

A further limitation in the dependent variable used (in both models) has to do with the nature of boating activity occasions. It is not clear, as a result of this study, what "boat days" means, i.e., there is a problem of interpersonal definition of boating activity occasions. A "boat day" was defined, for purposes of this study, as ". . . the number of days that a boat was actually in the water under power or sail." Each part day of boating was counted as a full day. Respondents were also asked to list the number of boat days spent on particular boating activities, e.g., trout/salmon fishing, other fishing, hunting, water skiing, cruising, or "other." Because of memory bias, the data on the number of boat days spent on particular activities was ignored. This deficiency limits the usefulness of the study. It would have been interesting, for example, to examine the effects of activity specialization, and the implications that this may have upon boating use in various destination counties of the state. Separate equations might then be estimated for the various categories of activity specialization.

Finally, the data on boat use collected in this study does not represent a valid expression of boating demand. There is good evidence to suggest that the prices charged at public boating facilities in the state are nominal (or zero), and do not reflect actual supply costs. This means that attendance or user statistics reflect current market rules governing public provision of boating facilities. Under such conditions, it is erroneous to consider user statistics as either demand (or supply) estimates. A different set of prices charged might significantly alter observed attendance statistics.

Under current conditions, user statistics on boating participation are a reflection of non-market (or quasi-) demand. Any attempt to account for existing patterns of use are a reflection of both supply and demand conditions and should be so qualified. Consideration of only the demand side of the picture is tantamount to admitting that users will be allowed to manipulate the market without sending appropriate market signals; while consideration of only supply conditions allows recreation planners to manipulate the market without receiving market signals. Under current market conditions (where high transfer costs exist) supply factors are important and have significant welfare connotations. Supply conditions represent policy variables. If certain disadvantaged groups are to be granted recreation benefits as a conscious public policy, transfer costs between origin and destination areas should be reduced. This can be done most expeditiously by altering supply conditions in close proximity to the population class which is to receive recreation benefits, assuming no change in present public pricing policies.

Recommendations for Further Research

This study has, for the most part, emphasized the effects of non-price variables on participation in recreational boating. Information on the price of the "whole recreation experience" was not collected in the survey instrument. However, some emphasis was given to estimation of the relationship between boating participation and the consumer's level of income. This analysis did not prove to be entirely adequate since the family income data was collected in grouped form, with unequal intervals between classes.

Future research can be more meaningful if family income data are collected in ungrouped form. Also, information collected on the number of boating trips taken should be collected. Because of the unusual nature of the (transfer) costs associated with recreational boating, the quantification of demand functions is possible when cross-sectional data are used. Using the cost of the "whole recreation experience" will ensure that the price variable takes on a wide range of values since the supply of boatable water surface areas is geographically dispersed over space.

Information relating to the value of recreational resources to the using public is becoming increasingly important to public decision makers. However, obtaining information on the value of boating waters depends upon knowledge of the demand function for recreational boating. Future research should concentrate upon providing this type of information.

Future research could also be helpful by concentrating on the relationship between recreational boating and the level of consumer income. By collecting data on boating trips and consumers' incomes, information on income elasticities could be obtained. Boating trips could be segregated by type of activity, e.g., fishing, hunting, cruising, water skiing, etc. Such information could then be used to estimate cross-elasticities between various boating activities.

The data collected in this study were obtained well after the peak boating season had ended. Furthermore, when questionnaires were distributed, many sampled boat owners had probably begun boating during the 1969 boating season. Future research should concentrate upon a much shorter period of time for which data is collected--perhaps 1-3 months during the period of peak boating activity (July through August). Also, much better control should be exercised over the collection of data. Household interviews would be the preferred method of data collection. However, if this is not possible, carefully distributed mail questionnaires could be used if they were received by sampled watercraft owners on a monthly basis during the actual time that boating was being undertaken.

The sample frame used in this study represents a continuing source of information which may be used by future researchers. However, it is restricted to households which own powered watercraft. In order to be truly representative of the recreational boating fleet in the state, some effort should be made to include households owning non-powered watercraft (canoes, rowboats, etc.) in the sample.

The survey questionnaire developed for use in this study proved to be quite lengthy and complex to administer and interpret. Information collected on number of boating activity occasions undertaken by sampled watercraft owners may contain considerable error due to memory bias and the complexity of the questions posed in the survey instrument. Future research could benefit by rewording the questions on boating activity occasions on (a) Great Lakes, and (b) inland lakes and streams.

APPENDICES

APPENDIX A

MAIL SURVEY QUESTIONNAIRE

STATE OF MICHIGAN

GEORGE ROMNEY, Governor

DEPARTMENT OF NATURAL RESOURCES

RALPH A. MAC MULLAN, Director

Stevens T. Mason Building
Lansing, Michigan 48926
373-0626

Dear Boat Owner:

At this time of year, when boats are out of the water, the Waterways Commission, like everyone else, is making plans for the coming season and seasons ahead. We want to make sure that the rivers and lakes of Michigan, including the Great Lakes, offer safe and accessible recreation to all who love the water.

To help us in our job, we need your assistance in finding out more about the kinds of facilities you and other boaters require. If there are shortages in certain areas, we would like to know about them. We are, therefore, sending you this questionnaire with the request that you take a few moments to fill it out and send it back to us. This study is one of several research projects being undertaken for the Waterways Division by the Recreation Research and Planning Unit at Michigan State University.

Your name was taken at random from the list of boat registrants, and your reply need not be signed. It will be used with all the other replies to show us the pattern of boating in Michigan and indicate where we should be providing new or improved facilities. Simply place your completed questionnaire in the stamped, pre-addressed envelope and mail it back to us at your convenience.

Thank you very much for your help.

With best wishes for a good season in 1969.

Sincerely,

Keith Wilson

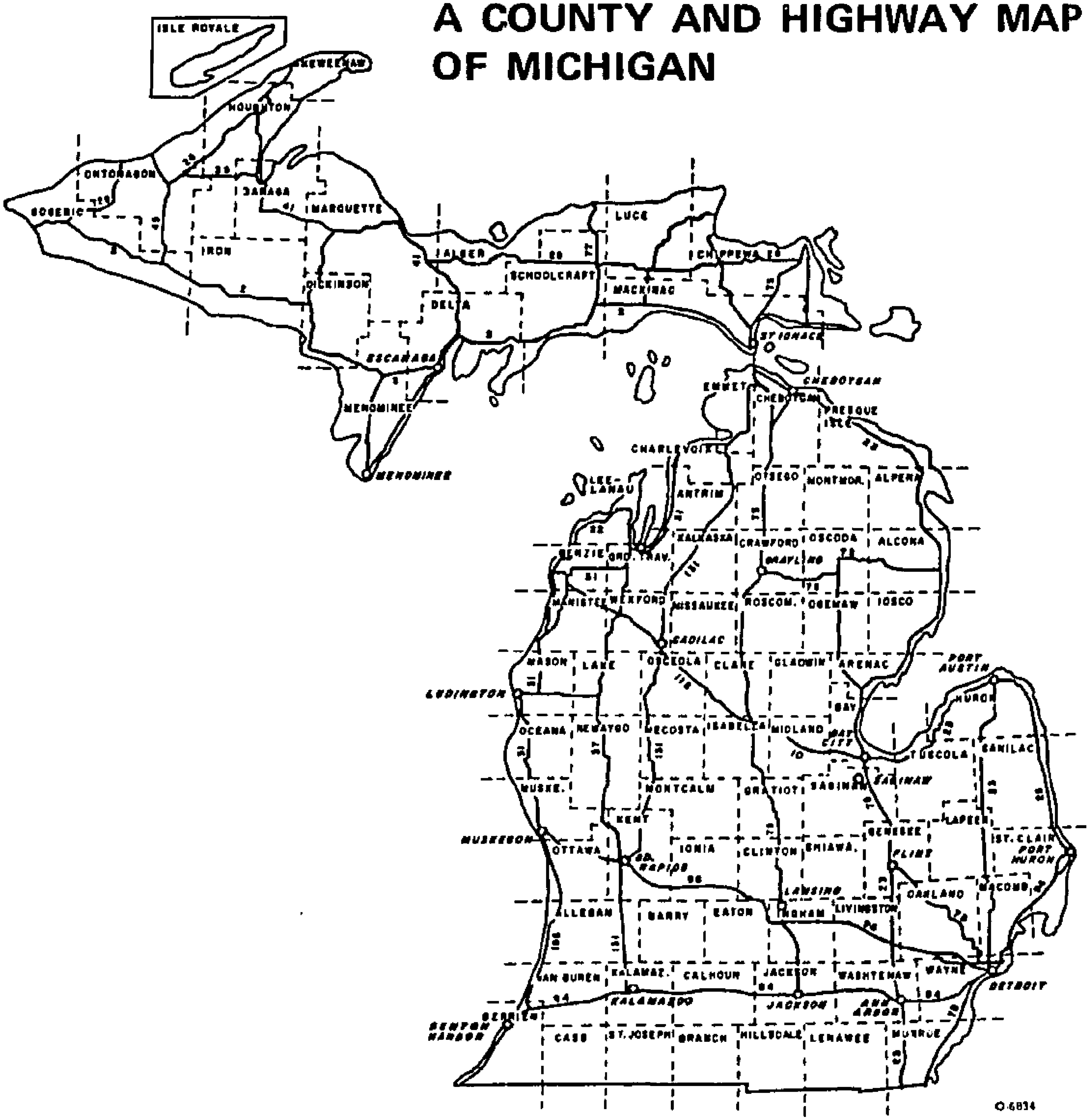
Keith Wilson
Director

KW:jaw
Enclosures

MICHIGAN THE GREAT LAKE STATE

FOR YOUR ASSISTANCE:

A COUNTY AND HIGHWAY MAP OF MICHIGAN



MICHIGAN RECREATIONAL BOATING NEEDS QUESTIONNAIRE

PLEASE ANSWER QUESTIONS 1 THROUGH 13 FOR THE BOAT IDENTIFIED BY THE REGISTRATION NUMBER AND BOAT LENGTH WHICH APPEAR UNDER YOUR ADDRESS ON PAGE 1

1 WHAT TYPE OF POWER SYSTEM DOES THIS BOAT HAVE? (Check one)

☐ Outboard motor ☐ Inboard motor ☐ Inboard motor with outboard drive
☐ Sailboat with motor ☐ Other (write in)__________

2 WHAT IS THE HORSEPOWER RATING OF THE PRIMARY MOTOR (OR MOTORS) USED ON THIS BOAT?
____Hp. ____Hp.
Indicate horsepower of any other motors used on this boat: ______, ______, ______

3 WHAT COUNTY IS THIS BOAT REGISTERED IN?__________County

4 WHERE DO YOU USUALLY KEEP THIS BOAT DURING THE BOATING SEASON? (Check one)

☐ At my permanent home, which is not on a lake or river.
☐ At waterfrontage located at my permanent home lot.
☐ At a commercial marina–berth.
☐ At a summer cottage.
☐ At a publicly-owned marina.
☐ At a boat or yacht club.
☐ Other (specify)__________

5 WAS THIS BOAT TRANSPORTED FROM YOUR HOME OR OTHER LOCATION TO PARTICULAR LAUNCHING SITES DURING THE PAST BOATING SEASON (calendar year 1968)?

☐ YES ☐ NO If "NO" skip over questions 6, 7, and 8, and proceed with question 9.

6 WAS THIS BOAT TRANSPORTED BY: ☐ trailer ☐ car-top carrier

7 PLEASE INDICATE THE TOTAL NUMBER OF TIMES YOU TRANSPORTED THIS BOAT FROM THE PLACE OF STORAGE OR MOORING TO THE PLACE OF USE. Number of times__________

8 IN THE TABLE BELOW, NAME THE COUNTIES WHERE YOU MOST OFTEN LAUNCHED THIS BOAT; AND INDICATE THE NUMBER OF TIMES THE BOAT WAS LAUNCHED AT EACH BOATING ACCESS POINT.

	County (Write in)	Number of Times This Boat Launched at–				
		Public Marina or Ramp			Commercial Marina	Private property or other
		City, County or Township	State Facilities	Federal		
Most Launches: →						
2nd most Launches: →						
All other Launches: →						

9 DID YOU USE THIS BOAT ON ANY OF THE MICHIGAN SECTIONS OF THE GREAT LAKES, OR CONNECTING WATERS*, DURING THE PAST BOATING SEASON (calendar year 1968)?

*(Great Lakes and connecting waters are Lakes Huron, Superior, Erie, Michigan, and St. Clair; St. Mary's River, St. Clair River, and Detroit River.)

☐ NO --- If "NO", please proceed to question 11.
☐ YES --- If "YES" please continue with question 10.

10 IN THE TABLE BELOW, NAME THE THREE GREAT LAKES OR CONNECTING WATERS COUNTIES WHERE THIS BOAT WAS USED DURING THE PAST BOATING SEASON. Give the number of days that the boat was actually in the water under power or sail in each county; and give the number of boating days spent on particular activities. (See map on page 2.)

USE OF THIS BOAT ON GREAT LAKES AND CONNECTING WATERS ONLY

Note: Count each part day spent boating as a full day. The number of days spent on specific boating activities may not equal the total number of days shown in the left-hand column.

Count each part day spent on a particular boating activity as a full day for that activity.

	Total Days of Boating		County (Write in)	Boating Activities No. days you used this boat for—					
				Trout/Salmon fishing (No. Days)	Other fishing (No. Days)	Hunting (No. Days)	Water skiing (No. Days)	Cruising (No. Days)	Other (No. Days)
EXAMPLE	17		Manistee	11	2	0	9	8	0
		County of most use:							
		County of 2nd most use:							
		County of 3rd most use:							
		Boating in "All Other" Counties:							

11 DID YOU USE THIS BOAT ON ANY INLAND LAKES OR STREAMS IN MICHIGAN DURING THE PAST BOATING SEASON (calendar year 1968)?

☐ NO --- If "NO" please proceed to question 13.
☐ YES --- If "YES" please continue with question no. 12.

12 IN THE TABLE BELOW, NAME THE THREE MICHIGAN COUNTIES WHERE THIS BOAT WAS USED MOST ON INLAND LAKES AND STREAMS DURING THE PAST BOATING SEASON' Give the number of days that this boat was actually in the water under power or sail in each of these counties; and give the number of boating days spent on various activities. (See map on page 2.)

USE OF THIS BOAT ON INLAND LAKES & STREAMS

Note: Count each part day spent boating as a full day. The number of days spent on specific boating activities may not equal the total number of days shown in the left-hand column.

Count each part day spent on a particular boating activity as a full day for that activity.

	Total Days of Boating		County (Write in)	Boating Activities No. days you used this boat for– Trout/Salmon fishing (No. Days)	Other fishing (No. Days)	Hunting (No. Days)	Water skiing (No. Days)	Cruising (No. Days)	Other (No. Days)
EXAMPLE	18		Montmorency	2	14	3	2	0	0
		County of most use:							
		County of 2nd most use:							
		County of 3rd most use:							
		Boating in "All Other" Counties:							

13 DID YOU USE THIS BOAT IN ANY CANADIAN PROVINCE OR A STATE OTHER THAN MICHIGAN DURING THE PAST BOATING SEASON (calendar year 1968)?

☐ NO ——— If "NO", skip over the remainder of this question and proceed with question 14.
☐ YES ——— If "YES," please complete the table below.

	Other States: Give the Number of Days Boat was in the Water Under Power or Sail — County or nearest city (if known)*	Name of State or Canadian Province	Number of boating days**
County of most use:			
County of 2nd most use:			
County of 3rd most use:			

*If unknown, please consult a highway map.
**(NOTE: count each part day of boating as a full day).

THE FOLLOWING QUESTION CONCERNS OTHER RECREATIONAL BOATS OWNED IN ADDITION TO THE ONE IDENTIFIED BY THE REGISTRATION NUMBER ON PAGE 1.

(Note: If you own no other boats, please check here ☐ and skip over to question 15)

14 IN THE TABLE BELOW, GIVE THE NUMBER OF OTHER REGISTERED AND UNREGISTERED BOATS OWNED BY YOU, AND BY THE MEMBERS OF YOUR IMMEDIATE FAMILY RESIDING WITH YOU. Also, give the boat length and horsepower rating of the motor used on it.

Type of boat*	Length	Horsepower rating of the motor

*Include other inboards, outboards, sailboats, canoes, inboard-outboards, rowboats, etc.

IN ORDER TO FORECAST THE FUTURE DEMAND FOR BOATING FACILITIES IN MICHIGAN, IT IS NECESSARY FOR US TO BE ABLE TO TIE IN FAMILY CHARACTERISTICS WITH BOATING USE PATTERNS. PLEASE ASSIST US BY ANSWERING THE QUESTIONS IN THE FOLLOWING SECTION.

15 PLEASE GIVE YOUR COUNTY AND STATE OF PERMANENT RESIDENCE, AND WRITE IN YOUR POSTAL ZIP CODE.

County name__________ State________ Postal Zip Code______

---

16 WHAT IS THE AGE AND SEX OF THE "HEAD OF YOUR FAMILY?"

Age:___years Sex: ☐ Male ☐ Female

---

17 GIVE THE AGE AND SEX OF EACH MEMBER OF YOUR FAMILY RESIDING WITH YOU (excluding the "head of household")

Male: ages:___, ___, ___, ___, ___ Female: ages:___, ___, ___, ___, ___, ___

---

18 WHAT IS THE OCCUPATION OF THE "HEAD OF YOUR FAMILY?" (Please indicate the type of job that you hold, NOT the organization for which you work).

____
(Write in)

---

19 PLEASE ESTIMATE YOUR TOTAL FAMILY INCOME FOR 1968 BY CHECKING THE PROPER BOX BELOW. (Check only one box).

☐ Under $3,000 ☐ $6,000 to $7,999 ☐ $10,000 to $14,999 ☐ $25,000 and over
☐ $3,000 to $5,999 ☐ $8,000 to $9,999 ☐ $15,000 to $24,999

20 WHICH OF THE ANSWERS BELOW BEST INDICATES THE TOTAL YEARS OF EDUCATION COMPLETED BY THE "HEAD OF YOUR FAMILY?" (Check one box)

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ or more

---

21 IN THE SPACE BELOW, PLEASE INDICATE ANY SPECIAL BOATING PROBLEMS YOU MAY HAVE:

THANKS FOR YOUR HELP!

If you accidently misplace the return envelope provided, please mail to:

Recreation Research and Planning Unit
Room 312 Natural Resources Building
Michigan State University
East Lansing, Michigan 48823

APPENDIX B

CODE NUMBERS FOR MICHIGAN COUNTIES, TOTAL NUMBER OF REGISTERED WATERCRAFT, NUMBER OF QUESTIONNAIRE RESPONSES USED IN ANALYSIS, AND EXPANSION FACTORS CALCULATED FOR USE IN ESTIMATING TOTAL BOATING ACTIVITY OCCASIONS, BY MICHIGAN ORIGIN COUNTY

CODE NUMBERS FOR MICHIGAN COUNTIES

01	Alcona	42	Keweenaw
02	Alger	43	Lake
03	Allegan	44	Lapeer
04	Alpena	45	Leelanau
05	Antrim	46	Lenawee
06	Arenac	47	Livingston
07	Baraga	48	Luce
08	Barry	49	Mackinac
09	Bay	50	Macomb
10	Benzie	51	Manistee
11	Berrien	52	Marquette
12	Branch	53	Mason
13	Calhoun	54	Mecosta
14	Cass	55	Menominee
15	Charlevoix	56	Midland
16	Cheboygan	57	Missaukee
17	Chippewa	58	Monroe
18	Clare	59	Montcalm
19	Clinton	60	Montmorency
20	Crawford	61	Muskegon
21	Delta	62	Newago
22	Dickinson	63	Oakland
23	Eaton	64	Oceana
24	Emmet	65	Ogemaw
25	Genesee	66	Ontonagon
26	Gladwin	67	Osceola
27	Gogebic	68	Oscoda
28	Grand Traverse	69	Otsego
29	Gratiot	70	Ottawa
30	Hillsdale	71	Presque Isle
31	Houghton	72	Roscommon
32	Huron	73	Saginaw
33	Ingham	74	Sanilac
34	Ionia	75	Schoolcraft
35	Iosco	76	Shiawassee
36	Iron	77	St. Clair
37	Isabella	78	St. Joseph
38	Jackson	79	Tuscola
39	Kalamazoo	80	Van Buren
40	Kalkaska	81	Washtenaw
41	Kent	82	Wayne
		83	Wexford

NUMBER OF REGISTERED WATERCRAFT AND NUMBER OF RETURNED QUESTIONNAIRES USED, BY MICHIGAN ORIGIN COUNTY

Origin County	No. of Registered Watercraft[1]			No. of Returned Questionnaires Used			Expansion Factor
	20 ft. or Less	Over 20 ft.	Total	20 ft. or Less	Over 20 ft.	Total	
1-Alcona	705	8	713	17	1	18	39.611
2-Alger	870	16	886	9	0	9	98.444
3-Allegan	4,255	126	4,381	53	4	57	76.860
4-Alpena	3,178	100	3,278	35	4	39	84.051
5-Antrim	2,305	67	2,372	36	0	36	65.889
6-Arenac	590	18	608	10	0	10	60.800
7-Baraga	678	11	689	10	1	11	62.636
8-Barry	3,593	98	3,691	53	4	57	64.754
9-Bay	5,204	337	5,541	65	6	71	78.042
10-Benzie	1,607	32	1,639	18	0	18	91.056
11-Berrien	8,442	356	8,798	102	12	114	77.175
12-Branch	5,122	121	5,243	61	1	62	84.565
13-Calhoun	8,295	238	8,533	100	6	106	80.500
14-Cass	6,651	194	6,845	62	4	66	103.712
15-Charlevoix	1,914	180	2,094	30	4	34	61.588
16-Cheboygan	2,512	109	2,621	28	0	28	93.607
17-Chippewa	3,007	135	3,142	24	2	26	120.846
18-Clare	1,378	27	1,405	20	1	21	66.905
19-Clinton	2,531	56	2,587	33	0	33	78.394
20-Crawford	526	28	554	5	1	6	92.333
21-Delta	1,774	53	1,827	34	0	34	53.735
22-Dickinson	1,626	9	1,635	25	0	25	65.400
23-Eaton	3,538	97	3,635	62	0	62	58.629
24-Emmet	2,133	127	2,260	33	5	38	59.474
25-Genesse	22,660	763	23,423	297	20	317	73.889
26-Gladwin	1,127	24	1,151	15	1	16	71.938
27-Gogebic	1,896	39	1,935	19	2	21	92.143
28-Gd. Traverse	4,681	167	4,848	58	6	64	75.750
29-Gratiot	2,078	37	2,115	14	2	16	132.188
30-Hillsdale	2,674	58	2,732	26	3	29	94.207
31-Houghton	1,907	93	2,000	31	4	35	57.143
32-Huron	1,340	73	1,413	15	3	18	78.500

Origin County	No. of Registered Watercraft[1]			No. of Returned Questionnaires Used			Expansion Factor
	20 ft. or Less	Over 20 ft.	Total	20 ft. or Less	Over 20 ft.	Total	
33-Ingham	12,960	391	13,351	210	12	222	60.140
34-Ionia	2,757	55	2,812	37	1	38	74.000
35-Iosco	2,102	35	2,137	25	0	25	85.480
36-Iron	1,941	13	1,954	22	0	22	88.818
37-Isabella	1,698	34	1,732	29	1	30	57.733
38-Jackson	9,993	287	10,280	111	10	121	84.958
39-Kalamazoo	11,395	398	11,793	162	8	170	69.371
40-Kalkaska	703	16	719	5	0	5	143.800
41-Kent	23,102	985	24,087	253	17	270	89.211
42-Keewenaw	183	12	195	4	0	4	48.750
43-Lake	640	3	643	11	0	11	58.455
44-Lapeer	1,905	32	1,937	27	1	28	69.179
45-Leelanau	1,801	96	1,897	31	4	35	54.200
46-Lenawee	5,354	168	5,522	58	5	63	87.651
47-Livingston	3,500	83	3,583	50	7	57	62.860
48-Luce	759	7	766	10	1	11	69.636
49-Mackinac	1,975	156	2,131	23	6	29	73.483
50-Macomb	18,510	3,769	22,279	154	77	231	96.446
51-Manistee	2,097	70	2,167	14	3	17	127.471
52-Marquette	3,266	76	3,342	49	2	51	65.529
53-Mason	2,237	66	2,303	22	1	23	100.130
54-Mecosta	1,967	43	2,010	24	1	25	80.400
55-Menominee	1,215	57	1,272	11	3	14	90.857
56-Midland	4,232	130	4,362	52	8	60	72.700
57-Missaukee	613	9	622	7	1	8	77.750
58-Monroe	4,801	431	5,232	47	13	60	87.200
59-Montcalm	3,192	43	3,235	38	3	41	78.902
60-Montmorency	839	21	860	12	1	13	66.154
61-Muskegon	8,505	377	8,882	111	7	118	75.271
62-Newaygo	2,531	34	2,565	36	0	36	71.250
63-Oakland	34,686	2,306	36,992	429	60	489	75.648
64-Oceana	1,191	21	1,212	15	2	17	71.294
65-Ogemaw	1,045	10	1,055	22	1	23	45.870
66-Ontonagon	659	18	677	20	2	22	30.773

Origin County	No. of Registered Watercraft[1]			No. of Returned Questionnaires Used			Expansion Factor
	20 ft. or Less	Over 20 ft.	Total	20 ft. or Less	Over 20 ft.	Total	
67-Osceola	956	13	969	20	1	21	46.143
68-Oscoda	402	3	405	6	0	6	67.500
69-Otsego	1,108	24	1,132	9	1	10	113.200
70-Ottawa	6,599	495	7,094	98	25	123	57.675
71-Presque Isle	1,300	13	1,313	13	1	14	93.786
72-Roscommon	2,976	139	3,115	38	3	41	75.976
73-Saginaw	9,766	342	10,108	140	15	155	65.213
74-Sanilac	885	29	914	17	1	18	50.778
75-Schoolcraft	1,259	13	1,272	13	0	13	97.846
76-Shiawassee	3,116	67	3,183	49	1	50	63.660
77-St. Clair	5,827	895	6.722	53	30	83	80.987
78-St. Joseph	5,557	124	5,681	77	7	84	67.630
79-Tuscola	1,828	64	1,892	28	2	30	63.067
80-Van Buren	4,554	61	4,615	58	1	59	78.220
81-Washtenaw	7,869	267	8,136	116	9	125	65.088
82-Wayne	61,553	6,852	68,405	520	118	638	107.218
83-Wexford	1,884	35	1,919	21	2	23	83.435
Total	402,590	23,485	426,075	4,807	572	5,379	---
Mean	4,850.482	282.952	5,133.434	57.916	6.891	64.810	---

[1]Taken from Size and Type of Registered Boats in Michigan Counties, unpublished Statistics, Michigan Department of State, December 1968.

APPENDIX C

OPTICAL SCAN SHEETS USED IN CODING MAIL SURVEY RESPONSES

Identification Number

Deck 1

1	Identification Number	2	
3		4	
		6	X
7	Power System	8	X
9	Motor 1, H.P.	10	
11	Motor 2, H.P.	12	
13	Motor 3, H.P.	14	
15	Motor 4, H.P.	16	
17	Motor 5, H.P.	18	
19	County where registered	20	
21		22	Location during season
23	Transported? Yes No	24	How? Trail Car
25	Number of times	26	
27	Question 13 Canada or Outside Yes No	28	X
29	County	30	
31		32	X
33	Days Used	34	
35	County	36	
37		38	X
39	Days Used	40	
41	County	42	
43		44	X
45	Days Used	46	
	Question 14 Skip Check	48	X
	1st boat type	50	X
51	Length	52	
53	Horsepower	54	
55	2nd boat type	56	X
57	Length	58	
59	Horsepower	60	
61	3rd boat type	62	X
63	Length	64	
65	Horsepower	66	
67	4th boat type	68	X
69	Length	70	
71	Horsepower	72	

I.D. Number

Question 8

DECK 2

1 2

3 4

5 6

County where launched most

7 8

9 10

City, county, twp.

11 12

State

13 14

Federal

15 16

Commercial marina

17 18

Private property, other

19 20

County — 2nd most launches

21 22

23 24

City, county, twp.

25 26

State

27 28

Federal

29 30

Commercial marina

31 32

Private property, other

33 34

County — all other launches

35 36

37 38

City, county, twp.

39 40

State

41 42

Federal

43 44

Commercial marina

45 46

Private property, other

48

I. D. Number GREAT LAKES DECK 3

1 2

3 4

6 X

Used Great Lakes

7 Yes No 8 X

Total days

9 10

County most used

11 12

13 14 X

Trout/salmon fishing

15 16

Other fishing

17 18

Hunting

19 20

Water skiing

21 22

Cruising

23 24

Other

25 26

Total days

27 28

County – 2nd used

29 30

31 32 X

Trout/salmon fishing

33 34

Other fishing

35 36

Hunting

37 38

Water skiing

39 40

Cruising

41 42

Other

43 44

Total days

45 46

County – 3rd used

47 48

49 50 X

Trout/salmon fishing

51 52

Other fishing

53 54

Hunting

55 56

Water skiing

57 58

Cruising

59 60

Other

61 62

Total days

63 64

All other counties

65 66

67 68 X

Trout/salmon fishing

69 70

Other fishing

71 72

Hunting

73 74

Water skiing

75 76

Cruising

77 78

Other

79 80

I.D. Number — INLAND LAKES AND STREAMS — DECK 4

1	I.D. Number	2	
3		4	
		6	X
7	Used Great Lakes: Yes / No	8	X
9	Total days	10	
11	County most used	12	
13		14	X
15	Trout/salmon fishing	16	
17	Other fishing	18	
19	Hunting	20	
21	Water skiing	22	
23	Cruising	24	
25	Other	26	
27	Total days	28	
29	County — 2nd used	30	
31		32	X
33	Trout/salmon fishing	34	
35	Other fishing	36	
37	Hunting	38	
39	Water skiing	40	
41	Cruising	42	
43	Other	44	
45	Total days	46	
	County — 3rd used	48	
49		50	X
51	Trout/salmon fishing	52	
53	Other fishing	54	
55	Hunting	56	
57	Water skiing	58	
59	Cruising	60	
61	Other	62	
63	Total days	64	
65	All other counties	66	
67		68	X
69	Trout/salmon fishing	70	
71	Other fishing	72	
73	Hunting	74	
75	Water skiing	76	
77	Cruising	78	
79	Other	80	

I.D. Number

DECK 5

1 2

4

6

Question 15 County of residence

7 8

9 10

Zip Code

11 12

13 14

15 16

Age — Head of family

17 18

Sex — Head of family

19 M 20

Males ages

21 22

23 24

25 26

27 28

29 30

Females ages

31 32

33 34

35 36

37 38

39 40

Occupation

41 42

Income

43 44

Education

45 46

APPENDIX D

ORIGIN-DISTINATION MATRIX AND TABLE SHOWING PROCEDURE FOLLOWED IN CALCULATING THE ONE-WAY TRAVEL DISTANCE, BY MICHIGAN ORIGIN COUNTY

Appendix Table

Estimated Total Boat Days by Origin County and Distribution by Destination County, State of Michigan, 1968

County of Origin	Origin County Code	Destination: Destination County Code	Destination: Number of Boat Days[1]
Alcona	1	1	12,200
		10	1,981
		4	198
		35	1,386
		53	158
		48	197
Total			16,120
Alger	2	2	23,134
		17	98
		21	4,824
		52	98
		72	197
		75	2,166
Total			30,517
Allegan	3	2	384
		3	72,710
		8	15,679
		17	769
		28	154
		39	307
		43	3,920
		49	231
		51	4,612
		53	3,920
		59	769
		61	3,074
		62	3,074
		80	4,842
Total			114,445
Alpena	4	1	3,194
		4	92,456
		10	2,522
		16	336
		17	1,777
		48	132

Alpena (con't)		49	672
		51	336
		60	1,681
		68	84
		71	5,211
		72	588
		75	252
Total			108,641
Antrim	5	5	77,222
		10	988
		15	1,647
		21	3,329
		25	1,450
		28	659
		40	1,450
		51	66
		54	791
		75	198
Total			87,800
Arenac	6	6	8,208
		16	243
		35	790
		63	2,614
		82	182
Total			12,039
Baraga	7	7	18,853
		31	1,127
		32	376
		42	626
		48	3,886
		52	626
		66	63
		70	2,819
Total			28,376
Barry	8	3	259
		8	121,448
		16	907
		17	907
		40	1,619
		49	194
		51	2,397
		52	324
		53	389
		54	842
		59	2,526
		62	1,490
		67	389

Barry (con't)		70	389
		72	648
		80	777
Total			135,501
Bay	9	1	3,746
		4	7,726
		6	4,683
		9	54,942
		10	1,873
		15	1,717
		16	6,946
		17	1,483
		18	1,093
		24	312
		26	10,458
		28	2,029
		32	1,093
		35	12,564
		40	2,341
		45	234
		51	4,214
		52	1,639
		53	234
		56	468
		60	2,263
		62	78
		65	4,917
		69	1,561
		71	780
		72	5,385
		73	78
		79	780
		83	1,873
Total			137,510
Benzie	10	10	39,245
		28	911
		72	637
Total			40,793
Berrien	11	2	77
		3	8,952
		7	154
		8	232
		10	9,107
		11	118,232
		14	10,959
		15	849
		16	1,080
		24	154

Berrien (con't)		28	3,704
		36	849
		39	77
		41	77
		42	2,315
		43	1,003
		49	1,003
		51	13,660
		52	386
		53	3,087
		54	1,158
		61	154
		62	9,415
		64	7,795
		70	2,701
		75	1,080
		78	1,080
		80	22,689
		83	540
Total			222,569
Branch	12	2	2,114
		8	5,074
		12	99,195
		13	1,691
		15	507
		20	1,776
		27	169
		61	85
		63	592
		65	254
		66	677
		68	507
		71	85
		78	677
Total			113,403
Calhoun	13	2	402
		3	2,495
		8	42,665
		10	10,062
		11	322
		12	10,384
		13	112,619
		15	1,851
		16	966
		17	3,864
		18	403
		19	403
		20	725
		21	403

Calhoun (con't)		23	7,970
		27	322
		28	805
		34	3,301
		36	402
		38	402
		39	15,697
		40	2,737
		43	6,037
		45	1,288
		51	4,025
		53	1,047
		54	3,542
		55	1,449
		57	242
		60	805
		61	1,208
		62	483
		64	805
		67	1,127
		68	1,208
		69	5,877
		70	4,508
		72	8,291
		75	2,415
		77	644
		78	2,334
		80	3,059
		83	483
Total			270,077
Cass	14	11	1,556
		12	1,245
		14	142,500
		17	311
		27	207
		48	616
		51	3,734
		62	2,593
		75	933
		78	3,734
		80	14,416
		83	519
Total			172,364
Charlevoix	15	5	862
		10	308
		15	52,781
		17	123
		21	123
		24	3,942

Charlevoix (con't)		28	308
		35	739
Total			59,186
Cheboygan	16	15	281
		16	75,354
		24	468
		48	604
		49	187
		72	1,404
Total			78,298
Chippewa	17	17	96,435
		49	2,296
Total			98,731
Clare	18	10	67
		16	134
		18	12,578
		26	669
		37	1,338
		40	134
		49	335
		51	803
		53	134
		57	201
		67	67
		72	803
Total			17,263
Clinton	19	10	78
		16	470
		17	4,312
		18	7,683
		19	3,214
		20	157
		24	1,489
		28	6,428
		29	1,098
		33	314
		34	784
		37	10,426
		38	1,254
		40	627
		43	4,704
		49	862
		51	314
		53	706
		59	5,644
		61	157
		62	3,136

Clinton (con't)		67	1,803
		72	6,585
		75	470
		83	549
Total			63,264
Crawford	20	20	16,435
		40	923
Total			17,358
Delta	21	2	3,439
		21	38,367
		22	752
		23	1,773
		27	376
		47	376
		49	376
		52	3,600
		55	806
		75	7,792
Total			57,657
Dickinson	22	7	1,046
		21	4,120
		22	31,065
		31	1,373
		32	262
		36	5,690
		53	785
		66	262
Total			44,603
Eaton	23	1	469
		2	293
		5	2,345
		6	2,638
		8	11,667
		10	1,524
		12	469
		13	18,820
		15	117
		16	654
		17	176
		18	704
		20	176
		23	3,635
		25	2,345
		28	654
		32	1,935
		33	351
		34	997

Eaton (con't)		35	704
		37	1,759
		38	469
		40	704
		43	117
		48	714
		49	1,231
		51	1,173
		53	5,511
		54	3,635
		59	13,954
		62	117
		69	3,694
		72	5,218
		77	235
Total			89, 204
Emmet	24	10	1,487
		15	3,152
		16	6,245
		17	335
		24	61,318
		45	1,130
		48	2,954
		57	119
		83	238
Total			76,978
Genesee	25	1	17,501
		2	517
		4	1,625
		5	10,560
		6	5,612
		7	738
		9	6,277
		10	5,686
		15	2,732
		16	15,730
		17	3,101
		18	24,443
		19	222
		20	2,954
		21	517
		24	5,338
		25	158,693
		26	59,962
		27	369
		28	13,809
		31	2,954
		32	11,446
		34	517
		35	33,452

Genesee (con't)		36	591
		38	295
		40	3,323
		43	1,034
		44	24,960
		45	6,055
		47	14,400
		49	1,920
		50	148
		51	17,206
		52	591
		53	1,108
		54	2,215
		55	443
		57	1,698
		60	4,135
		61	738
		62	222
		63	7,532
		64	443
		65	14,695
		66	738
		67	2,142
		68	4,431
		69	2,511
		70	222
		71	5,981
		72	50,141
		73	2,363
		74	3,101
		75	3,766
		76	1,920
		77	1,772
		78	7,311
		79	14,991
		83	443
Total			590,340
Gladwin	26	9	216
		16	144
		17	360
		20	1,655
		21	360
		26	8,417
		35	72
		43	360
		51	2,446
		56	2,878
		63	4,316
		72	288
Total			21,511

Gogebic	27	27	21,746
		31	92
		66	4,054
Total			25,892
Gd. Traverse	28	5	8,100
		10	7,797
		15	1,060
		16	303
		24	454
		28	158,219
		40	757
		45	5,375
		51	4,542
		83	151
Total			186,758
Gratiot	29	1	4,759
		9	1,322
		18	3,305
		20	3,966
		29	793
		35	4,759
		37	3,966
		51	1,718
		54	13,351
		59	2,247
		61	264
		72	16,259
Total			56,709
Hillsdale	30	11	283
		12	6,406
		13	471
		28	754
		30	75,083
		38	2,920
		46	1,884
		49	188
		51	1,507
		54	4,992
		57	188
		58	942
		60	377
		61	377
		68	1,970
Total			98,342
Houghton	31	7	6,971
		30	629

Houghton (con't)		31	40,172
		42	17,200
Total			64,972
Huron	32	1	942
		6	2,198
		17	157
		32	19,154
		51	157
		72	236
Total			22,844
Ingham	33	3	842
		4	1,804
		5	3,488
		6	361
		8	15,516
		9	421
		10	11,667
		11	722
		13	4,811
		15	11,366
		16	8,720
		17	5,032
		18	24,718
		19	3,368
		20	5,052
		23	3,308
		26	4,511
		27	481
		28	7,698
		29	241
		31	120
		33	34,941
		34	8,600
		35	1,804
		36	4,511
		37	7,217
		38	5,473
		39	180
		40	4,029
		41	7,758
		45	361
		47	10,464
		49	3,608
		50	2,225
		51	14,975
		53	1,624
		54	33,378
		55	2,526
		57	2,706
		59	17,320

Ingham (con't)		60	1,924
		61	1,263
		62	2,406
		63	722
		67	3,308
		68	1,804
		69	1,564
		70	1,022
		71	3,608
		72	46,067
		75	361
		76	1,443
		77	4,511
		78	301
		81	4,630
		82	301
		83	7,578
Total			360,760
Ionia	34	2	222
		8	2,960
		12	74
		20	1,924
		23	1,628
		29	1,480
		34	26,492
		40	666
		41	7,326
		43	518
		51	1,036
		53	296
		54	4,292
		57	444
		59	4,588
		67	74
		72	1,036
Total			55,056
Iosco	35	24	256
		35	74,710
Total			74,966
Iron	36	36	41,389
Total			41,389
Isabella	37	1	173
		5	231
		10	635
		16	3,464
		17	231
		18	520
		20	464

Isabella (con't)		27	346
		35	58
		37	9,237
		51	404
		54	4,388
		56	346
		59	1,732
		63	1,732
		65	1,155
		69	1,386
		71	346
		72	4,388
		83	520
Total			31,754
Jackson	38	4	5,098
		5	5,607
		8	1,020
		10	1,529
		12	85
		13	4,333
		16	8,411
		18	8,496
		26	7,731
		28	10,620
		30	1,274
		33	1,104
		38	156,069
		39	850
		46	2,039
		48	1,399
		49	340
		51	2,889
		52	1,359
		53	935
		60	255
		62	3,549
		67	14,613
		68	1,189
		69	1,189
		70	850
		71	510
		72	6,882
		75	1,189
		81	4,928
Total			256,302
Kalamazoo	39	3	9,355
		5	694
		8	29,691
		9	1,526
		10	1,804

Kalamazoo (con't)		11	971
		14	2,775
		16	416
		23	139
		28	624
		30	832
		38	139
		39	92,541
		40	347
		43	7,631
		49	277
		51	14,013
		52	971
		54	139
		57	139
		60	277
		61	486
		62	4,509
		64	208
		66	208
		70	1,596
		75	1,318
		78	7,006
		80	30,038
		83	971
Total			211,641
Kalkaska	40	-	0
Total			0
Kent	41	1	178
		3	44,516
		5	8,653
		6	535
		7	446
		8	41,483
		10	9,724
		15	4,282
		16	2,855
		17	624
		20	2,409
		21	1,695
		22	892
		26	357
		27	3,122
		28	13,203
		33	89
		34	2,944
		37	892
		39	1,695
		40	1,249
		41	188,057

Kent (con't)		42	1,071
		43	19,002
		44	268
		48	1,071
		49	13,917
		51	33,633
		52	892
		53	9,813
		54	34,882
		55	535
		59	32,027
		60	1,338
		61	20,162
		62	84,750
		64	8,029
		67	9,813
		70	70,209
		72	2,052
		75	981
		80	357
		82	89
		83	11,419
Total			686,210
Keewenaw	42	42	2,194
Total			2,194
Lake	43	9	233
		16	175
		43	2,806
		49	585
		51	468
		53	292
Total			4,559
Lapeer	44	1	533
		20	415
		25	553
		31	277
		32	692
		35	415
		36	484
		44	23,106
		49	208
		50	415
		51	208
		60	692
		63	553
		66	208
		69	277
		72	1,176

Lapeer (con't)		74	69
		77	899
		79	138
Total			31,318
Leelanau	45	10	5,799
		28	2,873
		45	38,807
		46	867
		47	54
Total			48,400
Lenawee	46	1	1,315
		5	1,052
		6	2,630
		10	526
		12	1,139
		15	2,454
		16	7,450
		17	363
		30	3,418
		31	614
		36	614
		38	3,681
		41	351
		46	81,077
		49	3,367
		52	526
		57	263
		58	18,494
		59	263
		64	1,315
		67	1,841
		72	263
		77	175
		79	526
		81	1,928
		82	351
Total			135,996
Livingston	47	1	2,074
		15	189
		17	3,897
		18	1,119
		26	1,886
		28	1,257
		32	189
		33	691
		47	81,027
		55	440
		63	629

Livnigston (con't)		68	440
		81	4,463
Total			98,301
Luce	48	7	347
		48	9,724
		49	2,361
Total			12,432
Mackinac	49	16	2,058
		49	59,521
		75	147
Total			61,726
Macomb	50	1	8,487
		4	3,086
		6	1,350
		9	96
		10	772
		15	1,640
		16	7,041
		17	5,690
		18	579
		21	482
		24	1,061
		25	1,157
		26	1,736
		28	2,797
		32	6,365
		35	2,893
		38	386
		40	1,157
		44	2,700
		46	2,508
		47	4,340
		48	193
		49	5,015
		50	426,098
		51	5,980
		57	4,822
		58	772
		59	772
		60	1,543
		63	25,462
		65	4,244
		68	4,437
		69	37,421
		70	96
		71	675
		72	4,822
		74	193

Macomb (con't)		75	2,122
		77	112,360
		79	1,543
		82	28,644
		83	964
Total			724,501
Manistee	51	10	1,530
		28	255
		45	8,413
		51	59,911
		53	1,657
Total			71,766
Marquette	52	2	5,963
		7	6,684
		21	1,442
		22	131
		25	655
		36	852
		49	655
		52	86,171
Total			102,553
Mason	53	3	200
		10	1,001
		28	401
		43	2,103
		51	4,706
		53	42,655
		57	200
		64	1,001
Total			52,267
Mecosta	54	5	241
		10	322
		16	161
		17	161
		37	402
		45	804
		49	563
		51	1,930
		53	161
		54	32,964
		60	161
		62	2,412
		64	161
Total			40,443
Menominee	55	7	454
		52	727

Menominee (con't)		55	23,805
		75	636
Total			25,622
Midland	56	6	1,309
		9	13,813
		10	945
		15	4,144
		16	1,309
		17	291
		18	2,617
		20	364
		24	145
		25	291
		26	13,886
		28	2,254
		35	727
		40	1,745
		43	436
		45	2,181
		51	1,091
		54	2,399
		56	22,901
		57	1,309
		61	291
		62	436
		67	2,181
		71	2,908
		72	8,070
		73	1,018
		75	654
		83	654
Total			90,369
Missaukee	57	17	78
		22	1,244
		36	233
		57	5,831
Total			7,386
Monroe	58	1	2,616
		4	262
		7	610
		12	1,918
		17	5,494
		21	3,662
		28	262
		30	2,965
		31	872
		38	16,481
		43	1,744

Monroe (con't)		46	13,865
		47	1,308
		50	959
		51	174
		54	2,616
		57	174
		58	92,781
		60	1,395
		62	1,744
		67	4,366
		68	2,616
		71	3,924
		75	1,046
		81	872
		82	7,412
Total			73,933
Montcalm	59	4	552
		5	1,105
		10	473
		15	158
		16	1,578
		17	158
		18	79
		21	473
		24	868
		28	4,736
		40	158
		41	1,026
		43	473
		45	3,551
		51	4,103
		52	79
		54	5,444
		59	38,583
		61	789
		62	2,209
		66	789
		69	316
		72	2,209
		75	3,235
		83	789
Total			73,933
Montmorency	60	4	132
		20	132
		50	662
		60	23,220
		67	463
Total			24,609

Muskegon	61	3	452
		8	151
		10	6,398
		11	4,516
		15	1,807
		16	3,086
		21	903
		27	2,258
		28	3,839
		40	75
		41	7,602
		43	6,473
		45	2,258
		48	151
		49	1,581
		51	17,087
		53	16,334
		56	1,957
		57	151
		58	75
		59	2,258
		61	185,787
		62	2,032
		64	11,893
		70	9,635
		72	1,581
		76	301
		83	1,129
Total			291,770
Newaygo	62	7	513
		10	366
		28	733
		43	513
		48	293
		49	806
		51	3,223
		52	293
		53	220
		54	440
		61	879
		62	66,151
		67	1,465
Total			75,895
Oakland	63	1	17,702
		2	3,253
		4	10,818
		5	13,541
		6	7,414
		7	3,345

Oakland (con't)	9	76
	10	12,785
	11	378
	12	1,059
	13	605
	15	6,203
	16	16,945
	17	2,194
	18	15,508
	20	6,052
	21	1,362
	22	303
	23	530
	24	3,555
	25	13,238
	26	18,004
	27	530
	28	2,950
	30	5,901
	31	2,648
	32	20,955
	35	33,436
	36	756
	37	530
	38	3,404
	40	1,362
	42	7,565
	43	1,210
	44	2,194
	45	11,498
	47	21,938
	48	1,135
	49	5,598
	50	109,311
	51	4,615
	53	983
	54	756
	56	6,884
	57	9,229
	58	5,371
	59	454
	60	15,886
	61	1,210
	63	466,597
	64	378
	65	7,262
	67	6,960
	68	11,045
	69	4,236
	70	2,799
	71	8,019
	72	24,888

Oakland (con't)		74	3,404
		75	983
		77	64,906
		79	303
		81	6,657
		82	25,418
		83	2,345
Total			1,069,379
Oceana	64	10	428
		51	2,139
		53	1,283
		64	25,310
		82	285
Total			29,445
Ogemaw	65	5	2,752
		6	688
		35	734
		49	138
		51	734
		61	642
		63	7,058
		65	24,816
		72	550
Total			38,112
Ontonagon	66	7	431
		27	677
		31	154
		66	13,017
Total			14,279
Osceola	67	7	554
		18	1,800
		67	1,246
		83	554
Total			4,154
Oscoda	68	16	1,350
		35	337
		60	743
		68	4,725
Total			7,155
Otsego	69	5	113
		16	2,264
		40	3,396
		69	11,546
Total			17,319

Ottawa	70	2	231
		3	23,935
		5	346
		7	1,038
		8	1,327
		9	115
		10	2,422
		15	1,730
		16	2,711
		18	1,154
		24	1,442
		28	807
		35	692
		40	807
		42	2,480
		44	2,480
		46	1,557
		47	750
		48	173
		51	6,517
		53	3,460
		54	346
		59	58
		61	5,710
		62	20,821
		64	9,170
		67	4,845
		70	143,841
		83	1,038
Total			242,003
Presque Isle	71	16	938
		71	39,015
Total			39,953
Roscommon	72	4	76
		10	304
		21	532
		40	152
		72	80,231
Total			81,295
Saginaw	73	1	3,065
		2	848
		3	196
		4	456
		5	717
		6	16,108
		9	24,194
		10	1,696
		16	4,043

Saginaw (con't)		17	1,109
		18	17,868
		20	522
		24	1,304
		26	25,303
		27	130
		28	7,239
		29	130
		31	978
		32	2,087
		35	11,999
		36	652
		37	1,369
		40	456
		45	6,326
		49	1,304
		51	1,043
		52	652
		56	6,913
		57	1,696
		59	7,434
		60	326
		65	5,152
		67	2,087
		68	587
		69	4,369
		71	2,348
		72	31,302
		73	12,064
		74	391
		75	913
		77	1,369
		79	456
		83	11,151
Total			220,352
Sanilac	74	1	254
		9	203
		28	355
		35	3,504
		40	1,066
		50	102
		60	2,234
		65	152
		71	2,031
		74	14,218
		77	1,066
		79	152
Total			25,337

Schoolcraft	75	21	391
		48	587
		52	489
		75	17,221
Total			18,688
Shiawassee	76	5	127
		10	2,483
		16	764
		17	828
		18	1,146
		25	1,401
		26	1,591
		28	5,093
		35	64
		40	6,366
		41	955
		42	509
		49	191
Total			68,310
St. Clair	77	1	243
		16	1,701
		17	121
		24	405
		28	3,401
		32	801
		35	1,620
		44	810
		48	1,215
		50	17,169
		58	567
		72	1,620
		74	4,697
		75	81
		77	191,446
		82	2,268
Total			228, 174
St. Joseph	78	8	609
		10	68
		11	406
		12	1,758
		14	9,333
		16	473
		17	135
		28	2,367
		36	1,150
		43	2,097
		48	812
		71	338
		78	132,149

St. Joseph (con't)		80	6,695
		83	947
Total			159,337
Tuscola	79	7	126
		9	4,730
		10	631
		16	2,523
		18	883
		26	1,261
		32	4,162
		35	4,352
		51	126
		68	2,144
		79	9,649
Total			30,587
Van Buren	80	3	1,643
		4	4,146
		10	469
		11	235
		14	391
		16	4,693
		30	235
		35	78
		42	1,095
		43	626
		51	626
		54	156
		57	235
		70	156
		80	104,424
		82	1,799
		83	704
Total			121,711
Washtenaw	81	4	65
		5	3,189
		9	521
		10	846
		13	65
		15	1,497
		16	781
		17	2,083
		18	1,041
		21	325
		24	1,172
		25	260
		26	781
		28	3,319
		33	65

Washtenaw (con't)		38	3,059
		40	651
		43	3,905
		45	195
		46	2,408
		47	41,005
		48	651
		49	2,994
		50	2,148
		51	3,580
		53	65
		58	5,923
		60	781
		61	130
		63	846
		68	2,734
		69	130
		71	911
		72	716
		81	79,342
		82	10,089
Total			178,273
Wayne	82	1	30,235
		2	4,396
		4	5,039
		5	16,083
		6	5,575
		7	858
		8	18,656
		9	107
		10	9,864
		11	858
		14	2,680
		15	19,192
		16	74,731
		17	18,763
		18	21,980
		20	5,897
		21	2,037
		24	8,470
		25	5,683
		26	21,229
		27	1,072
		28	13,188
		30	10,507
		31	2,252
		32	35,918
		35	12,973
		36	751
		38	34,846
		40	9,542

Wayne (con't)		41	429
		42	4,289
		43	4,182
		44	14,903
		45	6,326
		46	8,256
		47	88,777
		48	3,109
		49	3,002
		50	213,793
		51	28,091
		53	9,328
		54	5,683
		57	3,002
		58	54,038
		60	27,877
		61	2,895
		62	17,584
		63	124,909
		64	214
		65	9,221
		66	6,433
		67	1,394
		68	4,074
		69	16,726
		70	9,650
		71	10,829
		72	27,769
		74	10,400
		75	5,683
		76	3,753
		77	190,741
		79	322
		81	69,370
		82	641,056
		83	1,715
Total			2,023,200
Wexford	83	5	334
		7	167
		9	250
		10	2,670
		16	167
		28	417
		43	417
		45	83
		51	834
		53	167
		54	417
		57	1,335

Wexford (con't)	58	334
	59	1,168
	62	1,252
	67	334
	83	32,873
Total		43,219
Total, All Origins		11,700,274

[1]For percentage distribution of boat days see Table which follows.

Travel Distances From Origin Counties to all Boating Destination Counties, Percent of Total Boat Days Taken at Destination Counties, and Calculation of Average Travel Distance For Each Origin County, Michigan, 1968

Origin County i	Destination County j	Travel Distance (miles)	Percent of Total Boat Days	
Alcona (1)	(1)	18	.7568	75.68(18)+12.29(35)+1.23(175)
	(4)	35	.1229	. . . +8.60(39)+.98(210)+1.22
	(10)	175	.0123	. . . (235)=2,835.54÷100=
	(35)	39	.0860	. . . 28.35 miles
	(48)	210	.0098	
	(53)	235	.0122	
			1.0000	
Alger (2)	(2)	16	.7581	75.81(16)+.32(128)+15.81(63)+
	(17)	128	.0032	. . . .32(44)+.64(261)+7.10
	(21)	63	.1581	. . . (47)=2,765.70÷100=27.66
	(52)	44	.0032	. . . miles
	(72)	261	.0064	
	(75)	47	.0710	
			1.0000	
Allegan (3)	(2)	428	.0034	.34(428)+63.53(16)+13.70(51)+
	(3)	16	.6353	. . . .67(368)+.14(183)+.27
	(8)	51	.1370	. . . (28)+3.42(117)+.20(316)
	(17)	368	.0067	. . . +4.03(144)+3.42(118)+.67
	(28)	183	.0014	. . . (76)+2.69(60)+2.69(84)+
	(39)	28	.0027	. . . 4.23(39)=4,190.91÷100=
	(43)	117	.0342	. . . 41.90 miles
	(49)	316	.0020	
	(51)	144	.0403	
	(53)	118	.0342	
	(59)	76	.0067	
	(61)	60	.0269	
	(62)	84	.0269	
	(80)	39	.0423	
			1.0000	
Alpena (4)	(1)	35	.0294	2.94(35)+85.10(14)+2.32(173)+
	(4)	14	.8510	. . . .31(80)+1.08(183)+.12(202)
	(10)	173	.0232	. . . +.62(130)+.31(194)+1.55

Alpena (con't)		(16)	80	.0031	. . . (44)+.08(58)+4.80(41)+.54
		(17)	183	.0108	. . . (114)+.23(213)=2,463.22÷
		(48)	202	.0012	. . . 100=24.63 miles
		(49)	130	.0062	
		(51)	194	.0031	
		(60)	44	.0155	
		(68)	58	.0008	
		(71)	41	.0480	
		(72)	114	.0054	
		(75)	213	.0023	
				1.0000	
Antrim	(5)	(5)	12	.8795	87.95(12)+1.13(78)+1.88(34)+
		(10)	78	.0113	. . . 3.79(255)+1.65(179)+
		(15)	34	.0188	. . . .75(41)+1.65(17)+.07
		(21)	255	.0379	. . . (99)+.90(94)+.23(202)=
		(25)	179	.0165	. . . 2,666.05÷100-26.66 miles
		(28)	41	.0075	
		(40)	17	.0165	
		(51)	99	.0007	
		(54)	94	.0090	
		(75)	202	.0023	
				1.0000	
Arenac	(6)	(6)	10	.6819	68.19(10)+2.02(140)+6.56(40)+
		(16)	140	.0202	. . . 21.72(109)+1.51(136)=
		(35)	40	.0656	. . . 3,799.94÷100=37.99 miles
		(63)	109	.2172	
		(82)	136	.0151	
				1.0000	
Baraga	(7)	(7)	10	.6644	. . . 66.44(10)+3.97(36)+
		(31)	36	.0397	. . . 1.33(497)+2.21(77)+13.69
		(32)	497	.0133	. . . (182)+2.21(72)+.22(63)
		(42)	77	.0221	. . . +9.93(523)=9,496.45÷100=
		(48)	182	.1369	. . . 94.96 miles
		(52)	72	.0221	
		(66)	63	.0022	
		(70)	523	.0993	
				1.0000	
Barry	(8)	(3)	51	.0019	.19(51)+89.63(16)+.67(339)+
		(8)	16	.8963	. . . 1.19(157)+.14(287)+1.77
		(16)	244	.0067	. . . (154)+.24(441)+.29(134)+
		(17)	339	.0067	. . . .62(92)+1.86(57)+1.10(82)
		(40)	157	.0119	. . . +.29(105)+.29(58)+.48
		(49)	287	.0014	. . . (156)+.57(74)=2,732.78÷
		(51)	154	.0177	. . . 100=27.33 miles
		(52)	441	.0024	
		(53)	134	.0029	
		(54)	92	.0062	
		(59)	57	.0186	

Barry (con't)		(62)	82	.0110	
		(67)	105	.0029	
		(70)	58	.0029	
		(72)	156	.0048	
		(80)	74	.0057	
				1.0000	
Bay	(9)	(1)	102	.0272	2.72(102)+5.62(129)+3.41
		(4)	129	.0562	. . . (31)+39.95(12)+1.36
		(6)	31	.0341	. . . (150)+1.25(166)+5.05
		(9)	12	.3995	. . . (169)+1.08(276)+.79
		(10)	150	.0136	. . . (54)+.23(159)+7.60(54)
		(15)	166	.0125	. . . +1.48(146)+.79(61)+
		(16)	169	.0505	. . . 9.14(68)+1.70(124)+
		(17)	267	.0108	. . . .17(173)+3.06(144)+
		(18)	54	.0079	. . . 1.19(369)+.17(144)+
		(24)	159	.0023	. . . .34(22)+1.65(118)+
		(26)	54	.0760	. . . .06(122)+3.58(58)+
		(28)	146	.0148	. . . 1.13(124)+.57(153)+
		(32)	61	.0079	. . . 3.92(83)+.06(14)+.57
		(35)	68	.0914	. . . (32)+1.36(100)=6,785.61
		(40)	124	.0170	. . . ÷100=67.86 miles
		(45)	173	.0017	
		(51)	144	.0306	
		(52)	369	.0119	
		(53)	144	.0017	
		(56)	22	.0034	
		(60)	118	.0165	
		(62)	122	.0006	
		(65)	58	.0358	
		(69)	124	.0113	
		(71)	153	.0057	
		(72)	83	.0392	
		(73)	14	.0006	
		(79)	32	.0057	
		(83)	100	.0136	
				1.0000	
Benzie	(10)	(10)	8	.9621	96.21(8)+2.23(40)+1.56(87)=
		(28)	40	.0223	. . . 994.60÷100=9.95 miles
		(72)	87	.0156	
				1.0000	
Berrien	(11)	(2)	464	.0004	.04(464)+4.02(58)+.07(518)+
		(3)	58	.0402	. . . .10(88)+4.09(206)+53.12
		(7)	518	.0007	. . . (14)+4.92(36)+.38(266)+
		(8)	88	.0010	. . . .49(309)+.07(271)+1.66
		(10)	206	.0409	. . . (218)+.38(476)+.04(54)+
		(11)	14	.5312	. . . .04(80)+1.04(588)+.45
		(14)	36	.0492	. . . (152)+.45(351)+6.14(173)
		(15)	266	.0038	. . . +.17(488)+1.39(146)+.52
		(16)	309	.0049	. . . (142)+.07(89)+4.23(112)+

Berrien (con't)		(24)	271	.0007	. . . 3.50(115)+1.21(54)+.49
		(28)	218	.0166	. . . (434)+.49(71)+10.19(25)+
		(36)	476	.0038	. . . .24(184)=5,113.49÷100=
		(39)	54	.0004	. . . 51.13 miles
		(41)	80	.0004	
		(42)	588	.0104	
		(43)	152	.0045	
		(49)	351	.0045	
		(51)	173	.0614	
		(52)	488	.0017	
		(53)	146	.0139	
		(54)	142	.0052	
		(61)	89	.0007	
		(62)	112	.0423	
		(64)	115	.0350	
		(70)	54	.0121	
		(75)	434	.0049	
		(78)	71	.0049	
		(80)	25	.1019	
		(83)	184	.0024	
				1.0000	
Branch	(12)	(2)	440	.0186	1.86(440)+4.47(63)+87.47(14)+
		(8)	63	.0447	. . . 1.49(38)+.45(248)+
		(12)	14	.8747	. . . 1.57(210)+.15(606)+
		(13)	38	.0149	. . . .08(136)+.52(122)+.22
		(15)	248	.0045	. . . (203)+.60(601)+.45(238)+
		(20)	210	.0157	. . . .07(298)+.60(26)=
		(27)	606	.0015	. . . 3,536.55÷100=35.36 miles
		(61)	136	.0008	
		(63)	122	.0052	
		(65)	203	.0022	
		(66)	601	.0060	
		(68)	238	.0045	
		(71)	298	.0007	
		(78)	26	.0060	
				1.0000	
Calhoun	(13)	(2)	414	.0015	.15(414)+.92(44)+15.80(27)+
		(3)	44	.0092	. . . 3.72(196)+.12(74)+3.84
		(8)	27	.1580	. . . (38)+41.70(22)+.68(217)+
		(10)	196	.0372	. . . .36(259)+1.43(354)+.15
		(11)	74	.0012	. . . (132)+.15(67)+.27(191)+
		(12)	38	.0384	. . . .15(437)+2.95(28)+.12
		(13)	22	.4170	. . . (601)+.30(192)+1.22(50)+
		(15)	217	.0068	. . . .15(534)+.15(44)+5.81
		(16)	259	.0036	. . . (26)+1.01(172)+2.23(134)+
		(17)	354	.0143	. . . .48(219)+1.49(180)+.39
		(18)	132	.0015	. . . (157)+1.31(117)+.54(454)+
		(19)	67	.0015	. . . .09(146)+.30(244)+.45
		(20)	191	.0027	. . . (99)+.18(107)+.30(125)+
		(21)	437	.0015	. . . .42(131)+.45(219)+2.18

Calhoun (con't)		(23)	28	.0295	. . . (211)+1.67(65)+3.07(171)+
		(27)	601	.0012	. . . .89(385)+.24(163)+.86
		(28)	192	.0030	. . . (48)+1.13(64)+.18(146)=
		(34)	50	.0122	. . . 6,997.46÷100=69.97 miles
		(36)	534	.0015	
		(38)	44	.0015	
		(39)	26	.0581	
		(40)	172	.0101	
		(43)	134	.0223	
		(45)	219	.0048	
		(51)	180	.0149	
		(53)	157	.0039	
		(54)	117	.0131	
		(55)	454	.0054	
		(57)	146	.0009	
		(60)	244	.0030	
		(61)	99	.0045	
		(62)	107	.0018	
		(64)	125	.0030	
		(67)	131	.0042	
		(68)	219	.0045	
		(69)	211	.0218	
		(70)	65	.0167	
		(72)	171	.0307	
		(75)	385	.0089	
		(77)	163	.0024	
		(78)	48	.0086	
		(80)	64	.0113	
		(83)	146	.0018	
				1.0000	
Cass	(14)	(11)	36	.0090	.90(36)+.72(67)+82.67(17)+
		(12)	67	.0072	. . . .18(414)+.12(551)+.36
		(14)	17	.8267	. . . (434)+2.17(187)+1.50
		(17)	414	.0018	. . . (126)+.54(445)+2.17(48)+
		(27)	551	.0012	. . . 8.37(39)+.30(195)=
		(48)	434	.0036	. . . 3,107.09÷100=31.07 miles
		(51)	187	.0217	
		(62)	126	.0150	
		(75)	445	.0054	
		(78)	48	.0217	
		(80)	39	.0837	
		(83)	195	.0030	
				1.0000	
Charlevoix	(15)	(5)	34	.0146	1.45(34)+.52(89)+89.18(11)+
		(10)	89	.0052	. . . .21(186)+.21(269)+6.66
		(15)	11	.8918	. . . (18)+.52(52)+1.25(150)=
		(17)	186	.0021	. . . 1,506.53÷100=15.06 miles
		(21)	269	.0021	
		(24)	18	.0666	

Charlevoix		(28)	52	.0052	
(con't)		(35)	150	.0125	
				1.0000	
Cheboygan	(16)	(15)	91	.0036	.36(91)+96.24(13)+.60(85)+
		(16)	13	.9624	. . . .77(123)+.24(52)+1.79
		(24)	85	.0060	. . . (106)=1,631.81÷100=
		(48)	123	.0077	. . . 16.32 miles
		(49)	52	.0024	
		(72)	106	.0179	
				1.0000	
Chippewa	(17)	(17)	10	.9800	98.00(10)+2.00(58)=1,096÷
		(49)	58	.0200	. . . 100=10.96 miles
				1.0000	
Clare	(18)	(10)	102	.0039	.39(102)+.78(139)+72.86(16)+
		(16)	139	.0078	. . . 3.87(30)+7.75(19)+.78
		(18)	16	.7286	. . . (78)+1.94(181)+4.65(96)+
		(26)	30	.0387	. . . .78(96)+1.16(52)+.39(46)+
		(37)	19	.0775	. . . 4.65(45)=2,798.08÷100=
		(40)	78	.0078	. . . 27.98 miles
		(49)	181	.0194	
		(51)	96	.0465	
		(53)	96	.0078	
		(57)	52	.0116	
		(67)	46	.0039	
		(72)	45	.0465	
				1.0000	
Clinton	(19)	(10)	164	.0012	.12(164)+.74(201)+6.82(295)+
		(16)	201	.0074	. . . 12.14(68)+5.08(15)+.25
		(17)	295	.0682	. . . (126)+2.35(188)+10.16
		(18)	68	.1214	. . . (160)+1.74(34)+.50(20)+
		(19)	15	.0508	. . . 1.24(29)+16.48(51)+1.98
		(20)	126	.0025	. . . (57)+.99(140)+7.43(123)+
		(24)	188	.0235	. . . 1.36(243)+.50(158)+1.12
		(28)	160	.1016	. . . (156)+8.92(50)+.25(101)+
		(29)	34	.0174	. . . 4.96(106)+2.85(106)+
		(33)	20	.0050	. . . 10.41(107)+.74(326)+
		(34)	29	.0124	. . . .87(114)=10,629.55÷100=
		(37)	51	.1648	. . . 106.29 miles
		(38)	57	.0198	
		(40)	140	.0099	
		(43)	123	.0743	
		(49)	243	.0136	
		(51)	158	.0050	
		(53)	156	.0112	
		(59)	50	.0892	
		(61)	101	.0025	
		(62)	106	.0496	
		(67)	106	.0285	

Clinton (con't)		(72)	107	.1041	
		(75)	326	.0074	
		(83)	114	.0087	
				1.0000	
Crawford	(20)	(20)	9	.9500	95(9)+5(27)=990÷100=9.90 miles
		(40)	27	.0500	
				1.0000	
Delta	(21)	(2)	63	.0597	5.97(63)+66.54(6)+1.30(53)+
		(21)	6	.6654	. . . 3.08(417)+.65(181)+.65
		(22)	53	.0130	. . . (431)+.65(144)+6.25(68)+
		(23)	417	.0308	. . . 1.40(40)+13.51(55)=
		(27)	181	.0065	. . . 3,843.38÷100=38.43 miles
		(47)	431	.0065	
		(49)	144	.0065	
		(52)	68	.0625	
		(55)	40	.0140	
		(75)	55	.1351	
				1.0000	
Dickinson	(22)	(7)	86	.0234	2.34(86)+9.24(53)+69.65
		(21)	53	.0924	. . . (6)+3.08(115)+.59(61)+
		(22)	6	.6965	. . . 12.75(47)+1.76(426)+
		(31)	115	.0308	. . . .59(125)=2,921.81÷100=
		(32)	461	.0059	. . . 29.22 miles
		(36)	47	.1275	
		(53)	426	.0176	
		(66)	125	.0059	
				1.0000	
Eaton	(23)	(1)	200	.0052	.52(200)+.33(394)+2.63(170)+
		(2)	394	.0033	. . . 2.96(130)+13.08(29)+
		(5)	170	.0263	. . . 1.71(181)+.52(47)+21.10
		(6)	130	.0296	. . . (28)+.13(202)+.73(239)+
		(8)	29	.1308	. . . .20(333)+.79(106)+.20
		(10)	181	.0171	. . . (164)+4.10(6)+2.63(70)+
		(12)	47	.0052	. . . .73(177)+2.17(155)+.39
		(13)	28	.2110	. . . (20)+1.12(35)+.79(167)+
		(15)	202	.0013	. . . 1.97(89)+.52(38)+.79
		(16)	239	.0073	. . . (157)+.13(132)+.80(353)+
		(17)	333	.0020	. . . 1.38(281)+1.31(175)+6.18
		(18)	106	.0079	. . . (158)+15.64(57)+.13(106)
		(20)	164	.0020	. . . +4.14(191)+5.85(145)+
		(23)	6	.0410	. . . .26(364)+4.07(103)=
		(25)	70	.0263	. . . 8,877.30÷100=88.77 miles
		(28)	177	.0073	
		(32)	155	.0217	
		(33)	20	.0039	
		(34)	35	.0112	
		(35)	167	.0079	

Eaton (con't)		(37)	89	.0197	
		(38)	38	.0052	
		(40)	157	.0079	
		(43)	132	.0013	
		(48)	353	.0080	
		(49)	281	.0138	
		(51)	175	.0131	
		(53)	158	.0618	
		(59)	57	.1564	
		(62)	106	.0013	
		(69)	191	.0414	
		(72)	145	.0585	
		(77)	364	.0026	
		(54)	103	.0407	
				1.0000	
Emmet	(24)	(10)	106	.0193	1.93(106)+4.09(18)+8.11(85)+
		(15)	18	.0409	. . . .43(179)+79.66(6)+1.47
		(16)	85	.0811	. . . (97)+3.84(198)+.16(80)+
		(17)	179	.0043	. . . .31(89)=2,465.78÷100=
		(24)	6	.7966	. . . 24.66 miles
		(45)	97	.0147	
		(48)	198	.0384	
		(57)	80	.0016	
		(83)	89	.0031	
				1.0000	
Genesee	(25)	(1)	146	.0296	2.96(146)+.09(371)+.28(173)+
		(2)	371	.0009	. . . 1.79(179)+.95(75)+.12
		(4)	173	.0028	. . . (482)+1.06(46)+.96(190)+
		(5)	179	.0179	. . . .46(210)+2.66(213)+.53
		(6)	75	.0095	. . . (311)+4.14(93)+.04(46)+
		(7)	482	.0012	. . . .50(141)+.09(394)+.90
		(9)	46	.0106	. . . (203)+26.88(12)+10.16
		(10)	190	.0096	. . . (93)+.06(557)+2.34(186)+
		(15)	210	.0046	. . . .50(511)+1.94(88)+.09
		(16)	213	.0266	. . . (74)+5.67(112)+.10(491)+
		(17)	311	.0053	. . . .05(88)+.56(166)+.18
		(18)	93	.0414	. . . (151)+4.23(21)+1.03
		(19)	46	.0004	. . . (213)+2.44(45)+.33(258)+
		(20)	141	.0050	. . . .02(62)+2.91(184)+.10
		(21)	394	.0009	. . . (413)+.19(184)+.38(129)+
		(24)	203	.0090	. . . .07(432)+.29(140)+.70
		(25)	12	.2688	. . . (162)+.12(145)+.04(144)+
		(26)	93	.1016	. . . 1.28(37)+.07(172)+2.49
		(27)	557	.0006	. . . (102)+.12(535)+.36(134)+
		(28)	186	.0234	. . . .75(137)+.43(168)+.04
		(31)	511	.0050	. . . (132)+1.01(197)+8.49
		(32)	88	.0194	. . . (127)+.40(37)+.53(80)+
		(34)	74	.0009	. . . .64(341)+.33(26)+.30
		(35)	112	.0567	. . . (68)+1.24(141)+2.54(51)+
		(36)	491	.0010	. . . .07(140)=9,550.25÷100=

Genesee (con't)		(38)	88	.0005	. . . 95.50 miles
		(40)	166	.0056	
		(43)	151	.0018	
		(44)	21	.0423	
		(45)	213	.0103	
		(47)	45	.0244	
		(49)	258	.0033	
		(50)	62	.0002	
		(51)	184	.0291	
		(52)	413	.0010	
		(53)	184	.0019	
		(54)	129	.0038	
		(55)	432	.0007	
		(57)	140	.0029	
		(60)	162	.0070	
		(61)	145	.0012	
		(62)	144	.0004	
		(63)	37	.0128	
		(64)	172	.0007	
		(65)	102	.0249	
		(66)	535	.0012	
		(67)	134	.0036	
		(68)	137	.0075	
		(69)	168	.0043	
		(70)	132	.0004	
		(71)	197	.0101	
		(72)	127	.0849	
		(73)	37	.0040	
		(74)	80	.0053	
		(75)	341	.0064	
		(76)	26	.0033	
		(77)	68	.0030	
		(78)	141	.0124	
		(79)	51	.0254	
		(83)	140	.0007	
				1.0000	
Gladwin	(26)	(9)	54	.0100	1.00(54)+.67(134)+1.67(229)+
		(16)	134	.0067	. . . 7.69(60)+1.67(312)+
		(17)	229	.0167	. . . 39.13(9)+.34(65)+1.67
		(20)	60	.0769	. . . (87)+11.37(103)+13.38
		(21)	312	.0167	. . . (37)+20.07(127)+1.34
		(26)	9	.3913	. . . (36)=6,291.51÷100=
		(35)	65	.0034	. . . 62.91 miles
		(43)	87	.0167	
		(51)	103	.1137	
		(56)	37	.1338	
		(63)	127	.2007	
		(72)	36	.0134	
				1.0000	
Gogebic	(27)	(27)	20	.8399	83.99(20)+.35(110)+15.66(65)=

Gogebic (con't)	(31)	110	.0035	. . . 2,736.20÷100=27.36 miles
	(66)	65	.1566	
			1.0000	
Gd. Traverse (28)	(5)	41	.0434	4.34(41)+4.17(40)+.57(52)+
	(10)	40	.0417	. . . .16(115)+.24(69)+
	(15)	52	.0057	. . . 84.72(13)+.41(30)+
	(16)	115	.0016	. . . 2.88(31)+2.43(63)+.08
	(24)	69	.0024	. . . (51)=1,769.45÷100=
	(28)	13	.8472	. . . 17.69 miles
	(40)	30	.0041	
	(45)	31	.0288	
	(51)	63	.0243	
	(83)	51	.0008	
			1.0000	
Gratiot (29)	(1)	149	.0839	8.39(149)+2.33(53)+6.99(95)+
	(9)	53	.0233	. . . 1.40(13)+8.39(116)+6.99
	(18)	36	.0583	. . . (19)+3.03(127)+23.54
	(20)	95	.0699	. . . (61)+3.96(49)+.47(97)+
	(29)	13	.0140	. . . 28.68(75)=7,373.28÷
	(35)	116	.0839	. . . 100=73.73 miles
	(37)	19	.0699	
	(51)	127	.0303	
	(54)	61	.2354	
	(59)	49	.0396	
	(61)	97	.0047	
	(72)	75	.2868	
			1.0000	
Hillsdale (30)	(11)	118	.0029	.29(118)+6.51(24)+.48(55)+.77
	(12)	24	.0651	. . . (238)+76.35(14)+2.97
	(13)	55	.0048	. . . (41)+1.92(35)+.19(331)+
	(28)	238	.0077	. . . 1.53(233)+5.08(164)+.19
	(30)	14	.7635	. . . (192)+.96(74)+.38(266)+
	(38)	41	.0297	. . . .38(153)+2.00(241)=
	(46)	35	.0192	. . . 3,659.23÷100=36.59 miles
	(49)	331	.0019	
	(51)	233	.0153	
	(54)	164	.0508	
	(57)	192	.0019	
	(58)	74	.0096	
	(60)	266	.0038	
	(61)	153	.0038	
	(68)	241	.0200	
			1.0000	
Houghton (31)	(7)	36	.1073	10.73(36)+.97(583)+61.83(11)+
	(30)	583	.0097	. . . 26.47(42)=2,743.66÷100=
	(31)	11	.6183	. . . 27.44 miles
	(42)	42	.2647	
			1.0000	

Huron	(32)	(1)	161	.0412	4.12(161)+9.62(90)+.69(326)+
		(6)	90	.0962	. . . 83.85(10)+.69(204)+
		(17)	326	.0069	. . . 1.03(143)=2,880.61÷
		(32)	10	.8385	. . . 100=28.81 miles
		(51)	204	.0069	
		(72)	143	.0103	
				1.0000	
Ingham	(33)	(3)	89	.0023	
		(4)	208	.0050	
		(5)	172	.0097	
		(6)	110	.0010	
		(8)	47	.0430	
		(9)	83	.0012	
		(10)	183	.0324	
		(11)	120	.0020	
		(13)	47	.0133	.23(89)+.50(208)+.97(172)+
		(15)	204	.0315	. . . .10(110)+4.30(47)+.12(83)+
		(16)	219	.0242	. . . 3.23(183)+.20(120)+1.33
		(17)	314	.0140	. . . (47)+3.15(204)+2.42(219)+
		(18)	86	.0685	. . . 1.40(314)+6.85(86)+.93
		(19)	20	.0093	. . . (20)+1.40(145)+.92(20)+
		(20)	145	.0140	. . . 1.25(110)+.13(561)+2.13
		(23)	20	.0092	. . . (179)+.07(52)+.03(514)+
		(26)	110	.0125	. . . 9.68(12)+2.38(39)+.50
		(27)	561	.0013	. . . (148)+1.25(494)+2.00(69)+
		(28)	179	.0214	. . . 1.52(38)+.05(72)+1.12
		(29)	52	.0007	. . . (159)+2.15(66)+.10(206)+
		(31)	514	.0003	. . . 2.90(36)+1.00(262)+.62
		(33)	12	.0969	. . . (96)+4.15(177)+.45(163)+
		(34)	39	.0238	. . . 9.25(107)+.70(436)+.75
		(35)	148	.0050	. . . (133)+4.80(62)+.53(197)+
		(36)	494	.0125	. . . .35(106)+.67(111)+.20
		(37)	69	.0200	. . . (70)+.92(121)+.50(172)+
		(38)	38	.0152	. . . .43(171)+.28(89)+1.00
		(39)	72	.0005	. . . (232)+12.77(125)+.10
		(40)	159	.0112	. . . (344)+.40(32)+1.25(117)+
		(41)	66	.0215	. . . .08(91)+1.28(65)+
		(45)	206	.0010	. . . .08(89)+2.10(133)=
		(47)	36	.0290	. . . 11,534.80÷100=115.35 miles
		(49)	262	.0100	
		(50)	96	.0062	
		(51)	177	.0415	
		(53)	163	.0045	
		(54)	107	.0925	
		(55)	436	.0070	
		(57)	133	.0075	
		(59)	62	.0480	
		(60)	197	.0053	
		(61)	106	.0035	
		(62)	111	.0067	
		(63)	70	.0020	

Ingham (con't)		(67)	121	.0092	
		(68)	172	.0050	
		(69)	171	.0043	
		(70)	89	.0028	
		(71)	232	.0100	
		(72)	125	.1277	
		(75)	344	.0010	
		(76)	32	.0040	
		(77)	117	.0125	
		(78)	91	.0008	
		(81)	65	.0128	
		(82)	89	.0008	
		(83)	133	.0210	
				1.0000	
Ionia	(34)	(2)	365	.0040	.40(365)+5.38(35)+.13(81)+
		(8)	35	.0538	. . . 3.49(141)+2.96(35)+
		(12)	81	.0013	. . . 2.69(53)+48.12(12)+
		(20)	141	.0349	. . . 1.21(123)+13.31(34)+
		(23)	35	.0296	. . . .94(100)+1.88(141)+
		(29)	53	.0269	. . . .54(131)+7.80(69)+.81
		(34)	12	.4812	. . . (97)+8.33(23)+.13(82)+
		(40)	123	.0121	. . . 1.88(122)=3,740.10÷
		(41)	34	.1331	. . . 100=37.40 miles
		(43)	100	.0094	
		(51)	141	.0188	
		(53)	131	.0054	
		(54)	69	.0780	
		(57)	97	.0081	
		(59)	23	.0833	
		(67)	82	.0013	
		(72)	122	.0188	
				1.0000	
Isabella	(37)	(1)	141	.0054	.54(141)+.73(106)+2.00(116)+
		(5)	106	.0073	. . . 10.91(153)+.73(247)+
		(10)	116	.0200	. . . 1.64(19)+1.46(78)+1.09
		(16)	153	.1091	. . . (494)+.18(108)+29.09
		(17)	247	.0073	. . . (20)+1.27(110)+13.82
		(18)	19	.0164	. . . (43)+1.09(30)+5.45(55)+
		(20)	78	.0146	. . . 5.45(122)+3.64(77)+
		(27)	494	.0109	. . . 4.36(105)+1.09(176)+
		(35)	108	.0018	. . . 13.82(58)+1.64(66)=
		(37)	20	.2909	. . . 7,090.83÷100=70.91 miles
		(51)	110	.0127	
		(54)	43	.1382	
		(56)	30	.0109	
		(59)	55	.0545	
		(63)	122	.0545	
		(65)	77	.0364	
		(69)	105	.0436	

Isabella (con't)		(71)	176	.0109	
		(72)	58	.1382	
		(83)	66	.0164	
				1.0000	
Iosco	(35)	(24)	143	.0034	.34(143)+99.66(15)=1,543.52÷
		(35)	15	.9966	. . . 100=15.43 miles
				1.0000	
Iron	(36)	(36)	16	1.0000	100(16)=1,600÷100=16.00 miles
Jackson	(38)	(4)	245	.0199	
		(5)	207	.0219	
		(8)	65	.0040	
		(10)	218	.0060	
		(12)	47	.0003	1.99(245)+2.19(207)+.40(65)+
		(13)	44	.0169	. . . .60(218)+.03(47)+1.69
		(16)	257	.0328	. . . (44)+3.28(257)+3.32(123)+
		(18)	123	.0332	. . . 3.02(148)+4.14(213)+.50
		(26)	148	.0302	. . . (41)+.43(38)+60.89(16)+
		(28)	213	.0414	. . . .33(66)+.79(39)+.55(370)+
		(30)	41	.0050	. . . .13(299)+1.13(211)+.53
		(33)	38	.0043	. . . (454)+.37(194)+.10(234)+
		(38)	16	.6089	. . . 1.38(142)+5.70(153)+.46
		(39)	66	.0033	. . . (210)+.46(209)+.33(108)+
		(46)	39	.0079	. . . .20(270)+2.68(162)+.46
		(48)	370	.0055	. . . (382)+1.92(37)=7,665.18÷
		(49)	299	.0013	. . . 100=76.65 miles
		(51)	211	.0113	
		(52)	454	.0053	
		(53)	194	.0037	
		(60)	234	.0010	
		(62)	142	.0138	
		(67)	153	.0570	
		(68)	210	.0046	
		(69)	209	.0046	
		(70)	108	.0033	
		(71)	270	.0020	
		(72)	162	.0268	
		(75)	382	.0046	
		(81)	37	.0192	
				1.0000	
Kalamazoo	(39)	(3)	28	.0442	1.31(46)+.20(279)+.07(52)+
		(5)	205	.0033	. . . .29(190)+.39(77)+.07(66)+
		(8)	36	.1403	. . . 43.72(15)+.16(192)+3.61
		(9)	153	.0072	. . . (124)+.13(321)+6.62(168)+
		(10)	193	.0085	. . . .46(476)+.07(114)+.07(165)+
		(11)	54	.0046	. . . .13(266)+.23(84)+2.13(97)+
		(14)	46	.0131	. . . .10(110)+.10(583)+.75
		(16)	279	.0020	. . . (50)+.62(404)+3.31(49)+

Kalamazoo (con't)		(23)	52	.0007	. . . 14.19(40)+.46(156)=
		(28)	190	.0029	. . . 4,155.33÷100=41.55 miles
		(30)	77	.0039	
		(38)	66	.0007	
		(39)	15	.4372	
		(40)	192	.0016	
		(43)	124	.0361	
		(49)	321	.0013	
		(51)	168	.0662	
		(52)	476	.0046	
		(54)	114	.0007	
		(57)	165	.0007	
		(60)	266	.0013	
		(61)	84	.0023	
		(62)	97	.0213	
		(64)	110	.0010	
		(66)	583	.0010	
		(70)	50	.0075	
		(75)	404	.0062	
		(78)	49	.0331	
		(80)	40	.1419	
		(83)	156	.0046	
				1.0000	
Kalkaska	(40)	0	0	0	
Kent	(41)	(1)	226	.0003	.03(226)+6.49(44)+1.26(158)+
		(3)	44	.0649	. . . .08(156)+.07(498)+6.04
		(5)	158	.0126	. . . (37)+1.42(144)+.62(190)+
		(6)	156	.0008	. . . .42(232)+.09(327)+.35
		(7)	498	.0007	. . . (166)+.25(410)+.13(461)+
		(8)	37	.0604	. . . .05(132)+.45(573)+1.92
		(10)	144	.0142	. . . (142)+.01(66)+.43(34)+
		(15)	190	.0062	. . . .13(90)+.25(52)+.18(145)+
		(16)	232	.0042	. . . 27.41(18)+.16(568)+2.77
		(17)	327	.0009	. . . (75)+.04(126)+.16(346)+
		(20)	166	.0035	. . . 2.03(274)+4.90(121)+.13
		(21)	410	.0025	. . . (429)+1.43(100)+5.08
		(22)	461	.0013	. . . (66)+.08(448)+4.67(35)+
		(26)	132	.0005	. . . .19(219)+2.94(43)+12.35
		(27)	573	.0045	. . . (49)+1.17(69)+1.43(79)+
		(28)	142	.0192	. . . 10.23(28)+.30(146)+.14
		(33)	66	.0001	. . . (357)+.04(59)+.01(153)+
		(34)	34	.0043	. . . 1.66(107)=6,299.16÷100=
		(37)	90	.0013	. . . 62.99 miles
		(39)	52	.0025	
		(40)	145	.0018	
		(41)	18	.2741	
		(42)	568	.0016	
		(43)	75	.0277	
		(44)	126	.0004	
		(48)	346	.0016	

Kent (con't)		(49)	274	.0203	
		(51)	121	.0490	
		(52)	429	.0013	
		(53)	100	.0143	
		(54)	66	.0508	
		(55)	448	.0008	
		(59)	35	.0467	
		(60)	219	.0019	
		(61)	43	.0294	
		(62)	49	.1235	
		(64)	69	.0117	
		(67)	79	.0143	
		(70)	28	.1023	
		(72)	146	.0030	
		(75)	357	.0014	
		(80)	59	.0005	
		(82)	153	.0001	
		(83)	107	.0166	
				1.0000	
Keewenaw	(42)	(42)	11	1.0000	100(11)=1100÷100=11.00 miles
Lake	(43)	(9)	111	.0511	5.11(111)+3.84(170)+61.55(14)+
		(16)	170	.0384	. . . 12.83(312)+10.27(48)+
		(43)	14	.6155	. . . 6.40(35)=5,531.46÷100=
		(49)	213	.1283	. . . 55.31 miles
		(51)	48	.1027	
		(53)	35	.0640	
				1.0000	
Lapeer	(44)	(1)	160	.0170	1.70(160)+1.32(156)+1.78(21)+
		(20)	156	.0132	. . . .88(525)+2.21(68)+1.33
		(25)	21	.0178	. . . (126)+1.54(505)+73.78
		(31)	525	.0088	. . . (16)+.66(272)+1.33(54)+
		(32)	68	.0221	. . . .66(199)+2.21(176)+1.77
		(35)	126	.0133	. . . (32)+.66(549)+.88(182)+
		(36)	505	.0154	. . . 3.76(141)+.22(60)+2.87
		(44)	16	.7378	. . . (47)+.44(34)=5,297.33÷
		(49)	272	.0066	. . . 100=52.97 miles
		(50)	54	.0133	
		(51)	199	.0066	
		(60)	176	.0221	
		(63)	32	.0177	
		(66)	549	.0066	
		(69)	182	.0088	
		(72)	141	.0376	
		(74)	60	.0022	
		(77)	47	.0287	
		(79)	34	.0044	
				1.0000	

Leelanau	(45)	(10)	62	.1198	11.98(62)+5.94(31)+80.18(9)+
		(28)	31	.0594	. . . 1.79(276)+.11(105)=
		(45)	9	.8018	. . .2,154.11÷100=21.54 miles
		(46)	276	.0179	
		(67)	105	.0011	
				1.0000	
Lenawee	(46)	(1)	236	.0097	.97(236)+.77(242)+1.93(165)+
		(5)	242	.0077	. . . .39(253)+.84(58)+1.80
		(6)	165	.0193	. . . (273)+5.48(292)+.27(386)+
		(10)	253	.0039	. . . 2.51(35)+.45(587)+.45(566)+
		(12)	58	.0084	. . . 2.71(39)+.26(132)+59.62(15)
		(15)	273	.0180	. . . +2.47(334)+.39(489)+.19
		(16)	292	.0548	. . . (203)+13.60(42)+.19(129)+
		(17)	386	.0027	. . . .97(198)+1.35(188)+.19
		(30)	35	.0251	. . . (198)+.13(122)+39(143)+
		(31)	587	.0045	. . . 1.42(42)+.26(71)=7,001.07
		(36)	566	.0045	. . . ÷100=70.01 miles
		(38)	39	.0271	
		(41)	132	.0026	
		(46)	15	.5962	
		(49)	334	.0247	
		(52)	489	.0039	
		(57)	203	.0019	
		(58)	42	.1360	
		(59)	129	.0019	
		(64)	198	.0097	
		(67)	188	.0135	
		(72)	198	.0019	
		(77)	122	.0013	
		(79)	143	.0039	
		(81)	42	.0142	
		(82)	71	.0026	
				1.0000	
Livingston	(47)	(1)	185	.0211	2.11(185)+.19(238)+3.96(348)+
		(15)	238	.0019	. . . 1.14(120)+1.92(128)+
		(17)	348	.0396	. . . 1.28(213)+.19(131)+.70
		(18)	120	.0114	. . . (36)+82.43(11)+.45(470)+
		(26)	128	.0192	. . . .64(41)+.45(176)+4.54(31)=
		(28)	213	.0128	. . . 3,883.35÷100=38.83 miles
		(32)	131	.0019	
		(33)	36	.0070	
		(47)	11	.8243	
		(55)	470	.0045	
		(63)	41	.0064	
		(68)	176	.0045	
		(81)	31	.0454	
				1.0000	

Luce	(48)	(7)	182	.0279	2.79(182)+78.22(17)+18.99(78)=
		(48)	17	.7822	. . . 3,318.74÷100=33.19 miles
		(49)	78	.1899	
				1.0000	
Mackinac	(49)	(7)	52	.0333	3.33(52)+96.43(12)+.24(91)=
		(48)	12	.9643	. . . 1,352.16÷100=13.52 miles
		(49)	91	.0024	
				1.0000	
Macomb	(50)	(1)	205	.0117	1.17(205)+.43(232)+.19(135)+
		(4)	232	.0043	. . . .01(106)+.11(250)+.23
		(6)	135	.0019	. . . (269)+.97(273)+.78(370)+
		(9)	106	.0001	. . . .08(153)+.07(454)+.15(263)
		(10)	250	.0011	. . . +.16(62)+.24(153)+.39(245)
		(15)	269	.0023	. . . +.88(98)+.40(172)+.05(92)
		(16)	273	.0097	. . . +.16(226)+.37(54)+.35(86)
		(17)	370	.0078	. . . +.60(65)+.03(389)+.69(318)
		(18)	153	.0008	. . . + 58.81(13)+.82(244)+.67
		(21)	454	.0007	. . . (200)+.11(56)+.11(151)+
		(24)	263	.0015	. . . .21(222)+3.51(28)+.59(162)
		(25)	62	.0016	. . . +.61(197)+5.16(228)+.01
		(26)	153	.0024	. . . (182)+.09(257)+.67(187)+
		(28)	245	.0039	. . . .03(61)+.29(401)+15.51(37)
		(32)	98	.0088	. . . +.21(87)+3.95(24)+.13(199)
		(35)	172	.0040	. . . =5,401.19÷100=54.01 miles
		(38)	92	.0005	
		(40)	226	.0016	
		(44)	54	.0037	
		(46)	86	.0035	
		(47)	65	.0060	
		(48)	389	.0003	
		(49)	318	.0069	
		(50)	13	.5881	
		(51)	244	.0082	
		(57)	200	.0067	
		(58)	56	.0011	
		(59)	151	.0011	
		(60)	222	.0021	
		(63)	28	.0351	
		(65)	162	.0059	
		(68)	197	.0061	
		(69)	228	.0516	
		(70)	182	.0001	
		(71)	257	.0009	
		(72)	187	.0067	
		(74)	61	.0003	
		(75)	401	.0029	
		(77)	37	.1551	
		(79)	87	.0021	
		(82)	24	.0395	
		(83)	199	.0013	
				1.0000	

Manistee	(51)	(10)	34	.0213	2.13(34)+.36(63)+11.72(91)+
		(28)	63	.0036	. . . 83.48(12)+2.31(32)=
		(45)	91	.1172	. . . 2,237.30÷100=22.37 miles
		(51)	12	.8348	
		(53)	32	.0231	
				1.0000	
Marquette	(52)	(2)	44	.0581	5.81(44)+6.52(72)+1.40(68)+
		(7)	72	.0652	. . . .13(82)+.64(413)+.83
		(21)	68	.0140	. . . (89)+.64(163)+84.03(13)=
		(22)	82	.0013	. . . 2,365.84÷100=23.66 miles
		(25)	413	.0064	
		(36)	89	.0083	
		(49)	163	.0064	
		(52)	13	.8403	
				1.0000	
Mason	(53)	(3)	118	.0038	.38(118)+1.92(65)+.77(94)+
		(10)	65	.0192	. . . 4.02(35)+9.00(32)+81.61
		(28)	94	.0077	. . . (9)+.38(85)+1.92(37)=
		(43)	35	.0402	. . . 1,508.55÷100=15.08 miles
		(51)	32	.0900	
		(53)	9	.8161	
		(57)	85	.0038	
		(64)	37	.0192	
				1.0000	
Mecosta	(54)	(5)	94	.0060	.60(94)+.79(93)+.40(168)+.40
		(10)	93	.0079	. . . (262)+.99(43)+1.99(116)+
		(16)	168	.0040	. . . 1.39(210)+4.77(78)+.40
		(17)	262	.0040	. . . (65)+81.51(11)+.40(155)+
		(37)	43	.0099	. . . 5.96(39)+.40(69)=
		(45)	116	.0199	. . . 2,483.89÷100=24.84 miles
		(49)	210	.0139	
		(51)	78	.0477	
		(53)	65	.0040	
		(54)	11	.8151	
		(60)	155	.0040	
		(62)	39	.0596	
		(64)	69	.0040	
				1.0000	
Menominee	(55)	(7)	157	.0177	1.77(157)+2.84(107)+92.91(12)+
		(52)	107	.0284	. . . 2.48(93)=1,927.33÷100=
		(55)	12	.9291	. . . 19.27 miles
		(75)	93	.0248	
				1.0000	
Midland	(56)	(6)	46	.0145	1.45(46)+15.29(22)+1.05(134)+
		(9)	22	.1529	. . . 4.59(154)+1.45(168)+.32
		(10)	134	.0105	. . . (263)+2.90(37)+.40(94)+
		(15)	154	.0459	. . . .16(155)+.32(61)+15.37

Midland (con't)		(16)	168	.0145	. . . (37)+2.49(129)+.80(84)+
		(17)	263	.0032	. . . 1.93(110)+.48(94)+2.41
		(18)	37	.0290	. . . (157)+1.21(128)+2.66(71)+
		(20)	94	.0040	. . . 25.34(12)+1.45(83)+.32
		(24)	155	.0016	. . . (129)+.48(106)+2.41(77)+
		(25)	61	.0032	. . . 3.22(167)+8.93(72)+1.13
		(26)	37	.1537	. . . (26)+.72(293)+.72(83)=
		(28)	129	.0249	. . . 5,887.21÷100=58.87 miles
		(35)	84	.0080	
		(40)	110	.0193	
		(43)	94	.0048	
		(45)	157	.0241	
		(51)	128	.0121	
		(54)	71	.0266	
		(56)	12	.2534	
		(57)	83	.0145	
		(61)	129	.0032	
		(62)	106	.0048	
		(67)	77	.0241	
		(71)	167	.0322	
		(72)	72	.0893	
		(73)	26	.0113	
		(75)	293	.0072	
		(83)	83	.0072	
				1.0000	
Missaukee	(57)	(17)	213	.0106	1.06(213)+16.84(348)+3.15
		(22)	348	.1684	. . . (393)+78.95(10)=
		(36)	393	.0315	. . . 8,113.55÷100=81.13 miles
		(57)	10	.7895	
				1.0000	
Monroe	(58)	(1)	231	.0152	1.52(231)+.15(258)+.35(567)+
		(4)	258	.0015	. . . 1.11(88)+3.19(396)+
		(7)	567	.0035	. . . 2.13(479)+.15(271)+1.72
		(12)	88	.0111	. . . (74)+.51(596)+9.57(66)+
		(17)	396	.0319	. . . 1.01(231)+8.06(42)+.76
		(21)	479	.0213	. . . (69)+.56(56)+.10(269)+
		(28)	271	.0015	. . . 1.52(202)+.10(225)+53.90
		(30)	74	.0172	. . . (9)+.81(247)+1.01(205)+
		(31)	596	.0051	. . . 2.54(216)+1.52(222)+
		(38)	66	.0957	. . . 2.28(282)+.61(426)+.51
		(43)	231	.0101	. . . (41)+4.31(39)=7,955.16÷
		(46)	42	.0806	. . . 100=79.55 miles
		(47)	69	.0076	
		(50)	56	.0056	
		(51)	269	.0010	
		(54)	202	.0152	
		(57)	225	.0010	
		(58)	9	.5390	
		(60)	247	.0081	
		(62)	205	.0101	

Monroe (con't)		(67)	216	.0254	
		(68)	222	.0152	
		(71)	282	.0228	
		(75)	426	.0061	
		(81)	41	.0051	
		(82)	39	.0431	
				1.0000	
Montcalm	(59)	(4)	219	.0075	.75(219)+1.49(127)+.64(137)+
		(5)	127	.0149	. . . .21(158)+2.13(201)+.21
		(10)	137	.0064	. . . (295)+.11(73)+.64(379)+
		(15)	158	.0021	. . . 1.17(163)+6.41(133)+.21
		(16)	201	.0213	. . . (113)+1.39(35)+.64(79)+
		(17)	295	.0021	. . . 4.80(160)+5.55(125)+.11
		(18)	73	.0011	. . . (398)+7.36(48)+52.19(13)+
		(21)	379	.0064	. . . 1.07(58)+2.99(59)+1.07
		(24)	163	.0117	. . . (519)+.43(153)+2.99(112)+
		(28)	133	.0641	. . . 4.37(326)+1.07(87)=
		(40)	113	.0021	. . . 7,631.34÷100=76.31 miles
		(41)	35	.0139	
		(43)	79	.0064	
		(45)	160	.0480	
		(51)	125	.0555	
		(52)	398	.0011	
		(54)	48	.0736	
		(59)	13	.5219	
		(61)	58	.0107	
		(62)	59	.0299	
		(66)	519	.0107	
		(69)	153	.0043	
		(72)	112	.0299	
		(75)	326	.0437	
		(83)	87	.0107	
				1.0000	
Montmorency	(60)	(4)	44	.0054	.54(44)+.54(63)+2.69(222)+
		(20)	63	.0054	. . . 94.35(14)+1.88(144)=
		(50)	222	.0269	. . . 2,246.58÷100=22.47 miles
		(60)	14	.9435	
		(67)	144	.0188	
				1.0000	
Muskegon	(61)	(3)	60	.0015	.15(60)+.05(76)+2.19(122)+
		(8)	76	.0005	. . . 1.55(89)+.62(185)+1.06
		(10)	122	.0219	. . . (233)+.31(411)+.77
		(11)	89	.0155	. . . (574)+1.32(136)+.03
		(15)	185	.0062	. . . (146)+2.61(43)+2.22(70)+
		(16)	233	.0106	. . . .77(164)+.05(347)+.54
		(21)	411	.0031	. . . (275)+5.86(89)+5.60(62)+
		(27)	574	.0077	. . . .67(129)+.05(120)+.03
		(28)	136	.0132	. . . (199)+.77(58)+63.68(10)+

Muskegon (con't)		(40)	146	.0003	. . . .69(28)+4.08(31)+3.30
		(41)	43	.0261	. . . (37)+.54(148)+.10(120)+
		(43)	70	.0222	. . . .39(108)=4,143.20÷100=
		(45)	164	.0077	. . . 41.43 miles
		(48)	347	.0005	
		(49)	275	.0054	
		(51)	89	.0586	
		(53)	62	.0560	
		(56)	129	.0067	
		(57)	120	.0005	
		(58)	199	.0003	
		(59)	58	.0077	
		(61)	10	.6368	
		(62)	28	.0069	
		(64)	31	.0408	
		(70)	37	.0330	
		(72)	148	.0054	
		(76)	120	.0010	
		(83)	108	.0039	
				1.0000	
Newaygo	(62)	(7)	471	.0068	.68(471)+.48(111)+.96(109)+.68
		(10)	111	.0048	. . . (42)+.38(319)+1.06(248)+
		(28)	109	.0096	. . . 4.25(88)+.39(402)+.29(62)+
		(43)	42	.0068	. . . .58(39)+1.16(28)+87.16
		(48)	319	.0038	. . . (12)+1.93(53)=2,642.93÷
		(49)	248	.0106	. . . 100=26.43 miles
		(51)	88	.0425	
		(52)	402	.0039	
		(53)	62	.0029	
		(54)	39	.0058	
		(61)	28	.0116	
		(62)	12	.8716	
		(67)	53	.0193	
				1.0000	
Oakland	(63)	(1)	179	.0166	1.66(179)+.30(405)+1.01(207)+
		(2)	405	.0030	. . . 1.27(213)+.69(109)+.31
		(4)	207	.0101	. . . (516)+.01(80)+1.20(224)+
		(5)	213	.0127	. . . .03(185)+.10(122)+.06
		(6)	109	.0069	. . . (113)+.58(243)+1.58(247)+
		(7)	516	.0031	. . . .21(344)+1.45(127)+.57
		(9)	80	.0001	. . . (175)+.13(428)+.03(479)+
		(10)	224	.0120	. . . .05(86)+.33(237)+1.24
		(11)	185	.0003	. . . (37)+1.68(127)+.05(591)+
		(12)	122	.0010	. . . .28(220)+.55(108)+.25
		(13)	113	.0006	. . . (545)+1.96(99)+3.13
		(15)	243	.0058	. . . (146)+.07(524)+.05(122)+
		(16)	247	.0158	. . . .32(84)+.13(200)+.71
		(17)	344	.0021	. . . (586)+.11(185)+.20(32)+
		(18)	127	.0145	. . . 1.07(247)+2.05(41)+.12
		(20)	175	.0057	. . . (364)+.52(292)+10.22

Oakland (con't)	(21)	428	.0013	. . . (28)+.43(218)+.09(217)+
	(22)	479	.0003	. . . .07(163)+.64(95)+.86
	(23)	86	.0005	. . . (174)+.50(54)+.04(125)+
	(24)	237	.0033	. . . 1.49(196)+.11(173)+43.63
	(25)	37	.0124	. . . (18)+.03(199)+.68(136)+
	(26)	127	.0168	. . . .65(168)+1.03(171)+.40
	(27)	591	.0005	. . . (202)+.26(156)+.75(231)+
	(28)	220	.0028	. . . 2.33(161)+.32(82)+.09
	(30)	108	.0055	. . . (375)+6.07(59)+.03(65)+
	(31)	545	.0025	. . . .62(50)+2.38(30)+.22
	(32)	99	.0196	. . . (173)=8,110.51÷100=
	(35)	146	.0313	. . . 81.10 miles
	(36)	524	.0007	
	(37)	122	.0005	
	(38)	84	.0032	
	(40)	200	.0013	
	(42)	586	.0071	
	(43)	185	.0011	
	(44)	32	.0020	
	(45)	247	.0107	
	(47)	41	.0205	
	(48)	364	.0012	
	(49)	292	.0052	
	(50)	28	.1022	
	(51)	218	.0043	
	(53)	217	.0009	
	(54)	163	.0007	
	(56)	95	.0064	
	(57)	174	.0086	
	(58)	54	.0050	
	(59)	125	.0004	
	(60)	196	.0149	
	(61)	173	.0011	
	(63)	18	.4363	
	(64)	199	.0003	
	(65)	136	.0068	
	(67)	168	.0065	
	(68)	171	.0103	
	(69)	202	.0040	
	(70)	156	.0026	
	(71)	231	.0075	
	(72)	161	.0233	
	(74)	82	.0032	
	(75)	375	.0009	
	(77)	59	.0607	
	(79)	65	.0003	
	(81)	50	.0062	
	(82)	30	.0238	
	(83)	173	.0022	
			1.0000	

Oceana	(64)	(10)	97	.0145	1.45(97)+7.26(63)+4.36(37)+
		(51)	63	.0726	. . . 85.96(13)+.97(218)=
		(53)	37	.0436	. . . 2,088.29÷100=20.99 miles
		(64)	13	.8596	
		(82)	218	.0097	
				1.0000	
Ogemaw	(65)	(5)	85	.0722	7.22(85)+1.81(30)+1.93(42)+
		(6)	30	.0181	. . . .36(162)+1.93(116)+
		(35)	42	.0193	. . . 1.68(175)+18.52(136)+
		(49)	162	.0036	. . . 65.11(20)+1.44(31)=
		(51)	116	.0193	. . . 5,190.82÷100=51.91 miles
		(61)	175	.0168	
		(63)	136	.1852	
		(65)	20	.6511	
		(72)	31	.0144	
				1.0000	
Ontonagon	(66)	(7)	63	.0302	3.02(63)+4.74(65)+1.08(60)+
		(27)	65	.0474	. . . 91.16(16)=2,021.72÷
		(31)	60	.0108	. . . 100=20.22 miles
		(66)	16	.9116	
				1.0000	
Osceloa	(67)	(7)	422	.1334	13.34(422)+43.33(46)+29.99(10)+
		(18)	46	.4333	. . . 13.34(32)=8,349.44÷
		(67)	10	.2999	. . . 100=83.49 miles
		(83)	32	.1334	
				1.0000	
Oscoda	(68)	(16)	86	.1887	18.87(86)+4.71(73)+10.38(35)+
		(35)	73	.0471	. . . 66.04(10)=2,990.35÷
		(60)	35	.1038	. . . 100=29.90 miles
		(68)	10	.6604	
				1.0000	
Otsego	(69)	(5)	29	.0065	.65(29)+13.07(50)+19.61(43)+
		(16)	50	.1307	. . . 66.67(12)=2,315.62÷
		(40)	43	.1961	. . . 100=23.16 miles
		(69)	12	.6667	
				1.0000	
Ottawa	(70)	(2)	412	.0009	.09(412)+9.89(26)+.14(183)+
		(3)	26	.0989	. . . .43(523)+.55(58)+.05
		(5)	183	.0014	. . . (155)+1.00(154)+.72
		(7)	523	.0043	. . . (214)+1.12(257)+.48
		(8)	58	.0055	. . . (132)+.60(219)+.33(167)+
		(9)	155	.0005	. . . .29(218)+.33(170)+1.03
		(10)	154	.0100	. . . (593)+1.03(151)+.64
		(15)	214	.0072	. . . (143)+.31(123)+.07(371)+
		(16)	257	.0112	. . . 2.69(121)+1.43(94)+.14
		(18)	132	.0048	. . . (90)+.02(60)+2.36(37)+

Ottawa (con't)	(24)	219	.0060	. . . 8.60(60)+3.79(63)+2.00
	(28)	167	.0033	. . . (104)+59.44(11)+.43
	(35)	218	.0029	. . . (132)=4,705.83÷100=
	(40)	170	.0033	. . . 47.06 miles
	(42)	593	.0103	
	(44)	151	.0103	
	(46)	143	.0064	
	(47)	123	.0031	
	(48)	371	.0007	
	(51)	121	.0269	
	(53)	94	.0143	
	(54)	90	.0014	
	(59)	60	.0002	
	(61)	37	.0236	
	(62)	60	.0860	
	(64)	63	.0379	
	(67)	104	.0200	
	(70)	11	.5944	
	(83)	132	.0043	
			1.0000	
Presque Isle (71)	(16)	45	.0235	2.35(45)+97.65(13)=1,375.20÷
	(71)	13	.9765	. . . 100=13.75 miles
			1.0000	
Roscommon (72)	(4)	114	.0009	.09(114)+.37(87)+.66(284)+
	(10)	87	.0037	. . . .19(50)+98.69(10)=
	(21)	284	.0066	. . . 1,226.29÷100=12.26 miles
	(40)	50	.0019	
	(72)	10	.9869	
			1.0000	
Saginaw (73)	(1)	112	.0139	1.39(112)+.38(338)+.09(158)+
	(2)	338	.0038	. . . .21(139)+.33(144)+7.31
	(3)	158	.0009	. . . (42)+10.98(14)+.77
	(4)	139	.0021	. . . (155)+1.83(180)+.50
	(5)	144	.0033	. . . (277)+8.11(58)+.24(108)+
	(6)	42	.0731	. . . .59(170)+11.48(58)+.06
	(9)	14	.1098	. . . (524)+3.28(150)+.06(41)+
	(10)	155	.0077	. . . .44(478)+.95(66)+5.44
	(16)	180	.0183	. . . (79)+.30(457)+.62(52)+
	(17)	277	.0050	. . . .21(131)+2.87(178)+.59
	(18)	58	.0811	. . . (225)+.47(148)+.30(380)+
	(20)	108	.0024	. . . 3.14(26)+.77(104)+3.37
	(24)	170	.0059	. . . (84)+.15(129)+2.34(69)+
	(26)	58	.1148	. . . .95(98)+.27(104)+1.98
	(27)	524	.0006	. . . (135)+1.07(164)+14.21
	(28)	150	.0328	. . . (93)+5.47(12)+.18(86)+
	(29)	41	.0006	. . . .41(308)+.62(99)+.21
	(31)	478	.0044	. . . (30)+5.06(104)=8,250.60÷
	(32)	66	.0095	. . . 100=82.51 miles
	(35)	70	.0544	

Saginaw (con't)		(36)	457	.0030	
		(37)	52	.0062	
		(40)	131	.0021	
		(45)	178	.0287	
		(49)	225	.0059	
		(51)	148	.0047	
		(52)	380	.0030	
		(56)	26	.0314	
		(57)	104	.0077	
		(59)	84	.0337	
		(60)	129	.0015	
		(65)	69	.0234	
		(67)	98	.0095	
		(68)	104	.0027	
		(69)	135	.0198	
		(71)	164	.0107	
		(72)	93	.1421	
		(73)	12	.0547	
		(74)	86	.0018	
		(75)	308	.0041	
		(77)	99	.0062	
		(79)	30	.0021	
		(83)	104	.0506	
				1.0000	
Sanilac	(74)	(1)	191	.0100	1.00(191)+.80(91)+1.40(235)+
		(9)	91	.0080	. . . 13.83(157)+4.21(213)+
		(28)	235	.0140	. . . .40(61)+8.82(207)+.60
		(35)	157	.1383	. . . (147)+8.02(242)+56.11
		(40)	213	.0421	. . . (9)+4.21(25)+.60(63)=
		(50)	61	.0040	. . . 8,188.06÷100=81.88 miles
		(60)	207	.0882	
		(65)	147	.0060	
		(71)	242	.0802	
		(74)	9	.5611	
		(77)	25	.0421	
		(79)	63	.0060	
				1.0000	
Schoolcraft	(75)	(21)	55	.0209	2.09(55)+3.14(70)+2.62(89)+
		(48)	70	.0314	. . . 92.15(10)=1,489.43÷
		(52)	89	.0262	. . . 100=14.89 miles
		(75)	10	.9215	
				1.0000	
Shiawassee	(76)	(5)	172	.0019	.19(172)+3.64(183)+1.12(218)+
		(10)	183	.0364	. . . 1.21(314)+1.68(86)+2.05
		(16)	218	.0112	. . . (26)+2.33(89)+7.46(179)+
		(17)	314	.0121	. . . .09(117)+9.32(159)+1.40
		(18)	86	.0168	. . . (81)+.74(556)+.28(262)+
		(25)	26	.0205	. . . .28(177)+.37(416)+1.77
		(26)	89	.0233	. . . (111)+.56(56)+.37(108)+

Shiawassee (con't)		(28)	179	.0746	. . . 5.59(69)+.28(167)+3.92
		(35)	117	.0009	. . . (107)+1.86(142)+8.02
		(40)	159	.0932	. . . (171)+30.75(124)+12.58
		(41)	81	.0140	. . . (14)+2.14(133)=
		(42)	556	.0074	. . . 12,386.46÷100=123.86 miles
		(49)	262	.0028	
		(51)	177	.0028	
		(52)	416	.0037	
		(54)	111	.0177	
		(56)	56	.0056	
		(58)	108	.0037	
		(59)	69	.0559	
		(60)	167	.0028	
		(65)	107	.0392	
		(68)	142	.0186	
		(69)	171	.0802	
		(72)	124	.3075	
		(76)	14	.1258	
		(83)	133	.0214	
				1.0000	
St. Clair	(77)	(1)	206	.0011	
		(16)	274	.0074	
		(17)	371	.0005	
		(24)	264	.0018	
		(28)	248	.0149	.11(206)+.74(274)+.05(371)+
		(32)	80	.0036	. . . .18(264)+1.49(248)+
		(35)	173	.0071	. . . .36(80)+.71(173)+.36
		(44)	47	.0036	. . . (47)+.53(390)+7.52(37)+
		(48)	390	.0053	. . . .25(92)+.71(188)+2.06
		(50)	37	.0752	. . . (25)+.04(402)+83.90(11)+
		(58)	92	.0025	. . . .09(60)=2,466.86÷100=
		(72)	188	.0071	. . . 24.67 miles
		(74)	25	.0206	
		(75)	402	.0004	
		(77)	11	.8390	
		(82)	60	.0009	
				1.0000	
St. Joseph	(78)	(8)	73	.0038	.38(73)+.04(236)+.26(71)+1.10
		(10)	236	.0004	. . . (26)+5.86(48)+.30(305)+
		(11)	71	.0026	. . . .08(400)+1.49(233)+.72
		(12)	26	.0110	. . . (520)+1.32(167)+.51
		(14)	48	.0586	. . . (419)+.21(323)+82.94(12)+
		(16)	305	.0030	. . . 4.20(81)+.59(191)=
		(17)	400	.0008	. . . 3,160.72÷100=31.62 miles
		(28)	233	.0149	
		(36)	520	.0072	
		(43)	167	.0132	
		(48)	419	.0051	
		(71)	323	.0021	
		(78)	12	.8294	

St. Joseph (con't)		(80)	81	.0420	
		(83)	191	.0059	
				1.0000	
Tuscola	(79)	(7)	469	.0041	.41(469)+15.46(32)+2.06(181)+
		(9)	32	.1546	. . . 8.25(200)+2.89(85)+4.12
		(10)	181	.0206	. . . (85)+13.61(37)+14.23(99)+
		(16)	200	.0825	. . . .41(175)+7.01(124)+31.55
		(18)	85	.0289	. . . (15)=6,632.30÷100=
		(26)	85	.0412	. . . 66.32 miles
		(32)	37	.1361	
		(35)	99	.1423	
		(51)	175	.0041	
		(68)	124	.0701	
		(79)	15	.3155	
				1.0000	
Van Buren	(80)	(3)	39	.0135	1.35(39)+3.41(309)+.39(184)+.19
		(4)	309	.0341	. . . (25)+.32(39)+3.86(287)+
		(10)	184	.0039	. . . .19(115)+.06(248)+.90
		(11)	25	.0019	. . . (612)+.51(130)+.51(151)+
		(14)	39	.0032	. . . .13(121)+.19(174)+.13(33)+
		(16)	287	.0386	. . . 85.80(12)+1.48(177)+.58
		(30)	115	.0019	. . . (162)=4,472.59÷100=
		(35)	248	.0006	. . . 44.73 miles
		(42)	612	.0090	
		(43)	130	.0051	
		(51)	151	.0051	
		(54)	121	.0013	
		(57)	174	.0019	
		(70)	33	.0013	
		(80)	12	.8580	
		(82)	177	.0148	
		(83)	162	.0058	
				1.0000	
Washtenaw	(81)	(4)	223	.0004	.04(223)+1.79(230)+.29(97)+
		(5)	230	.0179	. . . .47(240)+.04(78)+.84
		(9)	97	.0029	. . . (260)+.44(263)+1.17
		(10)	240	.0047	. . . (361)+.58(144)+.18(444)+
		(13)	78	.0004	. . . 1.86(236)+.04(65)+1.72
		(15)	260	.0084	. . . (37)+.36(216)+2.19(200)+
		(16)	263	.0044	. . . .11(263)+1.35(42)+23.00
		(17)	361	.0117	. . . (31)+.36(380)+1.68(309)+
		(18)	144	.0058	. . . 1.21(58)+2.01(234)+.04
		(21)	444	.0018	. . . (226)+3.32(41)+.44(212)+
		(24)	253	.0066	. . . .07(168)+.47(50)+1.53
		(25)	56	.0015	. . . (187)+.07(218)+.51(247)+
		(26)	144	.0044	. . . .40(177)+44.51(19)+5.66
		(28)	236	.0186	. . . (42)=6,457.82÷100=
		(33)	65	.0004	. . . 64.58 miles
		(33)	37	.0172	

Washtenaw (con't)		(40)	216	.0036	
		(43)	200	.0219	
		(45)	263	.0011	
		(46)	42	.0135	
		(47)	31	.2300	
		(48)	380	.0036	
		(49)	309	.0168	
		(50)	58	.0121	
		(51)	234	.0201	
		(53)	226	.0004	
		(58)	41	.0332	
		(60)	212	.0044	
		(61)	168	.0007	
		(62)	50	.0047	
		(68)	187	.0153	
		(69)	218	.0007	
		(71)	247	.0051	
		(72)	177	.0040	
		(81)	19	.4451	
		(82)	42	.0566	
				1.0000	
Wayne	(82)	(1)	207	.0149	
		(2)	432	.0022	
		(4)	234	.0025	
		(5)	241	.0079	
		(6)	136	.0028	
		(7)	543	.0004	1.49(207)+.22(432)+.25(234)+
		(8)	133	.0092	. . . .79(241)+.28(136)+.04
		(9)	107	.0001	. . . (543)+.92(133)+.01(107)+
		(10)	251	.0049	. . . .49(251)+.04(187)+.13
		(11)	187	.0004	. . . (177)+.95(271)+3.69(274)+
		(14)	177	.0013	. . . .93(372)+1.09(155)+.29
		(15)	271	.0095	. . . (203)+.10(455)+.42(264)+
		(16)	274	.0369	. . . .28(64)+1.05(155)+.05
		(17)	372	.0093	. . . (619)+.65(247)+.52(98)+
		(18)	155	.0109	. . . .11(572)+1.78(111)+.64
		(20)	203	.0029	. . . (174)+.04(552)+1.72(77)+
		(21)	455	.0010	. . . .47(227)+.02(153)+.21
		(24)	264	.0042	. . . (614)+.21(212)+.74(59)+
		(25)	64	.0028	. . . .31(274)+.41(71)+4.39
		(26)	155	.0105	. . . (55)+.15(391)+.15(320)+
		(27)	619	.0005	. . . 10.57(24)+1.39(245)+.46
		(28)	247	.0065	. . . (245)+.28(191)+.15(201)+
		(30)	98	.0052	. . . 2.67(39)+1.38(223)+.14
		(31)	572	.0011	. . . (192)+.87(198)+6.17(30)+
		(32)	111	.0178	. . . .01(218)+.46(164)+.32
		(35)	174	.0064	. . . (596)+.07(195)+.20(198)+
		(36)	552	.0004	. . . .81(229)+.48(175)+.54
		(38)	77	.0172	. . . (258)+1.37(188)+.51(83)+
		(40)	227	.0047	. . . .23(402)+.19(86)+9.43
		(41)	153	.0002	. . . (60)+.02(92)+3.43(42)+

Wayne (con't)		(42)	614	.0021	. . . 31.69(15)+.08(201)=
		(43)	212	.0021	. . . 8,675.26÷100=86.75 miles
		(44)	59	.0074	
		(45)	274	.0031	
		(46)	71	.0041	
		(47)	55	.0439	
		(48)	391	.0015	
		(49)	320	.0015	
		(50)	24	.1057	
		(51)	245	.0139	
		(53)	245	.0046	
		(54)	191	.0028	
		(57)	201	.0015	
		(58)	39	.0267	
		(60)	223	.0138	
		(61)	192	.0014	
		(62)	198	.0087	
		(63)	30	.0617	
		(64)	218	.0001	
		(65)	164	.0046	
		(66)	596	.0032	
		(67)	195	.0007	
		(68)	198	.0020	
		(69)	229	.0081	
		(70)	175	.0048	
		(71)	258	.0054	
		(72)	188	.0137	
		(74)	83	.0051	
		(75)	402	.0028	
		(76)	86	.0019	
		(77)	60	.0943	
		(79)	92	.0002	
		(81)	42	.0343	
		(82)	15	.3169	
		(83)	201	.0008	
				1.0000	
Wexford	(83)	(5)	53	.0077	.77(53)+.39(393)+.58(100)+
		(7)	393	.0039	. . . 6.18(56)+.39(127)+.97
		(9)	100	.0058	. . . (51)+.96(47)+.19(79)+
		(10)	56	.0618	. . . 1.93(50)+.39(74)+.96
		(16)	127	.0039	. . . (43)+3.09(13)+.77(225)+
		(28)	51	.0097	. . . 2.70(87)+2.90(81)+.77
		(43)	47	.0096	. . . (32)+76.06(10)=2,392.39÷
		(45)	79	.0019	. . . 100=23.92 miles
		(51)	50	.0193	
		(53)	74	.0039	
		(54)	43	.0096	
		(57)	13	.0309	
		(58)	225	.0077	
		(59)	87	.0270	
		(62)	81	.0290	

Wexford (con't)	(67)	32	.0077
	(83)	10	.7606
			1.0000

APPENDIX E

CORRELATION MATRICES

Correlation MATRIX--State of Michigan Equation

Modified User Characteristics Model

	TYPE 1-1	TYPE 2-1	TYPE 3-1	TYPE 4-1	HORPOS	RESIDS	COMMAR
HORPOW	-0.56653	-.03989	+.59540	+.30864	1.0000		
RESIDS	.20309	-.07853	-.16954	-.06105	-.17467	1.0000	
COMMAR	-.35826	.12158	.35247	.14696	.38786	-.19375	1.0000
YATCLUB	-.23071	.33604	.11767	.02836	.11348	-.08894	-.02544
BOAT LEN	-.54068	.23061	.51077	.17346	.62535	-.23217	.40765
INCOME	-.20624	.09617	.13749	.14816	.30006	-.16462	.16365
INCOMESQ	-.21252	.09789	.13937	.14795	.29623	-.17906	.16322
INCOMAGE	.18420	.06573	.13048	.13212	.25489	-.21476	.15285

Correlation MATRIX--State of Michigan Equation,

Aggregate Participation Model

LINCOME (X_4)	-.44219	-.44783	1.00000						
HINCOME (X_5)	.48119	.48036	-.86423						
POPDEN (X_6)	.30620	.98609	-.44927						
DGLAKE (X_7)	.41220	-.09286							
PMRACES (X_8)	.21042	.62207			.62922				
SDISTAN (X_9)	.60416	.41545	-.66290	.79873					
PCCAMPS (X_{10})	-.46861								
SUWATER (X_{11})								.47629	
HMCOURT (X_{13})		.88512			.87285	.58638			
ARSERV (X_{14})		.99573			.98536	.62326			
LABORER (X_{23})			.58209				-.45129		
SERWORK (X_{26})							-.51371		
WARCRAFT (X_{28})	-.52379								.58914
	TRVELD	DINCOME	LINCOME	HINCOME	POPDEN	PMRACES	SDISTAN	PCCAMPS	SUWATER

Correlation MATRIX--State of Michigan Equation,

Aggregate Participation Model

	HMCOURT	PROFESS	MANADM	SALWOK	CLERIC	CRAFTS	OPERA	FARMMAN
ARSERV (X_{14})	.90152							
SALWOK (X_{17})			.42325					
CLERIC (X_{18})		.53646						
CRAFTS (X_{19})		-.47061						
OPERA (X_{20})		-.54502	-.50565	-.44321				
FARMMAN (X_{24})				-.42148	-.60696			
FARMLAB (X_{25})				-.40652	-.46645			.74881
SERWORK (X_{26})						-.42806	-.65053	
WACRAFT (X_{28})			.46565					
TREQUIP (X_{29})					-.45488			

APPENDIX F

STATISTICS FROM INITIAL REGRESSION EQUATIONS

STATISTICS FROM INITIAL REGRESSION EQUATION, ALL VARIABLES, REGION 1--DETROIT

Variable*		Regression Coefficients[1]	Standard Errors of Regression Coefficients	Level of Significance[2]	Mean
Intercept	(a)	34.600031	20.226824	.083	
Type 1-1	(X_1)	13.148446	7.779197	.087	.79092
Type 2-1	(X_2)	13.805253	10.325022	.178	.02554
Type 3-1	(X_3)	9.924474	8.266970	.228	.12015
Type 4-1	(X_4)	11.940791	8.737971	.168	.04825
HOR POW	(X_5)	0.019479	0.023015	.402	50.97729
RESIDS 1-1	(X_6)	-12.054335	4.137616	.004	.40019
WATFRNT 2-1	(X_7)	3.091807	4.387019	.488	.17502
COMMAR 3-1	(X_8)	- 0.090843	5.144378	.934	.08420
SUMCOTS 4-1	(X_9)	- 0.597129	4.212349	.858	.24125
PUBMAR 5-1	(X_{10})	- 5.869255	9.874933	.560	.01041
YATCLUB 6-1	(X_{11})	6.082023	7.280685	.409	.02554
BOATRANS	(X_{12})	1.365402	2.410380	.578	.54305
NOBOOWN	(X_{13})	2.943962	1.090399	.007	1.59603
BOAT LEN	(X_{14})	0.860122	0.319399	.007	15.92999
AGE	(X_{16})	- 1.122992	0.635170	.074	48.27247
AGESQUR	(X_{17})	0.006781	0.006530	.300	2460.54115
FAMSIZE	(X_{18})	1.459226	0.596642	.014	3.60833
OCCU 1-1	(X_{19})	- 3.554467	6.777269	.607	.20341
OCCU 2-1	(X_{20})	- 4.036475	12.273565	.739	.00757
OCCU 3-1	(X_{21})	1.132263	6.753476	.843	.17502
OCCU 4-1	(X_{22})	18.521408	11.806793	.113	.00851
OCCU 5-1	(X_{23})	5.158391	7.415392	.494	.06055
OCCU 6-1	(X_{24})	1.805007	6.753476	.775	.26206
OCCU 7-1	(X_{25})	- 0.393649	7.198675	.911	.07569
OCCU 9-1	(X_{27})	6.692298	7.408217	.370	.05676
OCCU 11-1	(X_{29})	-12.975475	16.243211	.430	.00378
OCCU 12-1	(X_{30})	-12.198856	22.887508	.601	.00189

REGION 1--DETROIT.--Continued.

Variable*		Regression Coefficients[1]	Standard Errors of Regression Coefficients	Level of Significance[2]	Mean
OCCU 13-1	(X_{31})	6.764665	18.942935	.720	.00284
OCCU 14-1	(X_{32})	4.771915	7.631836	.539	.09839
OCCU 17-1	(X_{35})	10.018295	8.859254	.257	.02176
INCOME	(X_{36})	- 3.048400	2.401604	.202	5.72116
INCOMESQ	(X_{37})	0.152457	0.117574	.192	40.89977
INCOMAGE	(X_{38})	0.021769	0.032249	.507	271.83793
EDUCATN	(X_{39})	0.219280	0.310965	.488	12.55251
	R = .3672[3]		R^2 = .1348[4]	S_{yx} = 29.6868[5]	

[1]Values which appear in this column for X_5, X_{13}, X_{14}, X_{16}, X_{17}, X_{18}, X_{36}, X_{37}, X_{38}, and X_{39} are for continuous variables, and show the estimated effects of such variables on the slope of the regression line. Values for (X_1-X_4), (X_6-X_{11}), X_{12}, and (X_{19}-X_{35}) assume equal slope coefficients across all categorical classes. These latter values give the estimated net change in intercept attributable to zero-one variables in the various categorical classes.

[2]For 1,022 degrees of freedom.

[3]Multiple correlation coefficient.

[4]Coefficient of multiple determination.

[5]Standard Error of Estimate.

*Variables X_{28}, X_{33}, and X_{34} had a value = 0 for all observations. The mean value for the dependent variable was 29.49480.

STATISTICS FROM INITIAL REGRESSION EQUATION, ALL VARIABLES, REGION 6--Lansing

Variable*		Regression Coefficients[1]	Standard Errors of Regression Coefficients	Level of Significance[2]	Mean
Intercept	(a)	31.450982	56.043273		
Type 1-1	(X_1)	18.691171	12.983473	.151	.92366
Type 2-1	(X_2)	61.742538	33.332711	.065	.00763
Type 3-1	(X_3)	20.869342	23.400141	.373	.02672
Type 4-1	(X_4)	-11.676807	25.707193	.650	.01145
HOR POW	(X_5)	0.072400	0.076195	.343	29.00763
RESIDS 1-1	(X_6)	- 8.642484	15.076187	.567	.38550
WATFRNT 2-1	(X_7)	-20.930768	18.141682	.250	.04580
COMMAR 3-1	(X_8)	1.497064	23.855702	.950	.02290
SUMCOTS 4-1	(X_9)	8.689051	15.273587	.570	.51145
PUBMAR 5-1	(X_{10})	-28.432827	37.888381	.454	.00382
BOATRANS	(X_{12})	5.584693	5.137223	.278	.55344
NOBOOWN	(X_{13})	12.393486	2.723809	<.0005	1.71374
BOAT LEN	(X_{14})	0.376937	0.888597	.672	14.15267
AGE	(X_{16})	- 0.118903	1.591062	.940	49.28626
AGESQUR	(X_{17})	0.001969	0.016674	.906	2554.42366
FAMSIZE	(X_{18})	1.980579	1.702961	.246	3.22137
OCCU 1-1	(X_{19})	-40.371435	22.287543	.071	.14504
OCCU 2-1	(X_{20})	-53.194946	24.088158	.028	.03435
OCCU 3-1	(X_{21})	-30.881080	22.365824	.169	.14504
OCCU 4-1	(X_{22})	-54.918564	27.122778	.044	.01527
OCCU 5-1	(X_{23})	-35.020995	23.296149	.134	.06489
OCCU 6-1	(X_{24})	-39.454217	21.683001	.070	.32061
OCCU 7-1	(X_{25})	-36.193698	23.352069	.123	.06107
OCCU 9-1	(X_{27})	-44.374399	23.427739	.059	.05344
OCCU 10-1	(X_{28})	-55.641434	42.035986	.187	.00382

REGION 6--LANSING.--Continued.

Variable*		Regression Coefficients[1]	Standard Errors of Regression Coefficients	Level of Significance[2]	Mean
OCCU 14-1	(X_{32})	-47.870225	23.553202	.043	.09924
OCCU 17-1	(X_{35})	-48.738236	23.646294	.040	.04580
INCOME	(X_{36})	- 2.935518	8.127652	.718	5.23057
INCOMESQ	(X_{37})	0.450281	0.347855	.197	33.54481
INCOMAGE	(X_{38})	- 0.080475	0.105276	.445	253.26649
EDUCATN	(X_{39})	0.835713	0.705182	.237	11.92366

$R = .5354$[3] $R^2 = .2867$[4] $S_{yx} = 34.4302$[5]

[1] Values which appear in this column for X_5, X_{13}, X_{14}, X_{16}, X_{17}, X_{18}, X_{36}, X_{37}, X_{38}, and X_{39} are for continuous variables, and show the estimated effects of such variables on the slope of the regression line. Values for (X_1-X_4), (X_6-X_{11}), X_{12}, and (X_{19}-X_{35}) assume equal slope coefficients across all categorical classes. These latter values give the estimated net change in intercept attributable to zero-one variables in the various categorical classes.

[2] With 230 degrees of freedom.

[3] Multiple correlation coefficient.

[4] Coefficient of multiple determination.

[5] Standard Error of Estimate.

*Variables X_{11}, X_{26}, X_{29}, X_{30}, X_{31}, X_{33}, and X_{34} had a value = 0 for all observations. The mean value of the dependent variable was 36.64122.

STATISTICS FROM INITIAL REGRESSION EQUATION, ALL VARIABLES, REGION 7C--SAGINAW BAY

Variable*		Regression Coefficients[1]	Standard Errors of Regression Coefficients	Level of Significance[2]	Mean
Intercept	(a)	91.049955	61.066401		
Type 1-1	(X_1)	- 1.944470	15.743281	.902	0.94167
Type 3-1	(X_3)	-23.639548	32.846380	.474	0.00833
HOR POW	(X_5)	0.097721	0.208674	.641	16.70833
RESIDS 1-1	(X_6)	- 7.214900	12.960727	.579	0.33333
WATFRNT 2-1	(X_7)	- 5.825381	13.295381	.662	0.38333
COMMAR 3-1	(X_8)	1.421553	21.149680	.947	0.02500
SUMCOTS 4-1	(X_9)	- 3.135821	14.288054	.827	0.17500
BOATRANS	(X_{12})	-12.439959	7.950929	.121	0.42500
NOBOOWN	(X_{13})	- 0.438066	2.898784	.880	1.82500
BOAT LEN	(X_{14})	- 1.163342	0.835874	.167	14.52500
AGE	(X_{16})	- 1.222332	1.976785	.538	54.15000
AGESQUR	(X_{17})	0.008416	0.017946	.640	3090.71667
FAMSIZE	(X_{18})	4.322712	2.671201	.109	2.82500
OCCU 1-1	(X_{19})	-11.110714	22.134956	.617	0.11667
OCCU 2-1	(X_{20})	- 2.299274	27.673204	.934	0.01667
OCCU 3-1	(X_{21})	- 2.065611	20.968428	.922	0.13333
OCCU 4-1	(X_{22})	-16.533922	34.202237	.630	0.00833
OCCU 5-1	(X_{23})	-24.631585	22.213317	.270	0.06667
OCCU 6-1	(X_{24})	- 3.646774	20.705942	.861	0.13333
OCCU 7-1	(X_{25})	- 7.230253	23.100893	.755	0.05000
OCCU 9-1	(X_{27})	22.710413	25.521574	.376	0.03333
OCCU 11-1	(X_{29})	-29.627590	37.684580	.434	0.00833
OCCU 13-1	(X_{31})	-25.662060	35.103066	.467	0.00833
OCCU 14-1	(X_{32})	-14.862429	18.986305	.436	0.35000

REGION 7C--SAGINAW BAY.--Continued.

Variable*		Regression Coefficients[1]	Standard Errors of Regression Coefficients	Level of Significance[2]	Mean
OCCU 17-1	(X_{35})	-14.607802	23.078728	.528	0.05000
INCOME	(X_{36})	- 6.880577	10.129767	.499	3.34900
INCOMESQ	(X_{37})	0.255613	0.467086	.586	16.28732
INCOMAGE	(X_{38})	0.102000	0.139233	.466	170.49383
EDUCATN	(X_{39})	0.119981	0.747639	.873	11.10000

$R = .5089$[3] $R^2 = .2590$[4] $S_{yx} = 28.1917$[5]

[1]Values in this column for X_5, X_{13}, X_{14}, X_{16}, X_{17}, X_{18}, X_{36}, X_{37}, X_{38}, and X_{39} are for continuous variables, and give the estimated effects of such variables on the slope of the regression line. Values for X_1, X_3, (X_6-X_9), X_{12}, and (X_{19}-X_{35}) assume equal slope coefficients across all categorical classes. These latter values give the estimated net change in intercept attributable to specific zero-one variables in the various categorical classes.

[2]For 90 degrees of freedom.

[3]Multiple correlation coefficient.

[4]Coefficient of multiple determination.

[5]Standard Error of Estimate.

*Variables X_2, X_4, X_{10}, X_{11}, X_{26}, X_{28}, X_{30}, X_{33}, and X_{34} had a value = 0 for all observations. The mean value for the dependent variable was <u>24.52500</u>.

STATISTICS FROM INITIAL REGRESSION EQUATION, ALL VARIABLES, REGION 10--TRAVERSE BAY

Variable*		Regression Coefficients[1]	Standard Errors of Regression Coefficients	Level of Significance[2]	Mean
Intercept	(a)	-13.231337	42.750716	.757	
Type 1-1	(X_1)	- 2.018604	14.678752	.891	0.85938
Type 2-1	(X_2)	- 1.055200	19.157907	.956	0.02344
Type 3-1	(X_3)	20.872660	18.829205	.269	0.04297
Type 4-1	(X_4)	3.470293	17.413640	.842	0.05469
HOR POW	(X_5)	0.054395	0.066881	.417	32.28906
RESIDS 1-1	(X_6)	- 2.761351	9.269979	.766	0.32422
WATFRNT 2-1	(X_7)	13.270491	8.865665	.136	0.27734
COMMAR 3-1	(X_8)	11.326654	11.841585	.340	0.08594
SUMCOTS 4-1	(X_9)	7.023254	8.933350	.433	0.21875
PUBMAR 5-1	(X_{10})	-17.607739	17.189359	.307	0.02344
YATCLUB 6-1	(X_{11})	-58.528051	34.380010	.090	0.00391
BOATRANS	(X_{12})	0.152259	5.472258	.978	0.47656
NOBOOWN	(X_{13})	4.701949	1.881604	.013	1.85156
BOAT LEN	(X_{14})	0.713395	0.757170	.347	15.11328
AGE	(X_{16})	2.070163	1.238067	.096	53.74219
AGESQUR	(X_{17})	- 0.027384	0.011629	.019	3052.99219
FAMSIZE	(X_{18})	0.975122	1.573260	.536	3.04297
OCCU 1-1	(X_{19})	4.026746	11.841813	.734	0.14453
OCCU 2-1	(X_{20})	10.724516	19.636332	.586	0.01563
OCCU 3-1	(X_{21})	3.115157	11.366731	.784	0.21875
OCCU 4-1	(X_{22})	-11.575063	17.391050	.506	0.01953
OCCU 5-1	(X_{23})	5.854061	13.428997	.663	0.05469
OCCU 6-1	(X_{24})	4.095677	11.770728	.728	0.16797
OCCU 7-1	(X_{25})	4.873149	13.284149	.714	0.06641
OCCU 9-1	(X_{27})	- 5.313315	16.363782	.746	0.02344

REGION 10--TRAVERSE BAY.--Continued.

Variable*		Regression Coefficients[1]	Standard Errors of Regression Coefficients	Level of Significance[2]	Mean
OCCU 11-1	(X_{29})	- 3.961916	32.989879	.905	0.00391
OCCU 13-1	(X_{31})	-15.391058	32.393021	.635	0.00391
OCCU 14-1	(X_{32})	2.569912	11.158626	.818	0.21484
OCCU 17-1	(X_{35})	- 4.263038	16.456272	.796	0.02344
INCOME	(X_{36})	-15.397757	4.901290	.002	4.44961
INCOMESQ	(X_{37})	0.550976	0.242168	.024	28.40261
INCOMAGE	(X_{38})	0.120588	0.061136	.050	231.85996
EDUCATN	(X_{39})	0.930128	0.569042	.104	12.12891

R = .4903[3] R^2 = .2404[4] S_{yx} = 30.1459[5]

[1]Values in this column for X_5, X_{13}, X_{14}, X_{16}, X_{17}, X_{18}, X_{36}, X_{37}, X_{38}, and X_{39} are for continuous variables, and give the estimated effects of such variables on the slope of the regression line. Values for (X_1-X_4), (X_6-X_{11}), X_{12}, and (X_{19}-X_{35}) assume equal slope coefficients across all categorical classes. These latter values give the estimated net change in intercept attributable to specific zero-one variables in the various categorical classes.

[2]For 222 degrees of freedom.

[3]Multiple correlation coefficient.

[4]Coefficient of multiple determination.

[5]Standard error of estimate.

*Variables X_{26}, X_{28}, X_{30}, X_{33}, and X_{34} had a value = 0 for all observations. The mean value of the dependent variable was 31.84766.

STATISTICS FROM INITIAL REGRESSION EQUATION, ALL VARIABLES,
REGION 12A--MARQUETTE-IRON MOUNTAIN

Variable*		Regression Coefficients[1]	Standard Errors of Regression Coefficients	Level of Significance[2]	Mean
Intercept	(a)	80.679723	74.138372	.279	
Type 1-1	(X_1)	22.014925	14.172334	.124	0.89916
Type 2-1	(X_2)	-17.257420	38.33375	.654	0.00840
Type 3-1	(X_3)	42.176964	41.987903	.318	0.01681
Type 4-1	(X_4)	32.077843	39.659647	.421	0.01681
HOR POW	(X_5)	- 0.171941	0.199191	.390	18.76471
RESIDS 1-1	(X_6)	- 2.328867	14.055417	.869	0.37185
WATFRNT 2-1	(X_7)	2.895586	16.562457	.862	0.11465
COMMAR 3-1	(X_8)	-36.606852	35.404194	.304	0.01681
SUMCOTS 4-1	(X_9)	- 4.313560	14.086739	.760	0.39496
PUBMAR 5-1	(X_{10})	24.445517	32.521654	.454	0.01681
BOATRANS	(X_{12})	4.033884	8.474249	.635	0.57983
NOBOOWN	(X_{13})	12.285726	3.397059	<.0005	1.67227
BOAT LEN	(X_{14})	0.969531	2.273120	.671	13.84874
AGE	(X_{16})	- 3.277394	2.356621	.168	50.84034
AGESQUR	(X_{17})	0.018262	0.022307	.415	2732.06723
FAMSIZE	(X_{18})	1.503884	2.090614	.474	3.42857
OCCU 1-1	(X_{19})	-14.737218	23.953665	.540	0.14286
OCCU 3-1	(X_{21})	- 5.114983	22.383276	.820	0.20168
OCCU 4-1	(X_{22})	- 9.514436	32.914421	.773	0.01681
OCCU 5-1	(X_{23})	-15.872773	25.252662	.531	0.05882
OCCU 6-1	(X_{24})	- 3.487154	23.057552	.880	0.23529
OCCU 7-1	(X_{25})	2.265620	24.243073	.926	0.08403
OCCU 9-1	(X_{27})	3.073139	24.432529	.900	0.07563
OCCU 11-1	(X_{29})	7.593360	41.826172	.856	0.00840
OCCU 13-1	(X_{31})	-31.313564	41.243350	.450	0.00840
OCCU 14-1	(X_{32})	7.328208	22.085005	.741	0.13445

REGION 12A--MARQUETTE-IRON MOUNTAIN.--Continued.

Variable*		Regression Coefficients[1]	Standard Errors of Regression Coefficients	Level of Significance[2]	Mean
OCCU 17-1	(X_{35})	79.386824	40.988167	.056	0.00840
INCOME	(X_{36})	-11.718156	10.832339	.282	4.00647
INCOMESQ	(X_{37})	- 0.237022	0.449756	.600	22.45717
INCOMAGE	(X_{38})	0.271759	0.177241	.129	200.12050
EDUCATN	(X_{39})	0.774585	1.199490	.520	12.07563

R = .5383[3] R^2 = .2897[4] S_{yx} = 33.4280[5]

[1]Values in this column for X_5, X_{13}, X_{14}, X_{16}, X_{17}, X_{18}, X_{36}, X_{37}, X_{38}, and X_{39} are for continuous variables, and show the estimated effects of such variables on the slope of the regression line. Values for (X_1-X_4), (X_6-X_{10}), X_{12}, and (X_{19}-X_{35}) assume equal slope coefficients across all categorical classes. These latter values give the estimated net change in intercept attributable to specific zero-one variables in the various categorical classes.

[2]For 87 degrees of freedom.

[3]Multiple correlation coefficient.

[4]Coefficient of multiple determination.

[5]Standard Error of Estimate.

*Variables X_{11}, X_{20}, X_{26}, X_{28}, X_{30}, X_{33}, X_{34}, had a value = 0 for all observations. The mean value of the dependent variable was 28.9327.

STATISTICS FROM THE INITIAL REGRESSION EQUATION, ALL VARIABLES, THE STATE OF MICHIGAN

Variable*		Regression Coefficients[1]	Standard Errors of Regression Coefficients	Level of Significance[2]	Mean
Intercept	(a)	9.680392	9.372951		
Type 1-1	(X_1)	6.669133	3.015796	.026	0.87124
Type 2-1	(X_2)	10.841906	5.061623	.030	0.01494
Type 3-1	(X_3)	9.014766	3.841148	.018	0.05838
Type 4-1	(X_4)	10.794299	4.017613	.007	0.03236
HOR POW	(X_5)	0.045626	0.012913	.001	34.29418
RESIDS 1-1	(X_6)	- 8.973539	2.089817	<.0005	0.40371
WATFRNT 2-1	(X_7)	3.342072	2.189922	.123	0.17900
COMMAR 3-1	(X_8)	0.609173	2.905245	.816	0.05250
SUMCOTS 4-1	(X_9)	2.888814	2.087495	.163	0.28694
PUBMAR 5-1	(X_{10})	- 0.096124	5.065265	.933	0.00928
YAT CLUB 6-1	(X_{11})	3.723876	4.896971	.453	0.01154
BOATRANS	(X_{12})	3.744756	1.126519	.001	0.54899
NOBOOWN	(X_{13})	3.979111	0.485508	<.0005	1.69314
BOATLEN	(X_{14})	0.500767	0.150776	.001	14.99004
AGE	(X_{16})	- 0.033049	0.287596	.875	50.04594
AGESQUR	(X_{17})	- 0.002633	0.002821	.353	2651.97307
FAMSIZE	(X_{18})	0.949018	0.308601	.002	3.36999
OCCU 1-1	(X_{19})	1.270673	3.532572	.718	0.15479
OCCU 2-1	(X_{20})	- 4.100618	4.755454	.393	0.01675
OCCU 3-1	(X_{21})	0.096012	3.456149	.927	0.17923
OCCU 4-1	(X_{22})	- 0.650402	4.952981	.865	0.01448
OCCU 5-1	(X_{23})	2.242742	3.757836	.558	0.06200
OCCU 6-1	(X_{24})	0.747356	3.404931	.810	0.25979
OCCU 7-1	(X_{25})	- 0.112150	3.684416	.926	0.07355
OCCU 9-1	(X_{27})	3.695966	3.887242	.344	0.04639
OCCU 10-1	(X_{28})	- 2.139105	21.309344	.883	0.00045
OCCU 11-1	(X_{29})	- 1.079919	6.433061	.842	0.00656
OCCU 12-1	(X_{30})	- 6.305095	12.765285	.627	0.00136

STATE OF MICHIGAN.--Continued.

Variable*		Regression Coefficients[1]	Standard Errors of Regression Coefficients	Level of Significance[2]	Mean
OCCU 13-1	(X_{31})	- 5.271192	8.393942	.538	0.00339
OCCU 14-1	(X_{32})	4.461224	3.572615	.209	0.13781
OCCU 15-1	(X_{33})	20.088138	21.33314	.349	0.00045
OCCU 16-1	(X_{34})	-17.973505	17.501339	.305	0.00068
OCCU 17-1	(X_{35})	1.654696	4.417927	.708	0.02263
INCOME	(X_{36})	- 1.107231	1.174667	.349	4.92385
INCOMESQ	(X_{37})	0.079811	0.057770	.163	32.15150
INCOMAGE	(X_{38})	0.005809	0.015692	.711	239.84793
EDUCATN	(X_{39})	0.176822	0.143250	.215	12.03055

$R = .3295$[3] $R^2 = .1086$[4] $S_{yx} = 29.7355$[5]

[1]Values which appear in this column for (X_1-X_4), (X_6-X_{11}), X_{12}, and (X_{19}-X_{35}) assume equal slope coefficients. Regression coefficients for these variables give the estimated net effect on the intercept term. Values for variables X_5, X_{13}, X_{14}, X_{16}, X_{17}, X_{18}, X_{36}, X_{37}, X_{38}, and X_{39} give estimated net effect on the slope of the regression line.

[2]For 4381 degrees of freedom.

[3]Multiple correlation coefficient.

[4]Coefficient of multiple determination.

[5]Standard Error of Estimate.

*The mean value of the dependent variable was 28.7148.

STATISTICS FROM THE INITIAL REGRESSION EQUATION, ALL VARIABLES, THE STATE OF MICHIGAN

Variable*		Regression Coefficients	Standard Errors of Regression Coefficients	Level of Significance[1]	Mean
Intercept	(a)	9,727.174811	14,829.481203	.515	
TRAVELD	(X_2)	7.869137	6.217067	.211	43.53012
DINCOME	(X_3)	- 0.001048	0.001448	.472	331,933.15662
LINCOME	(X_4)	- 0.239358	59.247762	.997	21.53012
HINCOME	(X_5)	66.889963	41.285897	.111	23.48193
POPDEN	(X_6)	0.531051	1.365628	.699	165.19277
DGLAKE	(X_7)	- 7.938825	5.050546	.122	29.09639
PMRACES	(X_8)	-63.902708	34.438723	.069	2.96663
SDISTAN	(X_9)	-27.566422	31.653554	.388	12.03012
PCCAMPS	(X_{10})	0.013628	0.491320	.978	388.46988
SUWATER	(X_{11})	0.046662	0.019720	.021	9,594.77952
PBLSITE	(X_{12})	-12.939940	19.772066	.515	9.18072
HMCOURT	(X_{13})	- 1.325806	8.274936	.873	42.85542
ARSERV	(X_{14})	5.825296	9.614895	.547	50.69880
PROFESS	(X_{15})	-212.663072	149.221282	.160	12.13711
MANADM	(X_{16})	- 3.108161	115.843666	.979	7.47301
SALWOR	(X_{17})	-337.320577	189.607668	.081	6.07036
CLERIC	(X_{18})	-29.489353	146.968146	.842	13.39566
CRAFTS	(X_{19})	-143.470991	150.137061	.343	15.84217
OPERA	(X_{20})	-79.590738	138.959613	.569	17.27205
LABORER	(X_{23})	-175.279040	159.919964	.278	5.07807
FARMMAN	(X_{24})	8.046832	154.219828	.959	2.86096
FARMLAB	(X_{25})	-275.577827	201.528181	.177	1.19783

STATE OF MICHIGAN.--Continued.

Variable*		Regression Coefficients	Standard Errors of Regression Coefficients	Level of Significance[1]	Mean
SERWORK	(X_{26})	-13.614884	153.288944	.930	13.04229
HOUWORK	(X_{27})	-595.967989	262.167381	.027	1.15084
WACRAFT	(X_{28})	25.192953	3.445244	<.0005	94.26867
TREQUIP	(X_{29})	-95.743757	205.732342	.643	4.30566
		$R = .9200$[2]	$R^2 = .8468$[3]	$S_{yx} = 836.9941$[4]	

[1]For 56 degrees of freedom.

[2]Multiple correlation coefficient.

[3]Coefficient of multiple determination.

[4]Standard Error of Estimate.

*The mean value of the dependent variable was 2,403.03614.

STATISTICS FROM THE INITIAL REGRESSION EQUATION, TOP 30 COUNTIES OF ORIGIN

Variable*		Regression Coefficients	Standard Errors of Regression Coefficients	Level of Significance[1]	Mean
Intercept	(a)	15,720.334944	110,662.500823		
TRAVELD	(X_2)	16.037461	15.428900	.375	55.26667
DINCOME	(X_3)	0.003018	0.008141	.735	819,700.33333
LINCOME	(X_4)	251.310693	359.179482	.535	16.73333
HINCOME	(X_5)	-113.203100	103.486826	.354	29.96667
POPDEN	(X_6)	1.746125	3.288200	.632	394.16667
DGLAKE	(X_7)	11.866864	23.580670	.649	31.70000
PMRACES	(X_8)	0.635951	96.215601	.995	5.48000
SDISTAN	(X_9)	-0.719106	66.105103	.992	16.20000
PCCAMPS	(X_{10})	2.788693	2.316890	.315	380.76667
SUWATER	(X_{11})	0.216298	0.084935	.084	8,319.92000
PBLSITE	(X_{12})	-113.739196	122.286546	.421	9.03333
HMCOURT	(X_{13})	-25.079377	48.429563	.640	63.63333
ARSERV	(X_{14})	-13.049183	30.015474	.693	118.43333
PROFESS	(X_{15})	-137.718705	1,016.419004	.901	13.02933
MANADM	(X_{16})	-653.431672	954.071248	.543	7.24700
SALWOR	(X_{17})	203.398244	1,168.982064	.873	6.46067
CLERIC	(X_{18})	-121.467663	1,226.933700	.927	15.02200
CRAFTS	(X_{19})	13.382087	1,071.752958	.991	15.78767
OPERA	(X_{20})	-276.546670	1,055.579722	.810	18.21433
LABORER	(X_{23})	728.932509	1,399.789575	.684	4.29767
FARMMAN	(X_{24})	312.706836	866.294664	.742	1.78800

TOP 30 COUNTIES OF ORIGIN.--Continued.

Variable*		Regression Coefficients	Standard Errors of Regression Coefficients	Level of Significance[1]	Mean
FARMLAB	(X_{25})	424.917899	2,202.005600	.859	0.80167
SERWORK	(X_{26})	20.480208	1,261.491940	.988	12.42267
HOUWORK	(X_{27})	-6,266.944177	3,787.463882	.197	0.97500
WACRAFT	(X_{28})	20.536416	18.944907	.358	74.90000
TREQUIP	(X_{29})	-1,224.533777	1,062.138701	.332	4.04267
		R = .9809[2]	R^2 = .9622[3]	S_{yx} = 671.2163[4]	

[1]With 3 degrees of freedom.

[2]Multiple correlation coefficient.

[3]Coefficient of multiple determination.

[4]Standard Error of Estimate.

*The mean value of the dependent variable is 2,111.3333.

STATISTICS FROM INITIAL REGRESSION EQUATION, BOTTOM 30 COUNTIES OF ORIGIN

Variable*		Regression Coefficients	Standard Errors of Regression Coefficients	Level of Significance[1]	Mean
Intercept	(a)	80,477.521991	34,862.168358		
TRAVELD	(X_2)	-0.497307	11.460945	.968	36.53333
DINCOME	(X_3)	0.001301	0.021765	.956	47,572.20000
LINCOME	(X_4)	122.408581	110.569478	.349	25.46667
HINCOME	(X_5)	177.703301	46.174009	.031	18.86667
POPDEN	(X_6)	-20.297367	48.006006	.701	29.63333
DGLAKE	(X_7)	-50.984321	12.314543	.026	28.80000
PMRACES	(X_8)	-268.386815	54.417991	.016	1.80800
SDISTAN	(X_9)	40.058029	74.976628	.630	9.63333
PCCAMPS	(X_{10})	-1.920264	1.162263	.197	353.20000
SUWATER	(X_{11})	0.160476	0.043420	.034	8,527.08000
PBLSITE	(X_{12})	23.667932	48.728652	.660	9.53333
HMCOURT	(X_{13})	-32.616131	32.942718	.395	22.33333
ARSERV	(X_{14})	29.760782	37.096193	.481	10.83333
PROFESS	(X_{15})	-1,251.781742	331.869799	.033	11.42800
MANADM	(X_{16})	-408.325643	208.904269	.146	7.03333
SALWOR	(X_{17})	-1,097.403521	394.453530	.069	5.61633
CLERIC	(X_{18})	-528.489160	256.514313	.131	11.60367
CRAFTS	(X_{19})	-974.939796	405.348269	.095	15.96567
OPERA	(X_{20})	-799.896664	275.022745	.062	17.10800
LABORER	(X_{23})	-911.772947	349.405674	.080	6.04533
FARMMAN	(X_{24})	-445.914634	336.283537	.277	3.90567

BOTTOM 30 COUNTIES OF ORIGIN.--Continued.

Variable*		Regression Coefficients	Standard Errors of Regression Coefficients	Level of Significance[1]	Mean
FARMLAB	(X_{25})	-1,205.449575	431.316082	.068	1.61557
SERWORK	(X_{26})	-613.260571	383.133049	.208	13.67333
HOUWORK	(X_{27})	-2,396.969281	473.167289	.015	1.17433
WACRAFT	(X_{28})	15.539556	6.514173	.097	97.40000
TREQUIP	(X_{29})	-1,272.921713	471.538913	.074	4.47767

$R = .9962$[2] $R^2 = .9925$[3] $S_{yx} = 385.3592$[4]

[1]With 3 degrees of freedom.

[2]Multiple correlation coefficient.

[3]Coefficient of multiple determination.

[4]Standard Error of Estimate.

*The mean value of the dependent variable was 2,021.13333.

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