APPLICATION OF A TRAVEL COST DEMAND MODEL TO RECREATION ANALYSIS IN NEW ZEALAND: AN EVALUATION OF LAKE TUTIRA

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ABSTRACT

The concept of recreation analysis was investigated with particular emphasis on the Travel Cost Method as a technique for valuing non-market recreation sites.

A survey was carried out of visitors to Lake Tutira to obtain information on visitation behaviour and travel costs relating to the recreation experience. The data received in this survey was used within a Travel Cost framework in two forms; the individual observations approach, and the aggregated data approach. The individual observations approach was eventually rejected as being unworkable using the survey information from Lake Tutira and the analysis was restricted to the aggregated data approach.

Using the Travel Cost Method a prediction equation was calculated and used to model visitation behaviour as a result of variations in travel cost. This demand model was then applied to the second stage of the Travel Cost Method to derive a demand curve for Lake Tutira. A consumers' surplus figure was calculated from the demand curve and presented as an approximate monetary value of Lake Tutira as a recreational amenity.

The recreational value of Lake Tutira was included in a partial economic analysis of a proposed lake restoration scheme to indicate its economic viability. The application of the recreational value (consumers' surplus) was discussed in relation to public sector decision making.

The major result of the study was that the Travel Cost Method is a successful and acceptable technique for valuing recreation sites in New Zealand.

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INTRODUCTION

During the last thirty years in New Zealand the number of people taking advantage of our natural resource amenities for recreational purposes has increased considerably. This is consistent with a world-wide trend of increased recreational participation and is generally attributed to increased urbanisation, greater affluence and travel opportunity, more leisure time, and expanding population levels. This increased desire for outdoor recreation in New Zealand has led to conflicting demand for the natural resources that provide the recreational opportunity, e.g. forests, lakes, rivers and beaches. The conflict can arise between such requirements as recreation, industry, and conservation. If recreation is to be considered a legitimate alternative use of New Zealands' natural resources then the desirability of recreation compared to alternative uses needs to be identified.

It must be recognised that society does have multiple goals and that decisions involving alternative uses of resources will often involve a trade-off situation. In some instances several different objectives can be achieved simultaneously, but often this is not possible and one goal must be traded off against another. For this to be achieved satisfactorily, information on the costs and benefits relating to each alternative must be identified and compared.

An added problem in the recreational debate is that sometimes an alternative use of the resource involves an irreversable change such that it could no longer be considered for recreational use in the future, e.g. the clearing of native forests. Actions of this kind must be considered in the light of our responsibility to future generations, not merely current economic justification, and as such any decisions involving irreversible projects should be made at the government level, consistent with government policy on the matter.

In accepting the need for quantified costs and benefits relating to alternative uses of the same resources, the analyst is faced with a major difficulty in attempting to obtain them. The problem is that in New Zealand (and other market economies) the provision of natural resources for recreational use is not handled by the usual market mechanisms (explained in more detail in chapter 1). Recreational amenities in New Zealand are provided and maintained in most cases by central government. As a result of this, no pricing mechanisms exist to value the benefits people gain from a recreational experience, as they pay through their taxes, not for specific use. Therefore, resources are allocated without full quantitative knowledge of the costs and benefits involved, a situation that will inevitably lead to a misallocation of resources (as shown in chapter 1). Uncertainty about the true costs and benefits associated with an action can only lead to controversy as has been shown in New Zealand in the past. The 'Save Manapouri' campaign was a result of disagreement between government and the conservation lobby about the value of electricity generation compared to recreation and conservation. A current example is the 'wild and scenic rivers' controversy, once again a confrontation between recreational use and electricity generation. Emotive arguments are heard on both sides, but no quantitative benefit calculation is available for recreation, as there is for increases in electricity supply. The final decision remains subjective. In the U.S.A. the amount of over-regulation in environmental matters has raised concern that in some cases cost of regulation and protection could far outweigh its benefits. This is also a possibility in New Zealand.

The specific problem that this study will direct itself to is that of Lake Tutira, in the Hawkes Bay area. The lake is a valued recreation site that is threatened by advanced eutrophication. A 'clean-up' scheme is proposed that will reverse the lake deterioration, but the question is "do the benefits of such a scheme outweigh the costs"? An indication of the benefits of the lake to the users is required for this question to be answered.

It has become obvious in the last decade, due to the types of controversy described above, that some form of recreation analysis is required to provide quantitative measurement of the benefits associated with recreational use. Given such information, a study of the relevant costs and benefits relating to the alternative choices of resource allocation can be carried out, and decisions concerning the optimal use of the particular resource can be made objectively according to the particular allocation criteria in use.

The trend in New Zealand of increased recreational activity may or may not continue, it is difficult to forecast. Factors such as petrol price, static population level and a less favourable economic climate may slow down the trend. Regardless of this however, there will still exist a major demand for the finite recreation resources in the future and it remains the responsibility of the government to allocate a certain amount of resources for this purpose. It is possible that the value of recreation areas will increase in real terms in the future as demand increases for the finite recreational resources, and as such government might consider it necessary to give more weight to recreational use of resources in current allocation decisions in anticipation of this future development. To achieve efficient allocation, the decision makers must accept one form of recreational analysis that will provide a correct measurement of the benefits. The major purpose of this study is to present one particular method, the Travel Cost Method. The method is well accepted in many western countries and its application to a New Zealand situation will be evaluated.

The Aims of the Study

The aims of this study can be presented in five catagories:

1. To investigate techniques of recreational analysis and in particular the Travel Cost Method. The theoretical and practical aspects of recreational analysis will be identified and discussed.

2. To indicate the usefulness to decision makers of the results obtained by the Travel Cost Method.

3. To apply the Travel Cost Method to a New Zealand situation, specifically Lake Tutira, and to identify any problems involved with its practical implementation.

4. To critically discuss the data collection method used to provide information for use in the Travel Cost Method and to provide information for use in forming lake management policies.

5. To use the results of the recreation analysis in conjunction with information on the costs of a lake 'clean-up' scheme to ascertain if there is economic justification for the proposed action.

CHAPTER 1. THEORETICAL ASPECTS OF QUANTIFYING VALUE

1.1 Introduction

Presented in this chapter is the theoretical basis and justification for the recreational analysis carried out on Lake Tutira. How a good or service is allocated a value in a market orientated system like New Zealand is explained with particular reference to the difficulties associated with valuing public goods, such as recreation sites. In the initial sections the concepts of welfare, efficient resource allocation and willingness to pay are briefly explored. The concept of demand is developed and used to show how a non-market good can be valued objectively by society. The theory covered in this chapter provides the necessary background to an understanding of the application, interpretation and limitations of the recreational analysis techniques discussed in the next chapter.

1.2 The Problem of Resource Allocation

Economic analysis is carried out in Western countries to provide information on the changes in welfare to society of a certain project or action. The objective of a democratic society is to maximise total welfare, and it does this by allocating its resources in such a way as to bring about the most beneficial changes in the level of welfare. The problem that exists is deciding on whether or not welfare has changed as a result of a change in resource allocation due to a policy decision or resource development project, and if so, by how much. Compounding this problem is the use of maximisation of net social monetary benefits as a criterion for optimisation, i.e. total utility or satisfaction is reflected by economic welfare, whereas utility and satisfaction will actually depend on many non-economic factors, e.g. freedom, aesthetic appreciation and religious ideals. True welfare remains an elusive concept that is impossible to measure in economic terms, however the view that the welfare of society is, in part, dependent on the utility derived by its members through consumption justifies the kind of analysis performed in this study. Economic theory provides a framework that allows efficient resource allocation by assuming that the more goods and services available the greater the level of welfare, i.e. consumption maximisation is the objective. Accepting this implies that is is understood that the consumers are the best judge of what is valuable to them, and that they reflect this value in the price they are willing to pay for a product.

The provision of public good type amenities such as recreation sites is often not controlled by the market system, the commodity is 'unpriced' because of certain characteristics such as joint consumption and non-excludability of public goods, explained in more detail in the next section. The government performs the task of providing public goods, usually free of charge, hence no consumer valuation in terms of market prices is available. To determine an optimal level of provision government needs to know what value society places on a particular public good and what the costs are in providing and maintaining it. If the overall benefits exceed the overall costs then the government may consider that society's welfare position has improved. The net welfare improvement is accepted providing the following conditions are adhered to:

1. The initial income distribution is retained after the change.

2. The initial income distribution is considered to be the most appropriate for society.

3. The marginal social rates of transformation between commodities are equal to their marginal rates of substitution.

These conditions apply because the change being analysed may cause a redistribution of income, thus redefining the values used in the analysis. After an income redistribution and resultant change in the value of the goods, the intervention may no longer show a net increase in welfare. It is also necessary to make the assumption that the original distribution of income is, in some way, the 'best'. The price data used in the analysis is a result of the current distribution, therefore in order to utilize it the assumption must be made that the current distribution is acceptable. This is not always the case, and often governments will use the power of provision of public goods to redistribute some of society's wealth. Finally, if the marginal rate of substitution is less than the marginal rate of transformation, then total welfare can be increased by providing more of the good in question until an optimum position is found at marginal rate of substitution equal to the marginal rate of transformation.

In the particular example analysed in this study the first condition is acceptable because of the small amounts of the costs and benefits involved, thus there is a negligible income redistribution. The second condition is accepted on the basis that the New Zealand government has for years redistributed income through policy measures, therefore the current distribution can be viewed as acceptable. The third condition leads into the theory of 'second best'. Again, because of the partial equilibrium nature of the example, the assumption is made that application of an efficiency criterion will give a greater chance of moving towards a welfare optimum than not using any criterion at all. The criterion used by society to decide whether or not overall welfare has increased is called the Kaldor-Hicks Compensation Criterion which states:

> "Society is better off if the gainers could completely compensate the losers and still be better off".

Pareto optimum[1] is fulfilled through income redistribution, and the criterion applies regardless of whether or not compensation is actually paid.

. If a project is small enough to have negligible effects on the overall income distribution, the problems of redistribution are usually disregarded, allowing society to determine whether or not economic welfare will increase. The welfare concept is usually defined in terms of the values of society, so it is necessary to determine a level for costs and benefits accrueing to a particular activity or good before considering optimal welfare changes. The values of society are the sum of the individual values of its members. In the next section the concept of individual value, or willingness to pay, is explored.

1.3 The Value Concept; Willingness to pay and the demand curve

The value that a person places on a good, or service, usually reflects his preference for that particular commodity with regards to others, based on the utility he will gain from its use. This preference or utility is usually revealed, in a free market economy, by the person's willingness to pay for the particular activity or good. The amount of money a person would be willing to pay for a given quantity

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[1] Pareto optimum - A project will make society better off if it leaves no individual person in society worse off, and makes at least one person better off.

of a good or service provides a quantitative measurement of value to an individual. Taking the concept further, individual's willingness to pay for something can be aggregated to provide a total monetary value of worth to society, that is, society's willingness to pay. The worth of a recreation site can be viewed as the value of its services to the recreationists who utilize it, and this worth is equal to society's willingness to pay for the site[2].

Total consumer willingness to pay (value) can be presented in the form of a demand curve in which a relationship between the price and quantity consumed of a commodity is shown. For a market good, individuals express their preference by consuming a certain quantity of the good at a set price. This relationship is observable and the quantities demanded can be summed horizontally to provide a market demand curve, shown in Figure 1.1.

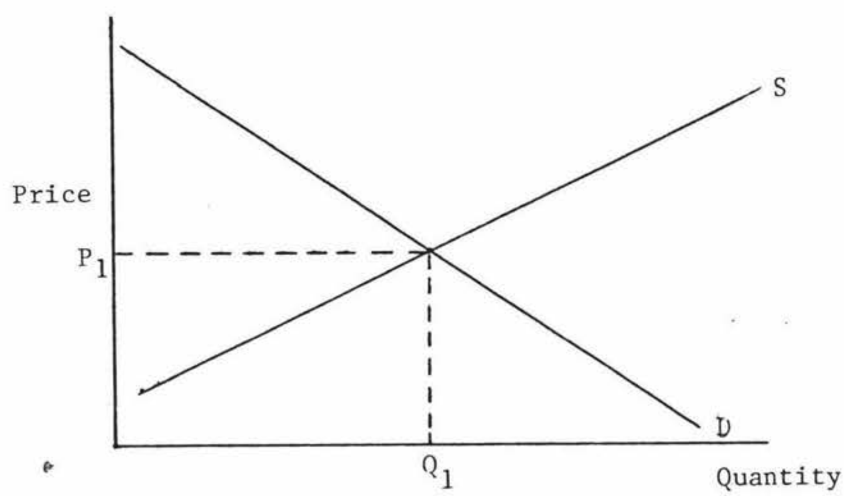

Figure 1.1 Market Demand Curve

S = Supply curve

D = Demand curve.

At P_1 the total consumer demand for the product is Q_1, which equals the sum of the individual quantities demanded. In most markets

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[2]Presuming acceptance of the current distribution of income.

the consumers are price takers, i.e. they must take the market price as given and reveal their preference by choosing the quantity they will purchase. In a perfect economy a producer will maximise his profits by producing at a rate that equates price with the marginal cost. At the optimal position, the value that the consumers place on the marginal unit bought (Marginal benefit) will equal the cost of purchasing that last unit of product (Marginal cost). Therefore, at the optimal position, in the abscence of external effects,

$$\text{Marginal cost} = \text{Marginal benefit} = \text{Price} \qquad (1.2)$$

Total consumer willingness to pay for the goods is equal to the area under the demand curve, but the actual amount paid by consumers at price P_1 (Figure 1.1) is $P_1 \times Q_1$. The difference is called the consumers' surplus. (This concept is discussed further in section 1.4). For a private market good the demand curve can be estimated from the price/quantity relationships observed in the market. However, for public goods like recreation facilities there exists no readily available market information for use in estimating demand curves.

If the benefits from the consumption of one unit of a good may be consumed jointly by more than one person in such a way that consumption by one person in no way reduces the quantity available for other consumers, then that good is termed a public good. Because of this property of non competing consumption, allocation of public goods requires a different set of conditions to achieve efficient resource allocation than for private goods. Unlike the price-taker situation with private goods, public goods are often supplied in fixed quantity and individual consumers will reflect their preferences by placing different values (willingness to pay) on that particular quantity. The total value of the public good will be equal to total consumer willingness to pay, obtained by vertical summation of individual demand (aggregated willingness to pay at a set quantity).

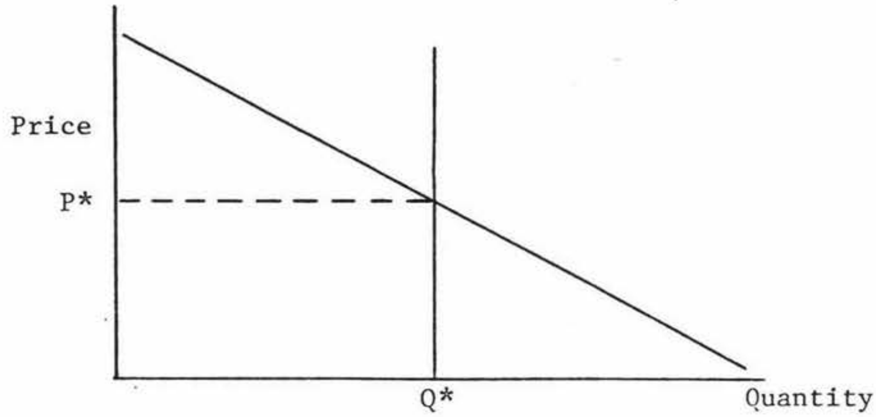

Figure 1.2   Public Good Demand Curve

Q* = Quantity available.

At Q* each individual is at an equilibrium position if he is charged equal to his willingness to pay, but without a market system it is difficult to force an individual to reveal his willingness to pay. Non market techniques for obtaining information on willingness to pay are outlined and discussed in the next chapter. If the total willingness to pay P* at Q* as indicated by the demand curve is merely divided by the number of consumers, some will be charged more than they are prepared to pay, and others less. This inequality causes public goods to suffer from a situation known as the free rider problem, i.e. consumers of a public good, when questioned about the benefits they receive, will say they receive no benefit from that good therefore their willingness to pay is zero, thus avoiding payment. For this reason, due to the non-excludability of public goods, services like recreation sites are usually administered by government agencies who have the power to extract payment from everyone through taxes, but usually without information on who in particular is benefiting. In practice, decisions involving public goods are seldom made with reference to who will bear the tax burden, and as a result many people feel that either the public good is not worth the portion of their tax allocated to it, or conversely think that it is worth more and should be expanded. Failure to efficiently allocate resources is inevitable unless information about consumer demand for the public good is made available. The recreational analysis techniques mentioned in the next chapter attempt to provide such data relating to recreation sites, so that a value figure can be weighed against the costs of providing the sites.

1.4 Consumers' Surplus and its Application to Recreation Analysis

1.4.1 Basic Theory

The concept of consumers' surplus has been mentioned earlier in relationship to willingness to pay. The nature and relevance of this concept to the evaluatory techniques to be discussed in the next chapter warrants some scrutiny. The idea of a form of 'economic surplus' was first conceived by Dupuit in 1844, but it was the work of Marshall (1930) based on surplus utility afforded by an economic change that presented the notion to economic theory. Marshall wrote:

> "The price which a person pays for a thing can never exceed, and seldom comes up to that which he would be willing to pay rather than go without it; so that the satisfaction which he gets from its purchase generally exceeds that which he gives up in paying away its price, and he thus derives from the purchase a surplus of satisfaction. The excess of the price which he would be willing to pay rather than go without the thing over that which he actually does pay is the economic measure of this surplus satisfaction. It may be called consumer surplus".

Marshall recognised that the area under the demand curve and above the price line (or the ordinate if there is no charge) provided a suitable measure of the consumers' surplus. Consider Figure 1.3,

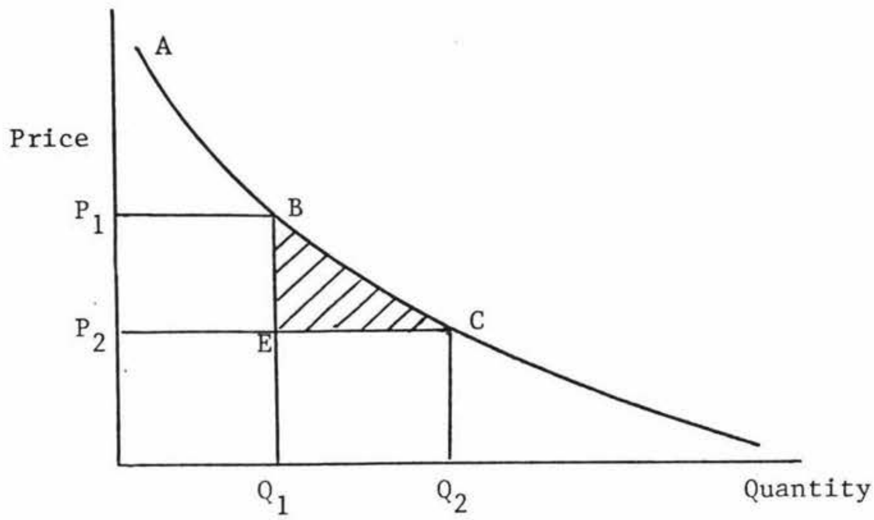

Figure 1.3 Marshallian Demand Curve (ABC)

where; initial consumption is Q_1 at price P_1. After a change in output to Q_2, price is P_2. Consumer willingness to pay for the new output = Q_1 BC Q_2, but he pays only Q_1 EC Q_2

Therefore the consumers' surplus = BEC = surplus benefit at consumption Q_2, equal to willingness to pay minus total revenue.

The basic problem with such analysis (which eventually discouraged even Marshall) is the <u>income effect</u>. In cases where expenditure on the commodity in question is a substantial part of the consumers' total expenditure, its aquisition will effect consumption of other commodities. The expenditure will result in a change in the consumer's 'real' income, changing the marginal utility of money and thus the position of the demand curve. Given this situation, the area under the demand curve will not be a suitable measure of consumers' surplus.

Such discrepencies in Marshall's theory eventually led to further work by economists Hotelling (1947) and Hicks (1943) and the formulation by Hicks of his compensated and equilibrated demand curves.

1.4.2 The Hicksian Analysis of Consumers' Surplus

Hicks attempted to calculate consumers' surplus from goods affected by income effects by forming a demand curve different to that put forward by Marshall. Marshall indicated changes in consumers' surplus as a result of changes in production, but as production (consumption) had changed, so would have 'real' income. Hicks showed that it was possible to construct a demand curve that would leave the consumers' real income the same, regardless of level of consumption. He called the new curve his compensated demand curve and used the curve to show the amount of compensation that would leave the consumers in the same welfare position following a change in price or consumption, what he called the compensating surplus. However, Hicks realised that the compensated demand curve might underestimate the benefits to the consumers of any change if the price were to decrease, thus increasing the real income. For this situation Hicks formed his equilibrated demand curve from which he showed the equivalent surplus, which measures the compensation consumers should receive if a change is not undertaken, i.e. equating their welfare with what it would be if the change were undertaken.

The problem remains which of the three curves, the Marshallian, the compensated or the equilibrated demand curve is the correct measure of consumers' surplus. It would seem (Burns, 1973) that the Marshallian curve can only be used for valid interpretation when the cost of the goods involved are only a small part of the consumers' expenditure thus negating the income effect. In this situation all three curves will be the same. In the case where the costs of the goods are a large part of the consumers' expenditure the three curves will differ and the problem arises which, if any, is the correct one.

1.4.3 Use of the Consumers' Surplus Concept

The result of extensive work done in the field of consumers' surplus (Hicks, 1943; Bhagwati and Johnson, 1960; et al) is that the theoretical basis can be accepted under the same restrictions that apply to the use of cost-benefit analysis techniques, that is, when the expenditure is but a small portion of the consumers' total expenditure (negligible income effect) and when the marginal utility of money can be assumed constant. Given such conditions the concept of consumers' surplus is useful within the framework of recreation analysis. If a price/quantity relationship (demand curve) can be predicted or hypothesised without actually having to impose a fee on the use of a recreation site, then the total area under the demand curve can be taken as a measure of the value of the site to the users at a zero admission fee. The area under the graph will equal the consumers' surplus at zero admission fee, which in turn will equal total consumer willingness to pay, i.e. value.

However, when using the concept of C.S. specifically for valuing recreation sites there is considerable dispute as to its applicability, and the ability of the analyst to calculate the absolute figure correctly. Dissenters include many eminent economists such as Clawson, Merewitz and others who remain dubious as to the practicability of the concept. Other authors such as Lerner and Pearse advocate the use of consumers' surplus for recreational analysis. For example Pearse (1968) stated;

> "The value of the resource to recreationists in terms of the consumers' surplus they enjoy under free access, consists of the sum of the maximum tolls that they would be prepared to pay in addition to their existing fixed costs".

A major problem seems to be agreeing on what recreation analysis is trying to quantify. It is necessary to make a distinction between the 'economic value' of the recreation site, and its total benefit to the users of that site. Tangible commodities have their economic value reflected by the market price, and this economic value does <u>not</u> include calculations of consumers' surplus. A measure of total user benefit from a recreation site includes consumers' surplus, and, in fact, at zero cost is equal to consumers' surplus. It is a measure of the worth of the public good to its consumers, and as such is of obvious value to decision makers concerning management and cost/benefit calculations, but relevant to that particular site only.

A different interpretation of value as suggested by economists Clawson, (1959); Brown, Singh and Castle (1964) et al., is the use of a figure estimating total revenue attributable to a non-discriminating monopolist. This figure would be equal to the largest possible rectangle under a demand curve. This alternative has the advantage of implying a single price, but will underestimate the true 'worth' of the site.

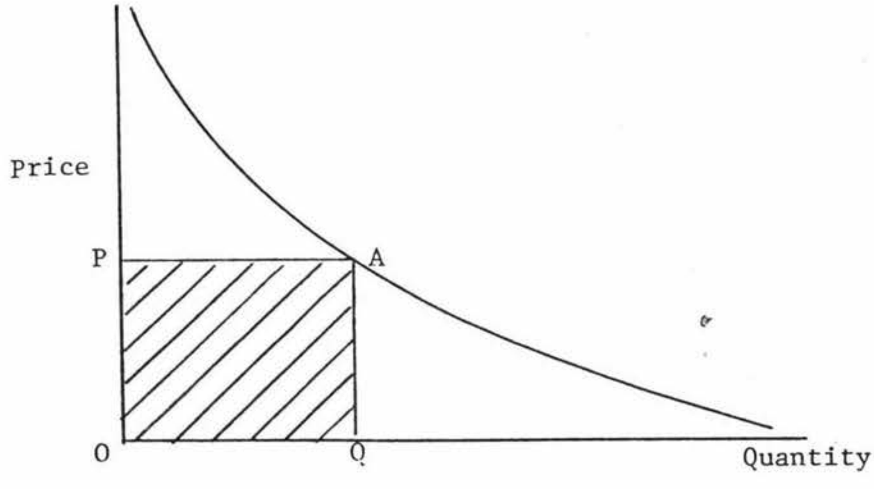

Figure 1.4 Recreation Site Demand Curve

The area OPAQ is the largest rectangle possible and therefore measures the maximum revenue attributable to a monopolist.

The arguments for or against this form of analysis depend on whether one is attempting to measure market value (as measured by monopolists revenue) for comparison with other values, or the worth of the recreation site per se (as measured by consumers' surplus). As it is unlikely that public good amenities in New Zealand will ever be administered by a monopolist, consumers' surplus may well be considered a more suitable measure of worth. It would seem that consumers' surplus can be used as an indicator of total consumer willingness to pay within certain restrictions. The assumptions of constant marginal utility of money and zero income effect although not totally justifiable are nonetheless necessary if analysis is to be attempted. The way in which the ideas of value, willingness to pay and consumers' surplus are successfully incorporated into the framework of the travel cost method of recreation evaluation is shown in the next chapter, along with an outline of other common methods of recreation analysis.

CHAPTER 2. THE STATE OF THE ART OF RECREATION ANALYSIS

2.1 Introduction

The purpose of this chapter is to present a cross section of the evaluatory techniques that are used or have been used extensively in the field of recreation analysis. Section 2.2 provides a brief summary of some of the most commonly used methods which are discussed critically in the light of the theoretical basis for benefit estimation as outlined in the previous chapter. The extensive use of the non-survey type techniques is explained mainly by their ease of application rather than their ability to estimate total consumer willingness to pay, as will be shown later.

Section 2.3 of this chapter will discuss in detail the Travel Cost Method (TCM), illustrated by a simple example, and in the final section the limitations and further refinements of the TCM are discussed in depth.

2.2 Techniques for Evaluating Recreational Benefits and Costs

2.2.1 Benefits Estimated by Educated Guess

The benefits accruing to a site are appraised using subjective judgement usually based on incomplete knowledge. A method of this kind requires a very high degree of 'personal judgement' in selecting values according to subjective appraisal of the quality aspects of the experience. A similar technique is to rate recreation resources according to such things as uniqueness of the resource, income groups of the users and accessibility. Both methods are obviously unsatisfactory when aspiring to objective measurement of people's willingness to pay. A commonly used offshoot of this approach is the 'Unit-Day Value' method. An educated estimate of a general value of a recreation site to an average visitor is made and this value is merely multiplied by the number of people attending the site. The method is non site-specific, subjective, and merely a function of visitation frequency.

2.2.2 Market Value of the Catch

The minimum value of a fishing experience is considered equal to the market price of the catch (or of a similar species) sold commercially. This method is useful in a few instances but is generally unacceptable, mainly because it implies that the catch alone is the primary objective of the recreational activity, which is obviously untrue for most kinds of hunting and fishing.

2.2.3 The Gross Expenditures Method

This technique measures the value of recreation as the total amount spent on recreation by the users e.g. travel, food and equipment costs. Estimates of these gross expenditures yield large monetary values, probably the reason for its use and relative popularity, but tend to overestimate the benefits accruing to the recreational experience. The argument for this method is that people spending the money must be receiving satisfaction at least equal to the amount spent or they simply would not continue to do so. If, however, the particular recreational facility was not available consumers would probably continue to spend as much on an alternative and still receive satisfaction. What has changed, however, is total welfare as measured by total consumer willingness to pay (i.e. expenditure plus consumers' surplus). Therefore, the real loss to the consumer of, for example, loss of access to the site is the decrease in consumers' surplus.

It was the magnitude of the consumers' surplus that made the visitor choose the particular site instead of an alternative, and it is this magnitude that should be measured as an indicator of value. Total expenditure as such has little relevance to consumers' surplus, but expenditure figures can be useful in analysing the local economic impact of the recreationists.

2.2.4 Value Added by Outdoor Recreational Expenditures

This is a refinement of the gross expenditures approach, by deducting what had to be spent by the supplier of the recreation related services in order to get the materials to make such a service possible. This approach at least localises the impact of gross expenditures. The value added by the recreation industry can easily be compared with returns from other industries. The main problem is that these amounts are spent not for the provision of the recreational opportunity as such, but for the provision of other services connected with the use of the recreational opportunity.

2.2.5 The Cost Methods

These techniques make similar assumptions to the gross expenditure method in that benefits should be at least equal to costs incurred, thus using costs as a proxy for benefits rather than calculating the consumers' surplus. The technique can be divided into two different approaches;

a) Benefits equal opportunity cost.

There are two versions of this approach. Firstly benefits are considered equal to wages foregone by the time spent in recreation. This is only valid when work is sacrificed, not leisure time. The second version considers recreation and leisure time complementary to work time, and assume that they contribute to real production. The benefits are considered equal to the value of the time foregone (opportunity cost) in recreation.

b) Benefits equal project costs.
This method renders all actions equally desirable and feasible so that no net value figure is available for the purpose of comparison. If benefits are equated to costs of a recreational project, a cost/benefit ratio of one is automatically achieved, and the project is thereby economically justified. Obviously this bears well for advocates of the project, but gives no true indication of benefits at all.

2.2.6 The Market Value Method

This measure involves a schedule of charges 'judged' to be the market value of the recreation services provided. The method occasionally provides a reasonable estimate of consumers' willingness to pay, however the figures used are usually based on private recreational facilities which cannot normally be compared with public recreational services. If the two facilities were comparable the public would not pay to use the private one. In addition, there can be a large variation in value between different areas of similar type, for example, in water quality.

2.2.7 The Interview Methods

These methods are widely used in recreation analysis with varying degrees of success. They have an advantage over the previously mentioned techniques in that they directly attempt to value the consumers' willingness to pay. By using a properly constructed interview approach, information on the maximum price consumers would be prepared to pay in order not to be deprived of the use of a recreation area can be obtained, i.e. their willingness to pay. Such methods presume that consumers will maximise their utility in using recreation if they are forced to pay by consuming at a level where the benefits resulting from the last unit consumed equals the cost of obtaining it, and no further. The major difficulty with this method is the reliability of response. For example, respondents may understate their willingness to pay if they think that they may be charged that same amount. Alternatively the respondents may overstate their willingness to pay to strengthen a case for preserving an area they don't want destroyed. Response error is a basic problem of any survey research, but it can be alleviated to a reasonable extent by correct design and phrasing of the questions. The questions should not be hypothetical, rather they should be as specific as possible, and asked preferably of actual users rather than potential users (ascertaining effective demand, not option demand). It is also preferable that the respondents are questioned whilst they are actually engaged in the recreational activity. Other problems of accuracy include interviewer bias, sampling error, selection error and incorrect questionnaire design (see chapter 4).

The interview techniques are used quite extensively but with perhaps less than satisfactory results due to the problems mentioned. However, as previously stated, these problems are related to survey design and considerable research is being done in this field to remove such potential bias from survey results, e.g. Juster's (1966) work on consumer intentions. The actual interview procedure will vary, naturally, in different circumstances, but generally will follow the basic framework outlined below.

A sample of respondents may be invited to react to increased costs associated with visiting a recreation site, and at the point just previous to the cost at which they would no longer visit the site, establishing their willingness to pay. A demand curve can be formed from the individual responses, from which an aggregate demand function can be derived. Using multiple regression techniques the percentage of variance in willingness to pay can be explained for each variable in the demand function, thus highlighting the most important determinants of demand.

Knetsch and Davis (1972) stated; "Both the success in finding acceptable and significant explanatory variables and a certain amount of internal consistency in the responses suggest that considerable weight can be attached to the interview method". One can conclude that used correctly the method is successful in certain situations. It does however need very skilled interviewers, the respondents need to have considered the questions seriously, and the whole process is time consuming and expensive.

A variation on the interview technique is to elicit response in terms of willingness to drive, rather than willingness to pay. This method was first proposed by Ullman and Volk in 1961. Using willingness to drive extra distance as a proxy for willingness to pay avoids the problem of bias associated with answering questions about amounts of money where paying is a possibility. Willingness to drive will be a function of length of stay and miles driven to reach the area. Some estimate of how willingness to pay increases with increases per mile in willingness to drive is necessary, for example 5¢/mile, as a basis for transforming willingness to drive into willingness to pay.

2.2.8 Surrogate Market Approaches

This is a refinement of the basic interview technique. The usual way of applying these techniques is to use bidding games during personal interviews to ascertain the respondent's willingness to pay, or willingness to sell, and indicate preference between hypothetical situations. The interviewer will usually explain the technique, alternatives and effects using visual aids, and then attempt to value loss or gain of recreational services. For example, if it were necessary to gauge a respondents willingness to sell for the loss of a recreational site, he would be presented with offers of compensation in the form of 'hypothetical monetary transactions', until the interviewer established the minimum amount of compensation he would accept.

The results of the survey on willingness to sell are aggregated to give points on a demand curve for that site. Alternatively, indifference maps can be formed from the preference data indicating benefit in terms of utility (Sinden, 1974). This adaption however required a more complex system of trade-offs presented to the respondents. The consumers are faced with alternative choices, like a recreation day at the site being analysed versus a day spent in a swimming pool. By observing the respondent's choice between alternatives an individual's utility functions can be derived from which a demand function can be estimated.

Surrogate market approaches include several methods of valuation which Sinden and Worrell (1979) have divided into two catagories:

1. Estimates of willingness to pay by direct questioning, which includes;
   - specific questions (as detailed in the interview method)
   - converging direct questions eventually ascertaining the respondents willingness to pay
   - providing the respondent with alternative goods and services to which he must allocate portions of a fixed budget
   - trade off games.

2. Inferred willingness to pay from direct questioning on quantities of goods and services demanded. i.e. a pseudo-market system simulating price/quantity relationships.

Although relatively new and unaccepted, some successful work has been achieved using hypothetical valuation (Bishop and Heberlein, 1979; Sinden, 1974; et al). The main opposition to the method (Scott, 1965) is that if you ask a hypothetical question you will get a hypothetical answer. Also, the correlation between attitudes about future behaviour and actual behaviour is often quite low, in that what people say they would do is often not what they end up doing[1].

The surrogate market approaches would seem to be no more or less accurate than the accepted travel cost method, and as such must be considered a promising technique, especially if research removes some of the areas of bias associated with response and interview error thus strengthening its creditability.

2.2.9 Concluding Comments

The techniques outlined above are of varying degrees of acceptability. The first five methods mentioned fail as satisfactory analytical techniques either because they are completely subjective or because they do not measure the true value of a recreation site in terms of society's willingness to pay for it. These techniques disregard the concept of consumers' surplus, i.e. there is value over and above that which is paid for the service. The methods use proxies of cost expenditures or market values as measures of benefit, and although such information can sometimes be useful in recreation analysis

[1]This idea was first presented by La Pierre in 1934 in a study on Chinese being served in public places in the U.S.A., and reinforced by a review of ideas by Schuman and Johnson (1976).

they do not measure true willingness to pay.

The more successful survey techniques presented in the latter part of the section include some useful methods of ascertaining individual's willingness to pay, but as stated earlier, the results are subject to various conditions of bias. Some of the problems of bias can be removed by using indirect methods for obtaining information on individual's willingness to pay for a recreation site. The most widely accepted technique for recreation analysis, the Travel Cost Method, elicits response on willingness to pay indirectly through information on travel costs, as shown in the following section.

2.3 The Indirect Travel Cost Method (TCM)

This approach was originally proposed by Hotelling in 1947 when he suggested the existence of a consumers' surplus for people living close to a recreation site (in terms of transport costs). The idea was advanced by Trice and Wood (1958) and Ulman and Volk (1961) by considering the approximation of demand by measuring willingness to pay indirectly.

The derivation of the demand curve for a recreational experience as a whole was originated by Clawson (1959) and developed by Clawson and Knetsch (1966) using a simple 'Marshallian' demand curve. A price/quantity relationship was imputed from users reactions to variation in travel cost, and was used to derive the demand curve, as shown in Figure 2.1.

The assumption is made that people use outdoor recreation opportunities to the extent to which they believe the satisfaction derived from the last unit of recreation is exactly equal to the costs of obtaining it and not beyond, i.e. they will optimise their utility

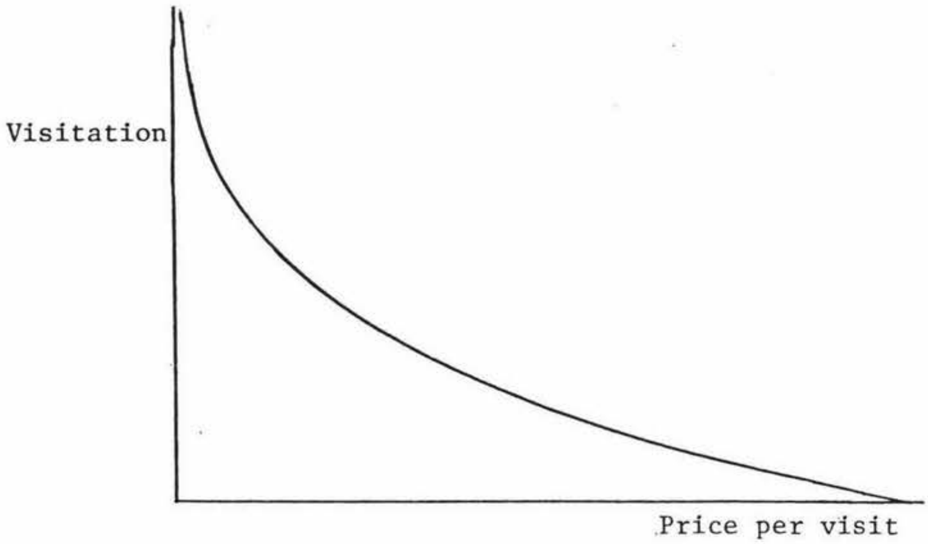

Figure 2.1 The Relationship between Visitation and Travel Cost

at marginal cost equal to marginal benefit. This provides a limit to their demand. According to Clawson (1972) estimation of the demand curve for a recreational site should proceed in two stages. The first stage consists of deriving an attendance prediction model in which "... visitation from a particular area is a function of the cost of travel". This will provide a demand curve for the total recreational experience, estimated from the actual experience of a sample of people.

The basic theme of the method is that visitation to a particular recreation site is influenced by the costs involved in getting there. The TCM methodology is as follows: (Bishop, 1979).
The area surrounding a particular site is divided into zones, usually concentric rings centered on the site, thus dividing the recreationists into distance catagories. Other, perhaps more successful, methods of zoning have been employed, but these will be discussed later.

More formally; assume Z rings of distance zones. Let V_i^o $(i = 1, 2 \ldots z)$ be the quantity of recreation currently recorded at the site by residents of zone i.[2]

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[2]The Clawson-Knetsch (1966) approach measures V_i^o in visitor days per thousand population of zone i.

Assume that, initially, there is no admission fee to the site. Then, a regression equation can be derived using OLS estimation[3] establishing a relationship between visitation and travel cost.

$$\text{i.e.} \quad V_i^o = f(\text{Travel Cost}) \qquad (2.1)$$

Greater accuracy of prediction can be achieved by including other possible explanatory variables in the equation i.e. variables that influence a recreationist's visitation behaviour. For example, the regression equation may take the form;

$$V_i^o = f(Ci, Ti, Ai, Si, Yi \ldots\ldots) \qquad (2.2)$$

where the explanatory variables (independent variables) are:

Ci = round trip travel costs from zone i to site

Ti = some measure of tastes and preferences of recreationists in zone i (very difficult to measure)

Si = measure of availability of substitutes

Yi = mean income for residents of zone i.

The results of the regression analysis will indicate the most influential variables in the demand function (equation 2.2), and the extent to which changes in their value will effect the visitation rate. The equation allows visitation rate to be predicted from information on zone travel costs.

Clawson chose to value the recreation site *per se* by assuming that the difference between zones in terms of distance (travel cost) can be used as a proxy for an admission fee, and that people will react to increased admission fees in the same manner as they would to higher travel costs. This is Clawson's 'second stage', deriving a demand

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[3]OLS stands for ordinary least squares estimation, and is a regression technique for establishing relationships between variables. For an explanation of linear regression you are referred to Appendix One.

schedule for an outdoor recreation site.

The first point on the demand curve is obtained by determining the total visitation at a zero admission fee. I.e. if Pi is the population of zone i, and Vi^{o} is the visitation rate from zone i, then the total number of visitor days consumed at a zero admission fee (x = 0) is equal to:

$$\bar{V}^{o} = \sum_{i=1}^{z} PiVi^{o}$$

= the first point on the curve, i.e if x = 0, the quantity consumed = $\bar{V}^{o}$ (i.e. the sum of the visitation from each zone at zero admission fee).

To obtain other points on the demand curve it is necessary to assume that recreationists will react to changes in travel costs in the same way as they would react to changes in admission fees. Increased admission fees are added to the travel cost variable in the regression equation which, for a bivariate relationship, would be of the form

$$Vi^{x} = A + B \text{ (Travel Cost plus x)} \qquad (2.3)$$

where; Vi^{x} = visitation rate from zone i at admission fee x

A = the Y intercept

B = regression coefficient

x = admission fee.

So, assocated with each value of x is a total visitation figure, summed for all the zones, giving a point on the demand curve.

$$\text{i.e.} \quad \bar{V}^{x} = \sum_{i=1}^{z} PiVi^{x} \qquad (2.4)$$

By repeating this procedure for various levels of admission fees, total visitation is found using the visitation rate/travel cost relationship established in stage one, forming a demand function of the form;

$$\bar{V}x = f(x) \tag{2.5}$$

and a demand curve similar to Figure 2.2

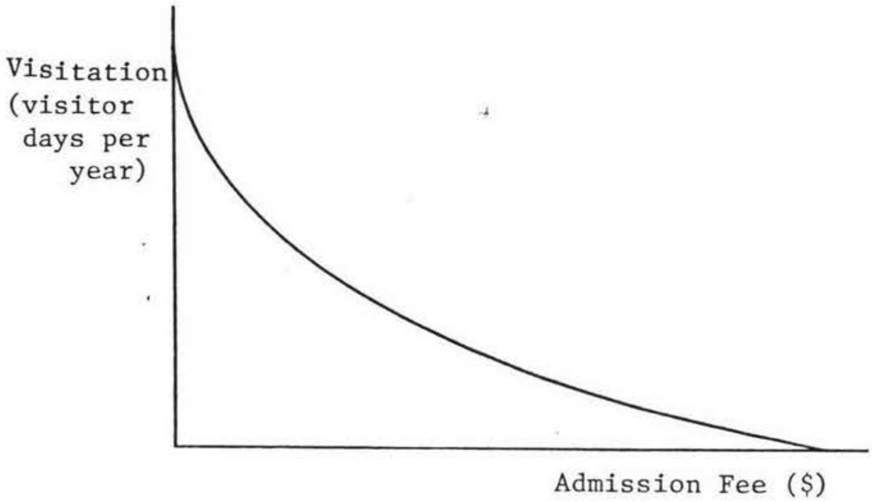

Figure 2.2 Recreation Site Demand Curve

At zero admission fee (i.e. the situation most relevant to outdoor recreation sites in New Zealand) consumers' surplus is equal to the total willingness to pay. In interpreting a 'Marshallian' demand curve it is necessary to assume that the marginal utility of income remains constant, that the utilities of different individuals can be aggregated and that the prices of other commodities do not change. Given these assumptions, there are two conventions associated with the Travel Cost Method for interpreting the derived demand curve. The first convention is to calculate the consumers' surplus equal to the area under the demand curve and present the value as a measure of 'worth' to the users. The alternative convention is to use the demand curve to find the maximum revenue obtainable by a non-discriminating monopolist, and accept that figure as the recreational value of the site comparable with similar private market evaluations. This latter method was used by Brown, Singh and Castle (1964) in analysing sports fishing in Oregon, they rejected consumers' surplus on the basis of being too difficult to interpret.

2.3.1 An Illustrative Example of the Travel Cost Method

The basic format of this hypothetical example was given by Knetsch and Davis (1966).

Consider the following data.

TABLE 2.1

VISITORS TO A HYPOTHETICAL RECREATION SITE

Zone	Population	Average cost of visit (TC)	Visitation	Visitation /1000 pop.
I	1,000	\$1	400	400
II	2,000	\$3	400	200
III	4,000	\$4	400	100
Beyond III			0	

From this data, a linear regression equation is estimated of the form

$$Y = a - b\ TC \tag{2.6}$$

where a = the Y intercept, and b = the regression coefficient.

The equation is:

$$V/1000 = 500 - 100\ (TC) \tag{2.7}$$

This equation (2.7) provides a 'whole experience' demand function, i.e. including the travel to and from the site. At zero admission fee, total visitation is equal to the sum of visitation from all the zones, i.e. 1200 visitor days.

At admission fee of \$1, the average cost of visit from each zone has increased by \$1.

Consider Table 2.2.

TABLE 2.2

VISITATION AT TRAVEL COST PLUS ADMISSION FEE OF $1

Zone	New Cost	Visits/1000 pop. (from regression equation (2.7))	Population (1000)	Visistation
I	$2	300	x 1	300
II	$4	100	x 2	200
III	$5	0	x 4	0
			TOTAL =	500

This step is repeated for various levels of admission fee to provide a demand schedule of the form shown in Table 2.3

TABLE 2.3

DEMAND SCHEDULE FOR HYPOTHETICAL RECREATION SITE

Price (admission fee $)	Quantity (total visitation, in visitor days)
0	1200
1	500
2	200
3	100
4	0

and a demand curve shown in Figure 2.3.

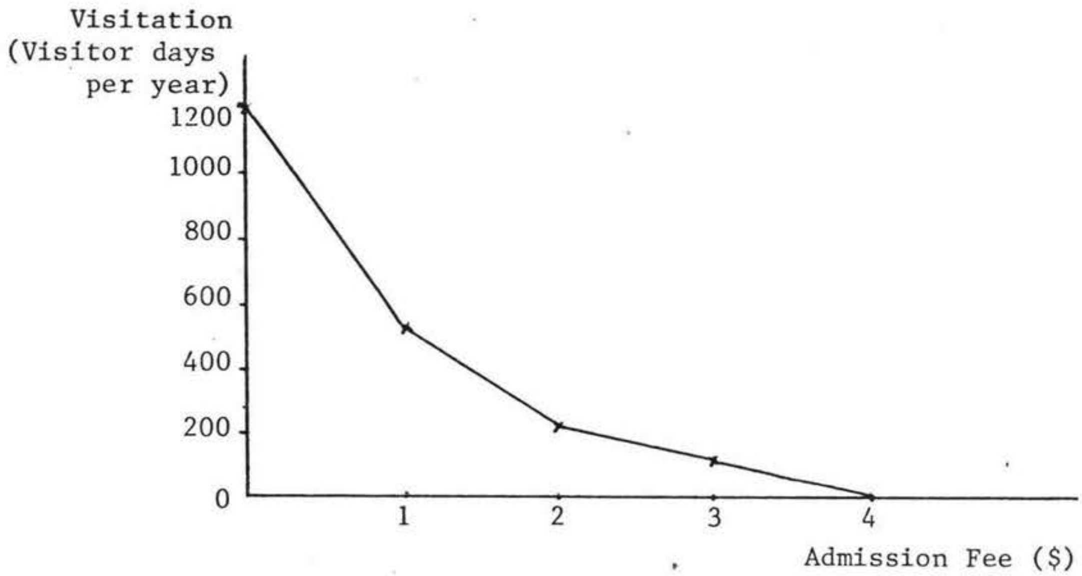

Figure 2.3 Demand Curve for Hypothetical Recreation Site

The area under the curve (Figure 2.3) will be equal to the recreationist's willingness to pay,

i.e.

$$\text{W.T.P.} = \int_{o}^{X_{max}} g(\lambda)d(\lambda) = \$1,500 \qquad (2.8)$$

where X_{max} is the admission fee at which the use of the site is zero,

and λ = index of integration.

So, in this example the consumers' surplus is equal to $1,550, therefore the hypothetical site is worth $1,500 per year to the recreationists.

2.4 Limitations and Further Developement of the Travel Cost Method

In order for the TCM to be applied confidently, several quite major assumptions must be accepted, some of which have been mentioned already. The extent to which the method is affected by theoretical restrictions, and various developments that have been introduced to improve the technique will be discussed in the remainder of this section.

The concept that minimum user benefits are reflected in user expenditure is essentially valid, (Comber and Biswas, 1973). Although public goods are not tangible market goods and no actual commodity is obtained through investment, returns may be assumed to be at least equal to the level of total expenditures. The assumption, however, that people will react in a similar manner to increases in site entrance fees as to increases in travel cost has drawn some criticism (Common, 1973). Travel costs consist of many smaller costs, some of which are not immediately obvious to the user, such that an increase would go unnoticed for a period. Entrance fees, however, are paid immediately. This problem depends largely on what definition of travel cost is used, that is, if 'perceived' travel costs[4] are used then the assumption may be considered valid.

The TCM assumes that a visitor's behaviour in relation to travel cost can be deduced from the behaviour of another visitor from a different zone. For example, a visitor from zone A with a travel cost of $2 and entrance fee of $3 will react in the same manner as a visitor from zone B with a travel cost of $5 and no entrance fee. Reaction (in terms of visitation) of the two visitors at the same cost may not be similar because the visitor from zone A still has less travel time (and associated travel time cost) than visitor B (Cesario and Knetsch, 1970). Given such a situation, total visitation rate may not fall to the extent indicated by the prediction equation and the estimated demand curve would understate the true benefits.

The idea of a value of travel time presents another obstacle to the TCM in that it should be included in any calculation of travel cost. The choice of the correct opportunity cost for the value of time is a

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[4]Perceived travel costs are costs that the traveller is aware of rather than the costs he actually does incur.

difficult task and is an area in which more research is needed before economists can confidently allocate a value to various groups of recreationists. Due to the lack of guidance in choosing a suitable value many studies choose to delete it from their analysis, although acknowledging the possible bias that may have resulted (Freeman, 1979). Some researchers have found that the value of travel time to the persons studied was actually zero. For example, Flegg (1976) carried out an iterative approach to 'anglers behaviour' in terms of a 'cost of travelling time' and found that it was best explained by a zero value. Cesario (1976), however, has reviewed and carried out many studies in an effort to allocate a correct value for time and has suggested an amount between a quarter and one half of the average wage rate of the zone in question. Cesario gave the following reasons for choosing this range of values:

1. His studies have shown that people do value their travel time in this range for urban transportation
2. Additional jobs do not pay as well as a main occupation therefore additional time is not worth as much
3. Recreationists include children and spouses who may be non-earners.
4. Travel is less burdensome than work and in fact may even be considered a benefit rather than a cost.

It would seem there is no general answer to the question of what value to use, the choice remains arbitrary.

Another problem is that travel cost and time spent on travel, both of which are demand variables, will usually increase by roughly the same proportions as they are likely to be highly correlated. This will lead to the problem of multicolinearity when including both variables in the regression equation, resulting in unreliable regression coefficients.

This situation is remedied by assigning a monetary value to travel time which is added to the travel cost. Although as mentioned earlier, there is a problem in allocating the correct shadow price.

One of the difficulties in allocating a travel cost figure to users is determining whether or not the visit to the recreation site was the only purpose for the excursion. The Clawson method assumes single purpose excursions but this is obviously not always the case, especially for visitors from distant areas. Tussey (1967) has provided the best workable solution in calculating "effective out of the way distance" rather than actual distance travelled, i.e. the distance that has been specifically travelled to make use of the recreational ammenity. Another alternative is if a visitor spends only half of his holiday time at a particular site his effective travel cost would be half that of his normal calculated travel cost (Jennings, 1975). Collins and Hodge (1981) deleted those respondents who did not return to the point of origin at the end of the trip as they felt that the distance travelled might not be related to the value they placed on the visit to the recreation site.

Smith and Kopp (1980) have considered the problems associated with visitors from distant zones and they hypothesise,

> "... an increase in distance from the site produces an increase in the likelihood of an origin zone's observed visit rate resulting from behaviour inconsistent with the conventional travel cost model".

They derived a statistical test with which to gauge the stability of the demand parameters and provide 'spatial limits' to the recreational Demand Model.

The TCM has difficulty in allowing for variations in quality of the recreation experience which intuitively would seem to be an important factor in determining visitation. For instance, crowding will decrease quality to many people. Stevens (1966) successfully allowed for quality changes in his analysis of the benefits from water pollution control by deriving a behavioural 'success-effort' relationship between the level of angling success and the quantity of angling taken. He linked the two factors to a biological production function effecting quality and formed demand curves for before and after a pollution clean up, thus providing an estimate of increased demand as a result of increased quality. The inclusion of quality aspects in the TCM is difficult, however, and perhaps necessary only in those situations where the recreation quality is expected to change to a reasonable extent.

The TCM has received further criticism for its failure to account for option demand (Anderson, 1974), that is, even though some consumers might never visit a recreation site they may still derive benefit from the knowledge of its existence, e.g. bird santuaries.

A main theme of the TCM is to derive a prediction equation for visitation using a variety of independent variables. Obviously the success of the model depends largely on whether or not the variables that do effect visitation are included in the regression equation.

The basic Clawson equation is:

$$V = f(TC,P) \tag{2.9}$$

V = visitation

TC = travel cost

P = population.

Many other variables have been tested over the years, for example Merewitz (1966) included population density and mean income. Tussey (1967) considered average family income, age, percentage of high income groups and route and competition characteristics. Stevens (1966), as mentioned earlier, introduced quality as a variable. The variables included in the model will obviously depend firstly on the ability of the analyst to obtain the data from the recreationists, and secondly on the variables having suitable influence on the dependent variable visitation. One variable that stimulates discussion is that of income. A basic assumption of the Clawson approach is constant taste. However it is argued (Seckler, 1966) that the amount of recreation taken will be dependent on the incomes of the users. Income can be included in the analysis in two ways. Firstly by including it as an independent variable, i.e.

$$V = a - b_1 TC + b_2 I \qquad (2.10).$$

I = income

or secondly by dividing the respondents into income groups and deriving prediction models for each group. Pearse (1968) considered that income groups would be more homogenous than distance zones. However, in many studies income has not been found to be greatly significant. Smith (1975) did not include income in his regression analysis on the grounds of statistically insignificant effects. Beardsley (1970, 1971) found that income was not a particularly significant determinent of recreational travel. Stevens (1966) and Sinden (1974) found income was significant, but for only some of the activities that they surveyed. Merewitz (1966) and Flegg (1976) did not find mean zone incomes consistently useful in explaining visitation rates. It would seem that it is prudent to test the significance of income for the particular study with the option of rejecting it as a dependent variable if it is non-predictive.

Another independent variable considered necessary in the travel cost prediction equation is one describing tastes and preferences. Deleting this variable would be equivalent to assuming all individuals have the same tastes and preferences, but its inclusion is usually considered to be much too complex. If there are different cultural and ethnic groups residing in the same zones then the problem becomes more acute. A workable solution to this predicament is presented in Sinden's (1974) utility approach to recreation valuation in which he gains, by means of a photochoice game[5], estimates of the intensity of tastes and preferences for a given recreation activity. However, within the basic TCM format, taste and preferences is a difficult variable to include.

A further variable considered desirable in the prediction equation is one that will account for variations in availability and quality of alternative recreation sites. The accessibility of substitutes will obviously vary from zone to zone making it a difficult variable to quantify and include in the analysis. Two distinct areas of thought have emerged as possible solutions to this problem, both of which however are largely ineffective, (Bishop, 1979). The first of these is a system of interrelated travel cost demand functions in which travel costs to substitute sites appear (Burt and Brewer, 1971; Cicchetti, Fisher and Smith, 1973). The second system is to use Gravity Models (Knetsch, Brown and Hansen, 1976; Cesario and Knetsch, 1976). These studies use single equation models that attempt to explain visitation rates between various sites by using accessibility measures and measures of attractiveness. Merewitz (1966) attempted to include availability of alternative sites in his study of the lake of the Ozarks but found it was not influential, probably as it failed to account for the quality of the alternatives as well. An added complication is expressed by Anderson (1974) in pointing out that the zones that generate trips to

[5]A photochoice game consists of presenting alternative choices to respondents in a visual form and establishing maximum w.t.p. for alternative strategies.

the site under study are not subject to the same set of prices for competing goods. Although distances vary, the price of getting alternate recreation will vary between zones also.

Further restrictions on the TCM include:

1. The method is applicable only if a large share of those who will be economically effected use the resource. For example, bird sanctuaries benefit many people who do not actually visit them because they gain satisfaction from the knowledge that wildlife is being protected.
2. The users of the site in question must be dispersed over a sufficiently wide area in order to get a meaningful curve relating visitation activity.
3. The TCM is a measure of physical actions with regard to recreation, it is not a 'true' measure of the gains from the experience which is wholly subjective. Even though people may do the same thing, some will enjoy doing it more than others.

Studies carried out using individual observation data (Nawas and Pierce, 1968; Michalson and Hamilton, 1973; Brown and Nawas, 1973; Gum and Martin, 1975) have indicated an increase in visitation estimation efficiency beyond that found when zone average data is used. Although it is generally accepted that individual observations provide more precise estimates of visitation, they do require more extensive surveys. Several economists (Flegg, 1976; Loomis, 1980; Freeman, 1979) have been unable to establish a clear relationship between travel cost and visitation due to the large variation in behaviour between individuals. Basically, prediction of individual rather than group behaviour requires the inclusion of many more independent variables in the regression analysis. The aggregated zone data will provide a higher correlation coefficient for the prediction equation, but this is considered to be due to the aggregation itself, not increased accuracy of prediction

(Flegg, 1976).

The TCM has developed further with the understanding that it is desirable to have separate demand functions for each activity at a particular site, (Kalter and Gosse, 1970). Flegg (1976) and Sinden (1978) have carried out extensive surveys to provide estimates of the benefits applicable to specific activities at a recreation site, but it would seem that a greater number of cases need to be surveyed and in more detail to provide a data base for the analysis.

2.4.1 Travel Cost Method - Conclusions

The Travel Cost Method has been used extensively and is perhaps the most accepted of current methods of recreation analysis, particularly with its various refinements directed towards specific situations. The numerous shortcomings of the technique are well documented such that we are at least aware of its limitations. The results of a Travel Cost Analysis will not provide a definite plan for development of a future site (it is perhaps best suited to existing sites) but it will provide reasonably clear alternatives of public policy and action, and decisions can be made with a clear (but not exact) statement of costs and benefits. Final decisions will be made on the basis of judgement and, to some degree, subjective appraisal, but the decision maker will have a more defined picture of his alternatives. A sensitivity analysis of the results is of value as an indicator of accuracy and confidence in the results.

CHAPTER 3. BACKGROUND TO LAKE TUTIRA AND ITS PROBLEM

3.1 Description of the Lake

Lake Tutira is situated 50 km north of Napier on state highway two and is a freshwater lake covering 174 hectares. The road to Wairoa follows the lake edge for a few miles providing easy accessibility for the recreationists who use the area for a variety of activities. The lake is surrounded by rolling hill country in pastoral use, farmed mostly by Tutira station, a sheep run first developed in the early 1900's. There are three adjacent lakes that form the area known as Tutira domain, these being Orakai, the smallest, and Waikopiro, both at the southern end, and Tutira, the main water area (see Figure 3.2). The lake waters are approximately 152 metres above sea level and Lake Tutira itself has a maximum depth of approximately 43 metres. On Lake Tutira can be seen the mythical floating island of Tauranga Koall which, when seen from successive vantage points along the highway, gives the impression that it is moving.

The area around the lake is extremely picturesque with an abundance of native trees, willows and grassy areas (see Figures 3.3 and 3.4). The original willow cuttings are rumoured to have come from Napoleon's graveside. The lake also supports a large variety of wildlife including black swan introduced from Australia. As a result of its pictorial splendour and peaceful, natural atmosphere, Lake Tutira has become a unique recreational resource to the many people who use it. Visitors attend Lake Tutira for many activities such as camping, picnicking, swimming, boating, sailing and fishing, as well as for just quiet relaxation. The Department of Lands and Survey and the

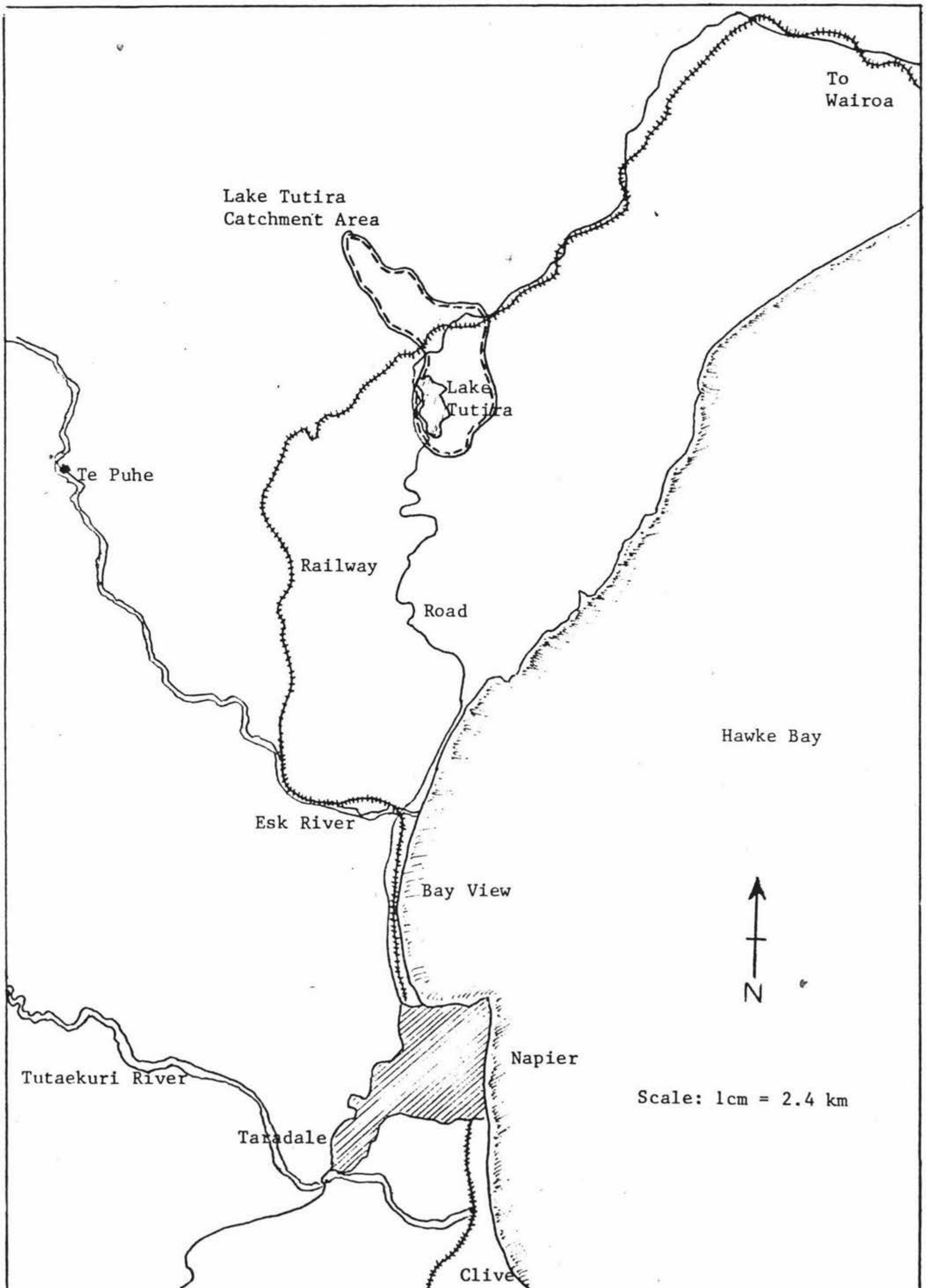

Figure 3.1 Lake Tutira Locality Map

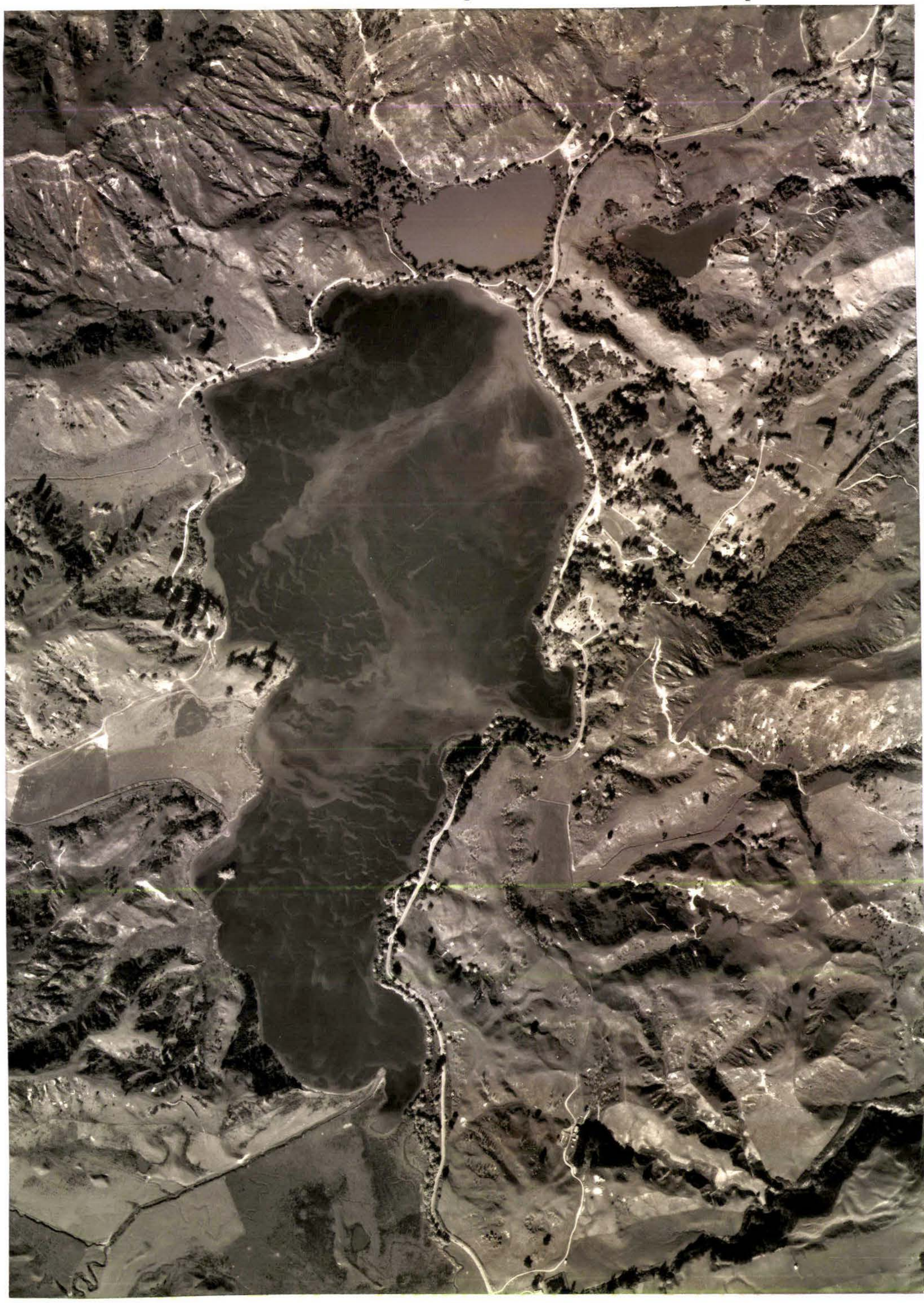

Figure 3.2 Aerial Map of Lake Tutira and Tutira Station (N.Z. Aerial Mapping Ltd., by permission of the Guthrie-Smith Trust)

Figure 3.3 Lake Waikapiro from northern end.

Figure 3.4 The eastern bank of Lake Tutira.

Tutira station manager have provided interesting walkways around the lake's edge and up into the surrounding hills which have proved very popular with the visiting recreationists.

Tutira station also provides facilities for a youth hostel on the edge of the lake which is popular throughout the year with low budget travellers. In addition to this, the trust administers an outdoor recreation institute which is available to school parties throughout the year for the teaching of outdoor skills, and for introducing city children to a rural environment. The institute caters for up to 1800 children each year.

During recent years however, the lake waters have been subjected to severe eutrophication which has resulted in a marked decrease in the quality of both the water and the recreational experience. The number of people visiting Lake Tutira has decreased in direct contrast to the national trend of increasing recreational activity. The problem becomes more acute when it is considered that Lake Tutira is the only freshwater lake of reasonable size in the region. For many recreationists an alternative recreation site to Lake Tutira involves travelling to Lake Waikarimoana (180 km from Napier) or Lake Taupo (150 km from Napier) both of which involve travelling on steep, windy roads.

The reasons for the decreasing water quality have been identified and these are outlined in section 3.3. Also a remedy for the situation has been proposed, and this is presented in section 3.4. The remedy, however, involves public expenditure which, up until early 1981, was not forthcoming due to two main reasons. Firstly, nobody could decide who should provide the funds, and secondly, whether or not the expenditure was justified in terms of the benefits received. The potential benefits were mostly of an intangible, non-monetary nature and there was no information as to whom these benefits would accrue. After a lengthy period of debate between local bodies and central government a financing package was finally approved in 1981. Seventy percent of the clean-up costs would be met by central government and thirty percent would have to be found from within the Hawke's Bay. It should be noted that the decision to provide finance for the clean-up scheme was a result of subjective consideration, there was no acceptable objective measurement of the value of a restored Lake Tutira to the public. This is not to be taken as a criticism of the decision, the point is mentioned merely to highlight the problem, mentioned in chapter one, of allocating funds for the provision of public goods. In the remainder of this study an objective technique is used to measure the monetary value of Lake Tutira to the public as a recreational amenity.

3.2 History of the Lake Area

Lake Tutira is thought to have been formed thousands of years ago by massive volcanic upheaval, and has evolved slowly over the years into an ecosystem supporting an abundance of vegetation and animal life. Geologists feel that the original lake outlet was probably at the southern end of the lake where it joined the Waikoau river, but a massive landslide sealed the southern outlet, giving rise to the unusual situation of having the outlet and inlet adjacent to each other at the norther end. The existing outlet is called Tutira stream, which later becomes the Maheawha stream, until it joins the Waikoau River. The inlet is called Papariki or Sandy Creek.

In the early 1800's it was estimated that as many as five different fortified Maori pa's were positioned around the lake, relying on Tutira for food and protection. In 1873 the land surrounding Lake Tutira was leased from the Maoris and cleared of bush by burning. The land was then used as a sheep run (see Figures 3.5, 3.6) and gradually, because

Figure 3.5 The eastern side of Lake Tutira showing open pasture-land and direct stock access.

Figure 3.6 A view of the lake from Tutira Station homestead on the western aspect.

of conflicts between Pakeha and Maori, the local Maori people were driven away from the lake area. In the 1880's magnificent black swan were introduced to the lake from Australia and remain today one of the main attractions of the Tutira domain. In the 1890's the station owner H. Guthrie-Smith, as part of his land clearing policy, cut a drain through the existing swamp at the northern end of the lake, what is now Papariki stream. This, however, had the adverse effect of nullifying the filtering action of the swampland in removing nutrients and sediment from the inlet waters, a major cause of the present-day eutrophication. In the early 1920's trout were successfully introduced to the waters of Lake Tutira, however their propogation has always been restricted by the lack of good spawning grounds, the only suitable spot being Papariki stream. Nevertheless superb trout fishing was enjoyed on the lake for many years until the water quality began to effect fishing success. In 1925 Guthrie-Smith surveyed the lake by recording 375 depth soundings, and he later noted that in 1931 a massive earthquake raised the level of the lake by several feet.

In the 1950's the first aerial topdressing of phosphate fertiliser began, a major factor in the resulting eutrophication. In 1959 the first algal blooms were noticed on the lake and by the early 1960's a definite problem of eutrophication had become obvious to the lake users in the form of dense weed beds, scum on the lake surface and the occasional dead fish.

In 1963, P.J. Grant carried out the second survey of Lake Tutira and discovered that the mean depth of the lake had decreased by 1.1 metres, presumedly from a massive inflow of sediment into the lake over the intervening years. In 1970, the fisheries management division of the Ministry of Agriculture and Fisheries did an initial study on the situation at Lake Tutira which confirmed that the area was in an advanced state of eutrophication. As a result of this study, during the years 1973 to 1975 a detailed sampling programme was carried out to record the seasonal pattern of summer thermal stratification and winter mixing. In 1974 the local people were sufficiently worried about the future of the lake to form a Lake Tutira Technical Committee, set up to investigate the problem and make recommendations on a solution. In an attempt to stop the process that was effectively killing the lake water six air guns were placed beneath the surface of the lake in 1975 to facilitate the mixing of the water during the summer months. This attempt at destratification was marginally successful in preventing further deterioration in water quality however the process was discontinued in March 1979 due to the rising costs of electricity and maintenance.

In 1976 the Tutira Technical Committee released a report based on their investigations entitled "Lake Tutira and its Catchment: Current Condition and Future Management". This report was studied and then discussed at a public meeting in early 1977 during which the majority of the committee's recommendations were approved. In late 1980, this study was begun in an attempt to quantify the value that Lake Tutira has to its users, thus providing information for inclusion in a cost-benefit framework that could be used to help decide whether or not finance for the clean-up programme should be forthcoming from central government. In a surprise, but well received move, a government grant of $181,630 was approved in early 1981, seventy percent of the total clean-up cost of $259,470, leaving $77,840 to be found from within Hawke's Bay over the five year period of the scheme. Work was started in 1981 on the initial stages of the scheme, outlined in section 3.4, and it is hoped that a major improvement in Lake Tutira as a recreational resource will be seen in the not too distant future.

18.4.80

Funds sought to improve Lake Tutira

The four main local authorities in Hawke's Bay are to be asked for funds toward financing the local share of a $250,000

"Parochialism" alleged on Tutira issue

"Petty parochialism" was to blame for the lack of support for Lake Tutira improvement scheme, the chairman of the Catchment Board's soil conservation com... said yesterday.

22.4.80

Lake support not favoured

Financial assistance for the improvement of Lake Tutira is unlikely to be forthcoming from the Napier City Council.

28/6/8

Chairman deplores Tutira controversy

The controversy sparked off by the Hawke's Bay Catchment Board's recent request local authorities to contribute a "small sum of money" for the rehabilitation of Lake Tutira w "disappointing — in fact deplorable", the board chairman, Mr D. G. J. Walker, said yesterday

20/11/80

Lake Tutira scheme awaits local share

Work on the first stage of the Lake Tutira Improvement Scheme could be under way early next year if the local share of the finance needed were available.

Save 'our' lake

Hastings City councillors against aiding lake work

Could the Hastings City Council justify giving money towards improvements to a place as far away as Lake Tutira while at the city's back door there was an amenity like the Clive river which was "crying out" for assistance, Cr J. G. Seton said last night.

'Save Tutira' plan adopted

A public meeting in Napier yesterday unanimously adopted a Hawke's Bay Catchment Board plan to save Lake Tutira.

25.6.80

Council won't aid lake

29.1.80

Fate of Lake Tutira up to HB public?

Lake Tutira could die if public support and public opinion do not get behind the lake's cause.

3.3 The Eutrophication Problem

The waters of Lake Tutira have gradually over the last thirty years taken on the appearance and smell of a stagnant pond, especially during the summer months (see Figure 3.7). This algal growth, discolouration and smell is called eutrophication and the phenomena is usually caused by plant nutrient enrichment of the lake water. The nutrients which are most associated with algal growth are phosphorus and nitrogen, both of which are supplied to New Zealand pasture land in copious amounts. This algal growth causes a change in the natural balance of plants and animal life in and around the lake and eventually causes the lake water to lose its clarity. As the algal bloom continues, consisting of many different algae types, scum is formed on the water surface and certain algae types emit an unpleasant odour. Toxic substances are produced which eventually threaten the fish population, already placed under stress by the oxygen debt created by bacterial action in the lower water regions. Ministry of Agriculture and Fisheries data from the 1973-75 survey of Lake Tutira indicated that the water below 10 metres (i.e. 70% of the lake's volume) was completely devoid of oxygen. With this stratified situation arising during each summer period, bacterial action in the oxygen-free region converts nitrates to harmful ammonia, and hydrogen sulfide is produced in toxic quantities by anaerobic bacteria. At Lake Tutira the fish are forced to obtain their oxygen from the top few metres of the lake thus placing them under even more stress from the sun heated surface water. The two year M.A.F. investigation concluded that Lake Tutira was in an advanced state of eutrophication, a situation which would eventually result in the lake no longer being available for recreational purposes.

Figure 3.7 The Algal Bloom

The eutrophication problem is more visually obvious when the surface waters are disturbed by a light wind.

The Hawke's Bay Catchment Board report entitled "Lake Tutira Catchment Control Scheme", (Peptoe, 1980) identifies four main factors that are considered to be causing eutrophication in Lake Tutira.

1. The development of the lake catchment for agriculture resulting in increased runoff levels, fertilizer policies, waste disposal and stock access.
2. The frequent high-intensity storms depositing large quantities of silt in the lake.
3. The proximity of the outlet to the inlet resulting in minimal flushing action of the lake.
4. Other activities of man, such as road development and sewage disposal.

These factors greatly increase the nutrient flow into the lake causing enrichment far beyond the natural level and eventually leading to advanced eutrophication.

Before consideration was given to ways and means of decreasing the nutrient loading into Lake Tutira, a nutrient budget was calculated by the Soil Bureau, Department of Scientific and Industrial Research. In particular, a phosphorus budget was worked out to estimate the magnitude of any suggested works needed before a reasonable improvement in the lake waters could be expected. The conclusion of the scientist in charge of the nutrient survey was that the phosphorus loading would need to be reduced by 5-10 times the current quantity (McColl, 1978). The D.S.I.R. report also pointed out that approximately 90% of the harmful nutrients seem to enter Lake Tutira via the inlet, Papariki stream, implying that diversion of this nutrient rich water would have a marked effect on the lake's level of deterioration. A comparison of Lake Tutira's phosphorus loading compared with an acceptable level as determined by Vollenweider and Dillon, (1974) is illustrated in Figure 3.8, and Table 3.1 gives a breakdown of phosphorus inputs to Lake Tutira.

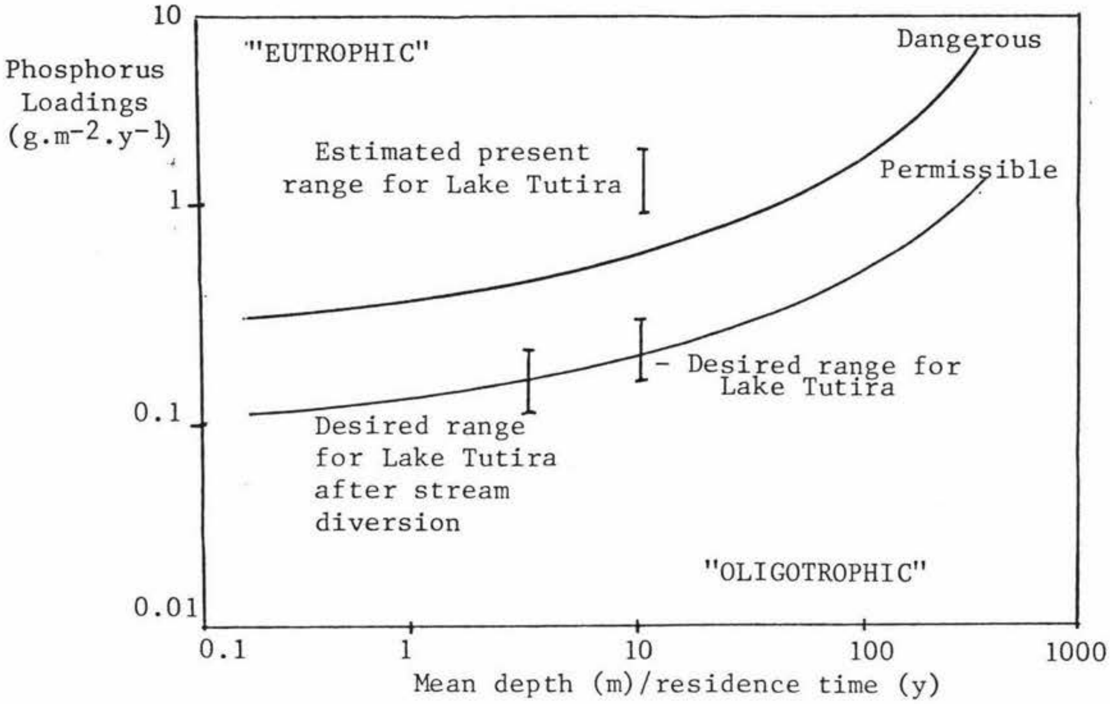

Figure 3.8 Phosphorus loading curves (from Vollenweider and Dillon, 1974) showing the estimated loading for Lake Tutira. (From McColl, 1978)

TABLE 3.1

ESTIMATED PHOSPHORUS INPUTS TO LAKE TUTIRA FROM ITS CATCHMENT. (FROM McCOLL, 1978)

Input	Phosphorus ($kg.y^{-1}$)
Fertilizer run-off	700
Dung/urine run-off	300 - 1600
Soil erosion	1000
Sub surface run-off	300
Other sources	100
Total	2400 - 3700 $kg.y^{-1}$

3.4 The Proposed Remedy

The overall objective of the clean-up scheme prepared by the Hawke's Bay Catchment Board and Regional Water Board is to reduce the levels of nutrients entering Lake Tutira. The scheme was designed on the basis of the recommendations of the Lake Tutira Technical Committee. The proposed scheme has been divided up into four areas (Peptoe, 1980) and these will be dealt with separately.

A. On-farm erosion control works

This involves retiring the stream and lake edges from stock to eliminate bank erosion, and the planting of trees in erosion susceptible areas. Control of goat and noxious weed problems will also require consideration.

B. Lake shore considerations

A buffer area in the form of a reserve will be created around the lake's edge preventing direct stock access, providing a vegetative filtering zone for runoff, and presenting an aesthetically pleasing environment suitable for an increased level of wildlife. In addition to this, a number of ponding areas are proposed for the lower catchment area to allow the sediment time to settle out of the water before its entry into the lake.

C. Sandy Creek (Papariki) division

The objective of the diversion canal is to divert nutrient-rich and sediment-laden runoff from entering the lake during excessive rainfall or flood conditions. It is thought (McColl, 1978) that such a diversion option could possibly reduce the annual phosphorus loading from approximately 3100 kg/year to around 850 kg/year. The diversion canal itself will link up with the adjacent lake outlet, Tutira stream

(Mahiaruhe), thus causing extra flow during peak rainfall to bypass the lake completely.

D. Operating guidelines and management techniques for specific activities

Guidelines are recommended concerning effluent disposal, road maintenance, lake shore public use and vegetative removal. The estimated costs for the scheme are presented in Table 3.2 (Peptoe, 1980).

TABLE 3.2

SUMMARY OF COSTS OF THE TUTIRA SCHEME

On-farm soil conservation works	105,185
Lake shore protection measures	63,824
Sandy Creek (Papariki) diversion	20,000
Contingencies (10%)	18,900
Conservation fee (20%)	41,581
TOTAL COST	$249,490
Yearly maintenance cost	$10,000

A successful cost-benefit analysis on the scheme to evaluate its feasibility and financial viability was not possible due to the lack of information regarding the recreational benefits resulting from the clean-up. Using the available information some attempts have been made to present an economic analysis of the scheme (King, 1976; Peptoe, 1980) but the results were inconclusive. In chapter 8 the scheme is re-evaluated using the information gained from this study to provide an accurate indication of the scheme's economic viability.

CHAPTER 4 THE SURVEY

Part One: Survey Design and Technique

4.1 Introduction

The objective approach of the indirect TCM is heavily reliant on the quality and form of the information available for analysis. This information is, in the majority of cases, most readily obtainable through a survey of the population of interest. The method used to elicit information from recreationists of Lake Tutira was the personal interview approach, a system used extensively throughout the world to provide data for predictive purposes.

Before designing a survey, however, it is necessary to be clear on three important points. Firstly, the purpose of the exercise is to be made perfectly clear to the survey designer. For the survey of Lake Tutira it was envisaged that information on visitation and travel costs relating to the recreationists journey to the site would be obtained in a form that would allow manipulation of the data into many suitable variables. The visitation and travel cost information is fundamental to the TCM. Further information on socio-economic factors pertaining to the recreationists was considered necessary for predictive purposes, as was data on user activities, travel time and alternative sites. Finally, information on the recreationists feelings and comments with regard to Lake Tutira was considered to be of some use in formulating lake management policies.

The second point the analyst should determine carefully is the correct population on which the survey should focus. Obviously the data would only have credence if elicited from the correct respondents, that is, those people who are use-related to Lake Tutira. In the case of Lake Tutira the correct survey population (sampling frame[1]) was considered to be any family or group who spent more than a few hours at the lake itself.

Thirdly, the intended survey needs to be restricted to within the bounds of the resources available. The extent of the survey was dependent on the amount of finance available, the number of labour units available, the period of time allowable, and the survey needed to be carried out during the summer recreation months of the year (i.e. December to March).

After establishing these three points, the design of the survey base began, and the steps taken were divided into six stages; qualitative and exploratory work, questionnaire construction, sampling, interviewing, and editing. Each of these stages will be dealt with separately.

4.2 Qualitative and Exploratory Phase

This stage of the survey consisted of a non-quantitative collection of all available information relating to the study. Usually in survey design the first sources of information that are checked are the secondary sources, for example, data that has already been collected, and studies that have already been done. Little work has been done on Lake Tutira, and studies that have been done are mainly on the scientific/ecological side. The reports resulting from these investigations were obtained and studied. Information on frequency of use, past visitation figures, management policies, future prospects for

[1]The sampling frame is explained in more detail in section 4.4.

Lake Tutira, past attempts at recreation analysis and levels of pollution experienced was available from the secondary sources.

Another form of exploratory work carried out was personal discussions with people involved with Lake Tutira. Meetings and correspondence were had with Mr.Gailbraithe, the custodian of Lake Tutira; a neighbouring farmer; the local M.A.F. advisory officer (econs.); a member of the Fisheries Research Division, MAF; a member of the soil division, D.S.I.R.; the chief engineer of the regional water board; and the president of the Hawke's Bay Trailer-Sailor Club. The information gained from these informal discussions allowed an overall picture of the situation at Lake Tutira to be built up, thus providing a base for future analysis and information for use in the survey design. The final source of secondary data was the university library which provided a book on Tutira entitled "Tutira. A Story of a N.Z. Sheep Station" by H. Guthrie-Smith containing useful background information, and the 1980 Official N.Z. Year Book was used for statistical information about the origin visitation areas.

During discussions with survey experts from the marketing department at Massey University it was decided that in the Tutira survey emphasis would be placed on the quality of the data obtained rather than the quantity. This attitude towards smaller samples is a result of the lessening of errors due to the sampling process and the understanding that a lot of erroneous information is not of great value to anyone. This attitude was carried through into the questionnaire design stage.

4.3 Questionnaire Construction and Piloting

The final draft of the questionnaire was a result of extensive design and testing of the individual questions. Once the basic format was established the form of the questions was refined many times by contact with marketing personel and collegues, during which all foreseeable misconceptions and irregularities were removed. This is a necessary, though time-consuming, part of survey design. The format required eight or nine corrected drafts before it was considered of sufficient correctness to be tried out in a pilot survey. The pilot survey was necessary to indicate any ambiquities and misconceptions in the question design not picked up by the university staff involved whom it was thought may have a better understanding of the question format than the average recreationist. The pilot study was carried out over two days at Lake Tutira during which no major difficulties were found in administering the questionnaire to the recreationists.

The individual questions used in the questionnaire are presented in the remainder of this section, with the reasons for, and problems associated with their use. A copy of the questionnaire can be found in Appendix Four.

The first question was designed to prevent people being interviewed twice on the same visit, i.e.

question (1) "HAVE WE ASKED YOU TO COMPLETE A QUESTIONNAIRE ALREADY ON THIS VISIT TO THE LAKE?"

The questions 2 to 6 serve the purpose of providing a picture of the trip made to Tutira and back again to determine the importance of the visit to Lake Tutira as a part of the overall trip, i.e.

question (2) "WHERE IS YOUR HOME TOWN?"

question (3) "FROM WHAT TOWN DID YOU BEGIN YOUR TRIP?"

Question 3 was included after it was found that some people began their trips from centers other than what they considered to be their home town, and question (4) "AT WHAT PLACES DID YOU STOP ON THE JOURNEY FROM YOUR HOME TO TUTIRA?"

question (5) "WHAT PLACES DO YOU PLAN TO VISIT WHEN YOU LEAVE TUTIRA?"

Questions 6, 7 and 8 were designed to provide information on visitation frequency and length, i.e.

question (6) "HAVE YOU VISITED TUTIRA BEFORE?"

(7) "HOW MANY DAYS WOULD YOU ESTIMATE YOUR GROUP WOULD SPEND AT TUTIRA PER YEAR?"

(8) "HOW MANY VISITS WOULD YOU ESTIMATE YOUR GROUP WOULD MAKE TO LAKE TUTIRA EACH YEAR?"

Questions 9 and 10 provide data to calculate the percentage of the overall trip or holiday time spent at Lake Tutira, i.e.

question (9) "HOW LONG ARE YOU PLANNING TO STAY AT TUTIRA ON THIS TRIP?"

(10) "HOW LONG WILL YOU BE AWAY FROM HOME ON THIS TRIP?"

Question 11 was an attempt to get the respondents' 'perceived' travel costs for the round trip to Tutira. It was thought that the visitors conception of their travel costs was the more appropriate variable for measuring demand. However, after initial piloting and testing over the first two visits to Lake Tutira it became obvious that a large majority of the respondents 'perceived' their travel costs to be petrol costs. After this was realised, the question was removed from the questionnaire as it was possible to calculate a petrol cost variable from exogenous information.

question (11) "WHAT WOULD YOU SAY YOUR APPROXIMATE ROUND TRIP TRAVEL COSTS WOULD BE FROM YOUR HOME TO TUTIRA AND BACK

AGAIN? THE TRAVEL COSTS ARE THOSE OVER AND ABOVE THAT WHICH YOU WOULD HAVE SPENT IF YOU HAD REMAINED AT HOME"

Question 12 established driving time to Tutira, i.e.

question (12) "WHAT IS THE APPROXIMATE DRIVING TIME FROM TUTIRA TO YOUR HOME?"

It was thought at the time of questionnaire design that the variable, travel time, could be used as a predictor variable but this was not possible due to multicolinearity[2].

Questions 13 and 14 divided the respondent groups into lake use catagories, firstly for the purpose of visitation prediction, and secondly to provide quantitative lake management information on the uses to which the lake is put. The respondents were asked,

question (13) "WHAT ACTIVITIES WILL YOU GROUP PARTICIPATE IN WHILE AT TUTIRA?"

and a list of possible activities was shown to the respondents on a show card, thus allowing the answers to be easily coded within the catagories listed,

question (14) asked,

"WHICH OF THESE ACTIVITIES IS THE MAIN REASON FOR YOUR GROUP'S VISIT TO TUTIRA?"

thus classifying the groups into one main catagory.

Question 15 was introduced to the questionnaire in an attempt to obtain usable information on alternative sites for use in the visitation prediction model. The second part of the question allowed a list of alternative sites to be made up with an indication of their relative

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[2] Multicolinearity results when more than one highly intercorrelated variable is introduced into a regression equation, e.g. where distance and travel cost are highly correlated.

popularity, "IF LAKE TUTIRA WERE NOT OPEN TO THE PUBLIC WOULD YOU HAVE CHOSEN AN ALTERNATIVE PLACE TO VISIT?" and if yes, "WHAT ALTERNATIVE AREA WOULD YOU HAVE CHOSEN?"

Question 16 obtained information on engine size of the group vehicle for use in calculating round trip petrol costs, i.e.

question (16) "WHAT IS THE ENGINE SIZE OF THE VEHICLE YOU TRAVELLED IN TO LAKE TUTIRA?"

If the respondent did not know the answer to this question the interviewer was to make a note of the make and model of the vehicle.

Question 17 was used in the questionnaire to help determine the necessity of including a travel time cost in the prediction equation (as advocated by Cesario, 1976). As most studies in this field involve travel time related to work, it was decided that a question would be included in the survey to ascertain whether or not the majority of groups considered the time spent in driving to the recreation site a cost incurring experience. The question was,

question (17) "GENERALLY, WOULD YOU SAY THAT THE TIME SPENT IN DRIVING TO TUTIRA WAS A PLEASANT OR AN UNPLEASANT EXPERIENCE?"

Question 18 was not necessary for use in the TCM, but as willingness to pay questions of a similar kind have been used extensively in the past to value recreation sites, it was thought that the results of such a question might provide an interesting comparison with the results of the TCM. The question was,

question (18) "DUE TO POLLUTION, LAKE TUTIRA MAY NOT BE AVAILABLE TO THE PUBLIC IN THE FUTURE. WHAT AMOUNT OF MONEY

WOULD YOU BE WILLING TO PAY PER YEAR TO RETAIN THE USE OF THE LAKE IN GOOD CONDITION? IT IS NOT INTENDED THAT YOU SHOULD EVER BE ASKED TO PAY SUCH AN AMOUNT, BUT I WOULD APPRECIATE YOUR OPINION"

Question 19 involved eliciting information about the group on socio-economic factors of age, sex and occupation. This question was restricted to these three catagories to minimise the possible non-response reaction from the people being interviewed. As it was, the question still required some tact from the interviewer when questioning age and specific occupation. Occupation was chosen as being less intrusive than asking for income level. The occupation was later given an Elley-Irvine socio-economic ranking[3] for use in the analysis. The form of the question was left to the interviewer, allowing flexibility in obtaining the information.

The final question, number (20) was,

" DO YOU HAVE ANY COMMENTS YOU WOULD CARE TO MAKE ABOUT LAKE TUTIRA?"

This question was chosen for two reasons. Firstly, to provide valuable impressions from the users about Lake Tutira which could be used in management proposals, and secondly to make the respondent feel happier and more involved in the questionnaire by being able to state his or her view, however irrelevant, at its conclusion. The interviewer was instructed to make a note of any relevant information pertaining to Lake Tutira. The slight disadvantage of prolonging the time span of the questionnaire was considered insignificant against the goodwill the concluding remarks often generated.

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[3]An explanation of the Elley-Irvine socio-economic index is given in Appendix Five.

Finally, the respondent was asked for his or her name and home address, and thanked for their co-operation. Asking home addresses presented no problem as the questionnaire involved no particularily personal questions and confidentiality was stressed at the beginning of the questionnaire. The information on name and address was useful for cross-checking respondents who had been interviewed more than once.

In practice the questionnaire was found to be easy to administer and the respondents in most cases had little trouble in understanding the questions. The layout of the questionnaire (see Appendix Four) facilitated easy recording of the answers and the period of time spent doing the questionnaire did not impose on or bore the respondents to any great extent. A basic rule that was adhered to throughout the design stage was that, wherever possible, the data obtained from the questions should be of a metric nature[4]. Non-metric data severely limits the statistical analysis that can be carried out and in fact is meaningless when used in the context of regression analysis[5].

4.4 Sampling

In order for the survey to be of a representative sample it is necessary for the analyst to have information on four points; the sampling frame, the distribution of attendance, an estimate of total yearly visitation, and the survey method. These points will be dealt with separately.

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[4]Metric data (interval and ratio level measurements) have the property that the distance between the catagories is defined in terms of fixed and equal units.

[5]The exception to this rule is the use of dichotomies, such as yes and no answers.

4.4.1 The sampling frame is that part of the population from which the sample will be drawn, and in the case of Lake Tutira it is all groups that visit Lake Tutira for more than a period of three hours. This distinction is made to distinguish between recreationists and groups that merely stop for a short period for lunch or a cup of tea and then carry on with their journey. In the survey of Lake Tutira the sampling frame is equivalent to the sampling universe, i.e. the actual population using Lake Tutira is sampled.

4.4.2 The second point concerns the distribution of attendance. An estimate of the times when people visit Tutira is necessary to ensure that the times of concentrated use are sampled. Exploratory work had indicated that Lake Tutira is patronised mainly on the weekends and public holidays during the summer period. As a result of researching secondary sources, contact with persons involved with Lake Tutira, and the author's personal observations, a picture of the use distribution was built up. The estimated distribution is illustrated in Figure 4.1. The research also indicated that visitation within monthly periods was mostly during the weekends and public holidays.

4.4.3 The third necessary piece of information for the survey design was an estimate of the total visitation to Lake Tutira per year. Once again this figure was estimated from secondary sources and personal contact. The amount arrived at was 10,000 individual visitor days per year, although local residents commented that visitation had decreased during the past five years by as much as 7,000 visitor days, apparently due to the decreasing quality of the lake water. The figure of 10,000 visitor days can be considered a conservative one, and in chapter 7 a sensitivity analysis is done on the final results to test the effect of using a larger estimate of visiting population in the analysis.

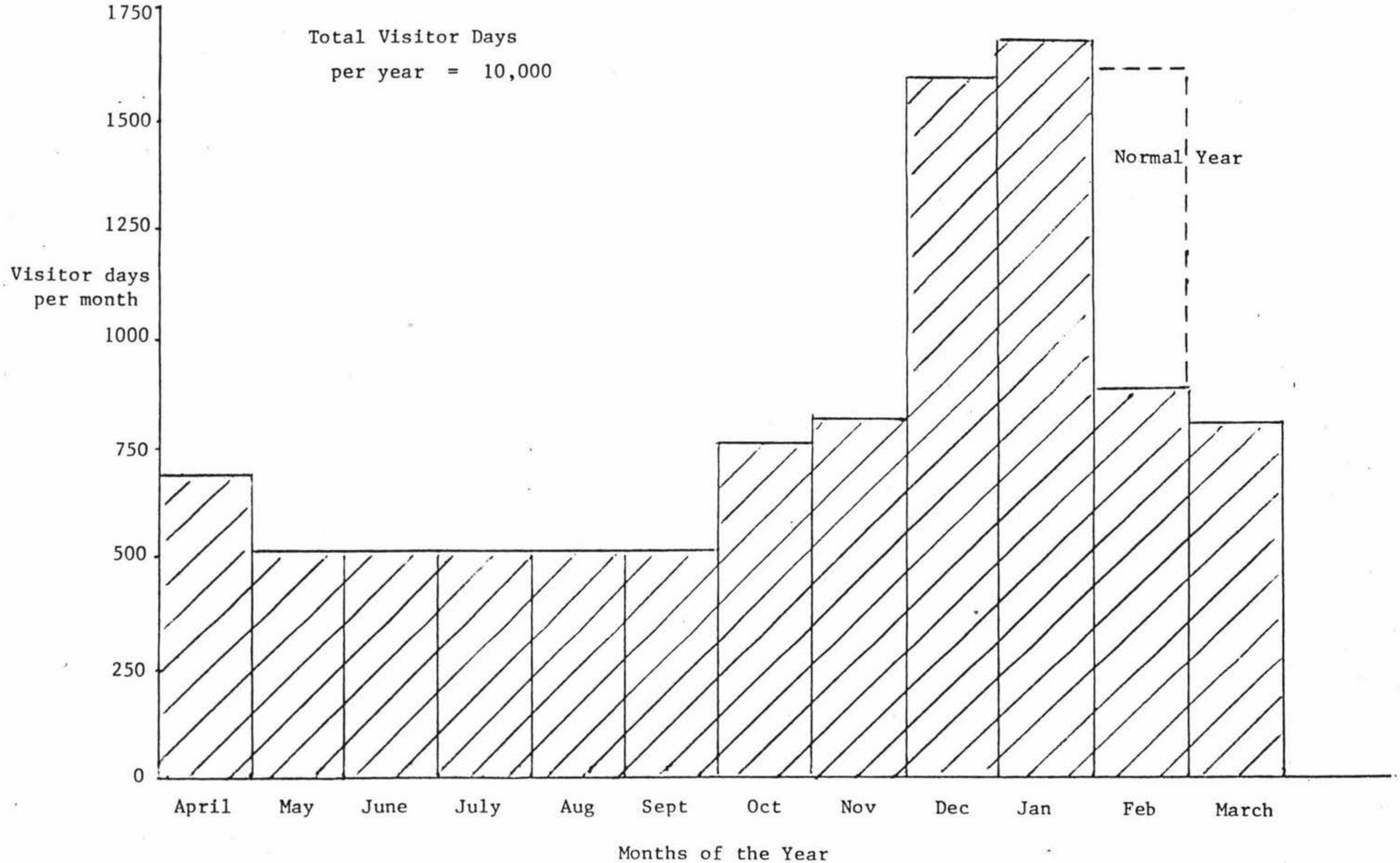

Figure 4.1 Distribution of Yearly Visitation to Lake Tutira (1980/81)

4.4.4 Finally, given the previous three points, a decision was made on the sampling method. Ideally the type of sampling method should be a simple random sample[6], but this survey was restricted firstly by finance, and secondly by the fact that the interviewers were based 196 kms away from Tutira, in Palmerston North. Obviously some control had to be maintained over the number of trips made for the purpose of surveying. After discussions with survey experts it was decided to sample on the weekends and public holidays as much as possible. Additional sampling accuracy was obtained by sampling every eligible group during the sampling period. That is, on a particular survey weekend, every visiting group, with the exception of the 'outlaws' motorcycle gang, was sampled. In addition to this, several random mid-week days were chosen for sampling to check for any sampling bias associated with the method.

In total, twenty days during the months December to March were spent at Lake Tutira for the purpose of sampling the population. During the survey 150 groups of recreationists were interviewed, but after editing this number reduced to 143 sampled groups. This accounts for approximately 570 individual users of Lake Tutira within the sampled groups.

4.5 Interviewing

The survey research methodology used was the personal interview approach administered by the author and two other persons. The interviewer systematically worked through all the groups visiting Lake Tutira on a sampling day, firstly establishing the head of the group or

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[6] Each member (group) in the sampling universe has an equal chance of being included, and that chance is not dependent on whether any other member is included or not.

driver of the vehicle associated with the group. The questionnaire was then administered to this person. The confidentiality of the information received was stressed at the beginning, and the interviewers wore identification cards as proof of the survey's university basis. The following list of instructions was delivered to the interviewers in order to minimise error.

1. The purpose of the study and who was carrying it out was to be made perfectly clear at the outset in order to gain the respondent's interest.
2. The interviewers were to endeavour to be neutral in their approach, e.g. try not to give the impression that they were environmentalists, as this might effect the type of response.
3. If the respondent had any doubts or problems, the aims of the study were to be explained and any questions answered before beginning the questionnaire.
4. If during the questionnaire the respondent did not understand a particular question it was to be repeated slowly and clearly, but the interviewer was not to try and explain the question in his own words. It is important that all respondents answer the same questions, administered in the same form.

This personal interview approach resulted in only one respondent out of 150 refusing to answer the questions.

4.6 Editing and Coding

The editing stage of the survey involved preparation of the information for analysis. This involved firstly checking the quality of the questionnaires, correcting any recording errors and making sure the answers were within valid ranges. Following this the results were made clear for coding purposes by ensuring that answers were in the correct units and within coding ranges. Next, the data was coded in a form that would facilitate computer analysis. Answers in numerical form were recorded to within two decimal places if necessary, and dichotomised answers were coded 1 and 2. Open ended questions such as the one on 'main activity' were given numeric codes for each catagory. The 'main accupation' answer was coded one to six using the Elley-Irvine socio-economic ranking (see Appendix Five). The use of numeric rather than alphanumeric codes was due to the ease of computer manipulation of numeric data compared to alphanumeric information. All 'don't know' answers were recorded as 999 so as not to be counted as zero. At no stage was metric data coded into catagories as this would cause a loss of precision in the analysis.

The coded results were then placed on a B6700 computer disc file for future access. The computer editing facilities allowed manipulation and transformation of the data within the main file.

4.7 Survey Error

In an attempt to minimise survey error the possible problem areas that might result in errors were considered. The precision of the sampling method was important to the final results, so some indication of the causes of sampling error was considered worthwhile. Sampling error is dependent firstly on sample size, which in the case of the Tutira study was not large. Secondly it is dependent on the variability of the characteristic under study, and the third factor is the survey design. It is in the third area that precision of the Lake Tutira survey could be controlled. Interviewing and recording errors were minimised by clear questionnaire design, and successful attempts were made to minimise non-response. The measure of this sampling error is called the standard error of the estimate and is provided within the analysis framework in later chapters (5 and 6).

Another source of survey error is bias which can be brought about by such things as interviewing the wrong people and non-response, and is a result of some persons having a greater chance of being included in the analysis than others. A possible source of bias in the Lake Tutira study was the emphasis on surveying weekends. The people attending the site on weekends might not be a true representation of the visiting population. To test for this, random days during the week were surveyed but no great difference was found in the sample make-up.

During the design and implementation of the survey of Lake Tutira attempts were made to obtain data of the highest quality possible given the limited resources. However, a paragraph from Hoinville, Jowell and Associates (1978) sums up the difficulty quite clearly:

> "Survey errors vary greatly in their cause, nature and importance. They can arise, for example, from bad selection... However careful the sampling scheme may be, the laws of chance determine that a sample will rarely represent a total population perfectly.
> But, rigorous application of the principles of sampling will ensure that errors deriving from chance (or probability) will be small...".

Part Two: Survey Results and Management Recommendations
(analysis of data not related to the Travel Cost Method)

4.8 Breakdown of Visitation Origins

The number of groups visiting Lake Tutira from the various places of origin and the total number of visitor days per year consumed by these groups is presented in Table 4.1. The figures are also shown as a percentage of total visitation for ease of illustration.

A total of 143 groups were successfully interviewed at Lake Tutira which, when adjusted by the population factor[7], amounts to a total of 720 groups of recreationists visiting the site each year. The total yearly visitation had been estimated at 10,000 visitor days per year.

As would be expected, a large majority of visitor groups (65%) originated from the Napier/Hastings area. Also Wellington and Auckland areas supply a significant portion of the lake visitation even though the distance is quite large. This could be explained by the large population centres from which the visitors are drawn. It becomes obvious that visitation to Lake Tutira originates from throughout a major part of the North Island, not just from local areas.

4.9 The Value of Travel Time

The respondent groups were asked to comment on how they viewed the time spent in travelling to Lake Tutira. This question was considered necessary to provide information on whether or not a value (cost) of travel time should be included in a calculation of travel cost (as used in the travel cost method outlined in chapter 2). The

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[7] The sample totals are multiplied by a population factor to bring the levels up to the true population totals.

TABLE 4.1

BREAKDOWN OF VISITATION ORIGINS

Origin Area	No.of visit. groups	% of total groups	Total no.of visitor days	% of total visitor days
Napier	290	40	3,050	31
Hastings	175	25	2,915	29
Wairoa	10	1	70	0.7
Waipukurau	10	1	130	1
Taupo	5	0.7	15	0.2
Pahiatua	5	0.7	30	0.3
Gisborne	30	4	335	3
Palmerston North	35	5	270	3
Rotorua	15	2	70	0.7
Masterton	15	2	45	0.5
Tauranga	5	0.7	20	0.2
Waikanae area	25	3	110	1
Wellington area	80	11	2,150	22
Auckland area	15	2	500	5

Note: 1. The Waikanae area includes Paraparaumu and Paekakariki.

2. Total percentage does not equal 100% due to rounding error.

respondents had the choice of answering pleasant, unpleasant, or indifferent to the question about time spent in travel. The results are shown in Table 4.2. 141 respondents answered the question.

TABLE 4.2

THE VALUE OF TRAVEL TIME

	No. of groups	% of groups
Pleasant	134	95
Unpleasant	3	2
Indifferent	4	3
	141	100

The results show almost all the respondent groups (95%) consider the travel time spent in getting to and from Tutira a pleasant experience. This would indicate that it is unnecessary to place a cost value on travelling time to New Zealand recreation sites. There would seem to be some benefit derived from the journey, however this benefit is not a result of the recreation site per se and therefore should not be added to any calculation of consumers' surplus.

4.10 Alternative Recreation Sites

The respondents were asked if they would have chosen an alternative place to visit if Lake Tutira had not been available for their present trip. Of the 141 groups who replied to the question, 114 (81%) stated they would have chosen another site, 14 (10%) of which were uncommitted as to where they would have gone as an alternative.

100 groups responded with specific alternative sites (shown in Table 4.3), although the majority noted that they would not exchange recreation areas willingly. Twenty-seven (19%) of the respondent groups expressed no alternative planning, stating that they would have remained home if Lake Tutira were not available.

TABLE 4.3

LIST OF ALTERNATIVE SITES TO LAKE TUTIRA

Alternative Recreation Area	Percentage of Respondent Groups
Campground at Napier or Hastings	14
Mahia Peninsula	12
A beach in the Napier Area	30
Taupo	4
Waikarimoana	8
Wairoa	4
Lake Hatuma (Waipukurau)	4
White Pine Bush Sanctuary	6
Hawkes Bay river (Tuki Tuki, Eastdale, Dartmoor)	16
Lake Opuaki	1
Takapau	1
	100

Based on the comments of the respondents and the results in Table 4.3, it would seem that there is no real alternative site of a freshwater lake to Lake Tutira, other than Taupo and Waikaremoana which only 12% of the respondents would have turned to in the absence of the Tutira opportunity. It is also possible to conclude from the comments of individuals at Lake Tutira that any change to an alternative site would involve a definite loss of welfare to the users.

4.11 Breakdown of Recreation Activities

The respondent groups were asked to indicate the activity that was the main reason for their visit to Lake Tutira. The possible activities were listed on a showcard to help the respondents place their answers within the survey classifications. The respondents were asked to pick a classification that best explained the activity that was the main reason for their visit. The results are displayed in Table 4.4.

TABLE 4.4

CHOICE OF ACTIVITY

Main Activity of the Group	Percentage of User Groups
General Recreation and Relaxation	62
Sailing/boating	18
Fishing	3
Walking/hiking	17
	100

These results indicate that the majority of groups (62%) attend Lake Tutira for the purpose of relaxed non-specific recreation, for example picnicking and birdwatching, enjoying the aesthetic surroundings and sunbathing. A significant number of the visitor groups (18%) travelled to Lake Tutira specifically for the sailing and boating opportunities. This large percentage might indicate the usefulness of developing easier access for boats and yachts along the lake's edge. The many walks and trails around the lake and surrounding hills attracted 17% of the visitors to Lake Tutira. The number of walkers and hikers would seem to justify both the upkeep of the trails and any work done developing new tracks.

The percentage of the groups visiting Lake Tutira for the fishing is very low (3%). This is probably due to the pollution of the water affecting fishing quality, but it is also possible that more people fish at Tutira during the winter months not surveyed by this study.

4.12 Willingness to Pay Data from Direct Questioning

The respondents were asked to estimate the amount of money they would be prepared to pay per year to retain the use of Lake Tutira. This question was designed to indicate the sorts of problems that are associated with asking people to state their willingness to pay (explained in chapter 2) and the results were to be used as a comparison with those obtained using the Travel Cost Method. However, on completion of the survey it was realised that as the question was asked of the group leader, it was the willingness to pay of the group leaders being collected, not total individual willingness to pay. This means that the estimate of value using data from this survey question will severely underestimate the true figure as it has been obtained from only a portion of the sample. As individual willingness to pay varies widely between individuals, it is of no use multiplying the figure obtained by the average number in a group to account for all the individuals in the sample.

The total willingness to pay figure for the group heads, adjusted to the population level, was $15,372 per year. Although this figure is worthless as a measure of total consumer willingness to pay for Lake Tutira, it does at least provide an absolute minimum value for the lake.

4.13 Analysis of Respondent Comments

Of the 143 respondents, 108 took advantage of the opportunity at the end of the questionnaire to express their views and to make relevant comments about Lake Tutira. The opportunity was provided firstly to give the respondents a feeling of involvement, and secondly to obtain information that would possibly be useful in developing management ideas. The comments were grouped into specific areas of interest, the strength of interest indicated by the number of groups making a comment about it (indicated by the percentage of the total number of groups who chose to make a comment).

The most common area of comment was a statement about how Lake Tutira was a beautiful, peaceful spot that the respondents did not want to see ruined, and 76% of the groups made a comment of this form. Repeated statements were made on the wish of the recreationists for a supply of clean, fresh, running water at the lake (15%), and some form of proper toilet facilities (15%) preferably away from the main road where the current toilet block is prone to vandalism.

A definite statement was made by 16% of the groups on the quality of the lake water and how it should be cleaned up. Seven percent of the respondents commented that they would not like to see the recreation site developed into a camping ground with all the associated facilities and rules. One respondent expressed the opposite to this view.

The fact that Lake Tutira is very safe for young children was noted by 6% of the respondents, while 4% stated that they would like to see more trees planted around the lake.

Other points that were raised by the visitors were: the signs directing the walkways were not of sufficient clarity for children's use; the lake is a good place for free camping; motor boats should be kept out of the lake; the wildlife should be maintained; the surroundings provided ideal walking conditions; and the possibility was raised of charging lake users on a voluntary basis.

This information was not obtained under a control situation and the study makes no claim that the results outlined above have any statistical significance. The information was collected merely to provide points of possible interest in formulating lake management objectives.

4.14 Lake Tutira Management Recommendations

In this section, specific recommendations on the running of Lake Tutira are made, based on the survey data, secondary data and the researcher's observations. The feasibility of some of the recommendations in terms of cost is not discussed within the framework of this study, they are merely presented as possible improvements to the overall management of the lake and surrounding area. The comments are as follows:

1. The survey has established that yearly visitation is at least 10,000 visitor days per year, with 65% of the visitors originating from the Napier/Hastings area. The remaining visitation is accounted for from all over the North Island, from Auckland to Wellington. It is obvious from the results that Lake Tutira is the responsibility of both national agencies and regional bodies as it is utilized both on the national and regional levels. The non-productive dis-association of responsibility by both government and regional parties in the past must not continue. Co-operation and sharing in the costs associated with Lake Tutira is in the mutual interests of all those concerned.

2. Lake Tutira must be accepted as a unique recreational resource to Hawkes Bay as there exists no alternative freshwater lake of its size until Taupo (140 km) or Waikarimoana (180 kms). The uniqueness of the lake and its surroundings deserves some level of priority within the region regarding its maintenance and development.
3. The general atmosphere of quiet and scenic beauty at Lake Tutira should be maintained as the main attraction of the site. The majority of visitors stated that they travel to Lake Tutira mainly for relaxation, not for vigorous recreation.
4. Due to the patronage given to Lake Tutira by people involved in sailing and boating the regional bodies should take a financial interest in the upkeep of the existing boat ramp. The ramp was built by the local Trailer-Sailor club at their own expense, but is available for public use at the northern end of the lake. Lake Tutira is considered by many sailors to be an ideal area of water for teaching boating skills and safety.
5. The walkways provided by the Lands and Survey Department and Tutira station are popular with the recreationists, and maintenance and development of these trails should be encouraged. It is thought that with the planting of exotic and native trees around the lake's edge an even more pleasant walking environment will emerge in time.
6. Many users of Lake Tutira expressed a need for a supply of clean, fresh, running water as campers are presently obliged to bring their own fresh water in containers. Possibly some form of supply could be arranged with the co-operation of Tutira station. Some visitors are restricted from staying

for longer periods at the lake due to the lack of water, and many first time visitors are not aware of the need to bring their own supply.

7. An issue of some importance to the users of Lake Tutira is the provision of toilet facilities. At present, a toilet block is available alongside the main road, just within the boundaries of the reserve. However this block is subjected to such a degree of vandalism as to be unuseable most of the time. The general feeling amongst the recreationists is that the disadvantage to passers-by of siting the block well away from the road would be easily outweighed by the lack of vandalism and availability of toilets to the lake users.

8. A common theme discovered from the recreationists' comments is that the site should remain in an undeveloped, natural state except for the provision of rubbish tins, the occasional barbeque, a water tap and toilets. The people using the lake are, on the whole, avid free campers and would not like to see a formal campground set up on the reserve, believing that such development would ruin the setting.

9. The wildlife at Lake Tutira should continue to be monitored and protected, the birdlife on the lake is a major attraction. When the water quality begins to improve, steps should be made to re-establish the trout population to the levels once enjoyed by fishermen at the lake.

10. Motor boats should continue to be banned from the lake as the general concensus of the users indicates that they feel that power boats would detract from the peaceful atmosphere of the area. Power boats would also introduce the added problem of erosion of the lake shore from wake movement.

Further recommendations resulting from the study have already been accepted for implementation (see chapter 3). These include the planting of more trees around the lake's edge, the fencing off of stock from the lake's edge, the diversion of nutrient-rich runoff during periods of heavy rain and the removal of stock yards from near the lake.

CHAPTER 5. TCM - METHOD ONE. THE INDIVIDUAL OBSERVATIONS APPROACH

5.1 Introduction

This chapter presents an application of the Travel Cost Method to the individual travel cost observations as obtained from the survey data. The use of individual observations rather than zone average data, as advocated by Clawson and Knetsch (1966), has been found in some studies to increase the behavioural prediction efficiency beyond that achieved by using zone average data aggregated from all respondents within a zone (Nawas and Pierce, 1968; Michalson and Hamilton, 1978; Gum and Martin, 1975). Although it is accepted that this method can provide more precise estimates of visitation, it has also been shown (Flegg, 1976; Freeman, 1979; Bowes and Loomis, 1980) that the quantity of data required and the quality of the survey approach must be correspondingly high. In many countries such high quality surveys are restricted by the amount of funds allocated to carry them out, as is the case in New Zealand.

In analyses done by several economists (Flegg, 1976; Loomis, 1980; Freeman, 1979) a clear relationship was not established between travel cost and visitation due to the large variation in visitation behaviour between individuals with similar travel costs. Obviously more information on the individuals would be required to help explain visitation behaviour more precisely, however prediction of human behaviour from individual observation is a very difficult task (Fishbein, 1975). Basically, prediction of individual rather than group behaviour requires the inclusion of many more independent variables in the regression analyses to account for the variability observed in individual behaviour.

An application of the individual observations technique (method 1) is attempted using the survey data obtained from respondents at Lake Tutira, however this method is eventually rejected as no workable relationship between travel cost and visitation could be established. Because of this difficulty the emphasis of the analysis is successfully shifted to the aggregated data approach (method 2) which is described in detail in the next chapter, and a clear relationship is established between visitation and travel cost. However, even though method 1 was not successful using the survey data collected at Lake Tutira, the approach is still a valid and useful one which could provide excellent results in other applications. For this reason the analysis of individual observation data is described in some detail in the remainder of this chapter. A description of the attempts taken to resolve the difficulties associated with the application of method 1 may be useful in highlighting possible mistakes in this study's approach. The following sections are divided into the steps taken in an attempt to obtain a suitable predictive relationship between travel cost and visitation for use in the TCM.

5.2 Summary of Requirements

For the Travel Cost Method to successfully utilize individual observation data for prediction of visitation behaviour there must exist a certain relationship between travel cost and visitation. The TCM relies heavily on the assumption that visitation to a particular recreation site (Lake Tutira) is influenced by the costs involved in getting there, such that as the cost increases, visitation will decrease. For this reason the relationship between visitation and travel cost must be negatively sloped, of a reasonable level of correlation and must be significant[1]. Then, ideally, the relationship would follow the form shown in Figure 5.1 with visitation as the dependent variable.

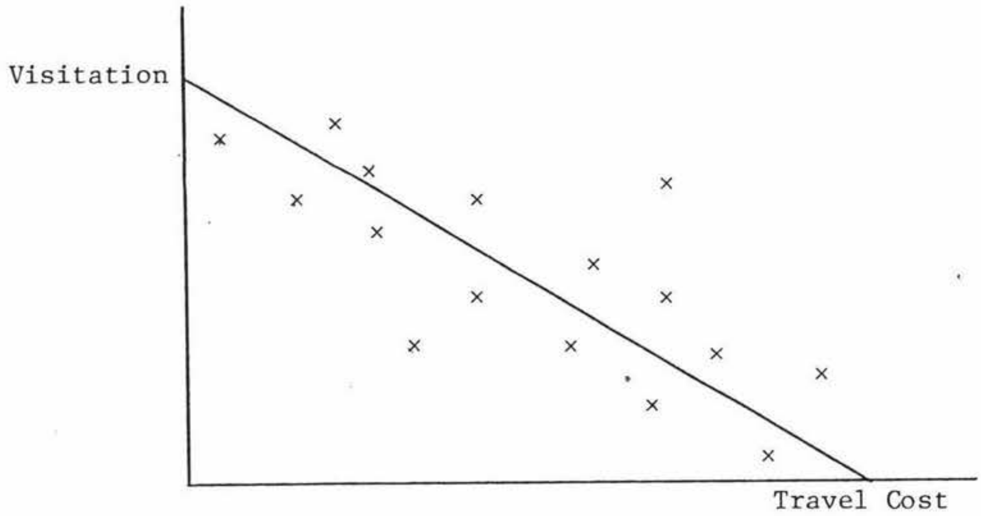

Figure 5.1 Relationship between visitation and travel cost

Consider the relationship;

$$V = f(TC + \text{other independent variables})$$

with R^2 greater than 0.5 (refer to Appendix One)

where V = visitation

TC = travel cost

Given this relationship, visitation can be predicted at different levels of travel cost. Admission fees can then be added to the travel cost variable to provide a demand curve for the recreation site (as explained in Chapter 2). A relationship between visitation and travel cost as shown above can be established using regression analysis, described in Appendix One.

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[1] Correlation and significance is explained in more detail in Appendix One.

5.3 Variables List

The following list of variables was observed and calculated from data obtained by the survey of recreationists at Lake Tutira. Due to the problems associated with allocating a travel cost figure to individual members of families and groups (e.g. how much of the expenditure accrues to a five-year-old child) the sampling unit taken was that of the family or group associated with one vehicle. The variables are:

Visitation variables:

1. VDY: Total individual visitor days[2] consumed by the group in a year. i.e. a group aggregation of individual visitor days per year.
2. VDT: Individual visitor days consumed by the group on the trip during which they were interviewed.
3. VISIT: Total number of visits made to Tutira by the group per year.
4. GRVIS: Total number of days consumed by the group per year (i.e. group days not individual).
5. VARY: Log_{10} (VDY) i.e. $\log_{10}$ of the variable VDY.

Travel cost variables

6. TC: Calculated travel cost. This variable was decided on when it became apparent that the perceived travel cost figure was being interpreted by the respondents as basically petrol cost. (See chapter 3).

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[2] A visitor day consists of a visit by one individual to a recreation area for recreation purposes during any reasonable proportion, or all, of a 24 hour period.

i.e. $TC = E + Di \times d$ (5.10)

E = entrance fee

Di = round trip distance to home i.

d = cost of motoring (c/km) based on engine size and the price of petrol (52¢/litre).

The cost of motoring calculated from litres consumed per 100 kms was a difficult figure to obtain as such information is not provided in New Zealand in a complete form. However, using aggregated average consumption figures from all of the cars assembled in N.Z. (obtained from the A.A. publication "N.Z. Motor World") and holding discussions with motor industry personnel, approx. consumption figures for different engine sizes were obtained. The figures used are shown in Table 5.1.

The information on engine size was obtained from the survey and allocated an appropriate fuel consumption which in turn was multiplied by the price of petrol at the time of the survey. The resulting figure was then taken as the 'cost of motoring' designated d in the travel cost equation (5.10). An allowance for the value of travel time was not included as the majority of respondents did not consider it a cost (Refer to Chapter 4, Section 8).

7. TCAV: The average round trip travel cost ($) incurred by groups travelling from the same areas (zones).

8. COST: The group round trip travel cost per <u>individual visitor day</u> consumed ($).

i.e. $COST = \frac{TC}{VDT}$

TABLE 5.1

APPROXIMATE CONSUMPTION FIGURES FOR VARYING MOTOR VEHICLE ENGINE SIZES

Engine Size	Fuel Consumption (L/100 km)
less than 1200 cc	6
1200 to 1500 cc	7
1500 to 1900 cc	8
1900 to 2400 cc	9
2400 to 3000 cc	10
3000 to 4000 cc	11
greater than 4000 cc	13 and greater

Note: For those calculations requiring a consumption figure for an average car, a 2000 cc motor vehicle was chosen with consumption of 9 L/100 km. At petrol cost of 52¢ per litre, the average cost of motoring was then calculated at 4.68 ¢/km.

9. GRCOST: The round trip travel cost of the group per group day consumed.

i.e. $$GRCOST = \frac{TC}{\text{group days this trip}}$$

Further explanatory variables

10. TIME: Travel time (hours) from the group home to Lake Tutira.

11. DIST: One way distance from the group home to Lake Tutira (kms).

12. OCCRATE: The occupation rating of the group head based on the socio-economic ranking of the Elley-Irvine Scale.
The ranking applied only to the group head with the assumption that a group's standard of living and income was most likely based on the group head's position.
The scale from 1 - 6 is presented in Appendix Five.
The ranking system was used in preference to an income variable because asking a person's occupation is a less personal question than enquiring about income (and less susceptible to incorrect answers), and also because it was considered a better and easier indicator of ability to consume recreation time.

13. AGE: The age (years) of the group head.

14. SEX: The sex of the group head.
Male was designated the number 1, female 2.

15. WTP: The willingness of the group head to pay for the recreation experienced by his group at Tutira in dollars per year.

16: ALTERN: This variable indicates whether or not the respondent would have chosen an alternative site to visit for that particular trip if Lake Tutira were not available.
designated 1 - affirmative
2 - would not have chosen an alternative.

17. VTT: The value to the group head of the time spent in travelling to Tutira.

designated 1 - pleasant

2 - unpleasant

3 - indifferent

18. CHILD: The number of children in the group under the age of seventeen.

19. GROUP: The total number of people in the group

20. ACTV: The major activity stated as the reason for visiting Lake Tutira.

designated 1 - General recreation, relaxation

2 - Sailing/boating

3 - Fishing

4 - Walking the trails/birdwatching.

Transformation variables

21. T_1: Inverse of the travel cost per individual visitor day.

$$T_1 = \frac{1}{\text{COST}}$$

22. T_2: Variable calculated to give the reciprocal functional for

$$Y = a + \frac{1}{x}$$

$$\text{i.e. } T_2 = 30 + T_1$$

23. VARY: logarithmic base ten transformation of VDY.

24. VARX: logarithmic base ten transformation of COST.

5.4 Step 1. Exploring the Relationship between Visitation and the Explanatory Variables

The first step of the analysis is to establish if any relationship exists between the dependent variable, visitation, and the independent variables.

A regression analysis was run with VDY (total visitor days per year consumed by the group) against age, sex, occupation rating, travel cost, time, presence of alternatives, distance, the number of children, and total number in the group. The results (ref. summary Table 5.2) indicate a very low $R^2 = 0.23$, and more importantly a positive partial regression coefficient for travel cost.

TABLE 5.2

REGRESSION SUMMARY

Dependent variable VDY

Variable	R Square	B
GROUP	0.12495	4.23
TC	0.18824	1.27
DIST	0.21170	- 0.13
TIME	0.21892	4.51
SEX	0.22302	-10.49
ALTERN	0.22739	4.49
AGE	0.23057	0.14
OCCRATE	0.23366	1.33
CONSTANT (A)		- 2.57

(NOTE - The relationships between the independent variables was assumed to be noncausal, allowing a standard regression strategy to be used rather than hierachial procedure).

It was possible that the relationship between visitation and travel cost was being influenced by the other indepdent variables, so a simple bivariate regression was run between visitation and travel cost. i.e. VDY = f(TC). This resulted in an $r^2 = 0.08$, and a regression coefficient equal to 0.91. This is a weak, non significant relationship.

The variable VISIT (number of visits taken per year) was introduced as the dependent variable and a multiple regression was carried out with travel cost, age, time and distance as the independent variables. The results showed an increase in R^2 value ($R^2 = 0.32$). The regression coefficient for travel cost was however negative, thus at least indicating a correct slope for use in the TCM. The regression results are shown in summary Table 5.3.

TABLE 5.3

REGRESSION SUMMARY

Dependent variable: VISIT

Variable	R Square	RSQ Change	B
AGE	0.004	0.004	0.62
TC	0.012	0.008	- 0.51
TIME	0.022	0.010	- 0.13
DIST	0.323	0.300	0.32
CONSTANT			- 2.45

Intuitively it could be expected that the higher the cost of getting to a particular site, the fewer the number of trips that would be made. However, the number of visits is not a measure of the quantity of recreation consumed as each visit will often consume different amounts of visitor days. The VISIT variable would be appropriate in an analysis of a recreation site that is utilized in one day units as would, for example, bird sanctuaries. Some surveys (Shucksmith, 1977; Loomis, 1980) have wrongly used this variable in the analysis as a measure of quantity consumed whereas it is actually a measure of the frequency of consumption.

A further visitation variable obtainable from the survey data was VDT, the total number of individual visitor days consumed by the group during the current trip. VDT was introduced to the regression analysis as the dependent variable with travel cost as the independent variable. The result of the regression analysis showed a reasonable $r^2 = 0.4$ with a regression coefficient B = 1.2, significant at the 1% level (F ratio = 84.2). The slope of the relationship is positive as could be expected considering that visitors from greater distances would be far more likely to stay at the site longer than visitors from nearby who can consume day trips. However, the positive sloping relationship is not usable in the TCM framework.

A linear relationship is found between individual observations of visitation and travel cost of the form shown in Figure 5.2. The problem is that this relationship is positive sloping with a very low correlation. The variables travel cost and visitation involved in the relationship need to be adjusted in some manner to remove the variation in visitation between individuals with similar travel costs, and if possible obtain a negative sloping relationship.

5.5 Step 2. Modification of the Data File and of the Travel Cost Variable

In an attempt to remove a portion of the variability in visitation about set travel cost figures, the extreme values of travel cost were

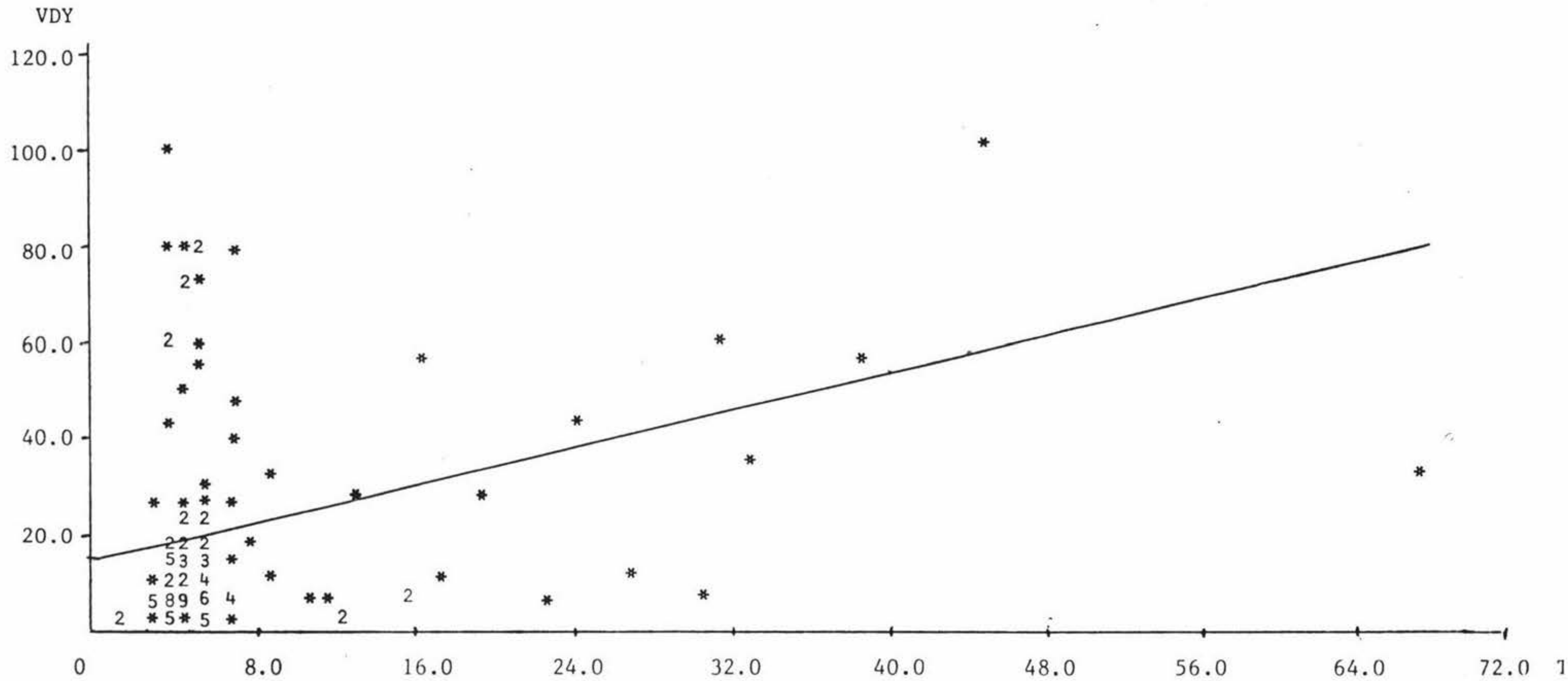

FIGURE 5.2: The Linear Relationship between Visitation and Travel Cost

removed and a new data file was formed. Justification for this move lies in the fact that many visitors from the more distant centers are likely to exhibit visitation behaviour inconsistent with the travel cost model (as described by Smith and Kopp, 1980; and Collins and Hodge, 1981). The visits to Tutira from distant areas may not be the main reason for the trip. The visitors may be moving on elsewhere at a later date, or they may have a reason beyond that of recreation for being in the area.

In addition to this modification, the travel cost figures were adjusted to an average figure within set distance catagories regardless of the engine size.

These modifications to the data had little effect on the correlation between visitation and travel cost, however the slope of the relationship did at this stage become negative.

5.6 Step 3. Formation of a New Travel Cost Variable - COST

Reflection on the problem of variability revealed that possible factors influencing the variation in visitation at a given travel cost could be:

a) The number of people in the group interviewed

b) The number of days consumed by the group on their present visit at Lake Tutira.

The variable travel cost was adjusted to form a new variable, $COST = \frac{TC}{VDT}$, measuring the travel cost per individual visitor day consumed by the group.

A regression with VDY as the dependent variable and COST as the independent variable revealed no significant linear relationship, as shown by the scatterplot of VDY vs COST (Figure 5.3), but once again

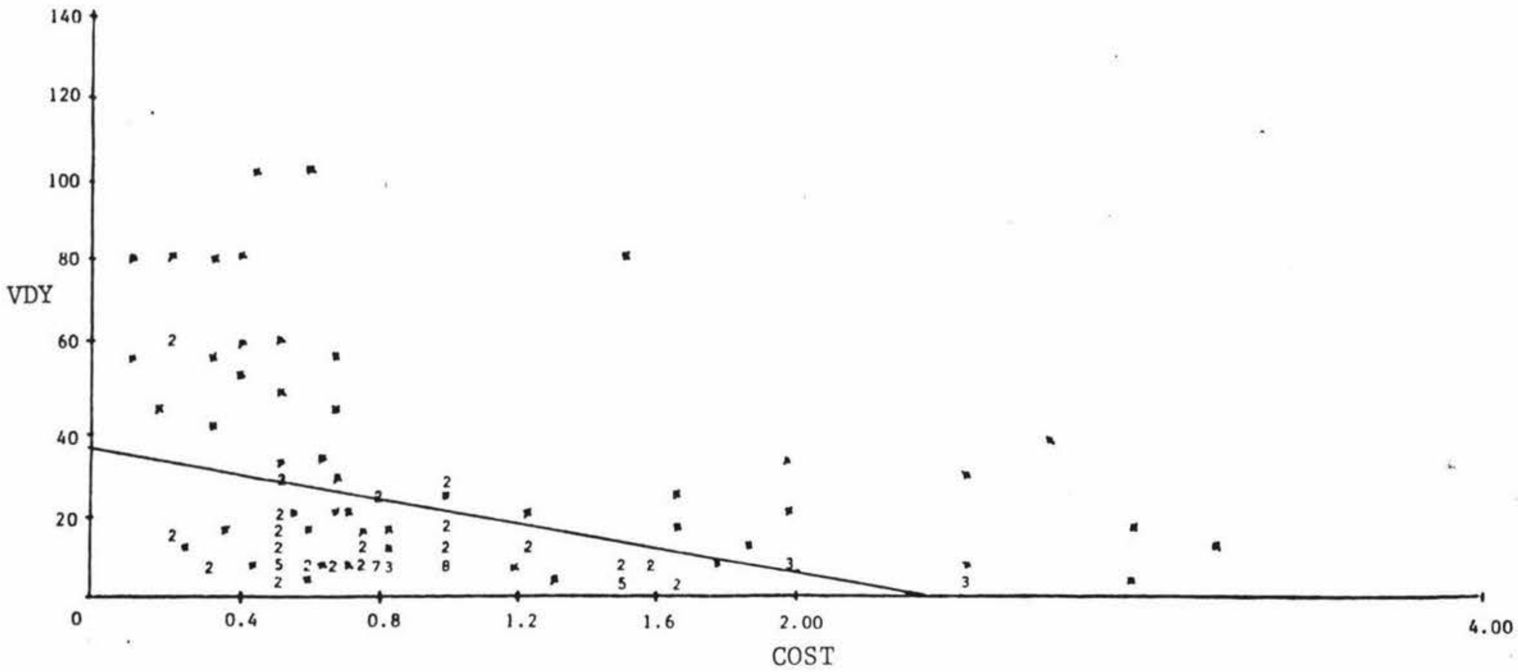

Figure 5.3 The Linear Relationship between Visitation and COST

$r^2 = 0.07$; S.E.E. = 30; F = 9.7 with 132 d.f.

a negative sloping relationship was obtained.

The variables were next transformed to fit the functional form;

$$Y = a + \frac{1}{x}$$

exhibiting the form shown in Figure 5.4

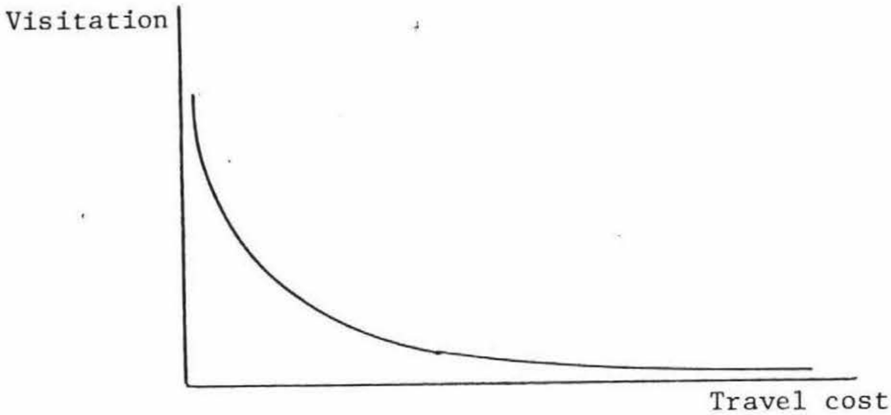

Figure 5.4 Functional Form Displayed by Survey Data

by creating two new variables:

$$T_1 = 1/COST, \text{ and}$$

$$T_2 = 30 + T_1$$

The transformed relationship revealed no significant linear relationship. It was subsequently decided that COST and VDY were not the most appropriate variables for the analysis as they reflect individual user days whilst the data has actually been collected from groups (usually families).

5.7 Step 4. Formation of Group Variables

The visitation variable was next considered in terms of group days consumed per year. A total visitation figure could be calculated by assuming an average number in the groups (calculated from the survey data).

Two new variables were created:

GRVIS = Group days consumed per year.

GRCOST = Travel Cost to the group per group day consumed.

Intuitively these variables would seem more correct in describing the relationship between visitation and travel cost. A regression was carried out with GRVIS as the dependent variable and GRCOST as the independent variable. A scatterplot was obtained of the relationship between GRVIS and GRCOST and this is presented in Figure 5.5.

The prediction equation had a very low r^2 value (0.045). Inspection of the scatterplot did not suggest a possible variable transformation which would provide a better data fit:

The variation in GRVIS about GRCOST was thought to be possibly due to the influence of the number of individuals in the groups sampled. To test the existence of this influence a simple regression analysis was carried out with GRVIS as the dependent variable and the number in the group, GROUP, as the predictor. The results indicated little correlation ($r^2 = 0.002$) between the two variables so it was decided there was little value in adjusting the visitation variable for the influence in group numbers.

Similarly, a simple regression was done to test the relationship between travel cost, GRCOST, and the number in the group, but once again negligible influence was indicated ($r^2 = 0.0009$). As a result it was concluded that the variation in visitation figures recorded was not due to the variation in the group numbers surveyed.

5.8 Step 5. Division of the Main Data File by Recreation Types

The next attempt to remove the intra-travel cost variation in visitation involved dividing the respondent groups into day trippers

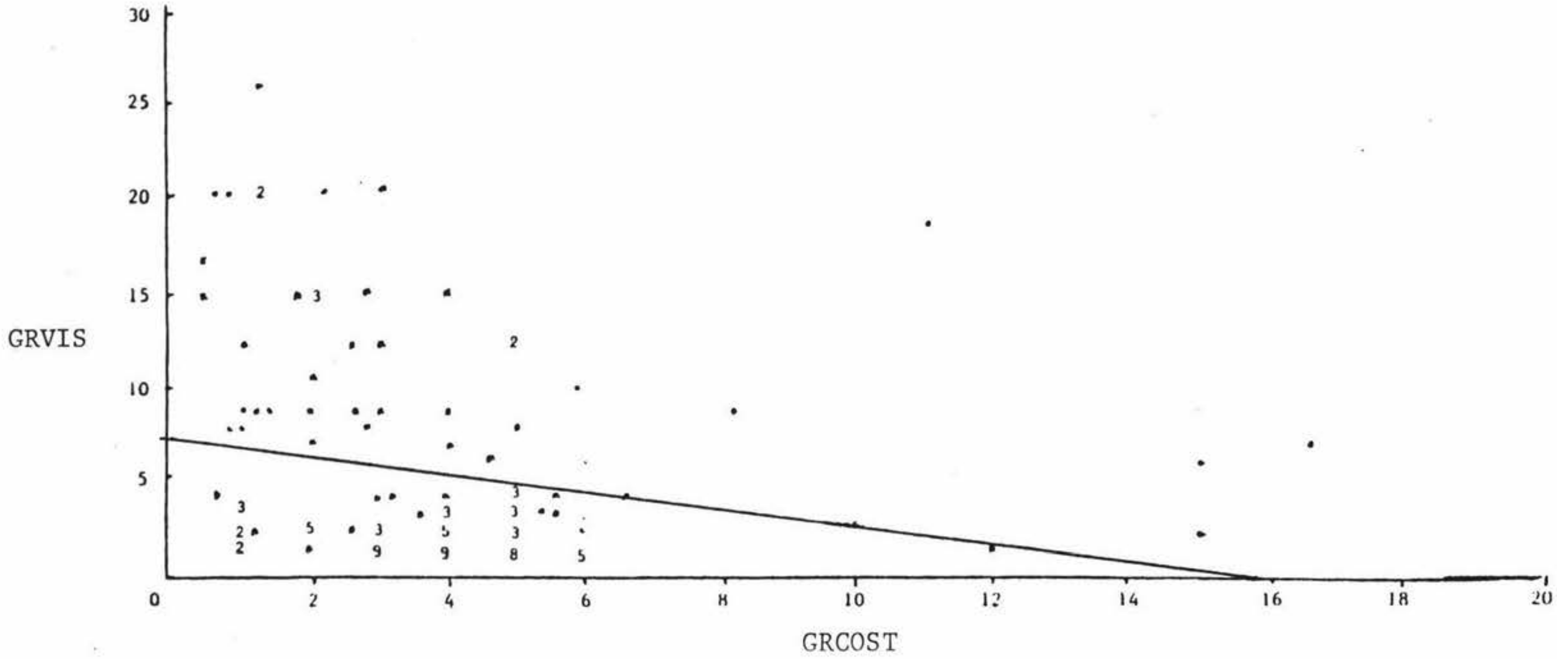

Figure 5.5 The Linear Relationship between Group Visitation and Group Cost

$r^2 = 0.045$; S.E.E. = 6.6; F = 6.24, with 132 d.f.

that consume the recreation in one day periods, and campers who stay at Lake Tutira for periods of more than one day. This action considered the possibility that the two catagories would conform to different functional forms, that is, the behavioural reaction to travel cost changes in terms of visitation could conceivably differ between the two catagories[3]. The following relationships were tested for by regression analysis.

GRVIS with GRCOST

GRVIS with TC

VDY with TC

VDY with GRCOST

VDY with COST

GRVIS with COST.

The action of dividing the recreationaists into two catagories was not sufficient to remove the variation in visitation. The type of recreation user is not an influential factor in visitation to Lake Tutira, although the relationship between visitation and travel cost is slightly more pronounced for the respondents who spend more than one day at the site than for those who visit merely for the day.

5.9 Conclusions

At this stage of the research it was decided to reject Method 1 on the grounds that it would not provide a workable solution using the data collected during the survey at Lake Tutira. It is seen from other attempts (Brown and Nawas, 1973; Gum and Martin, 1975) that the

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[3]Often in recreation analysis the respondents are divided into their respective recreation activities (ref. Cesario, 1971) however in the case of Lake Tutira the results showed that 80% of the visitors attended Lake Tutira for general relaxation, thus division was impractical.

individual observation technique can provide accurate estimations of visitation, but invariably under the conditions provided by an extensive survey supplying copious data cases in response to a well designed questionnaire. The research attempted at Lake Tutira was restricted by finance, time and labour input all of which impeded the quality of the survey. This is not to be taken as a criticism of the survey carried out which must be considered more than adequate given the resources available.

As will be seen in the following chapter the quality of the survey data was sufficient to allow an accurate estimation of visitation using aggregated data. As with most things, an increase in finance and resources will inevitably provide an increase in estimation efficiency, but sometimes precision has to be traded for economy.

CHAPTER 6. METHOD 2. THE AGGREGATED ZONE DATA APPROACH (STAGE ONE)

6.1 Introduction

In the previous chapter the individual observations approach was presented but eventually rejected due to the lack of suitable data. In this chapter the Aggregated zone data approach to the TCM, as advocated originally by Clawson (1959), is discussed. This approach involves dividing the recreationists into respective geographical areas (or zones) and attempting to predict total visitation from each zone using regression techniques. It differs from the individual observations method mainly in that it attempts to predict zone visitation rather than individual visitation, and this in turn is used to establish a demand schedule.

To use this approach, information on the respective zones is required, such as population, distance from the recreation site, existence of alternatives, and socio-economic parameters. The first stage in applying this approach is to delineate the zonal areas and then determine the actual current visitation to Lake Tutira, i.e. the visiting population.

6.2 Zone Specification

The zones were designated as the major centers in the North Island from which recreationists travelled to Lake Tutira. Due to the unique distribution of population in New Zealand no absolute boundaries were allocated to the zones, i.e. the large majority of the population of the zones reside in the main center serving what is usually a rural area, often bounded by its own topography. The zone average distance to Lake Tutira was taken from the major population center. Due to the concentration of population within the regional centers it was thought that the error component caused by visitors from similar distances but different zones (i.e. on the borders of two zones) would be minimised.

As it was considered impossible to divide single towns into separate zones as they would not reflect different travel costs, the town unit was taken as the smallest possible zone unit. It transpired that it would have been useful to have obtained more zonal divisions within 100 km of Tutira but unfortunately the population within this distance is mainly restricted to three population centers, and it was considered infeasible to attempt to break them down into further divisions.

The zonal divisions are outlined below.

Zone 1. NAPIER and surrounding area
2. HASTINGS, HAVELOCK NORTH, WAIROA
3. WAIPUKURAU and surrounding area
4. TAUPO area
5. PAHIATUA and district
6. GISBORNE area
7. PALMERSTON NORTH and Manawatu area
8. ROTORUA area
9. MASTERTON and surrounding area
10. TAURANGA area
11. WAIKANAE, PARAPARAUMU, PAEKAKARIKI
12. GREATER WELLINGTON AREA, including Hutt Valley
13. GREATER AUCKLAND area.

The geographical distribution of these zones is shown in Figure 6.1.

Figure 6.1 Zone Centers within the North Island of New Zealand

6.3 Determination of Current Visiting Population

An estimation of the total annual visitation to Lake Tutira was necessary to allow the use of sample data to predict population activity. A survey will sample only a portion of the actual number of persons visiting Lake Tutira. In order to use sample information to predict actual behaviour it is necessary to know the percentage of the actual population that has been sampled so that the sample results can be weighted to the population level.

No accurate figure on yearly visitation was available for Lake Tutira, so it was necessary to ascertain the figure in a variety of ways, some of which were subjective. The final estimate of the distribution of visitation (illustrated in Figure 4.1, section 4.3) was the result of an overall consideration of the survey data and the relevant information available. This included the author's own observations; information on the number of anglers from a Fisheries technical report; visitation estimates for 1976 by the Ministry of Agriculture and Fisheries; correspondence with the Hawkes Bay Trailer-Sailor club; personal communication with the manager of Tutira station and custodian of Lake Tutira; and personal observations of M.A.F. staff. The resultant figure is considered to be a conservative estimate, allowing for the fact that the area suffered an abnormally wet summer compared with previous years, especially during peak visitation periods such as Christmas, New Year, and most of February. A sensitivity analysis was performed on the final result of the analysis to determine the extent to which a variation in the total visitation figure would effect the final consumers' surplus. This is presented in chapter 7, section 7.6.

An assumption was made, based on available information, that visitation to Lake Tutira during the winter months May through October was restricted to persons from within a 100 km radius. This assumption restricts the estimated winter visitation of 2500 visitor days to the origin areas of Napier, Hastings/Wairoa, and Waipukurau.

The number of visitor days sampled from these zones within 100 kms was 738 visitor days. Therefore, during the winter months May to October the visitation is broken down in the following manner.

$$\frac{348}{738} = 0.47 = \text{percentage of winter visitation from Hastings zone.}$$

The estimated winter visitation from Hastings was calculated as,

$0.47 \times 2500 = 1175$ visitor days

i.e percentage of winter visitation from Hastings multiplied by total winter visitation equals the estimated total winter visitation from Hastings.

Similarily, for:

Napier $\frac{365}{738} = 0.49 \times 2500 = 1225$ visitor days

Waipukurau $\frac{16}{738} = 0.02 \times 2500 = 50$ visitor days

Wairoa $\frac{9}{738} = 0.01 \times 2500 = 25$ visitor days.

During the summer months (November to April) the visitation was estimated as 7,500 visitor days. The number of visitor days actually sampled during this period was 1500. Therefore the population sample ratio is equal to $\frac{7500}{1500} = 5$.

This population factor was multiplied by the sampled visitation per zone to give an estimate of the total summer visitation per zone. For those zones within a 100 km radius, the winter visitation was added on. The total annual zone visitation figures are presented in Table 6.1 under the zone headings, along with average travel cost figures, average travel time, and calculated visitation per 1000 population.

TABLE 6.1

RELEVANT ZONE INFORMATION

Zone	Population	Distance (kms)	Time (hrs)	TC ($)	Total Annual Visitation (V days / per year)	V/1000 pop.
1	50,000	30	0.75	3	3050	61
2	50,000	50	1.00	5	2985	59.6
3	7,870	100	2.00	10	130	16.5
4	13,100	167	3.00	16	15	1.15
5	2,120	175	3.5	17	30	14.5
6	30,000	185	4.0	18	335	11.2
7	58,800	196	3.5	19	270	4.6
8	47,000	229	4.0	22	70	1.5
9	19,650	261	5.0	25	45	2.3
10	34,000	289	6.0	28	20	0.58
11	15,300	290	5.5	28	110	7.2
12	349,900	349	6.0	34	2150	6.14
13	805,900	426	7.0	42	500	0.62

(NOTE: the population figures were obtained from the 1980 Official N.Z. Year Book; and the travel cost figures were calculated from distances from the main center of the zone to Lake Tutira).

The total visitation per zone was adjusted to visitation per thousand population in order to give equal weighting to visitation from zones of unequal populations, (i.e. greater visitation could be expected from a large center like Auckland than from Wairoa due to the large populations, regardless of the travel costs).

6.4 The Variables List

The variables used in the analysis of the zone aggregated data are as follows:

1. VISTHOU: Individual visitor days consumed per thousand population of the zone.
2. TCZONE: Average round trip travel cost from the zone to Lake Tutira
   - This figure was calculated for a 2000 cc motor vehicle driving at normal speeds from the main center of the zone to Lake Tutira and back again (dollars).
3. DIST: The one way distance from the zone center of population to Lake Tutira (kilometers).
4. ORT: Average occupation rating for that zone (Elley Irvine scale 1-6).
5. ZONPOP: The population of the zone (in 1000^s).
6. ZONAGE: Average age of group head in zone (years).
7. SQVIS: The square root of visitation per thousand population. i.e. $\sqrt{\text{VISTHOU}}$
8. TRAN 1: Natural log transformation of VISTHOU.
9. TRAN 2: Natural log transformation of TCZONE.
10. LOGVIS: Logarithmic base ten transformation of the VISTHOU variable.
11. LOGTC: Logarithmic base ten transformation of the TCZONE variable.

12. INT: Grafted regression line intercept (Set equal to unity during grafting method).

13. ZVAL: On the grafted regression line, ZVAL is the difference between the travel cost value and the point of intersection of the two lines (read from the travel cost axis).

14. INV: The inverse of the travel cost variable. i.e. $INV = \frac{1}{TCZONE}$

6.5 Deriving a Visitation/Travel Cost Relationship

The relationship between visitation rate and travel cost is not explained sufficiently well by an ordinary linear relationship. For this reason several different functional forms were applied to the data in an attempt to find a line of 'best fit'. The functional form eventually chosen as best describing the relationship is a reciprocal transformation of the travel cost variable. If the reader is merely concerned with how this relationship is used to calculate a consumers' surplus figure he should move straight to Chapter 7. If, however, the reader is interested in the different functional forms that were applied to the data, and the statistical methods that were used to accept or reject them, he should continue with the remainder of this chapter.

As with Method 1 (Chapter 5) a negative sloping relationship must be established between visitation and travel cost in order to conform to the TCM framework. In this case, visitation is total zone visitation per 1000 population, and the travel cost is an average figure for a particular zone. Obviously the number of cases (zones) will be much less than for the individual observations technique.

The aggregated zone data is used to obtain a regression prediction equation with visitation rate as the dependent variable, and travel cost as the independent variable.

A scatterplot of the form shown in Figure 6.2 was obtained and observed. Fitting the data with a linear relationship using least squares estimation resulted in a relationship of moderate strength and predictability, i.e. an r^2 value of 0.56, significant at the 1% level[1] with S.E.E. = 14.5 (see Figure 6.2). The equation is:

$$Y = 43.49 - 1.42 (X) \qquad (6.1)$$

where Y = visitation per thousand population

X = travel cost.

The percentage of variation in visitation explained by travel cost is just over fifty percent. It was considered that an equation could be found using other explanatory variables which would be more predictive of visitation per 1000 population.

6.6 Test For Explanatory Variables

A linear regression analysis was carried out with VISTHOU (visitation/1000 population) as the dependent variable, and ORT (average accupation rating), TCZONE (travel cost) and ZONAGE (average zone age) as the independent variables. The influence of occupation and age on visitation rate was found to be negligible, as shown by the regression summary given in Table 6.2.

However, the R^2 change for TCZONE is slightly higher than the r^2 value for the simple bivariate relationship between visitation rate and travel cost indicating that the relationship is affected to a small extent by occupation rating and average zone age.

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[1] A brief discussion of sigificance testing is presented in Appendix A1-2.

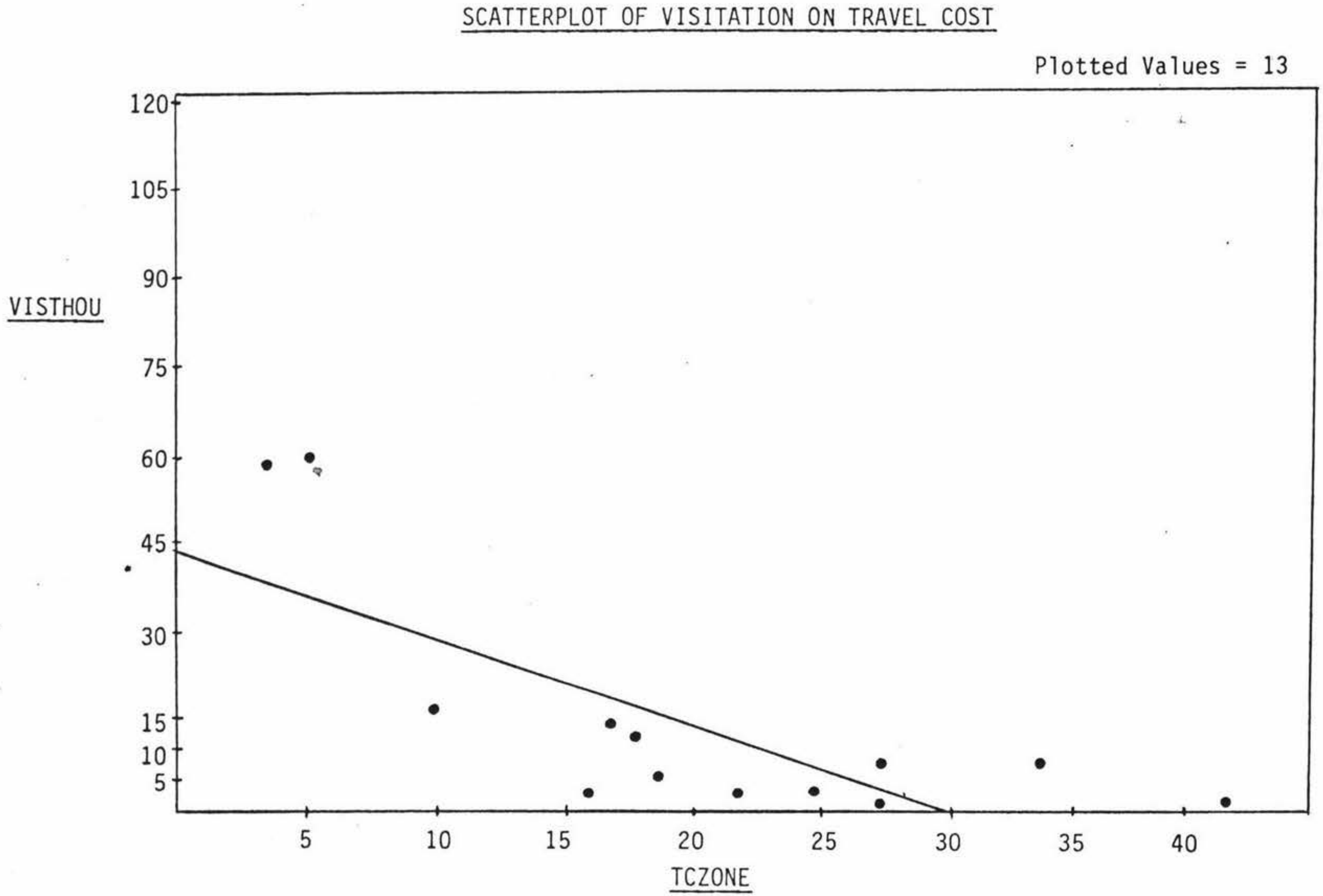

Figure 6.2 The relationship between visitation rate and travel cost explained by a simple linear function form

TABLE 6.2

RESULT OF REGRESSION ANALYSIS

Variable	R SQUARE	RSQ CHANGE
ORT	0.02587	0.02587
TCZONE	0.68729	0.66142
ZONAGE	0.74271	0.05542

Inspection of the scatterplot between VISTHOU and TCZONE (Figure 6.2) indicated that the functional form was probably not best described by a simple linear relationship. The scatterplot diagram indicated that some form of variable transformation to obtain a better fitting linear functional form might be successful. The first variable transformation carried out was a square root transformation of the visitation rate variable.

6.7 Square Root Transformation

In an attempt to transform a curvilinear relationship of the form shown in Figure 6.3 to a linear relationship, the visitation rate variable was transformed to a square root of the visitation rate variable and entered into a regression analysis with travel cost as the independent variable.

The resulting relationship between visitation rate and travel cost with a square root functional form is displayed in Figure 6.4.

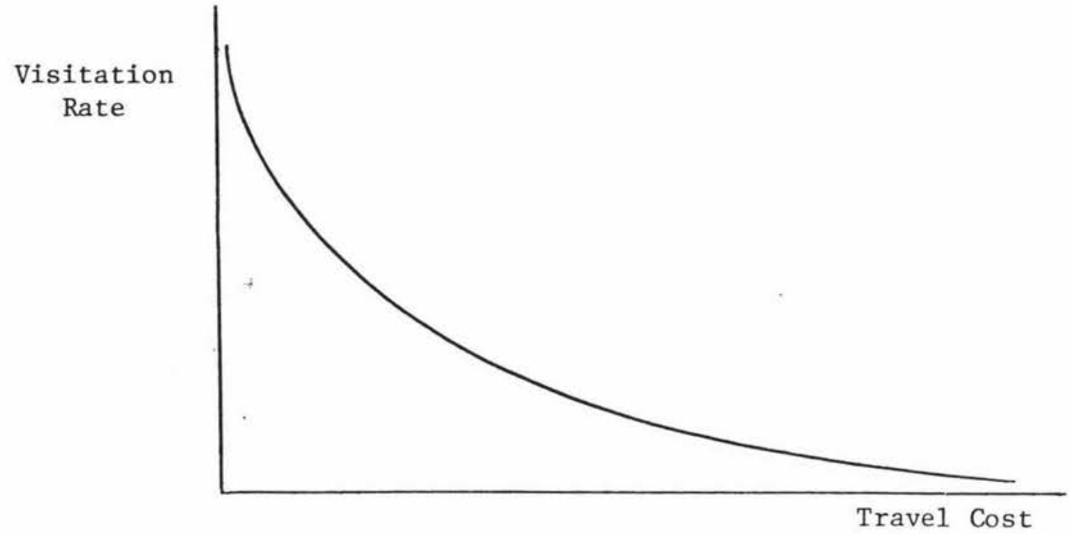

Figure 6.3 The Curvilinear Relationship Displayed by the Survey Data

The linear prediction equation obtained by the transformation was an improvement on the original prediction equation (6.1) as shown by a coefficient of determination, r^2 equal to 0.6, and the standard error of the estimate equal to 1.5. The equation form is:

$$Y = 6.44 - 0.17 (X) \quad (6.2)$$

where Y = square root of visitation rate

X = travel cost.

Taking the SQVIS variable as dependent, a regression was run with ORT, TCZONE and ZONAGE as independent variables. Once again the variables ORT and ZONAGE had negligible influence on the visitation rate, as shown in Table 6.3.

However, the relationship was still not strong enough to accurately predict visitation rate from zone travel cost data, so a logarithmic functional form was investigated.

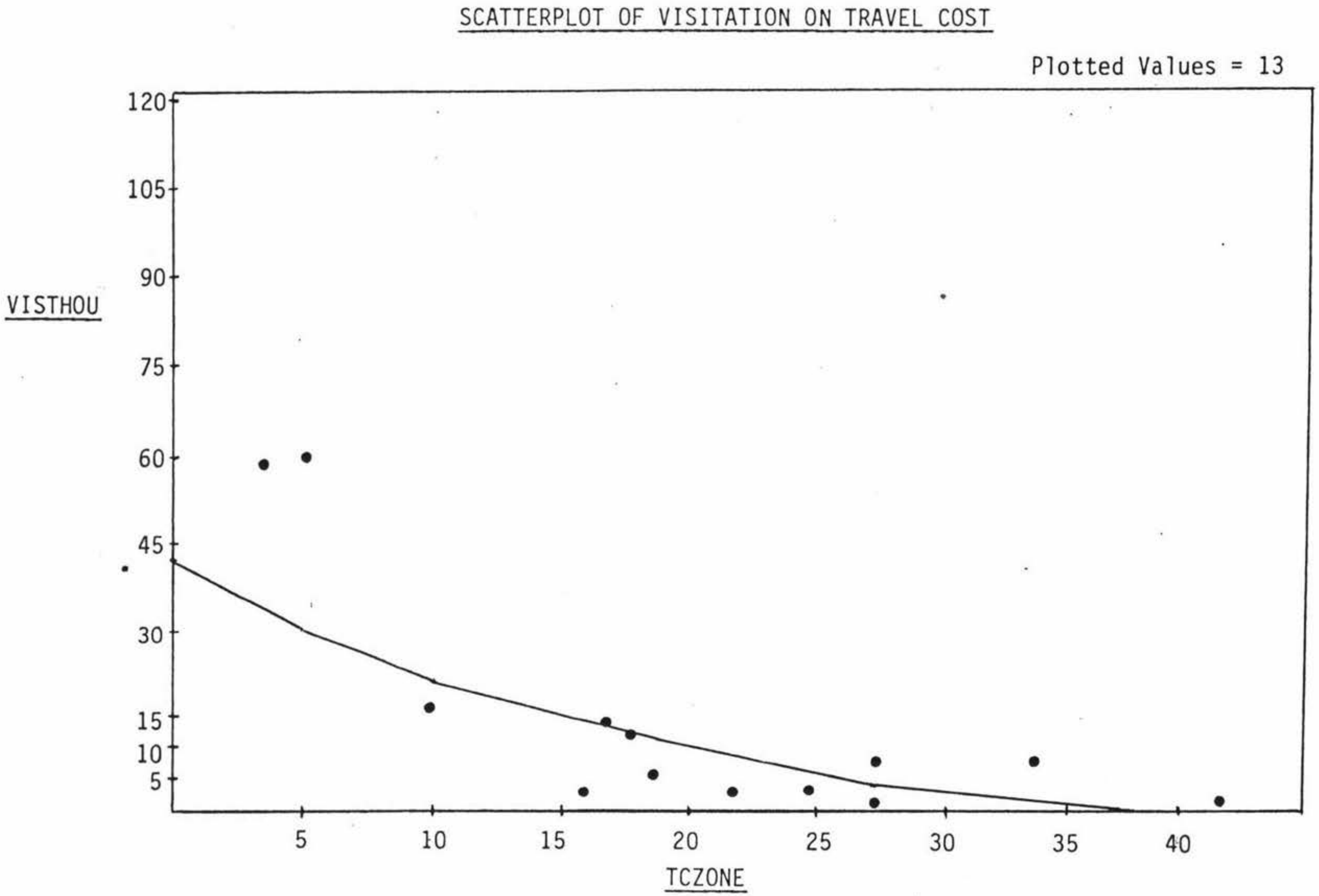

Figure 6.4 The relationship between visitation rate and travel cost explained by a square root functional form

TABLE 6.3

REGRESSION RESULTS ON SQUARE ROOT TRANSFORMATIONS

Dependent variable SQVIS

Variable	R SQUARE	RSQ CHANGE
ORT	0.00985	0.00985
TCZONE	0.69675	0.68691
ZONAGE	0.74953	0.05281

6.8 Log Transformation

In a further attempt to find a functional form to fit the survey data, log base ten transformations of the visitation rate and travel cost variables were carried out. Using the transformed variables, a linear regression analysis was carried out to test the 'goodness' of linear fit of a semi-log and a double-log transformation. These are dealt with separately below.

6.8.1 Semi-log transformation

The relationship $\log_{10}$ visitation rate as a function of travel cost was rejected due to its low r^2 value, ($r^2 = 0.54$). The relationship visitation rate as a function of $\log_{10}$ travel cost takes the form shown in Figure 6.5.

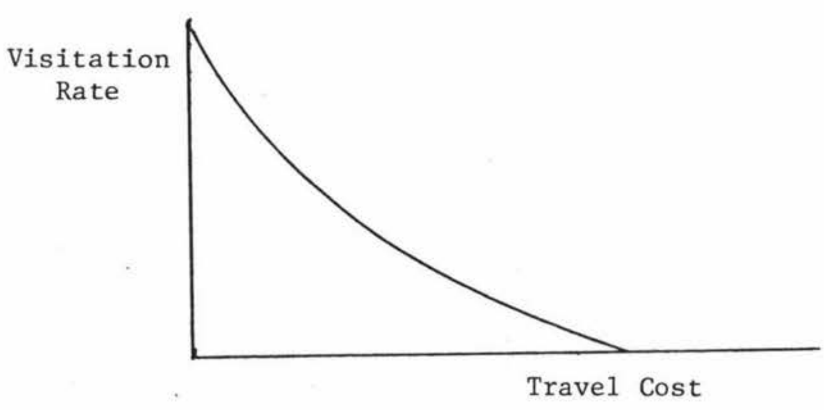

Figure 6.5 A Negative Sloping Semi-log Function

where Y = A - BlogX. (6.3)

The relationship investigated is:

$$\text{Visitation} = A - B \log(\text{travel cost}) \qquad (6.4)$$

This transformation of the travel cost variable gives a linear relationship of strong correlation that is significantly different from the null hypothesis that B = 0 (i.e. no relationship) at the 1% level.

The regression analysis results are summarised in Table 6.4.

TABLE 6.4

LINEAR REGRESSION SUMMARY ON SEMI-LOG TRANSFORMATION

Dependent Variable: VIS
Independent Variable: LOGTC

Multiple R	0.92
R Square	0.84
Adjusted R Square	0.82
Standard Error	8.82

Analysis of Variance	D.F.	Sum of Squares	Mean Square
Regression	1	4458.06733	4458.06733
Residual	11	855.90498	71.80954

F ratio = 57.29 (significant at 1%)

Variables	B	std. error
LOGTC	- 59.0	7.79
CONSTANT (A)	86.7	

The semi-logarithmic relationship between visitation rate and travel cost was plotted within the survey data points (Figure 6.6). The transformed linear relationship has a high r^2 and significance level, however the curve cuts the X axis at travel cost equal to $29. This makes the relationship unsuitable for predicting the visitation per thousand population as it excludes the distant zones from the analysis,

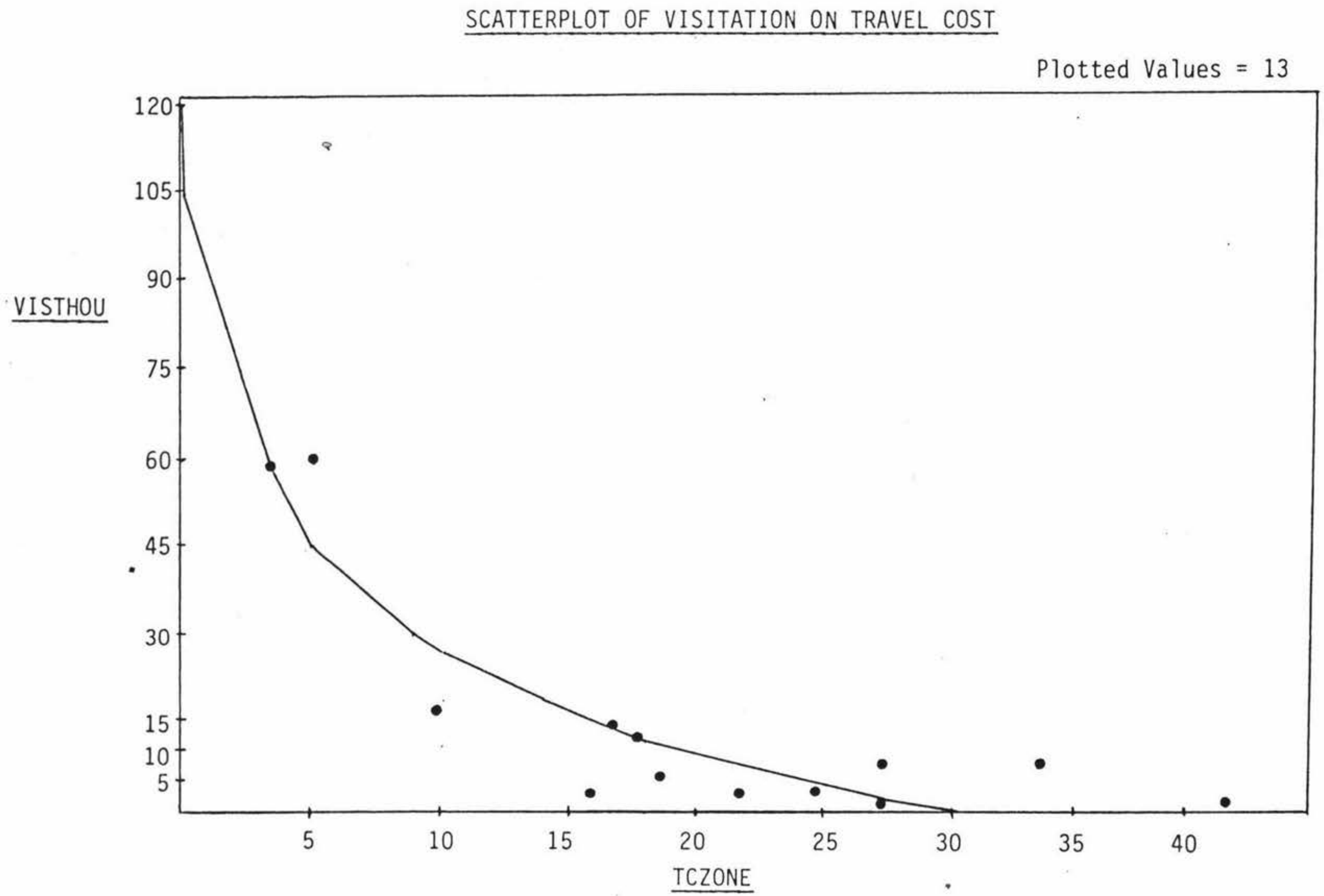

Figure 6.6 The relationship between visitation rate and travel cost explained by semi-log functional form

which includes Wellington and Auckland. This is important as they are both large populations, such that even a small value of Visitation/1000 population will result in a fairly large actual visitation figure (i.e. Visitation rate (0.5) x population/(1000^s (800) = total visitation (400)). If overall visitation from these centers is excluded the TCM will seriously under-predict true visitation.

6.8.2. Double-log transformation

The functional form,

$$\log Y = A - B \log X \quad (6.5)$$

was next considered as a possible relationship to fit the survey data. Such a relationship has the graphical form displayed in Figure 6.7.

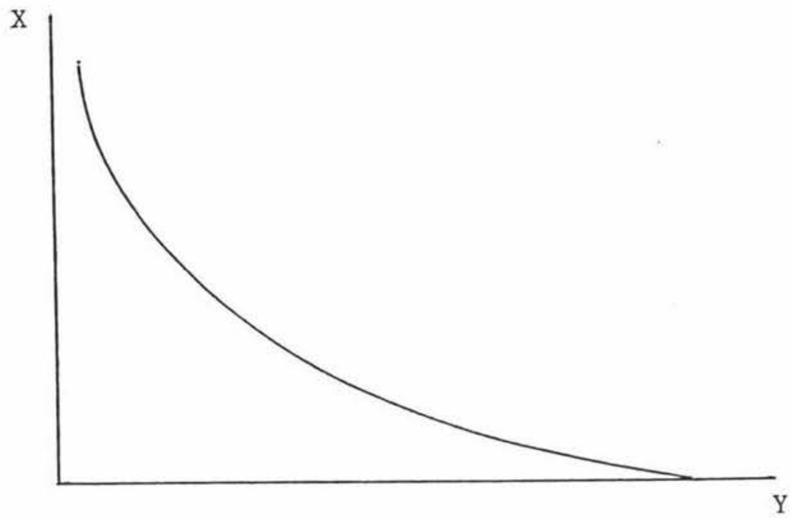

Figure 6.7 Negative Sloping Double-log Function

The transformation of the visitation rate and the travel cost variables providing the relationship ($\log_{10}$visitation = f($\log_{10}$ travel cost)) resulted in a linear relationship of strong correlation which was significant at the 1% level. The regression results are summarised in Table 6.5.

TABLE 6.5

LINEAR REGRESSION SUMMARY OF DOUBLE-LOG TRANSFORMATION

Dependent Variable: LOGVIS

Independent Variable: LOGTC

Multiple R	0.80
R Square	0.64
Adjusted R Square	0.61
Standard Error	0.39

Analysis of Variance	D.F.	Sum of Squares	Mean Square
Regression	1	2.99761	1.99761
Residual	11	1.68627	0.15330

F ratio = 19.55 (significant at 1%)

Variables	B	std.error B
LOGTC	- 1.53	0.34
CONSTANT (A)	2.64	

The linear relationship derived using regression analysis is of the form:

$$\log_{10} \text{Visitation rate} = 2.64 - 1.53 (\log_{10} \text{travel cost}) \quad (6.6)$$

The double-log relationship between visitation rate and travel cost is presented in Figure 6.8.

Although the double-log transformation provided a strong linear relationship for predicting visitation rate at Lake Tutira, further attempts were made to obtain a better functional fit of the data.

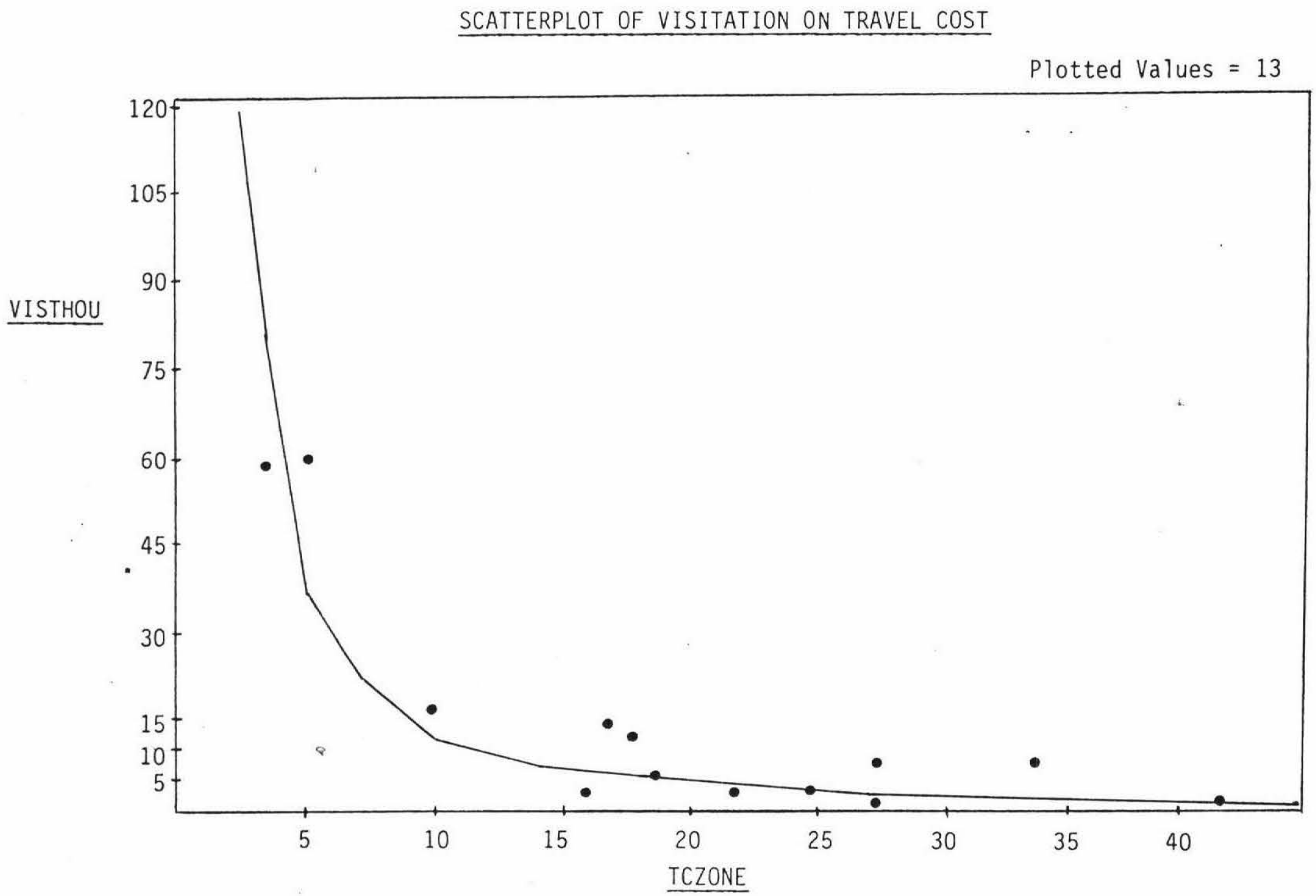

Figure 6.8 The relationship between visitation rate and travel cost explained by a double-log functional form

6.9 Grafted Linear Function

The next step taken was to try and increase the relative strength of the relationship (expressed by the r^2 value) by fitting two straight lines to the data, of the form shown in Figure 6.9.

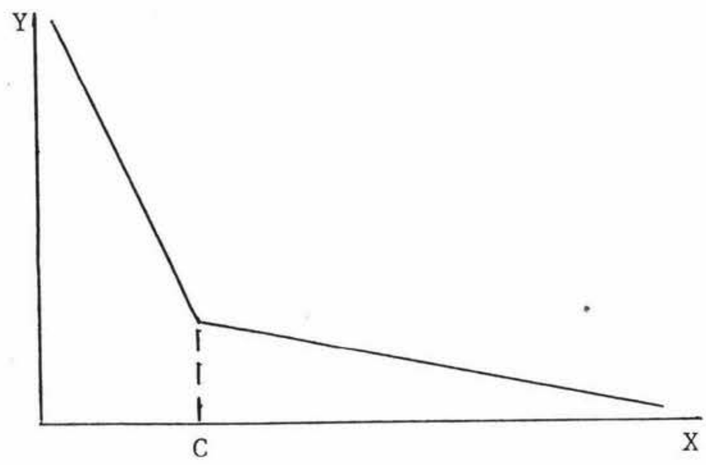

Figure 6.9 Grafted Linear Function

The justification for this move was the possibility that the visitation reactions of people close to Lake Tutira to travel cost changes were explained by a different function than those living further away. Such a phenomena could be explained by; geographical factors such as a mountain range; different income levels between the zones; or the fact that visitors from close to Tutira include 'marginals' who will not continue visiting if faced with even a small increase in cost, while those visitors from further away are more committed to the visit.

Two new variables were created, INT (intercept value = 1) and ZVAL (the difference between the X value and the point of interception of the two lines). For an explanation of the technique of linear grafting, see Appendix Two, Grafted linear functions. The technique requires that the point of interception of the two lines must have the X value (C) specified. It was arbitrarily set at C = \$10, as a travel cost figure beyond this would originate from outside the regional boundaries of the Hawkes Bay

The results of the regression analysis are summarised in Table 6.6.

TABLE 6.6

REGRESSION RESULTS OF A LINEAR GRAFTED RELATIONSHIP

Dependent Variable: VISTHOU
Independent Variables: ZVAL
TCZONE

Multiple R	0.97
R Square	0.94
Adjusted R Square	0.93
Standard Error	5.7

Analysis of Variance	D.F.	Sum of Squares	Mean Square
Regression	2	4989.06	2494.5
Residual	10	324.90	32.5

F ratio = 76.7 (significant at 1%)

Variables	B	std.error B	F
ZVAL	7.51	0.95	62
TCZONE	- 7.91	0.84	89
CONSTANT (A)	90.75		

The grafted regression line is given by the equation:

$$Y = 90.75 - 7.91 (X) + 7.51 (ZVAL) \qquad (6.8)$$

where Y = VISTHOU

X = TCZONE.

The coefficient of determination is very high ($r^2 = 0.94$) and at first reflection the relationship seems to be highly significant

(F = 76.7 with 11 d.f.). However, observation of Figure 6.10 showing the grafted regression line set amongst the survey data points indicates that possibly only the second part of the line (i.e. after C = \$10) is statistically significant. The first part of the line is derived from only three points, and as such might not be significantly different to a slope of zero (significant in a statistical sense).

Tests of significance were run on both slopes individually using the t test of statistical significance[2]. For the first part of the line, i.e. slope B_1, the slope was significantly different from zero at the 10% level, i.e. there is a 10% probability of rejecting the hypothesis that B = 7.91. For the second part of the line, the slope was found to be significantly different from zero at the 2% level. For the purpose of scientific research the slope of the initial line (B = 7.91, significant at 10%) cannot be considered statistically significant, i.e. there is too great a chance that the actual form of the line is something different from that estimated. For this reason, and the fact that the large change in slope at travel cost equal to \$10 is not fully explainable, the grafted function was rejected as a prediction relationship for visitation rate.

6.10 Reciprocal Transformation

Intuitively, it seemed that a continuously sloping relationship similar to the logarithmic functions would best describe the relationship between travel cost and visitation rate, so a reciprocal transformation was attempted of the form shown in Figure 6.11.

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[2] Explanation of the t test of significance is provided in Appendix A1-2.

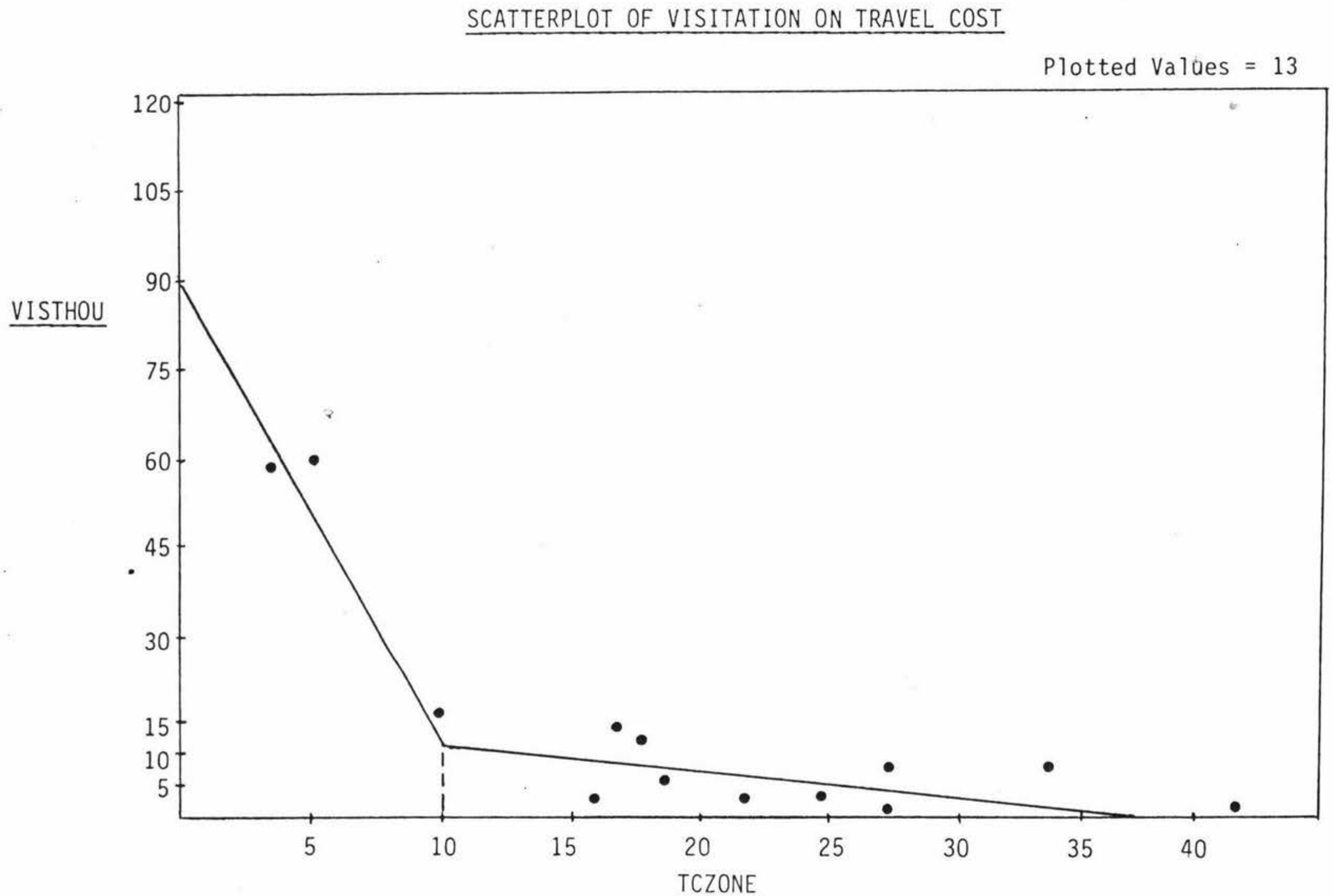

Figure 6.10 The relationship between visitation rate and travel cost explained by a grafted linear function

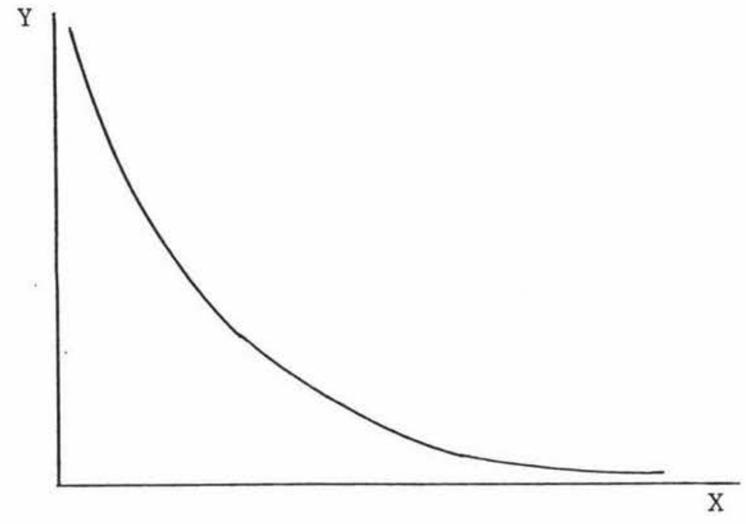

Figure 6.11 Reciprocal Function of the Form $Y = f(\frac{1}{X})$

i.e. $$Y = A + \frac{B}{X} \qquad (6.9)$$

where Y = visitation rate

X = travel cost.

$$\frac{dY}{dX} = - B/X^2 \qquad (6.10)$$

such that the slope is everywhere negative and decreases in absolute value as X increases. The relationship is assymptotic on both axis, i.e. as X tends to zero, Y tends to infinity, and as Y tends to zero, X tends to infinity.

To obtain a linear relationship, a regression analysis was carried out with visitation rate as the dependent variable and the inverse of travel cost as the independent variable. The linear relationship is strong ($r^2 = 0.88$) and statistically significant at the 1% level ($F = 81$ with 11 d.f). The regression equation is:

$$Y = 3.99 + \frac{233.5}{X} \qquad (6.11)$$

where Y = visitation

X = travel cost.

The regression results are summarised in Table 6.7.

TABLE 6.7

REGRESSION SUMMARY FOR RECIPROCAL TRANSFORMATION

Dependent Variable: VISTHOU
Independent Variable: INV

Multiple R	0.94
R Square	0.88
Adjusted R Square	0.87
Standard Error	7.58

Analysis of Variance	D.F.	Sum of Squares	Mean Square
Regression	1	4681.63	4681.63
Residual	11	632.34	57.48

Variables	B	std.error B
INV	223.53	24.76
CONSTANT (A)	- 3.99	

A graph of the relationship between visitation rate and travel cost using the reciprocal functional form (Figure 6.12) indicates a good data fit and as the curve is assymptotic on both axis it includes the distant zones with positive predicted visitation. Due to the assymptotic nature of the curve it is necessary to draw boundary limits to the travel cost axis. The Auckland zone provided visitors from the greatest distance (hence greatest travel cost) so it was decided that the travel cost limit would be just beyond the figure for zone 13. It was considered highly unlikely that people would travel from further afield than Auckland with Lake Tutira as the main destination. Therefore the travel cost limit was set at $45.

SCATTERPLOT OF VISITATION ON TRAVEL COST

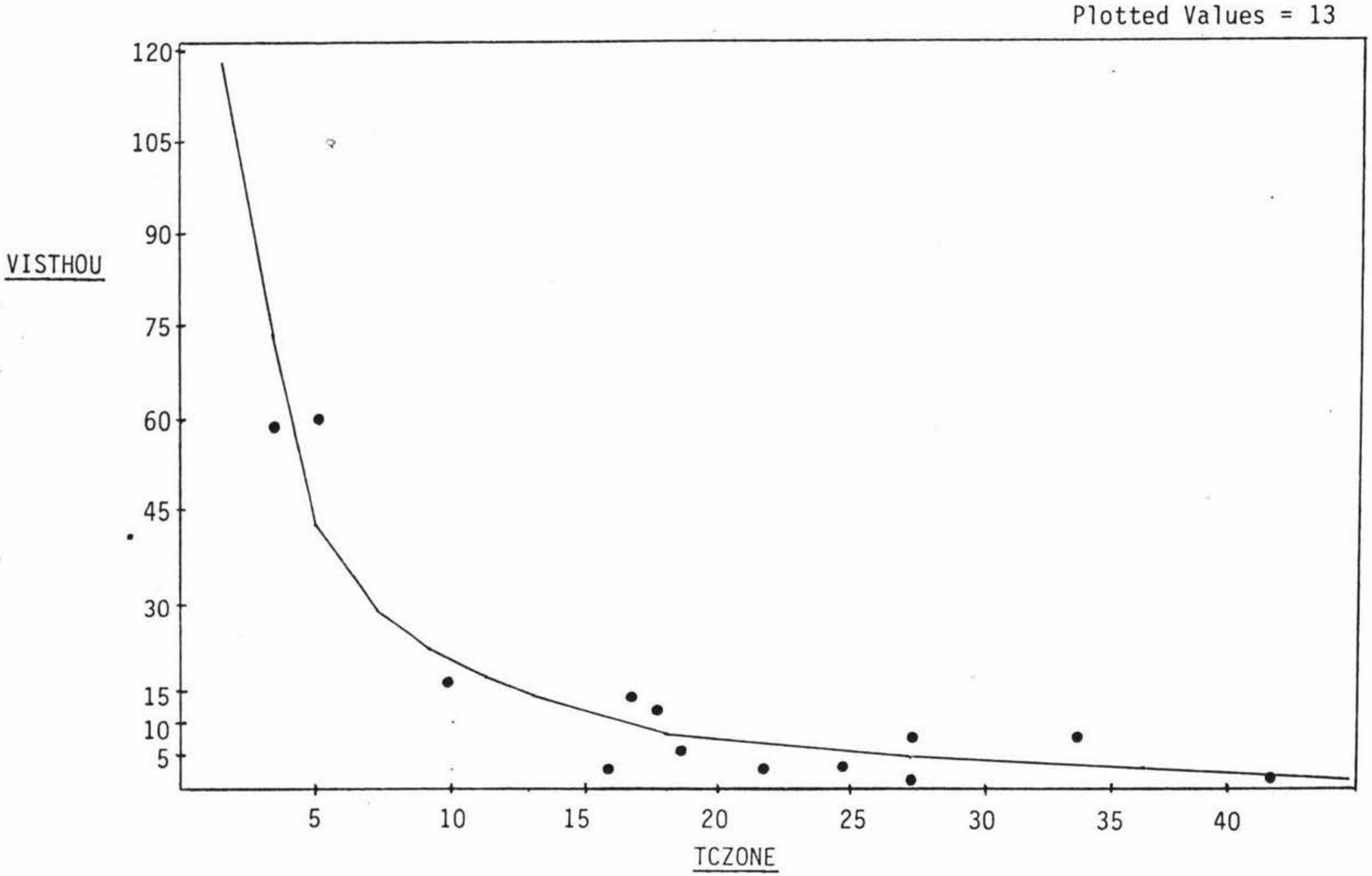

Figure 6.12 The relationship between visitation rate and travel cost explained by a reciprocal functional form

Of the five visitation/travel cost relationships tested, the reciprocal transformation provides the best combination of strength of relationship and statistical significance. It also fulfils the requirement that the prediction line is positive for the more distant zones. For these reasons the prediction equation resulting from the reciprocal transformation was chosen for use in the next stage of the analysis, the formation of the demand curve and calculation of the consumers' surplus, presented in Chapter 7.

6.10.1 Confidence intervals

It is possible to establish confidence intervals for the slope of the linear relationship, giving an indication of the amount of variability to be expected in the resultant predictions (see Appendix A1-3). If 95 percent confidence intervals are calculated on the estimate of the slope, then the analyst can state that if many samples were drawn from the population, 95 percent of the time the slope estimates would fall within the range described by the confidence interval, presuming either a normal or a students t distribution in the variation about the slope.

So, for the linear relationship;

$$\text{visitation rate} = A + \frac{B}{\text{travel cost}} \qquad (6.12)$$

it is possible to obtain values for;

Slope B = 223.5

Standard error of the estimate (S.E.E.) = 7.5

Number of cases = 13.

With a small sample size (13) the B estimates will follow the _t distribution_ with N - 2 (11) degrees of freedom. The confidence intervals will follow the form;

$$\hat{B} \mp (SEE) < B < \hat{B} \mp (SEE)$$

where t is taken from the students t distribution with probability = 0.05 at degrees of freedom V = 13 - 2 = 11.

$$\text{i.e.} \quad 223.5 - 1.796(7.5) < B < 223.5 + 1.796\ (7.5)$$

$$210 < B < 237.$$

Given the above calculations it is possible to state that one is 95 percent sure that the true slope of the linear regression line will be within the bounds of 210 to 237. The confidence limits on the slope of the linear regression line resulting from the reciprocal transformation are displayed in Figure 6.13.

The confidence region can be taken one step further from the linear relationship by indicating a confidence belt for the reciprocal relationship in terms of the slope of the regression equation, shown in Figure 6.14. The region indicated in Figure 6.14 (the shaded area) is bounded by the prediction line calculated from the regression equation with the slope B within the range 210 to 237 (i.e. the confidence interval for B in the regression equation).

It can be stated that the researcher is 95% certain that if the whole population were sampled, the resulting line of best fit would fall within the regions specified in Figures 6.13 and 6.14, i.e. a 95 percent confidence belt around the regression line.

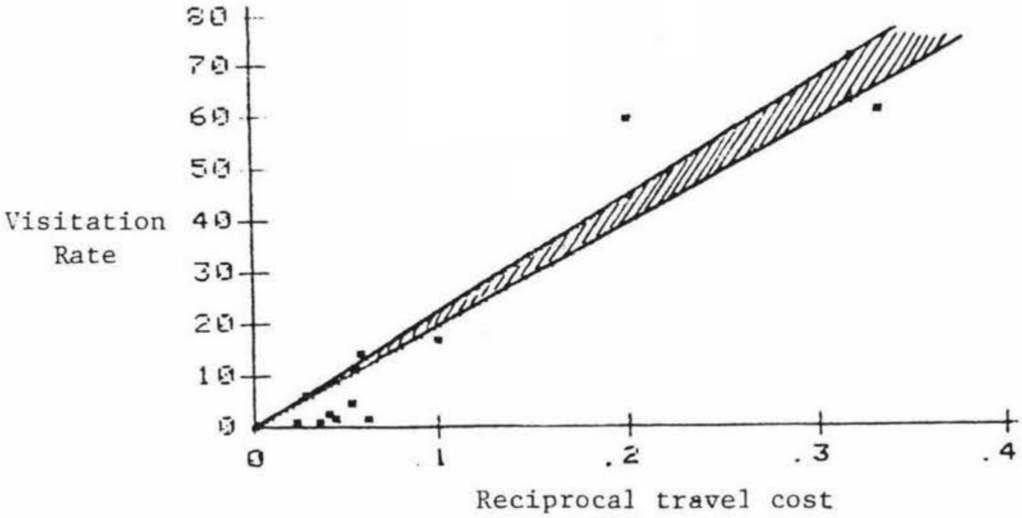

Figure 6.13 The Confidence Region for the Linear Function

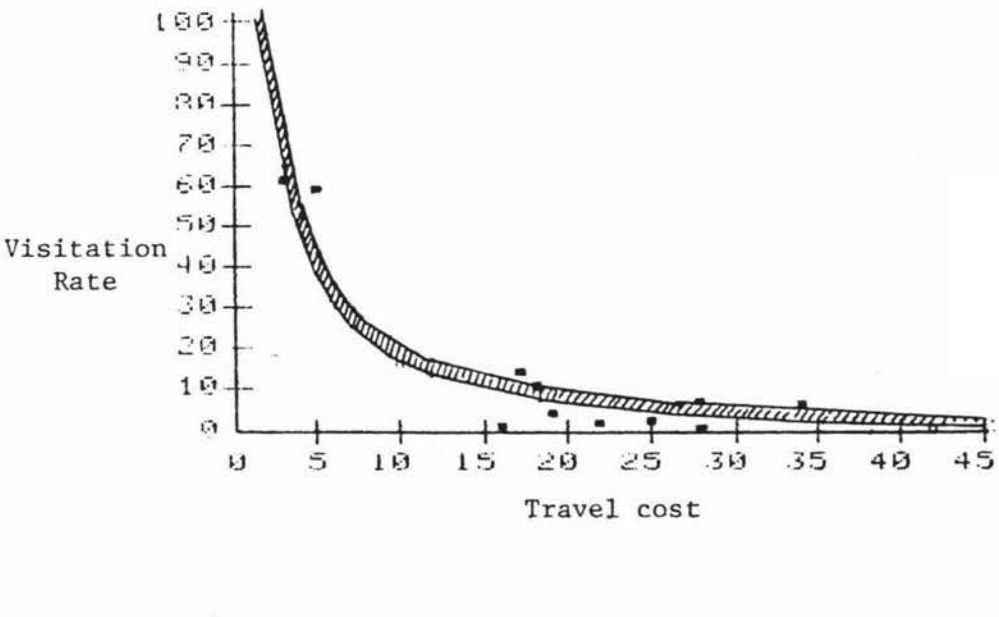

Figure 6.14 The Confidence Region for the Reciprocal Function

CHAPTER 7. FORMATION OF THE DEMAND CURVE AND CALCULATION OF CONSUMERS' SURPLUS (STAGE TWO)

7.1 Introduction

In this chapter the second stage of the Travel Cost Method is presented. A demand curve for Lake Tutira as a recreational amenity is derived using the travel cost relationship established in the previous chapter. From the derived demand curve, a consumers' surplus figure for the users of Lake Tutira is obtained and presented as a measure of the value of the resource to its consumers.

In the final section a series of sensitivity analyses are carried out to ascertain the 'robustness' of the final consumers' surplus figure to changes or error in the input data. Two variables tested are the estimated yearly visitation figure and the calculation of vehicle travel cost. Also, a consumers' surplus is calculated using an alternative prediction equation obtained from a different transformed function. This action was undertaken to check the degree of influence the chosen visitation rate prediction model has on the final consumers' surplus figure.

7.2 Estimation of Visitation Rates at Increasing Admission Fees

In chapter 6 a prediction equation for visitation rate to Lake Tutira was derived using regression analysis techniques. The next stage of the travel cost method involves calculation of total visitation at corresponding admission fees. The admission fee is taken as an absolute entrance charge incurred by the visiting group, and is a constant amount regardless of how long the group remains at Lake Tutira. One of the major assumptions of the TCM is that people will react to increases in admission fees in the same manner as they would to increases in travel cost. The effect of changes in travel cost on visitation is described by the regression equation, so the effect of increased admission fees can be calculated by adding the new admission fee to the travel cost figure for each zone and then calculating the new zonal visitation rates. Using the new zonal visitation rates, total zone visitation at a given admission fee can be calculated and the sum of the total zone visitation figures will indicate total visitation to Lake Tutira at that particular admission fee. The regression equation formulated in chapter 6 is,

$$Y = -3.99 + \frac{233.5}{X} \tag{7.1}$$

where Y = visitation per thousand population

X = travel cost plus admission fee.

The new travel cost figures from each zone resulting from increased admission fees were calculated and are presented in Table 7.1. The calculated visitation rates at increased admission fees obtained using the regression equation are displayed in Table 7.2. An example of the calculation involved is as follows:

Zone 1, travel cost = \$3 at zero admission fee, therefore

visitation rate = 73.8 visitor days/1000 population, calculated from equation (7.1).

If one introduces an admission fee = \$3 then the travel cost figure becomes \$6. The new travel cost figure is fed into equation 7.1.

i.e. $Y = -3.99 + \frac{233.5}{6} = 34.9$

i.e. visitation rate = 34.9 visitor days/1000 population

= the new visitation rate at admission fee equal to \$3.

TABLE 7.1

ZONAL TRAVEL COST PLUS ADMISSION FEE

ADMISSION FEE ($)

ZONE	0	3	5	10	15	20	25	30	35	40	45
1	3	6	8	13	18	23	28	33	38	43	48
2	5	8	10	15	20	25	30	35	40	45	50
3	10	13	15	20	25	30	35	40	45	50	55
4	16	19	21	26	31	36	41	46	51	56	61
5	17	20	22	27	32	37	42	47	52	57	62
6	18	21	23	28	33	38	43	48	53	58	63
7	19	22	24	29	34	39	44	49	54	59	64
8	22	25	27	32	37	42	47	52	57	62	67
9	25	28	30	35	40	45	50	55	60	65	70
10	28	31	33	38	43	48	53	58	63	68	73
11	28	31	33	38	43	48	53	58	63	68	73
12	34	37	39	44	49	54	59	64	69	74	79
13	42	45	47	52	57	62	67	72	77	82	87

TABLE 7.2

PREDICTED VISITATION RATES AT INCREASED ADMISSION FEES USING REGRESSION EQUATION $Y = -3.99 + \frac{233.5}{X}$

ZONE	ADMISSION FEE ($) 0	3	5	10	15	20	25	30	35	40	45
1	73.8	34.9	25.2	14.0	8.9	6.1	4.3	3.1	2.2	1.4	0.9
2	42.7	25.2	19.4	11.6	7.7	5.4	3.8	2.7	1.8	1.2	0.7
3	19.4	14.0	11.6	7.7	5.4	3.8	2.7	1.8	1.2	0.7	0.3
4	10.6	8.3	7.1	5.0	3.5	2.5	1.7	1.1	0.6	0.2	-
5	9.7	7.7	6.6	4.7	3.3	2.3	1.6	1.0	0.5	0.1	-
6	9.0	7.1	6.1	4.3	3.1	2.2	1.4	0.9	0.4	-	-
7	8.3	6.6	5.7	4.1	2.9	2.0	1.3	0.8	0.3	-	-
8	6.6	5.4	4.7	3.3	2.3	1.6	1.0	0.5	0.1	-	-
9	5.4	4.3	3.8	2.7	1.8	1.2	0.7	0.3	-	-	-
10	4.3	3.5	3.1	2.2	1.4	0.9	0.4	-	-	-	-
11	4.3	3.5	3.1	2.2	1.4	0.9	0.4	-	-	-	-
12	2.9	2.3	2.0	1.3	0.8	0.3	-	-	-	-	-
13	1.6	1.2	1.0	0.5	0.1	-	-	-	-	-	-

Similar calculations were made for all the zones, and at ten different admission fees, shown in Table 7.2.

7.3 Total Visitation at Increasing Admission Fees (the Demand Schedule)

Having obtained estimates of visitation rates for the various zones, the total visitation figure for each zone at different admission fees was calculated by multiplying the visitation rate by zone population. At each level of admission fee, the total visitation from each zone was summed to provide an estimate of the total yearly visitation to Lake Tutira. The results of these calculations are shown in Table 7.3. The easily observable total site visitation at corresponding admission fees provides a demand schedule for Lake Tutira as a recreation site. This derived demand schedule is best displayed by a demand curve, as shown in Figure 7.1.

From the graph it is possible to observe the effect that imposing a form of admission fee on access to Lake Tutira would have on total yearly visitation.

7.4 Measurement of Consumers' Surplus

Consumers' surplus is defined as the benefit consumers receive from the consumption of a good or service over and above that which they actually pay for it, and is equal to the area under the demand curve and above the price line. In the case of Lake Tutira, no charge is actually attached to the use of the lake. A demand curve is derived using the TCM which predicts consumer reaction to the introduction of a charge. However, as no charge is actually imposed, consumers' surplus is equal to the whole area under the demand curve. This area is a measure of total consumer willingness to pay rather than go without the

TABLE 7.3

TOTAL ZONE VISITATION RESULTING FROM INCREASED ADMISSION FEES

ZONE	POPULATION (000's)	ADMISSION FEES 0	3	5	10	15	20	25	30	35	40	45
1	50.0	3691	1745	1260	700	445	305	215	155	110	70	45
2	50.0	2135	1260	970	580	385	270	190	135	90	60	35
3	7.9	153	111	92	61	43	30	21	14	9	6	2
4	13.1	139	109	93	66	46	33	22	14	8	3	0
5	2.2	21	17	15	10	7	5	4	2	1	0	0
6	30.0	270	213	183	129	93	66	42	27	12	0	0
7	53.8	447	355	307	221	156	108	70	43	16	0	0
8	47.4	313	256	223	156	109	76	47	24	5	0	0
9	19.7	106	85	75	53	35	24	14	6	0	0	0
10	34.3	147	120	106	75	48	31	14	0	0	0	0
11	15.3	66	54	47	34	21	14	6	0	0	0	0
12	349.9	1015	805	700	455	280	105	0	0	0	0	0
13	805.9	1289	967	806	403	81	0	0	0	0	0	0
	TOTAL	9792	6097	4879	2945	1759	1067	645	420	251	139	82

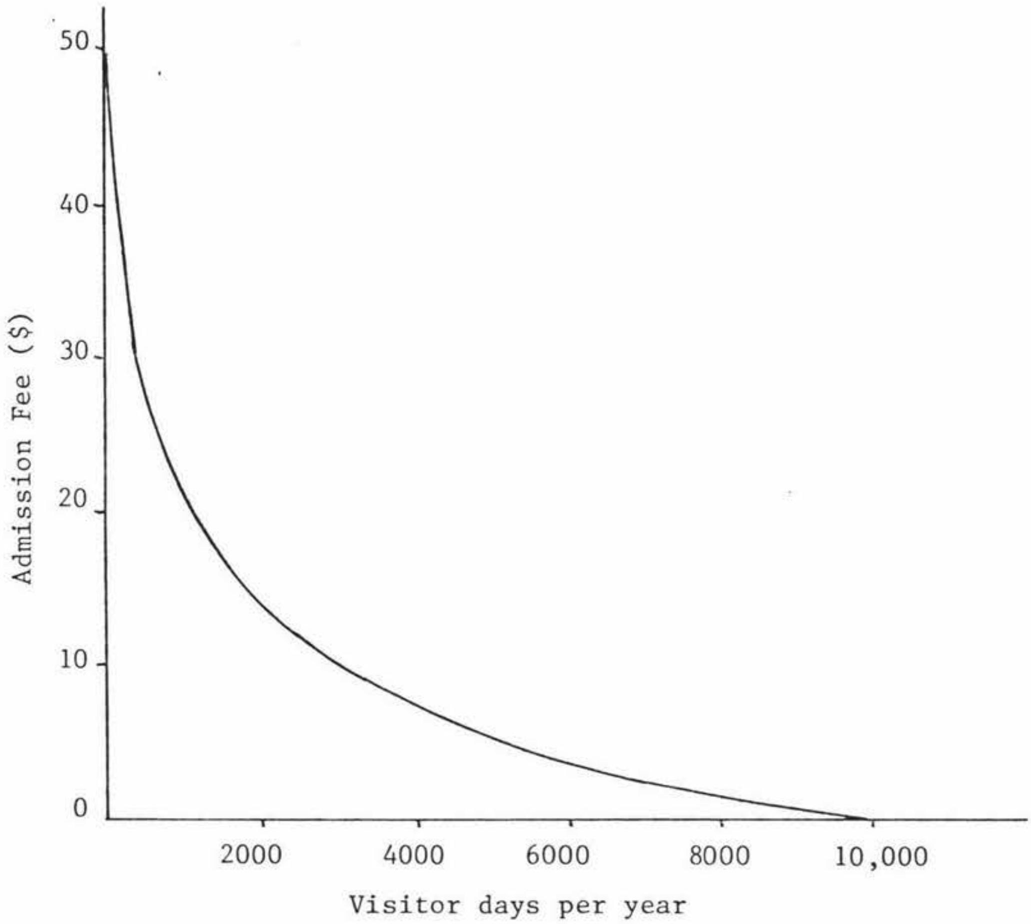

Figure 7.1 Demand Curve for Lake Tutira

recreational opportunity at Lake Tutira (see chapter 1).

The total area under the demand curve (Figure 7.1) was calculated in monetary units, and was found to be equal to \$83,349. Accepting consumers' surplus as the correct measure of the worth of Lake Tutira it can be stated that Lake Tutira is worth \$83,349 per year to its users.

Discussion on the implications of this consumers' surplus value for optimal resource allocation, what it reflects, and its interpretation in relation to Lake Tutira is presented in detail in chapter 8.

7.5 The Elasticity of Demand for Lake Tutira

The elasticity of a demand curve indicates the responsiveness of the quantity taken to changes in the price of a good or service. Observing Figure 7.1 it can be seen that as the admission price increases, the responsiveness of total visitation to the change decreases at an increasing rate. Consider Table 7.4.

TABLE 7.4

CHANGE IN TOTAL VISITATION WITH \$5 INCREMENTS IN ADMISSION FEE

Admission fee (\$)	Change in visitation (visitor days/year)
5	4913
10	1923
15	1186
20	692
25	422
30	225
35	169
40	112
45	52

From observation of the demand curve for Lake Tutira it can be stated that demand for Lake Tutira as a recreational amenity is elastic[1] at lower prices but inelastic at higher prices. i.e. demand reacts markedly to initial price increases but gradually loses its sensitivity to price changes at higher admission fees.

As a result of the elastic demand for the lake at the initial low charges it can be seen that the imposition of an entrance cost to Lake Tutira would greatly effect total visitation. For example, an entrance fee of $5 would result in a 50% decrease in total yearly visitation.

7.6 Sensitivity Analyses

In an attempt to illustrate the robustness of the travel cost prediction model to changes in input variables and functional form, the final consumers' surplus figure was recalculated using changed visitation variables, recalculated travel cost figures, and a grafted linear functional form.

7.6.1 The Visitation Variable

The biggest uncertainty associated with the visitation variable was the initial estimate of current yearly visitation to Lake Tutira as this figure was not available as an exact measurement (see chapter 4). The sample results were adjusted to this estimated population level to give total yearly visitation estimates from each zone. The figure used for current yearly visitation will therefore effect the final consumers' surplus calculation. In order to indicate the extent by which a change in the current yearly visitation estimate will effect

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[1] If the quantity is changed by more than 1 percent as a result of a 1 percent change in price, the relationship is said to be relatively elastic. Conversely if a 1 percent change in price causes a change of less than 1 percent the relationship is said to be relatively inelastic.

the total consumers' surplus figure, the prediction model was formulated again using a new value for current yearly visitation.

In 1976, the annual visiting population of Lake Tutira was estimated at approximately 15,000 visitor days (King, 1976). This figure represents fifty percent more visitation to the lake than the estimate used in the initial calculations. An increase in visitation of this magnitude might be considered possible in the future if the lake regains its earlier standard of water quality.

The calculations of the new zonal visitation rates are described below.

Assume that winter visitation to Lake Tutira originates from within 100 kms from the lake. The winter visitation (May to October) is estimated at 2500 visitor days (see chapter 4), so the zone breakdown of winter visitation is displayed in Table 7.5.

TABLE 7.5

WINTER VISITATION BREAKDOWN

	Zone	Percentage of visitation sampled times			Winter Visitation
1.	Napier	0.49	x	2500	1225
2.	Hastings/Wairoa	0.48	x	2500	1200
3.	Waipukurau	0.02	x	2500	50

During the summer months (November to April) visitation was re-estimated at 12,500 visitor days per year. The total number of visitor days sampled was 1500, therefore the population/sample ratio equals 12,500 divided by 15,000, i.e. 8.3.

Total zone visitation is shown in Table 7.6.

TABLE 7.6

ZONE BREAKDOWN OF YEARLY VISITATION

Zone	Visitor days sampled	Population/ sample ratio	Total visitation	
1.	365	8.3	(+ 1225)	4254
2.	357	8.3	(+ 1200)	4163
3.	16	8.3	(+ 50)	183
4.	3	8.3		25
5.	6	8.3		50
6.	67	8.3		556
7.	54	8.3		448
8.	14	8.3		116
9.	9	8.3		75
10.	4	8.3		33
11.	22	8.3		183
12.	430	8.3		3569
13.	100	8.3		830
			TOTAL	14485

Note: the figures in brackets are winter visitation figures.

From the figures shown in Table 7.6, the visitation rate per 1000 population for each zone was calculated. The visitation rate variable was incorporated in a regression analysis with the reciprocal of travel cost as the independent variable in the same way as described in chapter 6.

A new prediction equation was obtained.

$$Y = -4.08 + \frac{305.9}{X} \qquad (7.2)$$

where Y = visitation rate

X = travel cost.

The new equation (7.2) describes a strong relationship indicated by $r^2 = 0.86$, and was significant at 1%.

The plot of the relationship between the new visitation rates and the travel cost variable is shown in Figure 7.2.

In the same manner as presented earlier in the chapter, predicted visitation rates at increasing admission fees were calculated (Table 7.7) and used to find total visitation at increased admission fees (the demand schedule, presented in Table 7.8). Using this information a new demand curve (Figure 7.3) was formed, and a new consumers' surplus figure calculated.

The new consumers' surplus figure was $158,169. An increase in estimated visitation by 5000 visitor days resulted in an increase in the calculated consumers' surplus figure of $74,820. That is, a 50% increase in the estimated visitation figure results in 90% increase in the consumers' surplus value.

Obviously the current visitation figure is very important to the final result of the analysis, in that an over-estimated or under-estimated figure would surely mistate the true value of the recreation site by a considerable margin.

A reasonable degree of confidence was felt by the author in the estimate of current visitation for the 1980/81 season, and if any bias were associated with the figure it is considered that it would be a conservative one, i.e. the estimate is more likely to underestimate visitation than overestimate it.

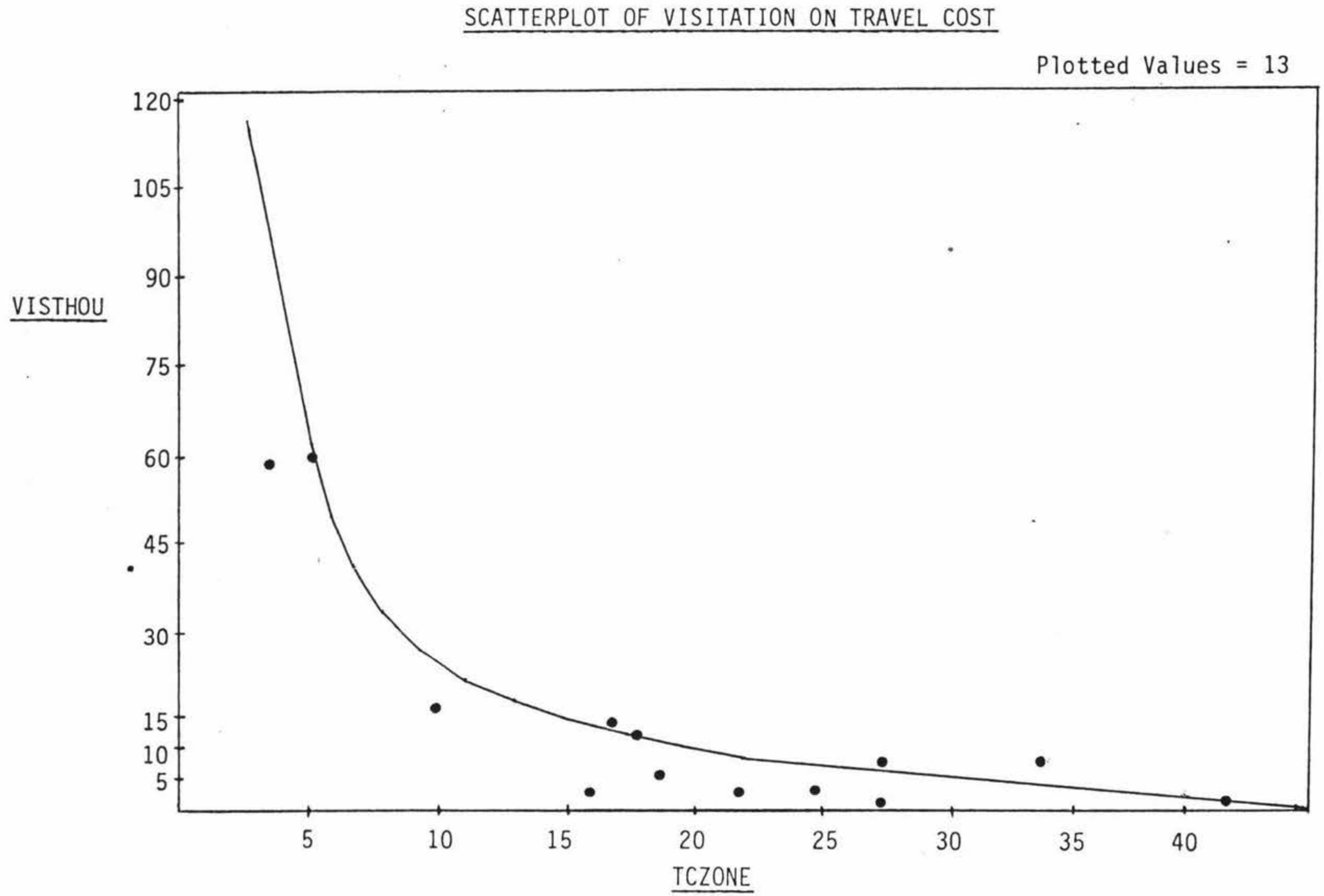

Figure 7.2 Relationship between travel cost and the new calculation of visitation rate

TABLE 7.7

PREDICTED VISITATION RATES AT INCREASED ADMISSION FEES - INCREASED ESTIMATED VISITATION PER YEAR

ADMISSION FEE ($)

ZONE	0	3	5	10	15	20	25	30	35	40	45
1	97.9	46.9	34.2	19.5	12.9	9.2	6.8	6.1	4.0	3.0	2.3
2	57.1	34.2	26.5	16.3	11.2	8.2	6.1	4.7	3.6	2.7	2.0
3	26.5	19.5	16.3	11.2	8.2	6.1	4.7	3.6	2.7	2.0	1.5
4	15.0	12.0	10.5	7.7	5.8	4.4	3.4	2.6	1.9	1.4	0.9
5	13.9	11.2	9.8	7.2	5.5	4.2	3.2	2.4	1.8	1.3	0.9
6	12.9	10.5	9.2	6.8	5.2	4.0	3.0	2.3	1.7	1.2	0.8
7	12.0	9.8	8.7	6.5	4.9	3.8	2.2	2.0	1.6	1.1	0.7
8	9.8	8.2	7.2	5.5	4.2	3.2	2.4	1.8	1.3	0.9	0.5
9	8.2	6.8	6.1	4.7	3.6	2.7	2.0	1.5	1.0	0.6	0.3
10	6.8	5.8	5.2	4.0	3.0	2.3	1.7	1.2	0.8	0.4	0.1
11	6.8	5.8	5.2	4.0	3.0	2.3	1.7	1.2	0.8	0.4	0.1
12	4.9	4.2	3.8	2.9	2.2	1.6	1.1	0.7	0.4	0.1	0
13	3.2	2.7	2.4	1.8	1.3	0.9	0.5	0.2	0	0	0

TABLE 7.8

TOTAL ZONE VISITATION RESULTING FROM INCREASED ADMISSION FEES - INCREASED ESTIMATED VISITATION PER YEAR

ZONE	POPULATION (000's)	ADMISSION FEES 0	3	5	10	15	20	25	30	35	40	45
1	50.0	4895	2345	1710	975	645	460	340	305	200	150	115
2	50.0	2855	1710	1325	815	56	410	305	235	180	135	100
3	7.9	209	154	129	88	65	48	37	28	21	16	12
4	13.1	197	157	138	101	76	58	45	34	25	18	12
5	2.2	31	25	22	16	12	9	7	5	4	3	2
6	30.0	387	315	276	204	156	120	90	69	51	36	24
7	53.8	646	527	468	350	264	204	118	107	86	59	38
8	47.4	464	389	341	261	199	152	114	85	62	43	24
9	19.7	162	134	120	95	71	53	39	30	20	12	6
10	34.3	233	199	178	137	103	79	58	41	27	14	3
11	15.3	104	89	80	61	46	35	26	18	12	6	2
12	349.9	1715	1470	1330	1015	770	560	385	245	140	35	0
13	805.9	2579	2176	1934	1451	1048	725	403	161	0	0	0
	TOTAL	14477	9690	8051	5568	4015	2913	1967	1374	828	527	338

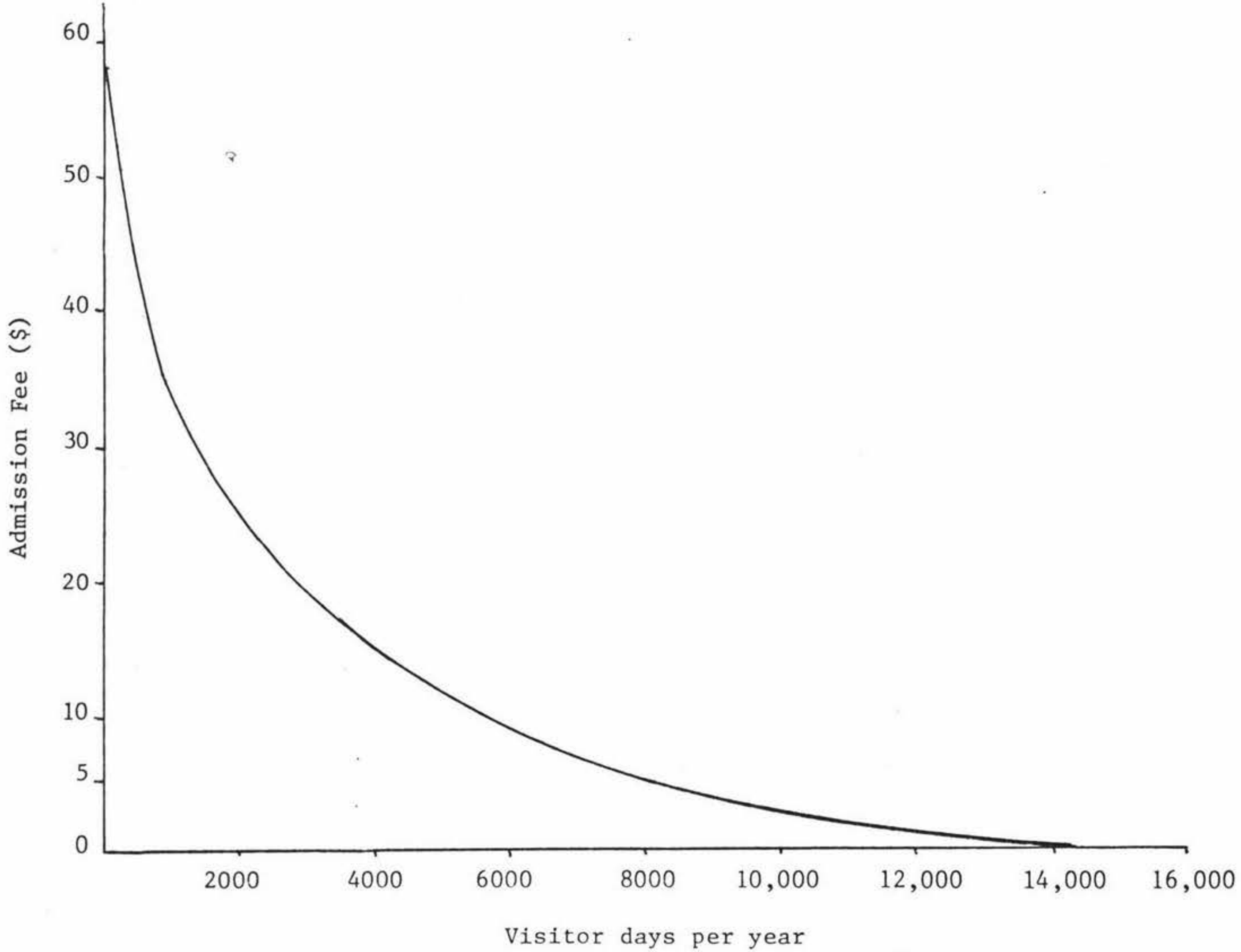

Figure 7.3 Demand Curve resulting from an Increased Yearly Visitation Estimate

7.6.2 The Travel Cost Variable

To test the robustness of the prediction model and the final consumers' surplus calculation to variations in the calculation of the travel cost variable, the travel cost values were allocated using a different 'cost per kilometer' constant. In the analysis outlined in chapter 6, a cost of travel equal to 4.86 per kilometer was approximated for all travellers (see chapter 5, section 2). This original calculation was based on an average car consuming 9 L/100 kms, this being the average fuel consumption of a vehicle with an engine size within the range of 1900 to 2400 cc. The estimate of 9 L/100 kms was obtained using A.A. figures and information from motor industry personnel. However, this figure is not exact and would probably be considered a conservative estimate as it is based on new car figures. Also, many of the visitors to Lake Tutira would be pulling caravans, boats or trailers and have fully laden cars. For this reason, the consumers' surplus was recalculated using 10 L/100 kms as the average vehicle fuel consumption, resulting in an average cost of travel of 5.2 cents/km (cost of petrol at this time was 52 cents per litre).

The travel cost variable was calculated from the following formula,

$$TC = A + D_i + d \tag{7.3}$$

where TC = travel cost

A = admission fee

D_i = round trip distance from zone 1.

d = cost of motoring (5.2 ¢/km).

In the absence of exact official estimates, it was hypothesised the average fuel consumption would probably be somewhere between the figures used in the two analyses, i.e. 9 - 10 L/100 kms.

Introducing the new travel cost figures (for each zone) into the regression analysis, a new regression equation was obtained,

$$Y = -3.54 + \frac{222.2}{X} \qquad (7.4)$$

The estimated visitation rates at increasing admission fees were obtained using equation (7.4). The visitation rates were multiplied by zone populations to provide total visitation estimates, shown in Table 7.9. The new demand curve was drawn (Figure 7.4) and the area under the curve measured as the consumers' surplus.

The new consumers' surplus figure was \$82,822. This negative change in consumers' surplus from \$83,349 to \$82,822 was unexpected as it was thought intuitively that a higher cost of travel figure would result in a larger consumers' surplus figure. On consideration it was hypothesised that the re-positioning of the data points due to changes in the travel cost figures only at costs higher than \$10[2] had caused the line of best fit to be drawn towards the ordinate by a fractional amount within the range 0 - \$10. This would result in estimated visitation from the nearby zones being less than the original prediction. To test this theory, the analysis was carried out once again using a large increase in the cost of travel, i.e. 10 ¢/km. This hypothetical figure is obviously an overestimation, but the analysis was carried out merely to indicate the direction of a change in consumers' surplus resulting from an increase in the cost of motoring.

The consumers' surplus was re-calculated to be \$142,780, indicating a positive increase in consumers' surplus with an increased cost of motoring, as would be expected. The total visitation at zero admission fee remains much the same as for the original calculations,

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[2] The changes in the TC values of less than \$10 were negligible and therefore caused no change in the zone average values.

TABLE 7.9

TOTAL VISITATION WITH NEW TRAVEL COST CALCULATION

ZONE	POPULATION (000's)	ADMISSION FEES 0	3	5	10	15	20	25	30	35	40	45
1	50.0	3525	1680	1210	680	440	305	220	160	115	80	55
2	50.0	2045	1210	935	565	380	265	195	140	100	70	45
3	7.9	148	107	89	60	42	31	22	16	11	7	4
4	13.1	124	100	88	62	45	33	24	16	9	5	0
5	2.2	19	15	13	10	7	5	4	2	2	1	0
6	30.0	246	198	171	123	90	66	45	30	18	6	0
7	53.8	409	328	285	210	151	108	75	48	27	11	0
8	47.4	270	223	194	142	104	71	47	28	9	0	0
9	19.7	93	77	67	49	35	24	14	8	0	0	0
10	34.3	134	110	96	69	48	31	17	7	0	0	0
11	15.3	60	43	46	31	21	14	8	3	0	0	0
12	349.9	910	770	665	455	280	140	35	0	0	0	0
13	805.9	1209	967	806	484	161	0	0	0	0	0	0
	TOTAL	9192	5828	4664	2940	1804	1093	706	458	291	180	104

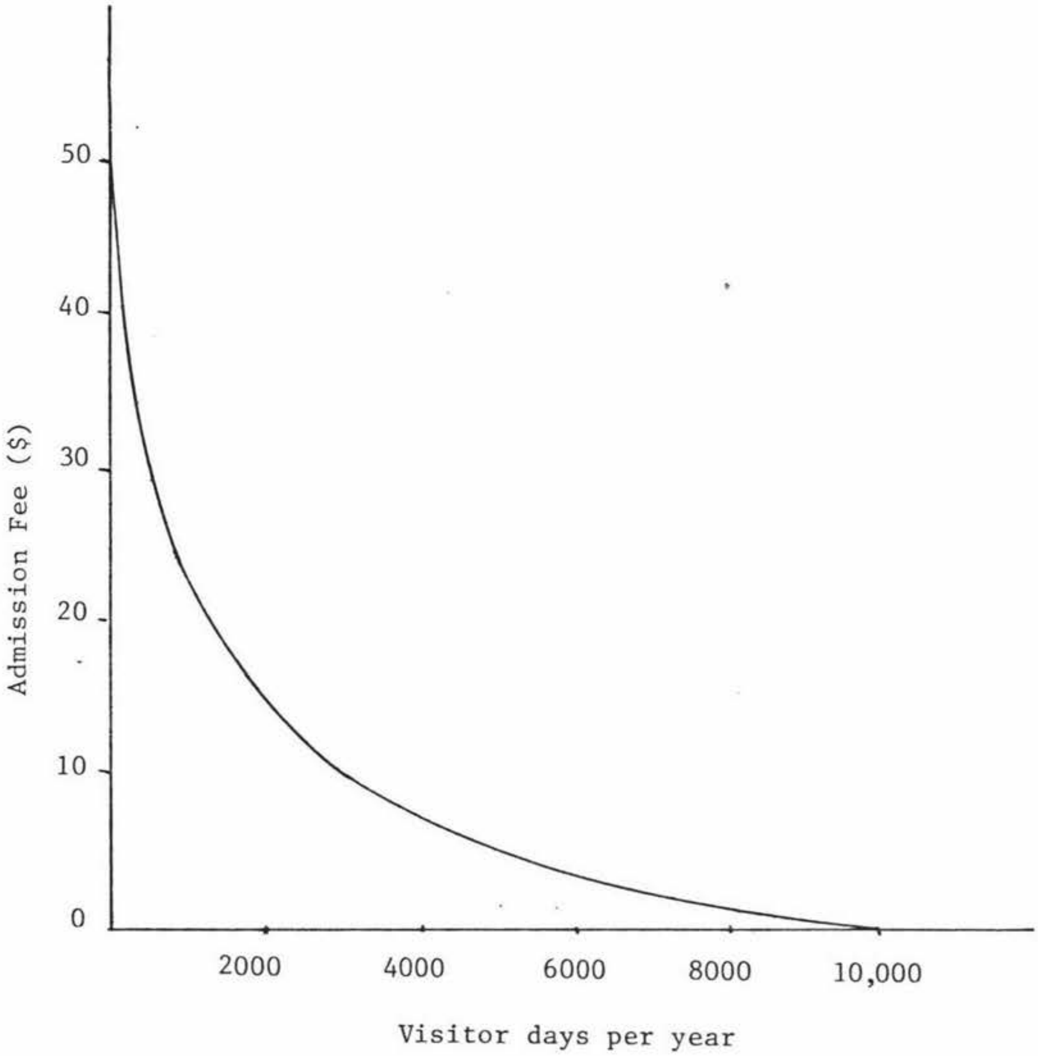

Figure 7.4 Demand Curve derived using New Travel Cost Calculation i.e. 5.2 ¢/km

but the decrease in visitation with increasing admission fees is less. This means that if it does cost recreationists more to visit Lake Tutira than has been estimated, their negative reaction to admission fees will be lessened.

It has been shown that an 11% change in the cost of motoring results in a neglible 0.6% change in the consumers' surplus figure. This would indicate that the accuracy of an approximation to the cost of motoring is not of great importance as the consumers' surplus figure is not sensitive to small changes in the cost of motoring. However, it can be seen that large changes in the cost of motoring value will cause quite significant changes in the consumers' surplus figure. A 50% change in the cost of motoring (from 4.68 to 10 ¢/km) resulted in a positive 70% change in the consumers' surplus. The difference in sensitivity between small and large changes would seem to indicate that the relationship between the cost of motoring and consumers' surplus is not linear.

7.6.3 The Functional Form - Grafted Linear

The consumers' surplus was next calculated using an alternative functional form. This was done to indicate the importance of finding the correct functional form to fit the data. Finding the correct functional form is not an easy task and often depends on personal judgement and systematic testing for best fit of the data. The alternative functional form chosen was the grafted linear relationship described in section 6.6. This relationship is of the form,

$$Y = 90.75 - 7.91\,(X) + 7.51\,(ZVAL) \qquad (7.5)$$

where Y = visitation rate

X = travel cost

ZVAL = $X_i - C$ (see Appendix Two).

The relationship described is very strong ($r^2 = 0.94$), however as can be seen from Figure 6.10, and shown in section 6.6 the first part of the curve is not significant, i.e. it is not possible to confidently say that the slope of the curve will be significantly different to zero. Accepting the slope of the first part of the line as being correct, observation of the line, which is drawn through the co-ordinates (10, 11.62), suggests that it might be lower than a true fit, and it intercepts both axis at too small a value compared to the actual information observed during the survey, i.e. it predicts visitation rate falling to zero at TC = $37 when in fact many visitors from Auckland incur a travel cost of $42. As a result of this lack of fit to the data it was considered possible that a prediction model resulting from this functional form might result in an erroneous calculation of consumers' surplus. The predicted visitation rates were re-calculated and used to formulate the total visitation at corresponding admission fees, shown in Table 7.10.

The demand curve is presented in Figure 7.5 and the consumers' surplus value was calculated to be $55,280. This functional form has calculated consumers' surplus to be $28,000 less than the figure obtained using the reciprocal functional form.

The choice of functional form to fit the survey data is exceedingly important, it must describe a relationship that is both strong and predictive. The choosing of the functional form is the single most important stage of the Travel Cost Method in that if a best fit to the data is not obtained, considerable discrepancies in the calculation of consumers' surplus are inevitable.

TABLE 7.10

TOTAL VISITATION AT INCREASING ADMISSION FEES - FROM GRAFTED LINEAR FUNCTIONAL FORM

ZONE	POPULATION (000's)	ADMISSION FEES 0	1	2	5	10	15	20	25	30	35
1	50.0	3351	2956	2561	1374	521	419	316	214	111	9
2	50.0	2560	2165	1769	583	480	378	275	173	70	0
3	7.9	92	89	86	76	60	44	27	11	0	0
4	13.1	121	115	110	94	67	40	13	0	0	0
5	2.2	20	19	18	15	10	6	2	0	0	0
6	30.0	253	239	227	190	128	67	5	0	0	0
7	53.8	432	406	384	318	208	98	0	0	0	0
8	47.4	324	300	280	222	125	30	0	0	0	0
9	19.7	100	95	92	68	28	0	0	0	0	0
10	34.3	153	132	118	76	6	0	0	0	0	0
11	15.3	68	60	53	34	3	0	0	0	0	0
12	349.9	732	490	346	0	0	0	0	0	0	0
13	805.9	0	0	0	0	0	0	0	0	0	0
	TOTAL	8206	7066	6044	3050	1636	1082	638	398	181	9

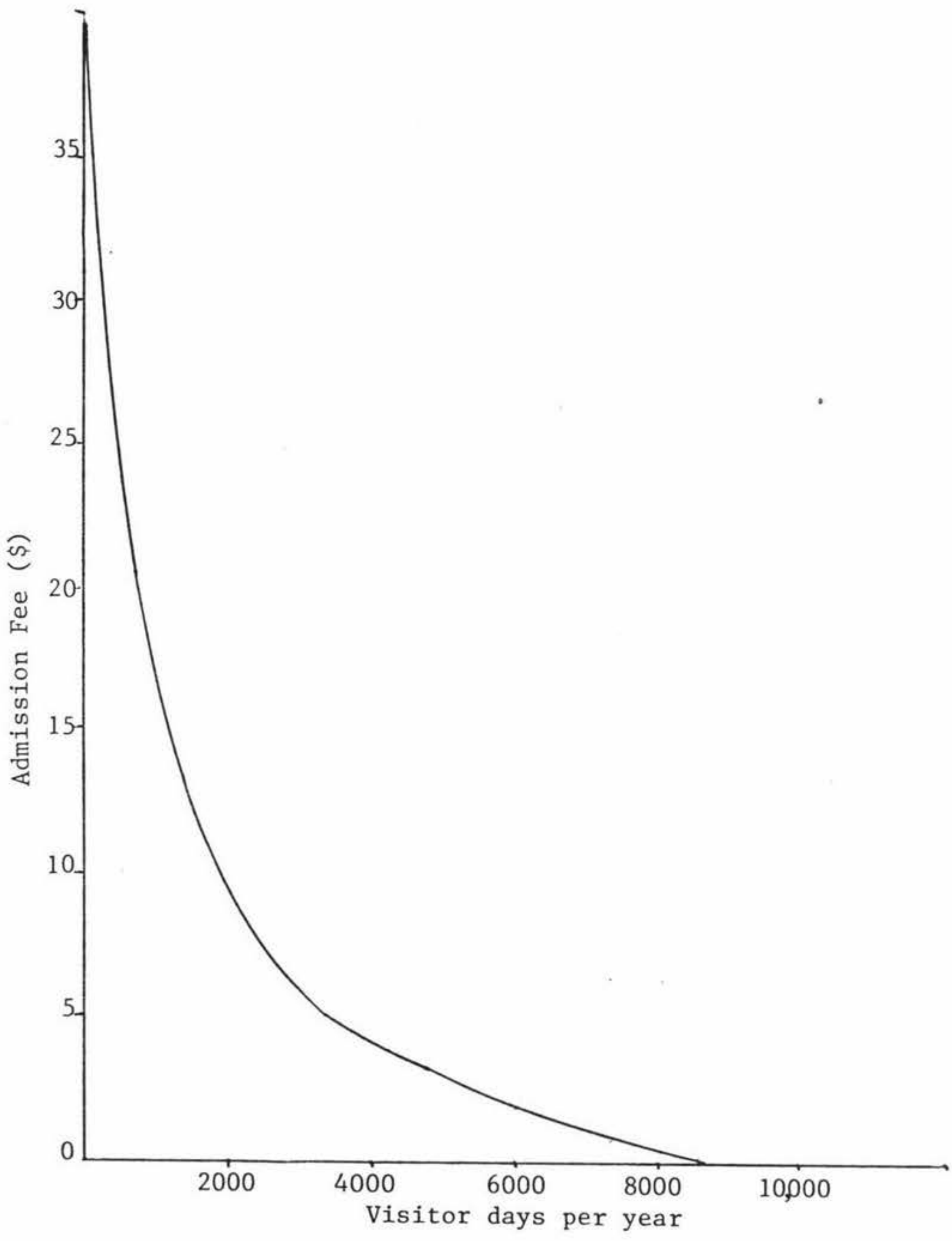

Figure 7.5 Demand Curve derived using Grafted Linear Function

7.7 Conclusions

The TCM has been used to indirectly provide a demand schedule for Lake Tutira. The area under the demand curve is calculated as a measure of the consumers' surplus associated with the use of Lake Tutira as a recreational amenity. The figure obtained is $83,349, which is presented as the value of Lake Tutira to its users per year.

The demand curve is used to show that demand for Lake Tutira is effected quite considerably by increases in admission fee, but that the demand gradually loses its sensitivity to price changes at higher admission fees.

The TCM prediction model is shown to be very sensitive to the choice of a value for current visiting population and that the figure is important to the final consumers' surplus figure. The consumers' surplus figure is not however very sensitive to the calculation of the travel cost variable, and small variations in the cost of motoring have little effect on the final result.

The choice of the functional form to fit the data and provide a linear prediction equation is critical to the end result. Large variations in consumers' surplus values obtained using different functional forms indicate the importance of finding the one with the highest predictive ability and significance.

CHAPTER 8. EVALUATION OF THE STUDY

8.1 Introduction

In this chapter the results of the study are considered in the light of its objectives. The TCM is evaluated in its two forms, the individual observations approach and the aggregated data approach, and its application is discussed.

The consumers' surplus result of the analysis is evaluated for Lake Tutira and included in a partial economic analysis to provide justification for the proposed Lake Tutira clean-up scheme. The future management of the lake is discussed briefly in relation to the survey findings in chapter 4, and comments on the overall study are made in conclusion.

8.2 The Travel Cost Method

The major purpose of this study was to evaluate the effectiveness of the TCM in valuing recreation sites in New Zealand. Two different approaches to the technique were tested and these will be discussed separately.

8.2.1 The Individual Observations Approach

It is generally accepted amongst resource economists that the individual observations approach (described in chapter 5) provides a better predictive model and a more accurate result than the aggregated data approach. In this study, however, it was found that the approach requires a great deal more data than was available from the survey and the secondary sources used, due mainly to the need for more independent variables to explain the variation in individual visitation behaviour. Because of this need for a greater quantity of and variation in the type of data, the individual observations approach requires more money, time and labour than the alternative method. The problem of obtaining information on individuals rather than groups also presents difficulty as the recreationists usually incur travel costs as a group. Defining individual variables increases the survey workload and level of difficulty quite markedly.

In order to obtain a downward sloping relationship between visitation and travel cost of reasonable predictive ability and significance it would most likely be necessary to divide the recreationists by recreational activity or length of stay. This is necessary as the behaviour of different types of recreationists appears to be different and therefore needs to be explained by different functional forms. Given such a case the results of a recreation analysis would consist of several consumers' surplus values (one for each activity) which would need to be summed to provide the total value of the lake to its users.

The choice of descriptive variables will depend on the situation being studied, but from the experience gained during this research it is possible to recommend some useful variables that should always be included in any attempt at the individual observations approach. These variables are:

Individual visitor days consumed per year; the number of trips to the site per year; length of stay; individual travel cost; travel time; distance; socio-economic factors determining ability to consume the recreation e.g. occupation, income, age, and days of holiday per year; presence of alternative recreation opportunities; major activity at the site.

It is the author's conclusion that a successful analysis can be carried out in New Zealand using the individual observations approach. However, it is debatable whether or not a study of the magnitude and expense required would ever be justified or accepted by agencies involved in the analysis of recreational expenditure. It is far more likely that the aggregated data approach described next would be much more acceptable.

8.2.2 The Aggregated Data Approach

This approach, in comparison with the individual observations approach, is far simpler to implement but will provide less accurate results. The method can be applied using very little survey information (thus low survey costs). The primary variables of visitation and travel cost can be obtained from information on yearly visitation, home town and zone specifications (as described in chapter 6). The specification of the zones is important in that the area chosen will effect the visitation per thousand population variable, i.e. the visitation per thousand population can be adjusted by changing the size (and population) of the origin zone.

Information on the current visiting population has been shown in this study to be very important to the final result so an effort in this direction is necessary to provide an accurate estimate.

In this study it was found to be relatively easy to obtain a predictive visitation/travel cost relationship, but it was shown (chapter 7) that the choice of the correct functional form to fit the data is of great importance to the final result. There are no set rules beyond a priori reasoning and statistical testing for finding a 'best fit' to the data, but testing all the logical alternatives will usually provide one functional form that has a stronger predictive ability and statistical significance than the others. In this study the reciprocal of travel cost was used with visitation to provide the most predictive functional form.

Although this approach is possible using only two variables (visitation and travel cost) other variables should be tested for influence on the visitation behaviour. If these other variables exhibit a notable effect on the correlation coefficient then they should be included in the equation, thus increasing its predictive nature. If, as was the case in this study, other independent variables show little influence on the visitation variable then the study should be restricted to a bivariate analysis for the sake of simplicity.

In summary, the aggregated data approach is a successful and usable technique for valuing recreational amenities in New Zealand. It is relatively cheap and easy to administer, but the consumers' surplus results are less accurate than could be obtained from the individual observations approach. The final consumers' surplus figure should be taken as an approximate estimate of the value of site, not an exact figure. A sensitivity analysis should be carried out at the end of the study to indicate the amount of variation to be expected in the final result.

8.2.3 Application of TCM Results

Accepting the methodology of the TCM an analyst is left with the problem of how to include a consumers' surplus value into a specific economic analysis of a recreational amenity. The use of consumers' surplus values in conjunction with cost or benefit values obtained from market prices is an area of concern. Market prices ignore surplus values received beyond the price paid i.e. economic surplus.

Economic theory defines willingness to pay as being the correct measure of benefit, rather than price paid, so the argument that consumers' surplus values should not be included in an analysis because the other values used do not include it, is essentially invalid. Just because other values are sometimes incorrectly presented is no reason not to use a correct measure of value for recreational benefits.

In an attempt to present the value of a recreation site in a similar manner to market values some economists (Brown, Singh and Castle, 1964) advocate the use of only part of the consumers' surplus. They suggest using the demand curve to calculate the maximum revenue obtainable by a non-discriminating monopolist, which they consider can then be used in cost-benefit calculations as a value figure of similar basis to market values (i.e. no inclusion of consumers' surplus).

Clawson and Knetsch (1966) have stated that as long as the additional output associated with the costs of a recreation based project is small relative to the total market output then the use of the resources will have a negligible effect on the price. If this is the case then the value of the marginal output is expressed by the price multiplied by the quantity supplied, and this is equal to total willingness to pay as the consumers' surplus is negligible. Given this situation Clawson and Knetsch maintain that taking the whole area under the demand curve for a recreation site that is consumed in large quantities (non-marginal consumption) is consistent with measuring value as the market price multiplied by quantity consumed for a relatively small portion of a market output.

This problem remains one of reconciling theoretical correctness with practical application. The consumers' surplus value is theoretically the correct measure of value, and in water project evaluation in the U.S.A. it has been used for analysis in its entirety. However, there may be some justification for using the monopolists' revenue value when recreational benefit is to be included with non-marginal market based values as it may provide a closer approximation of the market system. This study will present both values in the latter part of this chapter. The choice of which value to use will depend on the use to which it will be put, e.g. merely as an indicator of value or for use in a complete cost-benefit framework. It is the author's opinion that the consumers' surplus value should be used at all times but with the understanding that it will sometimes overstate the benefits of recreation in comparison to other market evaluated benefits.

8.3 The Value of Lake Tutira as a Recreation Site

Using the aggregated data approach to the Travel Cost Method a consumers' surplus figure of $83,349 was derived and presented as the value of Lake Tutira as a recreation site (chapters 6 and 7). The method cannot be viewed as providing exact quantified results therefore the value of the lake is presented as approximately $80,000 per year. In terms of individual visitation, the average amount people would be prepared to pay per year for the use of Lake Tutira for recreational purposes is $8. Obviously the variation around this average figure will be large but the figure does help to visualise individual willingness to pay. The aggregate willingness to pay figure of $80,000 gives an objective and quantified measure of the value of Lake Tutira, a very necessary piece of information for any considerations involving management proposals for the lake and surrounding area.

The consumers' surplus figure is presented as an alternative to subjective appraisal of the lake's value based on incomplete knowledge. Decisions relating to the lake clean-up can now be made with a clear understanding of the costs and benefits associated with the change, which must lead to a more efficient allocation of public funds.

In the next sub-section a short term, partial economic analysis of the proposed clean-up scheme is presented, showing the relevant cost/benefit flow over time.

8.3.1 Partial Economic Analysis of the Lake Tutira Proposal

An economic analysis can be carried out to compare the alternatives of either doing nothing to the lake resulting in a loss equal to the consumers' surplus, or carrying out the clean-up proposal resulting in benefits equal to the consumers' surplus value minus the associated cost of the clean-up. Using the Net Present Value criteria at 10 percent, the proposed expenditure is compared with the benefits resulting from that expenditure. If a positive Net Present Value figure is obtained it signifies that the clean-up proposal is an economically efficient one at a 10 percent discount rate.

It is necessary to assume that no pollution abatement expenditure at Lake Tutira will result in the lake no longer being available for recreational purposes. Judging by the advanced eutrophication already experienced at Lake Tutira this is not an unreasonable assumption.

It should also be mentioned that the calculation of consumers' surplus will underestimate the true benefits received by the public at Lake Tutira. Consumers' surplus does not include the benefits accruing to casual visitors who stop at the lake for a short period only. Such visitors were not a part of the sampling frame. No account has been made in this study for option demand, i.e. the benefits people receive from the knowledge that the lake recreation experience is available if they wish to utilize it, even if they do not actually travel to the lake. A similar demand that has not been included in the calculation of consumers' surplus concerns those people who would like to take advantage of the recreational benefits at Lake Tutira but are unable due to some reason, such as lack of finance. It is impossible to quantify these extra benefits mentioned but it is worthwhile to note that the consumers' surplus value of the recreation site will represent a minimum value of the total true benefits.

The consumers' surplus is presented as the value of the lake to the users during the year April 1980/1981. The value will change with time, effected by factors such as inflation, quality of the lake waters, ability to consume due to income levels and greater freedom to travel. In the partial analysis it is assumed that the value of the lake will remain constant over the years.

The cost of the clean-up scheme (described in chapter 3) is \$250,000 spent over the first five years of the project. After this time, \$10,000 per year will be required for maintenance.

The expenditure flow is discounted at 10 percent over 25 years and presented in Table 8.1.

TABLE 8.1

COST FLOW (1,000's)

Year	1	2	3	4	5	6	7	8	9	10 . . .	25
Capital Cost	50	50	50	50	50	-	-	-	-	-	-
Maintenance	-	-	-	-	-	10	10	10	10	10 . . .	10
Total	50	50	50	50	50	10	10	10	10	10 . . .	10

The present value of the expenditure is \$242,402.

The benefits of the scheme in a partial analysis are considered to be mainly recreational benefits. Savings on artificial breeding costs of \$1,000/year (Peptoe,1980) are also expected after the initial

5 year clean-up. The benefits associated with continued use of the outdoor recreation center are estimated (Peptoe, 1980) as approximately $4,000 per year.

The benefit flow is discounted at 10 percent over 25 years.

TABLE 8.2

BENEFIT FLOW (1,000's) USING CONSUMERS' SURPLUS

Year	1	2	3	4	5	6	7	8	9	10 . . .	25
Recreation	80	80	80	80	80	80	80	80	80	80 . . .	80
Ed. hostel	4	4	4	4	4	4	4	4	4	4 . . .	4
Fishery	-	-	-	-	1	1	1	1	1	1	1
Total	84	84	84	84	85	85	85	85	85	85	85

The present value of the benefit flow = $769,730

The Net Present value = Benefits - Costs

= 769,730 - 242,402

N.P.V = $527,328.

The NPV of approximately $500,000 is presented to show the economic viability of the clean-up proposal. Any final decision involving allocation of public funds would have to consider other factors such as the availability of substitutes to Lake Tutira, and the extent to which the nation's overall welfare might decrease if Lake Tutira visitors are forced to obtain their recreation elsewhere. Certainly, in the partial analysis, benefits clearly outweigh costs (in net present value terms).

The benefit flow was recalculated using the alternative measure of value, i.e. that which would accrue to a non-discriminating monopolist (given by the largest possible rectangle under the demand curve). This amount was found to be approximately $30,000 per year. The benefit flow is shown in Table 8.3.

TABLE 8.3

BENEFIT FLOW (1,000's) USING MONOPOLISTS' REVENUE

Year	1	2	3	4	5	6	7	8	9	10 . . . 25
Recreation	30	30	30	30	30	30	30	30	30	30 . . . 30
Ed. hostel	4	4	4	4	4	4	4	4	4	4 . . . 4
Fishery	-	-	-	-	1	1	1	1	1	1 . . . 1
Total	34	34	34	34	35	35	35	35	35	35 . . . 35

The present value of this benefit flow = $314,527

The Net present value = 314,527 - 242,402

= $72,125.

It is obvious from the large difference in NPV between the use of consumers' surplus and monopolists' revenue that the choice is critical. The consumers' surplus calculation is recommended in this study as being the correct measure of benefit, although some readers might find the alternative use of monopolists' revenue more justifiable in some situations.

8.3.2 The Future of Lake Tutira Domain

The results of this study have indicated that Lake Tutira is a highly valued recreational area to people from all over the North Island. If current trends of increased recreational demand continue the management of the Tutira Domain in its renovated state is likely to become more and more important. The administration of the domain is regulated under the Reserves Act of 1977, in which Lake Tutira is classified as a Recreation Reserve and must be administered (section 17-1) "... for the purpose of providing areas for recreation and sporting activities and the physical welfare and enjoyment of the public, and for the protection of the natural environment and beauty of the countryside, with the emphasis on the retention of open spaces and on outdoor recreational activities, including recreational tracks in the countryside".

The Act also states in Section 17-2(c)

"Those qualities of the reserve which contribute to the pleasantness, harmony, and cohesion of the natural environment and to the better use and enjoyment of the reserve will be conserved".

The funds forthcoming from central and local government are committed to a scheme that will improve the quality of the recreational experience and enhance the attractiveness of the area to recreationists. How the area caters to the visitors will affect the quality of the experience. It is the author's opinion, based on discussions with many of the lake visitors, that the area should remain an undeveloped source of enjoyable, unregulated camping. The peaceful, quiet nature of the lake should be maintained as a major attraction.

Several specific recommendations have resulted from the study and have been presented in part two of chapter 4. With regard to those recommendations it only remains to be stated that the Guthrie-Smith Trust and the Lake Tutira Domain Board should continue to administer the area in the responsible manner they have displayed to date.

8.4 Concluding Remarks

The Travel Cost Method used at Lake Tutira to determine the value of the lake to its users has proved to be a successful means of approximating non market recreational worth. The amount of resources necessary for its implementation is not excessive and the statistical analysis when understood is quite straight forward. The consumers' surplus result in a New Zealand application is of considerable value for comparison with costs associated with the provision of recreational resources. A partial economic analysis using the results of this study has indicated that the proposed clean-up scheme at Lake Tutira is an economically efficient proposal.

It is the author's opinion that the TCM can and should be included in any major evaluation of project viability that involves large expenditure and definite changes in the availability of recreational resources. Failure to evaluate recreational benefits and costs will invariably result in a less than optimum allocation of expenditure, and this is an inefficient use of public funds.

APPENDIX ONE REGRESSION ANALYSIS; SIGNIFICANCE TESTING; AND CONFIDENCE INTERVALS

The superficial description given below is directed at readers with some understanding of the technique of regression analysis. A more detailed coverage of the topics discussed can be obtained from books on statistical techniques.

A 1.1 Regression Analysis

Regression analysis is a general statistical technique by which one can analyse the relationship between a dependent variable and a set of independent or predictor variables. It can be viewed as a descriptive tool used to find the best linear prediction equation for the data and to evaluate prediction accuracy. When using regression as a statistical tool it is necessary to consider statistical inference, i.e. whether one can generalise the results of a sample observation to the overall population. Statistical inference is usually considered in two ways, estimation and hypothesis testing, and these will be dealt with in more detail further on in the Appendix.

Simple Bivariate Regression. Values of the dependent variable Y are predicted from a linear function of the form

$\hat{Y} = \hat{A} + \hat{B}X$, an estimate of the true linear function

$$Y = A + BX.$$

where $\hat{A}$ = the Y intercept.

$\hat{B}$ = Estimated regression coefficient; this indicates to what degree a change in X will result in a change in Y.

X = values of the independent variable.

The difference between the estimated value of Y ($\hat{Y}$) and the actual value of Y is called the residual (i.e. $Y - \hat{Y}$).

The regression involves selecting values for $\hat{A}$ and $\hat{B}$ such that the sum of the squared residuals is minimised, i.e. $\Sigma(Y - \hat{Y})^2$ is minimised.

It can be shown (Steel and Torrie, 1960) that optimum values for A and B are obtained from the following formula.

$$\hat{B} = \frac{\Sigma(X - \bar{X})(Y - \bar{Y})}{\Sigma(X - \bar{X})^2} \qquad \text{(where } \bar{X} \text{ denotes the mean)}$$

$$\hat{A} = Y - B\bar{X}$$

the resultant regression line given by the formula

$\hat{Y} = \hat{A} + \hat{B}X$, is called the least squares line.

If the total sum of squares in Y are divided into components of the regression and of the unexplained, then the sum of squares of Y can be written as;

$$\Sigma(Y - \bar{Y})^2 = \Sigma(Y - \bar{Y})^2 + \Sigma(Y - \hat{Y})^2$$

i.e. SSy = SSreg + SSres

where SSy = sum of squares of Y

SSreg = portion of sum of squares explained by the regression

SSres = sum of squared residuals.

From this, a measure of the prediction accuracy of the regression equation can be described.

i.e. $$r^2_{xy} = \frac{SSreg}{SSy} = \frac{SSy - SSreg}{SSy}$$

= simple correlation coefficient, and this describes the proportion of the variance in the dependent variable Y that is explained the independent variable X (for example if $r^2 = 0.5$, then X explains 50 percent of the variation in Y).

If it is necessary to consider the 'absolute' amount of unexplained variation, the usual statistic used is the <u>standard error of the estimate</u> (S.E.E.).

$$\text{S.E.E.} = \sqrt{\frac{\Sigma(Y - \hat{Y})^2}{N - 2}} \qquad N = \text{no. of cases}$$

$$= \sqrt{\frac{SSres}{N - 2}}$$

The S.E. of B can also be estimated in a similar manner,

$$= \sqrt{\frac{SSreg/(N - 2)}{SSx}}$$

$$= \sqrt{\frac{(Y - \hat{Y})^2(N - 2)}{\Sigma(X - \bar{X})^2}}$$

If it is assumed that the distribution of the actual Y values is normally distributed about the regression line, then it is possible to estimate the proportion of cases that will fall between plus or minus one standard deviation of the estimate.

e.g. $\pm$ 1 standard deviation on a normal distribution contains 68% of the cases. So if S.E.E. = 0.13, then 68% of the cases will fall between Y $\pm$ 0.13.

The <u>significance</u> of the regression coefficient, $\hat{B}$, can be tested either by calculating confidence intervals, or more simply by calculating and evaluating the <u>F ratio</u>. Confidence intervals and significance testing is explained in more detail in A 1.2 and A 1.3 but generally if there is only one coefficient to be tested, the t test is used, and if there are more than one the F-test is used. This is not a restrictive rule as an F- test will give correct results regardless of the number of coefficients.

Multiple Regression. i.e. two or more independent variables.

$$\hat{Y} = \hat{A} + \hat{B}_1 X_1 + \hat{B}_2 X_2 \ldots\ldots\ldots \hat{B}_n X_n$$

$\hat{B}_1$ is now a partial regression coefficient and indicates the expected change in $\hat{Y}$ with a one unit change in X_1 when the remaining independent variables are held constant or controlled for.

The relative magnitude of the partial regression coefficient of an independent variable can be different from its bivariate coefficient value as the bivariate value is not effected by other correlated independent variables.

$$R^2 = \frac{\text{variation in Y explained by the combined linear influence of all the independent variables}}{\text{Total variation in Y}}$$

$$= \underline{\text{multiple correlation coefficient}}.$$

So,

1. The overall explanatory power of the prediction equation is reflected by R^2, or r^2.
2. Prediction accuracy as an absolute value can be shown by the standard error of the estimate (S.E.E.)
3. Statistical significance can be reflected by the F ratio or the t-test.

A 1.2 Significance Testing for Regression Analysis

The F Ratio. In most cases regression techniques are carried out on data that the analyst is interested in generalising to a population level, and the regression statistics are used to estimate population parameters, or to test specific hypotheses about the population parameters. The hypothesis testing procedure used in this study on the regression results was the F-test of statistical significance. This statistic can be used to test the null hypothesis that the correlation under study in the population is zero. This is equivalent to the null hypothesis that the regression coefficient(s) is zero. If the overall null hypothesis is rejected by the F statistic it is possible to make a probability statement about the regression coefficient(s) being different to zero. It follows logically that the correlation between the variables under study is not zero.

The test statistic used is:

$$F = \frac{SSreg/k}{SSres/(N-k-1)}$$

where SSreg = sum of squares explained by the regression equation

SSres = residual (unexplained) sum of squares

k = the number of independent variables in the equation

N = sample size.

The F ratio is distributed as an F distribution about a mean of one with (N-k-1) degrees of freedom.

The figure obtained by the F statistic is compared to the F distribution in a statistical table which indicates the probability of getting an F ratio equal to or greater than the one obtained by chance alone, i.e. the correlation observed is not due to chance alone. If the probability is less than say, five percent, then the null hypothesis (no correlation) is rejected and the alternative hypothesis (H_A:B ≠ 0) is accepted.

In this study the F ratio was provided by the SPSS subprogramme REGRESSION along with information on sums of squares and degrees of freedom.

The t test. For the grafted linear function discussed in chapter 6, a different test of significance was carried out on the regression coefficients as the equation involved two separate straight lines. The t-test of significance was used to test whether the two slopes of the grafted line were significantly different from zero.

The t statistic is given by:

$$t = \frac{\text{sample value - population value}}{\text{standard error of the estimate}}$$

The null hypothesis was that the sample value for the slope of the line was equal to the population value, so,

$$t = \frac{\hat{B}_1 - B}{S_{\hat{B}}}$$

where B = population value

$\hat{B}$ = sample value

the standard error of the estimate of B is given by:

$$S_{\hat{B}} = \sqrt{\frac{\Sigma(Y - \hat{Y})^2/N - 2}{\Sigma(X - \bar{X})^2}}$$

where $\Sigma(X - \bar{X})^2 = \Sigma X^2 - \frac{(\Sigma X)^2}{n}$

For the grafted line, two tests were calculated, one for each slope.

1. $H_0 : \hat{B} = B = 0$

$H_A : B = - 7.91$

i.e. the null hypothesis was made that the population value is zero. If this is true then $\hat{B} = B$, and t will have a low value, thus the null hypothesis would be accepted. If the difference between what is expected ($\hat{B} = B = 0$) and what is found is so large that it cannot reasonably be attributed to chance then the null hypothesis on which the expectation is based is rejected at a certain level of probability (usually five percent).

So, $S_{\hat{B}} = \sqrt{\frac{129/1}{26}} = 2.24$

then, $t = \frac{\hat{B} - 0}{S_{\hat{B}}} \quad \frac{-7.91 - 0}{2.24}$

$= 3.53$ at 1 degree of freedom.

The calculated value of t is low in comparison with the value displayed in the t distribution tables, therefore the null hypothesis is accepted (a large value for the calculated t is consistent with the alternative hypothesis being accepted). Accepting the null hypothesis it can be stated that the slope of the line, B_1, is not significantly different from zero at the five percent level. This is equivalent to assuming that no relationship exists between the variables.

2. Another test was done on the second part of the line,

$B_2 = 0.4.$

$H_0 : \hat{B} = B = 0$

$H_A : B = 0.4$

$$S_{\hat{B}} = \sqrt{\frac{24.2}{829}} = 0.17$$

$$t = \frac{\hat{B}_2 - 0}{S_{\hat{B}_2}} = \frac{0.4}{0.17}$$

$= 2.35$ at 9 degrees of freedom.

Consulting the t distribution tables indicates that the null hypothesis should be rejected and the alternative hypothesis accepted at the two percent level.

A 1.3 Confidence Limits for Regression Coefficients

The sample regression coefficient is estimated as a single number parameter and it is expected that this figure would be close to the true population amount. However, estimates of B taken from different samples would seldom be the same, so it is of some value to calculate a statistic which describes the interval within which the estimates will fall a preassigned percentage of the time. The interval is called the confidence interval and the two statistics which describe the boundaries of the interval are called confidence limits.

The usual 'confidence coefficient' is 95 percent, such that the researcher can state that he is 95 percent confident that the true population value of B is within the regions of the confidence interval. The size of the confidence interval is dependent on the variation about a normal distribtuion of successive estimates of B, described by the standard error of the estimate of B, i.e. $S_{\hat{B}}$

$$S_{\hat{B}} = \sqrt{\frac{SSres/(N - 2)}{SSx}}$$

where SSres = sum of the squared residuals

SSx = sum of the squares of x.

With a small sample size however, the successive estimates of B follow the t distribution (rather than the normal distribution) with (N - 2) degrees of freedom.

The 95 percent confidence limits for a sample of less than 40 can be displayed as;

$$\hat{B} - t_{0.05}\,(S_{\hat{B}}) < B < \hat{B} + t_{0.05}\,(S_{\hat{B}})$$

where B = population value

$\hat{B}$ = sample value

$S_{\hat{B}}$ = standard error of the estimate

$t_{0.05}$ = value from t distribution tables at 11 degrees of freedom

for example, the regression coefficient for the linear function used in the TCM of this study (from chapter 6, section 9)

$\hat{B}$ = 223.5

$S_{\hat{B}}$ = 7.5

$t_{0.05}$ = 1.796 at 11 degrees of freedom therefore,

$$210 < B < 237$$

Thus it is possible for the analyst to state that if the whole population was sampled, he is 95 percent confident that the true value of the regression coefficient would fall within the range 210 to 237.

APPENDIX TWO GRAFTED LINEAR FUNCTIONS (Fuller, 1969)

Consider a relationship between a dependent variable Y and an independent variable X, of the form shown in Figure A 2.1, i.e. best fitted by two straight lines. It is possible to use regression analysis to find the two lines of best fit, the functional form of which is described by a single regression equation.

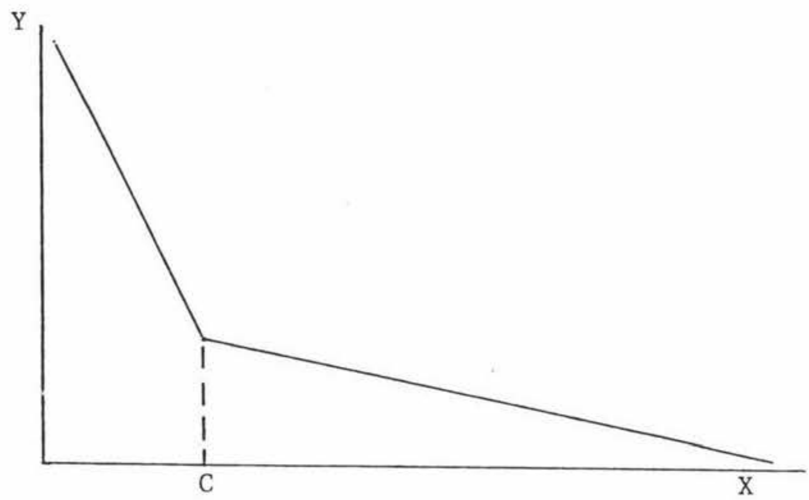

Figure A 2.1 Grafted Linear Form

The grafting method can deal with only one dependent variable (i.e. bivariate regression). The functional form displayed in Figure A 2.1 can be described by two equations;

$$Y_i = A_o + B_o X_i + U_i$$

where X_i is less than or equal to C

$$Y_i = A_1 + B_1 X_i + U_i$$

where X_i is greater than or equal to C

The greater than and less than restrictions imply that Y has the same value at C for both functions. C is a constant which is specified according to some predetermined criteria.

The continuity condition implies:

$$A_o + B_o C = A_1 + B_1 C$$

$$\Longrightarrow A_1 = A_o + (B_o - B_1)C$$

Thus for X greater than or equal to C;

$$Y_i = \left[A_o + (B_o - B_1)C\right] B_1 X_i + U_i$$

$$= \left[A_o + B_o X_i\right] - B_o X_i + (B_o - B_1)C + B_1 X_i + U_i$$

$$= A_o + B_o X_i + (B_1 - B_o)(X_i - C) + U_i$$

Thus the full response model is;

$$\boxed{Y_i = A_o + B_o X_i + (B_1 - B_o)Z_i + U_i}$$

where $Z_i = 0$ if X_i is less than or equal to C

$= X_i - C$ if X_i is greater than or equal to C.

A regression analysis is run on three independent variables, unity, X, and Z, to estimate the response function.

i.e. for X_i less than or equal to C

$$\hat{Y} = \hat{A}_o + \hat{B}_o X$$

for X_i greater than or equal to C

$$\hat{Y} = \hat{A}_o + \hat{B}_o X + (\hat{B}_1 - \hat{B}_o)(X_i - C)$$

A t test of significance can be run on the slopes $\hat{B}_o$ and $\hat{B}_1$ to test the hypothesis that one straight line would adequately explain the functional form, i.e. $B_1 = B_o$.

APPENDIX THREE THE S.P.S.S. COMPUTER PROGRAMME

To develop a predictive equation for visitation to Lake Tutira the SPSS[1] subprogramme REGRESSION was used to obtain least squares estimators for use in the analysis.

The computer printout from the REGRESSION subprogramme provides a variety of information pertinent to the regression analysis laid out in concise, readable, tables. The relevant information available from the programme is as follows;

1. A list of the dependent and independent variables
2. Multiple R - the correlation coefficient
3. R Square - the coefficient of determination (correlation coefficient)
4. Adjusted R Square - adjusted for the number of independent variables in the equation and the number of cases. It is a more conservative estimate of the variance explained than R^2
5. Standard Error - the standard error of the estimate (SEE)

Under the heading Analysis of Variances the printout gives figures for;

6. Regression and Residual degrees of freedom (DF)
7. Regression and Residual sum of squares
8. Regression and Residual mean squares
9. F ratio

---

[1]Statistical Package for the Social Sciences.

Under the heading Variables in the Equation the independent variables are given their associated values for;

10. B - Regression coefficient

11. Beta - Standardised Regression coefficient (when using standardised variables)

12. Std. Error of B - the standard error of the regression coefficient

13. F Ratio, for the particular independent variable.

The relevant information is presented neatly at the end of the printout in the form of a summary table. A listing and a plot of the residuals can also be outputted. To obtain accurate, graphical scatterplots of a bivariate relationship such as between visitation and travel cost the SPSS subprogramme SCATTERGRAM is a useful analytical tool. Statistics associated with a simple bivariate regression can also be computed; including the slope of the regression line, the Pearson product-moment correlation (r), tests of statistical significance, and others. Such a simple illustrative tool is of value in recreation analysis when attempting to establish relationships between variables.

APPENDIX FOUR THE QUESTIONNAIRE

Interviewers Name: ______________

Date: ______________

QUESTIONNAIRE

Human Use Value of Lake Tutira - Travel Cost Method

Identify the head of the family/group, or the driver of the vehicle.

General introductory statement:

- survey for Department of Agricultural Economics at Massey University.
- study of recreational use of the lake.
- information is confidential.

1. HAVE WE ASKED YOU TO COMPLETE A QUESTIONNAIRE ALREADY ON THIS VISIT TO THE LAKE?

   Yes - close questionnaire

   No

2. WHERE IS YOUR HOME TOWN? ______________

3. FROM WHAT TOWN DID YOU BEGIN YOUR TRIP?

   ____

4. AT WHAT PLACES DID YOU STOP ON THE JOURNEY FROM YOUR HOME TO TUTIRA?

   ____

5. WHAT PLACES DO YOU PLAN TO VISIT WHEN YOU LEAVE TUTIRA?

   ____

6. HAVE YOU VISITED TUTIRA BEFORE?

   No

   Yes. How long ago? ______________

7. HOW MANY DAYS WOULD YOU ESTIMATE YOUR GROUP WOULD SPEND AT LAKE TUTIRA PER YEAR?

   ____

8. HOW MANY VISITS WOULD YOU ESTIMATE YOUR GROUP WOULD MAKE TO LAKE TUTIRA EACH YEAR?

____

9. HOW LONG ARE YOU PLANNING TO STAY AT TUTIRA ON THIS TRIP?

____

10. HOW LONG WILL YOU BE AWAY FROM HOME ON THIS TRIP? _______________

11. WHAT WOULD YOU SAY YOUR APPROXIMATE ROUND TRIP TRAVEL COSTS WOULD BE FROM YOUR HOME TO TUTIRA AND BACK AGAIN? THE TRAVEL COSTS ARE THOSE OVER AND ABOVE THAT WHICH YOU WOULD HAVE SPENT IF YOU HAD REMAINED AT HOME.

____
(allow time for consideration, but do not prompt)

12. WHAT IS THE APPROXIMATE TOTAL DRIVING TIME FROM TUTIRA TO YOUR HOME?

____

13. WHAT ACTIVITIES WILL YOUR GROUP PARTICIPATE IN WHILE AT TUTIRA? (show card)

swimming	walking/hiking
fishing	picnicking
sailing	bird watching
boating	other (specify) _______________

14. WHICH OF THESE ACTIVITIES IS THE <u>MAIN</u> REASON FOR YOUR GROUP'S VISIT TO TUTIRA?

____
(record all if more than one)

15. IF LAKE TUTIRA WERE NOT OPEN TO THE PUBLIC WOULD YOU HAVE CHOSEN AN ALTERNATIVE PLACE TO VISIT?

Yes   No

If Yes, WHAT ALTERNATIVE AREA WOULD YOU HAVE CHOSEN?

____

16. WHAT IS THE ENGINE SIZE OF THE VEHICLE YOU TRAVELLED IN TO LAKE TUTIRA?

_______________ (if don't know make a note of the make and model of the vehicle). _______________

17. GENERALLY, WOULD YOU SAY THAT THE TIME SPENT IN DRIVING TO TUTIRA WAS A PLEASANT OR AN UNPLEASANT EXPERIENCE?

Pleasant   Unpleasant   Indifferent

18. DUE TO POLLUTION, LAKE TUTIRA MAY NOT BE AVAILABLE TO THE PUBLIC IN THE FUTURE. WHAT AMOUNT OF MONEY WOULD YOU BE WILLING TO PAY PER YEAR TO RETAIN THE USE OF THE LAKE IN GOOD CONDITION?

IT IS NOT INTENDED THAT YOU WILL EVER BE ASKED TO PAY SUCH AN AMOUNT, BUT I WOULD APPRECIATE YOUR OPINION.

____

Zero (if not willing to pay for this purpose)

Don't know

19. I would now like some background information about yourself and members of your group for my analysis.

	AGE	SEX	MAIN OCCUPATION (specific as possible)
Group head or Driver			
Members 1			
2			
3			
4			
5			
6			
7			
8			

COMMENTS

20. DO YOU HAVE ANY COMMENTS YOU WOULD CARE TO MAKE ABOUT LAKE TUTIRA?

____

____

____

____

____

____

Respondents NAME ______________________

and ADDRESS ______________________

____

THANK YOU FOR YOUR CO-OPERATION.

APPENDIX FIVE THE ELLEY-IRVING SOCIO-ECONOMIC INDEX

This socio-economic index was designed by W.B. Elley and J.C. Irving based on data collected in the New Zealand census as an alternative to income as an indicator of socio-economic position in society. The index reflects the respondents' level of education and the extent to which society places a monetary value on their contribution (income). All New Zealand occupations have been allocated a ranking between one and six by a panel of coders. The index allows researchers to question respondents about their occupation, rather than their income which is more intrusive and susceptible to error. The metric scale ranking can then be used as a socio-economic variable in regression analysis, as in this study. The ranking for men and women working in New Zealand is presented in Tables A 5.1 and A 5.2.

Table A5.1

Elley-Irving Classification of Male Jobs

INDEX

Each occupation is assigned its correct Elley-Irving level

CATEGORY No.	TITLE
01	Administrative, Managerial, Executive
02	Agricultural
03	Arts and Entertainment
04	Clerical
05	Education
06	Medical
07	Production
08	Professional
09	Sales, Warehouse and Retail
10	Service
11	Tradesmen
12	Transport Equipment Operators & Labourers

ADMIN/EXEC.

Level	Occupation
1	Administration/Personnel Manager
2	Airport Supervisor
2	Air Traffic Controller
2	Armed Forces Officer
3	Broadcasting Station Operator
2	Company Director
2	Company Manager (Not Retail)
2	Company Sales Manager
2	Company Secretary
2	Computer Programmer
2	Curator (Art Gallery & Museum)
4	Dockmaster (Dry-Dock)
4	Farm Manager
3	Foreman
2	Government Executive Official
1	Government Administrator
2	Health Inspector
3	Hostel Manager
3	Hotel and Motel Manager
1	Librarian (Professional)
2	Local Body Official
1	Magistrate
2	Manager (Factory Production)
2	Manager (Research & Development)
3	Manager (Retail & Shop)
2	Manager (Wholesale & Warehouse)
2	Market Research Analyst
1	Member of Parliament
2	Office Manager
1	Operations Research Analyst
2	Personnel Officer
2	Postal Services Supervisor
3	Postmaster
3	Producer (Performing Arts)
3	Production Supervisor
2	Public Relations Officer
3	Racecourse Steward
3	Railways Station Master
4	Railways Supervisor
1	Research Officer (NEC)
3	Restaurant Manager
2	Sales Manager (Company)
1	School Inspector
1	School Principal
2	Secretary-Organiser
3	Service Manager
2	Ship's Deck Officer
2	Ship's Master
3	Ship's Purser
4	Shopkeeper
2	Staff Training Officer
3	Stage Director
1	Stock & Share Broker
3	Telephone & Telegraph Supervisor
4	Zookeeper

ARTS.

Level	Occupation
3	Actor
2	Announcer
4	Artist
2	Author
3	Cameraman
4	Cinema Projectionist
3	Clothing Designer
3	Commercial Artist
2	Copywriter
2	Critic
5	Darkroom Worker (Photo)
4	Display Artist
2	Industrial Designing
3	Interior Decorator
3	Music Teacher
3	Musician
5	Painter
3	Photographer
3	Producer (Performing Arts)
4	Signwriter
4	Silk Screen Printer
3	Stage Director
4	Window Dresser

AGRICULTURE

AGRICULTURAL & RELATED WORKERS

Level	Occupation
4	Agricultural Machinery Mechanic
3	Agricultural Pilot
3	Agricultural Technician
1	Agronomist
4	Beekeeper
5	Bushman
5	Dairy Factory Hand
4	Dairy Products Processor (NEC)
5	Deer Shooter (Commercial)
1	Farm Advisor
4	Farm Contractor
6	Farm Hand
4	Farm Manager
3	Farmer
6	Fencer
4	Fisherman
1	Forest Scientist
3	Forest Technician
5	Forestry Worker
6	Freezing Worker
5	Furrier
5	Grape Grower
5	Herd Tester
6	Horse Trainer
2	Horticulturist
6	Hunter (NEC)
3	Livestock Buyer
3	Livestock Instructor
5	Logger
6	Market Garden Worker
4	Market Gardener
3	Meat Grader
3	Meat Inspector
4	Milk Products Maker
4	Milk Treatment Station Worker
6	Mineral Treater
5	Nursery Worker
4	Nurseryman
6	Orchard Worker
3	Orchardist
4	Pelt Grader
6	Pest Destruction Worker
4	Pest Inspector
6	Rabbiter
4	Ranger
4	Saw Doctor
6	Sawmill Worker
6	Sharemilker
5	Shearer
6	Shepherd
6	Stable Hand
3	Stock & Station Agent
6	Stockman
3	Stud Farmer
4	Taxidermist
3	Tobacco Farmer
6	Tractor Driver
1	Veterinarian
3	Veterinary Assistant
5	Wine Worker
3	Wool Buyer
4	Wool Classer
4	Zookeeper
1	Zoologist

CLERICAL

CLERICAL WORKERS

Level	Occupation
2	Audit Clerk
4	Bailiff
3	Bank Officer
3	Bookkeeper
5	Bookkeeping Machine Operator
4	Calculating Machine Operator
4	Cashier
2	Chief Clerk
3	Clerk
3	Clerk of Works
3	Computer Operator
2	Copywriter
2	Library Assistant
3	Mail Contractor
4	Mail Sorter
4	Office Machine Mechanic
4	Office Machine Serviceman
2	Office Manager
4	Post Office Counter Clerk
3	Postal Services Supervisor
5	Postman
3	Punch Card Operator
4	Telegraphist
4	Telephone Operator
3	Travel Agency Clerk
3	Typist

EDUCATION

EDUCATION

Level	Occupation
4	Driving Instructor
3	Flying Instructor
4	Guide
1	Librarian (Professional)
2	Library Assistant
3	Livestock Instructor
3	Music Teacher
2	Primary School Teacher
1	School Inspector
1	School Principal
1	Secondary School Teacher
2	Staff Training Officer
2	Teacher (Primary)
1	Teacher (Secondary)
1	Teachers' College Lecturer
1	Technical Institute Lecturer
1	University Lecturer
1	Vocational Guidance Officer

MEDICAL.

Level	Occupation
1	Anaesthetist
3	Chiropodist
1	Chiropractor
3	Dental Mechanic
1	Dentist
1	Doctor (Medical)
2	Health Inspector
6	Hospital Orderly
3	Medical Science Technician
4	Nurse (General)
5	Nurse Aid
3	Occupational Therapist
1	Optician
1	Optometrist
4	Orthopaedic Technician
1	Osteopath
2	Physiotherapist
3	Psychiatric Nurse
1	Psychologist
3	Radiographer
1	Radiologist
1	Surgeon

PROFESSIONAL

PROFESSIONAL AND RELATED WORKERS OCCUPATION

Level	Occupation
1	Accountant
3	Actor
1	Actuary
1	Agronomist
1	Airline Pilot
1	Anaesthetist
2	Announcer
1	Architect
3	Artist
1	Auditor
2	Author
1	Bacteriologist
1	Biochemist
1	Biologist
1	Botanist
1	Chemist (Analytical)
3	Chiropodist
1	Chiropractor
2	Clergyman
1	Dentist
1	Diplomat
1	Doctor (Medical)
3	Draughtsman
1	Economist
2	Editor
1	Engineer (Professional)
1	Entomologist
1	Forest Scientist
1	Geophysicist
2	Journalist
1	Judge
1	Lawyer
1	Librarian (Professional)
1	Magistrate
1	Mathematician
1	Metallurgist
1	Meteorologist
2	Minister of Religion
3	Music Teacher
3	Musician
4	Nurse (General)
3	Occupational Therapist
1	Optician
1	Optometrist
1	Osteopath
5	Painter
2	Pharmacist
3	Photographer
1	Physicist
2	Physiotherapist
2	Primary School Teacher
3	Producer (Performing Arts)
2	Psychiatric Nurse
1	Psychologist
3	Quantity Surveyor
1	Radiologist
2	Reporter
1	School Principal
1	Scientist (NEC)
1	Secondary School Teacher
1	Social Scientist
1	Soil Scientist
3	Sports Coach
3	Sportsman (NEC)
3	Stage Director
1	Statistician
1	Surgeon
2	Surveyor
2	Systems Analyst
2	Teacher (Primary School)
1	Teacher (Secondary School)
1	Teachers' College Lecturer
1	Town & Country Planner
1	University Lecturer
1	Valuer (Urban & Rural)
1	Veterinarian
1	Vocational Guidance Officer
1	Zoologist

PRODUCTION.

PRODUCTION & RELATED WORKERS

Level	Occupation
4	Aircraft Sheetmetal Worker
5	Aluminium Worker
5	Artificial Limbmaker
5	Baker
6	Baker's Labourer
4	Bale Press Operator
6	Basketry & Brush Maker
5	Biscuit Maker
5	Blacksmith
5	Bleacher
4	Boatbuilder
4	Boiler Attendant
4	Boiler Maker
4	Bookbinder
6	Bootmaker
4	Borer
5	Brewer
4	Bricklayer
4	Builder
6	Builder's Labourer
4	Butter Maker
4	Cabinet Maker
4	Cable Jointer
5	Canvas Worker
4	Carpenter
4	Carpet Layer
5	Chainmain (Surveyor's)
4	Cheesemaker
5	Chemical Process Worker
5	Coil Winder
5	Concrete Products Worker
4	Concrete Worker (Construction)
6	Confectionery Maker
4	Constructional Steel Erector
4	Construction Worker (NEC)
4	Cooper
5	Coppersmith
5	Dairy Factory Hand
4	Dairy Products Processor (NEC)
5	Dark Room Worker (Photo)
4	Demolition Contractor
6	Demolition Labourer
3	Die Maker
6	Ditch Digger
4	Drainlayer
6	Drainlayer's Labourer
5	Dyer
5	Electrical Equipment Assembler
3	Electrical & Electronics Technician
4	Electrical Fitter
4	Electrical Lineman
3	Electronics Fitter
5	Electroplater
6	Factory Labourer
5	Fellmonger
5	Fibre Preparer
4	Fibreglass Worker
4	Floor Tiler
6	Food Packer
5	Food Preserver
2	Food Technologist
3	Foreman
5	Fork Lift Operator
6	Freezing Worker
5	French Polisher
5	Furnaceman
5	Furrier
5	Galvaniser
5	Garment Maker
5	Glass Worker
5	Glazier
4	Guillotine Operator
4	Heating & Ventilation Operator
4	Ice Cream Maker
2	Industrial Designer
4	Jewellery Worker
4	Joiner
4	Kilnman (Glass & Ceramics)
5	Knitter
3	Laboratory Technician
6	Labourer (NEC)
5	Lathe Operator (Metal)
6	Leather Goods Worker
4	Lineman
4	Linoleum Layer
4	Linotype Operator
5	Machine Tool Operator
4	Machinery Mechanic (NEC)
2	Manager (Factory Production)
3	Meat Grader
3	Meat Inspector
3	Metal Pattern Maker
5	Metal Polisher
5	Metal Press Operator
5	Metal Process Worker
4	Milk Products Maker
4	Milk Treatment Station Worker
5	Milliner
6	Miner
6	Mineral Treater
5	Motor Vehicle Assembler
5	Oiler & Greaser
4	Optical Instrument Maker
5	Oyster Canner
6	Packer (NEC)
5	Panelwood Production Worker
5	Paper Box Maker
3	Paper Production Worker
5	Petroleum Worker
4	Pile-Driver
4	Pipe Fitter
3	Plant Maintenance Mechanic
5	Plastics Worker
5	Potter
4	Powerhouse Attendant
4	Precious Metal Worker
4	Precision Instrument Maker
4	Printing Engraver
3	Printing Machine Mechanic
4	Printing Pressman
3	Production Supervisor
3	Proof Reader
3	Pulp Production Worker
5	Pumping Station Operator
3	Quality Inspector (Production)
6	Quarryman
5	Radio & TV Assembler
4	Refrigeration Mechanic
4	Rigger
4	Roofer
5	Rubber Worker
6	Saddler
6	Sawmill Worker
4	Scaffolder
5	Sheet Metal Worker
3	Shift Operator (Hydro-Electric)
4	Shipwright
6	Shoe Factory Worker
6	Shoemaker
4	Silk Screen Printer
5	Slaughterman
5	Spinner
6	Springmaker
3	Station Operator (Hydro-Electric)
4	Stationary Engine Operator
4	Stereotyper & Electroplater
5	Storeman
5	Sugar Processor
5	Synthetic Fibre Maker
5	Tanner
3	Technician (Engineering)
3	Technician (NEC)
4	Telephone Installer
4	Terrazzo Worker
4	Textile Machine Mechanic
5	Textile Product Worker
4	Timber Carrier Driver
6	Timber Hand
6	Timber Treater
3	Timekeeper
5	Tobacco Preparer
3	Toolmaker
6	Toymaker
5	Trench Digging Machining Operator
4	Tyre Maker
5	Upholsterer
4	Waterside Worker
5	Waterworks Operator
5	Weaver
4	Weaving & Knitting Machine Setter
5	Welder
4	Well Driller
5	Wire Worker
5	Woodworking Machine Operator
5	Wool Fibre Preparer

SALES.

SALES, WAREHOUSE & RETAIL WORKERS

Level	Occupation
3	Auctioneer
4	Bookseller
3	Business Services Salesman
3	Buyer
6	Cafeteria Assistant
4	Cafeteria Proprietor
4	Cashier
3	Commercial Artist
3	Commercial Traveller
2	Company Sales Manager
4	Demonstrator (Shop)
4	Display Artist
2	Estate Agent
6	Fish Shop Worker
4	Florist
4	Greengrocer
4	Grocer
3	Indent Agent
2	Insurance Salesman
3	Manager (Retail & Shop)
2	Manager (Wholesale & Warehouse)
4	Milk Bar Proprietor
5	Milliner
5	News Vendor
2	Pharmacist
3	Purchasing Agent
2	Real Estate Agent
3	Restaurant Proprietor
2	Sales Manager (Company)
3	Sales Representative
3	Sales Supervisor
4	Salesman Driver
5	Service Station Attendant
4	Shop Assistant
4	Shopkeeper
5	Spare Parts Salesman
3	Stock & Station Agent
3	Store Detective
4	Street Vendor
2	TAB Agent
3	Technical Salesman
5	Warehouseman
4	Warehouse Salesman
4	Window Dresser
4	Working Proprietor (Retail)
3	Working Proprietor (Wholesale)

SERVICE

SERVICE WORKERS

Level	Occupation
3	Aircraft Steward
4	Ambulance Driver
3	Appraiser
2	Armed Forces Officer
4	Armed Forces Personnel (Not Officer)
3	Bank Officer
5	Barber
5	Barman
4	Building Maintenance Man
4	Bus Driver
5	Cafeteria Assistant
4	Cafeteria Proprietor
6	Caretaker
5	Chauffeur
3	Chef
3	Chief Steward (Ship)
2	Child Welfare Officer
6	Chimney Sweep
6	Cleaner
4	Coffee Preparer
5	Cook
2	Critic
2	Detective
4	Driving Instructor
6	Dustman
5	Dry Cleaner
4	Electrical Appliance Serviceman
2	Estate Agent
6	Factory Cleaner
3	Fireman
3	Flying Instructor
6	Gardener
6	Grave Digger
6	Groundsman
4	Guide
5	Hairdresser
6	Hospital Orderly
6	Hotel Porter
6	Housekeeper (NEC)
2	Insulator
6	Janitor
6	Kitchenhand
4	Landscape Gardener
5	Launderer
6	Lift Attendant
4	Lighthouse Keeper
3	Mail Contractor
5	Messenger
4	Milk Bar Proprietor
1	Milkman
4	Office Machine Serviceman
6	Park Cleaner
4	Pastry Cook
6	Pest Destruction Worker
4	Pest Inspector
4	Policeman
5	Postman
3	Prison Officer
3	Private Inquiry Agent
2	Probation Officer
3	Racecourse Steward
4	Radio & TV Repairman
3	Radio Operator
4	Radio-Telephone Operator
2	Real Estate Agent
3	Restaurant Proprietor
3	Safety Inspector
4	Security Officer
3	Ship's Cook
4	Ship's Fireman
2	Social Worker
3	Sports Coach
3	Store Detective
6	Street Cleaner
4	Taxi Driver
2	Tea Preparer
3	Traffic Officer
3	Undertaker
6	Vehicle Washer
5	Waiter
3	Warder
5	Watchman
6	Window Cleaner
5	Wine Steward
3	Working Proprietor (Boarding House)
4	Working Proprietor (Cafeteria)
3	Working Proprietor (Catering)
3	Working Proprietor (Hotel & Motel)
3	Working Proprietor (Restaurant)

TRADESMAN.

TRADESMEN

Level	Occupation
3	Aircraft Electrician
3	Aircraft Mechanic
4	Automotive Electrician
5	Baker
5	Blacksmith
4	Boatbuilder
4	Boilermaker
4	Bookbinder
4	Bricklayer
4	Builder
4	Butcher
4	Cabinet Maker
5	Car Painter
4	Carpenter
3	Chef
3	Clothing Designer
4	Compositer
5	Coppersmith
4	Diesel Mechanic
3	Electrical & Electronic Technician
4	Electrical Fitter
4	Electrical Lineman
4	Electrician
3	Electronics Fitter
2	Engineer (non-professional)
2	Fitter
5	French Polisher
4	Gas Fitter
5	Glazier
4	Gunsmith
3	Interior Decorator
4	Jewellery Worker
6	Jockey
4	Joiner
4	Locksmith
4	Machinery Mechanic (NEC)
4	Monumental Mason
4	Motor Mechanic
4	Motorcycle Mechanic
4	Musical Instrument Maker & Tuner
5	Panelbeater
5	Paperhanger
4	Pastrycook
4	Photo-engraver
4	Plasterer
4	Plumber
4	Printer
4	Ship's Electrician
2	Ship's Engineer
5	Spray Painter
4	Stonemason
5	Tailor
3	Toolmaker
4	Turner
4	Watchmaker
5	Welder

TRANSPORT & LABOUR.

TRANSPORT EQUIPMENT OPERATORS & LABOURERS

Level	Occupation
4	Agricultural Machinery Mechanic
3	Agricultural Pilot
3	Aircraft Electrician
4	Aircraft Loader
3	Aircraft Mechanic
4	Aircraft Sheetmetal Worker
3	Aircraft Steward
1	Airline Pilot
2	Airport Supervisor
2	Air Traffic Controller
4	Ambulance Driver
4	Automotive Electrician
4	Boatbuilder
4	Boatman
5	Bulldozer Operator
4	Bus Driver
5	Car Painter
5	Chauffeur
3	Chief Steward (Ship)
4	Cramp Operator
4	Diesel Mechanic
4	Dredge Operator
4	Driving Instructor
4	Earthmoving Machine Mechanic
5	Earthmoving Machine Operator
2	Flight Navigator
3	Flying Instructor
5	Fork Lift Operator
6	Lift Attendant
5	Lorry Driver
4	Motor Mechanic
4	Motorcycle Mechanic
5	Motor Vehicle Assembler
5	Panelbeater
4	Railway Engine Driver
5	Railway Goods Manager
4	Railway Guard
4	Railway Shunter
5	Railway Signalman
3	Railway Station Master
6	Railway Trackman
5	Railway Traffic Assistant
4	Railways Supervisor
3	Railways Traffic Inspector
6	Road Grader Operator
3	Road Transport Supervisor
4	Salesman Driver
4	Seaman
5	Service Station Attendant
3	Ship's Cook
2	Ship's Deck Officer
4	Ship's Electrician
2	Ship's Engineer
4	Ship's Fireman
2	Ship's Master
5	Ship's Oiler & Greaser
2	Ship's Pilot
3	Ship's Purser
4	Ship's Steward
4	Shipwright
5	Spray Painter
4	Taxi Driver
4	Timber Carrier Driver
6	Tractor Driver
4	Tyre Maker
6	Van Driver
6	Vehicle Washer

FAB

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