INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

UMI®

Bell & Howell Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

University of Alberta

"Individual Time Preference in Forest Management"

by

Cameron Leif Taylor ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Science

in

Agricultural Economics

Department of Rural Economy

Edmonton, Alberta

Spring, 1999

National Library of Canada
Acquisitions and Bibliographic Services
395 Wellington Street
Ottawa ON K1A 0N4
Canada

Bibliothèque nationale du Canada
Acquisitions et services bibliographiques
395, rue Wellington
Ottawa ON K1A 0N4
Canada

Your file Votre référence

Our file Notre référence

The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

L'auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

L'auteur conserve la propriété du droit d'auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

0-612-40115-4

Canada

University of Alberta

Library Release Form

Name of Author: Cameron Leif Taylor

Title of Thesis: Individual Time Preference in Forest Management

Degree: Master of Science

Year this Degree Granted: 1999

Permission is hereby granted to the University of Alberta Library to reproduce single copies of this thesis and to lend or sell such copies for private, scholarly, or scientific research purposes only.

The author reserves all other publication and other rights in association with the copyright in the thesis, and except as herein before provided, neither the thesis nor any substantial portion thereof may be printed or otherwise reproduced in any material form whatever without the author's prior written permission.

Cameron Leif Taylor
10182 89th Street
Edmonton, Alberta
T5H 1P9

December 10th, 1998

University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled "Individual Time Preference in Forest Management" submitted by Cameron Leif Taylor in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Economics.

Dr. Martin Luckert

Dr. Wiktor Adamowicz

Dr. Terry Veeman

Dr. Mel McMillan

Date: Dec. 7 '98

ABSTRACT

A forest management plan may be characterized by a number of attributes which affect the timber and non-timber benefits produced over time. Varying these attributes will generate different time paths of benefits that may be more or less desirable to the public. This study examines four specific attributes and how they might affect an individual's preference for a particular time path and the management plan from which it comes. The four attributes to be investigated are: basic time preference (as an internal rate of return within each time path), the ordering of gains and losses, uncertainty and goods effects. An econometric model was developed to try and explain how these factors, as well as socio-economic characteristics, might affect individual preference between alternate forest management scenarios.

A questionnaire was developed which presented a choice between two alternative forest management scenarios, each describing a 100 year time frame. Each scenario involved two goods, timber and recreational use, whose annual levels were determined by the attributes of the scenario. The goal was to examine individual choice behaviour and to estimate parameters of an individual's utility function that relate to the four attributes being studied.

Results from the study showed that individuals preferred forest management scenarios that produced a stable flow of benefits over the duration of the scenario. In the questionnaire, respondents favoured scenarios with attributes that led to flatter time paths, while rejecting scenarios with attributes producing large movements away from evenflow levels. Results also supported the existence of a goods effect, allowing distinct time preference rates for different goods.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I INTRODUCTION

A. TIME PREFERENCE and FORESTRY

Forest management is a complex process that seeks to oversee the intricate biological and economic systems that operate in forest areas. Because many forests are a public resource, management plans must frequently reflect public opinion while making compromises between conflicting interests. It is difficult to know what compromise the public would prefer. One area where contrary objectives are evident is in the amount of forest resources used over time.

The flow of benefits that a forest produces should reflect the public's preference of how social resources should be used over time. In an ideal situation, there would be a social discount rate that would reflect the public's time preference. This rate would then determine social resource allocation over time. But there exists no universally accepted method to precisely measure a social discount rate and this study will not attempt to estimate one. Without a clearly defined social discount rate, individuals must decide how to exploit forest resources in a time pattern that serves the social interest.

There are many components to the pattern of benefits that a forest may yield over time. Because of its significant impact on the forest, timber harvesting has become the most controversial of these components. Numerous approaches for harvesting timber have been employed, each reflecting a distinct rate of time preference in the pattern of yearly cut levels. One such approach is sustained yield forestry. Formally, sustained yield may be defined as "the yield that a forest can produce continuously at a given intensity of management. Sustained-yield management therefore implies continuous production, so planned as to achieve at the earliest practical time a balance between increment and cutting" (Forestry Handbook for British Columbia, 1971).

In Alberta, an inventory of timber and land base is used to calculate an Annual Allowable Cut (AAC) for each Forest Management Agreements (FMA) area. The AAC calculates a "level of harvest that is sustainable into perpetuity" (Expert Review Panel, 1990). One of the main policy objectives of the Alberta Forest Acts is full utilization [1] of the AAC without over-cutting within five-year quadrants of a twenty-year management plan (McDougall, 1990). This does allow for some year to year variation in harvesting, but no large fluctuations in the long-term.

There is little doubt that the public wants current forestry operations to be sustainable. But in certain areas, sustained yield has become synonymous with even-flow timber harvesting, where an equal amount of timber is cut every year. While many foresters are quick to list the benefits of even-flow harvesting, there is little to confirm that even-flow reflects the society's time preference rate. Even-flow harvesting may provide a stable timber supply, but may not maximize overall forest benefits possible under integrated management conditions. Regulating timber to a constant supply can impose an opportunity cost of maintaining standing stocks of timber at times when the proceeds of harvested timber could be put to better social benefit (Boyd & Hyde, 1989). Also, variable harvests might better respond to market fluctuations in the demand for forest products (Dowdle, 1984).

---

[1] Full utilization was considered to be above 90% of the AAC due to operational limitations in harvesting, although this threshold may have risen in more recent Alberta Forest Acts.

Recent debate has created an interest in harvesting patterns that deviate from even-flow. One idea is to follow the natural disturbance pattern of boreal forests, mimicking fire loss with small cut levels in most years and large cuts in other years. This 'natural disturbance' theory would imply uneven timber harvest levels for large areas (ie: one FMA), but these uneven levels may balance each other out over several FMAs (ie: the province), keeping annual levels close to constant. Would this 'natural disturbance' harvesting pattern better reflect public time preference? This study investigates peoples' preference regarding alternative patterns of forest resources over time.

B. TIME PATH ATTRIBUTES

A forest management plan can be characterized as yielding paths of timber and non-timber benefits over time. These time paths may be characterized by a number of attributes. Varying these attributes will produce different paths that may be more or less desirable to the public. This study examines four specific attributes of forest management and how they might affect an individual's preference for a particular time path. The four interrelated attributes to be investigated are: basic time preference, ordering of gains and losses, uncertainty and goods effects. An econometric model will be developed to try and explain how these factors, as well as socio-economic characteristics, might affect individual preferences between alternative forest management scenarios. The opinions that individual's express on these issues may help determine future forest management strategies.

1. BASIC TIME PREFERENCE

Basic time preference refers to how individuals value goods or services at different positions in time. Frequently, the human desire is to receive a reward sooner rather than later. As such, an individual would be willing to sacrifice part of a future reward to possess it sooner. Similarly, an individual may require compensation if they were asked to wait for a reward. How much the individual is willing to sacrifice, or how much compensation they require to wait, forms the basis of personal time preference. For example, someone indifferent between accepting $90 now instead of a $100 reward in one year demonstrates a positive time preference. An individual willing to postpone a $100 reward for a year in return for $90 reflects negative time preference. Someone who is indifferent between receiving $100 today and $100 a year from now exhibits a neutral time preference. How individuals are willing to shift rewards through time depends largely on personal time preference.

In this study, discount rates and timber harvesting patterns are not examined in the context of an optimal economic rotation. Instead, internal rates of return are used to measure an individual's willingness to sacrifice future timber volumes in return for increased volumes in the short term. The reverse case, an individual's required compensation in the future in order to reduce short-term harvest levels, is also measured. With variable harvesting, different time periods receive different volumes of timber. How an individual prefers these volumes to occur reflects a time preference rate. For example, preference for even-flow harvesting is assumed to reflect a neutral time preference because no one time period receives more or less timber benefits than another. If an individual has a non-neutral time preference for forestry resources, a management scenario with variable benefits paths may yield that individual a higher utility level. Employing variable patterns which reflect specific internal rates of return will hopefully provide insights into intertemporal trade-offs of forestry resources.

2. ORDERING of GAINS and LOSSES

Time preference associated with forest management decisions does not entirely describe timber harvesting patterns over time. The intertemporal trade-off between postponing gains or losses may also play a significant role. Basic time preference reflects the size of sacrifice or compensation necessary for an individual to be indifferent between two different amounts at two points in time, while the intertemporal trade-off aspect reflects whether an individual prefers to sacrifice first and be compensated later or vice versa. To expand the earlier example, suppose someone could choose between 1) losing $90 now and gaining $110 in one year or 2) receiving $90 now and losing $100 in one year. The ordering of whether the gain or the loss came first may be as important to the individual's choice as the dollar differences involved. Both may affect the intertemporal decision making process.

Also, the definition of the reference state is crucial in determining whether an event is perceived as a gain or a loss. In forest management, if we assume even-flow harvesting to be the reference state, variable harvesting patterns which move away from even-flow may be perceived as a series of gains and losses relative to the reference state. The ordering of gains and losses will determine if a forest's resources are 'consumed' earlier or later. For example, an even-flow strategy would harvest equal amounts of timber every period and distribute timber revenue evenly. With variable harvesting, a period of relatively high harvest followed by lower harvests may provide economic gains from timber in the short term with future periods experiencing losses relative to the even-flow state. Conversely, postponing high harvest periods will shift timber gains into the future, but at the expense of near time periods.

3. UNCERTAINTY

Forest management planning involves future projections that are inherently uncertain. A common assumption is that uncertain values will be discounted at a rate that includes a basic time preference plus a risk premium (Klemperer et al, 1994). It may be possible to limit the level of this uncertainty and so lower the risk premium. Less uncertainty may also reduce the risk of harmful 'irreversibilities', damage that cannot be undone once it occurs. But lowering future uncertainty comes with additional costs, such as increased information gathering, extra planning and additional managing requirements. How individuals view the trade-off between accepting and lowering the level of uncertainty may be important for forest management planning.

4. GOODS EFFECT

Forest areas provide a wide range of goods and services. Do individuals value the forest as a whole at a single discount rate, or value different forest benefits according to multiple rates? Prior research has shown that individuals may value different goods at different intertemporal rates (eg. Luckert & Adamowicz, 1993). If the forest is managed to provide a variety of goods, the goods effect would allow for a variety of time preference rates within a management strategy, allowing the management of separate forest benefits according to separate discount rates. Little empirical work has been done to identify whether time preference rates vary across forest resources.

C. THESIS OVERVIEW

Chapter II will introduce a literature review of general time preference issues, as well as previous work on attributes that affect time preference. Chapter III will present the methods to be used in the study including theoretical background on random utility and discrete choice modeling. Chapter III will also outline the survey design for this study and the data collection procedure. Chapter IV will summarize the data collected. Chapter V will contain data analysis, with model development and estimation. Chapter VI will offer the summary and conclusions from the study.

CHAPTER II LITERATURE REVIEW

A. INTRODUCTION

Resource management decisions frequently involve a trade-off between time periods. This requires an intertemporal choice where the decision maker must consider values over time. Costs and benefits that occur over a range of periods can be brought to a single point in time for comparison through discounting. For decisions that affect large sectors of social resources, the decision maker must attempt to use a discount rate that serves the public's interest. Further complicating this choice, the discount rate may have an ambiguous effect on environmental resources (Markandya & Pearce, 1991). A low rate may encourage investment in development leading to further environmental degradation. A high rate may discourage a development project by lowering the present value of its future benefits and thus protect an environmentally sensitive area. Unfortunately, there is no standard method for identifying a 'correct' discount rate that reflects the public's time preference for the allotment of social resources.

Benefit cost analysis does offer two approaches for determining a discount rate (Howe, 1971). In the opportunity cost approach, the pretax rate of return forgone on funds transferred from private to public investment is offered as the social discount rate. In the social time preference approach, society's propensity for current consumption versus saving for the future represents the discount rate. These two approaches may produce very different estimates of the social discount rate. The lack of an agreed upon social discount rate is a problem because of the potential significant negative consequences of employing the wrong rate. Social time preference is an important factor in issues like the following: "How much (of society's resources) should be invested altogether? How should this investment be divided between public and private sectors? Given the level of investment in the private sector how much should be allocated to long-term projects, how much to short-term projects?" (Baumol, 1968). Mis-allocated resources and an incorrect level of investment can seriously harm social welfare.

The capital market is assumed to solve these questions, but often falls short. In an ideal capital market, with perfect information and costless transactions, individual time preference would be aggregated into a single market discount rate equal to the social discount rate (SDR) and be applied to all intertemporal transactions. If potential investments were taken in order of descending return, the last investment as limited by capital availability would make a return defined as the marginal social productivity of capital (MSPC). The MSPC is the market rate of return on capital that society chooses to invest and represents the opportunity cost of capital.[2] But because capital markets are not ideal the MSPC limit occurs above the SDR. The result is that socially desirable investments, with a rate of return above the SDR but below the MSPC, are not made by private markets as the capital is not available (Harou, 1983). In reality, some of these 'sub-market' investments are still undertaken suggesting that decision makers do not always operate strictly according to market discount rates.

Much of the confusion in current discussion and research on time preference may stem from the proposed existence of four different kinds of time preference. Whereas Harou (1983) distinguishes between two rates, the SDR and the MSPC, Manning &

---

[2] Both SDR and MSPC contain the term 'social' because both involve societal decisions.

Adamowicz (1994) distinguish between four rates of time preference. Manning & Adamowicz's (1994) "group social time preference" corresponds to the SDR and concerns the managing of society's collective resources. Manning & Adamowicz's (1994) "group personal time preference" corresponds to the MSPC and is the basis for the market interest rate. Manning & Adamowicz (1994) define each of these group rates as aggregations of individual rates. "Individual social time preference" is the individual's opinion as to how the society's resources should be distributed over time. "Individual personal time preference" relates to delaying or advancing personal consumption as well as personal borrowing or saving decisions. Thus, the separation of MSPC and SDR may occur because they are the products of different levels of individual time preferences, with the MSPC coming from individual personal time preference and the SDR coming from individual social time preference.

There are a number of reasons why the capital market may fail to reconcile the MSPC and the SDR. One root of the separation may be that the two rates are based on separate individual and social utility functions. Marglin (1967) justifies two utility functions theorizing that people behave in a schizophrenic manner by maximizing individual utility while preferring the government to safeguard societal welfare. As such, there exist two optimal rates of time preference, one for the individual and one for society.

If individual utility is assumed to include concern for future generations, which is non-exclusive and non-rival, this introduces public good aspects and the incentive to free-ride. Public good externalities have led to two market failures, the isolation paradox and the assurance problem (Sen, 1967). In the isolation paradox, the dominant investment strategy of each individual leads to a Pareto-inferior outcome. A superior outcome is possible through co-operation, but without enforcement individuals may choose to cheat on a voluntary agreement. With the assurance problem, individuals would be willing to save toward future welfare if assured all others will save as well. While aware of potential free-riding, expectations of others' actions will dictate individual saving decisions. Thus, the individual utility function will govern private saving decisions which will determine the market discount rate optimal for private goods. The social utility function should produce a social saving level and a discount rate optimal for public goods, but there is no separate market to determine a social discount rate. If the isolation paradox and the assurance problem exist, social saving will be less than optimal and the welfare of future generations will be under-provided by private markets. Both Marglin (1963) and Sen (1967) discuss the role of government in attempting to correct for these market failures and reconcile the existence of two optimal discount rates. Marglin (1963) concludes that the government should undertake investments below the optimal private rate of return but above the optimal social rate.

If investments are discounted at different rates based on their public versus private nature, why shouldn't other factors affect how items are discounted? Instead of investments, what if a good's discount rate depended on its inherent characteristics. The goods effect allows the discount rate to vary based on how the individual perceives the attributes of the good being discounted. The capital market determines a single rate for all investments and does not apply different rates based on investment characteristics. There is no reason to assume that individuals act accordingly. With each individual having a potentially different discount rate for every good, the aggregation of all these diverse rates may help to explain the separation of the MSPC and the SDR.

Uncertainty may be a third factor in the separation of the market interest rate from the social discount rate. An ideal capital market assumes perfect information for all participants. In reality, uncertainty exists in many different forms and may be dealt with in a number of ways. Distinct levels of risk, from the individual to the group, are treated differently in the capital market. The question of the market's ability to pool risk may introduce a separation between the MSPC and the SDR and how the two rates are affected by uncertainty. Market diversification reduces the impact of uncertainty on the MSPC, while this may not be possible for the societal resource allocation issues in which the SDR is involved.

A fourth point in the separation between market and social discount rates may depend on socio-psycological phenomena. Capital markets look at dollar amounts when comparing net present values (NPVs) between investments. The human discounting process may not be as one-dimensional. Along with absolute values, the ordering of gains and losses may be a relevant factor when individuals evaluate intertemporal decisions. People have been shown to discount gains and losses at different rates, making the order of such events relevant when individuals are evaluating alternative distributions over time. When aggregating individual time preference rates, this subjective component may have a strong influence on the SDR which may be absent in market considerations of the MSPC, allowing for a significant separation between the two rates.

B. DECISION FACTORS

Some factors that cause the divergence between individual and social rates of time preference may also influence individual decision process as attributes of a forest scenario time path. In this study, the discount rate is not being used to determine the optimal economic rotation. Instead, the discount rate is used to measure the intertemporal trade-offs an individual prefers concerning forest resources by examining the pattern of benefits that an individual chooses. The objective is to identify a rate of time preference for forest resources. It is difficult to list all of the time preference factors that may affect an individual's preference for intertemporal resource management. This study looks at four specific factors, the goods effect, the risk effect, the ordering of gains and losses, basic time preference, as well as demographic characteristics. Previous literature on these four attributes is discussed in this chapter to better understand the theoretical basis of these issues.

1. GOODS EFFECT

An important characteristic for any time preference question is the good involved. Luckert & Adamowicz (1993) define time preference as the marginal rate of substitution of goods between time periods. Using an assumption of separability over goods and time, they demonstrate the possibility of different marginal rate of substitution between time periods for different goods, the essence of the goods effect. They found respondents displayed lower discount rates for income derived from a forest than income derived from a stock portfolio.

In developing a theory to explain the goods effect, Loewenstein (1987) notes that different goods with different characteristics can logically be discounted at separate rates. How individuals perceive these characteristics would determine how each good is discounted. Several empirical studies have elicited evidence of the goods effect based on characteristic variation. Using a model which measured the time delay of product attribute adoption, Sultan and Winer (1993) found that time preference rates differed between products as well as between individuals and that these rates tended to be noticeably different from the discount rates for money. A more 'controversial' study attempted to estimate a discount rate for human lives, asking respondents to choose between saving a certain number of people now or a greater number of lives at a future date (Cropper, Aydede & Portney, 1992). Several respondents refused to make such a trade-off, claiming that technology would somehow improve to save the future lives automatically. This unwillingness to answer may reflect that many individuals have a difficult time making intertemporal choices for abstract goods (ie. wildlife existence values, scenic beauty values). If respondents are expected to make a thoughtful choice rather than a random pick, the goods they are asked to evaluate must be something to which they can relate.

What might the goods effect mean for natural resource discounting? Most likely, the characteristics of the resource involved will affect individuals' time preference. There is little doubt the public wants forest resources to be managed sustainably. Sustainable forestry implies both economic and biological sustainability over the long-term. Above some limit discount rate, it may become unprofitable to replant a stand after harvesting as present replanting costs will outweigh discounted future harvesting benefits. Thus, depending on the growth function of the tree species involved, forestry becomes unsustainable at some calculable interest rate, termed the 'natural interest rate of the forest' (Akerman, 1994). Yet individuals may prefer a sustainable forestry management plan that is unprofitable at a market discount rate rather than suffer the unsustainable consequences from a plan yielding a market rate of return. Is it possible to justify such a decision, using a below-market rate for a sustainable outcome, without unbalancing the capital market? The goods effect allows the discount rate for forest management to differ from the market rate due the inherent characteristics of the forest resource.

Recent empirical work offers some evidence of individuals using below-market discount rates for decisions with environmental consequences (Lumley, 1997). Various economic and demographic variables were collected in a soil conservation study of Philippine farmers from respondents in four villages. As part of the Lumley (1997) survey, a bidding format was used to elicit individual personal time preference rates which were then compared against debt interest rates on borrowing and the level of soil conservation effort from individual farmers. The results showed borrowing rates to be significantly higher than personal time preference rates. Yet, some farmers facing higher borrowing rates were still willing to put money into soil conservation accepting a lower rate of return to ensure sustainability. Their decisions demonstrate the goods effect in a divergence of discount rates between borrowing and soil conservation.

2. UNCERTAINTY

The term uncertainty can be interpreted a number of ways when discussing time preference. Uncertainty may refer to the uncertain nature of human existence. People may die unexpectedly, making future benefits riskier than if the same benefits were received sooner, lowering the value of those future benefits. Uncertainty may also refer to the general uncertain nature of future values. An amount to be received in the future may be probabilistic, making its current value uncertain. Thus, uncertainty exists when determining *what* amount *if any* might be received.

The most common approaches for dealing with uncertainty are developed in finance theory. It is assumed that the risk averse investor requires a premium above the risk-free rate of return when future gains are uncertain. Klemperer et al (1994) try to estimate this risk premium specifically for forestry investments. The risk averse investor would also be indifferent between the expected value of the return and some certain amount, the certainty equivalent. Klemperer et al (1994) give an example where a 7% risk premium would lead a risk-averse investor to trade a $5000 Douglas-fir harvest uncertain return for approximately a $185 certain return if both were to be received in 50 years. Such a trade seems unreasonable given that recent analysis suggests forestry may actually be a low risk investment. Newly planted seedlings remain vulnerable but established trees are fairly certain to survive until harvested (although fire risk remains). Thus, these trees may not need to carry high risk premiums for all periods. Klemperer et al (1994) propose that the risk premium should decline as the length of the payoff period increases. As the investment matures, the probability of the harvest pay-off increases and therefore the risk-adjusted discount rate should decrease. In their approach, the risk premium may become insignificant for very distant time periods. The risk premium affects all elements being discounted in every period even if not all elements are uncertain. The Klemperer et al (1994) example shows that adding even a small risk premium to the discount rate would drastically affect certainty equivalents. Accounting for uncertainty with a risk premium might be too strong a step.

It may be better to incorporate uncertainty by allowing projected outcomes to vary within a range of possibilities. The level of uncertainty would determine the size of a variance bound around a projected mean. Even if forestry is accepted as a low-risk investment, there are still many aspects of forestry that remain uncertain. Natural factors affecting tree grow make future timber volumes variable. Also, predicting the effect from harvesting on the complex forest ecosystem is imprecise at best. These types of factors would determine a variance bound, without a risk premium discounting all values. Individual time preference would then determine if the size of this variance bound were acceptable.

How does the level of uncertainty in future harvests impact on individual time preference? Accepting a higher level of uncertainty may provide possible benefits, such as allowing for adaptive management, where acceptable variation provides knowledge of alternative approaches (Montgomery, 1996). As well, trying to eliminate all uncertainty would require more management intensity, thereby increasing costs and may require commitment to a fixed course of action. At the same time, decreasing the level of uncertainty may also be positive, by ensuring projected harvest levels are within 'safety' buffers to avoid potentially damaging irreversibilities. Individuals must consider these trade-offs when considering the level of uncertainty they are willing to accept in a forest management system.

3. ORDERING of GAINS and LOSSES

A third attribute that may affect individual intertemporal decision making is how positive and negative consequences are distributed over time. When comparing alternative gain and loss structures, the ordering of these events may be significant. Empirical studies have shown that individuals discount future losses at a lower rate than future gains, apply much lower rates to more distant outcomes, and use lower rates for more important consequences (Knetsch, 1997). Thus, the order of how these events are structured can influence an individual's decision process when choosing a preferred distribution of consequences.

How alternative orderings of gains and losses are presented can affect individuals' responses. An inconsistent element of many discounting experiments is a comparison between discount rates derived from a choice between two gains or between two losses. Knetsch (1997) states:

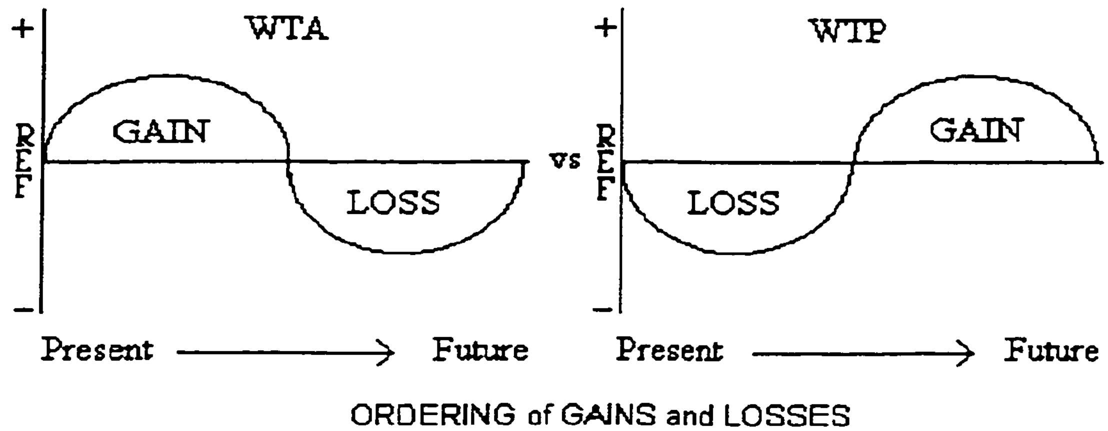
> "there is in these comparisons a possible confounding from the influence of the valuation disparity between gaining and losing immediate money, the numeraire used to measure the value of the future gain and the future loss" (1997, p.6).

The inherent difference between gaining and losing affects how much the individual would expect in the future to feel as well off regardless of their discount rate. To avoid this problem, Knetsch (1997) suggests using a present willingness to pay (WTP) for a future gain or a present willingness to accept (WTA) compensation for a future loss as measures of time preference. When a discount rate is being used to measure the present value of near- and long-term benefits and costs from short-term actions with long-term consequences, WTP and WTA measures are better suited for estimating this type of discount rate.

Using the example from Chapter I, receiving $90 now instead of a $100 in one year is a choice between a present and future gain. This choice gives no measure of what an individual would pay for either gain and hence no measure of economic value. In the WTP approach, suppose an individual would pay $90 now to receive $100 one year from now. The WTP provides a direct measure of the amount an individual values a future improvement (either to receive a gain or avoid a loss). In the WTA approach, suppose an individual would receive $90 now and agree to pay $100 in one year. The WTA provides a direct measure of the compensation required for a future deterioration (either to suffer a loss or forgo a gain). Because both WTP and WTA give a direct measure of value in the present, they provide more direct time preference information than the choice between a present and future gain or the choice between a present and future loss.

Both WTP and WTA can be expanded beyond single gain and loss events. As Figure 2.1 illustrates, a period of gains may be considered the compensation required to accept a series a future losses. Likewise, a sequence of losses may be suffered to secure a period of future gain. In this way, WTA and WTP display opposite sequencing of gains and losses. Because of this contrast, individuals may have different WTA and WTP amounts in similar situations depending on how the question is presented.

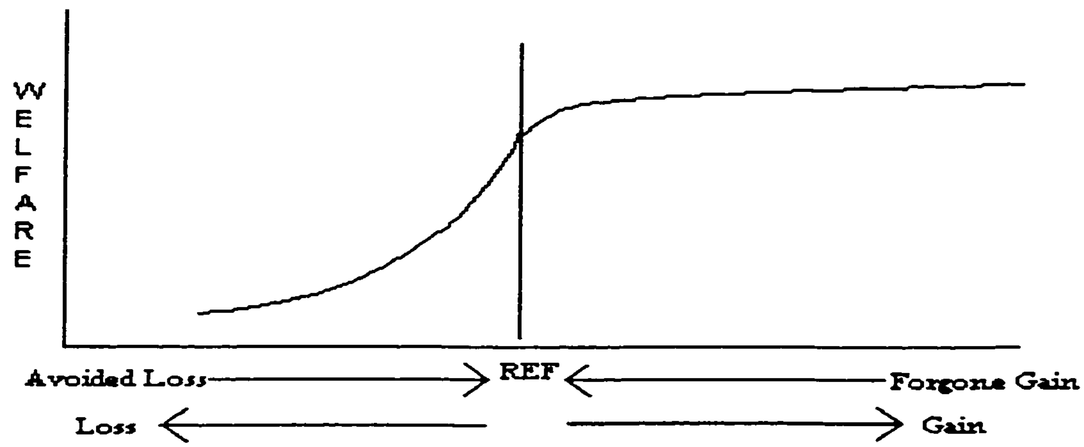
Figure 2.1: Gain and Loss Orderings



Before WTP or WTA measures are established, we must decide what an individual considers a gain or a loss. The x-axes in Figure 2.1 represent an individual's reference state, what they consider to be a normal level. This reference state need not be zero, but rather a level to which individuals feel they are entitled. A positive increase above the reference state may be perceived as a gain, while the same increase below the reference state may be considered a reduction in loss. Similarly, a negative change from the reference state may be deemed a loss, while those above the reference state may be perceived as foregone gains (Knetsch, 1997). An individual's reference state will affect their interpretation of a change and therefore will affect that individual's time preference decision making.

As Figure 2.2 illustrates, a gain is treated differently than a loss avoidance of the same amount. Likewise, a loss has a stronger impact on well-being than a forgone gain. The asymmetric welfare line around the reference state demonstrates a basic difference between changes of the same magnitude depending on how the change is presented to the individual.

Figure 2.2: Asymmetric Welfare Line Around the Reference State



The framing of any discounting question can have a strong influence on response. The combination of gains and losses being discounted at separate rates as well as their particular relation to the reference state implies that the future change presented in a question may affect an individual's discounting process. Thus, the ordering of gains and losses, how these changes are presented with respect to the reference state, and how their present economic values are measured, are all important components of a discounting question.

C. DEMOGRAPHICS

Many other factors can affect individual choice behaviour, especially the characteristics of the individual. The socio-economic traits of individuals may play a large part in their time preference decisions. Several previous studies have examined this issue, with differing results. Pope & Perry (1989) surveyed natural science students and business students about the management of a hypothetical income generating, depletable natural resource. Respondents were asked to choose between five income streams that were generated using an optimal control model, with five different discount rates used to optimize the rate of soil erosion. The respondent's choice of income stream was assumed to give an approximation of their discount rate and hence their rate of time preference. Along with stream choice, responses were tested for significant differences between the two groups of students based on several demographic variables like age, gender, income and education. Results showed that business students preferred a more rapid depletion of the resource, implying they possess higher rates of time preference. Business students had higher expected future incomes than natural science students suggesting income effects may be involved when the business students displayed higher discount rates in their choice of income stream. No other significant differences in terms of the other demographic factors were found between the two groups of students. The limited socio-economic variation between business and natural science groups meant Pope & Perry (1989) could draw no connection between demographics and discount rates. This may be because, across subject majors, university students tend to have similar personal characteristics.

Other researchers, using a broader sample of respondents, have found connections between socio-economic variables and time preference rates. Sultan & Winer (1993) provides a summary of theoretical and empirical works on the possible connections between personal characteristics and discount rates. They propose the standard argument, that lower discount rates are expected with higher incomes while higher discount rates are expected with lower incomes. Rook (1987) studied the correlation between age, income, intelligence and social responsibility with individual discount rates. Luckert & Adamowicz (1993) found gender and disposable income to be significant factors affecting social rates of time preference. If other factors like the goods effect and uncertainty are simultaneously affecting the discounting process, it may be difficult to establish a systematic relationship between socio-economic characteristics and discount rates. However, personal characteristics remain an important element of intertemporal decision making.

D. CONCLUSION

Public agencies frequently attempt to manage public resources for the best interest of social welfare. In an ideal setting, intertemporal decisions would be much more straightforward as all discounting would involve the market interest rate equal to the social discount rate. Actual resource management is made more complicated by a separation of the MSPC and the SDR, due in part to the issues discussed in this chapter; the goods effect, uncertainty, and the ordering of gains and losses. These same factors, along with demographic attributes, may also affect the discounting processes of individuals who must make resource management decisions without a unifying discount rate. The goods effect allows discount rates to vary between goods. The level of uncertainty may be an attribute that affects selecting a course for the future, rather than a risk premium on the discount rate. The reference state may determine how people perceive gains and losses, the ordering of which is a component of individual preference. Demographic characteristics may affect an individual's time preference decision making. The simultaneous influences of these multiple factors may have significant implications for resource management issues. An empirical survey of how individuals deal with these factors in their discounting process in a forestry context will be developed in Chapter III.

CHAPTER III METHODS

This study is from an economics perspective, yet because choice behaviour is involved, it is useful to examine psychology literature. Previous work on intertemporal decision making has been done in experimental psychology (Loewenstein & Elster, 1992), but very little work has been done in relation to environmental resources. In this study, goods effects, uncertainty, the ordering of gains or losses, and basic time preference become attributes used to describe forest management scenarios. Examining how these factors and socio-economic characteristics affect individual time preference requires a method for evaluating their impact on individual behaviour in an intertemporal resource allocation context. Such a method is provided by discrete choice theory, which proposes that an individual chooses the alternative that gives them the highest utility out of all possibilities in a universal choice set, with a utility function based on attributes of the alternative (Cropper *et al*, 1990). Discrete choice experiments allow the modeling of choice behaviour from aggregated individual choices (Batsell & Louviere, 1991). This procedure allows the collection of data from a large number of individuals, none of whom need to evaluate all possibilities in the choice set.

This chapter reviews individual choice behaviour and the technique necessary for analyzing the discrete choice data collected for this study. An overview of utility maximization and random utility theory will lead into a summary of binary choice modeling. In a discrete choice framework, this study will explore how attributes relating to goods effects, uncertainty, the ordering of gains or losses, basic time preference, and socio-economic characteristics affect individual choice behaviour, using a sample of observed choices to estimate parameters of an individual's utility function.

A. INDIVIDUAL CHOICE BEHAVIOUR

In this study, individual decisions are analyzed to form the basis of a behavioural model. Data collected on observed choices contains information on discontinuous, non-linear parameters from which a utility function is estimated. It is hoped that this utility function will help explain individual preferences when making decisions in a forest management context.

1. UTILITY MAXIMIZATION[3]

The first step in exploring individual choice behaviour is to formalize the structure of the decision process. Assume that each individual has a utility function which measures how goods and services, or alternative choices, satisfy their personal preferences. Utility maximization theory holds that: 1) each discrete choice alternative can be represented by a scalar utility index, and 2) individuals will choose the alternative with the highest utility index if we assume they are rational with transitive and consistent preferences. If we have a sample of n individuals, each making a discrete choice among i alternatives, we can define the indirect utility function for each individual for every alternative as:

$$U_{in} = V_{in} + \varepsilon_{in} \tag{3.1}$$

[3] Section 1 is based largely on Börsch-Supan (1987) chapters 2 and 3.

where U_{in} is a scalar representing utility level, V_{in} is deterministic component representing the attributes of the alternative *i* and the characteristics of the individual *n*, and ε_{in} is the additive disturbance. By assuming linear and additive separability, we can divide the deterministic component into:

(3.2) $$V_{in} = \beta' z_{in} + \gamma_i' S_n$$

where z_{in} is a vector of attributes specific to alternative *i*, S_n is vector of characteristics specific to individual *n*, while β and γ are unknown parameters to be estimated. A key property of discrete choice analysis is that "because only relative differences among attributes of alternatives and not their absolute levels are relevant for a choice among alternatives, utility components that are common to all alternatives cancel out" (Bӧrsch-Supan, 1987 p. 13). The disturbance term, ε_{in}, is used to capture unobserved or excluded elements, as the researcher can not completely measure all attributes. This term is stochastic and assumed to be independently and identically distributed (IIA assumption) across individuals. As well, the disturbance term is assumed to be from an I-dimensional joint distribution determined by the cumulative distribution function with a corresponding density function of:

(3.3) $$F(\varepsilon_{1,},\ldots,\varepsilon_I) \rightarrow f(\varepsilon_{1,},\ldots,\varepsilon_I)$$

This density function is assumed to be finite so that there is zero probability of ties between utility indices. An individual will maximize their utility by choosing alternative *i* over alternative *j* if and only if:

(3.4) $$U_{in} > U_{jn}$$

2. RANDOM UTILITY THEORY[4]

Utility maximization theory is not always able to predict individual behaviour. Individuals sometimes choose an alternative which does not appear to maximize utility. To explain these choice inconsistencies, another concept of individual behaviour was developed. The random utility approach recognizes that many factors in the decision process are unknown or unobservable. Random utility theory states that the true utility of an alternative *i* is random, so the probability of that alternative *i* being chosen rests on the probability of that alternative having the highest utility among the set of available alternatives C_n, such that:

(3.5) $$P(i \mid C_n) = \Pr[U_{in} = U_{jn}, \forall\, i,j \in C_n]$$

(3.6) $$P(i \mid C_n) = \Pr[V_{in} + \varepsilon_{in} = V_{jn} + \varepsilon_{jn}, \forall\, i,j \in C_n]$$

Because only the difference between two alternatives' deterministic and stochastic elements matter, (3.6) can be re-written as:

(3.7) $$P(i \mid C_n) = \Pr[V_{in} - V_{jn} = \varepsilon_{jn} - \varepsilon_{in}, \forall\, i,j \in C_n]$$

Utility indices are ordinal. Therefore any monotonic transformation does not affect the ranking of alternatives or choice probabilities. By making assumptions about the stochastic elements, the random utility approach allows the analysis of discrete choice data without requiring the precise specification of the individual utility function.

3. BINARY CHOICE MODEL

Using the random utility approach, we will now focus on a particular discrete choice instance, where an individual must choose between exactly two alternatives to

---

[4] Sections 2 & 3 are derived largely from Ben-Akiva & Lerman (1985) chapters 3 & 4.

develop a binary choice model. In the survey used for this study, individuals are asked to choose one of two forest management scenarios. In the model, the dependent variable Y_{in} is defined such that:

(3.8) $$Y_{in} = \begin{Bmatrix} 1 \text{ if Scenario A is chosen} \\ 0 \text{ if Scenario B is chosen} \end{Bmatrix}$$

The probabilities associated with this choice are:

(3.9) $$\Pr(\text{Scenario A}) = \Pr(Y=1) = \Pr(V_{An} - V_{Bn} \geq \varepsilon_{Bn} - \varepsilon_{An})$$
$$\Pr(\text{Scenario B}) = \Pr(Y=0) = \Pr(V_{Bn} - V_{An} \geq \varepsilon_{An} - \varepsilon_{Bn})$$

The deterministic components (*V's*) are obtained from the choice experiment survey. The random components (*ε's*) are by definition unobservable but must still be incorporated into the model, to satisfy random utility theory. It is common to assume that all of these disturbance terms have zero means and that their variances equal 1 (Ben-Akiva & Lerman, 1985). These assumptions are essentially arbitrary and are done for analytical and computational convenience.

Before the binary choice model can be estimated, the cumulative distribution function must be specified for the disturbance term. The two most common forms are the normal distribution, used in the probit model, and the Weibell Type I extreme value distribution, used in the logit model. A summary of the advantages of the logit model may be found in Börsch-Supan (1987, pp.27-31). The logit model was selected for this study because the logistic function allows more probability mass in the extreme tails relative to the probit model, permitting choice probabilities to better approximate human bevhaiour than with the probit model. The logit model is also more convenient to estimate than the probit model, with a likelihood function that is always concave and second derivatives that are always non-positive.

With the Type I extreme value distribution, choice probability can be defined as:

$$P(Y_{in} = i) = \frac{e^{V_{in}-V_{ij}}}{1 + e^{V_{in}-V_{ij}}} \qquad (3.10)$$

Expanding the deterministic components of (2.10) using equation (2.2) gives:

$$P(Y_{in} = i) = \frac{e^{\beta'(X_{in}-Z_{jn}) + (\gamma_i - \gamma_j)'S_n}}{1 + e^{\beta'(X_{in}-Z_{jn}) + (\gamma_i - \gamma_j)'S_n}} \qquad (3.11)$$

Once the data have been collected, survey responses are coded so that differences in attribute levels between the two choices are measured, meaning:

(3.12) if $Z_A = \alpha_A + \beta(D_A + \theta)$
and $Z_B = \alpha_B + \beta(D_A)$
then $Z_A - Z_B = \beta(\theta)$
so let $Z_n \equiv Z_{1n} - Z_{0n}$

Thus, the probability of choosing Scenario A, ($Y_{in} = 1$), is:

$$P(Y_{in} = 1) = \frac{e^{\beta'Z_n + (\gamma_i - \gamma_j)'S_n}}{1 + e^{\beta'Z_n + (\gamma_i - \gamma_j)'S_n}} \qquad (3.13a)$$

and the probability of choosing Scenario B, ($Y_{in} = 0$), is:

$$P(Y_{in} = 0) = \frac{1}{1 + e^{\beta'Z_n + (\gamma_i - \gamma_j)'S_n}} \qquad (3.13b)$$

Equations (3.13a) and (3.13b) are the basis for the binary logit model which are estimated using maximum likelihood techniques. With a sample of n (n = 1,...,N) individuals, the likelihood function is:

$$\text{(3.14)} \qquad L = \prod_{y_{in}=0} \left[\frac{1}{1+e^{\beta' z_n + (\gamma_i - \gamma_j)' S_n}} \right] \cdot \prod_{y_{in}=1} \left[\frac{e^{\beta' z_n + (\gamma_i - \gamma_j)' S_n}}{1+e^{\beta' z_n + (\gamma_i - \gamma_j)' S_n}} \right]$$

$$L = \prod_{y_{in}}^{N} \left[\frac{1}{1+e^{\beta' z_n + (\gamma_i - \gamma_j)' S_n}} \right]^{1-y_{in}} \cdot \left[\frac{e^{\beta' z_n + (\gamma_i - \gamma_j)' S_n}}{1+e^{\beta' z_n + (\gamma_i - \gamma_j)' S_n}} \right]^{y_{in}}$$

The log-likelihood function is:

$$\text{(3.15)} \qquad \pounds = \sum_{n=1}^{N} \left\{ (1-y_{in}) \ln\left(\frac{1}{1+e^{\beta' z_n + (\gamma_i - \gamma_j)' S_n}} \right) + y_{in} \ln\left(\frac{e^{\beta' z_n + (\gamma_i - \gamma_j)' S_n}}{1+e^{\beta' z_n + (\gamma_i - \gamma_j)' S_n}} \right) \right\}$$

This function is globally concave so a single maximum exists. (Ben-Akiva & Lerman, 1985). By maximizing $\pounds$ with respect to each β while setting partial derivatives to zero, we get the maximum likelihood estimators of the β's. These estimates are consistent as well as asymptotically normal and efficient.

Using this binary choice framework, a survey was designed to examine specific issues of time preference in forestry management. By presenting an individual with two alternative scenarios, the logit model can analyze how attributes that differ between alternatives affect a respondent's choice. The following sections will detail how the survey questionnaire was designed to be analyzed as a binary choice experiment.

B. SURVEY DESIGN

To examine how goods effects, uncertainty, the ordering of gains and losses, basic time preference and socio-economic characteristics affect individual choice behaviour, an original survey instrument was required. A questionnaire was developed which presented a choice between two alternative forest management scenarios. Each forest management scenario described a 100 year time frame, intended to approximate the length of one forest rotation[5]. The time paths contained in the scenarios were characterized by specific attributes related to goods effects, uncertainty, and the ordering of gains and losses. These scenarios were intended as simplified representations of forest management plans where only the attributes of interest to this study differed between choices, with other factors assumed constant. The following sections detail the development of these scenarios and the survey questionnaire. An example of the questionnaire is contained in Appendix A.

1. GOODS EFFECT ATTRIBUTES

Previous studies of goods effects (Loewenstein 1987, Luckert & Adamowicz, 1993) suggest different goods may have distinct time preference rates. Forest areas yield many goods, each with the possibility of a separate time preference rate. By focusing the survey scenarios on two goods, timber and recreation, we hope to avoid any possible confounding consequence multiple goods effects may produce. As such, all scenarios have a timber component representing the total harvest of both hardwood and softwood (in cubic meters, m3) each year. As well, all scenarios have a recreation component representing the number of recreational user days[6] provided each year. To examine potential conflicts between timber and non-timber resources, the survey required a non-timber resource that is obtainable from both harvested and unharvested areas.

---

[5] One forest rotation represents the time from when a tree is cut to when its replacement may be re-cut.
[6] For this study, 'recreational user days' was defined as the number of occasions, including full and part days, that any individual used this forest area for recreation.

Recreational use was chosen because it may be effected by timber harvesting but is not necessarily inversely correlated with harvesting levels. Some types of recreation may increase with timber activity, while others may decline. By defining recreational user days to include all activities, the annual number of user days can be specified independently of timber harvest level. Another good, such as biodiversity, may be more directly affected by timber harvesting, and it would have been more difficult to justify separating time preference aspects of the two goods. To test for goods effects, survey responses will be analyzed to see whether individuals prefer similar discount rates for both timber and recreation or whether their choices suggest divergent discount rates.

2. UNCERTAINTY ATTRIBUTES

As discussed in Chapter II, forestry planning may be very uncertain, especially over a 100 year period. To reflect this, each year of all time lines are presented as a projected value within an upper and lower variance bound. (See the sample profile page in Appendix A for an illustration of variance bounds). The center value is considered the target, but the actual level for that year may fall anywhere within the range. To reflect different levels of possible variation, the survey uses two levels of variance bounds. The low level variance bound is projected 2.5% above and 2.5% below the time path to create a 5% interval. The high level variance bound is projected 5% above and 5% below the time path to create a 10% interval. Within a given scenario, both the timber harvest time path and the recreational usage time path are depicted with the same size variance bounds. The survey will test whether differences in variance bounds between scenarios affects individual choice behaviour. Using the same size variance bound for both goods reduces the number of attributes and therefore lowers the number of profiles required in the experimental design. This was an important consideration because the relatively small intended sample group.

3. ORDERING of GAINS and LOSSES ATTRIBUTES

In each scenario, the timber harvest level and the recreational usage level begin and end at their respective reference states. Between the first and last years, these time paths may vary significantly from one scenario to another. In the survey, each time path begins one of three ways; by increasing, by decreasing or by remaining constant. An increasing start results in a period of values above the reference state and hence a period of gains. A decreasing start results in a period of values below the reference state and hence a period of losses. If the time path remains constant, there is no gain or loss, but continues at the reference state for the 100 year period.

Because of the cyclical nature of forest growth, time paths do not increase or decrease indefinitely. To reflect this in each scenario, any period of gain is balanced by a period of loss. To remove a possible confounding influence on results, periods of gain and loss are depicted as being of equal duration in all scenarios at 50 years each. Gains in the first half of the time path are followed by losses in the second half, and vice versa. Thus, the starting direction determines the ordering of gains and losses in the scenario. The survey tests whether the ordering of gains and losses affects individual choice behaviour.

4. BASIC TIME PREFERENCE ATTRIBUTES

As outlined in Chapter II, the favored approaches for examining time preference are WTP and WTA measures. In this survey, an initial period of loss is assumed to be the WTP measure for a later period of gain. Conversely, an initial period of gain is assumed to be the WTA measure for a later period of loss. Time preference is represented by the internal rate of return (IRR) required to balance gains with losses to achieve a zero NPV for each time path. This study is interested in choice behaviour as influenced by time preference and so must use IRRs that allow for sustainability. Otherwise, respondents may simply choose the sustainable option over the non-sustainable option, with time preference not part of the decision. By designing all time path options in this study to be sustainable, it is hoped that sustainability concerns will not dictate respondent's decision.

Sustainable time path scenarios require very low implied discount rates due to the tree species in Alberta forests. Akerman (1994) and Wietzman (1994) provided justification for using low discount rates for environmentally sensitive goods. With this in mind, four IRR levels are used in the survey: -2%, 0%, 2% and 4%. Using these IRR levels, four numeric time paths are developed with values for each year of the 100 year scenarios (see Appendix B).

Each path begins with positive values for 50 periods with negative values in the last 50 periods, representing gains followed by losses. To examine the ordering of gains and losses, the surveys requires time paths with identical IRRs, but with opposite starting directions. The four original paths are multiplied by –1 to produce four additional time paths (see Appendix B). Multiplying all periods by a scalar does not affect the IRR.

Also, the 0% IRR stream is unchanged when multiplied by –1. The result is a total of seven distinct numeric time paths. The survey test whether the shape of these time paths and hence their underlying IRR affects individual choice behaviour.

5. SUMMARY of ATTRIBUTES

In each scenario, one of these seven time paths is used to represent the timber harvest level and one is used to represent recreational use. The timber time path has two attributes, its ordering of gains or losses and its implied IRR. Likewise, the recreational user day time path has these same two attributes. The ordering of gains or losses attribute can be one of two levels, increasing or decreasing. The implied IRR attribute can be one of four levels, -2%, 0%, 2% or 4%. The uncertainty attribute can be one of two levels, 5% or 10%. Each scenario combines a timber time path and a recreational usage time path, both reflecting a specific combination of these attribute levels. Table 3.1 gives a summary of the five attributes and their respective levels used in the survey design. Each scenario will be characterized by a combination of these attribute levels. By manipulating these levels, we may examine how these attributes affect individual time preference. The remainder of this chapter details how these scenarios are compiled into the survey questionnaires.

Table 3.1: Attributes and Levels of the Survey Design		
Attributes	Levels	Description
Timber Time Path Ordering of Gains and Losses	Level 1 Level 2	Losses precede gains, time path decreases initially. Gains precede losses, time path increases initially.
Timber Time Path Implicit IRR	Level 1 Level 2 Level 3 Level 4	-2% IRR, some movement away from the reference state. 0% IRR, no movement away from the reference state. 2% IRR, some movement away from the reference state. 4% IRR, large movement away from the reference state.
Recreation Time Path Ordering of Gains and Losses	Level 1 Level 2	Losses precede gains, time path decreases initially. Gains precede losses, time path increases initially.
Recreation Time Path Implicit IRR	Level 1 Level 2 Level 3 Level 4	-2% IRR, some movement away from the reference state. 0% IRR, no movement away from the reference state. 2% IRR, some movement away from the reference state. 4% IRR, large movement away from the reference state.
Uncertainty Variance Bounds	Level 1 Level 2	5% variance bound around projected time paths. 10% variance bound around projected time paths.

C. THE ROSE CREEK FOREST

To help respondents evaluate these scenarios, the survey was put into the context of an actual Alberta forest. The Rose Creek Education Forest is located approximately 5 kilometers west of Alder Flats, Alberta or 140 kilometers southwest of Edmonton. The forest covers an area of 19,338 hectares and is bounded on the east by the Rose Creek and on the north and west by the North Saskatchewan river. The topography includes flat to rolling terrain with steep banks around waterways. The Rose Creek Forest is home to many types of wildlife including numerous bird species, reptiles, amphibians, as well as small and large mammals.

The Rose Creek area is already being used for many different purposes. There has been extensive oil and gas exploration and production, especially in the Northern half of the forest. Two pipelines cross the area from the northwest to the southeast. Several small commercial and agricultural users operate within the Education Forest's boundaries. As well, the area contains several sites of historical interest related to pioneer timber harvesting, fur trading, and earlier aboriginal settlement. Today, a number of people use the Rose Creek Education Forest for recreational activities including camping, hunting, hiking, snowmobiling and cross-country skiing. Many of these recreationalists use a network of basic roads built for oil and gas exploration.

1. TIME PATH HARVEST SIMULATIONS

Placing the survey scenarios into the context of the Rose Creek Education Forest required a program to simulate the timber harvest levels of each time path. *Forest Muncher* is a harvest simulator developed by Beck & Beck (1996). The program requires an initial survey of the forest inventory. From that inventory, the forest is divided into a large number of stands of no fixed size, each of a common tree age, species, and soil productivity. Overstory and understory volumes are also estimated for each polygon. This information provides the program with a profile of the forest area which allows it to predict growth patterns.

Parameters selected by the user will determine how *Forest Muncher* will select the areas to be cut. *Forest Muncher* can operate at a maximum even-flow cut (MEC) level or harvest a specified volume for each year of the simulation. The program harvests enough full or part polygons to fulfill the chosen harvest volume. *Forest Muncher* is capable of running simulations much longer than the 100 year scenarios required for this study, but will stop if stock rupture (no timber available) is reached.

The first step in adapting the time path values in the survey scenarios to the Rose Creek Forest is to find the MEC level for a 100 year period. *Forest Muncher* uses an iterative search, testing different harvest levels until an even-flow maximum is reached. For the Rose Creek Forest, the MEC is calculated at 39,619m^3 per year which includes both hardwood and softwood volumes. While the questionnaire could be developed using any random number as the MEC, employing a harvest simulator based on real-world information provides added credibility to the hypothetical scenarios.

The MEC volume is considered to be the reference state and corresponds to the zero value in IRR time paths. Thus, the 0% IRR time path scenario has a harvest level of 39,619m^3 every year. Other time path values are scaled in relation to the MEC to become variable harvest levels. So that variations in harvest levels would be most noticeable, the scaling factor was selected as large as possible, but small enough to avoid stock rupture in any of the time paths. To do this, the values in each of the seven time paths were multiplied by a factor of 60, with the result added to the reference state level of 39,619m^3. This multiplication converted the time path into harvest levels that were relevant to the Rose Creek while still maintaining the implied IRR in each time path. The resulting variable harvesting volumes are given in Appendix B. These volumes were then used for year by year *Forest Muncher* simulations to produce harvesting simulations for each of the seven time paths to ensure stock rupture did not occur. Conducting these simulations gave the scenarios a credible claim of sustainability, if this was raised by respondents as a concern when the questionnaires were distributed.

It was also necessary to adapt the same seven time path values for recreational usage. Very little numerical data had been collected on recreational use levels within the Rose Creek Educational Forest. The only information available was a sign-in log at a cross-country skiing trailhead. Based on this data, a mean annual usage level was estimated at 500 user days per year. This became the reference state usage level corresponding to the zero value in the IRR streams. Thus, the 0% IRR time path has a value of 500 user days each year of the 100 year scenario. As above, a scaling factor was chosen to produce the most variation as possible without reaching zero recreational user days in any time path. Using the same procedure as for the timber harvest levels, the seven time path values were now multiplied by a factor of 0.75, with the result added to the reference state of 500 annual user days. This yielded the annual recreational usage levels for each of the seven time paths (available in Appendix B).

D. QUESTIONNAIRE DESIGN

This study employs a conjoint experiment, which rests on the idea that any choice alternative can be characterized by a set of attribute values (Louviere, Hensher & Adamowicz, 1994). To examine how the time path attributes represented in the scenarios affect individual decision making, a binary choice framework is used. Respondents are asked to select one of two alternate forest management scenarios, an indication of which scenario offers the higher utility to the individual. Each pair of scenarios is called a profile. By varying attribute levels over a series of profiles, the goal is to identify and quantify how the different attributes affect individual choice behaviour.

1. MAIN EFFECTS PLAN

Conducting the binary choice experiment requires a series of profiles where the two alternative scenarios have different attribute level combinations. As mentioned earlier, the starting direction attribute can be one of two levels, increasing or decreasing, for both the timber (2x) and the recreation (2x) time paths. The implied IRR attribute can be one of four levels, -2%, 0%, 2% or 4%, for both the timber (4x) and the recreation (4X) time paths. The uncertainty attribute can be one of two levels, 5% or 10%, for the whole scenario (2x). Thus, each scenario has a (2x2x4x4x2) factorial design. But because the two scenarios in each profile must be independent, the factorial design must be doubled to (2x2x4x4x2) x (2x2x4x4x2) (Adamowicz et al 1994). This results in a total of 16 384 possible profiles, far too many to collect observations on all.

Fortunately, if utility is assumed to be strictly additive with no interactions between attributes, only a 'main effects plan' is required. The sample of profiles necessary are those where main effects are orthogonal to one another, but unobserved interactions are exactly correlated with one or more main effects required (Louviere, Hensher & Adamowicz, 1994, p.37). Each attribute is considered a separate main effect with 1 less degrees of freedom than the number of levels for that attribute. One condition for the smallest main effects plan is that number of profiles exceed the sum of all degrees of freedom by 1. That would make the minimum number of profiles for this experiment (1+1+3+3+1) + (1+1+3+3+1) +1 = 19. A second condition is that the total number of profiles be a multiple of all attribute levels in the experiment. This study uses 2-level and 4-level attributes. 19 is a multiple of neither so the smallest main effects plan must be larger than 19 profiles. Rather than search for the smallest main effects plan manually, it can be produced automatically. *CONSURV* (1993) is a computer program that takes the entered attributes and levels, offers a choice of experimental designs, and checks the orthogonality of the selected plan. For this experiment, *CONSURV* (1993) offers a main effects plan with no interaction terms consisting of 64 profiles. The attribute levels for each of these profiles are listed in Appendix C.

2. GRAPHICAL PROFILE PRESENTATION

Rather than present each profile as four series of numbers covering 100 years, it was decided to represent each time path as a graph. Each profile contains a choice between two scenarios. These scenarios both consist of two graphs, a timber graph depicting the annual harvest level within the upper and lower variance bound, and a recreation graph depicting the annual number of recreational user days within its variance bounds. Displaying the entire time path as well as the variance bounds as a single picture allows respondent to view the entire 100 year time frame together. Relative changes over that period are then more apparent as compared to a series of numbers.

The two alternative scenarios that make up each profile are presented side by side on a single page. It was hoped that this would make harvest levels and recreational usage values easier to compare across alternate scenarios. A sample profile is given in Appendix A. For each profile, the respondent simply chooses which scenario they prefer, Scenario A on the left or Scenario B on the right.

3. BLOCKING SCENARIO SETS

A single respondent was unlikely to devote the time necessary to fill out all 64 profiles. Blocking the 64 profiles into eight sets limited the number of binary choice comparisons that a single person was asked to evaluate. To accomplish this, each profile was placed in one of two groups (Group 1 or 2) and assigned a letter (A, B, C, or D). The total of 64 profiles was then separated based on these attributes into 8 versions of the questionnaire (Group1A, Group 1B, ..., Group 2D). Respondents were randomly given one of these 8 versions, each of which contained 8 profiles. With the blocking attributes, *CONSURV* (1993) produced two profiles with identical attribute levels for both Scenarios A and B. Because of this, profiles #1 and #62 were replaced with profiles #37 and #59 respectively.

E. DEMOGRAPHIC QUESTIONS

The last section of the survey contains a series of demographic questions about the respondent. The number and type of questions to include is debatable. The list of questions must be short enough so that respondents do not lose interest. Also, some individuals are uncomfortable answering certain demographic questions, especially relating to household income. To accommodate this, the survey emphasizes that all questions are voluntary and that answers are anonymous and confidential.

The selection of demographic questions must also take the intended sample group into account. Selecting questions becomes a balance between ensuring enough variation between respondents to allow for regression analysis and enough commonality between respondents to be able to identify significant tendencies. Without variation, the similarities between respondents will make it difficult to find correlation between a particular demographic characteristic and a behavioral pattern. Without some commonality, limited observations of each type will hinder possible analysis. Any prior knowledge about the sample group will help in selecting questions to provide this balance between variation and similarity.

The survey contains eight demographic questions. The first four are personal characteristics hypothesized to affect individual time preference. Respondents are asked their age, sex, household income, and education. The final four demographic questions in the survey relate to the intended sample group. Respondents are asked to indicate their place of residence, their household size, and the number of days spent in an outdoor recreational activity during the previous year. The last question asks respondents what interest they represent on the committee. After the demographic questions, there is a large space for respondents to give comments about the survey and about forestry management in general if they so wish.

CHAPTER IV DATA

A. SAMPLE GROUP

The sample group for this survey consists of members of Public Advisory Committees (PACs) from Forest Management Agreements across Alberta. As part of the condition for holding an FMA, each company must prepare a Detailed Forest Management Plan. Guidelines for developing this plan highlight public involvement as an important component (Alberta Environmental Protection, Land and Forest Service, 1997). As one public involvement approach, many FMA holders maintain committees that meet on a regular basis to discuss issues within the FMA area and to allow public input into forestry operations decisions. These committees were chosen as the sample group because the questionnaire requires some knowledge of forestry management, which these committees possess. Members were accustomed to discussing forestry issues, and so it was also assumed they would be willing to devote the time necessary to complete the questionnaire.

Because of the limited number of PAC's in Alberta, none were used to pre-test the survey. Rather, the questionnaire was circulated to selected staff and students within the Department of Rural Economy. Several of these individuals had experience with surveys.

Due to geographical overlap of FMAs and small town population limitations, some PACs jointly represent several FMAs. Thus, from the sixteen FMAs in Alberta, twelve PACs were identified as potential participants for the survey. In November and December 1997, initial contact was made by telephone through the various forestry companies to locate each committee chairperson. A letter outlining the study and requesting permission to attend a committee meeting to administer the questionnaire was then sent to each chairperson who expressed interest in participating in the study. Of the twelve PACs, one chairperson was unreachable, one committee declined to participate, one committee was not yet established and one committee initially agreed to participate but was forced to cancel due to time constraints. Appointments were scheduled with the remaining eight PACs to attend one of their meetings. At these meetings, between January and March 1998, a presentation outlining the study and explaining the questionnaire was given. If time permitted, committee members completed and returned their questionnaire following the presentation. Otherwise, members were given a stamped, addressed envelope to return their questionnaire. Because of the significant distance to the High Level PAC, the survey was conducted by mail with a written explanation accompanying each questionnaire.

B. SUMMARY STASTISTICS

Among the PACs that agreed to participate in the study, survey response rates varied considerably from a low of 25% to a high of 90%. An explanation may be that some committees were occupied with more pressing matters and members were possibly not able to devote the necessary time to complete the questionnaire. Of the 105 questionnaires distributed, 63 were returned with 3 being rejected because not all profiles were completed. This left a usable sample of 60 questionnaires or a response rate of

57%.[7] A summary of profile by profile responses is given in Appendix D. Within the usable sample of 39 men and 21 women, respondents had an average age of 44 years, an average household income of $66, 333.33, and an average household size of 2.8 people. The average level of education completed among respondents was the category defined as "some university undergraduate". A list of summary statistics for numerical demographic variables is given in Table 4.1 along with the response rate for the survey.

Table 4.1: Survey Summary Statistics

PAC MEETINGS	SURVEYS OUT	SURVEYS RETURNED	USABLE SAMPLE	RESPONSE RATE
8	105	63	60	57%

GENDER	39 MEN	21 WOMEN
SELECTED DEMOGRPAHIC VARIABLES	MEAN	STANDARD DEVIATION
AGE	44yrs	11yrs
HOUSEHOLD INCOME	$66333.33	$24664.99
HIGHEST LEVEL OF EDUCATION	5* (some university)	1.5
HOUSEHOLD SIZE	2.8	1.3

*Respondents were asked to choose their appropriate category, which was then recorded as a qualitative variable.

C. DATA CODING

Data collected through the survey were formatted before the analysis could proceed. To avoid statistical problems that can result when using qualitative data, effects coding was used (Louviere, 1988). Effects coding compares parameter estimates with

---

[7] This response rate does not include the four PACs that were not surveyed. There is no reason to suspect these four PACs to be systematically different from those sampled and therefore no reason to consider the data collected biased.

the base attribute level method and allows coefficient estimates to be integrated as marginal utilities associated with a particular attribute level (Adamowicz *et al.*, 1994). Effects coding avoids 1,0 dummy variables which contrast parameter estimates with a constant. The models in this study do not use a constant because individuals are choosing between two fixed alternatives. Effects coding eliminates one attribute level and creates a separate variable for each of the remaining levels. For the 2-level attributes, effects coding eliminates one attribute level, designated the base level, to create a single data column. In that column, the eliminated attribute level is coded with a –1 and the remaining attribute level is coded with a 1. For the 4-level attributes, a base level is eliminated and the three remaining attribute levels are coded in separate data columns. For each column, a 1 is coded if that attribute level is present in the profile, a 0 if it is not present, or a –1 if the base attribute is present. Co-efficient estimates for this base attribute level equal the negative sum of the estimates for the other three attribute levels.

Demographic variables were coded in three ways depending on the type of response. Where the respondent was asked to choose a range (eg. age and household income), the variable was coded at the mid-point of the selected range. Where the respondent supplied a value (eg. household size), that number was used. Other variables (eg. place of residence) were coded on a qualitative rather than quantitative scale.

Survey information was also entered without effects coding to create a second version of the data set. In order to test interactions between demographic variables and scenario attributes rather than specific attribute levels, these attributes needed to be entered as a single variables. Therefore, the internal rate of return (IRR) for each scenario was entered as its numerical IRR value in a single column. Thus, for example, a particular demographic variable could be interacted with the timber IRR variable, rather than with the 2% attribute level. It was hoped that this type of interaction would better identify a possible link between demographic variables and scenario attributes, rather than with a specific attribute level.

CHAPTER V ANALYSIS

A. MODEL DEVELOPMENT

The data collected through the questionnaire were analyzed using the binary choice model developed in Chapter III. The indirect utility function is assumed to be linear and of the form:

(3.1) $U_{in} = V_{in} + \varepsilon_{in},$

The deterministic component was separated into two elements:

(3.2) $V_{in}, = \beta' z_{in} + \gamma_i' S_n.$

where z_{in} is a vector of attributes specific to each scenario I, S_n is a vector of characteristics specific to each individual n, collected through the demographic questions, and β and γ_i are parameters to be estimated. The random components (ε_{in}'s) were assumed to be Weibull Type I extreme value distributed, making the difference between ε_{in} and ε_{jn} logistically distributed.

Using these assumptions and the framework outlined in Chapter III, two models were estimated: MODEL 1 where the internal rate of return (IRR) attribute was effects coded, and MODEL 2 where the IRR attribute is a single variable.[8] Interaction trials involving the demographic variables were conducted for both models. Interactions were necessary because a respondent's demographic information does not change between

[8] A preliminary specification included a constant which was shown to be insignificant and was subsequently dropped. This indicates that attributes are sufficiently randomized between the A and B sides of the profiles and that neither side is more likely to be chosen.

scenario pairs and therefore cancels out during model estimation, as explained in Chapter III.

B. VARIABLE DEFINITIONS

The variables used in this analysis relate to the five time preference aspects that this study was design to investigate: the goods effect, uncertainty, the ordering of gains and losses, basic time preference, and socio-economic characteristics. Table 5.1 provides a summary of the issues being examined and the corresponding variables. Note there is no specific variable for the goods effect. Rather, two goods are used in the study resulting in two types of variables, those for timber and those for recreation. By comparing variable coefficients between types, the goods effect may be examined.

Table 5.1: Summary of Issues and Variables

ISSUE	LEVELS	VARIABLE(S)	POSSIBLE VALUES
Uncertainty	2	(5% Variance Bound)	Dropped for Effects Coding
		VARBND	+1 or –1
Ordering of Gains and Losses	2 (Timber)	(Timber Loss First)	Dropped for Effects Coding
		TIMBGAIN	+1 or –1
	2 (Recreation)	(Rec. Loss First)	Dropped for Effects Coding
		RECGAIN	+1 or –1
Basic Time Preference	4 (Timber)	(TIMBIRR-2%)	Dropped for Effects Coding
		TIMBIRR0%	+1, 0, or –1
		TIMBIRR2%	+1, 0, or –1
		TIMBIRR4%	+1, 0, or –1
	4 (Recreation)	(RECIRR-2%)	Dropped for Effects Coding
		RECIRR0%	+1, 0, or –1
		RECIRR2%	+1, 0, or –1
		RECIRR4%	+1, 0, or –1

As discussed in Chapter III, one level for each issue was dropped during effects coding. All of these variables are described further in the following section, along with the demographic variables to be used in the analysis.

1. UNCERTAINTY

After the goods effect, uncertainty is the second issue being investigated. A two-level attribute represents the level of uncertainty in a scenario by measuring the size of the variance bounds around both timber recreation time paths. Uncertainty is represented by a single variable, as shown in Table 5.2, as one level is dropped for effects coding. VARBND takes a value of 1 if the scenario has a 10% variance bound around its time paths, and a value of -1 if the scenario has a 5% variance bound.

Table 5.2: Uncertainty Variable		
VARIABLE	DEFINITION	EXPECTED SIGN
VARBND	If variance bounds = 10%, then VARBND = +1. If variance bounds = 5%, then VARBND = -1.	-

According to decision theory, individuals may follow a number of decision-making rules. Information about the future may lower the level of uncertainty, reducing the number of factors the decision-maker must consider. As such, most decision-makers tend to favour less uncertainty to more (Fight & Bell, 1977). If a lower uncertainty level increases the utility a scenario yields to a respondent and thus increases the likelihood of that scenario being chosen, VARBND will have a negative coefficient estimate. A negative coefficient would interact with the negative effects coding for a 5% variance bound, producing a positive effect on utility. As such, VARBND is predicted to have a negative coefficient.

2. ORDERING of GAINS and LOSSES

The ordering of gains and losses is the third time preference characteristic being investigated. Because two different goods are involved, two separate variables are necessary investigating the ordering of gains and losses, one for timber and one for recreation, as shown in Table 5.3. TIMBGAIN represents the order of gains and losses for the timber time path. It has a value of 1 if gains precede losses and a value of -1 if losses precede gains. RECGAIN represents the order of gains and losses for the timber time path. It has a value of 1 if gains precede losses and a value of -1 if losses precede gains.

Table 5.3: Ordering of Gain and Loss Variables

VARIABLE	DEFINITION	EXPECTED SIGN
TIMBGAIN	If timber gains precede losses, TIMBGAIN = +1. If timber losses precede gains, TIMBGAIN = -1.	+
RECGAIN	If recreation gains precede losses, RECGAIN = +1. If recreation losses precede gains, RECGAIN = -1.	+

Prior research on personal time preference has shown individuals discount future gains at a higher rate than future losses (Knetsch, 1997). If this same effect holds in this experiment, a scenario where gains precede losses should, ceteris paribus, give an individual higher utility than a scenario where losses precede gains. Consider the following comparison, where t_0 represents the present:

Scenario A: (Loss =-10)t_0 + (Gain = 10)t_5 vs Scenario B: (Gain =10)t_0 +(Loss =-10)t_5

If future gains are discounted at a higher rate than future losses, eg.10% instead of 5%:

Scenario A:	$-10 + 10(1.10)^{-5}$	vs Scenario B:	$10 - 10(1.05)^{-5}$
Present Value:	-10 + 6.21	vs	10 - 7.84
Result:	-3.79	vs	2.16

The scenario with gains ahead of losses yields a higher result, and so should be more attractive. A positive coefficient estimate for TIMBGAIN or RECGAIN will indicate that respondents prefer gains to precede losses.

3. BASIC TIME PREFERENCE

The fourth aspect explored by this study is basic time preference. An internal rate of return attribute in the scenario time paths is used to incorporate basic time preference. Timber and recreation have independent IRR attribute levels, generating eight IRR variables. For both timber and recreation, the –2% attribute level was dropped during effects coding and therefore will not appear in the model.[9] To represent the IRR in the scenario time path the three variables take on one of three possible values: +1,-1 or 0. For example, if the timber time path reflects a 0% IRR, TIMBIRR0% will take a value of +1. If the timber time path reflects a –2% IRR, TIMBIRR0% will take a value of –1. With an IRR of +2% or +4%, TIMBIRR0% will take a value of 0. The same holds for the other timber and recreation variables, as described in Table 5.4, so that only one timber IRR and one recreation IRR will be coded as being present in a scenario.

Table 5.4: Effects Coded IRR Variables

TIMBER VARIABLES	DEFINITION	EXPECTED SIGN
TIMBIRR-2%	Base attribute level dropped during effects coding.	N/A
TIMBIRR0%	If the timber IRR = 0%, then TIMBIRR0% = +1. If the timber IRR = -2%, then TIMBIRR0% = -1. Otherwise, TIMBIRR0% = 0.	+
TIMBIRR2%	If the timber IRR = 0%, then TIMBIRR2% = +1. If the timber IRR = -2%, then TIMBIRR2% = -1. Otherwise, TIMBIRR2% = 0.	+
TIMBIRR4%	If the timber IRR = 0%, then TIMBIRR4% = +1. If the timber IRR = -2%, then TIMBIRR4%= -1. Otherwise, TIMBIRR4% = 0.	+

[9] It is possible to recover a coefficient estimate for these variables by taking the negative sum of the remaining three attribute levels for the two goods.

RECREATION VARIABLES	DEFINITION	EXPECTED SIGN
RECIRR-2%	Base attribute level dropped for effects coding.	N/A
RECIRR0%	If the recreation IRR = 0%, then RECIRR0% = +1. If the recreation IRR = -2%, then RECIRR0% = -1. Otherwise, RECIRR0% = 0.	+
RECIRR2%	If the recreation IRR = 0%, then RECIRR2% = +1. If the recreation IRR = -2%, then RECIRR2% = -1. Otherwise, RECIRR2% = 0.	+
RECIRR4%	If the recreation IRR = 0%, then RECIRR4% = +1. If the recreation IRR = -2%, then RECIRR4% = -1. Otherwise, RECIRR4% = 0.	+

Previous experiments have collected evidence of positive discount rates in many contexts (Benzion *et al*, 1989; Pope & Perry, 1989; Lumley, 1997). In this study, let us assume some level of positive time preference, implying individuals would prefer to receive both timber and recreation benefits sooner rather than later. As such, respondents are expected to favour the IRR attribute levels over the –2% base level, especially 2% and 4%. Because of effects coding, all variables must be interpreted in relation to the base level that was dropped from the model. Thus, positive coefficient estimates are predicted for the three attribute levels above the base. Predicting a relationship in magnitude between the three coefficients would require predicting whether 0%, 2%, or 4% and above is the most likely positive rate of time preference. Little evidence was found to make such a detailed forecast, so the prediction was limited to positive coefficient estimates for the 0%, 2% and 4% attribute levels.

If a goods effect is present, individuals could have distinct time preferences for the two goods, reflected in unequal coefficient estimates for each IRR level. Yet without any previous study of these two particular goods, there is no evidence for predicting coefficients of one good higher than the other.

4. DEMOGRAPHIC VARIABLES

When completing their questionnaires, respondents were asked to supply some basic demographic information. From this, six demographic variables were selected for analysis. Three of these (AGE, INC and HHOLD) were numerical, using numbers supplied by the respondent. For AGE and INC, respondents checked their appropriate age and household income from an increasing series of intervals. Responses were coded at the midpoint of the selected interval. For HHOLD, respondents were asked to give the number of individuals living in their household, with the given number entered as the HHOLD variable. Two variables (RESD and EDUC) applied categories defined by the researcher. The RESD variable described the level of urbanization where the respondent lives. This variable was coded on a scale of 0 to 7, representing progressively larger population centers from a farm to a city larger than 100,000 people. The EDUC variable described the education level of the respondent. This variable was coded on a scale of 0 to 8, representing progressively higher levels of education from no schooling to a postgraduate university degree. The sixth demographic variable (GEND) was a 0,1 dummy variable for the gender of the respondent, 0 for men and 1 for women. Note that a dummy variable differs from the effects coded variables used for the attribute levels. Table 5.5 gives a summary of the six demographic variables.

These demographic variables were used in interaction trials for both MODEL 1 and MODEL 2 where they are interacted with all of the attribute levels from the two models. Because each demographic variable will be interacted with many attributes, there is no expected sign predicted. The same demographic variable may have a positive relationship with one attribute and a negative relationship with another.

Table 5.5: Demographic Variables		
VARIABLE	DEFINITION	EXPECTED
AGE	Quantitative variable for the age of the respondent, coded at the midpoint of the selected interval.	N/A
GEND	If respondent is female, then GEND = 1. If respondent is male, then GEND = 0.	N/A
INC	Quantitative variable for the household income of the respondent, coded at the midpoint of the selected range.	N/A
RESD	Refers to where the respondent resides, coded on a scale from 0 (on a farm) to 7 (city over 100,000).	N/A
EDUC	Refers to the respondent's level of education, coded on a scale from 0 (grade school) to 8 (postgraduate university degree).	N/A
HHOLD	Refers to the number of people in the respondent's household, coded as the number given by the respondent.	N/A

5. NON-EFFECTS CODED DATA

As described earlier, the survey data were also analyzed without effects coding. In this approach, the four IRR attribute levels for both timber and recreation are collapsed into single variables, as identified in Table 5.6. Again based on an assumption of positive time preference, both TIMBIRR and RECIRR are predicted to yield positive coefficient estimates. It is expected that IRR values of either 2% or 4% will appear more attractive to respondents, increasing the likelihood of a scenario being chosen.

Table 5.6: Non-Effects Coded IRR Variables		
VARIABLE	DEFINITION	EXPECTED SIGN
TIMBIRR	Refers to the IRR reflected in the scenario's timber time path, coded as the appropriate IRR value (-2%, 0%, 2%, or 4%).	+
RECIRR	Refers to the IRR reflected in the scenario's recreation time path, coded as the appropriate IRR value (-2%, 0%, 2%, or 4%).	+

C. MODEL ESTIMATION

Using LIMDEP 7.0 (Greene, 1995), maximum likelihood parameter estimates of β's and γ_I's were done. With the NLOGIT command, observations were read as pairs, one line indicating the attribute levels for Scenario A and one line indicating the attribute levels for Scenario B from each profile. The dependent variable recorded which scenario of the pair was chosen by the respondent, using 1 if the scenario was chosen and 0 if it was not. The size and direction of the estimated coefficients describe their effect on individual utility, depending on the attributes a scenario contains, which then affects the likelihood of that scenario being chosen.

1. MODEL 1

A common indicator used to judge the performance of binary choice models is the percentage of correct responses the model is able to predict. MODEL 1 was able to predict 297 of 480 responses correctly, for a percentage of 61.875%. This is an acceptable success rate, not outstanding, but may have been hindered by the limited sample size used in the experiment and lower than expected response rate. Several summary statistics for MODEL 1 are given in Table 5.7. MODEL 1 displayed a McFadden R^2 of 0.190 and a ρ^2 of 0.191. For both statistics, values in the range of 0.3

would have been desirable, but values in the 0.19 range are respectable. As a tool for explaining individual choice behaviour, MODEL 1 is effective with most attributes significant at the 5% level, and others significant at the 10% level. Only RECIRR-2% was shown not to be significant at the 10% level.

Table 5.7: MODEL 1 - Binomial Logit Estimates					
Log-Likelihood					-269.049
Restricted Log-L (β's = 0)					-332.711
Chi-Squared (χ^2)					84.970
Significance Level					0.000
McFadden R^2					0.190
ρ^2					0.191
Correct Predictions					61.875%
VARIABLE	COEFFICIENT	PRED.	STD. ERROR	t – RATIO	PROB $\lvert t \rvert < x$
TMBGAIN	-0.347	+	0.081	-4.289	0.000
TMBIRR-2%	0.232	-	0.126	1.838	0.066
TMBIRR0%	0.761	-	0.132	5.774	0.000
TMBIRR2%	0.220	+	0.122	1.806	0.071
TMBIRR4%	-1.212	+	0.150	-8.073	0.000
RECGAIN	-0.144	+	0.072	-2.010	0.044
RECIRR-2%	-0.163	-	0.126	-1.294	0.196
RECIRR0%	0.405	-	0.131	3.082	0.002
RECIRR2%	0.313	+	0.122	2.561	0.010
RECIRR4%	-0.556	+	0.134	-4.140	0.000
VARBND	-0.134	-	0.073	-1.824	0.068

McFadden $R^2 = 1 - [L(\beta) / L(\text{constants only})$

$\rho^2 = 1 - [L(\beta) / L(\text{no coefficients})$

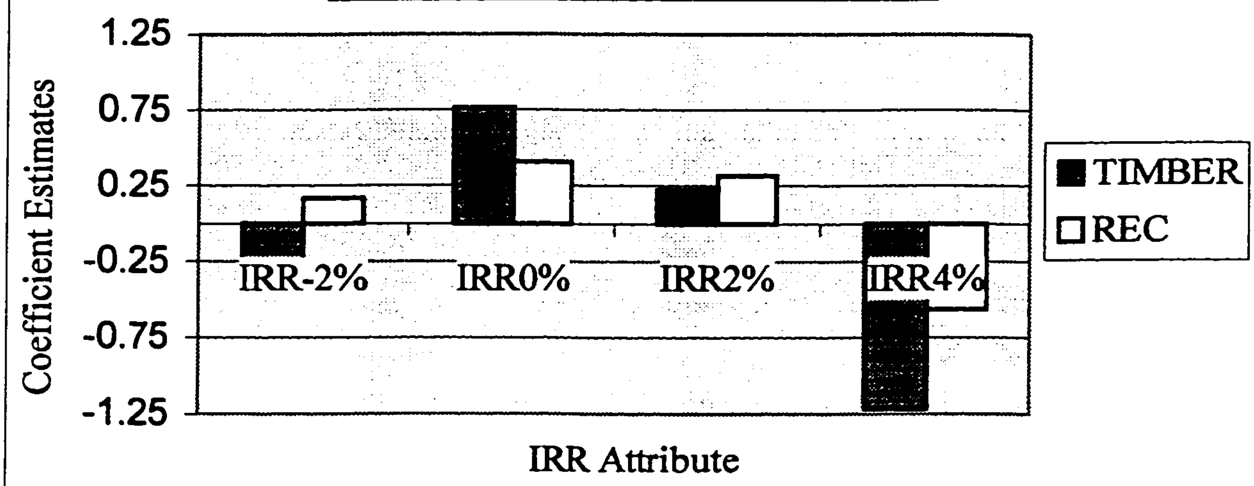
The first variables from Table 5.7 to be discussed are those concerning the ordering of gains and losses, TMBGAIN and RECGAIN. The base level for both goods was coded as 'losses ahead of gains'. TMBGAIN and RECGAIN displayed negative coefficients, the opposite of what was expected. This indicates that an initial gain in either time path decreases the probability of an individual choosing that scenario. The negative coefficients on both of these variables may result because initial gains are balanced by losses in the second half of the time path. Gain or loss movements away from the reference state in the second half of any time path must be much larger to balance movements in the first half because later values are discounted for more periods. Thus, ordering gains ahead of losses, losses appear much larger in the scenario time path so that they may balance earlier gains in present value terms. Respondents appear to choose away from scenarios with large losses in the last half of the time path, toward scenarios where losses precede gains.

This result does not agree with Knetsch (1997) which was used to predict a preference for gains ahead of losses. Other factors in this study may have confounded the effect of any discount rate applied to gains and losses. Respondents may have preferred losses ahead of gains, not because of different discount rates applied to gains and losses, but because of how future losses appear in the survey scenarios. Because future losses follow present gains, future timber harvest or recreational usage levels appear to be declining. Individuals may view such a decrease as symptomatic of environmental problems. Thus by comparison, when losses precede gains, future conditions appear to be improving even though all values are set at the beginning of the time path to reflect a specific IRR. It may be that individuals are perceiving variations in harvest levels as trends in environmental quality. This may confound their choice process, giving the appearance of preferring gains ahead of losses when in fact this may not reflect their true preference.

An alternate explanation for the preference of losses ahead of gains may be found in Loewenstein's (1987) work on anticipation and the value of delayed consumption. Loewenstein proposes that individuals prefer a negative outcome sooner rather than later. As such, the negative occurrence is over with quickly and the dread of its approach is not drawn out over a long period and is not adversely affecting utility in that time. Also, postponing a positive event allows for a period of anticipation which itself may be a source of utility.

The internal rate of return attributes are the second determinant in the shape of a scenario's time paths. Results from MODEL 1 show that time path IRR variables strongly influence individual choice behaviour. Previous examples of discounting research has shown that positive time preference is a reasonable expectation (Olson & Bailey, 1981). Based on this assumption, the coefficients for the three IRR variables were predicted to be positive, with the two positive IRR attribute levels, 2% and 4%, most preferred over the base level of –2%. MODEL 1 results contradict this expectation. While the 2% attribute level was slightly preferred to the –2% base level, the 4% level was highly unpopular with the 0% attribute level most attractive to respondents. Coefficient estimates for the timber time path IRR variables range from a high of 0.761 for TIMBIRR0%, to a low of –1.213 for TIMBIRR4%. The IRR coefficients for the recreation time paths follow a similar pattern, but with a smaller range from 0.405 for RECIRR0% to –0.556 for RECIRR4%. These coefficient estimates are graphed in Figure 5.1, which depicts a very non-linear relationship among the estimated coefficients. (This non-linearity was examined further in MODEL 2.)

Figure 5.1: Estimated IRR Coefficients



The coefficients estimated for the IRR variables indicate that the closer a time path's IRR is to 0%, the more likely it is respondents will prefer that scenario. Remember that gains and losses are gauged in relation to a reference state, the time path's starting value. These results suggest individuals prefer flatter time paths that deviate less from the reference state. In evidence, respondents often sacrificed gains in order to minimize losses by selecting time paths with little fluctuation. There is support for very low time preference rates, especially when natural resources are involved. Luckert & Adamowicz (1993) found that individuals displayed lower rates of time preference for a hypothetical income stream derived from a natural resource than for a stream derived from a portfolio of market assets. A low rate of time preference may be linked to concerns for intergenerational equity. Flat time paths, like those reflecting a 0% IRR, distribute both timber harvest and recreational user days most evenly through the duration of the scenario.

One issue which is examined without a separate variable is the goods effect, which allows time preference aspects to differ across goods. Figure 5.1 illustrates the difference between timber and recreation IRR coefficient estimates. When compared to the recreation coefficients, the timber time path coefficients display a larger positive value at 0% and a larger negative value a 4%. This suggests that the IRR reflected in the timber time path has a stronger influence on the scenario choice decision than the IRR in the recreation time path. The magnitude of the TIMBIRR4% coefficient, the largest in MODEL 1 at –1.213, indicates that respondents are strongly averse to timber time paths containing a 4% IRR. That individuals chose away from 4% IRR time paths, which deviate the most from the reference state, towards even-flow timber harvest patterns and balanced recreational usage levels.

In a formal test of the goods effect, coefficients from the four IRR attribute levels were compared for the two goods. Using a joint Wald test, three linear restrictions:

(5.1) β(TIMBIRR0%)-β(RECIRR0%)=0,
(5.2) β(TIMBIRR2%)-β(RECIRR2%)=0, and
(5.3) β(TIMBIRR4%)-β(RECIRR4%)=0

were used to see if there was a significant difference between the two sets of IRR attributes, one for timber and one for recreation. The Wald test produced a χ^2 statistic of 16.25 with a significance level of 0.001, thus rejecting the null hypothesis of no difference between the two sets of coefficients. This result supports the goods effect, that two different goods may have different discounting characteristics.

The fourth aspect of time preference this survey was designed to examine was how the level of uncertainty in a scenario affects individual choice behaviour. The coefficient for the VARBND attribute was negative, as expected. This indicates the presence of the larger 10% uncertainty bounds decreased utility which lead respondents to prefer scenarios with 5% variance bounds. The VARBND coefficient was significant at a 10% level, but small in magnitude at –0.134. These results suggests that uncertainty does play a role in an individual's decision process when choosing a preferred scenario, albeit a small one.

2. DEMOGRAPHIC TRIALS

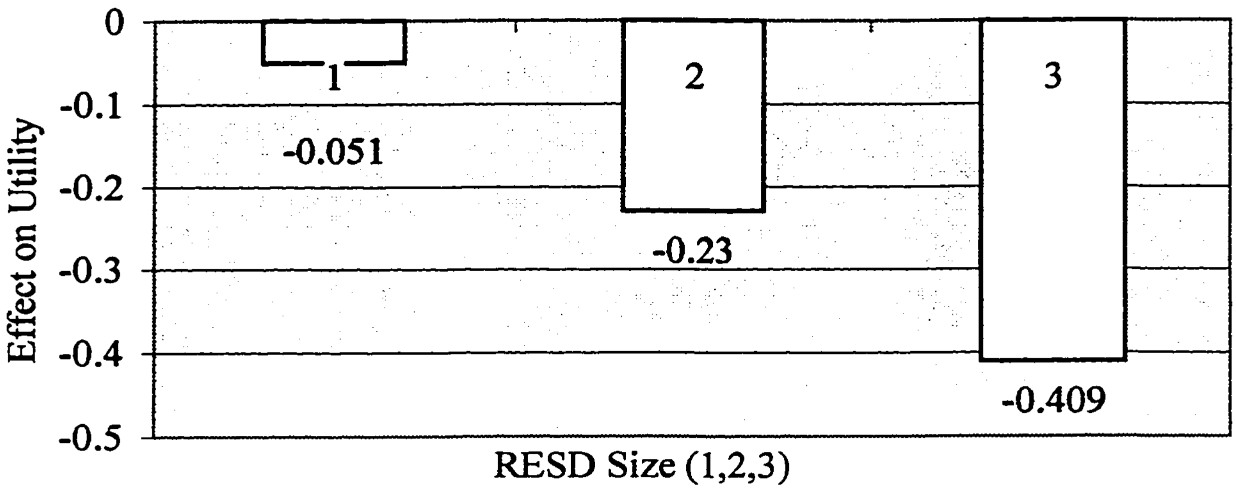
To examine the effect demographic characteristics have on an individual's choice of scenario, interaction terms were necessary because demographic information does not change between scenarios. An individual's demographic characteristics remain identical for both A and B scenarios. By interacting demographic variables with attribute levels that do vary across scenarios, it may be possible to establish a relationship between individual characteristics and scenario preference. To explore this relationship, a series of six trials were run. In each trial, a single demographic variable was interacted with all attribute level variables from MODEL 1. Across these six trials, all six demographic variables produced at least one interaction coefficient that was significant at the 10% level. However, to test whether a demographic variable significantly affected choice behaviour, a joint test of each trial's interaction terms was performed. Table 5.8 summarizes the results of the interaction trials. Of the six trials, only RESD and HHOLD passed the joint test with a significant Wald statistic.

Table 5.8: MODEL 1 – Demographic Interactions						
Demographic Variable	McFadden R^2	Joint Wald Test χ^2	Sig. Level	Significant Interaction Terms	Est. Coef.	Sig. Level
AGE	0.203	7.73	0.561	AGE & RECGAIN	-0.013	0.053
GEND	0.211	12.62	0.180	GEND & RECIRR2%	0.723	0.011
INC	0.201	7.34	0.602	INC & VARBND	0.006	0.065
RESD	0.222	19.47	0.022	RESD & TIMBGAIN	-0.179	0.000
EDUC	0.210	12.09	0.208	EDUC & RECIRR4%	0.273	0.011
HHOLD	0.216	16.54	0.056	HHOLD & RECGAIN	0.118	0.037
				HHOLD&TIMBIRR0%	-0.326	0.002
				HHOLD&TIMBIRR4%	0.305	0.008

Examining the significant interaction terms in the two trials that passed the joint Wald test offers information on the relationship between demographic characteristics and choice behaviour. In the interaction trial using the RESD demographic variable, the coefficient estimate for the TIMBGAIN term was estimated at 0.128 and the coefficient estimate for the interaction term TMBGAIN*RESD was estimated at -0.179. Together, these terms have a cumulative effect on an individual's utility. The RESD term describes the level of urbanization in the area where the respondent resides, with categories increasing from farm to small town to city.[10] As the RESD variable moves to a higher category, the interaction term will become larger and more negative, as illustrated in Figure 5.2. This decreases utility and thus decreases the probability of an individual preferring a scenario where TIMBGAIN equals 1.

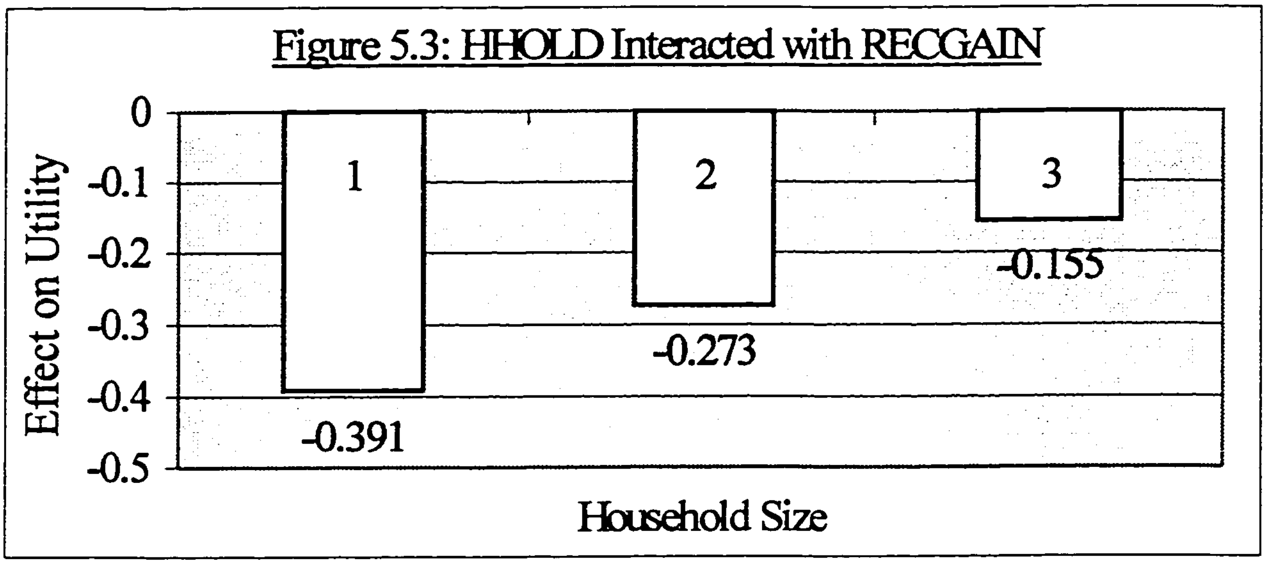
[10] Technically, because RESD is a qualitative variable rather than a cardinal sequence of values, a separate dummy variable could have been used for each category. However, the number of separate variables would have been impractical and the categorical scale can be accepted as a sufficient approximation.

Figure 5.2: RESD Interacted with TIMBGAIN



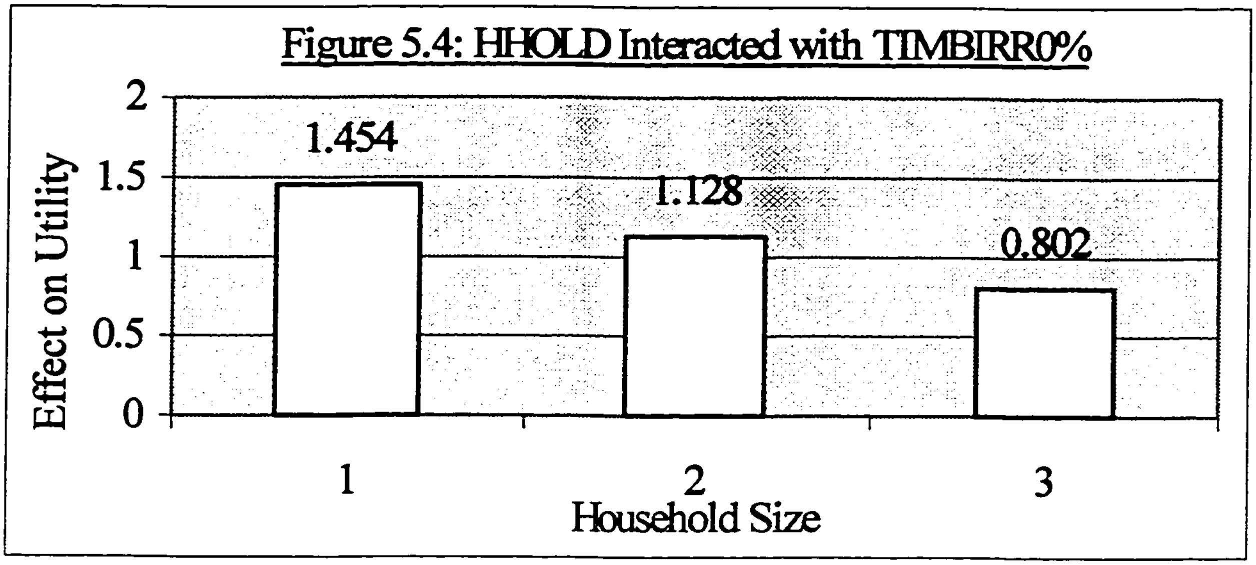
TMBGAIN will equal +1 when gains precede losses in a scenario. Therefore, when gains precede losses and as the size of a respondent's place of residence moves to a higher category, the interaction produces an increasingly larger negative effect on utility. This suggests that larger the urban center an individual comes from, the less likely they are to prefer a scenario where gains precede losses.

In the interaction trial using the HHOLD demographic variable, three interaction coefficients were estimated to be significant at a 10% level, TIMBIRR0%*HHOLD TIMBIRR4%*HHOLD, and RECGAIN*HHOLD. A scenario can not contain both TIMBIRR0% and TIMBIRR4% so these interactions must be considered separately. Figure 5.3 illustrates the interaction between HHOLD and RECGAIN and its effect on individual utility.

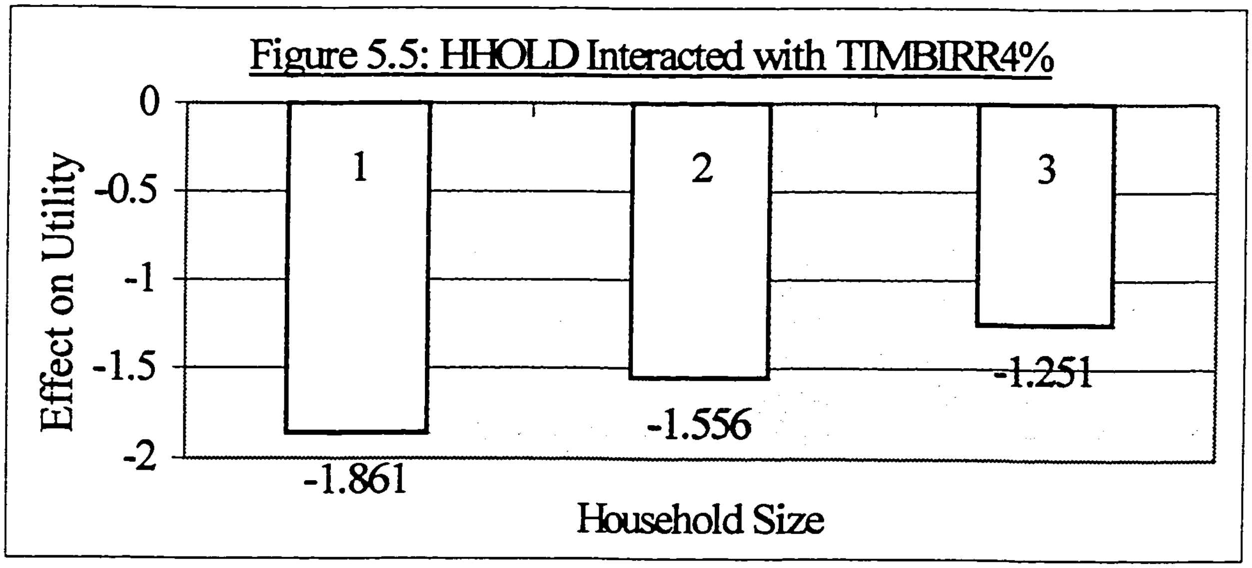


RECGAIN equals +1 in scenarios where gains precede losses. As household size increases, the interaction produces less of a negative effect on utility and will eventually become positive if household size is large enough. Thus, to respondents with small households, a recreation time path where gains precede losses reduces the utility of that scenario. Yet as household size increases, this aspect of the scenario becomes less of a deterrent to selection until the point when larger households will prefer for gains to precede losses.

Figure 5.4 illustrates the interaction between household size and the timber time path when it contains a 0% IRR. TIMBIRR0% equals 1 only for flat, even-flow timber time paths. As household size increases, the positive influence on utility of flat timber time paths decreases. Thus, as household size increases, even-flow timber time paths do less to increase the probability of a scenario being chosen.



Now compare the 0%IRR interaction above with Figure 5.5 where HHOLD is interacted with a 4% IRR timber path.



TIMBIRR4% equals 1 only in timber time paths with large fluctuations away from the reference state. As household size increases, the interaction produces less of a negative effect on utility. Thus, as household size increases, large fluctuations in the timber time path have less of a negative impact on the probability of scenario being chosen. The interaction effects of TIMBIRR4% and that of TIMBIRR0% support one another. The larger a respondent's household size, the less likely they are to prefer a scenario with a flat timber time path and the more likely they are to prefer a scenario with a fluctuating timber time path.

The interaction terms for household income did not pass their joint Wald tests. In previous research, an individual's income level has been shown to have a significant impact on their personal rate of time preference (ie: Hausman, 1979). However, most studies involved the discounting of assets belonging to the individual, either real or hypothetical. This experiment involves an Alberta forest area, presented as a public resource. Because respondents were evaluating an asset they did not own directly, their household income level may not have been as significant to their intertemporal decision making process. This may have eliminated the income effects often associated with studies of individual time preference.

3. MODEL 2

In MODEL 2, the IRR attributes reflected in the time paths of each scenario are no longer effects coded as in MODEL 1, but now coded as a single numerical variable. As a single variable, the IRR attribute may be squared to examine the possible non-linear relationship noticed in MODEL 1. The results from MODEL 2 were very similar to those from MODEL 1. As summarized in Table 5.9, MODEL 2 displayed a slightly higher log-likelihood function and an identical correct prediction percentage at 61.875%. All variables were significant at a 10% level, except TIMBIRR which was highly insignificant.

Table 5.9: MODEL 2 - Binomial Logit Estimates					
Log-Likelihood					-269.113
Restricted Log-L (β's = 0)					-332.711
Chi-Squared (χ^2)					84.76
Significance Level					0.000
McFadden R^2					0.190
ρ^2					0.191
Correct Predictions					61.875%
VARIABLE	COEFFICIENT	PRED.	STD. ERROR	t – RATIO	PROB $\|t\| < x$
TIMBGAIN	-0.347	+	0.081	-4.287	0.000
TIMBIRR	0.0004	+	0.048	0.009	0.993
TIMBSQ	-0.122	+	0.020	-6.215	0.000
RECGAIN	-0.145	+	0.072	-2.019	0.043
RECIRR	0.117	+	0.049	2.384	0.017
RECSQ	-0.090	+	0.020	-4.570	0.000
VARBND	-0.134	-	0.073	-1.837	0.066

McFadden R^2 = 1- [L(β) / L(constants only)
ρ^2 = 1- [L(β) / L(no coeffients)

TIMBSQ and RECSQ represent the square of TIMBIRR and RECIRR. That both of these squared variables were highly significant implies there is a non-linear relationship between the four IRR attribute levels. Yet, MODEL 2 coefficient estimates were so similar to those of MODEL 1 (TIMBGAIN, RECGAIN and VARBND had almost identical estimates) it was decided that MODEL 1 was already capturing the non-linear aspects of the IRR variables. The same inferences may be drawn from MODEL 2 to support the findings from MODEL 1. Both models showed that respondents were more likely to prefer scenarios where time paths were flatter rather than fluctuating and more likely to choose scenarios where losses preceded gains.

The goods effect was tested in MODEL 2, using a Wald test with two linear restrictions:

(5.4) β(TIMBIRR)- β(RECIRR)=0 and
(5.5) β(TIMBSQ)- β(RECSQ)=0

These restrictions produced a Wald test statistic of 16.18 and a significance level of 0.0003. Thus, the null hypothesis that both goods had equal coefficient estimates was rejected. This supports the existence of a goods effect, allowing for separate time preference rates for timber and recreation.

With MODEL 2, demographic variables were again interacted in separate trials. It was hoped that a single IRR variable would allow a better interaction with demographic variables. Results from the six trials, one for each demographic variable, are given in Table 5.10. In the six trials, only the RESD interaction and the HHOLD interaction passed a joint Wald test at a 10% significance level, the same two variables as in MODEL 1. Inferences drawn from these interactions also mirrored those of the earlier trials. As a respondent's population center increases in size, the more likely they are to choose a scenario where timber losses precede gains. Also, as a respondent's household size increases, the more likely they are to choose a higher timber time path IRR.

Table 5.10: MODEL 2 – Demographic Interactions

Demographic Variable	McFadden R^2	Joint Wald Test χ^2	Sig. Level	Significant Interaction Terms	Est. Coef.	Sig. Level
AGE	0.199	4.96	0.664	AGE & RECGAIN	-0.013	0.059
GEND	0.204	7.98	0.334	GEND & RECIRR	0.255	0.025
INC	0.202	7.00	0.429	INC & VARBND	0.006	0.066
RESD*	0.223	19.35	0.007	RESD & TIMBGAIN	-0.178	0.000
EDUC	0.205	8.51	0.290	None	-	-
HHOLD*	0.214	14.59	0.042	HHOLD & TIMBSQ HHOLD&RECGAIN	0.043 0.120	0.005 0.032

In the end, it was decided not to replace MODEL 1 with MODEL 2. There was no advantage to using a single IRR variable and there may have been some disadvantages. The separate IRR attribute levels of MODEL 1 better illustrated individual choice behaviour. The separate IRR variables of MODEL 1 displayed how a specific IRR level affected individual utility, from which the following conclusion was drawn. Respondents' utility was most increased by low IRR values and decreased by high IRR values. The single IRR variable of MODEL 2 showed only the effect that increasing the IRR in a scenario lowered the utility the scenario provided.

It was also decided not to re-specify MODEL 1 to include the demographic interaction terms. The interaction terms lowered the predictive success and the diagnostic statistics of MODEL 1 as well as rendering insignificant several variables which were highly significant when demographic interactions were not included. As a result, interaction terms were not incorporated into MODEL 1, but their influence need not be overlooked.

To conclude, this analysis showed that respondents preferred flatter time paths for both timber and recreation, above time paths with larger fluctuations. Individuals favored steady streams of forest benefits ahead of receiving as much benefit as soon as possible. Respondents also seemed to favour the ordering of losses ahead of gains, choosing to forgo immediate enrichment if it avoided future deprivation. In discounting studies of private goods, high discount rates are often displayed along with a preference to receive goods as soon as possible (Sultan & Winer, 1993). Results from this study do not follow these tendencies, suggesting forest resources may have significant public good characteristics.

Also observed in this study, individuals chose toward lower variance bounds around scenario time paths, indicating a desire for lower uncertainty in a forest management context. Dissimilar coefficients were estimated for timber and recreation, suggesting the existence of a goods effect which allows for distinct time preference rates to apply to different goods.

All of these results are compatible with even-flow forest management, which must incorporate all forest resources and not focus exclusively on timber. Even-flow management, by definition, has minimal fluctuations over the planning horizon, which also eliminates the need to order gains and losses. Also, even-flow management removes some of the uncertainty of future periods, provided the harvest level is fixed and sustainable. Even-flow forest management would seem to incorporate the time preferences of those individuals surveyed in this study.

D. SURVEY COMMENTS

On each profile page, respondents were asked to explain why they chose the scenario that they did. These comments provided useful insights into individuals' decision making. Respondents often listed large fluctuations in either timber or recreation time paths as a reason for choosing away from a particular scenario. Selected examples are given in Appendix E. The last page of the questionnaire provided a large space for respondents to give comments if they wished. Many respondents expressed opinions on the state of forestry in Alberta. Some suggested particular attributes they felt were missing from the scenarios. Again, selected comments are given in Appendix E.

CHAPTER VI SUMMARY & CONCLUSIONS

A. SUMMARY

This study created a discrete choice questionnaire to investigate individual time preference for forest resources. From this questionnaire, a binary choice model was developed to examine individual choice behaviour based on the intertemporal evaluation of alternative forest management scenarios. The results offer insights into how changes in scenario attributes affect individual utility and the likelihood of one scenario being preferred over another.

The objective of this study was to explore specific characteristics of individual time preference and their effect on intertemporal decision making. The characteristics of interest were basic time preference, the ordering of gains and losses, the goods effect, uncertainty, and individual demographic attributes. Simulated forest management scenarios were developed where attributes based on these four characteristics could be varied to create a discrete choice experiment. These scenarios were then set into a real-world context using the *Forest Muncher* (Beck & Beck, 1996) harvesting program for the Rose Creek Educational Forest.

Results from the study showed that individuals preferred forest management scenarios that produced stable flows of both timber and recreation benefits over the duration of the scenario. In the questionnaire, respondents favoured scenarios with attributes that created flatter time paths, while rejecting scenarios with attributes that produced large movements away from the reference state. Respondents also preferred scenarios where losses occurred ahead of gains. Scenarios where time paths displayed lower 5% variance bounds were more likely to be selected than scenarios with higher 10% variance bounds. Results also showed a distinction between coefficient estimates for timber and recreation. This suggests the existence of a goods effect, which allows for separate time preference rates for different goods. These results indicate that the individuals surveyed prefer forest management that provides benefits in a stable manner. Even-flow forest management would seem best suited to accomplish this, while ensuring that timber harvesting does not damage the sustainability of other forest resources.

B. LIMITATIONS & FUTURE RESEARCH

This research did provide some insight into individual choice behaviour in a forest management context. Despite encouraging results, there were factors that limited the success of the study. The survey sample is lacking on two points. The small number of Public Advisory Committees and the questionnaire response rate yielded a smaller than hoped for sample size. Comparisons between different PACs was not possible as the sample was too small to partition according to PAC. Also, because only PACs were sampled, the results may not reflect the general population. Each of these committees was intended to represent a cross-section of the local area. However, several committees presented a very pro-forestry view at their meetings. While other interests were represented, timber harvesting tended to be the primary concern in many discussions. Most committees had several forestry company employees as members, who often outnumbered any other single representative group.

A second limitation can be found in the applications for the analyzed results. No welfare analysis was undertaken because no marginal utility of income was specified.

Because the study is examining individual time preference, each respondent's marginal utility of income is intrinsic to their intertemporal decision making process. Alternate intertemporal allocations can not be compared in present value terms because there is no 'correct' discount rate to use in a present value calculation. This would have provided a useful measure of the implications of moving from an even-flow harvesting time path to any of the variable harvesting time paths. As such, the welfare effects of a change in temporal allocations resulting from a change in a particular attribute can not be measured in dollar terms.

One issue that was often raised at the PAC meetings was the connection between timber harvests and recreation. The survey profiles are constructed using an orthogonal design which assumes attributes are independent from one another. Because of the broad definition of recreation used in this study, we made the assumption that the timber harvest level and the recreational use level can move independently. An interesting expansion of this study could be to use correlated attributes, where variable timber harvest levels would have direct implications on one or several other forest resources. A correlated attribute design would hopefully provide insight into respondents' inter-resource trade-offs, as well as their intertemporal trade-offs.

As stated in the analysis section, respondents' preference for flat timber time paths would suggest a continuation of even-flow harvesting. However, there is the possibility that the predominance of even-flow harvesting in current forest management planning has shaped the public's preference. Because even-flow is so common, people may consider it to be the superior option as they have little familiarity with possible alternatives. While educable preferences may exist, the sample group in this survey was aware of alternative management approaches yet still displayed a preference for even-flow harvesting.

This study is one of few examples of empirical time preference research focusing on natural resources. Hypothetical constructs of forest management scenarios were developed to examine specific time preference issues. However, the questionnaire looked at the trade-offs between only two goods, timber and recreation, a small part of the resources a forest may provide. Limiting the survey to two goods was necessary to keep the survey design manageable and to make the questionnaire easier for respondents to understand. Perhaps repeated trials, each using timber and different alternate good may avoid confusion, but such an approach would require a much larger sample. A questionnaire using multiple goods would provide more information and be a more accurate portrayal of forest management, but may prove to be prohibitively complex. Some respondents were challenged when evaluating two time path graphs across two scenarios. If asked to compare multiple time paths between multiple scenarios, respondents may simply make a random choice.

This study used a simply binary-choice design to examine four specific time preference attributes. Perhaps time preference research can be extended into a greater number of issues without an overly complicated design. Multi-stage decision-making, using nested modeling approaches, may allow the investigation of more issues without creating a questionnaire that is too complicated to be functional. This may allow the incorporation of several forest resources with multiple factors changing over time, yet still allow respondents to make decisions sequentially based on a subset of attributes at each stage. This may provide better understanding of individual time preference as it applies to forest management.

The binary modeling approach used in this survey and the nested approach described above both employ hypothetical designs. Actual forest management decisions would provide an alternative approach to examining choice behaviour in an intertemporal trade-off context. One difficulty is that there are few sources for these types of decisions. The analysis of time preference issues would require a series of long-term management plans. The number of managed forest areas in Canada is limited and so the number of implemented plans is limited. It may prove challenging to collect a database of forest management decisions that can be analyzed on the basis of common attributes to allow the examination of time preference issues.

C. CONCLUSION

This study showed that individuals preferred stable time paths without large fluctuations for both timber and recreation. Respondents also favoured the ordering of losses ahead of gains, opting to avoid significant future losses even if that meant sacrificing immediate gains. As well, individual utility was increased by lower variance bounds around scenario time paths, indicating a possible desire for less uncertainty in forest management. Analysis also revealed a time preference distinction between timber and recreational usage, giving support to the existence of the goods effect.

The preferences individuals displayed would be satisfied with some form of even-flow forest management which incorporates all forest resources and does not focus exclusively on timber. Even-flow management would provide a stable flow of benefits with no large inequitable intertemporal transfers, without a great amount of future uncertainty. Allowing separate goods to be managed according to separate time preference rates would provide greater flexibility and avoid inefficient restrictions that a single rate for all goods may impose.

Even-flow timber harvesting has been subject to economic criticisms in the past. It can impose an opportunity cost from maintaining standing stocks of timber at times when the profits from harvesting that timber could be invested to benefit society (Boyd & Hyde, 1989). Variable management may be better able to adjust to demand fluctuations for forest products (Dowdle, 1984). Yet these are arguments based on strictly economic factors with no consideration of public preferences. The public may prefer even-flow forest management for the benefits it does provide, in spite of its associated economic faults.

This study has shown that for FMA-size planning areas, people are interested in a stable flow of benefits even though variable harvesting approaches may include temporal trade-offs that offer a higher internal rate of return. Nevertheless, depending on the size of an FMA, it may be possible to follow a form of natural disturbance harvesting by having many small cut-blocks in most years and single large cut-blocks in very few years with the resulting annual harvest close to constant over time. The public's acceptance of such a management approach may depend on whether the harvest level possible under natural disturbance differs significantly from the standard Allowable Annual Cut approach. The public might then be willing to accept a lower even-flow harvest level through natural disturbance harvesting if it can be shown to provide some other benefit. Under a natural disturbance system, a large cut-block could be left undisturbed for a very long time until re-harvest. This might be better for some biological systems than several dispersed cut-blocks with the possibility of nearby disturbance.

This investigation into individual time preference found a preference for stability in forest resources, with respondents willing to forgo the net present value maximizing option. A stable timber supply, not necessarily the most financially profitable harvesting schedule, is generally favoured. Forest management planning that takes this into account might better incorporate the public's time preferences of how the forest should be exploited as a public resource.

Bibliography

Ackerman, Frank. (1994) "The Natural Interest Rate for the Forest: Macroeconomic Requirements for Sustainable Development" *Ecological Economics* 10, 21-26.

Adamowicz, W.L., P.C. Boxall, J.J. Louviere, J. Swait and M. Williams. (1994) "Stated Preference Methods for Environmental Evaluation", *Staff Paper* 94-07. Department of Rural Economy, University of Alberta.

Alberta Environmental Protection, Land and Forest Service. (1997) "Interim Forest ManagementPlanning Manual-Guidelines to Plan Development" *Draft 4.1*.

Batsell, Richard R. and Jordan J. Louviere. (1991) "Experimental Analysis of Choice" *Marketing Letters* 2:3, 199-214.

Baumol, William J. (1968) "On the Social rate of Discount" *American Economic Review* 58, 789-802.

Beck, B. and J. Beck. (1996) Forest Muncher, *Version 3.7*, Beck Consulting, Edmonton, AB.

Ben-Akiva, M. and S. Lerman. (1985) Discrete Choice Analysis: Theory and Application to Travel Demand. MIT Press Series in Transportation Studies. Cambridge, Mass.

Benzion, Uri, Amnon Rapoport and Joseph Yagil. (1989) "Discount Rates Inferred from Decisions: An Experimental Study" *Management Science* 35, 270-285.

Bergstrom, Theodore, Lawrence Blume and Hal Varian. (1986) "On the Private Provision of Public Goods" *Journal of Public Economics* 29, 25-49.

Borsch-Supan, Axel. (1987) Econometric Analysis of Discrete Choice: With Applications on Demand for Housing in the U.S. and West Germany. Springer-Verlag, New York, NY.

Boyd, R.G. and W.F. Hyde. (1989) Forest Sector Intervention: The Impacts of Regulation on Social Welfare. Iowa State University Press. Ames, Iowa.

Burton, Peter S. (1993) "Intertemporal Preferences and Intergenerational Equity Considerations in Optimal Resource Harvesting" *Journal of Environmental Economics and Management* 24, 119-132.

Clawson, Marion and Roger Sedjo. (1984) "History of Sustained Yield Concept and its Application to Developing Countries" p.3-15. In History of Sustained Yield Forestry: A Symposium. Harold Steen ed. Forest History Society.

"CONSURV" (1993) User's Manual *Version 3.0.* Intelligent Marketing Systems Ltd. Edmonton, AB.

Cropper, Maureen L., Leland Deck, Nalin Kishor, and Ted McConnell. (1990) "The Estimation of Consumer Preferences for Attributes: A Comparison of Hedonic and Discrete Choice Approaches" *Discussion Paper*, Resources for the Future.

Cropper, Maureen L., Sema K. Aydede and Paul R. Portney. (1992) "Discounting Human Lives" *American Journal of Agricultural Economics* 82:2, 469-472.

Dowdle, B. "The Case for Selling Federal Timber Lands" p.21-46. In Selling the Federal Forests A.E. Gamache, ed. University of Washington.

Drepper, Friedhelm R. and Bengt A. Mansson. (1993) "Intertemporal Valuation in an Unpredictable Environment" *Ecological Economics* 7, 43-67.

Epstein, Larry G. and J. Allan Hynes. (1983) "The Rate of Time Preference and Dynamic Economic Analysis" *Journal of Political Economy* 91, 611-635.

Expert Review Panel, (Bruce P. Dancik chair). (1990) "Forest Management in Alberta" Alberta Energy/Forestry, Lands and Wildlife, Edmonton, AB.

Fight, Roger D. and Enoch F. Bell. (1977) "Coping with Uncertainty- A Conceptual Approach for Timber Management Planning" USDA Forest Service General Technical Report PNW-59.

Foster, Bennett B. (1979) "Multiple Discount Rates for Evaluating Public Forestry Investments" *The Forestry Chronicle,* 55:1, 17-20.

Greene, W.H. (1997) "LIMDEP User's Manual and Reference Guide" *version 7.0* Econometric Software Inc., Bellport, N.Y.

Hanley, Nick. (1992) "Are There Environmental Limits to Cost Benefit Analysis?" *Environmental and Resource Economics* 2, 33-59.

Harou, P.A. (1983) "A Note on the Real Rate of Discount" *Forest Science* 29, 249-252.

Harou, P.A. (1985) "On the Social Discount Rate for Forestry" *Canadian Journal of Forest Resources* 15, 927-934.

Harvey, Charles M. (1994) "The Reasonableness of Non-Constant Discounting" *Journal of Public Economics* 53, 31-51.

Hausman, J.A. (1979) "Individual Discount Rates and the Purchase and Utilization of Energy-using Durables" *Bell Journal of Economics* 10, 33-54.

Henderson, Norman and Ian Bateman. (1995) "Empirical and Public Choice Evidence for Hyperbolic Social Discount Rates and Implications for Intergenerational Discounting" *Environmental and Resource Economics* 5, 413-423.

Horowitz, John K. (1996) "Environmental Policy Under a Non-Market Discount Rate" *Ecological Economics* 16, 73-78.

Howarth, Richard B. and Richard B. Norgaard. (1990) "Intergenerational Resource Rights, Efficiency, and Social Optimality" *Land Economics* 66, 1-11.

Howarth, Richard B. and Richard B. Norgaard. (1991) "Sustainability and Discounting the Future" Chapter 7 in Ecological Economics: The Science and Management of Sustainability. Columbia University Press, New York, NY.

Howe, Charles W. (1971) Benefit-Cost Analysis for Water System Planning.American Geophysical Union: Water Resources Monograph Series. Washington, D.C.

Hultkrantz, Lars. (1992) "Forestry and the Bequest Motive" *Journal of Environmental Economics and Management* 22:2, 164-177.

Kashner, T. Michael. (1990) "Present-Future Gratification Tradeoffs: Does Economics Validate Psychometric Studies?" *Journal of Economic Psychology* 11, 247-268.

Kelly, Christopher. (1977) "Colin Price: 'Blind Alleys and Open Prospects' - A Comment" *Forestry* 50:2, 169-175.

Klemperer, W. David, James F. Cathcart, Thomas Haring and Ralph J. Alig. (1994) "Risk and The Discount Rate" *Canadian Journal of Forest Resources* 24, 390-397.

Knetsch, Jack L. (1997) "A Reinterpretation of Time Preference Findings: Some Implications and Evidence" *Draft* prepared for the TMR/Saving Workshop, July, 1997. Center for Economic Research, Tilburg University, the Netherlands.

Kohn, Robert E. (1993) "Measuring the Existence Value of Wildlife: Comment" *Land Economics* 69:3, 304-308.

Landsberger, Michael. (1971) "Consumer Discount Rate and the Horizon: New Evidence" *Journal of Political Economy* 72:2, 1346-1359.

Lesser, Jonathan A. and Richard O. Zerbe Jr. (1995) "What Can Economic Analysis Contribute to the 'Sustainability' Debate?" *Contemporary Economic Policy* 13, 88-99.

Lind, Robert C. et al. (1982) "Discounting for Time and Risk in Energy Policy" in A Primer for the Major Issues. Resources for the Future, Inc., 21-114.

Loewenstein, George. (1987) "Anticipation and the Valuation of Delayed Consumption" *Economic Journal* 97, 666-684.

Loewenstein, George and Drazen Prelec. (1992) "Anomalies in Intertemporal Choice: Evidence and an Interpretation" *Quarterly Journal of Economics* 107, 573-597.

Loewenstein, George and Jon Elster. (1992) Choice Over Time. Russell Sage Foundation, New York, NY.

Louviere, Jordan. (1988) "Conjoint Analysis Modelling of Stated Preferences: A Review of Theory, Methods, Recent Developments and External Validity", *Journal of Transport Economics and Policy,* 22:1, 93-119.

Louviere, J.J., D. Hensher and W.L. Adamowicz. (1994) "*Stated Preference Methods: Applications in Land Use, Transportation Planning and Environmental Economics*". Center for Urban Studies, Portland, OR.

Luckert, Martin K. (1997) "Toward a Tenure Policy Framework for Sustainable Forest Management in Canada" *Forestry Chronicle*73:2, 211-215.

Luckert, M. K., and W. L. Adamowicz. (1993) "Empirical Measures of Factors Affecting Social Rates of Discount" *Environmental and Resource Economics* 3, 1-21.

Lumley, Sarah. (1997) "The Environment and the Ethics of Discounting: An Empirical Analysis" *Ecological Economics* 20,. 71-82.

Maddala, G.S. (1991) Limited-Dependent and Qualitative Variables in Econometrics. Cambridge University Press.

Manning, Travis W. and Wiktor L. Adamowicz. (1994) "Economics of Natural Resources for Agriculture and Forestry" *Dept. of Rural Economy publication.* Edmonton, AB.

Marglin, Stephen A. (1963) "The Social rate of Discount and The Optimal Rate of Investment" *Quarterly Journal of Economics* 77, 95-111.

Markandya, Anil and David W. Pearce. (1991) "Development, the Environment, and the Social Rate of Discount" *The World Bank Research Observer* 6, 137-152.

Martin, Fernand. (1992) "Sustainability, the Discount Rate and Intergenerational Effects" *Working Paper 170.* Universite de Montreal, Montreal, PQ.

McConnell, K.E. (1997) "Does Altruism Undermine Existence Value?" *Journal of Environmental Economics and Management* 32:1, 22-37.

McDougall, F.W. (1990) "Sustained Yield in Alberta" *The Forestry Chronicle,* 66:1, 14-19.

McFadden, D. (1981) "Econometric Models of Probabilistic Choice". in Structural Analysis of Discrete Data. C. Manski and D. McFadden (eds.) MIT Press, Cambridge, Mass. 198-272.

McLoed, K., P.C. Boxall, W.L. Adamowicz, M. Williams and J.J. Louviere. (1993) "The Incorporation of Nontimber Goods and Services in Integrated Resource Management. 1. An Introduction to the Alberta Moose Hunting Study". *Interim Project Report No. 93-12,* Department of Rural Economy, University of Alberta.

Montgomery, Claire A. (1996) "Risk and Forest Policy: Issues and Recent Trends in the U.S." *Ecological Economics* 16, 65-72.

Morton, Karen M. (1993) "Economic Effects of Environmental Quality Change on Recreational Hunting in Northwestern Saskatchewan" *Master's Thesis,* University of Alberta, Edmonton, AB.

Newberry, David M. (1990) "The Isolation Paradox and the Discount Rate Benefit-Cost Analysis: A Comment" *Quarterly Journal of Economics*, February, 235-238.

Olson, Mancur and Martin J. Bailey. (1981) "Positive Time Preference" *Journal of Political Economy* 89, 1-25.

Page, Talbot. (1988) "Intergenerational Equity and the Social Rate of Discount" *from* Environmental Resources and Applied Welfare Economics. Fran Smith & V. Kerry eds.

Pope, C. Arden and Greg Perry. (1989) "Individual versus Social Discount Rates in Allocating Depletable Natural Resources Over Time" *Economics Letters* 29, 257-264.

Price, Colin. (1976) "Blind Alleys and Open Prospects in Forest Economics" *Forestry* 49, 99-107.

Price, Colin. (1993) "*Time, Discounting & Value*" Blackwell Press, Oxford, England.

Rabl, Ari. (1996) "Discounting of Long Term Costs: What Would Future Generations Prefer Us To Do?" *Ecological Economics* 17, 137-145.

Rook, D.W. (1987) "The Buying Impulse" *Journal of Consumer Research* 14, 189-199.

Row, Clark, H. Fred Kaiser, and John Sessions. (1981) "Discount Rate for Long Term Forest Service Investments" *Journal of Forestry,* 79:6, 367-376.

Sen, Amartya K. (1961) "On Optimizing the Rate of Saving" *The Economic Journal,* September, 479-496.

Sen, Amartya K. (1967) "Isolation, Assurance and the Social Rate of Discount" *Quarterly Journal of Economics* 81, 112-124.

Shepard, Ward. (1925) "The Bogey of Compound Interest" *Journal of Forestry* 23, 251-259.

Sultan, Fareena and Russell S. Winer. (1993) "Time Preferences for Products and Attributes and the Adoption of Technology-driven Consumer Durable Innovations" *Journal of Economic Psychology* 14, 587-613.

Tversky, Amos, Paul Slovic and Daniel Kahneman. (1990) "The Causes of Preference Reversal" *American Economic Review* 80, 204-217.

University of British Columbia, Forest Club. (1971) Forestry Handbook for British Columbia. *3rd ed.* University of British Columbia Undergraduate Forestry Society, Vancouver, BC.

Weitzman, Martin L. (1994) "On the 'Environmental Discount Rate" *Journal of Environmental Economics and Management* 26, 200-209.

Wright, Brian D. and Peter G. Warr. (1981) "The Isolation Paradox and the Social Discount Rate for Benefit Cost Analysis" *Quarterly Journal of Economics,* 96:1, 129-145.

Wright, Brian D. and Peter G. Warr. (1990) "The Isolation Paradox, the Social Discount Rate, and Neutrality: Further Thoughts" *Quarterly Journal of Economics,* 105:1, 239-241.

Young, R. (1992) "Evaluating Long-Lived Projects: The Issue of Inter-Generational Equity" *Australian Journal of Agricultural Economics* 36, 207-232.

Zinkhan, F. Christian. (1988) "Forestry Projects, Modern Portfolio Theory, and Discount Rate Selection" *South. Journal of Applied Forestry* 12, 132-135.

Appendix A: Information Sheet & Sample Questionnaire

This appendix includes the information distributed to respondents and an example of the questionnaire, Version 4, which includes profiles #45 to #48 and #13 to #16.

Information Sheet:

Dear Respondent,

My name is Cameron Taylor. I am a graduate student at the University of Alberta currently working on a Master's thesis in the Department of Rural Economy with Dr. Martin Luckert and Dr. Wiktor Adamowicz. We are researching how individuals value forest resources over time. Funding for this project has been provided by the Sustainable Forest Management Network of Centres of Excellence.

University guidelines on the ethical review of studies involving human subjects require the informed consent of the participant. Your participation is requested, but this survey is voluntary and individual committee members may choose not to take part. The entire process should take no more than 15 to 35 minutes to complete.

The purpose of this study is an attempt to measure individuals' time preference for forest resources. Time preference describes how people value something at different points in time. This survey examines how individuals value the benefits provided by a forest area, and also the pattern in which individuals prefer to receive these benefits. To measure individual time preference in this questionnaire, an individual will choose between a series of forest management scenarios that provide alternate combinations of timber and recreation benefits. Information on how to complete the questionnaire will be provided in the instruction sheet attached.

This study is part of a larger program, the Network of Centres of Excellence, that was set up to research many aspects of Canadian forestry. The final report from this survey will become part of this forestry information database. A summary of results from this study will also be made available through the Department of Rural Economy website at www.re.ualberta.ca. You may also contact me at (403) 492 - 4225 or by e-mail at cltaylor@gpu.srv.ulberta.ca. Should you choose to participate, please read the instructions on the following two pages.

I thank you for your time.

Sincerely,

Cameron Taylor
M.Sc. Candidate

A Survey of Your Opinions on Forest Management

Your participation in completing this survey is greatly appreciated. The information you provide is an important part in the study of forestry issues in Alberta.

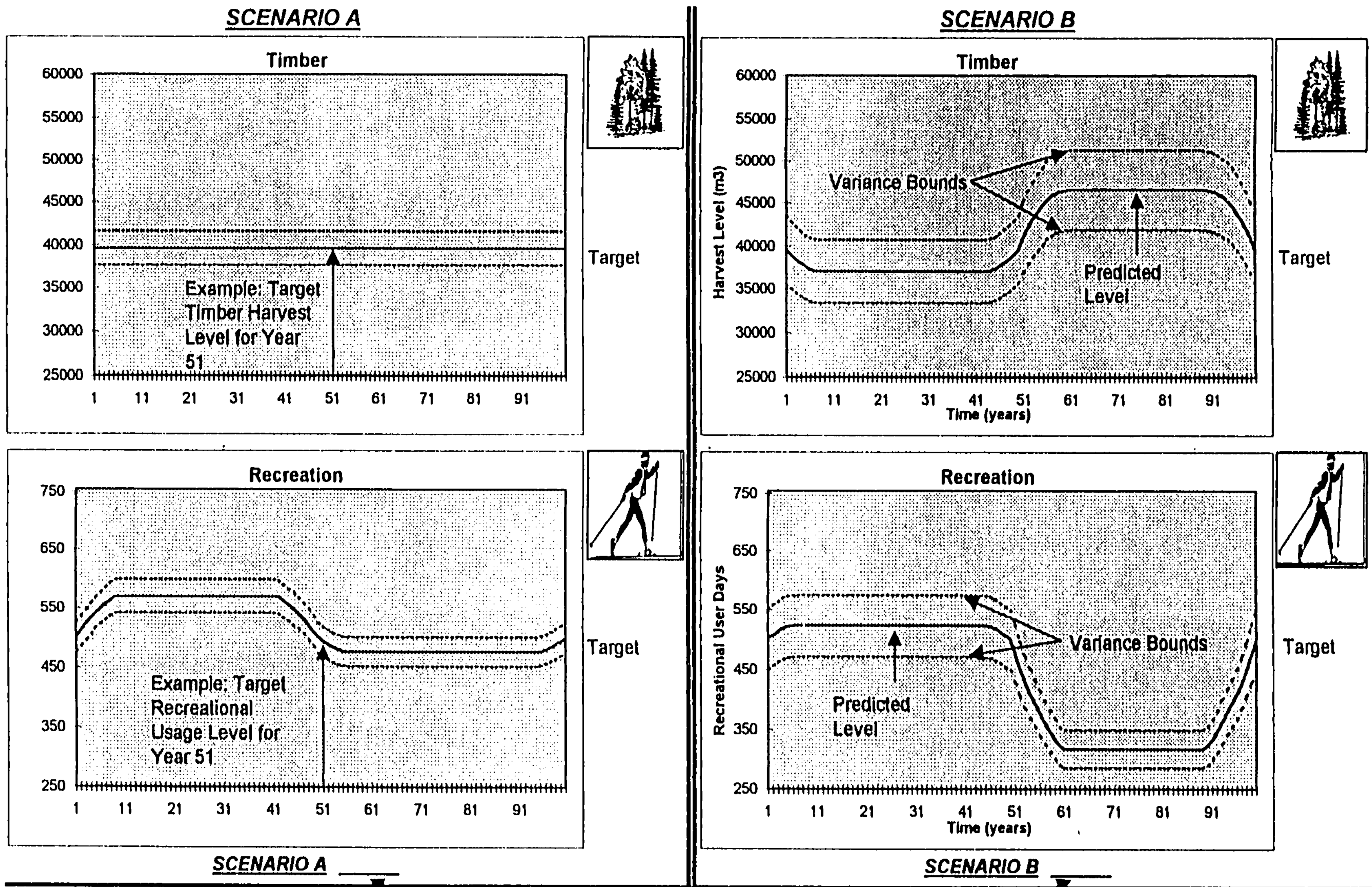
All information you provide is strictly confidential. Your name is not requested and will not appear with your answers.

A summary of the results from this project will be available after April, 1998 on the Department of Rural Economy website at www.re.ualberta.ca.

Martin K. Luckert
Associate Professor
Department of Rural Economy
University of Alberta
Edmonton, AB
T6G 2H1
Phone: (403) 492-5002

Cameron L. Taylor
MSc. Candidate
Department of Rural Economy
University of Alberta
Edmonton, AB
T6G 2H1
Phone: (403) 492-4225

Sustainable Forest Management Network of Centres Of Excellence



Which scenario do you prefer? Please check A or B:

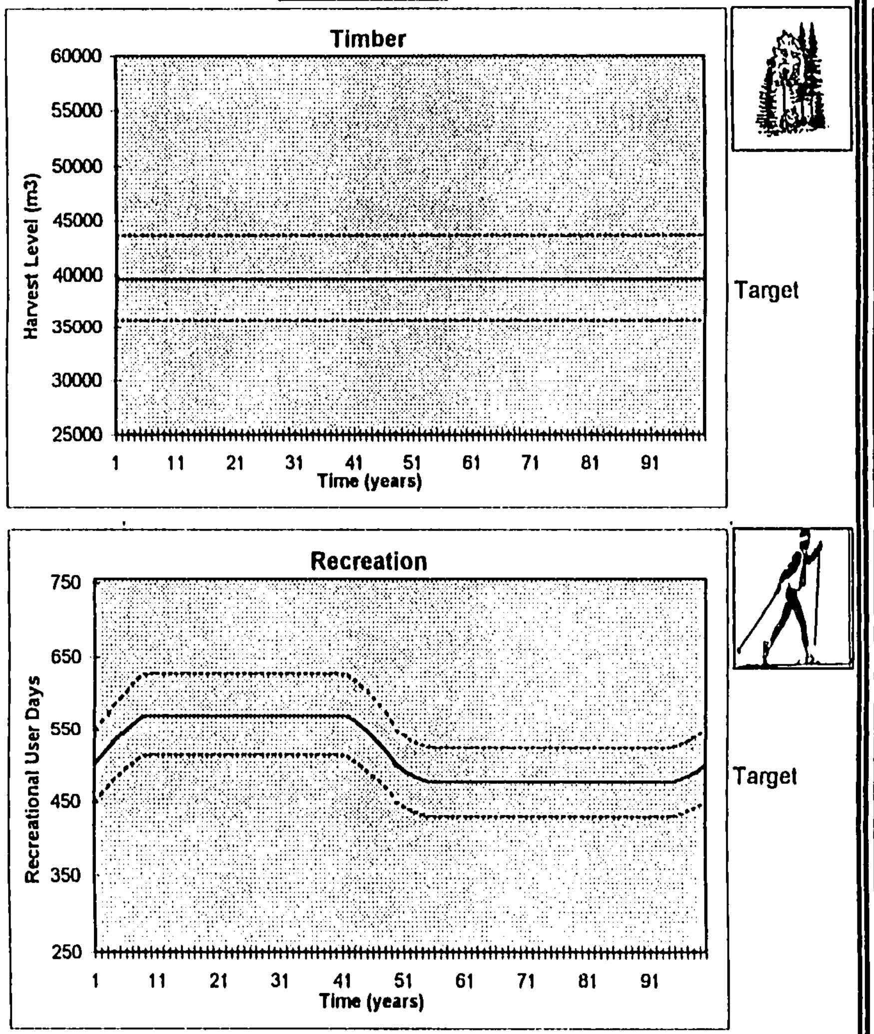
Respondents Check One of These Spaces

Please explain why you made the choice that you did:

SAMPLE PROFILE PAGE

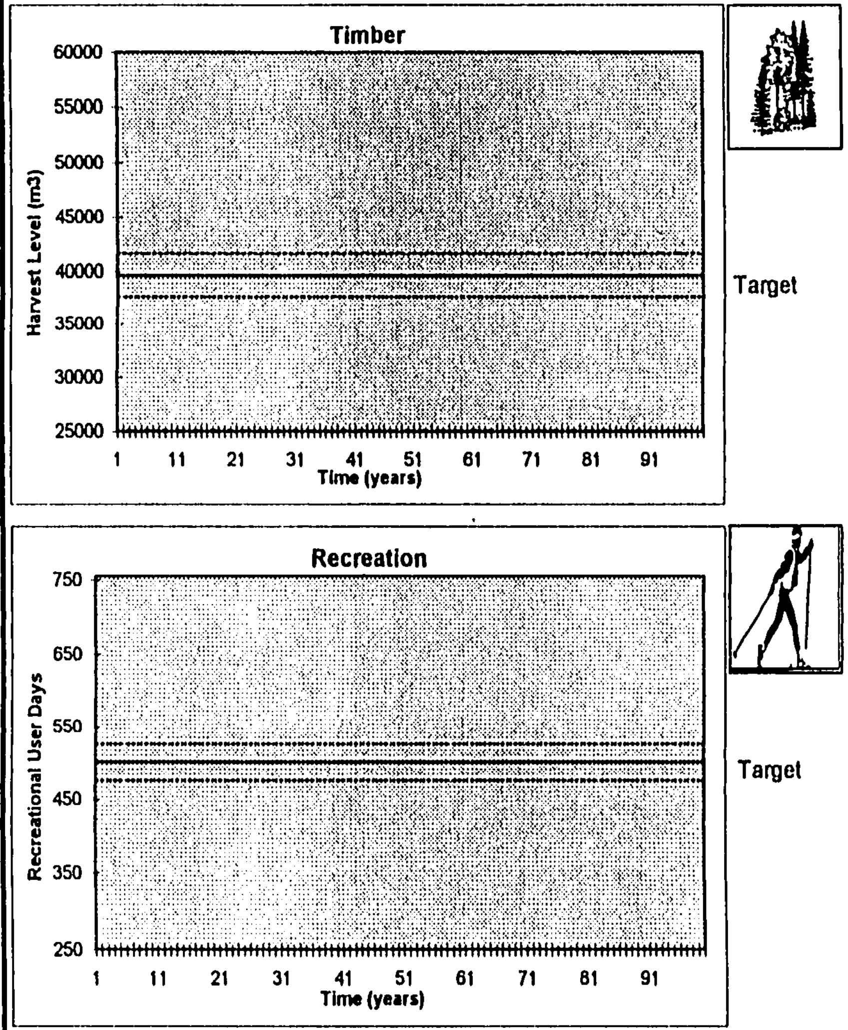
(Each Questionnaire Contains 8 Profiles)

SCENARIO A



SCENARIO A ____

SCENARIO B

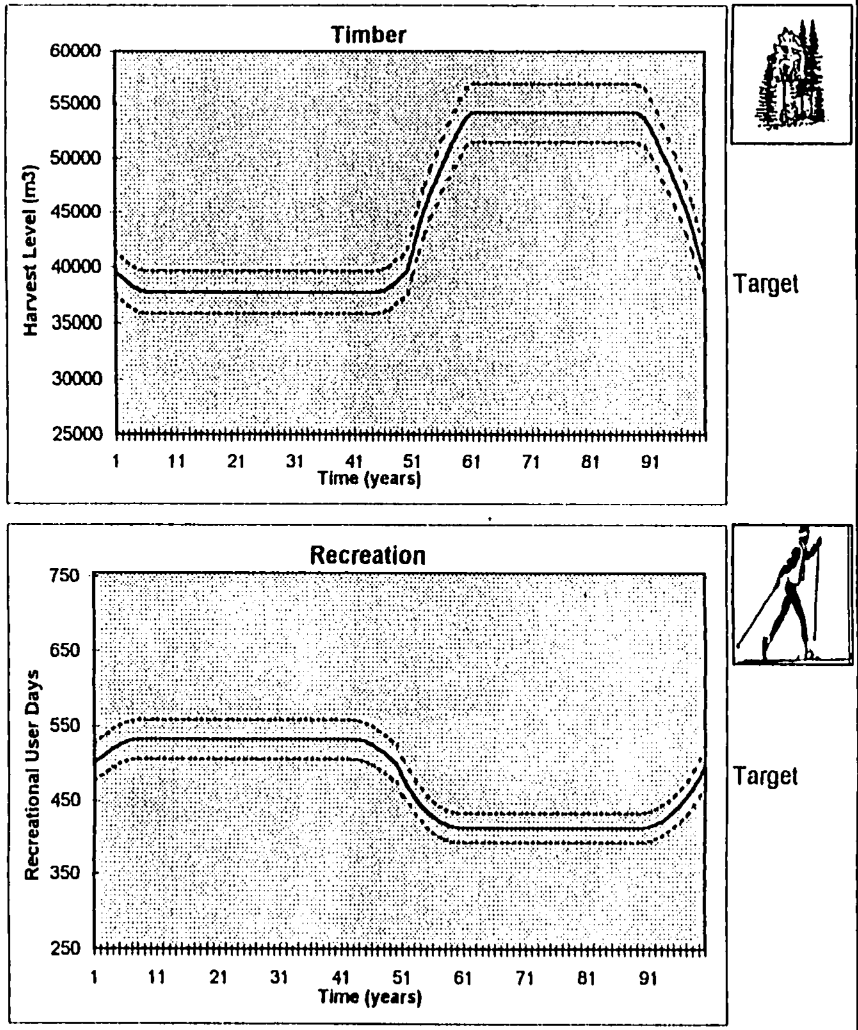


SCENARIO B ____

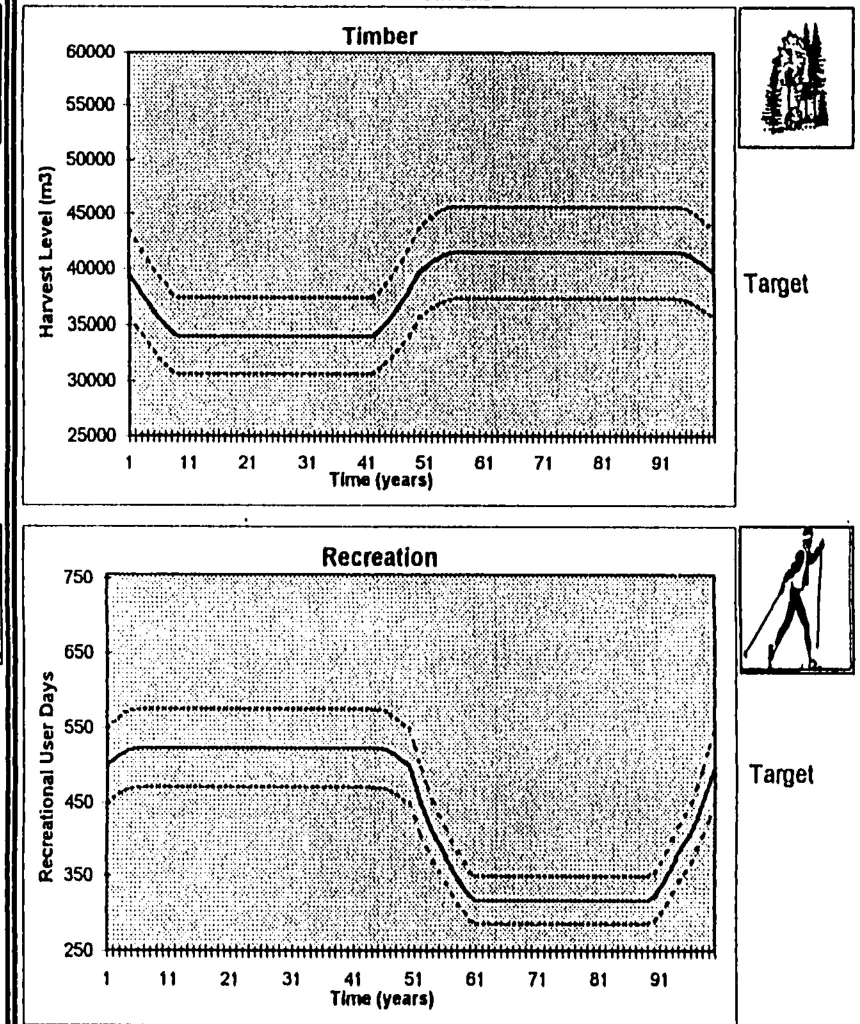
Which scenario do you prefer? Please check A or B:

Please explain why you made the choice that you did:

SCENARIO A



SCENARIO B

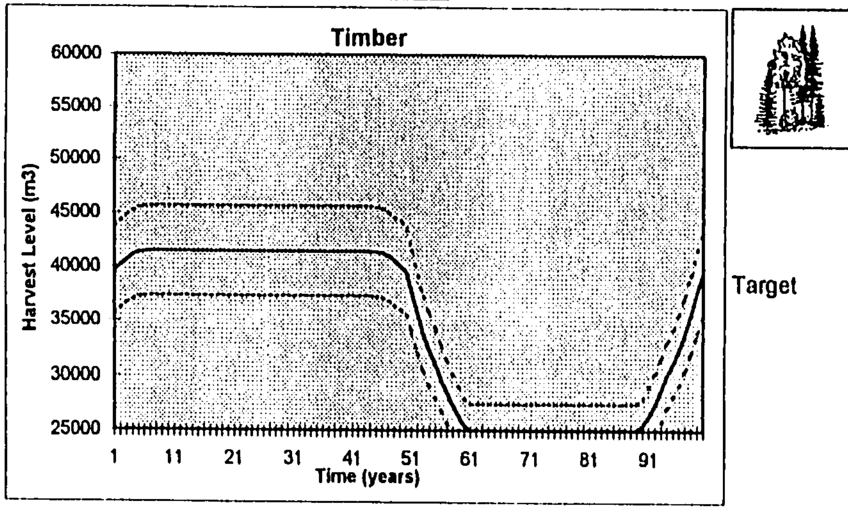


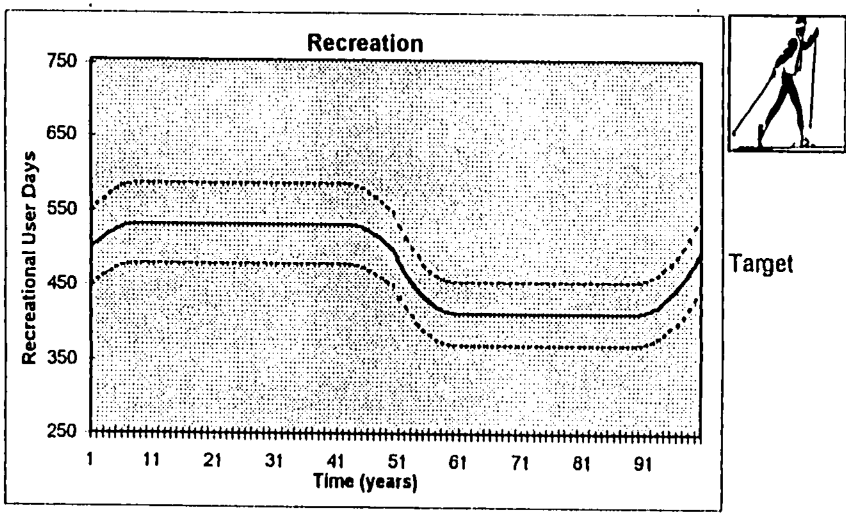
SCENARIO A ______ ***SCENARIO B*** ______

Which scenario do you prefer? Please check A or B:

Please explain why you made the choice that you did:

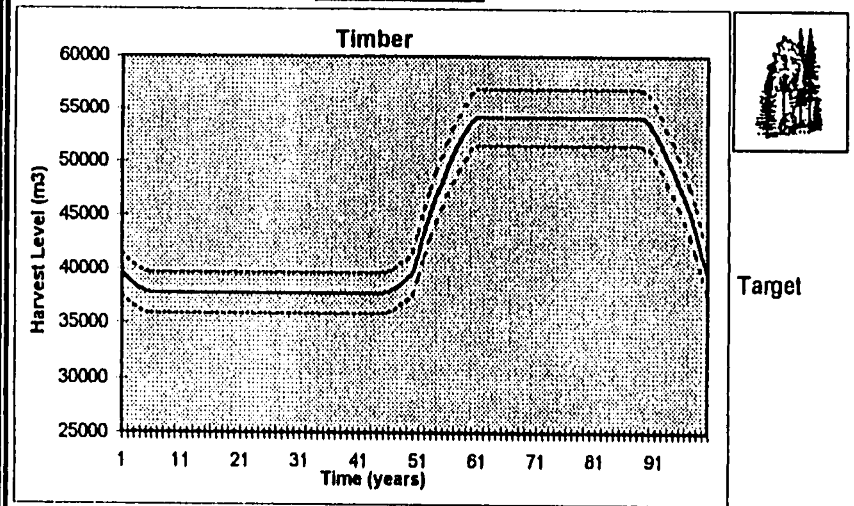
SCENARIO A

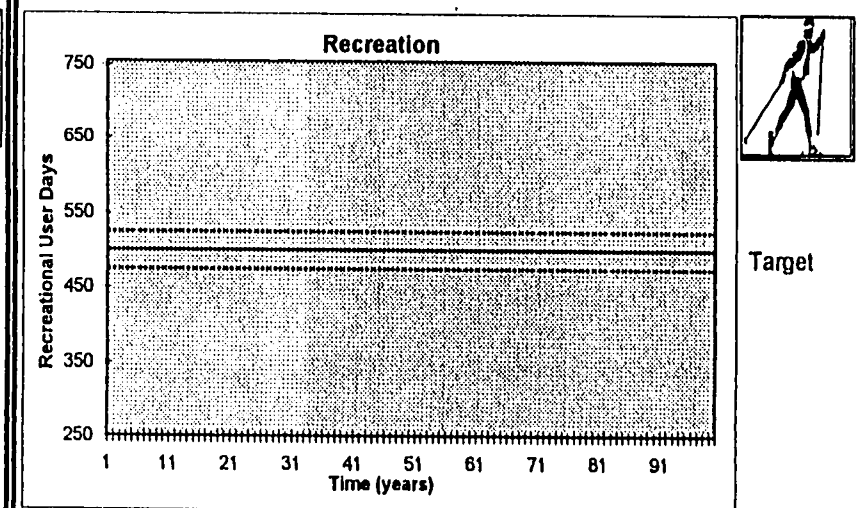




SCENARIO A ______

SCENARIO B



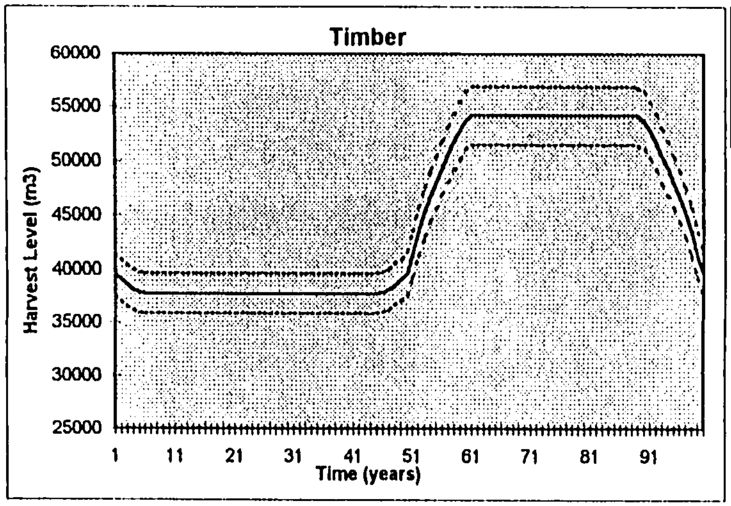


SCENARIO B ______

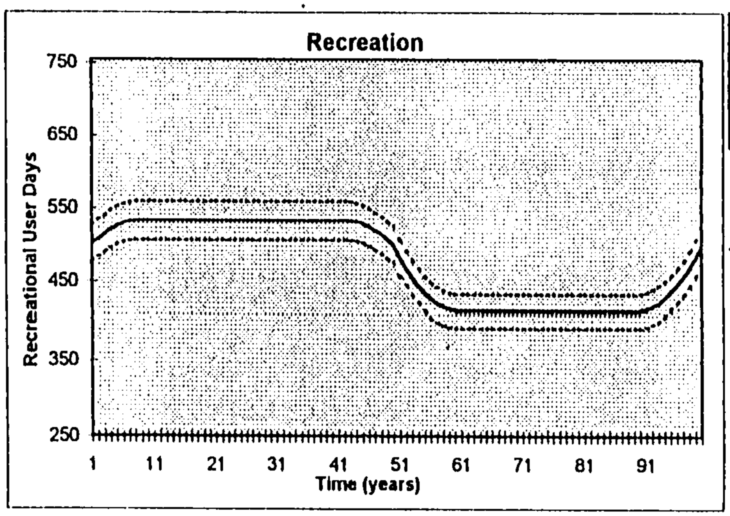
Which scenario do you prefer? Please check A or B:

Please explain why you made the choice that you did:

SCENARIO A



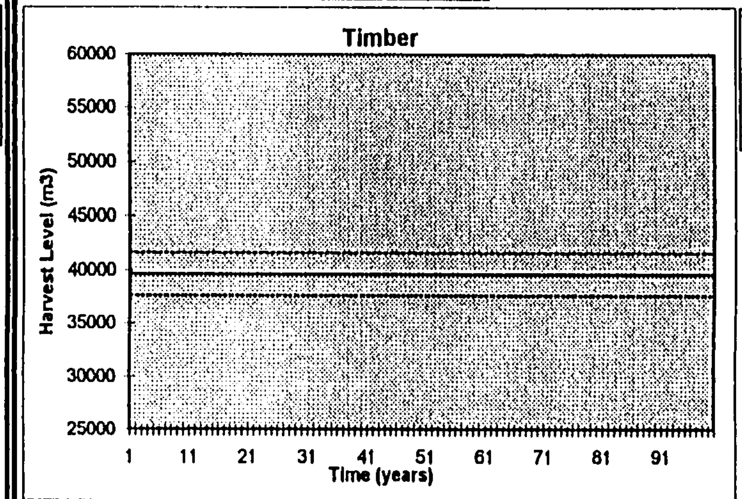
Target



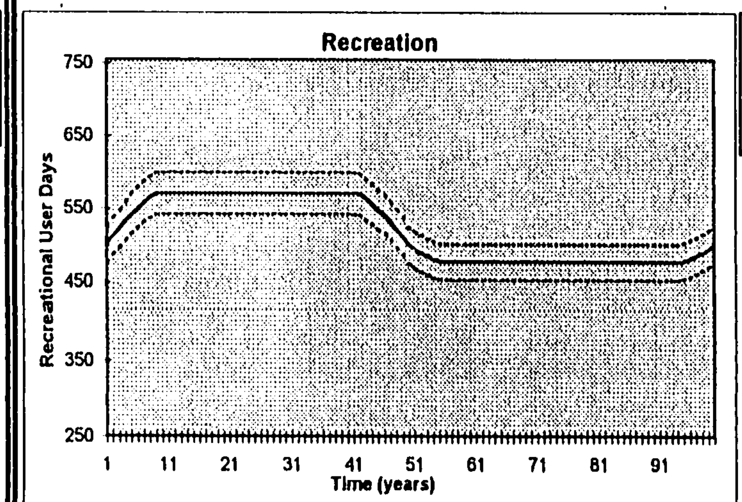
Target

SCENARIO A ______

SCENARIO B



Target



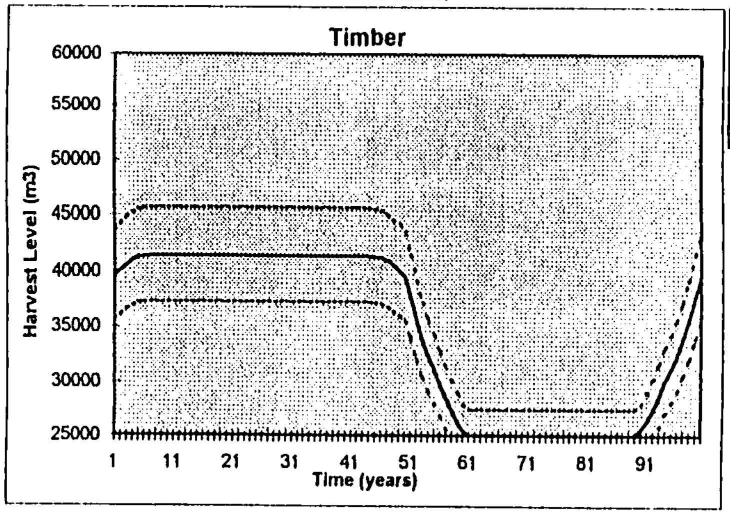
Target

SCENARIO B ______

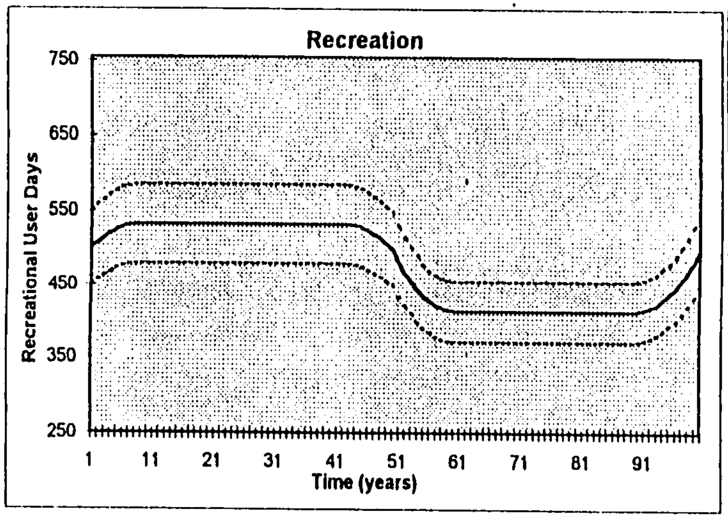
Which scenario do you prefer? Please check A or B:

Please explain why you made the choice that you did:

SCENARIO A



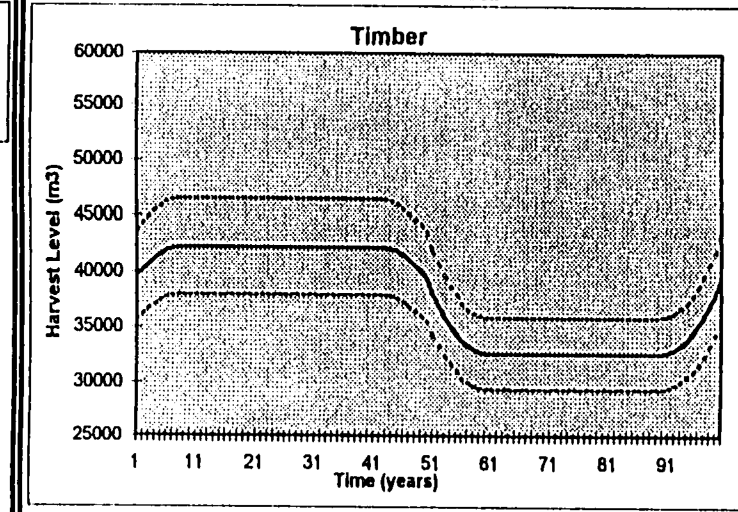
Target



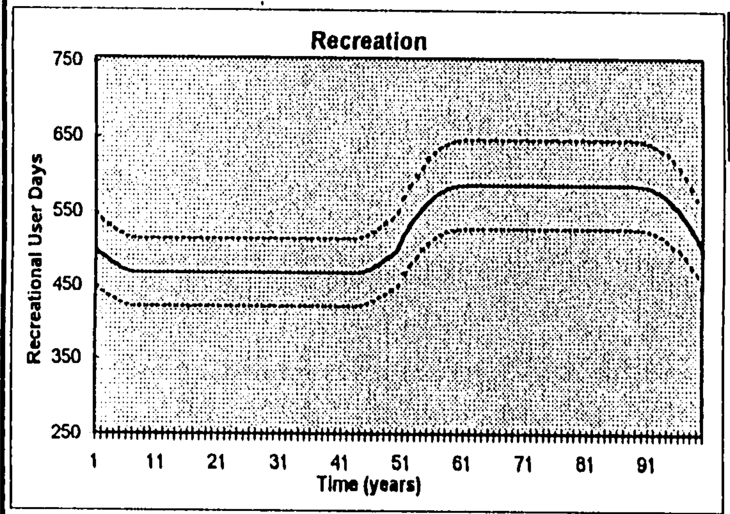
Target

SCENARIO A ______

SCENARIO B



Target



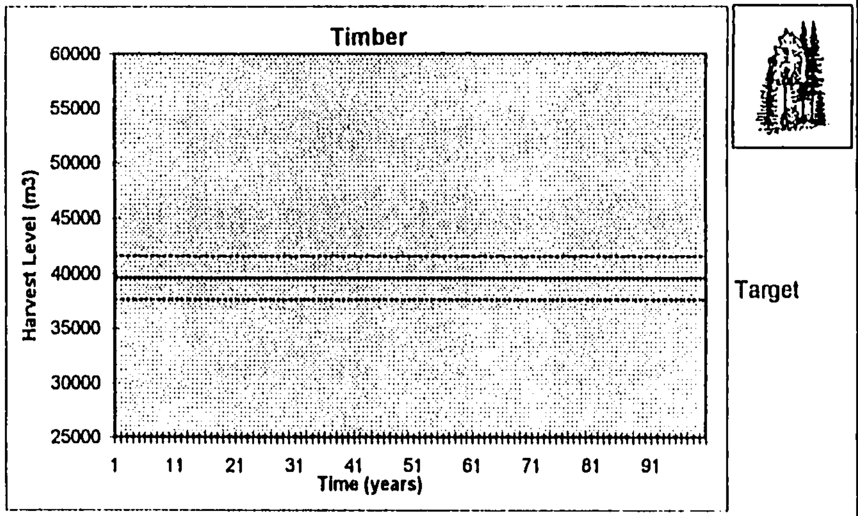
Target

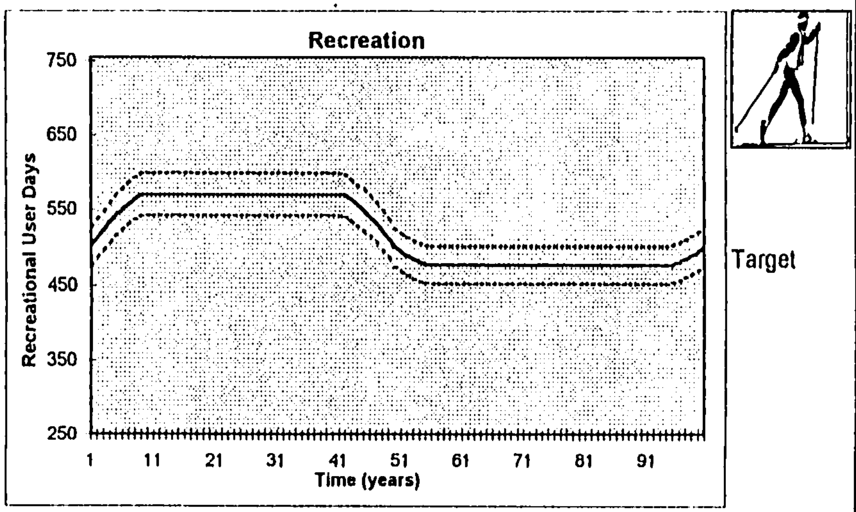
SCENARIO B ______

Which scenario do you prefer? Please check A or B:

Please explain why you made the choice that you did:

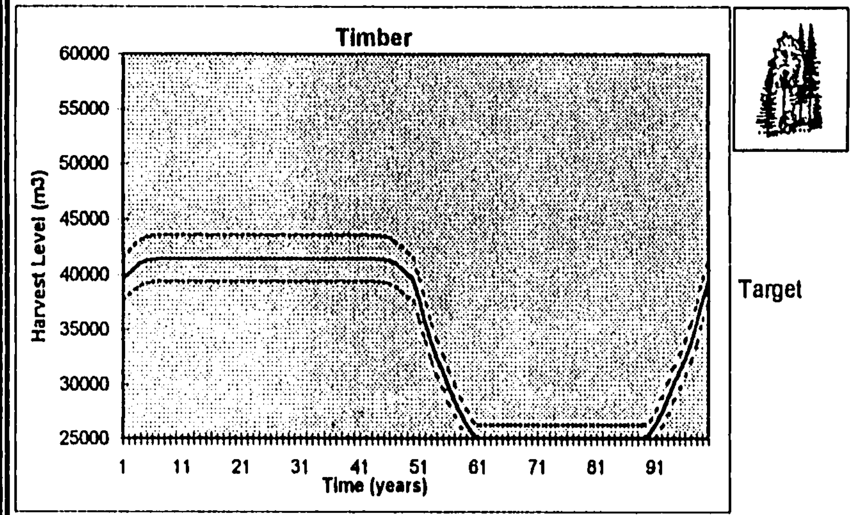
SCENARIO A

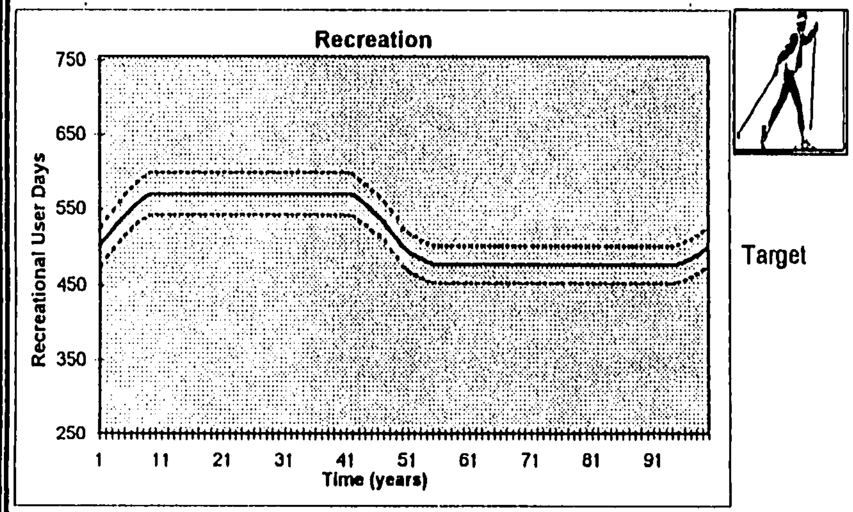




SCENARIO A ____

SCENARIO B

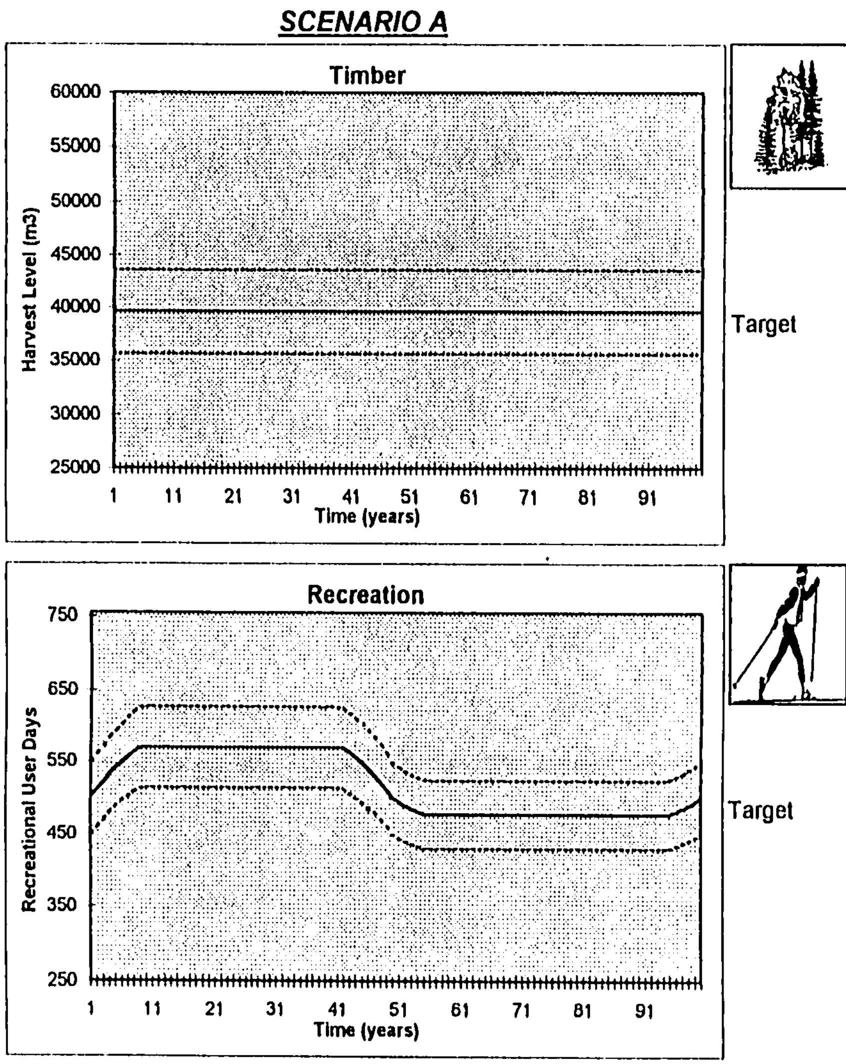


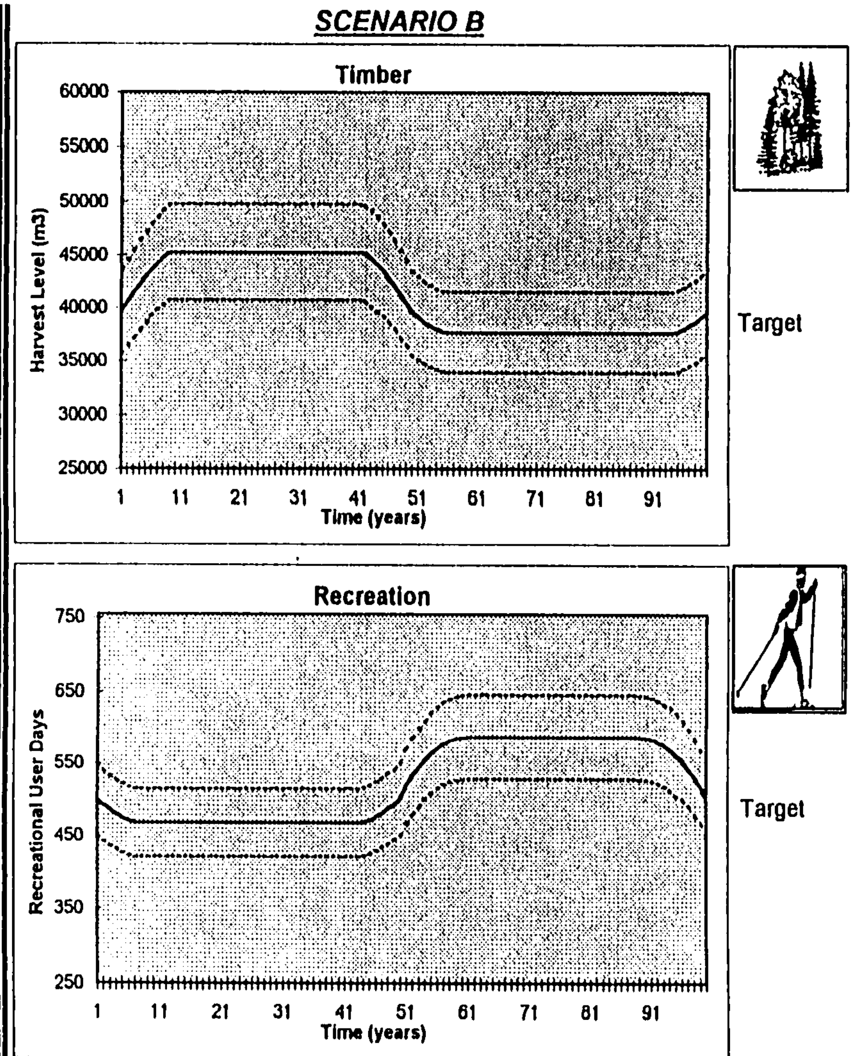


SCENARIO B ____

Which scenario do you prefer? Please check A or B:

Please explain why you made the choice that you did:





SCENARIO A _____

SCENARIO B _____

Which scenario do you prefer? Please check A or B:

Please explain why you made the choice that you did:

Section II

What is your age?

___ under 24 years
___ 25 to 34 years
___ 35 to 44 years
___ 45 to 54 years
___ 55 to 64 years
___ more than 65 years

You are: ___ Male ___ Female

3. Which of these best describes the area where you live?

___ On a farm
___ A rural area but not a farm
___ A community of less than 1, 000 people
___ A town of 1, 000 to 4, 999 people
___ A town of 5, 000 to 9, 999 people
___ A town of 10, 000 to 49, 999 people
___ A city 0f 50, 000 to 99, 999 people
___ A city larger than 100,000 people

4. Which category best describes your total household income (before taxes) in 1997?

___ less than $10, 000
___ $10, 000 - $19, 999
___ $20, 000 - $29, 999
___ $30, 000 - $39, 999
___ $40, 000 - $49, 999
___ $50, 000 - $59, 999
___ $60, 000 - $69, 999
___ $70, 000 - $79, 999
___ $80, 000 - $89, 999
___ $90, 000 - $99, 999
___ $100, 000 or above

5. What is the highest level of education you have completed?

___ Never attended school
___ Grade School
___ Some high school
___ Completed high school
___ Technical school
___ Some university
___ Undergraduate university degree
___ Some graduate study
___ Postgraduate university degree

6. How many people live in your household? ___

7. Please try to estimate the number of outdoor recreation days you spent in Alberta during the previous 1 year: ___ less than 5 days ___ 11 to 15 days

___ 6 to 10 day ___ more than 15 days

8. Which of the following interests do you represent on the committee? (You may check more than one)

___ Local or regional government

___ Forestry company

___ Non-forestry company (oil & gas, etc.)

___ Local community (member of the public)

___ Other (please specify ________________)

___ Aboriginal group

___ Environmental group

___ Recreational association

___ Labour group

9. Any comments about this survey or about forest management in Alberta are appreciated and may be written in the space below:

Appendix B: Time Path Values, Harvest Levels & Recreational User Days

Time Path Values	Gains Before Losses			Losses Before Gains			
IRR	-2%	2%	4%	0%	-2%	2%	4%
Year1	1	1	1	0	-1	-1	-1
	15	10	9	0	-15	-10	-9
	29	18.5	17	0	-29	-18.5	-17
	43	26	24	0	-43	-26	-24
	55	33	28.5	0	-55	-33	-28.5
	66	38.5	30	0	-66	-38.5	-30
	76	41.5	31	0	-76	-41.5	-31
	85	43	31	0	-85	-43	-31
	93	43	31	0	-93	-43	-31
Year10	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
Year20	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
Year30	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
Year40	93.5	43	31	0	-93.5	-43	-31
	93.5	43	31	0	-93.5	-43	-31
	93	43	31	0	-93	-43	-31
	85	43	31	0	-85	-43	-31
	76	41.5	31	0	-76	-41.5	-31
	66	38.5	30	0	-66	-38.5	-30
	55	33	28.5	0	-55	-33	-28.5

	43	26	24	0	-43	-26	-24
	29	18.5	17	0	-29	-18.5	-17
	15	10	9	0	-15	-10	-9
Year50	0	0	0	0	0	0	0
	-8	-25	-30	0	8	25	30
	-15	-43	-65	0	15	43	65
	-21	-59	-95	0	21	59	95
	-26	-73	-120	0	26	73	120
	-30	-85	-140	0	30	85	140
	-31.5	-95	-163	0	31.5	95	163
	-31.5	-103	-184	0	31.5	103	184
	-31.5	-109	-203	0	31.5	109	203
	-31.5	-113	-220	0	31.5	113	220
Year60	-31.5	-115	-235	0	31.5	115	235
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
Year70	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
Year80	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
	-31.5	-116	-243	0	31.5	116	243
Year90	-31.5	-115	-235	0	31.5	115	235
	-31.5	-113	-220	0	31.5	113	220
	-31.5	-109	-203	0	31.5	109	203
	-31.5	-103	-181	0	31.5	103	181
	-31.5	-95	-158	0	31.5	95	163
	-30	-85	-140	0	30	85	140
	-26	-73	-120	0	26	73	120
	-21	-59	-95	0	21	59	95
	-15	-43	-65	0	15	43	65

	-8	-25	-30	0	8	25	30
Year100	-1	-1	-1	0	1	1	1
Timber	Gains Before Losses			Losses Before Gains			
	-2%	2%	4%	0%	-2%	2%	4%
Year1	39679	39679	39679	39679	39559	39559	39559
	40519	40219	40159	39679	38719	39019	39079
	41359	40729	40639	39679	37879	38509	38599
	42199	41179	41059	39679	37039	38059	38179
	42919	41599	41329	39679	36319	37639	37909
	43579	41929	41419	39679	35659	37309	37819
	44179	42109	41479	39679	35059	37129	37759
	44719	42199	41479	39679	34519	37039	37759
	45199	42199	41479	39679	34039	37039	37759
Year10	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
Year20	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
Year30	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
Year40	45229	42199	41479	39679	34009	37039	37759
	45229	42199	41479	39679	34009	37039	37759
	45199	42199	41479	39679	34039	37039	37759
	44719	42199	41479	39679	34519	37039	37759
	44179	42109	41479	39679	35059	37129	37759
	43579	41929	41419	39679	35659	37309	37819
	42919	41599	41329	39679	36319	37639	37909
	42199	41179	41059	39679	37039	38059	38179

	41359	40729	40639	39679	37879	38509	38599
	40519	40219	40159	39679	38719	39019	39079
Year50	39619	39619	39619	39679	39619	39619	39619
	39139	38119	37819	39679	40099	41119	41419
	38719	37039	35719	39679	40519	42199	43519
	38359	36079	33919	39679	40879	43159	45319
	38059	35239	32419	39679	41179	43999	46819
	37819	34519	31219	39679	41419	44719	48019
	37729	33919	29839	39679	41509	45319	49399
	37729	33439	28579	39679	41509	45799	50659
	37729	33079	27439	39679	41509	46159	51799
	37729	32839	26419	39679	41509	46399	52819
Year60	37729	32719	25519	39679	41509	46519	53719
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
Year70	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
Year80	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
	37729	32659	25039	39679	41509	46579	54199
Year90	37729	32719	25519	39679	41509	46519	53719
	37729	32839	26419	39679	41509	46399	52819
	37729	33079	27439	39679	41509	46159	51799
	37729	33439	28759	39679	41509	45799	50479
	37729	33919	30139	39679	41509	45319	49399
	37819	34519	31219	39679	41419	44719	48019
	38059	35239	32419	39679	41179	43999	46819
	38359	36079	33919	39679	40879	43159	45319
	38719	37039	35719	39679	40519	42199	43519
	39139	38119	37819	39679	40099	41119	41419

Year100	39559	39559	39559	39679	39679	39679	39679

Recreation	Gains Before Losses			Losses Preceding Gains			
IRR	-2%	2%	4%	0%	-2%	2%	4%
Year1	500.75	500.75	500.75	500	499.25	499.25	499.25
	511.25	507.5	506.75	500	488.75	492.5	493.25
	521.75	513.875	512.75	500	478.25	486.125	487.25
	532.25	519.5	518	500	467.75	480.5	482
	541.25	524.75	521.375	500	458.75	475.25	478.625
	549.5	528.875	522.5	500	450.5	471.125	477.5
	557	531.125	523.25	500	443	468.875	476.75
	563.75	532.25	523.25	500	436.25	467.75	476.75
	569.75	532.25	523.25	500	430.25	467.75	476.75
Year10	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
Year20	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
Year30	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
Year40	570.125	532.25	523.25	500	429.875	467.75	476.75
	570.125	532.25	523.25	500	429.875	467.75	476.75
	569.75	532.25	523.25	500	430.25	467.75	476.75
	563.75	532.25	523.25	500	436.25	467.75	476.75
	557	531.125	523.25	500	443	468.875	476.75
	549.5	528.875	522.5	500	450.5	471.125	477.5
	541.25	524.75	521.375	500	458.75	475.25	478.625
	532.25	519.5	518	500	467.75	480.5	482
	521.75	513.875	512.75	500	478.25	486.125	487.25

	511.25	507.5	506.75	500	488.75	492.5	493.25
Year50	500	500	500	500	500	500	500
	494	481.25	477.5	500	506	518.75	522.5
	488.75	467.75	451.25	500	511.25	532.25	548.75
	484.25	455.75	428.75	500	515.75	544.25	571.25
	480.5	445.25	410	500	519.5	554.75	590
	477.5	436.25	395	500	522.5	563.75	605
	476.375	428.75	377.75	500	523.625	571.25	622.25
	476.375	422.75	362	500	523.625	577.25	638
	476.375	418.25	347.75	500	523.625	581.75	652.25
	476.375	415.25	335	500	523.625	584.75	665
Year60	476.375	413.75	323.75	500	523.625	586.25	676.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
Year70	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
Year80	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
	476.375	413	317.75	500	523.625	587	682.25
Year90	476.375	413.75	323.75	500	523.625	586.25	676.25
	476.375	415.25	335	500	523.625	584.75	665
	476.375	418.25	347.75	500	523.625	581.75	652.25
	476.375	422.75	364.25	500	523.625	577.25	635.75
	476.375	428.75	381.5	500	523.625	571.25	622.25
	477.5	436.25	395	500	522.5	563.75	605
	480.5	445.25	410	500	519.5	554.75	590
	484.25	455.75	428.75	500	515.75	544.25	571.25
	488.75	467.75	451.25	500	511.25	532.25	548.75
	494	481.25	477.5	500	506	518.75	522.5
Year100	499.25	499.25	499.25	500	500.75	500.75	500.75

Appendix C: Main Effects Plan & Profile Descriptions

Main Effects Plan:

Column A: Scenario A Timber Time Path Starting Direction
(0 = 'Loss First', 1 = 'Gain First')

Column B: Scenario A Timber Time Path IRR
(0 = -2% IRR, 1 = 0% IRR, 2 = 2% IRR, 3 = 4% IRR)

Column C: Scenario A Recreation Time Path Starting Direction
(0 = 'Loss First', 1 = 'Gain First')

Column D: Scenario A Recreation Time Path IRR
(0 = -2% IRR, 1 = 0% IRR, 2 = 2% IRR, 3 = 4% IRR)

Column E: Scenario A Variance Bound
(0 = 5% variance bound, 1= 10% variance bound)

Column F: Scenario B Timber Time Path Starting Direction
(0 = 'Loss First', 1 = 'Gain First')

Column G: Scenario B Timber Time Path IRR
(0 = -2% IRR, 1 = 0% IRR, 2 = 2% IRR, 3 = 4% IRR)

Column H: Scenario B Recreation Time Path Starting Direction
(0 = 'Loss First', 1 = 'Gain First')

Column I: Scenario B Recreation Time Path IRR
(0 = -2% IRR, 1 = 0% IRR, 2 = 2% IRR, 3 = 4% IRR)

Column J: Scenario B Variance Bound
(0 = 5% variance bound, 1= 10% variance bound)

Column K: Profile Set (1 to 8) #1 and #62 replaced with #37 and #59 respectively.

	A	B	C	D	E	F	G	H	I	J	K
1	0	0	0	0	0	0	0	0	0	0	-
2	1	0	0	0	1	0	3	1	2	1	1
	0	0	0	0	0	1	1	0	3	1	1
4	1	0	0	0	1	1	2	1	1	0	1
5	0	1	0	3	0	0	0	1	1	1	2
6	1	1	0	3	1	0	3	0	3	0	2
7	0	1	0	3	0	1	1	1	2	0	2
8	1	1	0	3	1	1	2	0	0	1	2
9	0	2	1	1	0	0	0	0	2	0	3
10	1	2	1	1	1	0	3	1	0	1	3
11	0	2	1	1	0	1	1	0	1	1	3
12	1	2	1	1	1	1	2	1	3	0	3
13	0	3	1	2	0	0	0	1	3	1	4
14	1	3	1	2	1	0	3	0	1	0	4
15	0	3	1	2	0	1	1	1	0	0	4
16	1	3	1	2	1	1	2	0	2	1	4
17	0	1	1	1	1	1	1	0	0	0	5
18	1	1	1	1	0	1	2	1	2	1	5
19	0	1	1	1	1	0	0	0	3	1	5

20	1	1	1	1	0	0	3	1	1	0	5
21	0	0	1	2	1	1	1	1	1	1	6
22	1	0	1	2	0	1	2	0	3	0	6
23	0	0	1	2	1	0	0	1	2	0	6
24	1	0	1	2	0	0	3	0	0	1	6
25	0	3	0	0	1	1	1	0	2	0	7
26	1	3	0	0	0	1	2	1	0	1	7
27	0	3	0	0	1	0	0	0	1	1	7
28	1	3	0	0	0	0	3	1	3	0	7
29	0	2	0	3	1	1	1	1	3	1	8
30	1	2	0	3	0	1	2	0	1	0	8
31	0	2	0	3	1	0	0	1	0	0	8
32	1	2	0	3	0	0	3	0	2	1	8
33	0	2	0	2	0	0	2	0	0	0	1
34	1	2	0	2	1	0	1	1	2	1	1
35	0	2	0	2	0	1	3	0	3	1	1
36	1	2	0	2	1	1	0	1	1	0	1
37	0	3	0	1	0	0	2	1	1	1	1and2
38	1	3	0	1	1	0	1	0	3	0	2
39	0	3	0	1	0	1	3	1	2	0	2
40	1	3	0	1	1	1	0	0	0	1	2
41	0	0	1	3	0	0	2	0	2	0	3
42	1	0	1	3	1	0	1	1	0	1	3
43	0	0	1	3	0	1	3	0	1	1	3
44	1	0	1	3	1	1	0	1	3	0	3
45	0	1	1	0	0	0	2	1	3	1	4
46	1	1	1	0	1	0	1	0	1	0	4
47	0	1	1	0	0	1	3	1	0	0	4
48	1	1	1	0	1	1	0	0	2	1	4
49	0	3	1	3	1	1	3	0	0	0	5
50	1	3	1	3	0	1	0	1	2	1	5
51	0	3	1	3	1	0	2	0	3	1	5
52	1	3	1	3	0	0	1	1	1	0	5
53	0	2	1	0	1	1	3	1	1	1	6
54	1	2	1	0	0	1	0	0	3	0	6
55	0	2	1	0	1	0	2	1	2	0	6
56	1	2	1	0	0	0	1	0	0	1	6
57	0	1	0	2	1	1	3	0	2	0	7
58	1	1	0	2	0	1	0	1	0	1	7
59	0	1	0	2	1	0	2	0	1	1	7and8
60	1	1	0	2	0	0	1	1	3	0	7
61	0	0	0	1	1	1	3	1	3	1	8
62	1	0	0	1	0	1	0	0	1	0	-
63	0	0	0	1	1	0	2	1	0	0	8
64	1	0	0	1	0	0	1	0	2	1	8

Profile Descriptions:

Profile # 1

Scenario A
Timber Time Path IRR: -2%
Gain / Loss Ordering: Loss First
First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: -2%
Gain / Loss Ordering: Loss
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Profile # 2

Scenario A
Timber Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Profile # 3

Scenario A
Timber Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Profile # 4

Scenario A
Timber Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Profile # 5

Scenario A
Timber Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Profile # 6

Scenario A
Timber Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR:4%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Profile # 7	Scenario A	Scenario B
Timber Time Path IRR:	0%	0%
Gain / Loss Ordering:	Loss First	Gain First
Recreation Time Path IRR:	4%	2%
Gain / Loss Ordering:	Loss First	Gain First
Variance Bound:	5%	5%

Profile # 8	Scenario A	Scenario B
Timber Time Path IRR:	0%	2%
Gain / Loss Ordering:	Gain First	Gain First
Recreation Time Path IRR:	4%	-2%
Gain / Loss Ordering:	Loss First	Loss First
Variance Bound:	10%	10%

Profile # 9	Scenario A	Scenario B
Timber Time Path IRR:	2%	-2%
Gain / Loss Ordering:	Loss First	Loss First
Recreation Time Path IRR:	0%	2%
Gain / Loss Ordering:	Gain First	Loss First
Variance Bound:	5%	5%

Profile # 10	Scenario A	Scenario B
Timber Time Path IRR:	2%	4%
Gain / Loss Ordering:	Gain First	Loss First
Recreation Time Path IRR:	0%	-2%
Gain / Loss Ordering:	Gain First	Gain First
Variance Bound:	10%	10%

Profile # 11	Scenario A	Scenario B
Timber Time Path IRR:	2%	0%
Gain / Loss Ordering:	Loss First	Gain First
Recreation Time Path IRR:	0%	0%
Gain / Loss Ordering:	Gain First	Loss First
Variance Bound:	5%	10%

Profile # 12	Scenario A	Scenario B
Timber Time Path IRR:	2%	2%
Gain / Loss Ordering:	Gain First	Gain First
Recreation Time Path IRR:	0%	4%
Gain / Loss Ordering:	Gain First	Gain First
Variance Bound:	10%	5%

Profile # 13	Scenario A	Scenario B
Timber Time Path IRR:	4%	-2%
Gain / Loss Ordering:	Loss First	Loss First

Recreation Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Recreation Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Profile # 14 — Scenario A
Timber Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Profile # 15 — Scenario A
Timber Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Profile # 16 — Scenario A
Timber Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Profile # 17 — Scenario A
Timber Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Profile # 18 — Scenario A
Timber Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Profile # 19 — Scenario A
Timber Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Profile # 20	Scenario A	Scenario B
Timber Time Path IRR:	0%	4%
Gain / Loss Ordering:	Gain First	Loss First
Recreation Time Path IRR:	0%	0%
Gain / Loss Ordering:	Gain First	Gain First
Variance Bound:	5%	5%

Profile # 21	Scenario A	Scenario B
Timber Time Path IRR:	-2%	0%
Gain / Loss Ordering:	Loss First	Gain First
Recreation Time Path IRR:	2%	0%
Gain / Loss Ordering:	Gain First	Gain First
Variance Bound:	10%	10%

Profile # 22	Scenario A	Scenario B
Timber Time Path IRR:	-2%	2%
Gain / Loss Ordering:	Gain First	Gain First
Recreation Time Path IRR:	2%	4%
Gain / Loss Ordering:	Gain First	Loss First
Variance Bound:	5%	5%

Profile # 23	Scenario A	Scenario B
Timber Time Path IRR:	-2%	-2%
Gain / Loss Ordering:	Loss First	Loss First
Recreation Time Path IRR:	2%	2%
Gain / Loss Ordering:	Gain First	Gain First
Variance Bound:	10%	5%

Profile # 24	Scenario A	Scenario B
Timber Time Path IRR:	-2%	4%
Gain / Loss Ordering:	Gain First	Loss First
Recreation Time Path IRR:	2%	-2%
Gain / Loss Ordering:	Gain First	Loss First
Variance Bound:	5%	10%

Profile # 25	Scenario A	Scenario B
Timber Time Path IRR:	4%	0%
Gain / Loss Ordering:	Loss First	Gain First
Recreation Time Path IRR:	-2%	2%
Gain / Loss Ordering:	Loss First	Loss First
Variance Bound:	10%	5%

Profile # 26	Scenario A	Scenario B
Timber Time Path IRR:	4%	2%
Gain / Loss Ordering:	Gain First	Gain First

Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Recreation Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Profile # 27 — Scenario A
Timber Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Profile # 28 — Scenario A
Timber Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Profile # 29 — Scenario A
Timber Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Profile # 30 — Scenario A
Timber Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Profile # 31 — Scenario A
Timber Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Profile # 32 — Scenario A
Timber Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Profile # 33 Scenario A
Timber Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Profile # 34 Scenario A
Timber Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Profile # 35 Scenario A
Timber Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Profile # 36 Scenario A
Timber Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Profile # 37 Scenario A
Timber Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Profile # 38 Scenario A
Timber Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Profile # 39 Scenario A
Timber Time Path IRR: 4%
Gain / Loss Ordering: Loss First

Scenario B
Timber Time Path IRR: 4%
Gain / Loss Ordering: Gain First

Recreation Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Recreation Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Profile # 40 Scenario A
Timber Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Profile # 41 Scenario A
Timber Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Profile # 42 Scenario A
Timber Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Profile # 43 Scenario A
Timber Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Profile # 44 Scenario A
Timber Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Profile # 45 Scenario A
Timber Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Profile # 46	Scenario A	Scenario B
Timber Time Path IRR:	0%	0%
Gain / Loss Ordering:	Gain First	Loss First
Recreation Time Path IRR:	-2%	0%
Gain / Loss Ordering:	Gain First	Loss First
Variance Bound:	10%	5%

Profile # 47	Scenario A	Scenario B
Timber Time Path IRR:	0%	4%
Gain / Loss Ordering:	Loss First	Gain First
Recreation Time Path IRR:	-2%	-2%
Gain / Loss Ordering:	Gain First	Gain First
Variance Bound:	5%	5%

Profile # 48	Scenario A	Scenario B
Timber Time Path IRR:	0%	-2%
Gain / Loss Ordering:	Gain First	Gain First
Recreation Time Path IRR:	-2%	2%
Gain / Loss Ordering:	Gain First	Loss First
Variance Bound:	10%	10%

Profile # 49	Scenario A	Scenario B
Timber Time Path IRR:	4%	4%
Gain / Loss Ordering:	Loss First	Gain First
Recreation Time Path IRR:	4%	-2%
Gain / Loss Ordering:	Gain First	Loss First
Variance Bound:	10%	5%

Profile # 50	Scenario A	Scenario B
Timber Time Path IRR:	4%	-2%
Gain / Loss Ordering:	Gain First	Gain First
Recreation Time Path IRR:	4%	2%
Gain / Loss Ordering:	Gain First	Gain First
Variance Bound:	5%	10%

Profile # 51	Scenario A	Scenario B
Timber Time Path IRR:	4%	2%
Gain / Loss Ordering:	Loss First	Loss First
Recreation Time Path IRR:	4%	4%
Gain / Loss Ordering:	Gain First	Loss First
Variance Bound:	10%	10%

Profile # 52	Scenario A	Scenario B
Timber Time Path IRR:	4%	0%
Gain / Loss Ordering:	Gain First	Loss First

Recreation Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Recreation Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Profile # 53 Scenario A
Timber Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Profile # 54 Scenario A
Timber Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 4%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Profile # 55 Scenario A
Timber Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Profile # 56 Scenario A
Timber Time Path IRR: 2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Profile # 57 Scenario A
Timber Time Path IRR: 0%
Gain / Loss Ordering: Loss First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Variance Bound: 10%

Scenario B
Timber Time Path IRR: 4%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Profile # 58 Scenario A
Timber Time Path IRR: 0%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: 2%
Gain / Loss Ordering: Loss First
Variance Bound: 5%

Scenario B
Timber Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Recreation Time Path IRR: -2%
Gain / Loss Ordering: Gain First
Variance Bound: 10%

Profile # 59

Scenario A		Scenario B	
Timber Time Path IRR:	0%	Timber Time Path IRR:	2%
Gain / Loss Ordering:	Loss First	Gain / Loss Ordering:	Loss First
Recreation Time Path IRR:	2%	Recreation Time Path IRR:	0%
Gain / Loss Ordering:	Loss First	Gain / Loss Ordering:	Loss First
Variance Bound:	10%	Variance Bound:	10%

Profile # 60

Scenario A		Scenario B	
Timber Time Path IRR:	0%	Timber Time Path IRR:	0%
Gain / Loss Ordering:	Gain First	Gain / Loss Ordering:	Loss First
Recreation Time Path IRR:	2%	Recreation Time Path IRR:	4%
Gain / Loss Ordering:	Loss First	Gain / Loss Ordering:	Gain First
Variance Bound:	5%	Variance Bound:	5%

Profile # 61

Scenario A		Scenario B	
Timber Time Path IRR:	-2%	Timber Time Path IRR:	4%
Gain / Loss Ordering:	Loss First	Gain / Loss Ordering:	Gain First
Recreation Time Path IRR:	0%	Recreation Time Path IRR:	4%
Gain / Loss Ordering:	Loss First	Gain / Loss Ordering:	Gain First
Variance Bound:	10%	Variance Bound:	10%

Profile # 62

Scenario A		Scenario B	
Timber Time Path IRR:	-2%	Timber Time Path IRR:	-2%
Gain / Loss Ordering:	Gain First	Gain / Loss Ordering:	Gain First
Recreation Time Path IRR:	0%	Recreation Time Path IRR:	0%
Gain / Loss Ordering:	Loss First	Gain / Loss Ordering:	Loss First
Variance Bound:	5%	Variance Bound:	5%

Profile # 63

Scenario A		Scenario B	
Timber Time Path IRR:	-2%	Timber Time Path IRR:	2%
Gain / Loss Ordering:	Loss First	Gain / Loss Ordering:	Loss First
Recreation Time Path IRR:	0%	Recreation Time Path IRR:	-2%
Gain / Loss Ordering:	Loss First	Gain / Loss Ordering:	Gain First
Variance Bound:	10%	Variance Bound:	5%

Profile # 64

Scenario A		Scenario B	
Timber Time Path IRR:	-2%	Timber Time Path IRR:	0%
Gain / Loss Ordering:	Gain First	Gain / Loss Ordering:	Loss First
Recreation Time Path IRR:	0%	Recreation Time Path IRR:	2%
Gain / Loss Ordering:	Loss First	Gain / Loss Ordering:	Loss First
Variance Bound:	5%	Variance Bound:	10%

Appendix D: Summary of Profile Responses

Profile	A Chosen	B Chosen	Total
#37	1	6	7
#2	7	0	7
#3	4	3	7
#4	1	6	7
#33	6	1	7
#34	2	5	7
#35	7	0	7
#36	1	6	7
#5	5	3	8
#6	2	6	8
#7	5	3	8
#8	4	4	8
#37	3	5	8
#38	2	6	8
#39	5	3	8
#40	2	6	8
#9	3	3	6
#10	3	3	6
#11	1	5	6
#12	4	2	6
#41	1	5	6
#42	0	6	6
#43	6	0	6
#44	3	3	6
#13	6	3	9
#14	2	7	9
#15	5	4	9
#16	1	8	9
#45	7	2	9
#46	1	8	9
#47	8	1	9
#48	4	5	9

Profile	A Chosen	B Chosen	Total
#17	7	0	7
#18	7	0	7
#19	5	2	7
#20	6	1	7
#49	4	3	7
#50	0	7	7
#51	0	7	7
#52	1	6	7
#21	2	6	8
#22	5	3	8
#23	5	3	8
#24	7	1	8
#53	7	1	8
#54	5	3	8
#55	6	2	8
#56	2	6	8
#25	0	7	7
#26	0	7	7
#27	1	6	7
#28	4	3	7
#57	6	1	7
#58	5	2	7
#59	5	2	7
#60	7	0	7
#29	7	1	8
#30	6	2	8
#31	3	5	8
#32	5	3	8
#59	6	2	8
#61	8	0	8
#63	6	2	8
#64	2	6	8

Appendix E: Summary of Survey Comments

Profile Comments:

-#2B: Increased cut suggests loss of opportunity for recreation.
-#2A: Scenario B timber target too high near end.
-#2A: I prefer the more consistent stream of timber harvest than the large cut increase in years 50-100.
-#3B: Timber remains sustained while recreation increased.
-#5A: Sustained even-flow timber harvest creates jobs and economic stability for communities over the long term.
-#5A: Would like to see timber activity remain constant or decrease.
-#6B: The uneven flow of timber harvest in B creates more jobs for the 50-100 year period than A, and recreation does not change between A and B.
-#9A: Preference to maintain of enhance the employment base without sacrificing recreation opportunities.
-#10B: Greater gains would be achieved overall even if recreation opportunities were reduced.
-#10A: Scenario A has less disturbance on average.
-#13A: Greater timber and recreation benefits.
-#13B: I think significant increases in harvest levels over present conditions will result in over exploitation therefore I am willing to trade off recreational use.
-#13B: Timber harvest is relatively stable and there are still about 300 recreation days in Scenario B, but increased harvest levels in Scenario A.
-#14B: Greater overall benefits.
-#14B: Enables continued harvesting without impacting recreational use.
-#15A: Timber can not be managed on a straight line graph, too many other variables involved.
-#16B: Relatively minor fluctuations for both user groups.
-#17A: Greater stability in timber supply and harvesting of forest land.
-#17A: I do not want to see a decline in recreation especially with population growth and increased demands on forest resources.
-#18A: Stable on both resources.
-#18A: I don't believe timber or recreation should have a lot of fluctuations.
-#18A: Short term benefits do not outweigh long term averages.
-#19B: As long as neither dips below current levels.
-#20A: Large fluctuations in timber harvest make it difficult to monitor impact on ecosystems and irreparable damage could be the result.
-#21B: Scenario B allows reasonable changes in the future without compromising opportunities now.
-#21B: Consistent harvest, easier to plan, budget, manage forest operations. Not any easier or more difficult on any particular generation or workforce. Recreation same for all generations. Most equitable.
-#22A: More predictable and stable workforce in the long term.
-#24Some short term pain for long term gain.

-#25B: Smaller fluctuations.
-#25B: I agree with Scenario B because it practices even-flow timber management and maintains and increases recreational use.
-#26B: I believe this to be a beneficial distribution of sustainable harvest resources.
-#29B: Did not like recreation going down.
-#30B: Scenario A is undesirable because timber and recreation are both reaching extremes, which may indicate a reduction in biodiversity of the forest. I also have concerns about the increased pressure that an increased number of recreational users will put on the environment.
-#31B: I like to see recreation fill in the void when harvesting is low.
-#37B: Seems to be reflective of more sustainable harvest levels.
-#37B: I prefer B because there is less of a rise and fall in timber harvest than A. Scenario B is a little more stable and recreation is unaffected.
-#45A: Appears somewhat sustainable timber harvest into the future without negative effect on recreation.
-#46B: Perfect Scenario B.
-#49B: Did not like timber crashing in Scenario B.
-#49A: An increase in harvesting is preferred to a decrease for economic and environmental reasons.
-#50B: Prefer a moderate approach.
-#50B: Less fluctuation around the long term average in both timber and recreation.
-#51B: Less variance in terms of harvest allows for a more stable economy on a local basis.
-#52A: Although recreation dropped drastically, timber harvest also dropped for 30 years which lessened the impact on the forest.
-#52B: Short term gains can never do better than long term sustainability, I do have children.
-#53A: Scenario B does not provide for sustainable development.
-#54A: Anything to avoid the extreme.
-#54B: Dip in timber isn't as severe with increased opportunities for recreation and resulting economic benefits.
-#54A: I prefer lower harvest levels over increased recreational use.
-#59A: Overall, I would prefer a flatter harvest line over time, not only to promote sustainability, but also to allow for realistic planning in the forest industry (ie. No great spurts in new plants coming on stream or false expectations of high AACs).
-#60A: Maintains even-flow timber management and increases recreational use.
-#64B: Scenario A is basically borrowing employment in the timber industry from the next generation without providing any benefits to the recreation side.

General Comments:
-I feel that there has to be a balance between the harvest, management and recreation of our woodlands. What is the point of having this resource without being able to enjoy it.

-Sustainable forest is prime importance. It has been proven elsewhere in the world what happens when we loose tree growth. Canada does not need to join the rest of the world with the attitude of "Cut down the forest"! Use it, don't abuse it!

-The issue is far too complicated to look at just timber and recreation.
-In order to answer these questions properly, an understanding of the 'land use objective' is necessary. Forest Management in Alberta could be greatly improved with a clear understanding of what the land use objectives are.

-I think forest harvest has gone beyond sustained yield. We are harvesting too much of our forests to ensure future supply.

-It is difficult to imagine some of these scenarios in true life. It would have been helpful to have some real life examples, not necessarily in a specific area.

-Pretty simplified view of forest and forestry. There are many interrelated values that are difficult to model.

-It would be more useful to compare harvest scenarios with ecological benefits such as O_2 production, habitat for wildlife, etc.

-As a professional forester, I found that this questionnaire was difficult to answer. Most of Alberta's long term planning for Forest/Environmental values is projected for at least '2 rotations' or 200-220 years, so without seeing the impact the practices of the first rotation will have on the structure of the future forest for timber, recreation and wildlife values, it is difficult to make a decision.