VALUING INTERNATIONAL RAINFORESTS:

A CHOICE MODELLING APPROACH

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1.0 Introduction

Economists infer value for environmental amenities in two main ways; by assessing the preferences that people reveal in associated market transactions, or by asking people to state their preferences directly. Both approaches have some shortcomings. Revealed preference techniques, such as the travel cost method, are restricted to a few areas where environmental factors impact substantially on market associated transactions. As well, these techniques are limited to purely use values, to historical data, and often suffer from problems of multicollinearity and narrow information ranges. Stated preference techniques such as contingent valuation overcome most of these shortcomings, being flexible, forward looking, and capable of measuring non-use as well as use values. However there are a number of biases and limitations in the use of this method[1], and a lingering suspicion among economists that stated preferences do not translate into action (Carson 1995).

Choice modelling is a relatively new direction in stated preference techniques. It reflects some of the more attractive features of revealed preference methods yet avoids some of the pitfalls. Choice modelling asks people to indicate their preferred choice from two or more different scenarios. These scenarios are comprised of bundles of attributes, and choices thus reveal preferences between bundles. Repeated experiments and statistical analysis of the data enables researchers to estimate the influence of different attributes on choices, and hence utility.

The process is attractive in that it is a much closer model of consumer behaviour than other stated preference techniques. People habitually make choices according to a range of different attributes or characteristics, and often choose between several different options at one time. Choice modelling can capture this realism by asking people to indicate their preferred choice from several different options. The challenge for researchers then is to dissaggregate the data to reveal the influence that each particular attribute has on choice. In this way it shares some passing similarities with revealed preference techniques such as hedonic pricing.

In this paper we report on a novel application for the choice modelling technique. We have estimated the demand that Australians have for the preservation of rainforests, both in Australia and in overseas countries. Our approach reveals a number of strengths inherent in the choice modelling technique. First, as a stated preference method, it is capable of capturing both use and non-use values. Second, it is capable of estimating demand for environmental amenities

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[1] See Mitchell and Carson (1989), Bennett and Carter (1993) and Rolfe (1996).

that is not well known or understood by respondents. Third, it avoids problems of embedding by obscuring a good of particular interest within an array of complementary and substitute goods. Fourth, it minimises ethical and moral concerns by de-emphasising price as a tradeoff and presenting respondents with realistic choice packages.

The choice modelling pathway though is not a well trodden one, and there are several complexities involved in its implementation. For convenience, these may be summarised into three stages. The first is the selection of attributes and levels necessary to depict the good in question. The second is to estimate the form of the relevant utility function and associated selection of scenarios to present > respondents. The third is to analyse statistically the s¹   , results.

We demonstrate the application of these stages to the rainforest valuation issue². This study had a specific valuation goal in mind; to assess the importance that Australians held for two protected areas in Vanuatu. Flatley and Bennett (1994) used contingent valuation to show that one section of the international community, Australian tourists visiting Vanuatu, would be prepared to pay around $30 per head to protect the two protected areas. However, their results provide little guidance for values that might be held by the rest of the Australian community because of the differences in knowledge about Vanuatu. As well, their approach is not appropriate for the wider Australian community. Limitations to the application of the contingent valuation method apply when respondents have poor knowledge and ability to construct preferences about a particular good (Mitchell and Carson 1989, Bennett and Carter 1993, Rolfe 1996). This would appear to be the case in this application.

This study is adventurous in two main aspects:

(a) it is trying to find values for an environmental asset that most people have little knowledge of - rainforests in Vanuatu, and

(b) it is valuing something in an international setting.

To progress these issues, this paper is structured in the following manner. An overview of the choice modelling process is provided in the next section, and in section three we report on the first stage of choice modelling, the identification of attributes and levels. Sections four and five outline how we have applied two iterations of the choice modelling technique, and section six concludes the paper.

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²   Some brief case studies involving international rainforests are presented in Dixon and Sherman (1990). Barbeir, Burgess and Markandya (1991) and Brown and Pierce provide insights into the economic causes of tropical deforestation. Carson (1991) outlines some of the issues involved in using contingent valuation to provide estimates of tropical rainforest values.

2. Choice Modelling

The choice modelling technique has developed from a market research field, conjoint analysis, on the one hand, and contingent valuation on the other. Conjoint analysis generally refers to market research techniques where respondents are asked to rank or rate scenarios according to preference (Green and Srinivasan 1978, 1990, Wittink and Cattin 1989). Mackenzie (1992) (1993) provides a discussion of ranking and rating techniques (contingent ranking and rating), and applications to hunting trips. The difficulty with this approach is that an assumption is necessary about the scales used being consistent between different respondents (Freeman 1991). Asking respondents simply to choose a preferred option makes the process more consistent with the foundations of economic theory (Adamowicz et al 1994).

Choice modelling developed from the work of Louviere and Woodworth (1983) and Louviere (1988). While it is still generically referred to as a "conjoint technique" (Adamowicz et al 1994), we prefer the more identifiable "choice modelling" term[3] as used by Carson et al (1994) to distinguish it from the mainstream conjoint analysis field, which relies on ranking and rating scales and often has different behavioural assumptions as a base. The "choice modelling" label is descriptive in that the technique models how people make choices.

Choice modelling is grounded in random utility theory (Thurstone 1927, McFadden 1974), which suggests that consumers make choices to maximise their utility subject to constraints. To the outside observer, the utility attached to choices is made up of an observable or systematic component, and an unobservable, or random component. This random component occurs because of individual variation in choice, and, for researchers studying groups of people, is emphasised by differences in individual choice. The aim of the researcher is to estimate the observable components of choice functions, and simultaneously minimise the random component.

Further, choice modelling is a model of discrete choice. The researcher typically models the probability that a particular option will be taken, relying on the particular combination of systematic (observed) variables that have been identified as well as including the random (unobserved) component. In order to estimate the utility function, the researcher must first make assumptions about the distribution of the random component (Louviere 1994). Assuming a normal distribution yields a binary Probit model (Thurstone 1927), while assuming a Gumbel distribution yields a Multinominal Logit model (McFadden 1974). The logit model is generally preferred

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[3] Louviere (1995) notes that these techniques have also been referred to as experimental choice analysis or choice-based conjoint. Choice modelling is the term used by Carson et al (1994).

because it is compuctionally easier to use (Pindyck and Rubinfeld 1981).

2.1 The Description of Scenarios

Drawing on Lancaster's (1966) theory of demand, practitioners of choice modelling view scenarios as being comprised of bundles of characteristic. Each characteristic or attribute can vary across an appropriate range, usually in a set of different levels. For example, scenarios involving the selection of eggs might be described according to the attributes of production method, origin, freshness information and price. Each attribute might vary across three different levels, so that production methods could be described as battery, barn or perchery, or free-range. Origin could be local, national or imported, while price per dozen could be $1.50, $2.50 or $3.50[4].

By selecting various levels for each attribute, it is possible for the researcher to construct a large number of different scenarios. Ultimately the aim of the researcher is to predict respondent choices to real life scenarios of particular interest, and it is this long term goal that focuses the description of scenarios. Here, careful selection of attributes and levels are paramount, and several requirements need to be met (Green and Srinivasan 1978, Louviere 1988).

The first requirement is that the attributes and levels chosen capture the essence of the real world situations to be modelled. In a sense, they need to embrace a wide range of ways that people view and make choices about particular items. Green and Srinivasan (1978) recommend that the range of levels be larger than reality, but not too large to be unbelievable. The second requirement is that attributes and levels need to be perceived consistently by different people to ensure their choices are congruous. A side issue here is that varying numbers of levels between attributes may bias results towards attributes with more levels (Steenkamp and Wittink 1994). It is generally preferable, for this and design reasons, to have consistent numbers of levels across attributes.

The third requirement, from the perspective of both model complexity and the limitations of respondent enthusiasm and cognisance, is that the selection of attributes and levels should be parsimonious. The fourth, slightly weaker requirement, is that scenarios should not be unrealistic. The challenge for the researcher is to select a parsimonious number of relevant attributes that summarise the way people think about the good in question and have the ability to impart accurately to potential respondents scenarios of interest (Louviere 1988). This is a role that may be undertaken by focus groups.

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[4] These attributes and levels have been taken from a conjoint analysis study of eggs by Ness and Gerhardy (1993).

2.2 Selection of Scenarios

The total number of different scenarios that can be described
from a set c attributes and levels, known as a "factorial",
is a combination of the numbers of each. For example, an
exercise involving six attributes, each varying over two
levels, could be combined in two to the sixth different ways,
or 64 different scenarios. An exercise involving four
attributes each varying across three levels can be combined in
three to the fourth different ways, or 81 different scenarios.

More complex goods, described by larger numbers of attributes
and levels, generate far greater numbers of different
scenarios. A good described by ten attributes of four levels
each has a factorial of more than one million possible
scenarios. Clearly, the choice modelling researcher cannot
hope to use all the possible combinations. A fraction of the
possible factorial, known as a "fractional factorial" needs to
be selected. Some systematic basis needs to be developed to
select the fractional factorial.

As well as sampling systematically from the possible
factorial, the researcher has to be systematic about how the
sampled scenarios are combined to form the choice sets put
before individuals. For example, 4032 different pairs of
scenarios can be drawn from a set of 64 scenarios. This
general area of selecting possible scenarios is a form of
experimental design (Louviere 1988, Winer 1991)

Unfortunately for the choice modelling practitioner, the
systematic selection process is itself open to variation. The
reason is that the probability attached to different
combinations needs to vary according to the circumstances of
each analysis. If the scenario attributes are completely
independent of each other (so that no interactions exist),
then the probability attached to each different scenario is
equal and constant, allowing a straightforward experimental
design process to be developed. However, if significant
interactions occur between attributes (i.e. it is the
combination of local production and free range eggs that is
important), then some scenarios are more important than others
and need to have a higher probability of being included in the
fractional factorial. The reasons for this become clearer
when functional forms are discussed in the following section.

2.3 Functional Forms and the Iterative Process

Choice modelling surveys provide a rich data set about which
bundles of attributes are preferred to others. The model is
set up on the basis that the utility of the respondents is
dependant on the attributes involved, and preferred scenarios
are those that offer higher levels of utility. In multi-
attribute scenarios, the difficulty is that it is hard to
match a choice (and thus higher levels of utility) with
changes in a particular attribute when several attributes have
changed simultaneously and when error terms are involved.

To perform the analysis, the researcher must make assumptions about the distribution of the error terms (usually a Gumbel distribution leading to the multinominal logit function), and the form of the utility function. For example, functions where the attributes are strictly additive (assuming that no interactions are significant) can be estimated by sampling what are called "orthogonal main effects designs" from the possible factorial (Louviere 1994). This strictly additive function is then the form that the multi-nominal logit model analyses.

However, if significant interactions between attributes are present, the results from using a main effects design will be biased, and a form of the utility function that specified the interactions correctly (i.e. a polynomial equation instead of an a strictly additive equation) would be more accurate. The difficulty for the researcher is that results from a main effects plan do not identify bias or indicate more accurate forms for the utility function (Louviere 1988, 1994). Unfortunately, complete designs that include all interactions as well as main effects are often less attractive, for two main reasons. First, including all the possible attribute interactions (two way, three way, and so on) substantially increases the number of effects to be measured, making the model much more difficult to compute. Second, problems in overfitting often reduce explanatory power when compared to a simple main effects design (Elrod et al 1992).

Main effects generally provide most explanatory power in a demand function. Using the example of eggs, it would be normal for the attributes (price, freshness, size, production method etc) to provide independently about 80% of the systematic variation. Including significant interactions (such as price/freshness, price/production method) increases the explanatory power of the model. Thus if significant interactions can be found and included in the model, explanatory power will rise. Note that the explanatory power of a function is also dependent on assumptions about error terms (IIA and IID), and so the coefficients of a model will be biased if any violations of these assumptions occur.

The search for the appropriate functional form is thus an iterative one that is driven by several signals rather than a statistical process. Choice modelling researchers usually begin with a strictly additive model because these typically explain 80% of choice variation. Results with low explanatory power and/or non-linear variations across attribute levels suggest that the strictly additive model is not appropriate, and researchers can then begin to specify non-linear models and drive the fractional factorial experimental design process accordingly. Repeated experiments allow the functional form to be specified more and more accurately.

This iterative process can be made more efficient by testing for violations of the independence of irrelevant alternatives (IIA) property of these simple logit models (Louviere 1988,

Adamowicz et al 1994). For example, if a simple main effects design is used, an implicit assumption is that no significant interactions exist, and that changes in choice can be directly related to changes in quantities of the various attributes. Louviere (1988) and Louviere and Woodworth (1983) point out that this assumption can be tested by checking if changes in an attribute produce greater than expected shifts in choice. More specifically, changes in one attribute generally cause shifts in the relative weighting of other attributes. Because the attributes are "packaged" into a profile, this change can be thought of as the influence that a particular profile has on the selection of another. If the attributes are strictly independent, then these "cross effects" should sum to zero, or, in a real world situation, be minimal (Adamowicz et al 1994).

Violations of IIA can thus be tested by checking for the symmetry of the cross effects. Violations of the IIA property indicate that the functional form used is not appropriate, and give some indication about which attributes are involved in these asymetrical effects (Elrod et al 1992)[5]. Testing for IIA violations thus helps to drive choice modelling iterations towards an efficient design. Elrod et al (1992) discuss different cross over tests that may be used.

Unfortunately, testing for IIA violations impacts on the factorial selection process. Louviere (1988) argues that the attributes of all choice alternatives need to be orthogonal both within and between choice alternatives. The first condition means that the variation of attributes between different profiles is consistent, and this orthogonality needs to be built into the design of the fractional factorial. To achieve consistency between separate choice sets of profiles, a constant alternative is added to each set. This usually takes the form of a "would not purchase either good" opt out, and has the dual role of imparting realism to choice options as well as providing a constant choice against which options can be evaluated (Adamowicz et al, 1994).

However, the addition of the constant "opt out" choice means that different behavioural processes are being modelled as compared to the more straightforward choices between profiles (Olsen and Swait 1993)[6]. Giving respondents a chance to make a "no response" increases the complexity of choice options, and this means the researcher may require a nested logit or other complex choice models (Carson et al 1994).

Clearly, the design of a choice modelling exercise is a

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[5] More specifically, IIA violations indicate that the IID assumptions leading to the Gumbel distribution of error terms are incorrect. These IID assumptions underpin the multinominal logit function (McFadden 1974).

[6] Quoted in Carson et al (1994).

complex process. The first requirement is that the profiles to be used are drawn systematically from the factorial of possible combinations. The second is that the selection of those profiles into the choice sets should also be systematic, and the third is that the variation between attributes within profiles should be orthogonal as well. In practice, a relatively small proportion of profiles can efficiently represent a large factorial of possible profiles. However, the minimum numbers of choice sets and profiles are often set by model parameters and the need to meet degrees of freedom requirements. In cases where this minimum number of profiles and choice sets is too onerous for a single respondent, it is standard practice to divide the choice sets into manageable blocks, and administer each block to a subsample of respondents.

2.4 Analysis of Data

Data from choice modelling surveys are analysed by fitting them to a multinominal logit model. Because the model used is a discrete choice one, most attributes have to be coded before input into the statistical process. Advances in software packages appropriate for multinominal logit analysis, such as LIMDEP, have improved the viability of choice modelling.

There are two main approaches that can be used for coding and statistical analysis. If the researcher is simply interested in generating values for the different attributes, as in normal regression analysis, then 1,0 dummy codes and metric values are adequate. In choice modelling though, the convention is to use "effects codes" (-1, 0, 1) so that each attribute is mean centred. This implies that the codes reflect how each attribute varies systematically from the constant choice. The reason for effects coding is that it indicates the orthogonal properties of the profiles, and thus allows the IIA tests to be performed (Adamowicz et al, 1994).

The IIA tests are performed by swapping the profiles within a choice set and testing that results are symmetrical. For example, in a standard three option set with profile one, profile two and the constant option third, the first and second profiles are interchanged, and the model reiterated. However, care needs to be taken with the interpretation of these test results because IIA violations may also be the result of heterogeneity within the sampled respondents. Particular groups of respondents may make choices according to specific attributes and levels, thus introducing heterogeneity. Before IIA violations can be assigned to an inappropriate model specification, tests for heterogeneity need to made[7].

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[7] Where heterogeneity is significant, terms relating to individual differences can be introduced into the models and the tests rerun. This enables the researcher to check whether the IIA violations occur solely because of heterogeneity (Louviere 1994).

The results of a choice modelling exercise can be applied in three main ways. The results of the statistical model give a log of the odds that a particular choice will be made. The first result is therefore the likelihood that particular profiles will be chosen. The second result derives from the fact that the log likelihood function is dependent on the various coefficients generated for each attribute in the model. These can be used to estimate a function that assess the contribution to utility of the various attributes and levels used. This can be manipulated to show how changes in one attribute can be offset by changes in another to maintain utility at a constant level. The third outcome relates the utility of the different attributes directly to price, thus giving willingness to pay estimates. Here the profile for a desired scenario can be generated, and the appropriate demand equation can then be expressed as a ratio to the price coefficient.

2.5 Summary of Choice Modelling

Choice modelling is a complex statistical and experimental design process that often requires more than one iteration to estimate accurately the appropriate functional form. However, developments in the computer software for both the experimental design and statistical analysis stages of choice modelling bring it within reach of a wide number of potential users.

There is a wide range of benefits involved in the use of choice modelling as compared to more traditional methods of non-market valuation. The first benefit is that by offering people choices between different scenarios (as well as a choice to do nothing), choice modelling more closely models consumer behaviour. People often make implicit tradeoffs across a range of attributes rather than just two, and choice modelling reflects these complexities.

The second benefit follows from the first. Choice modelling de-emphasises price as an opportunity cost. By offering sets of scenarios where price is simply one attribute, choice modelling more closely models actual consumer options. As well, down-playing price makes choice modelling a more appropriate technique for issues involving ethical and moral considerations. This is because people are often reluctant to tradeoff price against an ethical good, but are willing to tradeoff other "higher level" goods, such as health and life prospects. By using "packages" of tradeoffs, researchers can use choice modelling to find the opportunity costs attached to goods with ethical considerations.

The third benefit from the use of choice modelling is that it allows researchers to dissaggregate the utility attached to a particular good. Because choice modelling uses stated preferences, this utility flows from non-use and use purposes. Choice modelling also allows researchers a glimpse of how different ethical and moral positions affect preferences and

hence utility.

The fourth benefit of choice modelling is that it allows researchers to frame little known or poorly understood goods. Emphasising a particular good to be valued provides fertile ground for bias because of information transfer and learning effects (Rolfe 1995). Choice modelling allows a particular good to be simply one in an array of competing alternatives, thus minimising framing biases.

The fifth benefit of choice modelling is that it allows a sophisticated extrapolation process to occur. Once a functional form has been evaluated, choice modelling allows the utility to be estimated for any other scenario within the appropriate factorial. As well, by collecting and analysing demographic and attitudinal data, choice modelling can identify the groups within society that are significantly correlated to specific attributes and scenarios.

3.0 Stage One: The Identification of Attributes.

To explore the issues involved in assessing international demands for rainforest preservation in Vanuatu, a series of focus groups were held in Brisbane in March, 1995. A focus group is a small group of people where directed discussion and an interchange of ideas can take place, thus revealing people's views and thought processes about a topic, and the relevant characteristics or attributes that people used in forming choices or opinions.

REARK Research (a market research company) was contracted to select five groups of up to ten people each for the focus groups. One general group was drawn at random from the population, while three groups were selected on the basis of age. Age groups selected were 18 to 30 years, 31 to 45 years, and above 45 years. A fifth group of environmentally interested people was also selected (no age limits).

Each focus group session ran for about one and a half hours and was video and audio taped. The sessions followed a structured pattern of three stages where respondents were asked to consider environmental issues in general, tropical rainforests, and preferred institutional mechanisms for securing protection of those forests threatened by development.

3.1 General Levels of Knowledge

In this project, the focus groups had three primary goals. The first was to assess the general levels of knowledge and understanding of the good in question in order to determine the appropriate methodological approach. For example, demand for a good that is easily defined to respondents can possibly be estimated with the contingent valuation method, while neither contingent valuation nor choice modelling may be appropriate for a good with which respondents had very little

awareness.

Results from the focus group sessions were encouraging. First, the focus group sessions identified rainforest preservation as a major, but not overwhelming, environmental issue. Second, a short survey showed that nearly half of the focus group members were aware that Vanuatu possessed rainforests. Third, a small ranking exercise saw respondents rank Vanuatu rainforests second last in importance in a group of ten rainforest countries.

These results suggest that Vanuatu rainforests are familiar enough to respondents to be included in a choice modelling exercise, but not familiar enough to use the contingent valuation method. Rainforest preservation is a significant environmental issue for respondents, ensuring that participation rates will be high and framing effect problems low in a choice modelling exercise.

3.2 Preference Formation

The second main goal of the focus group sessions was to explore the ways in which respondents formed preferences and made choices about rainforest preservation. Several distinct themes emerged. First, the focus groups identified about five rationales for identifying environmental issues of importance.

These rationales were:

    (a) issues that affected health,

    (b) issues that people felt some responsibility for,

    (c) issues that affected the living or physical environment and were of direct interest,

    (d) issues about which they felt deeply, and

    (e) issues that were of global significance.

Only the last two rationales really provide a basis for valuing international rainforests. The link between global deforestation and weather patterns is too tenuous for people to think of specific forest destruction as impacting on their health. In the absence of visits or specific knowledge, people did not seem to treat international rainforests as areas of personal responsibility or direct interest as they might treat an environmental park in their immediate neighbourhood.

Tropical rainforest conservation does arouse strong interest and feeling in people. However, because people in the focus groups identified this issue on the basis of only a couple of underlying rationales, it appears that people would have difficulty ranking different environmental areas in order of importance. For example, people may find it difficult to rank

issues of tropical rainforest conservation against pesticide traces in their local food supply because these environmental issues impact on very different goals and groups of preferences.

A second major theme that emerged was that respondents often argued that all rainforests were of equal importance, yet were able to rank them in the short survey that was carried out. Thus respondents were able to prioritise which rainforests should be preserved, yet argued that all rainforests were of equal importance. Questions to the groups about ranking and valuation revealed the following patterns.

Importance was often seen as something relating to metaphysical goals that encompassed concerns about species extinction, the responsibilities held by humans towards the forests, the balance of nature and the importance of rainforests independent of human concerns. While respondents were not able to articulate clearly the logic behind many of their responses, the range of their responses touches on many of the ethical and philosophical arguments relating to the environment. These range from stewardship notions through to the non-anthropocentric arguments of the deep green movement.

Respondents seemed reluctant to regard forests as differing in importance because it implied they were making a societal choice about basic values. In the same way that many societies treats humans as having equal rights and value, respondents seemed to feel that it was not appropriate for them to rank rainforests in order of importance. This approach was reinforced when respondents were questioned about the sense of loss associated with rainforest destruction. Many respondents were adamant that a sense of loss was attached to any rainforest destruction, and for many, the sense of loss was unchanged by considerations such as size and location.

Impressions of importance and equivalent feelings of loss essentially seem to be the initial or base level of feeling for the rainforests. For some people that base level is low, and for others it is the most important component of their reactions towards rainforests. The introduction of rainforests as a topic seems to invoke the initial reaction that all rainforests are of equal importance. Yet careful examination reveals that people do hold different values for rainforests and are usually able to rank them in order of importance. Information about rarity, endangered species and indigenous people, among other factors, enables people to make choices quickly about which rainforests are most important.

3.3 Selection of Attributes

The third main goal of the focus group studies was to distil a concise but coherent group of key attributes that captured the essential processes by which people made choices about

rainforests. The key attributes that were identified are listed as follows and then discussed in turn:

(a) location
(b) rarity
(c) effect on local people
(d) potential for future visits
(e) size
(f) possession of special features

(a) Location

Respondents expressed substantial support for Australian rainforests over international ones because of identification, ownership, and responsibility. To some extent the support for Australian rainforests can be explained in terms of other major attributes. These rainforests are geographically close for respondents and therefore the forests most likely to be used and visited by current and future generations. Domestic rainforests receive the most media coverage. As well, people feel they have more ability to stop rainforest destruction in Australia. There is more trust in domestic institutional structures, and more understanding of the effectiveness of their actions.

However, the preferences of respondents for domestic protection goes beyond the effects of these attributes. Respondents identified a sense of ownership and responsibility with regards to Australian rainforests. These implied property rights had two main effects. First there was the feeling that because of the sense of ownership, Australian interests should come first. The other effect was to be hesitant about imposing judgements on other countries. It was better to 'clean up our own back yard first' and to 'lead by example'. Thus even if respondents ranked other rainforests as being more important, judgements about ownership and responsibility may lead them to rank protection of Australian rainforests ahead of overseas rainforests.

In the international setting, location is still important to respondents for a number of reasons:
 - size of the rainforest (Brazil),
 - diversity of rainforest (Costa Rica),
 - closeness to Australia (Papua New Guinea), and
 - ability to help (Pacific Islands).

(b) Rarity

The rarity of tropical rainforests is a key attribute in determining the importance attached by people to particular forests. In one sense, rarity invokes in people impressions of uniqueness. Thus people are likely to rate a rainforest as being very important if they think that it is the last of its kind. Rarity in this sense is a proxy for relative importance.

In another sense, rarity invokes in people impressions of
vulnerability. Rare rainforests are seen as forests that are
likely to be small, often remnant amounts, where any threat to
existence has the potential to be overwhelming. Rare in this
sense is a proxy for endangered. Forests that are not rare
are thus not seen as being endangered and do not need
immediate support.

(c) Effects on Local People

Respondents in the focus groups were very aware of the
difficult tradeoffs between conservation and economic growth
faced by other countries. There was a general feeling that
Australia can afford to set very high standards of
conservation, but other countries may not have that luxury.
These feelings of empathy for people in other countries had
three main elements.

The first element related to the effects on income generation
and improvements in standards of living. It was seen as
understan'able that other people wished to improve their
standard of living, and simplistic solutions, such as banning
the sale of rainforest timbers, may only exacerbate their
problems. Instead the emphasis should be on education, and
aid for viable long term projects. One of the best ways that
Australia could help would be to share knowledge and
experience.

The second element related to the effects on people indigenous
to the rainforests. There was widespread concern over the
loss of livelihood and habitat associated with rainforest
clearing. Here the effects on, and involvement of local
people would be important information to help people evaluate
a particular project.

The third element related to the support and attitudes of
indigenous people towards forest conservation. It was felt
that people in the overseas country, particularly those in the
local area of the project, have to support it in order for a
project to succeed. As well, respondents in the focus groups
were uneasy about imposing their opinions on other cultures,
and looked for local support as an indicator that clashes
between cultural values were not occurring.

(d) Potential to Visit

People in the focus groups felt that appreciation and
valuation of rainforests were enhanced with visits and direct
experience. The potential for future visits was seen as an
important component of value. However, the signals on this
issue were mixed.

Some people saw non-use values as being the main motivation
for their concern. However, the people who articulated these
non-use values had usually visited rainforests and were keen
to visit more. Despite this, they believed that forests

should be saved for a range of ethical, spiritual and moral
concerns rather than to support a burgeoning tourist industry.
These people were generally opposed to luxury tourist
developments which treated rainforests as an item to be viewed
from the comfort of airconditioning. Low scale, hands on eco-
tourism wins approval, while major development and luxury
class tourism is seen as exploitation.

Other people are much more relaxed about the development of a
range of tourism facilities. For them, eco-tourism carries
connotations of tourism based on environmental attractions
rather than the standard and style of the venture. These
people often saw tourism as a major alternative industry for
the people of the host country.

There is a paradox here. Respondents in the focus groups
generally felt that rainforests which had the potential to
develop substantial eco-tourism attractions had the most
chance of being valued highly enough to be saved from logging.
At the same time, eco-tourism success meant that these forests
did not need their support, as they could be saved through
commercial success. Interestingly though, people did not seem
keen to visit commercially successful tourist rainforests.
For them, eco-tourism meant something less, where the
rainforest experience was not diminished by the presence of
other tourists.

(e) Special Features

People treat forests with something special about them with
more interest. Rare and endangered species, spectacular
scenery, unique ecosystems and special attractions all count
towards value. Biodiversity and the purity or concentration
of rainforests were also mentioned as being features of
interest. Thus while respondents to the focus groups seemed
happy to treat rainforests in generally homogeneous terms,
features that were unique were of importance in deciding
whether a forest had special significance.

This attribute has two important corollaries. First, it tends
to be the major focus of threats to rainforests. Rainforests
are being cleared all the time, and to make choices, people
like to know what is special about the ones that they are
being asked about. That helps them to evaluate the severity
of the threat. If it is not just a patch of rainforest in
particular danger, but some unique identities as well, then
this increases the sense of urgency and loss. Conversely, if
there is nothing unique about a rainforest in danger, there is
not the same degree of loss associated with its being cleared.

The second main correlation is with the possibility of future
visits. People are attracted to rainforests with unique
features, or a unique package of features. Hence, the
preservation of forests with these characteristics keeps open
the option for future visits. As well, we would expect that
forests with the brightest eco-tourism potential are those

with special features.

(f) Size

People responded to size in two main ways. First, the amount of rainforest in a particular country was very important in rating those rainforests. For example, in the small survey conducted in our focus groups, rainforests in Brazil were generally ranked as being the most important, partly because of their perceived massive size. By contrast, the small size of Vanuatu rainforests on a global scale was a major reason why they were not highly ranked.

Secondly, size was not seen as being very important for the assessment of particular projects. People have hazy concepts of size, and the usage of terms such as hectares or tonnes does not mean much. Relative size data is of more use to respondents, particularly in helping them to assess threats. Thus people are interested in details such as the proportion of remaining vegetation, the rates of clearing, and the percentage of forest covered by a specific conservation project.

Although people in the focus groups did not respond strongly to questions about the size of particular conservation projects, it may be important information for another reason. Size is an important proxy for value for money. If people were comparing conservation projects across several countries, the area of the project in question may indicate to people the purchasing power of their donation. Thus although physical size of individual projects may not be a burning issue, the information may indicate to people the effectiveness of potential donations.

4.0 The Choice Modelling Process

Two choice modelling surveys were performed in Brisbane during 1995 by REARK Research. Both surveys involved; the random selection of a house, a front door introduction and explanation, and then a subsequent visit to pick up the completed form. Respondents completed the surveys at their own pace. Pretests were carried out before the first survey to check that the scenarios presented were understandable and comprehensive. Very high response rates were reported from the surveys, with 100% and 99% of respondents in the two surveys returning completed forms.

Both surveys followed the same structure; a section on attitudes and behaviour, a section on choice modelling sets, and a final section of socio-demographic questions. The two surveys were identical apart from the choice modelling sets. The first section began by asking people for their opinion on a range of general environmental goods, and then for their attitudes and behaviour in purchasing environmentally friendly goods (such as phosphate free laundry detergent). The first section of the survey had three main roles. The first was to

remind respondents about the wide range of environmental
issues, their weekly expenditure patterns, and the different
ways of supporting environmental causes. The second purpose
was to familiarise respondents with the style of the choice
modelling exercise in the second section of the paper. The
third purpose was to collect information on attitudes and
behaviour of respondents.

4.1 The First Survey

The first survey assumed a strictly additive model and used an
orthogonal main effects design to sample possible scenarios.
The location attribute was varied across eight locations,
while the other attributes each varied across four levels.
This meant that the factorial of possible profiles was a four
to the sixth by an eight to the first - 32,512 possible
combinations. 128 profiles were selected from this factorial
to make up 64 choice sets. These choice sets were then
divided into four blocks to form four different versions of
the survey. This presented each respondent with sixteen sets
of scenarios, and so reduced the questionnaire to a realistic
task.

Each choice set contained three options, scenario A, scenario
B, and a common opt out choice. For this survey, the common
option was "would not support either of the above options".
105 respondents were sampled, and a 100% response rate was
recorded. A sample of a choice set used in the survey is
given in Appendix 1.

Results for this survey are presented in Appendix 3 and
several points are worth noting. First, the results generally
match the outcomes of the focus group exercises. For example,
the Australian and South America locations received the
highest coefficients within the location attribute. Second,
the coefficients for each attribute (other than location)
generally increase with each level. Third, significant t-
statistics are reported for most coefficients. Thus the model
that is estimated from the results is a reasonably good fit to
the data.

However, the high coefficient values for Australian locations
also raise the possibility of bias in the results. These high
values suggest that many people chose Australian locations
ahead of other locations. Yet many of the choice sets
presented did not include an Australian location. This raises
the possibility that if more Australian locations had been
presented, they would have been chosen.

As well, although the coefficients for each attribute (other
than location) generally increased with each level, the
progression was not linear in many cases. This suggests that
interactions may be occurring between attributes. Further,
the high standard error terms for the locations suggest a
large degree of variability in choices.

The results were cross tabulated to the demographic data and chi square analysis performed to check if only a particular group was defaulting to choose Australian locations. No strong heterogeneity results were found, although the small sample size makes it difficult to identify interactions accurately. This suggests that variability in choices (the large standard error terms) is attributable to the whole sample rather than a particular demographic sub-sample. The implication of these factors is that the purely additive functional form used is not appropriate, and that a better specified model would be more significant.

5.2 The Second Survey

Outcomes from the focus groups and the results from the first survey suggested that location is the most significant attribute. As well, the focus group sessions had indicated that location was the attribute most likely to interact with other attributes. For example, there is likely to be some interactions between the location and potential to visit attributes. To be able to explore these potential interactions, it was necessary to capture the extent of demand for each location.

The second survey was designed specifically to concentrate on location and how it contributed to the utility of respondents. This survey was designed to offer respondents a choice of each location in each set. The design used remained as a simply additive "orthogonal main effects" model, but in this case was more specifically designed to test for IIA violations. Two latin square alogarithyms were used to ensure that the variations between attributes were symmetrical. However, to meet the implicit design requirements the number of locations were reduced to six, and the number of levels for each of the other attributes were reduced from four to three. The locations dropped were **Africa** and **QLD/NSW border**. For the other attributes, one of the central levels was dropped, so that the range for each attribute remained the same.

These changes had the effect of making the scenarios a little less complex for respondents. However, a choice set for each respondent now consisted of six scenarios (one for each location) as well as the standard "no choice" option. To reduce the demands on respondents, the number of sets presented to each respondent was reduced from eighteen to nine. The size of the factorial of possible profiles is three to the sixth by six to the first or 4374 profiles. We used 81 sets of profiles, blocked into nine versions of nine sets each. Because there were six profiles in each set, a total of 486 profiles were drawn from the full factorial. Appendix 2 gives a sample of a choice set for this survey.

This second survey was presented to 100 respondents in Brisbane in November 1995. The intention was to sample eleven respondents for each of the nine versions. However, the number of actual respondents surveyed by the market research

company for each version varied from ten to thirteen.

Results for the second survey are presented in Appendix 4. They are more satisfactory than the results to the first survey because the standard error terms are much lower (and the t-statistics slightly higher). There is little overall change in the results, apart from Australia becoming more significant in terms of location, and area becoming a less significant attribute.

6.0 Extrapolation of Results

The multinominal logit function essentially calculates the logarithm of probabilities that a particular choice will be made (Pindyck and Rubinfeld 1981). The general form of the model is given by:

$$\log \frac{\text{Prob (yes)}}{1 - \text{Prob (yes)}} = \beta_1 + \beta_1 Z_2 + \cdots + \beta_k Z_k$$

where **x** refers to the attributes used, j indexes the choices (or alternatives), and t indexes the observation (or individual) (Greene, 1995).

One possible restatement of a discrete choice model is the form:

$$\text{Prob[choice } j \text{]} = \frac{e^{\beta'_j x_{it}}}{\sum_i e^{\beta'_j x_{it}}}, j = 0, 1, \dots J$$

where the Z's represent the attributes of the choice sets (Pindyck and Rubinfeld 1981). Using this formulation, the results of the first survey (Appendix 3) can be expressed in the form:

-1.49 + -.162 VAN + .739 FNQ + .558 QLD/NSW + -.165 PNG +

.118 SAMER + -.162 AFR + -.600 THAI + -.326 INDON + .147 AREA

+ -.557 NOTRARE + -.127 SOMEWHATRARE + .105 FAIRLYRARE +

.535 EXTREMERARE + -.202 NOVISITS + -.001 ALLOWVISITS +

.192 VISITSPOSS + .011 EASYVISIT + -.652 LOCALWORSE +

-.021 NOLOCAL + .250 LOCALSTAY + .424 LOCALBETTER +

-.384 NOSPEC + -.014 SPECLAND + .157 SPECPLANTS + .242 SPECALL

+ -.193 PRICE.

Because results are expressed in a probability format, the coefficients reported are relative to the other coefficients for each attribute. Thus the coefficients for location sum to one, as do the coefficients for the other discrete choice attributes of rarity, visits, locals and special features. Area and price, as continuous variables, are simply reported as a single coefficient.

The coefficients reported relate to the probability that a particular choice will be made rather than to the utility contributed by each attribute. Yet utility is directly related to these coefficients; the higher the utility of a particular attribute level, the higher the contribution to a successful choice. An estimate of the dollar value of the contribution made to utility by each attribute can be made by taking the ratio between the particular attribute coefficients and the price coefficient.

These results mean that it is possible to estimate the utility of any scenario that can be formed from a combination of the attributes and levels used. The scenarios are not limited to the ones used in a choice modelling exercise. Take for example the two following hypothetical scenarios:

Scenario 1   Scenario 2

10,000 hectares in Vanuatu   10,000 hectares in Far North QLD

- fairly rare   - extremely rare
- visits possible   - easy to visit
- locals better off   - no locals affected
- no special features   - special landscapes and plants
                                and animals

Using the results of the first model estimated (see Appendix 3), the sum of the relevant coefficients divided by the price coefficient is as follows for the two scenarios:

Vanuatu   : -(-.161982 + .147962x3 + .105086 + .192025 +
              .424131 + -.384621)/-.192839

           = $ 3.21

Far North Qld: -(.738807 + .147962x3 + .535415 + .011246 +
              -.0216819 + .241655)/-.192839

           = $ 10.10

Using the results of the second model estimated (see Appendix 4), the sum of the relevant coefficients divided by the price coefficient is as follows for the two scenarios:

Vanuatu   : -(-.18695 + .053486x3 + .053901 + .119937 +
              .497359 + -.105786)/-.220139

           = $ 3.78

Far North Qld: -(1.47880 + .053486x3 + .5500159 + .043621 + -
.130999 + .125017)/-.220139

= $ 10.12

These examples show how the choice modelling results may be
extrapolated to estimate the utility of specific scenarios.
However, caution must be exercised in such extrapolation for
two main reasons. First, bias may arise if an inaccurate form
of the model has been estimated. For example, both of these
models are additive and do not capture interactions. The next
section reports on further tests regarding model accuracy.
Second, the results are limited to the pool of alternative
choices that respondents have been faced with. Some form of
testing (or scaling) would be necessary in order to
extrapolate results across a population where much wider
choice options are available.

The choice modelling results may also be used to conduct
sensitivity analysis by estimating WTP amounts for changes
within attributes. For example, the WTP for a scenario that
is extremely rare as compared to a scenario that is only
fairly rare can be calculated as the difference in rarity
coefficients divided by the price coefficient. Using the
results from the second survey, this can be calculated as
follows:

WTP (rarity increase) = -(.550 - .050)/-.220

= $ 2.27.

7.0 Model Specification

The results from the second choice modelling exercise indicate
a much more accurate estimation of the (log) likelihood
function that a particular choice will be made than was
derived from the first exercise. However, there are two major
indications that a more accurate model form should be sought.

First, the results from the first exercise (non-linear
variation between levels of non-location attributes) indicated
that some significant interactions between attributes may be
present. However, in the second exercise, variation between
levels was much more linear in appearance. Because the number
of levels for each attribute was reduced for the second
exercise, the explanatory power of variations between levels
is reduced. Thus interactions may be "hidden" because of the
parsimonious number of levels chosen in this exercise.

IIA tests from the second choice modelling exercise contradict
this hypothesis, indicating that the effect of different
attributes was independent. More complete model
specifications that include individual characteristics such as
age and income (and thus protect against problems of
heterogeneity) will allow better IIA tests to be conducted.

Second, there is evidence that the attributes are "nested" or hierarchal in nature. Results for the second survey (Appendix 4) show that Australia has a much higher coefficient than overseas countries, and that the standard error terms for overseas countries were also higher. These results suggest that respondents effectively made two levels of choice. The first level was to choose between the Australian scenario, the no choice scenario, or an overseas scenario. If an overseas scenario was preferred, then the second level of choice was to select which, among the five remaining options, was preferred.

If the choice process is nested, then an inappropriate model specification has been used. This is because, of the three first level choices offered, only overseas rainforests has further choices nested under it. To explore the nesting hypothesis, a further choice modelling exercise will need to offer respondents choices under each of the three hierarchal options.

8.0 Demographic Results

Cross tabulation of results to demographic data produced some significant relationships. The heterogeneity of the results increased from the first survey to the second survey, which confirmed the importance of location as an attribute. However, overall heterogeneity resulting from demographic factors was generally low in both surveys.

Generally it is possible to say that males, people aged between 20 and 50 years, higher income people, and members of environmental groups are more likely to support preservation choices. As well, females, people aged over 50, lower income ($5000 to $30,000), housewives and people associated with the timber industry are less likely to support preservation choices.

Some attitudinal and behavioural data were also significantly correlated to the choice modelling data. Respondents who habitually bought environmentally friendly goods (such as phosphate free laundry detergent and free range eggs) were more likely to support preservation options. As well, people who had visited overseas rainforests were generally more inclined to support preservation options than people who had not.

However, the attitudinal data do provide one note of caution. While the majority of respondents indicated they preferred to buy environmentally friendly goods at a premium over normal goods, a large majority also indicated that they would prefer to buy an environmentally friendly good (phosphate free laundry detergent) rather than donate money to preserving rainforest in another country (Solomon Islands). This suggests that many people prefer to support environmental causes close to home and of direct influence to them. Because the choice modelling sets focused exclusively on rainforest preservation rather than the wider set of environmental

choices, some potential for framing and scoping bias still exists. A nested logit process may more accurately model the way that people form preferences for rainforest conservation.

9.0 Conclusion

We have reported here on a novel application of a developing non-market valuation technique: the use of choice modelling to estimate demand by Australians for rainforest conservation in overseas countries. There are four general conclusions that can be drawn from our results.

The first is that we have demonstrated how the choice modelling process can be applied to environmental valuation issues, and how it is an iterative process with complex design and analytical stages.

The second is that we have demonstrated how it is possible to derive values for goods that are distant and poorly understood by people. These are items that people have general preferences for, but not enough information for more traditional valuation techniques to be applied. Our work shows how values can be derived for goods that are not well defined or familiar to people, but for which the cumulative weight of preferences is significant. Choice modelling is the gateway to assessing a range of issues with these characteristics. International preferences for whale preservation or pollution restriction are two examples.

In this paper we have shown how it is possible to derive estimates of value for rainforests in Vanuatu. Because tests indicate that the model we have specified is not fully accurate, the estimates of value are only indicative. However, with further iterations of the choice modelling process, it should be possible to provide "real" outcomes to the estimation process.

The third conclusion follows from the second. By pushing out the frontiers to environmental valuation, economics can be shown to be of relevance in areas where environmentalists argue that ethical and moral rules should apply. Choice modelling demonstrates how people make tradeoffs in areas of ethical importance, such as rainforest preservation. Because it de-emphasises price, choice modelling is an appropriate technique to use in many cases where people have difficulty in structuring preferences between a particular good (sometimes with ethical or moral connotations) and income.

The fourth conclusion is that we show how the preferences of Australians for rainforest conservation can be disaggregated according to essential characteristics. This demonstrates the relative weighting that Australians hold for the different characteristics, and enables researchers to predict the demand by Australians for the preservation of specific rainforest areas. As well, we have demonstrated how WTP bids are sensitive to changed levels of an attribute, and how

sensitivity estimates can be generated from choice modelling results.

Acknowledgments

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APPENDIX 1

Sample Choice Modelling set from first survey

In an introductory statement, respondents were told that we had selected several rainforests from around the world that would be lost within the next two years unless money was found to conserve them.   In the following scenario sets, we had "scrambled" the characteristics of those rainforests in order to offer people a lot of choices.   In this way, we could work out which characteristics made rainforests important to conserve.   Respondents were asked to treat each choice as an independent event.

Scenario 1   Scenario 2

500 hectares in Far North Queensland   10,000 in Papua New Guinea

 - extremely rare   - fairly rare

- easy to visit, full facilities   - difficult to visit, poor
                                                            facilities

- no locals affected   - locals will be better off

- special plants and animals   - special landscapes

- $50 donation required   - $10 donation required

Please indicate your preferred choice:

                         Scenario 1

                         Scenario 2

     I would not support either scenario

APPENDIX 2

Sample Choice Modelling set from survey 2.

Respondents were given the same introductory information as in
the first survey.

Scenario 1

100 hectares in Vanuatu

- extremely rare
- easy to visit, full facilities
- locals will be better off
- no special features
- $50 donation required

Scenario 2

1,000 hectares in Far North QLD

- not rare at all
- no visits allowed
- no locals affected
- special landscapes
- $10 donation required

Scenario 3

10,000 hectares in PNG

- not rare at all
- difficult to visit, poor facilities
- locals will be worse off
- special landscapes and plants and
             animals
- $5 donation required

Scenario 4

100 hectares in South America

- fairly rare
- no visits allowed
- no locals affected
- no special features

- $10 donation required

Scenario 5

1,000 hectares in Thailand

- extremely rare
- easy to visit
- locals will be better off
- no special features
- $50 donation required

Scenario 6

- 10,000 hectares in Indonesia

- extremely rare
- no visits allowed
- locals will be worse off
- special landscapes
- $5 donation required

Please indicate your preferred choice:

Scenario 1

Scenario 2

Scenario 3

Scenario 4

Scenario 5

Scenario 6

I would not support any scenario

APPENDIX 3

Multinominal Logit Results for first survey

VARIABLE	COEFFICIENT	STD ERROR	T
INTERCPT	.149849E+01	.234485E+00	-6.3906
LOCATIONS			
VANUATU	.161982E+00	.980987E-01	-1.6512
FAR NORTH QLD	.738807E+00	.104018E+00	7.1027
QLD/NSW BORDER	.558046E+00	.104985E+00	5.3155
PAPUA NEW GUINEA	.165136E+00	.106839E+00	-1.5457
SOUTH AMERICA	.118455E+00	.108047E+00	1.0963
AFRICA	.162219E+00	.102575E+00	-1.5815
THAILAND	.599584E+00	.117226E+00	-5.1148
INDONESIA	.326407E+00		-3.6213
AREA			
LAREA	.147962F+00	.238158E-01	6.2128
RARITY			
NOT RARE AT ALL	.557608	.0712662	7.8243
SOMEWHAT RARE	.127279	.0653375	-1.9480
FAIRLY RARE	.105086	.0684166	1.5360
EXTREMELY RARE	.535415		8.2363
VISITS			
NO VISITS ALLOWED	.202140	.0708846	2.8517
VISITS ALLOWED	.00113105	.0651942	-.0173
VISITS POSSIBLE	.192025	.0702895	2.7319
EASY TO VISIT	.011246		.1371
LOCALS			
LOCALS WORSE OFF	.652196	.0771546	-8.4531
NO LOCALS AFFECTED	-.0216819	.0642467	-.3375
LOCALS CAN STAY	.249736	.0607821	4.1087
LOCALS BETTER OFF	.424131		4.6819
SPECIAL FEATURES			
NO SPECIAL FEATURES	-.384621	.0685934	-5.6073
SPECIAL LANDSCAPES	.0136031	.0668037	-.2036
SPECIAL PLANTS AND ANIMALS	.156569	.0676558	2.3142
SPECIAL LANDSCAPES AND PLANTS AND ANIMALS	.241655		3.4967
PRICE			
LPRICE	-.192839	.0436730	-4.4155

```
          STATISTICS
                  L(ZERO):        -607.49
                  L(BETA):        -264.15
                 -2(L(0)-L(B)):    686.68      D.F.:    22
                  RHOSQ:            .56518
```

APPENDIX 4

Multinominal Logit Results for Second Survey

Variable	Coefficient	Std Error	T
Locations			
Vanuatu	-.186950	.0703299	-2.6582
Far North QLD	1.47880	.0441086	33.5262
PNG	-.314573	.0738960	-4.2570
South America	-.134416	.0683391	-1.9669
Thailand	-.410580	.0760970	-5.3955
Indonesia	-.432281		-19.2486
Area			
Logarea	.0534586	.0125476	4.2604
Rarity			
Not rare at all	-.600406	.0468383	-12.8187
Fairly rare	.0503901	.0413381	1.2192
Extremely rare	.5500159		11.5995
Visits			
No visits	-.163558	.0420350	-3.8910
Visits possible	.119937	.0405035	2.9612
Easy to visit	.043621		.9298
Locals			
Locals worse off	-.366360	.0441072	-8.3061
No locals	-.130999	.0429757	-3.0482
Locals better off	.497359		11.3543
Special			
No special	-.105786	.0431886	-2.4494
Special land	-.019231	.0416975	-.4612
Special land and plants & animals	.125017		2.9106
Price			
Logprice	-.220139	.0288974	-7.6179

Statistics

L(zero)	-1957.96
L(beta)	-1231.10
-2(L(0)-L(B)):	1453.72 DF: 15
RHOSQ:	.37123
Adjusted RHOSQ	.36357