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Author(s)	Garvey, Eoghan
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Accounting for skill levels in recreational demand modelling using a clustered RUM approach

Stephen Hynes[+*] Nick Hanley[++] Eoghan Garvey[+++]

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Department of Economics
National University of Ireland, Galway

http://www.economics.nuigalway.ie

[+] Rural Economy Research Centre, Teagasc, Galway, Ireland
[*] Address for correspondence: Stephen Hynes, Rural Economy Research Centre, Teagasc, Athenry, Galway. Email: shynes@rerc.teagasc.ie. We are grateful to participants at the Environmental, Energy and Natural Resource Economics Policy Symposium, Galway for helpful comments on an earlier version of this paper.
[++] Economics Department, University of Stirling, Scotland
[+++] Economics Department, National University of Ireland, Galway, Ireland

Abstract

We adapt the standard random utility model to take account of the heterogeneity of recreational preferences by using what we call a "clustered conditional logit framework". By separating out our sample of whitewater kayakers into two exogenously identifiable groups (based on their skill level) and running separate conditional logits for each group we are able to take account of the fact that kayakers of different skill levels are looking for different characteristics from the whitewater site they choose to visit. We find that not taking into account the differences in the skill of the kayakers and the grade of the river will result in an overestimation of the welfare estimates associated with improvements to lower grade whitewater sites (which are frequented by basic/intermediated proficiency level kayakers) and underestimating welfare estimates associated with changes in the attributes of higher grade whitewater sites (which are frequented by advanced proficiency level kayakers).

Keywords: Whitewater kayaking, basic, intermediate and advanced proficiency, Random Utility Model, preference heterogeneity.

JEL Classification: Q51 Q56

1. Introduction

In almost all forms of outdoor recreation, varying skill levels of participants partly determine both behaviour and preferences. This fact has not been adequately addressed in the travel cost literature to date. For example, participation in the sport of whitewater kayaking at technically challenging sites is mainly attractive to individuals who have learned specific skills gained from prior whitewater experience. Without those skills, the activity at these sites may be unfulfilling and possibly dangerous. For a given whitewater site with a particular skills portfolio, the population of potential kayakers likely to be observed by the researcher is self-selected. It is therefore important to take into account variations in skill levels when modeling the demand for recreation. The same can be said for many other outdoor activities where a proportion of sites are more suitable to participants of certain skill levels. Rock climbing, mountain biking, surfing and skiing are just a few examples. As far back as 1966, Davidson et al., highlighted the influence of skill and experience on the demand for outdoor recreation. Indeed they believed that "skill is often essential for the enjoyment of these (water based) activities". While Davidson et al.s' (1966) view is now widely accepted in the literature there is surprisingly little empirical evidence to show the magnitude of skill effects in a random utility model setting.

Rivers that may be kayaked in Ireland and Britain are classified by a five-grade system. This numerical grading system gives an idea of the technical difficulty of the rapids on the river or whitewater site. A grade of one indicates an easy run with occasional small rapids with regular and low waves, whereas grade five indicates extremely difficult rapids with completely chaotic water where the kayaker's reactive skills must be of the highest order. Table 2 outlines the associated grades of the whitewater sites in this analysis. In this paper we are concerned with kayaking on moving water of grade two or above. We would expect that advanced proficiency level kayakers are more likely to kayak on rivers with a grade of 4 or higher whereas basic and intermediate skilled kayakers are more likely to be found on moving water of grade 2 and 3.

Heterogeneous preferences due to differing skill levels are difficult to account for in behavioral choice models due to the structure of the conditional logit (CL) model, which forms the base of random utility models (RUM). Within a basic count data travel cost model the analyst can directly incorporate demographic or other individual characteristic data such as skill level directly into the individual's utility function to address preference heterogeneity. However under the specification of the CL, individual characteristics drop out of the probability of an individual selecting a specific choice, unless interacted with site attributes or an alternative specific constant. To overcome this problem we adapt the standard RUM model to take account of the heterogeneity of kayaker preferences by using what we call a "clustered conditional logit framework". By separating out our sample into two exogenously identifiable groups (based on their skill level in a kayak) and running separate conditional logits for each group we are able to take account of the fact that kayakers of different skill levels are looking for different characteristics from the whitewater site they choose to visit, and have different preferences for these characteristics.

In the next section, we briefly outline previous applications of the Random Utility Model for modelling recreation demand. In section 3 we discuss the RUM modeling approach taken here, which incorporates both site choice and kayaker heterogeneity. Section 4 then describes the design of our survey and summarises some sample characteristics. Model results are presented in section 5 while estimates of consumer surplus from whitewater recreation on Irish rivers, as predicted by our alternative skill based RUM models, are presented in section 6. Finally, section 7 concludes with some recommendations for further research.

2. The Random Utility Model and Participant Skills

The Random Utility Model (RUM) or random utility site choice (RUSC) model has been developed from earlier single and multiple-site count data travel costs approaches. In the RUM model, recreationalists choices over sites are modelled as being dependent on site attributes (one of which is travel costs as a proxy for price), plus an error term. A RUM model estimates the probability that an individual will choose to visit a given river, depending on the characteristics of that river and the characteristics of possible alternative whitewater sites. The better the characteristics of a whitewater site, the higher the probability that the kayaker will choose that site to kayak at, and thus the higher the value of the site will be. Using these probability values and the utility level associated with each site it is still possible to calculate the consumer surplus per kayaker associated with alternative sites.

There are numerous examples where the RUM model has been used to analyse the demand for water based recreational amenities; for example, McConnell and Strand (1994) for Atlantic Sports fishing, Parsons and Massey (2003) for beach recreation, Siderelis et al. (1995) for boating and Kaoru and Smith (1995) for saltwater fishing. All of these studies however fail to take account of varying skill levels amongst participants. An early solution to this problem was to interact specific individual variables, such as income or race with various choice attributes (Adamowicz et al. 1997). Smith (2000) points out that only McConnell et al. (1990) and Adamowicz (1994) have developed formal treatments similar to the habit/addiction models associated with Becker and Murphy (1988). Most other applications have confined their attention to incorporating the years of experience or proficiency level as a determinant of current recreation demand or site choice. One study by Shaw and Jakus (1996), of rock climbing, indicated that general participation, site choice, and the amount of use were influenced by the recreationists' ability.

Away from a RUM setting, but of relevance to this paper, is a study by Munley and Smith (1976), who found that proxies for willingness to pay for white-water rafting (i.e, willingness to travel) were affected by past experience and skill. Munley and Smith distinguished between different types of crafts that are used to navigate a stretch of whitewater and made the assumption that those in closed decked canoes or kayaks had a higher skill level than those in open canoes. Both these groups have higher skills compared to those in rubber rafts. These groups were then included as dummy variables in a simple OLS model. They found that the higher skill classes had a higher willingness to pay (or higher willingness to take on additional travel cost) for whitewater recreation. In contrast, our study looks at closed decked kayaks only and respondents categorise themselves as having either basic, intermediate or advanced kayak handling skills. Our study is also the first application of a "clustered" RUM model that implicitly takes into account the skill level of the participant when modeling the demand for an outdoor recreational pursuit. We use our model to produce estimates of welfare change that are of potential relevance to policy-making that impacts on whitewater kayaking sites in Ireland. These estimates are shown to differ greatly when the skill of the kayaker associated with a particular grade of whitewater are taken into account.

3. Methodology

The rich diversity among kayakers creates difficulties in terms of modeling whitewater site choice, and the economic value associated with a change in the whitewater resource characteristics. To address this type of heterogeneity, our approach involves the *a priori* selection of skill variables. In what Hilger (2003), refers to as "cluster models", individuals are segmented into demographically homogenous/similar groups. For our sample of kayakers, we might expect that an individual's decision to visit a particular whitewater site is based on the skill level of each kayaker. To investigate this hypothesis we separate out our sample into two groups (based on their skill level[1]) and run a separate conditional logit model for each group. Using a chow type test we will then investigate whether the coefficients produced using this "cluster" approach are significantly different from the CL model estimated using the full (pooled) sample.

The conditional logit of McFadden (1974) is the standard statistical model used to estimate recreation choice. Assume that a kayaker, *i*, has J possible multi-attribute whitewater sites from which to choose. The model assumes that once kayaker *i* decides on one whitewater site he or she does not care about the quality attributes of the other alternative whitewater sites. The basic choice model for our kayaker is then given by:

[1] The first group or cluster contains 143 individuals who have self-catergorised themselves as having basic or intermediate kayak handling skills. The second group contains 136 individuals who have self-categorised themselves as having advanced kayak handling skills.

$$U_{ji} = V(X_{ij}, y_i - p_{ij}) + \varepsilon_{ij} = V_{ij} + \varepsilon_{ij} \qquad (1)$$

U_{ji} is the indirect utility of kayaker i from visiting whitewater site j. $V(.)$ is the deterministic part of the indirect utility function and ε_{ij} is the stochastic part. X_{ij} is a vector of site attributes, y is income and p_{ij} is travel cost. Whenever the utility from visiting site *j* is greater than the utility from visiting all other sites J, site *j* will be chosen, i.e. if

$$V(X_{ij}, y - p_{ij}) + \varepsilon_{ij} \geq V(X_{iJ}, y - p_{iJ}) + \varepsilon_{iJ} \quad \forall J \qquad (2)$$

then site *j* will be chosen. The RUM model can be specified in different ways depending on the distribution of the error term. If the error terms are independently and identically drawn from an extreme value distribution, the RUM model is specified as multinomial (conditional) logit (McFadden 1974). This implies that the probability of choosing site *j* is given by:

$$pr_{ij} = \frac{\exp(V_{ij})}{\sum_{k=1}^{J} \exp(V_{ij})} \qquad (3)$$

where pr_j is the probability that site *j* is chosen. The conditional logit or RUM model is restricted by the independence of irrelevant alternatives (IIA) assumption (Luce, 1959). IIA assumes that the ratio of probabilities of choosing any set of alternatives remains constant no matter what happens in the remainder of the choice set. The IIA assumption implies that the errors in estimating utility across alternatives are un-correlated. To test this hypothesis we re-estimated the parameters of our full model, excluding one site (Cliften Play Hole) as a choice option, and performed a Hausman-McFadden[2] test: this showed no evidence that the IIA assumption had been violated (χ^2(16) = 10.51, prob = .8389).

[2] For an extensive discussion, see Hausman and McFadden (1984).

In this paper, we compare "clustered choice models" in terms of the Hicksian welfare measures that they produce. The Hicksian welfare measure for a change in a choice attribute (in our case improved quality of a characteristic at a whitewater kayaking site) based on a standard conditional logit model is the log-sum formula (Hanemann 1984):

$$CV_i = -1/\beta_m \left[\ln\left[\sum_i \exp(V^1(b_i^1))\right] - \ln\left[\sum_i \exp(V^0(b_i^0))\right]\right] \quad (4)$$

where CV stands for compensating variation, exp(V) is the deterministic component of utility with superscript 0 (1) denoting the initial (final) level of whitewater site characteristic *b*, and where β_m is the coefficient on trip cost in our estimated model. When the marginal utility of income is constant (as measured by β_m), expression (4) gives a valid measure of the compensating variation (CV) for a change in the characteristics or attributes of one or several of the whitewater sites. In the next section we review the data collection procedures and look at some sample characteristics.

4. Sample collection procedure and sample characteristics

The initial steps in this study were to identify the choice sets and their relevant attributes. To accomplish this, focus groups were conducted with kayakers from the university kayak club in Galway and a second group consisting of 7 kayakers who had no affiliations with any particular kayak club[3]. Discussions with the Irish Canoe Union (ICU), and the experience of one of the authors (Hynes) with kayaking, also helped in this process. Eleven principal whitewater sites were identified. These were:

- The Liffey

[3] Much of the kayaking population in Ireland are not affiliated with any particular club. Individuals have their own equipment and paddle rivers in groups of three or four. As such, it was felt necessary to get the opinions of non-club affiliated kayakers as well as club affiliated ones.

- Clifden Play Hole
- Curragower wave on the Shannon
- The Boyne
- The Roughty
- The Clare Glens
- The Annamoe
- The Barrow
- The Dargle
- The Inny
- The Boluisce

In regards to the site attributes we had to decide whether to use a subjective or an objective measure of each characteristic. Objective measures value characteristics using external sources of data whereas subjective measures allow the respondent themselves to place a value on the attributes of each alternative site. Following the approach adopted by Hanley et al. (2001) we use the respondents perceived or subjective measure for all attributes other than travel cost. This approach is in contrast to that used in much of the random utility literature where attribute measures are sourced externally from the respondents. For example, Parsons and Massey (2003) use a variety of external data sources such as travel guides, field trips, interviews with resource managers and geological maps to compile a dataset of characteristics in relation to 62 beaches in the mid-Atlantic region of the USA. However, we assume most kayakers have, through personal experience, a good knowledge of major whitewater kayaking sites and therefore allow them to use their own judgment to rank each alternative site in terms of the following attributes: average quality of parking at the site, average crowding at the paddling site, average quality of the kayaking site as measured by the star rating system used in The Irish Whitewater Guidebook, average quality of the water, scenic quality of the kayaking site, reliability of water information, travel distance to whitewater site and travel time[4].

[4] A more detailed explanation of these attributes is given in Table 1.

Respondents, as mentioned above, were also asked both to (i) rank attributes in terms of importance; and (ii) score each of the 11 whitewater kayaking sites on these attributes. The relevant information is given in Tables 4 and 5. As indicated in table 4, the majority (60%) of respondents ranked the star rating of the whitewater site as the most important attribute. Scenic quality of the kayaking site was ranked the least important attribute by 32% of respondents. Many respondents identified further factors, which they considered important. These included, the weather and the personality, skill and experience of the people they were kayaking with. Remoteness of the whitewater site and the kayaking experience was also a plus factor for many respondents. Table 5 gives the mean attribute scores by whitewater site.

The sampling frame was provided by two Irish kayaker email lists obtained from the Outdoor Adventure Store (one of the main kayak equipment outlet stores in Ireland) and the Irish kayaking instruction company, H2O Extreme. A random sample of these email addresses was selected, and questionnaires were emailed to these individuals, who were asked to complete and return the questionnaire via email. To widen the sample in terms of representativeness and increase the number of completed surveys, the questionnaire was also posted up on the homepage of the Irish Canoe Union website (www.irishcanoeunion.com) and administered at an organized kayaking meet on the Liffey river in January 2004. A sample of 279 useable responses from kayakers was eventually acquired.

In the travel cost model literature, travel cost has always been viewed as a very important attribute, as it provides the key to obtaining consumer surplus estimates for changes in recreation site quality or availability. Travel distance was converted into travel costs using a per-mile cost of €0.25 which reflects the Automobile Association (AA) of Ireland's calculations for the marginal costs of motoring for a car of average size. Many researchers include travel time along with petrol costs as one element of travel costs (Feather and Shaw 1999), and this is the approach we adopt here. We use each kayaker's potential hourly wage as the opportunity cost of leisure time, as predicted by an earnings model from a secondary dataset (the European Community Household Panel dataset) and based upon that person's actual socio-economic characteristics[5]. Once we have calculated the opportunity cost of leisure time, the total travel cost is then calculated by:

$$TC_{ij} = ((2^* (\text{distance} * €0.25))/2.3) + ((\text{travel time}/60) * HW_i) \quad (5)$$

Where TC_{ij} is the travel cost of kayaker i to whitewater site j and HW_i is the predicted potential hourly wage rate of kayaker i. It is usual for the petrol expenses of a kayaking trip to be divided amongst all the participating passengers in the vehicle traveling to the whitewater site. It was found that the average number of kayakers per vehicle was 2.3 individuals.

4.1 Descriptive statistics for the sample

Some 43% of all kayakers questioned were in the 16-25 years age bracket, which was the largest percentage of any of the age groups. 37% and 9% of the kayakers were in the age brackets 25-35 years and 35-45 years respectively. Only 3% of the kayakers questioned were aged over 45 years. The majority of respondents were male (78%). 70% of the sample was single, whilst 13% of those interviewed had children. The mean income before tax was €27,634[6]. Over 44% of kayakers had been paddling for 5 years or less, with another 15% and 19% indicating they had been kayaking for between 5 and 10 years and between 10 and 20 years respectively. Overall respondents had been kayaking for a minimum of 0.5 years, a maximum of 36 years with the mean at 7.4 years. In terms of participation, 39% of all respondents completed 20 kayaking trips or less in a year, with the next largest group being 23% of respondents, completing from 30 to 50 kayaking trips in the year.

Figure 1 shows the distribution of total trips taken to all whitewater sites in our sample. Overall the mean number of kayaking trips completed in the previous year

[5] For an extensive discussion of the methodology used to calculate the travel cost variable in this paper see Hynes et al. (2005).

[6] This figure includes average student income of €5000.

was 38, with the median at 26. Table 3 gives a picture of kayaking activity during the 12 months prior to the completion of the survey by skill level. It is obvious from this table that kayakers who have better kayak handling skills are more likely to visit a whitewater site of a higher degree of difficulty[7]. Indeed, kayakers who had only basic or intermediate proficiency level kayak handling skills (skill level 1) made 78%, 77% and 82% less trips to the grade 3+ rivers of the Roughty, Clare Glens and Dargle respectively, compared to kayakers who had advanced proficiency level kayak handling skills (skill level 2). In fact, advanced proficiency level kayakers undertake more trips to 9 of the 11 whitewater sites in the sample than their basic and intermediate level counterparts.

5. Results

Three conditional logit (CL) models have been estimated (one for our full sample and the other two based on kayaker skill level). In all models the choice probabilities of going to whitewater kayaking sites are regressed on travel cost, and the six quality attributes; parking, crowding, star rating, water quality, scenery and prior information on water levels. The other regressors are site dummy variables for all sites except the Liffey. The models were estimated in Stata using Maximum Likelihood estimation procedures. Results are presented in Table 6. The first column of table 6 presents the results of the model estimated using the full kayaker dataset (model CL1) ignoring the heterogeneity in preferences across respondents. The second column presents results for the sub-sample of our dataset that have basic and intermediate proficiency level kayak handling skills (model CL2). The third column presents the results for the remainder of our sample that have advanced proficiency level kayak handling skills (model CL3). The log likelihood values for Models CL1, CL2 and CL3 is -913.95, -358.22 and –447.78 respectively.

We first perform a likelihood-ratio test for the null-hypothesis that the parameter vector of the 2 clustered skill-based models may be nested in the parameter vector of

[7] As mentioned in the first section of this paper, table 2 outlines the associated grades of the whitewater sites in this analysis.

our full sample model. The likelihood-ratio test statistic is distributed as χ^2 (with k degrees of freedom, 17 in this case; where k is the number of variables in the model to be estimated), with a calculated value of 142.33. We thus reject the null hypothesis, at the 95% level of confidence, that the two subsets of the data (based on the skill level of the kayakers in the sample) can be described by the full model's (CL1) parameter vector. This is an important result as it indicates that the observations from our two different skill groups should not be pooled together but rather should be analysed using separate models.

The estimated coefficients for travel cost in both clustered models, CL2 and CL3, are of the expected sign and are statistically significant at the 1% level. Almost all the site dummies are statistically significant at the 1% level for both models. These site dummies represent the somewhat unique physical characteristics of each kayaking site. Given the fact that they are nearly all found to be highly significant we would expect a wide range of values associated with the loss in consumer surplus if access to alternative sites were to be denied. The variable indicating crowding was found to be statistically insignificant in both models CL2 and CL3. The results for water quality, star rating and scenic quality are very interesting for the two different skill groups. The water quality variable is insignificant and of the intuitively-wrong sign for basic and intermediate proficiency level kayakers (CL2). It is however highly significant and of the expected sign for the advanced proficiency level kayakers (CL3). This result, however, can be explained from a taste heterogeneity perspective. Basic and intermediate proficiency level kayakers will tend to paddle on rivers of lower grade with gentle rapids where they are less likely to topple over. Since they spend more of their time "above water" they are likely to be less concerned with the water quality they paddle in. Advanced proficiency level kayakers on the other hand paddle on more technically difficult whitewater where they are likely to spend more time upside down, getting their torso and face hit by larger rapids and "rolling" their kayak. For this reason we would expect this group to be much more concerned with the quality of the water they are paddling in that their basic and intermediate skill counterparts.

Similarly, the fact that scenic quality of the white water site is of the correct sign and statistically significant at the 1% level for basic and intermediate skill kayakers but insignificant for advanced skill kayakers is not unexpected. As discussed in the last section, advanced level kayakers may not have the time to appreciate the beauty (or lack of) of the surrounds of a whitewater site as they have to concentrate on the job at hand, whereas the lower skill group who are likely to be on less challenging rivers do have the luxury of time to appreciate the scenery around them. The star quality variable is of the expected sign for both skill groups but is only significant for the advanced skilled kayakers. Indeed, it is significant at the 1% level for this group. Again one might expect this, a priori.

Results from the clustered CL models thus show considerable variation in preferences across skill levels of kayakers. This suggests that whitewater site managers and policy makers in charge of such sites should think carefully about the particular type of kayaker utilising the site and the attributes and facilities that such kayakers might want. For example, a water clean up program might be worth more on the Roughty river which is frequented by more advanced level kayakers than at a whitewater site such as the Boyne which is frequented more by basic and intermediate skill kayakers who are not as concerned by the quality of the water they paddle in. To quantify these differences in the value of site changes by skill group, we now use the clustered CL models to calculate Compensating Surplus measures, according to equation (4) above.

6. Welfare Impacts of Site Changes

In this section, we consider a number of welfare scenarios for our alternative models. These include:

- The Roughty river becoming unnavigable by kayak due to the building of a hydro scheme.
- The Boyne river becoming unnavigable by kayak due to the building of a hydro scheme.
- A 25% improvement in water quality at the Curragower wave on the Shannon.
- A €3 parking fee at the put-in to the Liffey river.

The first two scenarios value site access and investigate the very real development threat coming from investments in new hydroelectric plants in Ireland. Such investments are deemed necessary under Irish government targets for increasing the fraction of energy produced from renewable sources (Department of the Environment 1999) but hydro developments on some rivers may come at the expense of significant foregone non-market recreation benefits, in terms of the use of "natural" rivers by whitewater kayakers (Hynes and Hanley 2005). The last two scenarios then value changes in a site characteristic.

The results based on all models are shown in Table 7. It is possible to compute by how much compensating surplus would fall on average if any of the whitewater kayaking sites were closed. All results are per kayaker per trip. The first column of table 7 presents the results of using the parameter estimates from our full sample RUM model. The second column presents the results of using the parameter estimates from our “clustered” RUM where the grade of the whitewater site and the proficiency level of the kayaker likely to be found on the site are taken into account. All values relate to the loss in consumer’s surplus if a kayaker is prevented from kayaking at his or her most preferred site only.

As can be seen from column 2 it is important for resource managers and policy makers to take into account the type of recreationalist that is likely to be found at a particular site. The Boyne and the Liffey are grade 2/3 rivers. The Roughty is a grade 4 and the Curragower wave on the Shannon is a grade 3, river feature. We would expect to find mainly basic and intermediate proficiency kayakers on the first 2 of these whitewater sites and advanced level kayakers on the Roughty and Curragower wave due to the technical difficulty of the whitewater involved. Using our skill based estimated RUM models yields welfare estimates that are significantly different compared to our overall RUM model. The expected CV loss per kayaker from the loss of the Roughty river is calculated at €2.54 when we take into account the type of kayaker that would be using this river. This is done by using the results of the advanced skill RUM model (column 3, table 6). This estimate of the loss in per-trip consumer surplus is estimated with 95% confidence to be between €2.19 and €3.06.

The corresponding estimate when we use the results of the overall RUM model is 32% less than this at €1.72.

The opposite result is found when we use the basic/intermediate skill RUM model (column 2, table 6) to calculate the welfare losses (or gains) associated a loss of or change in an attribute of a lower grade river. The expected CV loss per kayaker from the loss of the Boyne river is calculated at €1.06 when we take into account the type of kayaker that would be using this river. This loss in per-trip consumer surplus is estimated with 95% confidence to be between €0.93 and €1.24. The corresponding estimate when we use the results of the overall RUM model is 46% higher at €1.55. Similarly, the loss in kayaker welfare per trip when a €3 parking fee is imposed at the Sluice on the river Liffey is 50% less if one uses the basic/intermediate skill RUM model instead of the overall RUM, to take into account the fact that basic and intermediate kayakers are more likely to be on this river that advanced level kayakers, €0.19 compared to €0.29. The estimate in the loss in per-trip consumer surplus due to the parking fee (using the clustered model) is estimated with 95% confidence to be between €0.17 and €0.22.

Water pollution is another threat to whitewater recreation in Ireland. The result is virtually zero (€0.009) when we estimate the welfare gain to kayakers of a 25% water quality improvement at the Curragower wave on the river Shannon using the full RUM model. However, the estimated recreational benefit from a 25% improvement in water quality results in an increase in consumer's surplus of €0.13 per kayaker per trip when we take into account that it is mainly kayakers with advanced handling skills that will be utilising this whitewater site. This gain in per-trip consumer surplus is estimated with 95% confidence to be between €0.11 and €0.16.

Finally, skill differences are one aspect of heterogeneity in preferences. There are, of course, many alternative approaches to incorporating heterogeneity within RUM models of recreation, such as the latent class (LC) and random parameter logit (RPL) approaches. One interesting comparison is then between the clustered RUM approach used here, to account for heterogeneity, and these alternatives. In Table 8, we thus compare the welfare estimates of site quality/access changes between a random parameters model and the clustered RUM results of Table 7. As may be seen, the expected CV loss per kayaker from the loss of the Roughty river is calculated at €2.78 when we use the results of the RPL model[8], a result that is very similar to the clustered RUM estimate. A much more extreme difference is found when we calculate the welfare loss associated with the closer of the Boyne river to whitewater kayaking. The expected CV loss per kayaker in this case is calculated at €26.22 when we use the results of the RPL model. This is 24 times greater than the result from the clustered RUM model.

In relation to changes in the attributes of particular sites, the RPL model, once more, gives estimates of the welfare impacts on whitewater kayakers that are slightly higher than the clustered RUM results. For instance, the estimate of the welfare gain to kayakers, of a 25% water quality improvement at the Curragower wave on the river Shannon is once again very low at only €0.55 per kayaker per trip when using the RPL results. However, the loss in kayaker welfare per trip when a €3 parking fee is imposed at the put-in to the Sluice on the river Liffey is €3.70 if one uses the RPL model instead of €0.19 when we use the clustered RUM model. The differences in the results may be explained by the fact that the RPL model allows explicitly for a range of attitudes towards attributes within the kayaking population whereas our clustered RUM model only allows for differences in attitudes and tastes based on differing skill levels. This distinction will of course yield welfare estimates that vary in their magnitude.

7. Conclusions

Participation rates in outdoor activities like whitewater kayaking and mountaineering that require specialized skills and experience are increasing. Policy decisions impacting on access to and quality of these recreational service flows can be improved with valid estimates of consumer surplus values accruing to the

[8] The travel cost coefficient for the RPL model, which is used in estimating the welfare estimates was found to be –0.063.

recreationalists. To accurately estimate those values, it is necessary to account for the necessary skill levels that are required to participate at recreational sites of differing grades. This study accomplishes that goal by using an approach that implicitly takes account of the proficiency level of the kayaker in a "clustered" RUM model. We then used this "clustered" whitewater site choice model to estimate the welfare impacts of a number of different management scenarios.

By not taking into account the differences in the skill of the kayakers or the different type of recreationalist that frequent different recreational sites in general, recreation demand modellers may be underestimating (overestimating) the welfare losses (gains) associated with changes in site attributes. For our particular recreational activity, not taking into account the differences in the skill of the kayakers and the grade of the river will result in overestimating the welfare estimates associated with lower grade whitewater sites (which are frequented by basic/intermediated proficiency level kayakers) and underestimating welfare estimates associated with changes in the attributes of higher grade whitewater sites (which are frequented by advanced proficiency level kayakers).

In this paper, we estimated economic welfare values associated with access to whitewater kayaking sites and changes in the quality of the kayaking experience at these sites in Ireland. The results have potentially important implications for recreational demand policy and data collection. Our "clustered" RUM model gives higher welfare estimates of consumer surplus than the simpler model when the skill level of the kayaker is more advanced and the grade of the whitewater is higher. These findings are consistent with those of Munley and Smith (1976), the only other study that looked at the importance of skill and experience in whitewater recreation. Ultimately, we believe that by not taking into account the type of individuals that frequent different sites, policy makers and resource managers could potentially make incorrect resource allocation decisions that are based upon unreliable consumer surplus estimates and the misguided assumption of homogenous preferences amongst recreationalists.

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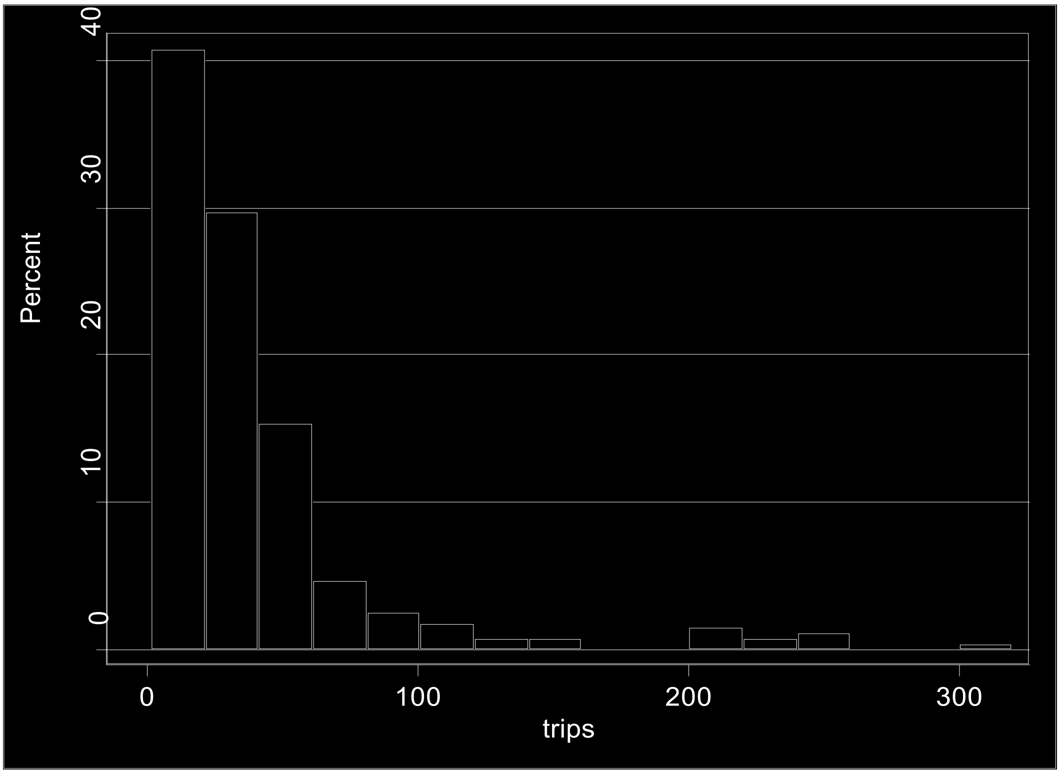
Figure 1. Distribution of Whitewater Recreation Trips to All Rivers



Tables

Table 1. Measured Attributes of Whitewater Sites and the Attribute Levels

Factor	Score/Level of Factor				
Average quality and safety of parking at the site (Score from 1 = poor to 5 = excellent).	1	2	3	4	5
Average crowding at the paddling site (How many other kayakers are on the water you are paddling - Score from 1 = very crowded to 5 = uncrowded)	1	2	3	4	5
Average quality of the kayaking site (i.e. No. of stars).	0 star	1 stars	2 stars	3 stars	
Average quality of the water (Score from 1 = extremely polluted to 5 = unpolluted).	1	2	3	4	5
Scenic quality of the kayaking site (Score from 1 = not at all scenic to 5 = very scenic).	1	2	3	4	5
Reliability of Water (score from 1 = before visiting the site, completely unsure of water level at the site to 5 = positive about water level at the site)	1	2	3	4	5

Table 2. Whitewater Sites and Associated Whitewater Grade

Kayaking Site	*Grade*
The Liffey	2/3
Clifden Play Hole	2
Curragower Wave	3
The Boyne	2/3
The Roughty	4
The Clare Glens	4/5
The Annamoe	3
The Barrow	2
The Dargle	4/5
The Inny	2
The Boluisce	2/3

Grades from the Irish Whitewater Guide book (MacGearailt, 1996)

Table 3. Mean Visits to Each Whitewater Site Last Year by Skill Level

	Skill Level 1		Skill Level 2	
Kayaking Site	*Mean Visits*	*Std. Dev*	*Mean Visits*	*Std. Dev*
The Liffey	8.80	20.30	24.78	55.67
Clifden Play Hole	2.43	6.33	2.85	4.53
Curragower Wave	2.76	5.51	3.96	7.25
The Boyne	4.63	7.29	6.72	19.64
The Roughty	0.30	0.69	1.36	2.66
The Clare Glens	0.37	1.08	1.66	2.70
The Annamoe	2.47	3.97	4.42	6.23
The Barrow	1.32	8.44	0.70	1.33
The Dargle	0.39	1.13	2.22	5.12
The Inny	0.87	1.23	1.28	2.26
The Boluisce	1.06	3.21	0.96	1.46
All Sites	2.31	7.99	4.63	19.37

Skill Level 1 refers to kayakers who have basic and intermediate proficiency level kayak handling skills. Skill Level 2 refers to kayakers who have advanced proficiency level kayak handling skills.

Table 4. Factors Ranked 1st in Importance and Last in Importance with Regard to Choosing a River to Kayak

Factors	% of kayakers ranking attribute 1st in Importance	% of kayakers ranking attribute Least in Importance
Quality of parking	2.87	18.28
Crowding at the paddling site	1.43	4.66
Quality of the kayaking site (stars)	60.22	3.58
Water Quality	5.73	2.51
Scenic quality of the kayaking site	3.58	31.54
Reliability of Water	15.05	2.51
Number of other sites within 10 miles	2.87	22.94
Travel Time (one way from home to site)	7.53	10.75

Table 5. Mean Ranking of Attribute by Whitewater Site

Factor	Liffey	Clifden	Curragower	Boyne	Roughty
Quality and safety of parking	3.35	2.99	3.08	2.36	3.06
Crowding at the paddling site	2.76	2.74	2.92	3.22	3.94
Quality of the kayaking site (stars)	1.66	2.37	2.64	1.64	2.72
Water Quality	1.93	4.15	2.61	3.27	4.57
Scenic quality of the kayaking site	2.63	4	2.37	3.97	4.41
Reliability of Water	3.33	4.52	3.34	3.2	2.62
Number of other sites within 10 miles	2.37	2.05	2.66	1.64	3.8
Travel Time (one way from home to site)	85	195	123	91	225

Table 5...continued. Mean Ranking of Attribute by Whitewater Site

Factor	Clare Glens	Annamoe	Barrow	Dargle	Inny	Boluisce
Quality and safety of parking	3.55	3.16	2.58	3.88	3.65	2.85
Crowding at the paddling site	4.03	2.98	3.65	4.13	3.51	3.6
Quality of the kayaking site (stars)	2.89	2.11	2.88	1.32	1.57	2.04
Water Quality	4.43	4.13	4.13	3.43	3.67	4.26
Scenic quality of the kayaking site	4.73	4.02	4.38	3.68	2.84	3.43
Reliability of Water	2.48	3.02	2.56	3.13	2.71	2.98
Number of other sites within 10 miles	2.57	4.07	3.2	2.15	1.5	1.85
Travel Time (one way from home to site)	143	111	102	145	127	134

Table 6. Random Utility Site Choice, all trips, Models 1, 2 and 3

Variable	All Kayakers	Skill Level 1^	Skill Level 2^
Travel Cost	-0.069	-0.099	-0.059
	(17.98)**	(14.15)**	(11.74)**
Quality of Parking	-0.145	-0.089	-0.22
	(2.04)*	-0.71	(2.16)*
Crowding	0.153	0.172	0.129
	(2.19)*	-1.51	-1.39
Star quality of the whitewater site	0.351	0.163	0.488
	(2.82)**	-0.82	(2.86)**
Water Quality	0.142	-0.241	0.397
	-1.39	-1.45	(2.87)**
Scenic quality	0.285	0.492	0.107
	(2.99)**	(3.22)**	-0.84
Availability of Information on water levels	-0.08	-0.311	0.178
	-0.92	(2.19)*	-1.52
Clifden Play Hole	-0.905	0.304	-1.643
	(2.47)*	-0.54	(3.18)**
Curragower Wave on the Shannon	-1.413	-1.141	-1.586
	(5.34)**	(2.89)**	(4.10)**
The Boyne	-1.772	-1.586	-1.864
	(5.93)**	(3.51)**	(4.41)**
The Roughty	-1.641	-1.707	-1.397
	(4.10)**	(2.67)**	(2.51)*
The Clare Glens	-3.387	-4.224	-2.734
	(8.63)**	(6.72)**	(4.99)**
The Annamoe	-2.076	-1.787	-2.105
	(6.25)**	(3.58)**	(4.47)**
The Barrow	-2.914	-2.408	-3.115
	(9.27)**	(5.18)**	(7.07)**
The Dargle	-5.011	-6.195	-4.303
	(12.33)**	(8.96)**	(7.87)**
The Inny	-1.769	-0.892	-2.393
	(6.04)**	(2.07)*	(5.70)**
The Boluisce (Spiddle)	-2.344	-1.437	-2.899
	(6.96)**	(2.81)**	(6.06)**

Absolute value of z statistics in parentheses; * significant at 5%; ** significant at 1%. Models CL1, CL2 and CL3 have log likelihood values of –913.95, -358.22 and –447.78 respectively.
^Skill Level 1 refers to kayakers who have basic and intermediate proficiency level kayak handling skills. Skill Level 2 refers to kayakers who have advanced proficiency level kayak handling skills.

Table 7. Welfare Impact of Different Policy Scenarios as measured by loss/gain in Consumer Surplus per kayaker per visit

Scenario	Base RUSC Model(€)	Skill RUSC Model (€)
Loss of the Boyne river due to the building of a hydro scheme	1.55	1.06*
Loss of the Roughty river due to the building of a hydro scheme	1.72	2.54**
25% improvement in water quality at Curragower wave	0.009	0.13**
€3 parking fee at the Liffey	0.29	0.19*

Source: Calculated from models reported in Tables 5.
* indicates estimated using the RUSC model for kayakers who have basic and intermediate proficiency level kayak handling skills.
** indicates estimated using the RUSC model for kayakers who have advanced proficiency level kayak handling skills.

Table 8. Welfare Impact of Different Policy Scenarios as measured by loss/gain in Consumer Surplus per kayaker per visit

Scenario	RPL Model (€)
Loss of the Boyne river due to the building of a hydro scheme	26.22
Loss of the Roughty river due to the building of a hydro scheme	2.78
25% improvement in water quality at Curragower wave	0.56
€3 parking fee at the Liffey	3.70

Source: RPL model results available from authors upon request.