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## Staff Papers Series

TIME IN RECREITION MODELING AND DECISION MAKING
by

Wiktor L, Adanowlez
and
Theodore Grahan-Tomasf

## LTI

## Department of Agricultural and Applied Economics

# TIME IN fECREATION MODELING AND DECISION MAKING* 

$B Y$
Wiktor L" Adamowices
and
Theodore Graham...Tomas $=$

June 19日7
${ }^{4}$ Thi $=$ research wes mupported by the Minmesotea Agricultural Experiment Station Froject 14 - 88 and the bepartment of Agricultural and Appli jed Ecomomics, University of Mimmentan Some data were provided by the Minnesota Department of Matural Fiesoumesen no encomsement of the researcti findings by them is implied.
massimtent Frofessor, Department of Fural Economy, Univerieity of Alberta and Fesearch Assistamt, Departinent of Agricultural and Applied Ewomomics, University of Minnesotan

Fssistant Frofeswor, Department of Agricultural and Amplied Ecomomics and Department of Forest Fesources, Umiversity of Mjnmemte, wnd Yisiting Assistant Frofessor", School of Naturel. Resources, Umiversity of Michigan.

Steff Fapers are putaished without formal review withint the Department of Agriculturel and Applied Ecomomics.

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## TIME IN RECREATIDN MODELING AND DECISION MAKING

The interest in modeling recreation decision making has mjsen rapidly in the past two decuctes. Valuing the effecta of environmentel quality changes has become a major research effort for womomists. However, ome of the most troutlesome aspects of this effort has bem the value and role of time in the dewision mating prowess. A veriety of approaches have beem suggested for Hhe veluatiom of travel and site time in recreation ztudies \{see Smith, Desvousges and NcGivmey, Wi 1 inam, Cesario and knetsch, and Micomiell. None of these approches are entirely satisfactory. Firstiy, most rely on time as a constreint in the recreation decision promess while in fact itw mey be an arghment in the utinity furnction see zectimuser for an interestimg approach to modeling time am the main source of utility in ecomomic dife). secondiy, the question of the value of timesemis to be ma unanswerable one in general. Wost economic model a assume that time is valued at the wage rate, however, many empirion studies value recreational time at some fraction of the wage rate. which is correct: Harioch has formulated a model by whict the value of time differs from the wage rate on non-work days however this moclel has not been used in mewreation wtudies as of yet. Enonomir theory appears to provide little definitive guidance as to how to value time. Thirdly, most dete gethering efforts have not inoluded consideration of the variables requifed for an Empiricel examination of the role and value of time on recreatiom decisionsa thus most research into this question is either theoreticej in meture or uses weat proxies in the empiricul
amalyses. It would seem that empirical examination is the only avemue left to explome the value of time in an issue as complex as recreation decimion makimg.

This paper reports the results of a project to collect information on the role and value of time in recreation decisions. the data wollected arebased on severad models Formudeted in the recreation decision making literature. The next sewtion will outline the comstruction of the questionmaires mhat the underlying theoretical models. The third section of the peper presemts the resulte of the survey research and some of the findinge. The foumth section contains an analysis of verious time value models and their reswlts given our more complete data structure. The fifth section presents our conclusioms.

## Theory and Questionnaire Design

Two mejor tembmapes are utilized for the valuation of recremtional activities using marbet data as the source of information (as opposed to contingent valuation which uses direct
 the hedonice price model (HFw). While other techniques exist. " these are the most: populer empirical approacties to valuimg nonmarbet gocd: The TCM bases estimates of comsumers sumplus on How travel costs affect site use (eme Mcommeli). Time emters the TCM both im terme of the opportumity cost of travel to the site (astravel mad time (wowt ) me well aw whough the wey time spent in recreation $i s$ modeled in the demend system. Early
studies utilized a fraction of the wege rate times travel time as a measure of the opportunity cost of travel time and added this amount to the travel. cost, thus reising estimates of consumers surplus relative to Estimates whictignore the value of time (Cemario and knetsch). Wilmen describes a theoretical model in which travel and on-site time are measured, each with a different price, and are added to the opportunty cost of the trip. This alwo would result in an increese in the consumers surplus estimaten Most approaches to including the value of time in TCM studies lieve either made momewhat ad hoc ewtimetes of the value of time or have mot performed empirical work (wilman ise an玉x whple of the latter while Smith, Desvousges and Mecivney is an example of the former, Mcmonnell and Strand $i s$ an example of a stualy with theoretical and empirical analysis). we are interested in collecting data that allow us to better determine the velue of time jorecreetion and to examine the various time value models and estimate them with these deta.

Hedomic travel cost models (HTGM) are a new approam to valuing not mites thenselves, but rather site characteristics and Eheriges in them. Brown and Memdelsohn developed the HTGM model as a variant of the hedonic price mocels popular in the environmentel 1 itereture. The HTCM does not possess a strong theoretical basis: mevertheless it has been utilized in a variety of studies of the economic effects of weter qualjty (Brown and
 entimeted by regressing the travel costs or travel time on the characteristice of various mites for each population zone. The
basis ja that recreationists are willing to pay, through travel or time wosts, for higher characteristic levelan The coefficients of such a regression make up the "hedomic prices" which are then used to derive a demand function for chracteristics. Clearly, wime costs are an integral part of the HTCM. Gimjar studies that fall umder the hedonic price cetegory estimete expenditure on recreation activities as a fumction of wharacterisites, analogous to the Ledd and Guvanmunt arialysis of food characteristics. Both approaches yicld implicit prices and demand functions for characteristics.

Fepers by widmen and Smith, Desvousces and McGivemy have shown that under certain amsumptions both travel time and site time should be valued at some rete in a TCM. These papers utilize a traditiomal utility meximizimg moclel with either household production components or time constraints. However, often consumers ere interested in mpending time in a certan activity rather than consuming a "unit" of that activityn Utility may be an increasimg function of tite time spent. This type of model, imspired by the analysis by zectheuser, is employed below.

Let us examine a monsumer who mhooses to maximize utility as a function of the time spent recreating Tw, the time mpent travelling to the recreation site Tan and the time mpent in other activities $T_{, ~(n o t e ~ t h a t ~ a p p r o p r i a t e ~ d e f i n i t i o n s ~ o f ~}^{*} \quad$ will. return us to a traditional travel cost framewort where $T_{m}$ is a trip. The presente approach allows more flexibility in the defintion of travel and site time) " The consumer must purctiase market goocs in order to participate in each of these
activities. Let $\gamma\left(T_{m}\right), \eta\left(T_{a}\right)$ and $\alpha\left(T_{m}\right)$ be the functions that convert recreation, travel and other activity time into dollar
 function of travel time. Let 5 be mon-wage income, w the wege rate, Tw the time spent working regular time, w the comstant multiple that converts the regular time wage rate into an overtime raten and To the time spent working overtime. The basic model $\mathrm{i}=$

$$
\begin{equation*}
\text { MAX U } U=U\left(T_{x}, T_{\pi}, T_{m}\right) \tag{1}
\end{equation*}
$$

subject ta: $5+W T_{\omega}+\omega W T_{0} \vdots Y\left(T_{x}\right)+T_{1}\left(T_{\pi}\right)+a\left(T_{\mu}\right)$

$$
\begin{equation*}
T \fallingdotseq T_{m}+T_{0}+T_{2}+T_{a}+T_{m} \tag{2}
\end{equation*}
$$

One specification which will consider time constraimts explicituy wi.l. incuude the constraints:


Constraint (4) indicates that there is some minimum time required to consume each unit of activity $\boldsymbol{n}_{n}$ while constraint (E) $i s$ a similar minimum time required to travel to the recreation siten Comstraint (6) indicates that the time on site may be lems than or equal to the masimum possible length of stayn For examples if the recreation activity js womstrained by daylight hour= (or the fact that the rewreationist must return to work), there $i s$ a limit on the number of hours that cen be fpent in the metivity Maximizing the system above yields aseries of fuhri...

multiplier on the private good time requirement, $\lambda$, the multiplier on travel time, $\lambda$ or the multiplier on site time, $\lambda$ en the
 constraint. The lugrangian is

$$
\begin{align*}
& +\lambda=\left(T_{x-\zeta}-\zeta\left(T_{m}\right)\right)+\lambda_{4}\left(S+w T_{w}+\omega w T_{0}\right.  \tag{7}\\
& \left.-\gamma\left(T_{x}\right)-\eta_{0}\left(T_{c}\right)-a\left(T_{\mu}\right)\right)+\lambda_{m}\left(T_{-\cdots} T_{w}-T_{0}-T_{z}-T_{a}-T_{\mu}\right)_{n}
\end{align*}
$$

The $k-T$ conditions include the relations that if the travel time constraint is bincing (that is, is the shortest route to the site is chosem), then the mutipliem $\lambda_{2}$ is monzeron and if the site time constraint is binding, $\lambda \boldsymbol{r}$ is monazeron These multipliers. in addition to the multiplier on the budget wonstraint, can be rearranged to form the value of travel time and the value of site time as ratios between the multiplier: In particular, differentiation with respect to Tm and Ta yields

Equating ( $B$ ) and (9) via $\lambda_{0}$ (assuming To and $T=$ are positive) and dividing through by da yields an expression in the velue of
 Altermately we can form:

$$
U_{t=}-U_{t a}=\lambda_{a z}-\lambda_{0}+\lambda_{4}\left(\gamma^{\prime}\left(T_{x}\right) \cdots \Pi^{\prime}\left(T_{G}\right)\right)(10)
$$

This comettion is very similar to equation 10 in wilman. The right hand side of (lo) is the marginal cost of recreation time including the marginal utility of additional mite time, the


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marginal utility of saving travel time and the marginal utility of income times marginal time costs. The typical travel cost model results from assumimg $\lambda_{\mathrm{m}}=\lambda_{2}=0$ and jgnoring U'ten The formulation in (10) results in travel time and site time being velued at dirferent rates. The posited constraints result in Euch a formu The travel time constraint is similar to Deserpas formulation of time constraints and the site time constraint is simi. ar to wilman's trip comstraint, of course, this is not the only model that might be platsible for recreation decisions. If trevel time is not binding or site time is not bindingy a different time value is possiblesince these multipliers are zerm. In much arese the value of time is obtajed from the k-T womditions of the wage time variablen


$$
\begin{aligned}
& a L / a T_{w}=\lambda_{4} w-\lambda_{0} O(11) \\
& a L / a T_{0}=\lambda_{4} \omega W-\lambda_{0} 0(12)
\end{aligned}
$$

Equation (11) states that the value of time is the wage rate if individual $i s$ working (regular hours, Tw 0 ) and the value of time is the overtime premium wege if To $\gamma$ on Note that the ratio of $x$ over ha is the ratio of the merginal utility of income over the marginal utility of time, or the value in income of time. Therefore, depending on what constraints are binding and what the individual's alternate activity is, the value of time ditfers from some factor times the wage rate to an unbmown retio of legramge multipliers.

If te remove the site time comstraint (o) we return to a situation where site time is valued at the wage rate and only travel time cer potentially be valued at a rate different than
the wage rate. Mamipulation of these constraints and models can also mesult in the model of Smithy Desvousges and Mcivivney, in whicm travel time and on mite time are valued at some monn 1. imear function of the wage rate.

Let us manipulate the model ome last time by adding a constraint which requires that wage time and overtimetime must be 1ess than of equal to some constant factor. This constrant wi.l. illustrete the bimding effect of wort hours on the recreation issue. Let the Legrange multipiner om this cometrant be No, Equations (11) and (12) becomen

$$
\begin{aligned}
& a L / a T_{w}=\lambda_{4} \omega-\lambda_{0}-\lambda_{0} 0(11) \\
& a L / a T_{m}=\lambda_{4} \omega W \cdots \lambda_{0} \cdots \lambda_{0}(0(12)
\end{aligned}
$$

Upon rearrangement these equations imply that the value of time ( $\lambda_{\text {e/hat }}$ ) is Less that the wage rete (or the overtime rate) by the ratio $\lambda_{6} / \lambda_{4}$, the shadow value of the work time comethaint over the marginal utility of incomen

Clentry, altermate versions of the model above can be formed to model wort time constraints and other aspects of the recreation decision. However, this model suggests that several variables that have not tywically been collected in recreation activity surveys meed tw be included in questionmeires. In particular, we require more information on the constraints affecting the recreationists and their travel amo onmeite time usen Gur attempt to collect wuch data through a survey instrument is deworibed belown Before turning to the issue of date collection and quemtionmaire design we discuss the hedomic price
model of mecreation use and the role of time in this model.
An alternate version of the wime value issue, which results directly from the jombusion of time in the utidity function, is $\quad$ f hedonic price formulation of the recreation decision. Let the comsumer maximize utility as a function of recreation time (Tx) and a site characteristic (C). In this wase we treat time in the metivity as a mharacteristic siroce it is produced by a Combinatiom of twavel and other purchased goods and time on site. In the form of a hedonic price model the consumer maximizesu

$$
U=U\left(T_{x, y} \quad C_{,} X\right)
$$

subject ton $M$ F $F_{\mu} X+V\left(T_{x,}, C\right)$,
where $x$ is a vector of other market goods, Fis is the price of $x$, M is income and $v($.$) is the cost function for activity$ cheracteristics. It is hypothesized that recreatiomists will spend more to yield more units of time in the activity or more units of the activity characteristic (see Erown and Mendelsohn) * Am estimate of trip costs as a fumetion of activity time and site characteristics will yield the price of site time and the prices of the characteristics. Such a model can be used to estimate the demand for characteristics. It is important that the time used as the characteristic be the desired "characteristic" For example, the desired time may be fishing time and mot travel or other related onsite time. we use such a specification in the empiricel model below.

Ouf analysis shows that the value of onnsite time and the value of travel time may differ. In applications it will be diffimult to determine the value of on-site and travel timen The opportunty cost of tine may be the wage rate for persons who are
employed and who would work as an altermate activity. However, for those who are comstrained from wortimg either by institutiomal or physicel constrejnts the value of time may differ from the wage raten Most researchers have argued thet the value of time should be less tham or equal to the wage ratey but if there is a comstraint on the amount of timerequired in the remreation activity, it is possibleto envision a value of travel time higher than the wage rate comsider the individual who leaves wort early to beat the rush houry the value of time saved appears to be greater than the wage ratel. The data required to detemmine the value of travel and on site time include: (1) how muwh time was spent traveling to the rewreation site, (2) what altermate activity would be pursued if the individual was not rewreating (eg. worbing), (3) whether the shortest route to the site taken (eg. wes trevel time a binding eonstrainty, (4) accurete estimates of wages for the imdivicual and the household, (6) accurate estimates of travel costs and on-wte expenditures, (6) accurate estimates of miles travelled and travel time, and (7) information on whether the trip was taken during a regular worl: dey, holiday or weetend.

## Survey Design and Results

The collewtion of these data as well as various socigeconomic and recreational attitude variables was the goal of the Fhese 1 of this project. Fhese 2 was desicmed to collect detailed time ume and recreatimal activity data on the respondents. There are no examples in the literature of the
collection of such a data set or the examination of the various altermate models of time value in recreation decisions execpt for ad moc measures of time value (see wilman and Fauls: Ginith, Desvousges and McGivmey).

The data requirements described above led to the construction of two questionnaires, one to yield general information on a sample of recreationiste and nom-recreationists, and a second to collect information relevent to our model of time value for a recreation activity. Gport fishimg im Mimmegota was chosen as the recreational activity. The aeneral population survey wes performed to collewt socioeconomic and general recreation participation information on a sample of the Minmesota population. This semple was wiso whosen to determiriz the probability of participation in remreational fishing, since a survey of anglers alone would suffer from self selection bias (for a diswussion of the trunceted nature of recreation models see Kealy arid Eistiop).

The general (Fhase 1) sample wes draw from the Mimmesta Fublic: Safety Name and Address Listing, provided by the Minnesota Department of Naturel Fesources. One thousand names were provided. The survey (in Appendis 1) elicited information on the individuel's perception of environmentel problems in the staten the marticipation of the imdividual in various recreation activities as well as detailed bigraphimel imformetion on the individual and bisher family Notebly, income ciass information wes collected for the various part of the family umit in order to obtain a more detailed breakdown of the most important variable in determinimg the value of timen the wage
rete.
Qf the 1,000 surveys mailed out on July $8,1986, \quad 38$ were returned completed, 120 were returned unopened due to improper adctsesing or lack of forwarding, for a net percentage return of S9. $5 \%$ The high return of umusable surveys led us to believe thet the mailimg list may mave beem momewhet dated. Follow up cerds were sent on July 31, 1986 but there was no 1 arge increase in the rewponsen Descriptivestetictice of some of the more important variables are in Table i. The Fliase 1 survey frovided the participants im recreatiomed fishing required for the fhase a surveyn

The Friase 2 Burvey eliwited infommation on four fishimg trips taken during the 1996 fishing season (See Appendix 2) " One humdred anglers were ohosen from the $74 \%$ of the respondente to the Fhase f survey who indicated that they would perticipate in rewremtiomel fishimg in 1906. of the loosurveys medied on Dctober 2, 1986,31 were returned and 8 were returmed umusable, for a met response rate of 3 u $7 \%$ while tite return perceritages are rether disappodintingy they are not surprising given the complex riature of the deta requested and the apparent problems in the mailing list. The Fhase 2 data were organized on a per trip basis in order to malyze the detua on a trip basis rather than an individual basis m minar to the approach of Eocretael, Hanemann mat kifmg bescriptive statistics on the trip data are summarized in tablez.

Descriptive statistics from the phase 2 sample provide some significant informetion on the alternate activities and the tine


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use decisions made by the angler. In particular, on nearly $90 \%$ of the trips the recreationists took the shortest route to the siten thereby indicating that the Lagrange multiplier on travel time is zerg. We also foum that travel time was mearly 2 hours on average and trip length was about 100 miles, total costs over丰doper trip and travel costs about $15 \%$ of total costs, fishing time made up about $45 \%$ of total site time and average fishing time was about 15 hours per trip. Soine 2g. $\%$ of the trips were on a regular work day. However, it is not clear whether this question picked up respondent's vacation periods or time after work, or both. Closer examination of the data indicates that many of the longer trips were taken on "regular working days" indicatimg that the respondent may have comsidered a vacution a regular worting day. The variable "alternate activity" may provide more information on this issue.


Table 3 contains a frequency distribution for each of the alternate activity categories for the 77 trips. working and worfing overtime matie up a large proportion of the total, although gardening and relaxing seem to be the major alternate choices. The value of time estimates should be based, at least in some part, on the altermate activity the individual would particiapte in. This variable will be utilized in the time models below. It is interesting to note that all recreation analyses that the authors are aware of assume that recreators have complete information (a possible exception is the wort of gmith et al, 1986 where the variance of water guality js an important
paremeter, but there ie no explicit modeling of this attribute). We inchuded a question about the recreator's information fegarding whether or mot they changed thejr mind about how much time to spend at the site. Nearly $24 \%$ of respondents chamged thejr mind. Table 4 conteims crosstabulations of water quality, site quality and crowding effects with the decision to stay on site the deeired amount of time "pid you mbange you mind about how mucti time to spend on this site?"). The only quality varimble whim wemme to be related to the decision to change the trip lengtim is fishing quality. The majority of respondents who chamged their mind about trip lemgth ineiceted that fishing quality was a serious problemn This suggests that quality and expectations play a role in recreation decisions. The authors i.ntemd to explore this further in another paper.

Table E indicates thet the decision to choose the shortest woute $i=p o s i t i v e l y$ correlated with the rumber of individuels in the fishimg perty, Table 6 crosstabulates the alternate activity with the decision to change the length of stay, the decision to choose the shortest route amd the variatie indicating if the trip was taken on a regular work day. The results of the crosstabs suggests that when work is the alternate acvtivity the shortest route is more likely to be chosen. as one would expect. There does not eppear to be a pattern between the alternete activity and the desicion to whange the lemgth of the trip. Finally, the alternate activity variable and the regular work day variable are compared to examine if wombing is alwaye the alternate activity on arequidr work dey. This does not appear to be the case. Four respondents imdicated that work was the alternate activity even


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though the trip was mot on a regualr work day and many respondents indicated that wort was rot the alternate activity even though the trip was on a regular work day. This suggests that time valuation studies which value the opportunity cost of time at the wage rate may be incorrect. of course it may also suggest that respondents did not understand the question very wE 11.


## Valuation Models

Two types of valuation models are estimated in this section. Firstiy, a modified travel cost model is estimated using the method of kealy and Eishop devised to estimate travel cost models with daye at the site as the deperoment variable. Secondiy, 2 hedomic price models are estimated to determine the implicit price of trip charecteristics anc time. The fifmt of these hedmaie price models is estimated on the basis of the value of time as a fumition of the characteristics, somewhat like the HTCM of Brown and Mendel sohn.

The travel cost model wstimates days to a site as a function of travel costs, socioecomomic characteristics and recreation quality variables. Frior to estimetion of the TWM the self.selection bias problem inherent in recreation activity must be treeted. Fecause the respondents to the phase 2 survey are anglers while the other mon maglers heve zero demend for fishing ciays the result is a self-selection problem in that only individuals with non-zero fishing days are in the demand for days
sample. The Heckman procedure provides a solution to this bias by first estimating the probability that someone will participate in recreational fishing and then using the ratio of the ordinate of the normed FDF at this probebility over i mimus the mormal CDF value for thjs probability a= a variable in the demand regressions. This ration known as the inversemilus ratio, eliminates the bias associated with the trumceted sample (wi. man and Feuls). The probability of participation in recreational fishing was estimeted as a function of fishing experience and income. Theresults of this probit estimetiom are in tatue 7 .

The demand functions, estimated as a fumetion of travel wost. water quadity and the wills ratio are presented in table Qn There are four separate travel cost regressions. The first is estimated with mo value placed on travel time, the second values travel time at the wage rate and adde this value to the travel cost, the third adds one third of the wage rate to the travel cost while the fourth forms an index which adds 1.5 times the wage rete for individuels who responded that overtime was their altermate activity, ome times the wage rate for individuals who chose work as their alternate activity and one third times the wage rate for those choosing some non-wort: item as the alternate metivity This was am attempt wo use the additional imformation gathered in our survey to estimate the value of time. Eoth lineat and semi-1og forme of tite demand function were estimated. The approach tatem here is clearly an ad hoc ome in thent the specific wime valuations chosen ere arbitrary. Due to deficiencies in the data, no attempt was made to measure time values for different wlesses of rewreatore. However, we do feel
that: our approach of aistinguishing groups of recreators with different time values based on the mature of their recreation tripe yieldm some insight intothe time valuation issue.

The comsumer surplus estimates are presented in table 9 . These estimates imdicate that the value of time is a very important contributor to the value of recreation. However, which om: of these estimates is correct? lncorrect valuation could result in an overstatement or understatement of benefits by a factor of 10 : Thus, the correct modeling of the value of time is crucial. The formulatiom with the value of time priced at the wage rate for thoce whose alterriate activity is worting and $1 / 8$ the wage rate for those not working seens to be a reasomabley yet stil. ad hoc, method of valuing timen the corisumer mirplus mesulte for this value of time arestill nearly to times the value without any time costs but with trerel costs relatively low (an averege of about $\$ 15$ per trip) and income redetively high (averege income for the semple is too,ooo) this result is not surprisjr. However, it is interesting to mote that the consumers "orplum for the full wage rete velue of time and the wonsumers surplus for the altermate activity value are mot very different. rel ative to the difference between these values anch the $1 /$ wage rate and ho time value estimates. This suggests that it may not be umbeasomable to use the full wage rate as the value of time in studies thet do not have data on the aternete activities.

The final empiricul investigation into the value of time specifications is an hedonic price function. Two types of hedonic
price functions are estimted. Firstlyn a more traditiomel furnction with the value of travel time as a function ot site characterjstics is estimated. secomdty, the model presented above with activity time as a mbmecteristic: i= estimeted.

The results of the estimetiom of travel time as a fumetion
 estimates are applied trathis model, inen movalue of time. time times the wage, $1 /$ w whewace and the mitemmete activity andiamtor times the wage retwen The most signiticant finding is that the best fit $j=p r o v i d e d$ by the altermete activity model com the basis of Fowsumed). The hedonic prices estimeted from theme model = are of the experted =igm, a mositive pricefor additiomel fish catcm and a megetive price for additional "problems" in water quality.

The second form of the redomic. price model is estimeted as Expenditures as a function of fishimg time and catohn Fishing time $j=$ chosen as the approprime activity time variable and Gatwh is whe other site emeramteristic. fromer to meintain flesibility in the fumctiomal form in thig model a generelized Box Cox form was estimated. This form is

$$
\left(y^{m}-1\right) / a=a_{0}+a_{1}\left(x^{b}-1\right) / b+a_{n}\left(x^{c}=-1\right) / E
$$

where a, and $c$ are the Eox Cox parameters. if all the parameter: Equal zeron the model is double logn The results of this prowedure are in Table th. The coefticients of this model, combined with the functional form, provide the implicit price of ench characteristic as the first derivative of expenditures with respect tothe oheracteristicn The implicit price of fishing
time was worrelated with the wage rate and the value of time estimated using the alternate activity index to determine if this measure of the value of time was related to the more typical indicators (Table 1 ). There is littie relationship between the value of time measured at the wage rate and the hedonic price of fishing time (a correlation of about . i). However, therg is a stromger reletionship (uzz) between the value of time using the atternate activity and the hedonic price. while these results are from a limited date set they are interesting in an exploratory semse. They suggest that the atternate activity index may be a better valuation of time than the wage rate or =ome fraction of it. Hence the value of time may be less then or greater than the wage rate.

Conclusions

This paper has presented a theoretiral model that is moderately different from others in the recreation arean Specifically, the model presents value of site and travel time as well as the comsumption of metivity time as the source of utility producing activity. Based on this model an effort was urnertaken to ottan data to estimate the reletionships. Also. in order to concentrate on time value and more micro level. behavioral derisions the survey was designed to collect detailed date om the alternate activities and time uses of the recteationists.

Although exploratory in nature the tentative resulta indicete that time value is a very womplex issuen The use of ata such as mitermete activities mey melp in identifying a more
appropriete model and estimate of time value. There are many avenues for additional researcha Tlis paper sugqests that more Effort is required in the empiricel estimation of recreation decision models in the face of time and activity constraints.

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table 1: descriptive statistics phase I

|  | MEAN | STD DEV |
| :--- | :---: | :---: |
|  | --- | $--\cdots$ |
|  |  |  |
| Years living in MN | 37.68 | 18.46 |
| Percent who fished in MN previously | $96.5 \%$ |  |
| Percent who fished in 1996 | $74.1 \%$ |  |
| Fishing experience (years) | 23.57 | 17.97 |
| Age (\% female) | 43.88 | 15.37 |
| Sex (\% | $26.3 \%$ |  |

TABLE 2: DESCRIPTIVE STATISTICS PHASE 2

|  | MEAN | STD DEV |
| :---: | :---: | :---: |
|  | ---- | ------- |
| Travel cost per trip | 14.50 | 15.27 |
| Food cost per trip | 33.56 | 65.66 |
| Equipment cost per trip | 10.43 | 27.45 |
| Lodging cost per trip | 34.63 | 98.75 |
| Other costs per trip | 11.49 | 37.96 |
| Total cost per trip | 104.62 | 183.96 |
| Fishing Time (minutes) | 886.84 | 850.92 |
| Site Time (minutes) | 1993.42 | 2489.27 |
| Travel Tine (minutes) | 119.21 | 104.68 |
| Miles Traveled | 100.93 | 94.09 |
| Percent of trips on a reqular work day Percent of trips which shortest route | 28.9\% |  |
| is chosen | 88.2\% |  |
| Percent of trips where respondent change mind about time to spend on site | 23.7\% |  |
| Percent of trips with spouse | 31.6\% |  |
| Party size | 4.10 | 3.40 |
| Fish catch | 21.47 | 31.80 |

TABLE 3: FREQUENCY OF ALTERNATE ACTIVITIES


## table 4: crosstab of quality variables versus



Water quality

|  |  |  |  | R QUA | ITY |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | O(NO PROBLEM) | 1 | 2 | 3 | 4 | 5 | 6 | 7 (SERIOUS PROB) |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| SITE | YES | 9 | 0 | 0 | 2 | 2 | 2 | 2 | 1 |
|  |  | FISHING QUALITY |  |  |  |  |  |  |  |
|  |  | O(NO PROBLEM) | 1 | 2 | 3 | 4 | 5 | 6 | 7 (SERIOUS PROB) |
| STAY | ND | 13 | 8 | 5 | 9 | 6 | 9 | 7 | 2 |
| AT |  |  |  |  |  |  |  |  |  |
| SITE | YES | 2 | 0 | 2 | 1 | 5 | 0 | 1 | 7 |

table 5: CROSSTAB of party size versus decision to take shortest route to site
$\qquad$ party sile

| 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 | 22 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| --- | --- | --- | --- | --- | --- | --- | ---- | ---- | ---- |  |

SHORT : YES $1 \begin{array}{lllllllllll}16 & 22 & 16 & 12 & 3 & 4 & 4 & 2 & 2 & 1 & 1\end{array}$ ROUTE : CHOSEN: NO $4 \begin{array}{llllllllllll} & 1 & 2 & 0 & 0 & 2 & 0 & 0 & 0 & 0 & 0\end{array}$

TABLE 6: CROSSTAB OF ALTERNATE ACTIVITY VERSUS:
(1) Change mind agdut lengit of stay at site
(2) DECISION TO CHOOSE SHORTEST ROUTE TO SITE
(3) REGULAR HDRKINE DAY



```
dEPENDENT VARIAELE: PARTICIAPTION IN FISHING
OESEFVATIONS: 34B
LOG-LIKELIHOOD: -169.62
```

| COEFFICIENT | STD.ERR. | T-STAT | P-VALUE |  |
| :--- | :---: | :---: | :---: | :---: |
| VARIAELE |  |  |  |  |
| CONSTANT | -.219050 | 0.169694 | -1.293525 | 0.1958 |
| EXPEFIENCE | .033644 | 0.004894 | 6.939099 | 0.0000 |
| INCOME (RESPONDENT) | .040358 | 0.026164 | 1.542499 | 0.1229 |

TABLE 8: OLS ESTIMATES OF TRAVEL COST DEMANDS

## DEPENDENT VARIABLE: DAYS

FINCTIONAL FORMS: L=LINEAR, SL=SEMI-LOG
TRAVEL TIME VALUE: $0=$ ND TRAVEL TIME value, $1=$ hage rate, $2=1 / 3$ wage rate $3=A L T A C T$ indicator * wage rate (see text)

| FORM | time value | REGRESSION RESULTS |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| L | 0 | Observations: | 5176 | Degrees of freedon: |  | 720.258 |
|  |  | fi-squared | : 0.288 | Rbar-squared | : |  |
|  |  | Var | Coef | Std. Error | t-Stat | P-Value |
|  |  | COMST | 3.889430 | 1.225194 | 3.174543 | 0.002 |
|  |  | WRUAL | -0.663110 | 0.148722 | -4.458710 | 0.000 |
|  |  | TCOST | -0.579369 | 0.135320 | -4.281466 | 0.000 |
|  |  | MILLS | 1.046139 | 0.673545 | 1.553184 | 0.125 |
| L | 1 | R-squared | : 0.223 | Rbar-squared | 0.191 |  |
|  |  | Var | Coef | Std. Error | t-5tat | P-Value |
|  |  | COMST | 3.668801 | 1.276232 | 2.874713 | 0.005 |
|  |  | WQUAL | -0.596580 | 0.153144 | -3. 895551 | 0.000 |
|  |  | TCOST | -0.048760 | 0.014807 | -3.292985 | 0.002 |
|  |  | MILLS | 0.934631 | 0.704332 | 1.326975 | 0.189 |
| L | 2 | R-squared | : 0.244 | Rbar-squared | 0.213 |  |
|  |  | Var | Coef | Std. Error | t-Stat | $p$-Value |
|  |  | CONST | 3.746997 | 1.260122 | 2.973520 | 0.004 |
|  |  | HOUAL | -0.622712 | 0.152170 | -4.092222 | 0.000 |
|  |  | TCOST | -0. 136772 | 0.037733 | -3.624781 | 0.001 |
|  |  | HILLS | 1.001125 | 0.696121 | 1.438148 | 0.155 |
| L | 3 | R-squared | : 0.159 | Rbar-squared | 0.124 |  |
|  |  | Var | Coef | Std. Error | t-5tat | P-Value |
|  |  | CONST | 3.343802 | 1.320884 | 2.531489 | 0.014 |
|  |  | houal | -0.529314 | 0.157462 | -3.361536 | 0.001 |
|  |  | TCOST | -0.058614 | 0.027414 | -2.138057 | 0.036 |
|  |  | mills | 0.858291 | 0.744107 | 1.153450 | 0.253 |



TABLE 9: CONGUMERS' SURPLUS ESTIMATES

| FORM | TIME | CONSUMERG' SURPLUS |
| :---: | :---: | :---: |
| L | 0 | 7.36 |
| L | 1 | 87.49 |
| L | 2 | 31.19 |
| L | 3 | 72.78 |
| SL | 0 | 5.96 |
| SL | 1 | 67.58 |
| SL | 2 | 24.32 |
| SL | 3 | 54.83 |

FUNCTIONAL FORMS: L=LINEAR, SL=SEMI-L0G
travel time value: $0=$ NO travel time value, $1=$ wage rate, 2=1/3uAGE RATE 3=ALTACT INDICATOR * WAGE RATE (SEE TEXT)

TIME VALUE

travel time value; $0=$ No travel TiME value, $1=$ whage rate,
$2=1 / 3$ HAGE RATE $3=A L T A C T$ INDICATOR * WAGE RATE (SEE TEXT)
table 11: results of edx-cox hedonic regressions
gox-cox parameters

OPTIMILATION RESULTS
Date : 5/23/1997 Tine: 20:26
*** Value of objective Function: 274.516401 ***

| Parameter Name | Parameter Value | Relative Gradient |
| :---: | :---: | :---: |
| $\ldots 1$ | 0.035719 | 0.000000 |
| $\ldots 2$ | 0.556979 | 0.00000 |
| X3 | 0.240098 | 0.00000 |

Computation Tine: 4 ainutes 36.16 seconds Iterations: 10

## REGRESSION PARAMETERS


table 12: correlation matrix: hedonic price of time, hage, altactahage

|  | HEDONIC | HAGE | ALTACT |
| :--- | :--- | :--- | :--- |
| HEDONIC PFICE | 1.000000 | 0.101769 | 0.223823 |
| WAGE | 0.101769 | 1.000000 | 0.728293 |
| ALTACTHAGE | 0.223823 | 0.728293 | 1.000000 |

1. We vould like to knov vhether you feel the folloving environmental problems are affecting lakea and rivers in Minnesota. Please circle one number on the scale from zero to seven ( 0 - 7) for each condition listed below.


PROBLEM PROBLEM

| Water aurface crovding | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Shoreland crovding | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Declining vater quality | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Unsightiy development | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Excess algae, aquatic veeds | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Acid Rain |  |  |  |  |  |  |  |  |
| Declining fishing quality | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

2. Do you ovn or have the use of any of the following items? Place a check in the YES column if you do or check NO if not. If you checked YES, please indicate if you use this item for fishing or during a fishing trip by placing a check in the USE FOR FISHING column.
```
Cabin near a recreation site
Motorhome
Trailer
Motor Boat
Canoe
```

| YES | NO | USE FOR EISHING |
| :--- | :--- | :--- |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

3. Have you ever fished in Minnesota before?
(please check yes or no)
YES $\qquad$ NO $\qquad$
If you answered YES, how many years have you been fishing in Minnesota? $\qquad$ years
4. Have you fished or do you intend to go fishing in Minnesota this year (1986)? (please check yes or no) YES _ NO
S. Do you participate in any other vater-based forms of recreation other than fishing (for example, swimming, camping)? Please place a check in front of front of the recreation activities you participate in.
$\qquad$ swimming boating
sailing
$\square$ vaterskiing $\qquad$ camping
$\qquad$ pienicing birdvatching $\qquad$ canoeing

We vould like to have some information about you and your family. Please answer questions 6 through 11 about yourself and questions 12 and 13 about your family.
6. Reaidence (please fill in neareat city or tovn) $\qquad$
7. Age
8. Sex $\qquad$ F $\qquad$
9. Hav long have you lived in Minnegota? $\qquad$ yeare
10. Pleame indicate vhere you apent the majority of your youth (check one): Rural area (population leas than 1,000 ) Small town (population leas than 25,000 ) Urban area (population greater than 25,000)
11. Please indicate the LAST grade of achool you completed by checking the appropriate category belov:
$\qquad$ Grade School or leas (0-8)
Some High School (9-11)
Some College
____ Postgraduate Work
12. For clasmification purposez, ve vould like to know the general category which beat describea the income that you and your family earned in 1985. Please place a check on the appropriate line for yourself, your spouse and the reat of your family (if applicable).

| YOU | SPOUSE |  | \% of | you | SPOUSE | REST <br> FAMI |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | under \$5,000 |  |  |  | 55, 000-59,999 |
|  |  |  | \$10,000-314,999 |  |  |  | \$15, 000-\$19, 999 |
|  |  |  | \$20,000-s24,999 |  |  |  | \$25, 000-\$29,999 |
|  |  |  | \$30, 000-934, 999 |  |  |  | \$35, 000-539, 999 |
|  |  |  | \$40, 000-\$44, 999 |  |  |  | \$45, 000-549, 999 |
|  |  |  | \$50,000-\$99,999 |  |  |  | \$100,000 or more |

13. We vould like to have some information about your immediate family and their participation in recreational fishing. Please fill in the folloving table vith this information: place age in the first column, indicate sex with an $M$ or $F$ in the second column, and write YES or NO in the third column if the individual participates in fishing or not. (If you are single or have no children, please leave the appropriate spaces blank in the table belov. If you have more than 5 children, please fill in the information in the space at the bottom of this page.)

Spouse
Child 1
Child \#2
Child ${ }^{3}$
Child 4
Child 4

| AGE | SEX | PARTICIPATE IN FISHING (Yes or NO) |
| :--- | :--- | :--- |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

14. Please share vith us your opinion about vater-based recreation and the most serious iseuea you feel affect Minnesota's recreation resources today.

Thank you for participating in our survey and sharing your concerns about Minnesota's environment vith us. Please return this survey in the envelope provided.

PLease amsher the follonimg ouestions for the last four fishimg trips you took this seasom.
TRIP 11


11. Did you change your eind bout how auch tine to spend at this site after reaching it? ...... YES ...... MD
12. If you had not taken this trip what would you have been doing instead?
(eg. working overtine, working at another job, gardening, reading)
13. Was this trip taken on one of your reqular working days? ......YES ...... MD.

## TRIP $\$ 2$


10. Please carcie a number indicating how serious you feel each of the following conditions is at this fishing site.

|  | ND |  |
| :--- | :--- | :--- |
|  | PROBLEA | SERIOUS |
| PROBLEA |  |  |

11. Died you change your aind about how auch tice to spend at this site after reaching it? YES NO
12. If you had not taken this trip what mould you have been doing instead? (eg. working oyertine, working at another job, gardening, reading) $\qquad$
13. Was this trip taken on one of your regular working days? ......yes ....... No
