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Static modeling of dynamic recreation behavior: Implications for prediction and welfare estimation

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Abstract

This paper examines the consequences of using a static model of recreation trip-taking behavior when the underlying decision problem is dynamic. Specifically we examine the implications for trip forecasting and welfare estimation using a panel dataset of Lake Michigan salmon anglers for the 1996 and 1997 fishing seasons. We derive and estimate both a structural dynamic model using Bellman's equation, and a reduced-form static model with trip probability expressions mimicking those of the dynamic model. We illustrate an inherent identification problem in the reduced-form model that creates biased welfare estimates, and we discuss the general implications of this for the interpretation of preference parameters in static models. We then use both models to simulate trip taking behavior and show that although their in-sample trip forecasts are similar, their welfare estimates and out-of-sample forecasts are quite different.

Keywords: Dynamic programming; Bellman's equation; Dynamic structural estimation; Reduced-form estimation; Random utility model; Rum; Logit; Kuhn-Tucker; Mental accounting; Recreation benefits estimation

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1. Introduction

Two of the more practical applications of recreation demand modeling are forecasting the effects of site quality changes on both behavior and welfare. This is particularly true for resource managers who must allocate limited budgets across multiple management activities, including investments in site quality improvements. In a recent paper that focuses on the role of preference heterogeneity in out-of-sample prediction, Provencher and Bishop [13] demonstrate for recreational angling that static random utility models (RUMs) tend to overstate the impact of inter-seasonal changes in site quality on trip frequency. This implies the actual number of trips taken during a season is less elastic than the predicted number of trips and therefore any welfare estimates based on those predictions may be exaggerated.

Although several explanations for this result are possible, perhaps the most reasonable is that angler behavior is constrained on a seasonal basis in a way not considered by static RUMs. One approach that addresses this possibility is the Kuhn-Tucker (KT) model which imposes a seasonal budget constraint on each agent, as in Phaneuf et al. [10]. However, although appealing for its utility-theoretic basis, KT models do not account for the temporal allocation of trips throughout a season and therefore overlook useful information that might be gleaned from observing the impact of intra-seasonal variability on recreation behavior.

An integrated utility-theoretic model linking a seasonal recreation budget with a dynamic (forward-looking) RUM therefore would seem to be appropriate, but empirical estimation of structural dynamic models is both complicated and time consuming. As evidence of this, one need look no further than the existing literature on recreation demand which contains a preponderance of static RUMs (see Herriges and Kling [7] for an overview) despite the fact that the recreation decision clearly involves the evolution of predictable state variables and the expenditure of limited resources through time, thus making the decision appropriate for modeling in a dynamic framework.

With this in mind, the purpose of this paper is to examine the consequences of using a much simpler static model of trip-taking behavior when a more complicated dynamic one is appropriate. In particular, we examine the implications for trip prediction and welfare estimation using Lake Michigan salmon angling data for the 1996 and 1997 fishing seasons. Our results suggest that although a static model can forecast in-sample trip-taking behavior quite well, the out-of-sample forecasts are not as good and the welfare estimates are significantly different from those produced by a fully dynamic model.

2. Derivation of the behavioral model

We model the trip decision as a simple binary process in which the angler decides on each day of the season whether to fish for salmon, or instead spend the day doing other things. This is a reasonable representation of the decision faced by our Lake Michigan salmon anglers: on any given day the variability in catch rates along the Lake Michigan shore is difficult to detect and, because fishing is most often done far from shore, aesthetic differences among launch sites are few.