Modeling users' behaviour of a carsharing program: Application of a joint hazard and zero inflated dynamic ordered probability model

Catherine Morency and Vincent Grasset, Ecole Polytechnique of Montreal
Khander Nurul Habib, University of Alberta

Abstract

Carsharing is one of the most innovative transportation alternatives that have the potential to rapidly increase its market share in dense urban areas. This transportation alternative fits between public transportation and private car (Britton et al., 2000), as it offers the flexibility of a private car when required without the total financial burden that usually comes with it. Typically, people who become members can use vehicles from a fleet on an hourly basis without the constraint of individual car ownership. It is not a new transportation mode. Years ago, when cars were luxurious goods, households were uniting to buy one. Its ownership and use were shared. It was for some households the only way to access automobile. Nowadays, car sharing responds to new needs and is provided in an organized system. People want to benefit from the car’s flexibility without supporting all its inherent costs: insurance, parking, maintenance, etc. Users are also attracted to car sharing because of its good environmental image (Steininger et al., 1996). This is why, carsharing is considered as a viable alternative for travel demand management as well as part of the innovative strategies to develop sustainable urban transportation systems (Goldman and Gorham, 2006). Considerable attention is paid to management (supply side) issues related to carsharing programs, but systematic investigation on members' behaviour is rare. It is imperative that we need better understanding of such use in order to increase market share of this modal alternative. Designing an efficient carsharing program by attracting higher number of users as well as influencing existing members to maximize usage of the system is crucial to the success of this sustainable alternative mode of urban transportation. To contribute to this critical need, this paper presents advanced econometric model of users' behaviour of the most important carsharing program operating in North America.

The paper concentrates on modelling member’s decision of being active in a carsharing program, at various points in time, as well as the level of usage in any given time period. A dynamic ordered probability model with Hidden Markov Chain is developed to model such decision making processes. The model is of two stages: for every month, decision to use the system and frequency of use (number of transactions). Decision to use the system is modelled as a binary probit model and number of time usage is modelled as ordered probit model. The frequency of use is conditional to the decision of being an active member, during a particular month of observation. The model takes into account history dependence of choice behaviour by considering the decision making process over time as a Hidden Markov Process. In addition the dynamic model considers seasonal variations in users' decision by introducing month specific dummy variables in the model. The other critical variables used in the model are:

- Accessibility to the service (for instance the number of shared cars within 800 meters of the home location, the average utilisation ratio of available cars, which estimate the ease of access to the service);
- First month of appearance in the service (to account for seasonality, knowing that usage increases both during weekends and holiday periods (Morency et al., 2008);
- Type of neighbourhood where is located the member ( (density, average age, etc., distance to CBD);
- Transportation services supply (all modes).

Models are estimated using monthly transaction data of the Montreal's carsharing system. Datasets on
monthly transactions as well as members' attributes are made available by 'Communauto inc.', company operating the carsharing systems in the Quebec's province. The dataset contains detailed disaggregate information from three continuous years of observation (2005-2006-2007). This dataset provides a unique opportunity to investigate the dynamics of growth in membership over the years and changes in users' behaviour over time. As this paper concentrates on the demand side of carsharing services, the advanced dynamics econometric model, estimated using this unique dataset, reveals many behavioural details. It provides detailed understanding of users' behaviour in terms of factor affecting the decisions to use the system as well as dynamics of carsharing demand with respect to seasonal variation and dynamics of overall urban transportation system performance. Also paying more attention to the day to day behaviour of clients improves our understanding of the system and contributes to a better assessment of the true market of carsharing and its impacts in an urban area.

References


