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Applications of Discrete Choice Models - Selected papers from the 11th World Conference on Transport Research

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In this special issue of the Journal of Choice Modelling we showcase six examples of discrete choice applications spanning a wide variety of geographic, social and decision making contexts. The papers are improved versions of the original submissions for presentation at the 11th World Conference on Transport Research hosted by the University of California in 2007. The first two papers describe regional simulation model systems aiming at the same objective of delivering a regional/metropolitan model system that can be used to perform policy analysis at the most disaggregate level possible. The policies appear to be similar across geographical areas and include, but are not limited to, land use restrictions on urban sprawl and tolling and pricing of transportation services to decrease air pollutant emissions. The first paper titled "SACSIM: An applied activity-based model system with fine-level spatial and temporal resolution" by Mark Bradley, John Bowman, and Bruce Griesenbeck is a detailed description of the latest model system in the evolution of US applications using discrete choice models and microsimulated populations developed for the metropolitan area of the capital of California, Sacramento, and is a foundational reference for many other model systems currently under development. It is also the most popular model paradigm to replace the aging four-step trip based systems and heavily relying of Nested Logit model structures to replicate daily tours in the schedule of people.

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It is also an example of the finest geographic resolution which is the parcel of land and a somewhat finer temporal resolution which is the 30 minute period. In this model exogenously given are home location and socio-demographics and endogenously simulated are long(er) term choices such as work and school locations, and car ownership. Then, conditional on all these individual daily patterns, tour-level choices, and trip level choices are simulated following this hierarchy. Throughout the model system Logit and Nested Logit models are used. In these models many household and person variables were found to have significant effects on the likelihood of participating in different types of activities and their insertion in tours and these include employment and students status, age, income, car availability, work at home, gender, presence of children by age group, presence of other adults in the household, and family/non-family status. Moreover, accessibility indicators measured as logsums were also significant determinants of travel behavior. Key consideration is the use of Nested Logit logsums to capture lower level choice impacts of upper level in hierarchies and they are also used to represent accessibility and impedance. This is a practice that is observed in many applications including some of the other papers in this special issue. This paper also points out to the need for detailed input and supplementary data preparation that allows policy analysis. This is shared as a view with the second paper in this special issue with title "An Activity-Based Microsimulation Model of Travel Demand in the Jakarta Metropolitan Area" by Sadayuki Yagi and Kouros Mohammadian from University of Illinois Chicago laboratory describing a system which is also based on these tour-based ideas designed for the Jakkarta metropolitan area with a population by far larger than many cities where a tour-based model is applied that is even larger than many countries in Europe and states in the US. The choices are daily activity-travel patterns, times of day, and mode and destination in a hypothesized decision making hierarchy. Lower level choices depend on the decisions at the higher level, and higher level decisions are linked to the lower level choices through the logsum variables reflecting expected maximum composite utility of lower-level choices. The basic inputs to this "activity-based" modeling system are household and household member information, zone-based socioeconomic and land use data, and highway and transit network data. Exercising all these models the authors create Origin Destination tables by mode and by time of day to be used in network assignment. It is also interesting to note the sample size used for model estimation with 4,000 activity diaries and a linked household survey of 166,000 households (3% of Jakarta population) by far exceeding Australian, European, and US sample sizes available for modelling. In addition, the array of explanatory variables is fairly rich including socioeconomic variables with household composition details (i.e., number of members, adults, children, and infants), household income, number of automobiles and motorcycles owned by the household), household location (i.e., central business district (CBD), Jakarta city, and urban/suburban area) as well as individual characteristics such as status, income, school type if student, gender and age. The paper provides a comprehensive discussion of microsimulation and the myriad of activity scheduling and modeling outcome adjustments needed to make sure the model system outputs a reasonable and realistic synthetic sequence of activities and trips.

The third paper with title "California Statewide Model for High-Speed Rail" by Maren Outwater, Kevin Tierney, Mark Bradley, Elizabeth Sall, Arun Kuppam, and Vamsee Modugula, provides a good contrast to the two tour-based approaches above because it is a more traditional trip-based model system applied to a major planned investment in California. This is claimed to be a new transportation option available to more than 90

percent of the residents of the state and since it is envisioned as electric will also provide a "greener" that air travel option to long distance travel. At completion the rail system will run from San Diego at the border with Mexico to Sacramento and San Francisco in the North. The model system developed to assess this proposed infrastructure addition covers the entire state of California and includes an interregional suite of models for trip frequency, destination choice, main mode choice, and access/egress mode choice. As the authors mention "They are network-based and provide more accurate assessments of time and cost tradeoffs with other modes, modal choices are sensitive to reliability, party size, and detailed access and egress options, induced travel is assessed based on changes in level of service for all modes, and intraregional travel is estimated based on detailed urban area models where interregional travel is estimated based on statewide models estimated from observed travel behavior. The intraregional and interregional models are integrated to assess impacts of congestion on other modes and to reflect differences in peak and off-peak conditions." Again, these models also use extensively Nested Logit models that employ logsum accessibility measures at all levels of the model system.

In the fourth paper with title "Analyzing Competition between the High Speed Train and Alternative Modes, The Case of the Corridor Madrid-Zaragoza-Barcelona" by Concepción Román, Raquel Espino, and Juan Carlos Martín we find another High-Speed rail application of mode choice models in the corridor Madrid-Zaragoza-Barcelona. The analysis is based on the estimation of disaggregate demand models using both RP and mixed RP/SP databases specifying utilities for the RP and SP alternatives using main mode level-of-service attributes and an array of socioeconomic characteristics of the individuals interviewed. The models thus defined explain the changes in the demand for High-Speed service as a function of changes in travel times, travel costs, access and egress times, headways, and two variables the authors call latent that are reliability and comfort across all the modes that are considered competing in this corridor. The authors in this paper provide estimates of willingness-to-pay by trip purpose and mode and they also show that willingness–to-pay is a function of comfort. They also show segment-specific elasticities that are different depending on trip length. In the paper the authors also provide an interesting section on policy scenarios raising doubts about rail as a "true" competitor to air travel for "longer" distance travelled.

The last two papers are unique in their own way because of the manner with which discrete choice models are formulated and they possibly represent the way of the future in applications by enriching discrete choice models with more observed variables but also formulations that allow capturing the impact of latent constructs on choice. From Switzerland we have a paper with title "The Impacts of Road Pricing on Route and Mode Choice Behaviour" by Milenko Vrtic, Nadine Schuessler, Alexander Erath, and Kay Axhausen. This is an interesting stated preferences experiment using more than 1,000 subjects from a larger national survey. The overall aim is to assess the impact of fuel price, tolls, parking costs and public transport fares on behavior using a combined route, mode and departure time choice model. The analysis is done on a substantial amount of choice situations using a somewhat flexible Logit specification which offered unique insights about the nonlinear relations among costs and times in choice. The authors show that different cost components are valued differently and the perception of different cost components is not linear and depends on household income, overall travel cost and "specific" travel time. The analysis also addresses issues of departure and arrival times but also dispositions (they call this

political preference) towards pricing. From Greece with data from the Seattle metropolitan area called the Puget Sound region we have a paper with title "Modelling the Effect of Risk Aversion on Travelers' Switching Behaviour" by Athena Tsirimpa, Amalia Polydoropoulou, and Constantinos Antoniou. This is a latent variable and discrete choice combined Logit model application using data from the only longitudinal transportation survey in the US. The model presented combines attitudes toward risk with switching propensity of travelers under information and also considers the source of information. The authors find that a joint choice and latent variable model that is able to capture attitudes can be formulated, specified, and used to predict travellers' switching patterns and to account for habitual travel pattern maintenance. Moreover, there are specific occurrences that act as triggers for behavioural changes. In this paper the authors also provide an interesting section on next steps in model formulation and testing.

All six papers use discrete choice models at the level of decision makers (individuals and/or households), rely of Random Utility Model formulations, and their Logit and Nested Logit variants. This is done to capture complexity in correlation structures among choices and contain a variety of pragmatic enhancements to ensure downward and upward congruence of decisions at different hierarchical levels. Their databases could be used to explore different decision making paradigms and provide good case studies for the more behaviourally realistic and theoretically stronger models appearing in this journal. We consider these examples a solid base and starting point for many new discoveries finding their way to practice and are hopeful that practitioners will more rapidly take advantage of feasible options in modelling and simulation.

The guest editors are grateful to the WCTR organizers for an interesting meeting with many participants that we are confident was not easy to organize. We are also grateful to the authors who provided multiple versions of their papers for review and the reviewers for the very difficult task of identifying issues and suggest remedial corrections. The journal editors helped us tremendously to prepare this special issue of the journal. As always all errors or inaccuracies are the responsibility of the authors.