Modeling Competition among Airline Itineraries

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1 Introduction

Understanding demand for products is an integral part of many fields, including aviation. Airlines, airports, local and regional planning organizations, national government agencies, aircraft manufacturers, and other private and public organizations need to understand demand for air travel to evaluate and implement different business and policy options. Understanding how individuals make choices among itineraries is also a critical part of network planning models, which airlines and aircraft manufacturers use to forecast the profitability of airline schedules. Network planning models forecast schedule profitability by determining the number of passengers who travel in an origin destination (OD) pair, allocating these passengers to specific itineraries, and calculating expected costs and revenues. The passenger allocation model is often referred to as an itinerary choice model because it represents how individuals make choices among itineraries. Many airlines use discrete choice models to capture how individuals make trade-offs among different itinerary characteristics, e.g., departure times, elapsed times, the number of connections, equipment types, carriers, and prices. These network planning models support many important long- and intermediate-term decisions. For example, they aid airlines in performing merger and acquisition scenarios, route schedule analysis, code-share scenarios, minimum connection time studies, price-elasticity studies, hub location and hub buildup studies, and equipment purchasing decisions (Garrow, 2010).

2 Literature review

There have been few published studies describing how itinerary choice models are estimated and used in practice. A notable exception is work done in the early 2000s by Greg Coldren. His dissertation (Coldren, 2005) describes itinerary choice models that were estimated and implemented by United Airlines. Several papers and book chapters have resulted from his dissertation (e.g., see Coldren et al., 2003; Coldren, 2005; Coldren and Koppelman, 2005a,b; Koppelman et al., 2008; Garrow, 2010; Jacobs et al., 2012). Unfortunately, all of the models Coldren and colleagues estimated did not account for price endogeneity. As part of our prior work described in Lurkin et al. (2016), we estimated the first itinerary choice model that accounted for price endogeneity. In developing this model, we intentionally selected a multinomial logit (MNL) model as the MNL it is the discrete choice model that is most commonly used in practice. However, the MNL model suffers from several limitations. Most notably, it does not incorporate inter-itinerary competition.

3 Contributions

Our analysis provides several important contributions. This is the first study to control for price endogeneity for NL and OGEV models that are representative of those currently used in practice. Second, we find strong evidence that inter-alternative correlation patterns have remained stable over the past 10-15 years for itinerary choice models estimated for domestic U.S. itineraries. Further, these inter-alternative correlation patterns do not appear to be heavily influenced by the mix of distribution channels in the estimation database. Third, models that incorporate correlation across itineraries that share similar departure times result in significant improvements in model fit. Among the GEV model structures estimated, those structures that included an upper-level departure time of day nests consistently fit the data better. For NL models, the 3-level NL model nested by time and carrier produced the best fit while for the OGEV models the constrained model using hourly time periods with allocation to three adjacent time periods produced the best fit. Our study also contributes to the literature by examining the robustness of VOT estimates when different discrete choice models are used to model itinerary choices.

4 References

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