

Forecasting Urban Travel: Past, Present and Future, by David Boyce and Huw Williams. 2015. Cheltenham, U.K. and Northampton, Massachusetts: Edward Elgar. 650+ix. ISBN: 9781848449602. \$205.00.

David Boyce and Huw Williams have written the definitive history of travel demand modeling to date. The book really begins (chapter 2) with Douglass Carroll, whose innovations in Detroit, and then Chicago, developed the foundational four-step transportation planning forecasting tool that is widely used and abused in metropolitan areas across the globe. The aim at the time was to develop forecasts of future traffic—how many trips, where are they going, how many would drive, which routes would they use—that could be used to locate and size freeways being deployed with the upcoming Interstate Highway System. In one sense it was enormously successful, as the model spread from the Midwest of the United States across the globe, and has been used to conduct analyses, inform, and justify projects. It also spurred enormous methodological advances, one of which earned Daniel McFadden a Nobel Prize in economics for his work on developing random utility choice models.

After developing the framework, the book explores the formalization of spatial interaction models, especially the work of Alan Wilson (chapter 3), as well as the emergence of choice models in the 1960s, through development and generalization of multinomial logit in its many, many forms (chapters 4 and 5), and the unification of the two. I have experience working as a travel demand modeler, so while it was familiar territory, it was also clarifying in many ways. Reading the book, I understood the linkages far more deeply than before. One of the merits of the book is the hiding of most of the mathematics in the end notes.[1] The book also provides a very detailed history of developments in the United Kingdom and some discussion of developments in other European countries, in addition to the history from the United States' perspective, providing a more global perspective on the issue. I was not aware the East Germans

had developed their own modeling methods, and remain curious about practices elsewhere in the Eastern Bloc.

The book turns to the present trend in microscopic models, including activity-based models (chapter 6), which model tours of individuals rather than trips of aggregate flows, and the Transims project (chapter 8). From a methodological perspective, this is clearly an improvement, and the direction most applied models seem to be moving towards. By recognizing time-space constraints as formulated by Hägerstrand, the models become more realistic. If it were presented clearly to the public, it would probably be more intuitive and comprehensible than traditional aggregate models. This has not improved their predictive value however, and Transims was, as the book describes, a diversion of resources with little to show for it.

After dealing with the first three steps of the travel demand model, the book then discusses network equilibrium, solution methods for route assignment or route choice (chapter 7). These evolved independently from the work of Beckmann, McGuire, and Winsten in the 1950s (coincidentally also in Chicago, though not interacting with Carroll's group), were operationalized with steadily improving algorithms in the 1970s, and were mainstreamed into practice by the late 1980s. While equilibrium for route choice is now standard (whether or not traffic is in equilibrium, and whether or not route choice depends solely on travel cost), there is no standard "feedback" method to ensure that the travel time inputs to the travel demand process are consistent with the travel time outputs of route choice procedures, one of the many problems with actual transportation modeling practice, and a problem that as the authors note has received insufficient attention in the literature (the authors notably excepted).

Travel demand models have their uses. Long term forecasting—their putative rationale—is probably the weakest. Yet, this entire enterprise was nominally driven by the desire to forecast

travel demand, not simply understand or model it. It is indeed in the title of the book. On that score, the field has, in my opinion, failed miserably. Boyce and Williams note that accuracy is poor, and not improving over time. While one can understand the naivety of early modelers in the 1950s and 1960s, (who undoubtedly well understood the limitations) by the 1970s (and certainly by the 2010s), the futility of accurate forecasting should have become apparent to those both within and outside the field. The forecasts are driven by the assumption that behavior in the future given identical characteristics will be the same as today. Culture is outside the scope of models, with good reason, but if culture matters, or anything else that is also outside the model's data, there will be misses. Modelers may claim data issues, or poor inputs, and those certainly matter, yet as the authors note, estimation of models across time is never done in practice. There are always reasons—incompatibility of surveys, time, budget, and so on. The excuse for using cross-sectional analysis in the 1950s was there was no time series, only one survey (at most) had ever been done in any metropolitan area. The excuse today is what?

In addition to behavior being static in these models, technology is as well. As the book notes, use of Stated Preference models to examine what would happen given a new technology attempts to push the boundaries of this, but it fails to say what technologies will actually be around, which will affect demand in ways we just have to admit we cannot accurately foresee. This issue is increasingly important as new modes like shared autonomous vehicles are being considered, and autonomous vehicles (even if unshared) change the character of automobile travel. That a forecasting tool considering 30 years into the future cannot consider the possibility of such change in any reliable way suggests that it is probably not the right tool.

For this reason, these travel demand forecasts, at one time the most sophisticated analyses done by humans with their early use of mainframes (described in chapter 10), fall into the same

trap as much simpler forecasts: under-estimating growth in the early years of a technology's lifecycle and over-estimating in the late stages. Boyce and Williams note the many problems with forecasts toward the end of the book (chapter 11), but remain more optimistic than I would. I believe the field should take its tools and apply them where they might be useful: short-term analyses of minor changes, scenario analyses of alternatives, but most definitely not forecasts. This requires changing evaluation procedures and government regulations. However there are enough problems today that remain unsolved, so that looking for problems 20 to 30 years down the road seems futile.

In the end, this book serves as an excellent history of ideas about the research and its application in travel behavior and travel demand modeling forecasting, and should be widely read by researchers and practitioners in the field, and owned by their library. In my mind, however, it is a history of proceeding very deeply down the wrong rabbit hole, of systematic application of mathematical methods providing a veneer of science to cover in the end for political decisions.

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1. As Alfred Marshall wrote: "But I know I had a growing feeling in the later years of my work at the subject that a good mathematical theorem dealing with economic hypotheses was very unlikely to be good economics: and I went more and more on the rules---(1) Use mathematics as a short-hand language, rather than as an engine of inquiry. (2) Keep to them till you have done. (3) Translate into English. (4) Then illustrate by examples that are important in real life. (5) Burn the mathematics. (6) If you can't succeed in 4, burn 3. This last I did often." pp. 427-428 of *Memorials of Alfred Marshall*, edited by A. C. Pigou. One edition is: New York, A. M. Kelley, 1966.