Developing transport demand models

State-of-practice tools to enable detailed assessment of transport policy

A lmost all European countries are struggling to deal with congestion and the safety and environmental problems caused by traffic. There is a need to understand how to mitigate these problems without imposing undue burdens on the economies of the countries concerned.

RAND Europe's modelling team have been working for many years on these issues and have developed discrete choice and other modelling methods to understand the processes underlying the demand for transport at a detailed level. Our methods have helped governments and transport operators at local, regional, national and international levels to predict what is likely to happen on their networks and what policy options they have available to address the issues they face.

Abstract

RAND Europe's modelling team provide expert advice and support on every step of the development process for transport demand models, namely:

- guiding model development

- predicting the future population

- predicting the future population's travel choices

- keeping model systems up to date

- supporting policy decisions.

Guiding model development

The main considerations at the model development phase are the policies that the model is to be used to evaluate. When developing complex travel demand model systems, a range of stakeholders with different policy requirements must be considered. However, model systems are developed from limited public funds, and therefore it may not be possible to develop a model that exactly meets the requirements of every stakeholder.

In several projects, we have reconciled the needs of different stakeholders, whilst achieving buy-in to the model development process so that stakeholders feel actively engaged in model development. Where clients are seeking to update an existing model system, we can also advise on how to develop model systems incrementally, so that the ability to produce model forecasts is maintained at all times during the development process.

Predicting the future population

In order to apply model systems, it is necessary to generate detailed forecasts of the future population by geographical areas—termed zones—and by socioeconomic segmentations, such as car availability and working status.

We have pioneered 'prototypical sampling' methods, which generate forecasts of future populations by combining detailed travel survey information collected in or around the model base year with the more aggregate future land-use forecasts typically provided by planning agencies.

The future population's travel choices

Once the spatial location of the future population has been predicted, the core questions may be posed: namely where, how and when are these individuals going to travel? To answer these questions properly, we must incorporate detail in our models, tailor them to local requirements and be flexible according to data availability.

The model systems are detailed in terms of the number of modes, purposes and population segments included, and the level of spatial representation. This ensures that variations in preferences between different decision-makers are properly represented, and allows assessment of the effect of policy on particular groups of the population.

The model systems are tailored by selecting the modes and segments according to the particular characteristics of the study area and the policy questions that need to be answered.

Flexibility is a key aspect in model design, allowing the model to be adapted to work with a range of policy issues—often not thought of when the model was developed. The keys to maintaining flexibility are the appropriate use of data and careful structuring of the model. Utilising all available data allows us to maximise the precision with which we can identify model parameters, and therefore allows more accurate assessment of policy. However, data sources must be combined intelligently, drawing upon their relative strengths and fully recognising their weaknesses. Appropriate model structures should be used to account for the different levels of error associated with different data sources.

Indeed model structure is an area of particular RAND Europe expertise, and we have authored sections of the UK Department for Transport's web-based transport modelling advice (WebTAG) on this topic. Our approach is to assess the relative sensitivity of different choice decisions (frequency, mode, destination, time of travel) as far as possible on the basis of local data rather than to impose a model structure a priori.

The model systems we develop are fundamentally concerned with predicting the demand for transport services. However, an important consideration in individuals' choices is the supply of transport services, for example, how long it will take them to drive, or take the bus, to work. Therefore our models are designed to exchange information with standard network modelling packages.

An important consideration when interacting with such models is the need to achieve convergence between our demand model and the complementary supply model. We have developed methods to combine outputs from previous iterations intelligently in order to reach a point of acceptable convergence efficiently.

Keeping model systems up to date

The policy agenda is continually evolving, and indeed can change direction quite suddenly following an election. Therefore there is a need to ensure that our policy evaluation tools remain focused on the current policy agenda. We can advise on how best to manage a model update process

Examples

Six large-scale disaggregate model systems have been developed by RAND Europe's modelling team:

- Dutch National Model System, which has been used extensively for policy evaluation since 1986, and is currently undergoing its eighth major update
- Policy Responsive Integrated Strategy Model (PRISM) for the West Midlands region of the UK
- Impact and ANTONIN model systems for the Greater Paris region, developed for the Parisian public transport operator (RATP) and authority (STIF), respectively
- Stockholm Integrated Model System (SIMS)
- Sydney Strategic Model (STM) system.

Several other models are currently being developed.

in a manner that prioritises improvements based on policy and cost effectiveness, while maintaining a forecasting capability at all times.

Supporting policy decisions

In many of our transport demand model projects, we develop a policy-responsive tool which we deliver to the clients, who are best placed to specify and evaluate policies in their local area. However, our extensive experience in model development means we are ideally placed to advise on how to translate policy into model input and, at the other end of the process, how to interpret model output properly in full awareness of the caveats associated with predictions of future behaviour.

To support policy analyses more fully, we are continually working to extend the scope of the models. One recent advance is to assess the uncertainty in forecasting, so that planners know how reliable forecasts of traffic flow are. Another advance is to incorporate an improved and extended measure of travellers' benefits, allowing the impact of 'soft measures' to be included and showing how transport changes impact on different population segments. ■

Further reading:

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Hess, S., Polak, J., Daly, A. and Hyman, G. (2007) 'Flexible substitution patterns in models of mode and time-of-day choice: new evidence from the UK and the Netherlands', *Transportation,* Volume 34, No. 2.

Tuinenga, J. G. and Pieters, M. (2006) 'ANTONIN: Updating and Comparing a Transport Model for the Paris Region', presented at the European Transport Conference, Strasbourg.

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