New model better predicts our daily travel choices

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Janody Pougala, transportation engineer. Credit: 2024 EPFL/Alain Herzog, CC-BY-SA 4.0

An EPFL engineer has developed a forecasting model that factors in not just our commuting habits, but also our activities during the day. Her

flexible approach incorporates the idea of trade-offs in order to deliver more realistic predictions.

Transportation engineers often use computer models to estimate demand on a given itinerary, answering questions such as how many cars drive along the stretch of highway between Lausanne and Geneva each year and which train lines carry the most passengers. It's a broad and fascinating field, and one that Janody Pougala, a civil engineering student at EPFL's Transport and Mobility Laboratory, decided to study for her Ph.D. thesis.

Pougala developed a new model for predicting individuals' travel choices that factors in a wider range of variables, and therefore maps actual behavior more closely. Her program, available in open source, looks at not just the way people typically get around but also their everyday activities. It represents a particularly sophisticated approach because it accounts for how people respond to the unpredictable events that inevitably form part of our daily lives.

In conventional models, transportation engineers start by examining each trip an individual makes along with the reasons for that trip, the transportation method the person uses, and the chosen itinerary. The engineers then develop programs that describe this behavior in a sequential, chronological way. But these programs often aren't well-suited to complex realities.

Modeling trade-offs

To design more accurate models, engineers need to gain a better understanding of how people behave. That's especially true in light of today's increasingly diverse lifestyles. With more people working from

home, the roll-out of car-sharing systems, and infrastructure improvements that enable employees to live further away from their employer, commuting patterns have changed considerably. These are some of the structural shifts that Pougala wanted to address with her new model, which is based on individuals' activities and preferences, and therefore stands to be more accurate.

How does the model work? "It starts by scheduling an individual's activities over the course of a day, and then links the corresponding variables together with mathematical equations," says Pougala. "I pulled data for the variables from a number of sources, including the results of commuting surveys and statistics." The key to her model lies in its extremely flexible design. "It doesn't go through the factors sequentially but rather analyzes all of them at the same time," she says.

And because her model isn't bound by a predefined order of events during the course of a day, it can account for decisions based on personal satisfaction and constraints. In short, it's a new way of modeling trade-offs. Pougala took behavioral hypotheses described in the literature and studies of sociology and urban environments, and translated them into mathematical equations.

Then she combined the equations with statistical data so that the model would make as realistic forecasts as possible. To give an example, suppose a woman named Emma decides to work late and not go to the gym. On her way home, her train encounters a technical difficulty at the Lausanne train station. Instead of waiting for a replacement train, Emma decides to take the bus.

Pougala explains, "My model can predict how different individuals would respond under these types of circumstances and how long they'll tolerate situations they don't really like. It can also describe how people adapt and use alternative transportation methods."

City officials can use Pougala's model in their long-term planning to determine which type of transportation infrastructure to develop. It's already been tested against the model used by the Swiss railway company as well as in an urban planning project in Zurich designed to show what the city could look like if half of the transport that takes place there were non-motorized.

More information: OASIS: An integrated optimisation framework for activity scheduling: infoscience.epfl.ch/record/307077?ln=fr

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