Sensitivity analyses for ride-hailing and ridesharing modelling strategies

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Abstract

Agent-based models are widely used to simulate on-demand mobility services. This enables the capturing of the supply and demand dynamics and the complex interactions between individual travelers and the operational decisions of the on-demand system. Such models usually have nonlinear interactions between input parameters and the model components, which affects the model outputs. Controlling for the effects reduces uncertainty in the model. This can be done through sensitivity analyses, which help to determine to what extent the input parameters contribute to the outcome of a model.

Shared automated vehicles (SAVs), a form of on-demand mobility service, are seen as a potential future modal mix in the advent of autonomous vehicles. This is because when coupled with ridepooling, SAVs can reduce the environmental impacts that AVs are purported to bring, as less vehicles would be required to serve the population. With this outlook, the research interest in modelling SAVs has grown, as researchers, planners try to understand what operational scenarios, and transport policies are needed for their successful implementation in reality.

With the growing interest in these agent-based SAV models, sensitivity analysis then becomes crucial. SAVs specific model parameters could include, trip density, fleet size, vehicle capacity, operating hours, spatial distribution, fares and service constraints such as maximum acceptable wait time for a pickup or detour time (the extra time added to one's trip while another passenger is picked up). Model outcomes could be the SAV operational (e.g. average vehicle occupancy, or vehicle kilometers traveled (VKT)), demand, level of service or externalities measures.

Therefore, to what extent do each of these model parameters affect the model outcomes or other model parameters? For example, what is the relationship between trip density and the fleet size or the vehicle occupancy of the system? How would modeling a small sample of the demand affect the results? The aim of this study is to provide an understanding of how the different model parameters interact and how they affect the model outcomes. Particularly, this paper would discuss the impact of demand sampling, fleet sizing and spatial distribution of vehicles.

Keywords

Agent-based models, shared automated vehicles, on-demand mobility, sensitivity analysis