OR-MSM Transport Supply modeling

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Agenda

Introduction

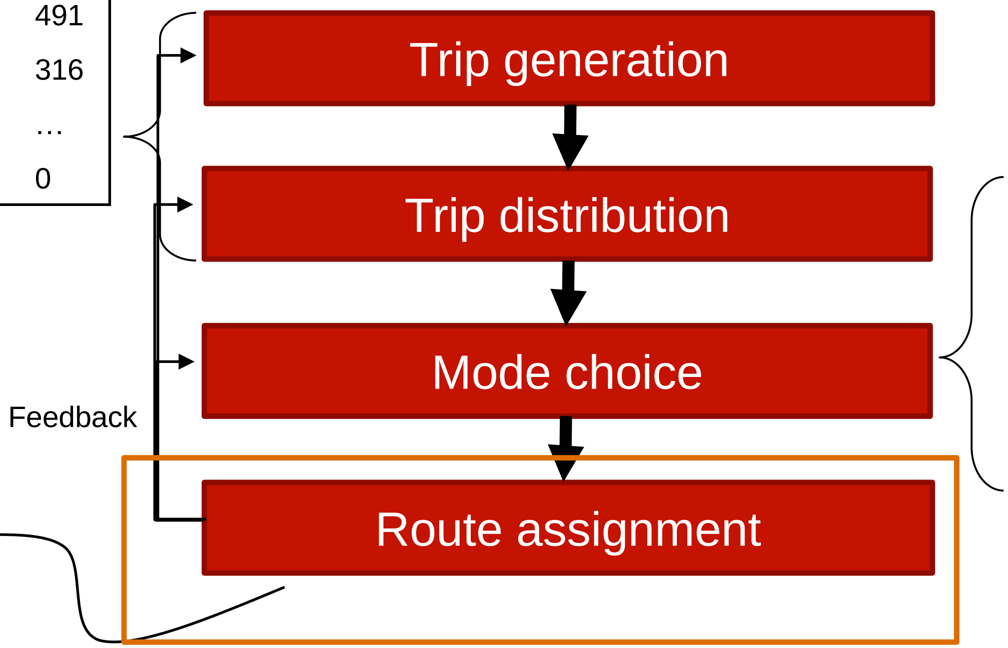
Transport supply modeling

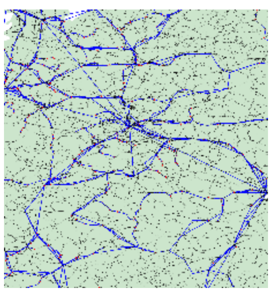
- Transport supply methods
- Application

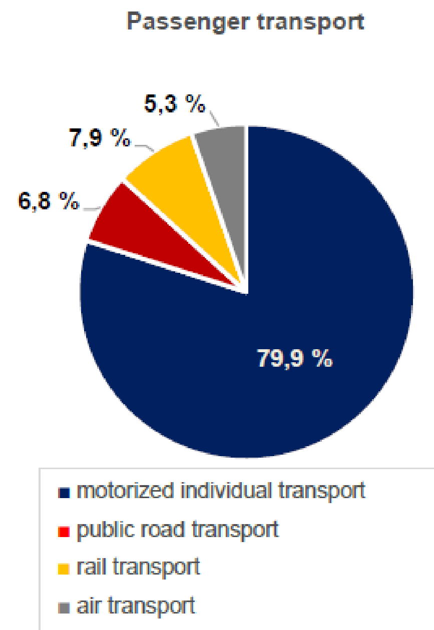
Transport demand modeling

Four steps of transport modeling

O/D	1	2	…	n
1	0	156	…	491
2	294	0	…	316
…	…	…	…	…
n	534	128	…	0







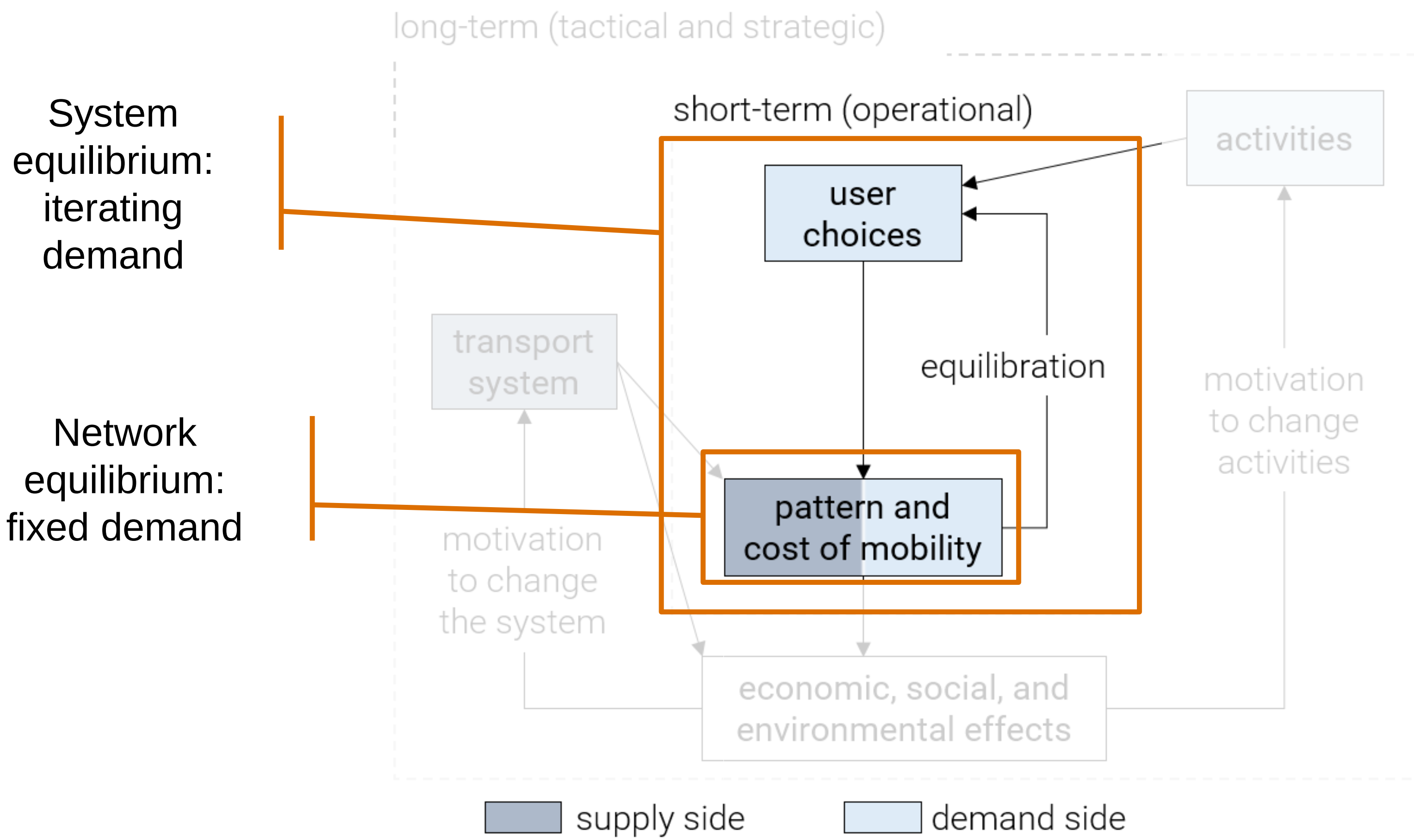
Transport supply methods

Which network methods do you know?

- Shortest-paths-finders: …
- …

?

Transport supply from an economist perspective



Source: Own illustration based on Allsop (2008): Transport networks and their use: how real can modelling get?. Philosophical Transactions of the Royal Society A, 366, 1879-1892

Transport supply formalization

Notation

- T_{ijr}: Travel volume from origin *i* to destination *j* via route *r*
- V_a: Volume flow on link *a* (usually in passenger car units (PCU))
- C_a: Travel cost on link *a* (time, monetary, etc.)

Cost functions

- $t = t^{a/e} + t^{wait} + t^{trans} + t^{in-v}(V)$
- Smock (1962): $t^{in-v}(V) = t_0 \exp(V/Q)$ with capacity *Q* and free-flow time t_0
- Most common: $t^{in-v}(V) = t_0\left[1 + \alpha(V/Q)^{\beta}\right]$
- $C = t + \frac{price}{VoT} + \frac{rel}{VoR} + \cdots$ with value of time *VoT*, value of reliability *VoR*, etc.

Assignment techniques

Assumptions:

- Rational travelers
- with perfect information
- and common perceptions

We can relax them through:

- Random utility maximization,
- stochastic effects,
- and user groups

		Stochastic effects included?	
		No	Yes
Single user class	No capacity restraint	All-or-nothing	Pure stochastic: Dial's, Burrell's
	With capacity restraint	Wardrop's equilibrium	Stochastic user equilibrium SUE
Multiple user classes	No capacity restraint	All-or-nothing with multiple user classes	Multiple user classes stochastic: Dial's, Burrell's
	With capacity restraint	Wardrop's equilibrium with multiple user classes	Stochastic user equilibrium with multiple user classes

Source: Ortúzar and Willumsen (2011): Modelling Transport. Wiley, 357

Paris example

Open source: https://github.com/systragroup/quetzal_paris
Toy model for the city of Paris

Exercises (one notebook each; small groups):
1. Create transport networks (see AXX notebooks)
   a) Use OpenStreetMap data for roads and the GTFS feed (input folder) for PT
   b) Fix the network integrity
   c) Create connecting links between networks and to/from zones
   d) Try clustering your PT nodes and visualize the differences
2. Create an OD-LoS stack
   a) Find shortest paths (OD-path stack)
   b) Parametrize OD-paths with LoS attributes time and cost
3. Run the four transport modeling steps (see B20 and B40 notebooks)
4. Implement a CO2 tax of 100€/t. Discuss necessary assumptions in your group. How does the overall modal split change (as a measure of trips and passenger-kilometer)?
5. How does the modal split change, if 50% of the car owners sell their vehicle?

Questions?