Bevorzugter Zitierstil für diesen Vortrag

Axhausen, K.W. (2010) Thinking about SUE and best response, presentation at the *CCSS Seminar*, ETH Zürich, November 2010.

Thinking about SUE and best response

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Thinking about equilibrium

Wardrop, 1952

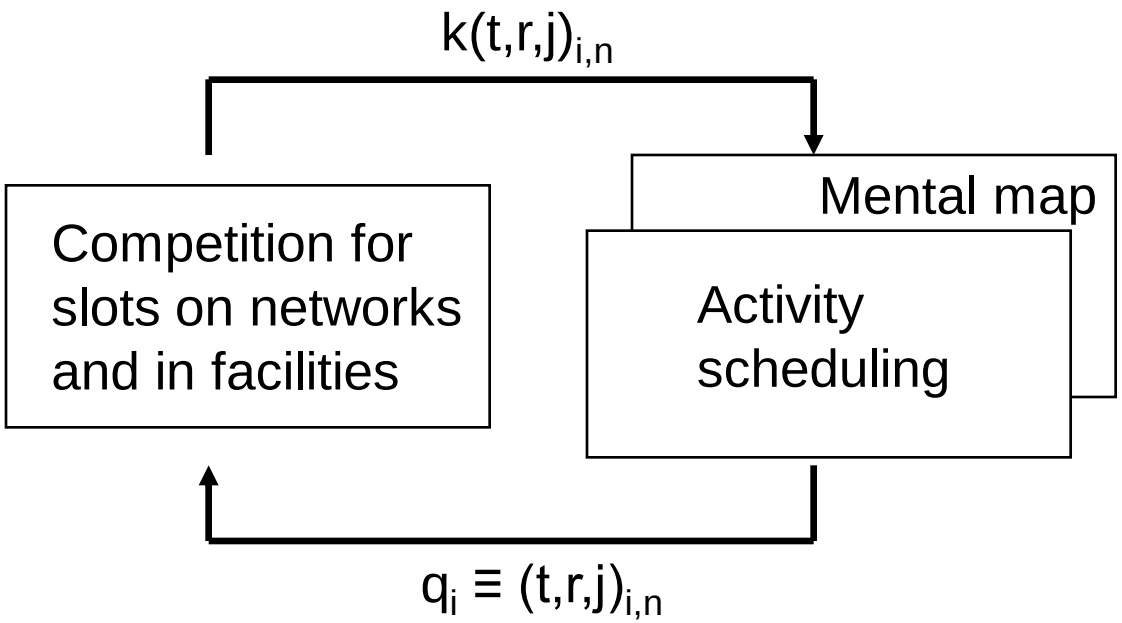
(1) The journey times on all the routes actually used are equal, and
less than those which would be experienced by a single vehicle on any unused route.
(2) The average journey time is **a** minimum.

Activity-based analysis

- Travel is derived demand, with some exceptions
- The travellers are constrained by their commitments and tool ownership
- Travellers aren’t in equilibrium
- Travellers don’t know all alternatives
- Travellers don’t plan their whole day (week) in advance

Thinking about SUE and best response

Learning approach of the generic one-day transport model



Generic model structure

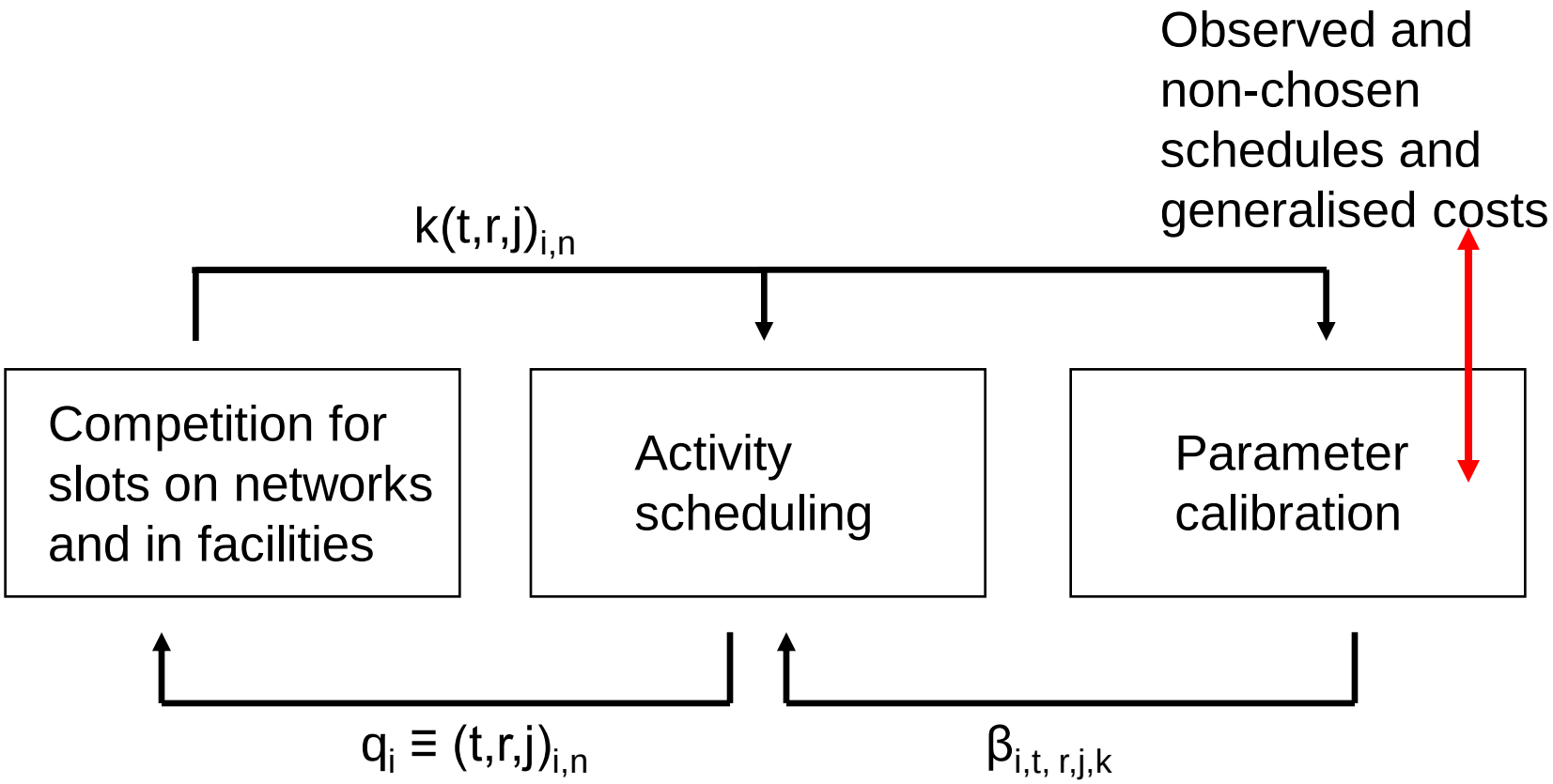
Equilibrium searches for:

$$k'_{tsmgz} = q'_{tsmgz}(k''_{tsmgz}, B_{igz}, A_{tsmz})$$

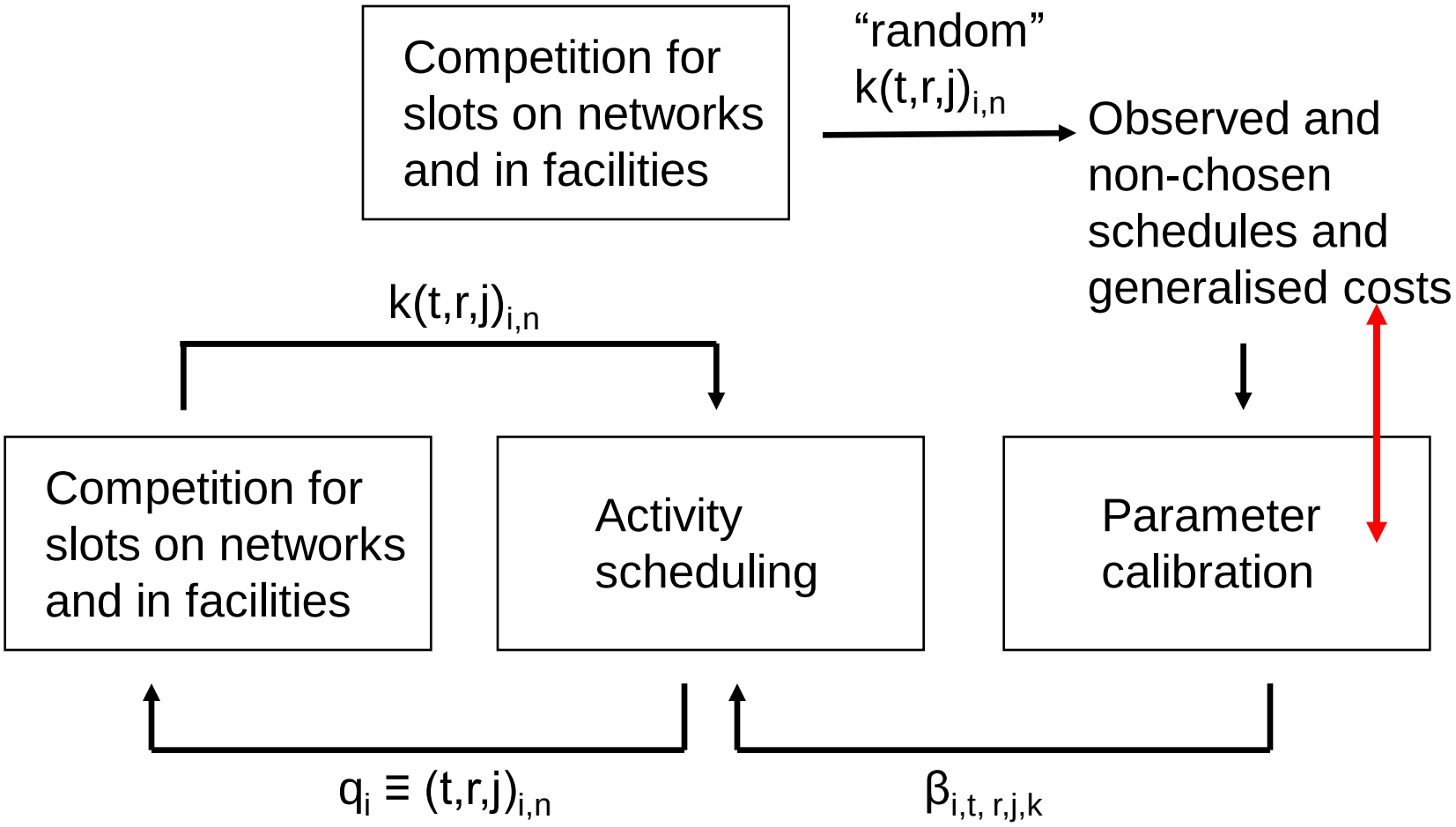
k‘	:	Generalised costs of travel (schedules)
k‘‘	:	Last set of values of k
q	:	Estimated volumes
A	:	Supply (Infrastuctures, services, destinations)
B	:	Population (natural and legal persons)

t	:	Time of day t	i	:	Origin i
s	:	Link s	j	:	Destination j
r	:	Route r	g	:	Group g
m	:	Mode m	z	:	Year z

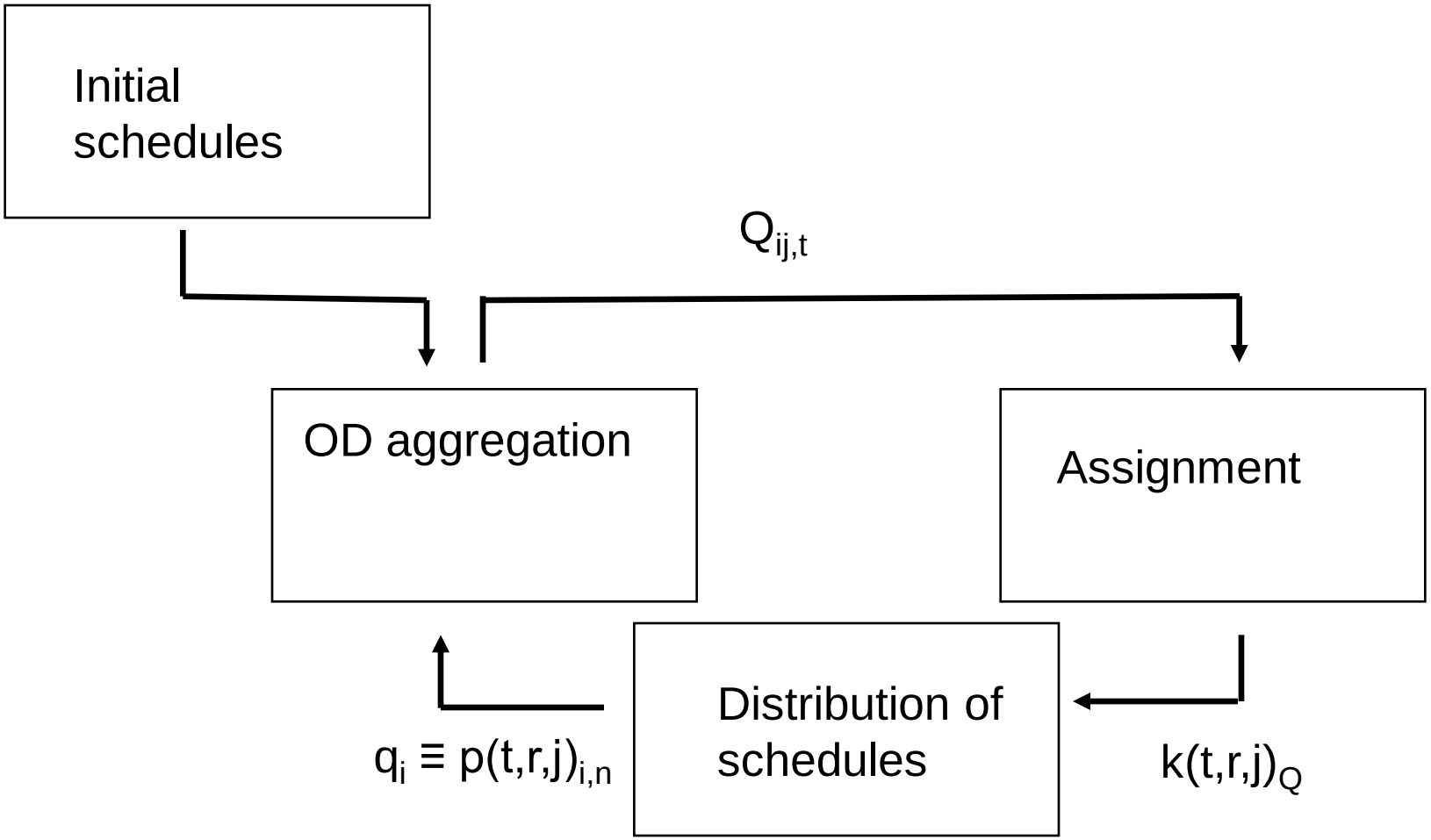
Which equilibrium ? With parameters ?



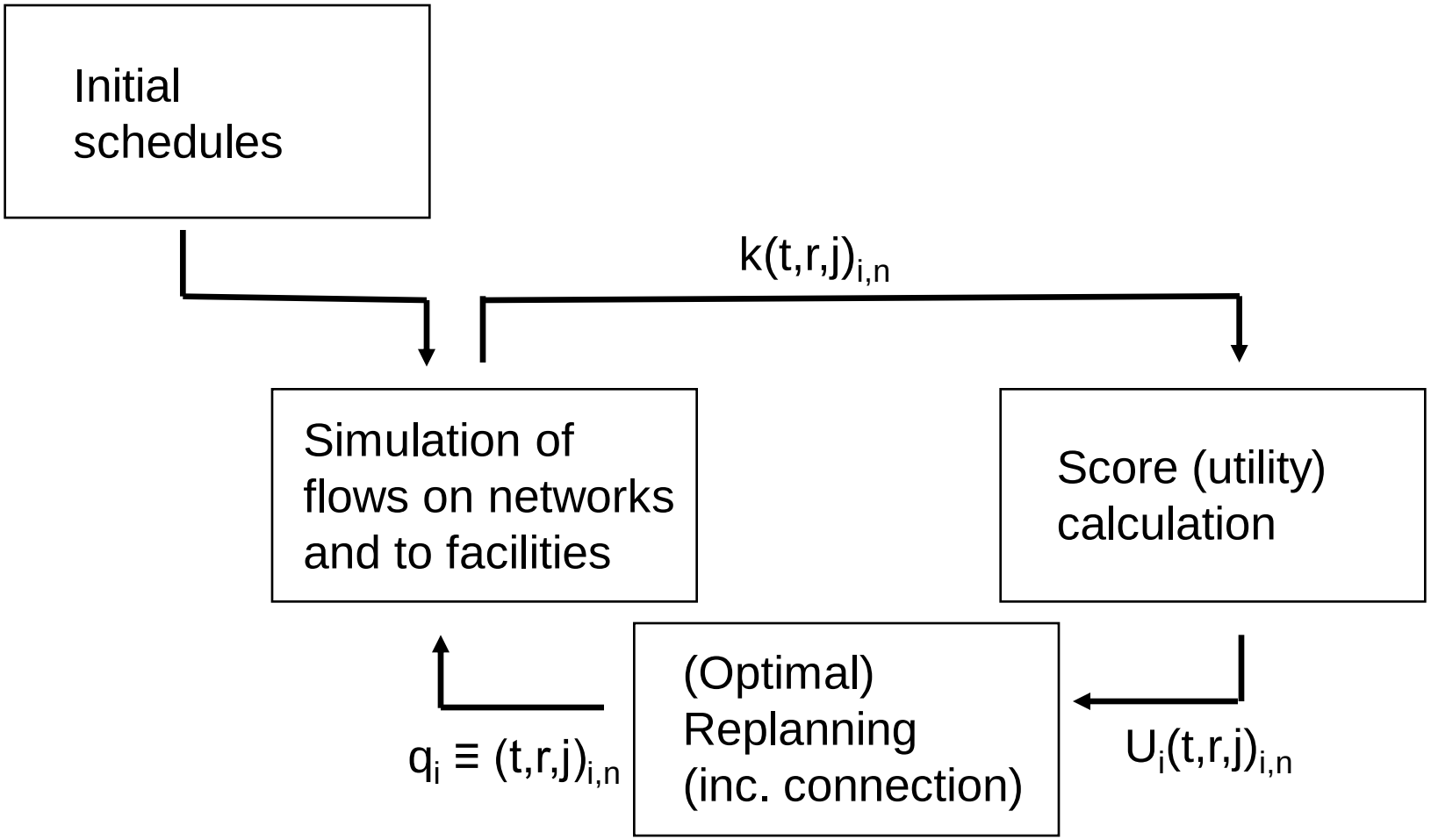
But what we do



Equilibrium search in ABM & assignment combinations



Equilibrium search in MATSim



Current Vickrey-type utility function

$$U_{plan} = \sum_{i=1}^{n} U_{act,i} + \sum_{i=2}^{n} U_{trav,i-1,i}$$

$$U_{act,i} = U_{dur,i} + U_{late.ar,i}$$

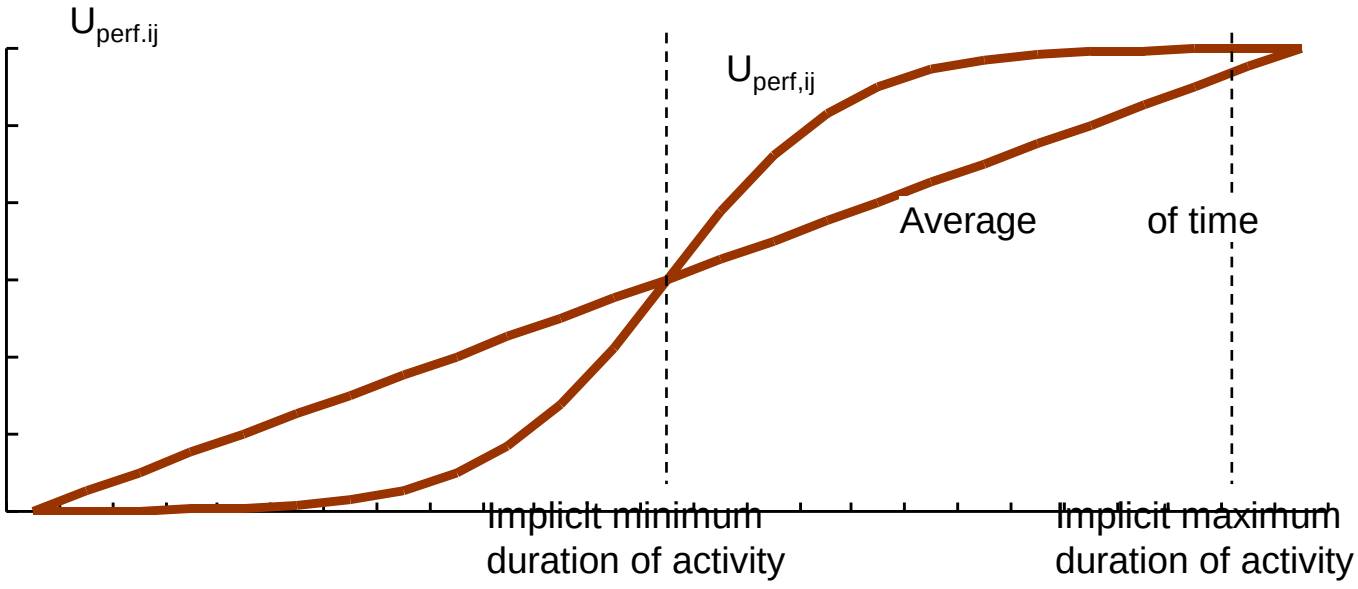
Activity scheduling with Vickrey-style utility function

Number and type of activities
Sequence of activities

- Start and duration of activity
- Composition of the group undertaking the activity
- Expenditure division
- Location of the activity
    - Movement between sequential locations
        - Location of access and egress from the mean of transport
            - Parking type
        - Vehicle/means of transport
        - Route/service
        - Group travelling together
        - Expenditure division

Joh's 2004 utility function for activities

$$U_{perf,ij}(t_{perf,ij}) = U_{ij}^{min} + \frac{U_{ij}^{max} - U_{ij}^{min}}{(1 + \gamma_{ij} \cdot exp\left[\beta_{ij}(\alpha_{ij} - t_{perf,ij})\right])^{1/\gamma_{ij}}}$$



Activity schedule with Joh-style utility function

Number and type of activities
Sequence of activities

- Start and duration of activity
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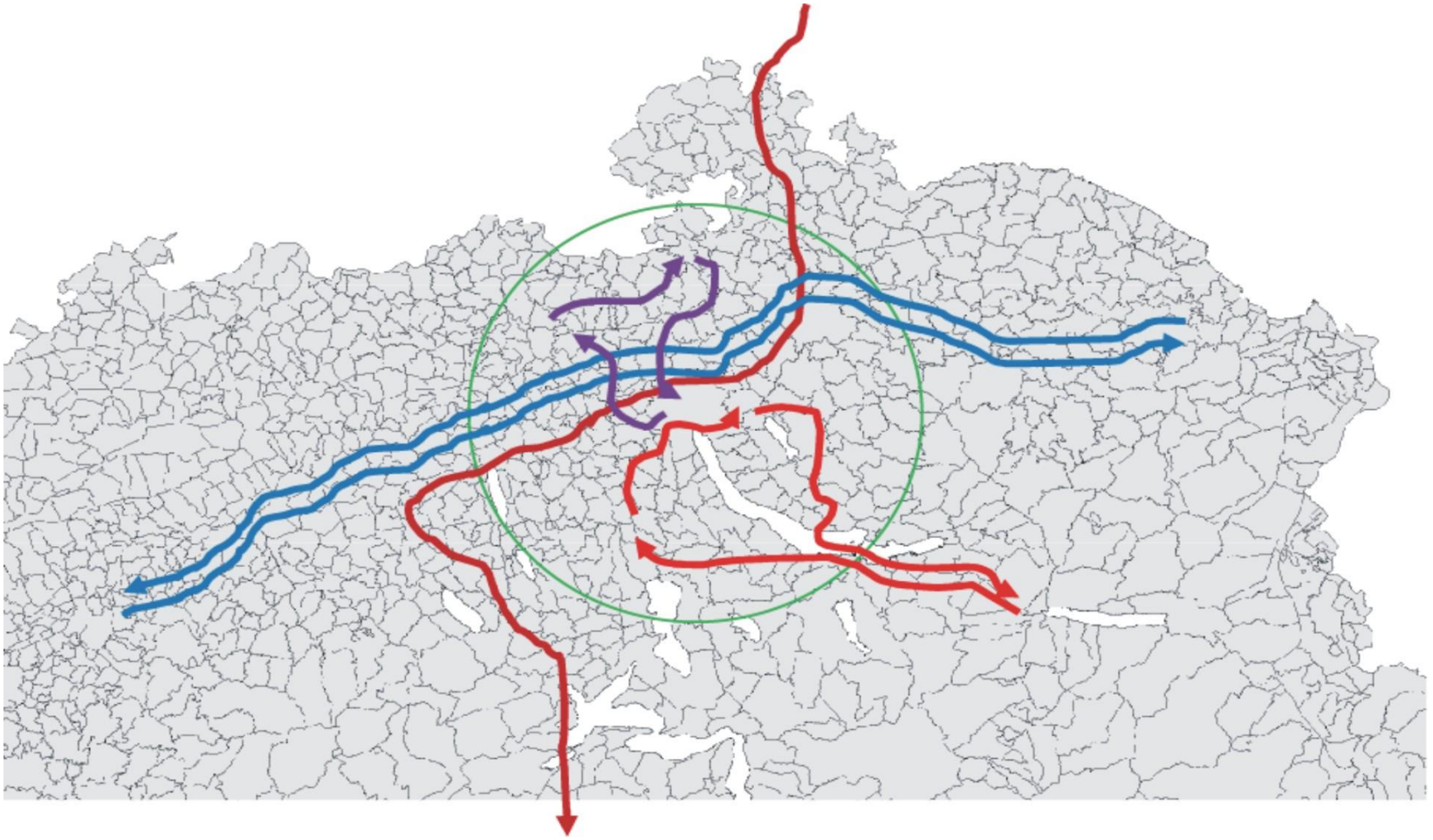
Case study area: 10% sample with NPVM network



Case study, but

170’000 agents travelling in and through 30 km radius

NPVM – planning network

1’300’000 home locations, 300’000 facilities

No freight traffic

No border crossing traffic

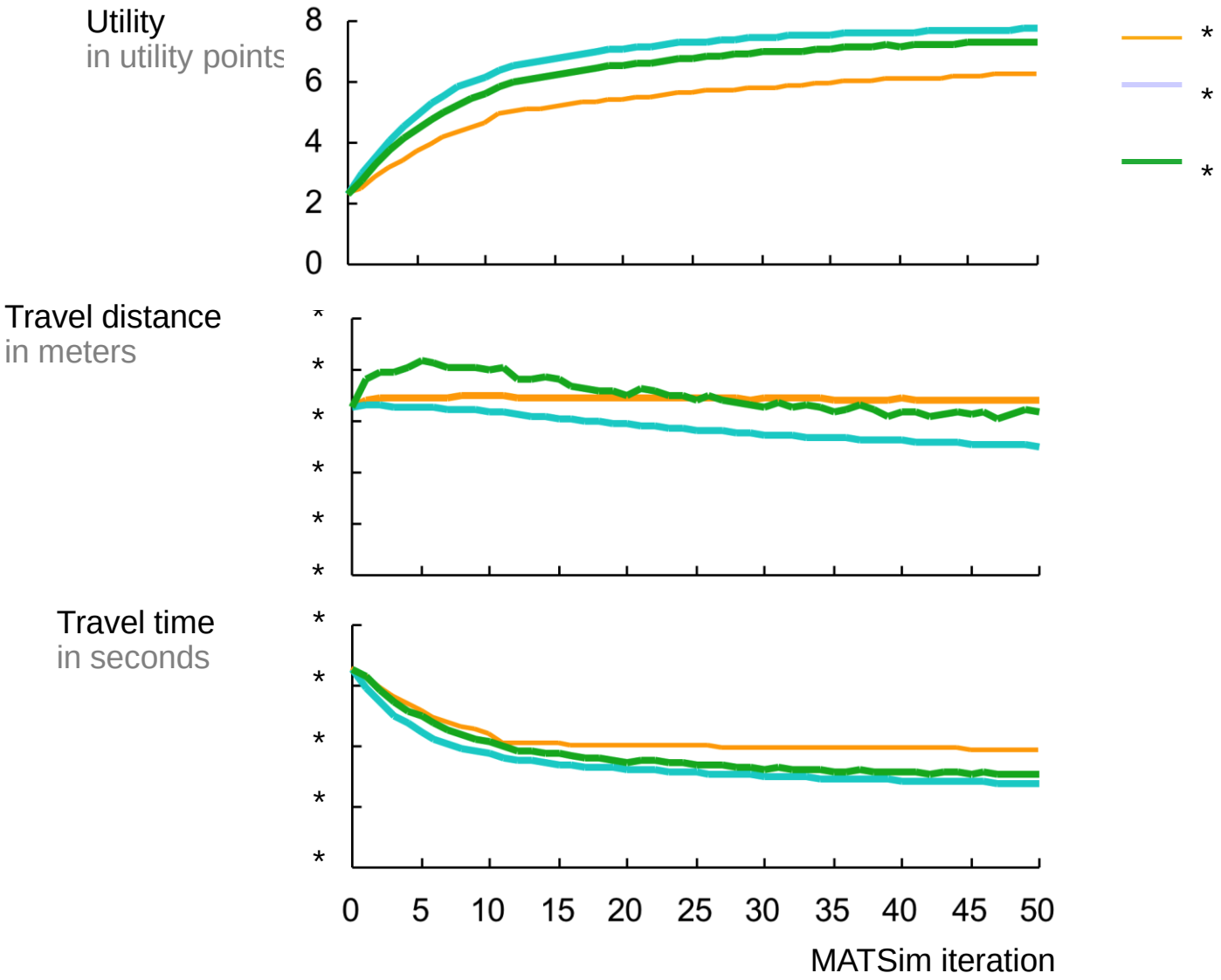
Rule of thumb - public transport travel times

Rule of thumb – marginal cost estimates (accounting for mobility tool ownership)

Undifferentiated closing times for leisure facilities

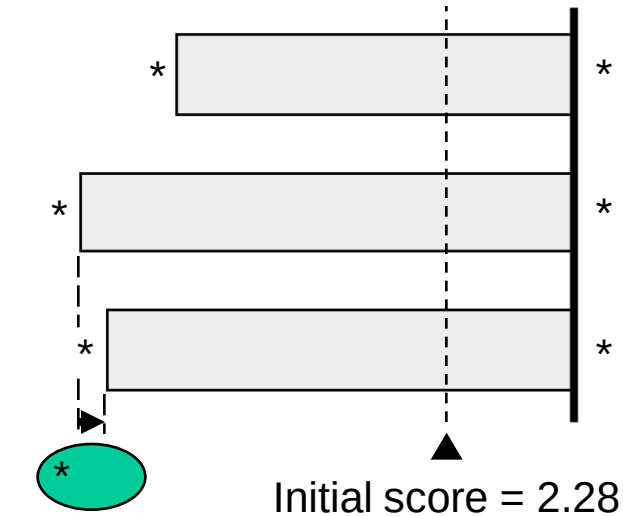
Leisure only out-of-home

Planomat-X with schedule recycling



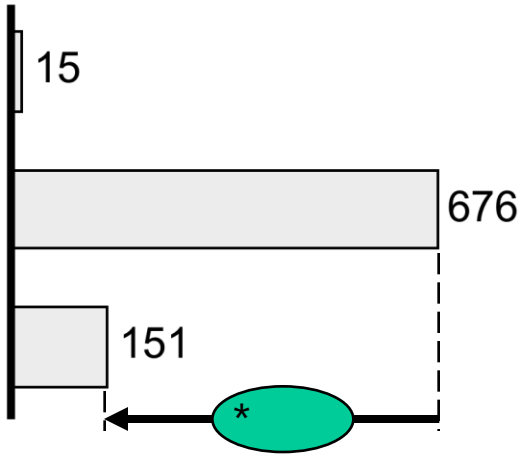
Planomat-X with schedule recycling

Final average utility score of executed schedules (in utility points)



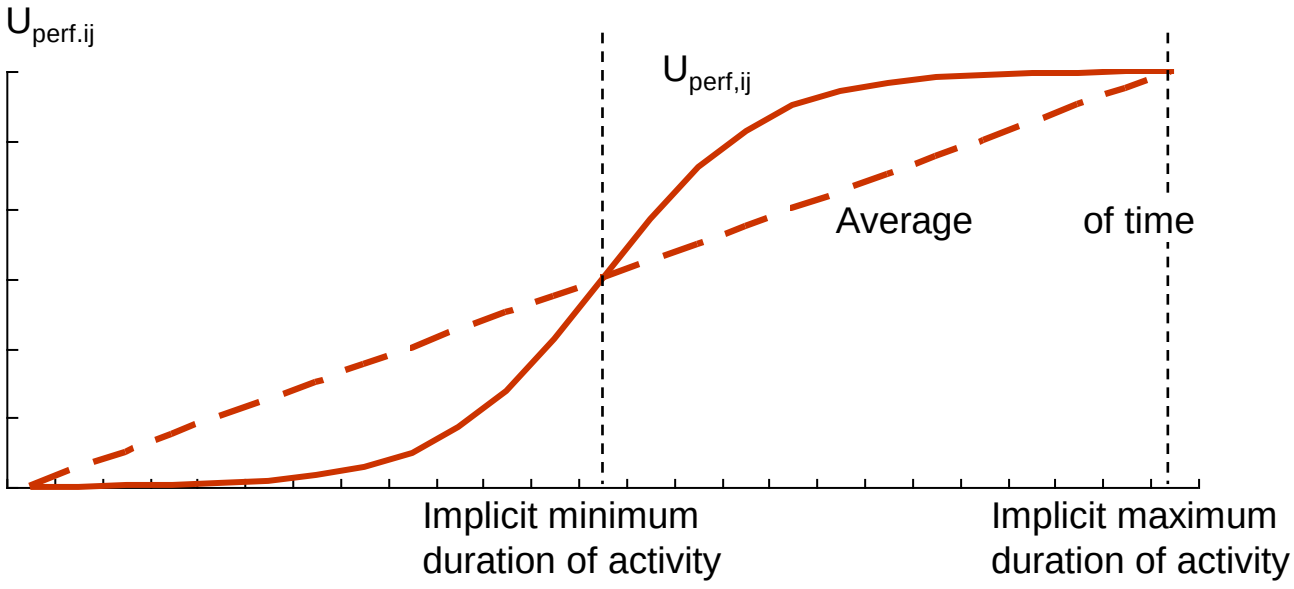
Initial score = 2.28

Replanning runtime* per agent (in msec)



Joh's 2004 utility function for activities

$$U_{perf,ij}(t_{perf,ij}) = U_{ij}^{min} + \frac{U_{ij}^{max} - U_{ij}^{min}}{(1 + \gamma_{ij} \cdot exp\left[\beta_{ij}(\alpha_{ij} - t_{perf,ij})\right])^{1/\gamma_{ij}}}$$



Choice set for estimation

- 19 randomly selected sequences
- Personalised with Planomat-X (locations, mode, timings)

- “dissim” based Joh’s multi-dimensional similarity measure (sequence, mode, location)

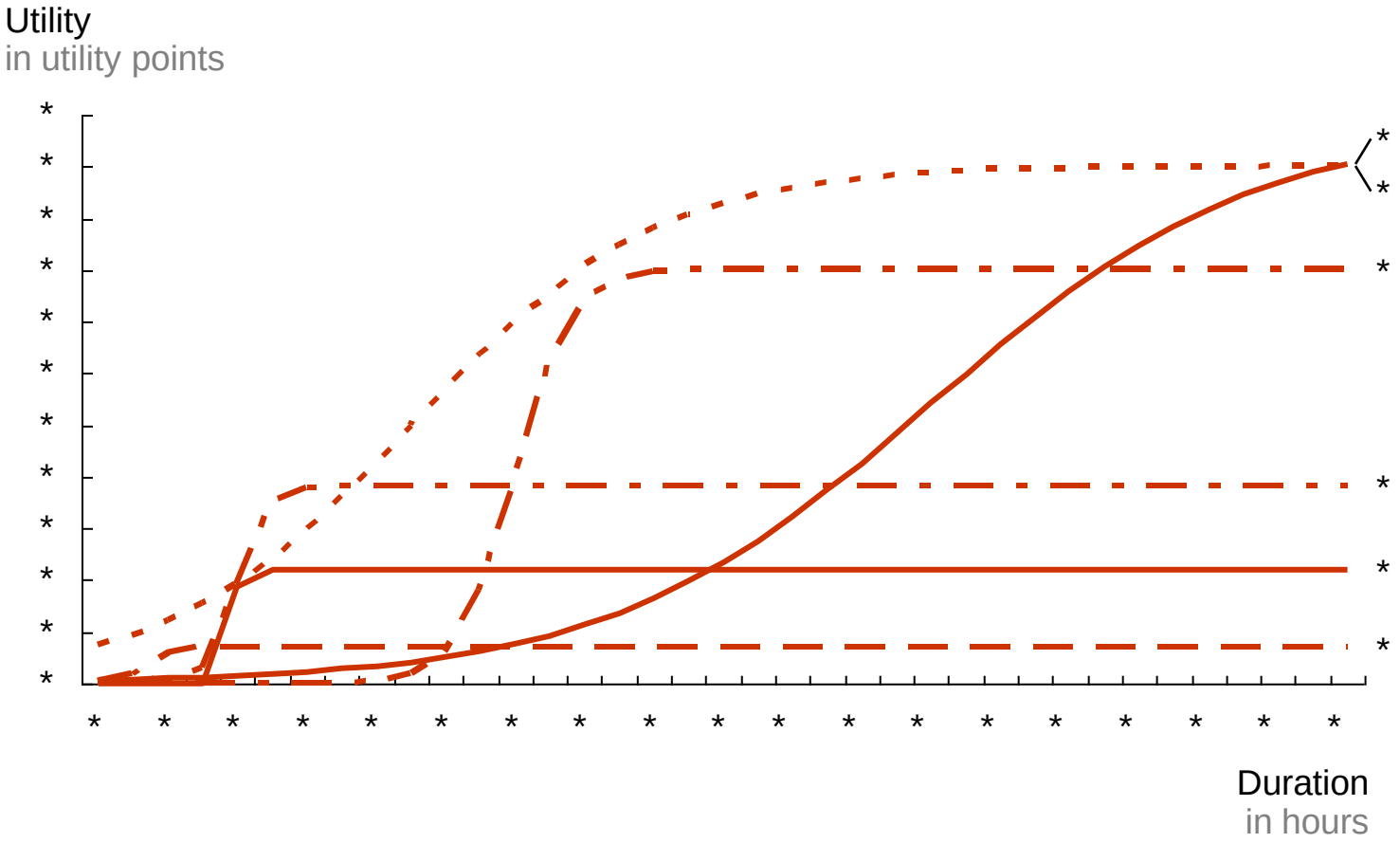
Estimates and corrections

Parameter		Estimated parameters Value	Estimated parameters t-test	Manually calibrated parameters Value
home	α	5.32	9.72	12.00
	β	0.249		0.429
	γ	1.00		1.00
	V min	0.00		0.00
	V max	9.58	14.49	5.41
innerHome	α	0.249	8.5	1.90
	β	15.2		17.80
	γ	1.00		1.00
	V min	0.00		0.00
	V max	1.92	26.38	1.10
work	α	3.86	26.24	4.50
	β	0.491		0.568
	γ	1.00		1.00
	V min	0.00		0.00
	V max	4.97	19.09	5.00
education	α	1.49	11.54	6.00
	β	2.29		2.50
	γ	1.00		1.00
	V min	0.00		0.00
	V max	5.09	18.83	4.00
leisure	α	0.0488	6.91	2.00
	β	100.0		5.00
	γ	1.00		1.00
	V min	0.00		0.00
	V max	1.92	30.88	1.90
shopping	α	0.0453	5.22	0.70
	β	100.0		5.00
	γ	1.00		1.00
	V min	0.00		0.00
	V max	1.94	25.49	0.35

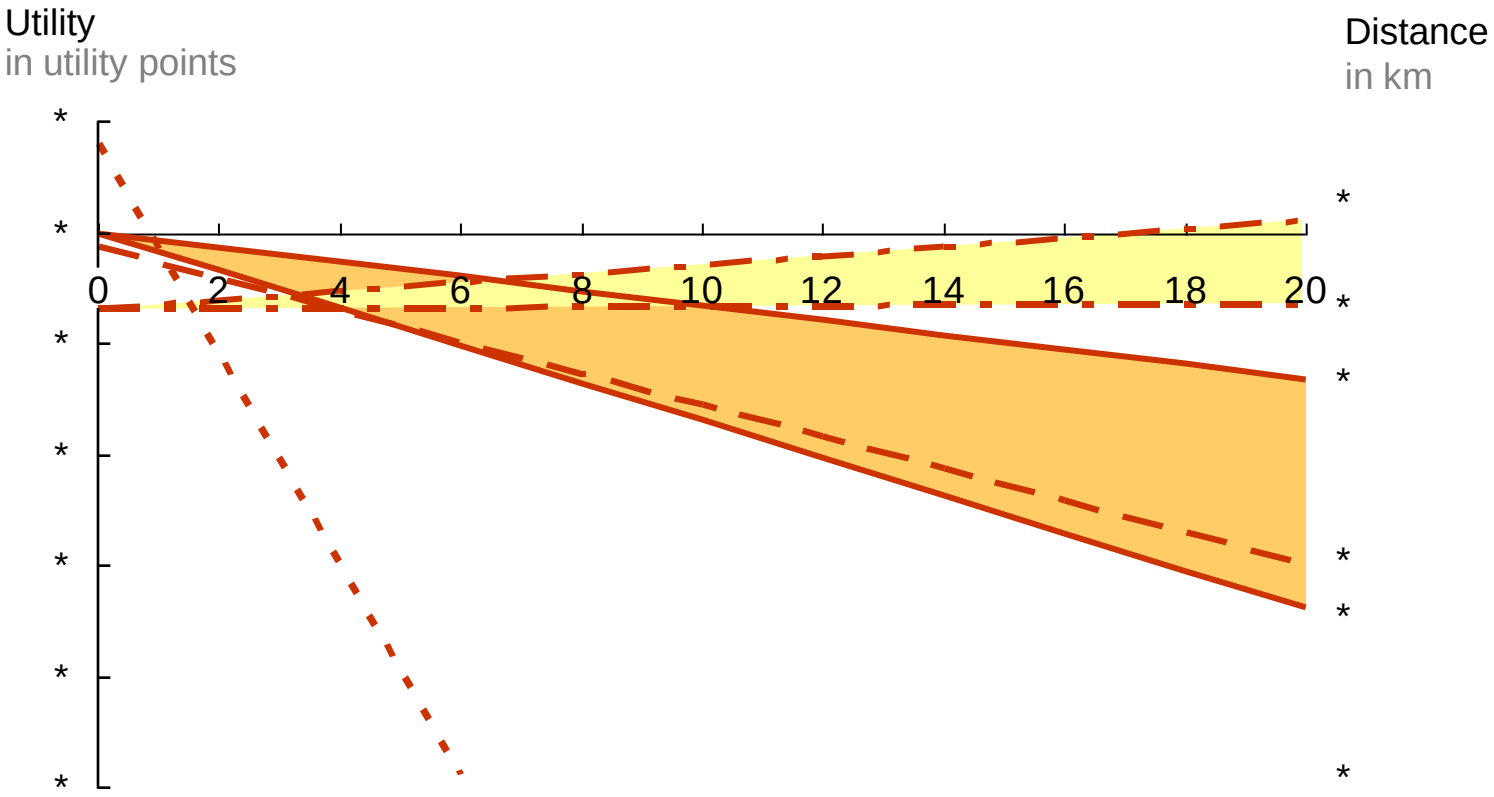
Estimates and corrections

Parameter		Estimated parameters Value	t-test	Manually calibrated parameters Value
car	β travelTime	-3.77	-15.33	**-3.10**
	β travelCost	0.0374	6.83	0.0374
	λ income	0.185	2.67	0.185
pt	constant	-0.578	-16.17	**-0.35**
	β travelTime	0.563	8.77	0.563
	β travelCost	-0.117	-9.7	-0.117
	λ income	-0.27	-3.88	-0.27
bike	constant	0.145	3.21	**-0.07**
	β travelTime	-1.07	-10.49	-1.07
walk	constant	0.854	19.34	**0.40**
	β travelTime	-1.48	-18.83	**-1.90**
β female_act		-0.0577	-2.35	-0.0577
β female_travel		0.0797	4.13	0.0797
β age_education		-0.0146	-16.08	-0.0146
β age_work		-0.00664	-11.49	-0.00664
β license_car		-0.537	-15.11	**-0.25**
β dissim		-139.0	-3.63	-139.0
λ dissim		-0.949	-8.47	-0.949
β repeat		-	-	**-0.50**

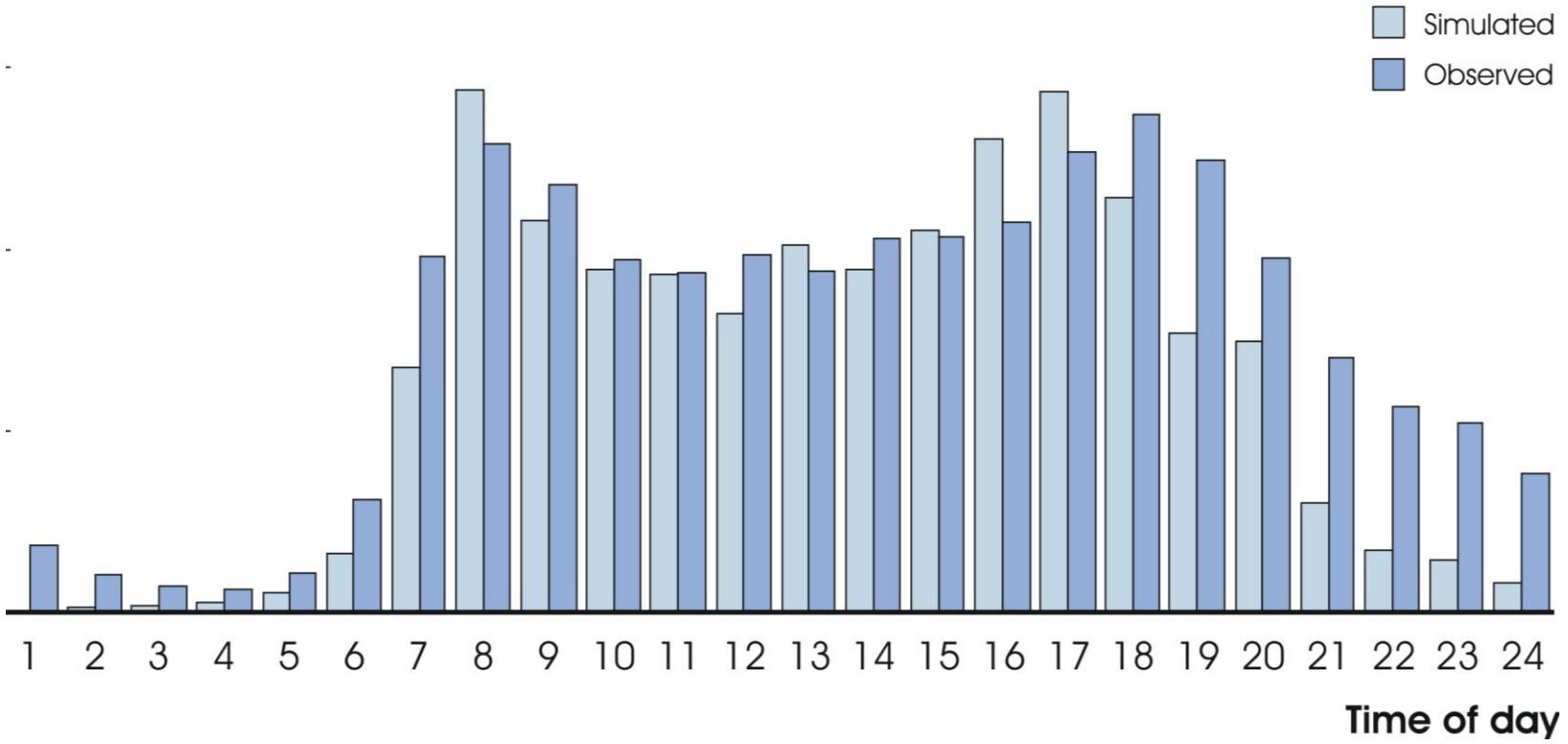
Utility profiles for activities



Modal utilities by distance



110 counting stations in the study area



Thinking about SUE and best response – 2. round

Basics: Traffic DUE and SUE

- Search or add a shortest path to the set of paths considered
- Allocate flows among the set of paths considered
- Check if chosen convergence criterion is met

Basics: Traffic DUE and SUE

- Search or add a shortest path given the current generalised cost estimate to the set of paths considered
- Allocate flows among the the set of paths considered
- Check if chosen convergence criterion is met

Basics: ABM scheduling SUE

- Enumerate all possible schedules
- Allocate flows randomly among the set of schedules
- Execute the schedules without within-day replanning
- Check if chosen convergence criterion is met

Basics: ABM scheduling SUE

- Construct all schedules considered relevant
- Allocate flows randomly among the set of schedules
- Execute the schedules without within-day replanning
- Check if chosen convergence criterion is met

Disconnect from true choice situation

- (Implicit) full-factorial choice set across all dimensions
- (Unweighted) random selection from exhaustive choice set

- No on-the-spot change during the day
- No history of the choice situation
- No social content variables
- No quality of location variable(s)
- Poor description of the choice situation (weather, luggage, social pressure etc.)

- No iteration between generalised cost estimation and parameter estimation

Activity scheduling with some best response modules

- **Number and type of activities**
- **Sequence of activities**
  - **Start and duration of activity**
  - Composition of the group undertaking the activity
  - Expenditure division
  - **Location of the activity**
    - Movement between sequential locations
      - **Location of access and egress from the mean of transport**
        - Parking type and location
      - **Vehicle/means of transport**
      - **Route/service**
      - Group travelling together
      - Expenditure division

Source of variance in MATSim today

- Home location
- Work location

- (Socio-Demographics)

- Congestion feedback through the facilities and network

- MNL – models, if variance among the plans is still available

Source of variation in MATSim tomorrow

- Home location
- Work location

- Congestion feedback from facilities and network

- Quality of location
- Social network membership

- Agent-specific taste parameters (via socio-demographics)
- (Agent-specific choice sets)

Scheduling SUE with MATSim (tomorrow)

- For all agents:
  - Find dissatisfied agent
  - Construct a best schedule given the current generalised cost estimate and agent specific tastes to add to the set of schedules already considered.
  - Rescore existing schedules
  - Select best schedule
- Execute schedule with congestion feedback
- Check if convergence criterion is met

Challenges

Parameters

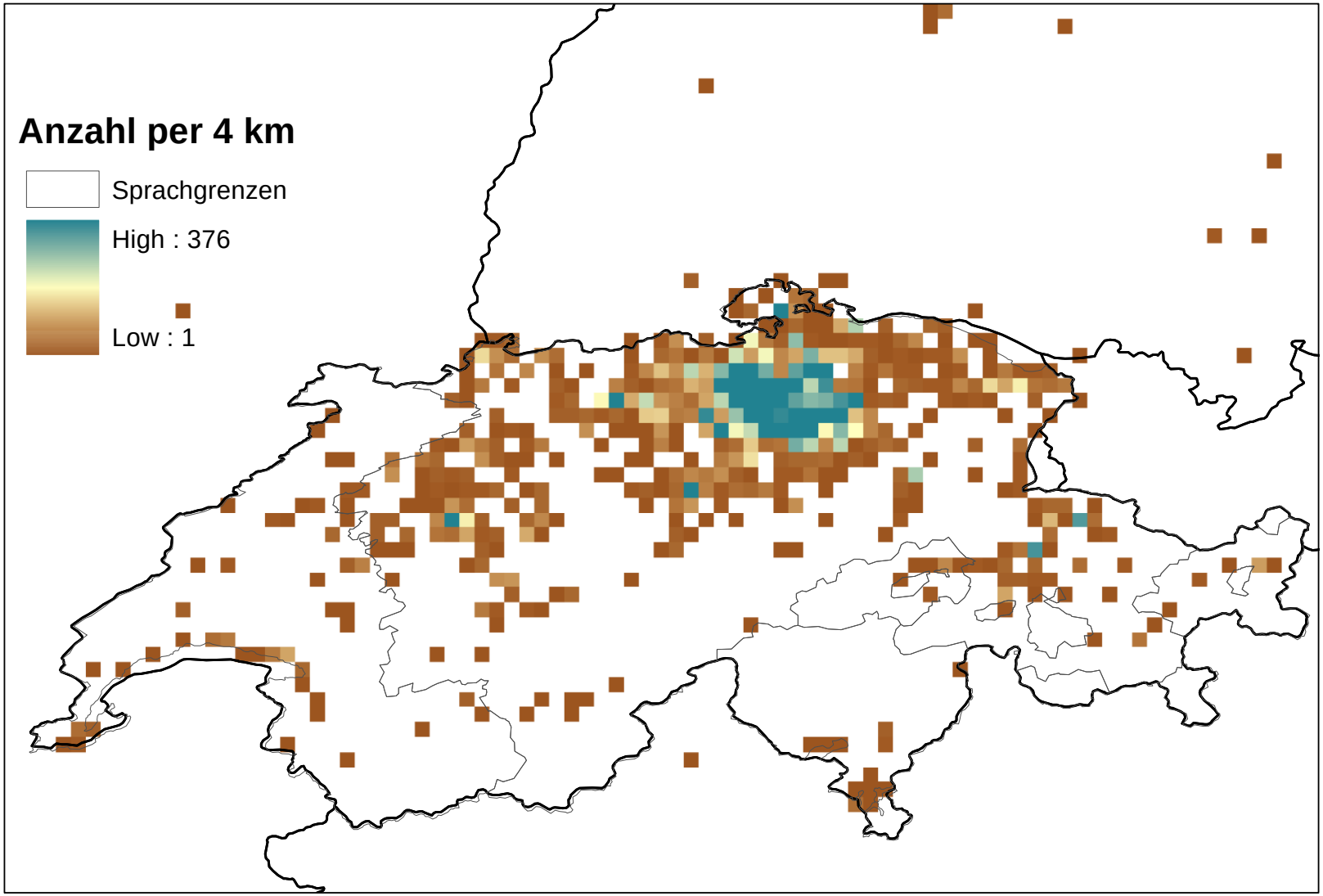
- Find/define the minimum set needed
- Get an idea of the distributions and their correlations

- Finding general attitudional scales for:
  - Variety seeking
  - Risk seeking- and aversion
  - Impatience (short term) and myopia (personal discount rates) (mid- and long-term)
  - Modal preference as a product of comfort, status, independence seeking
  - Location preference as a product of value for money, quality needed, goods and budgets

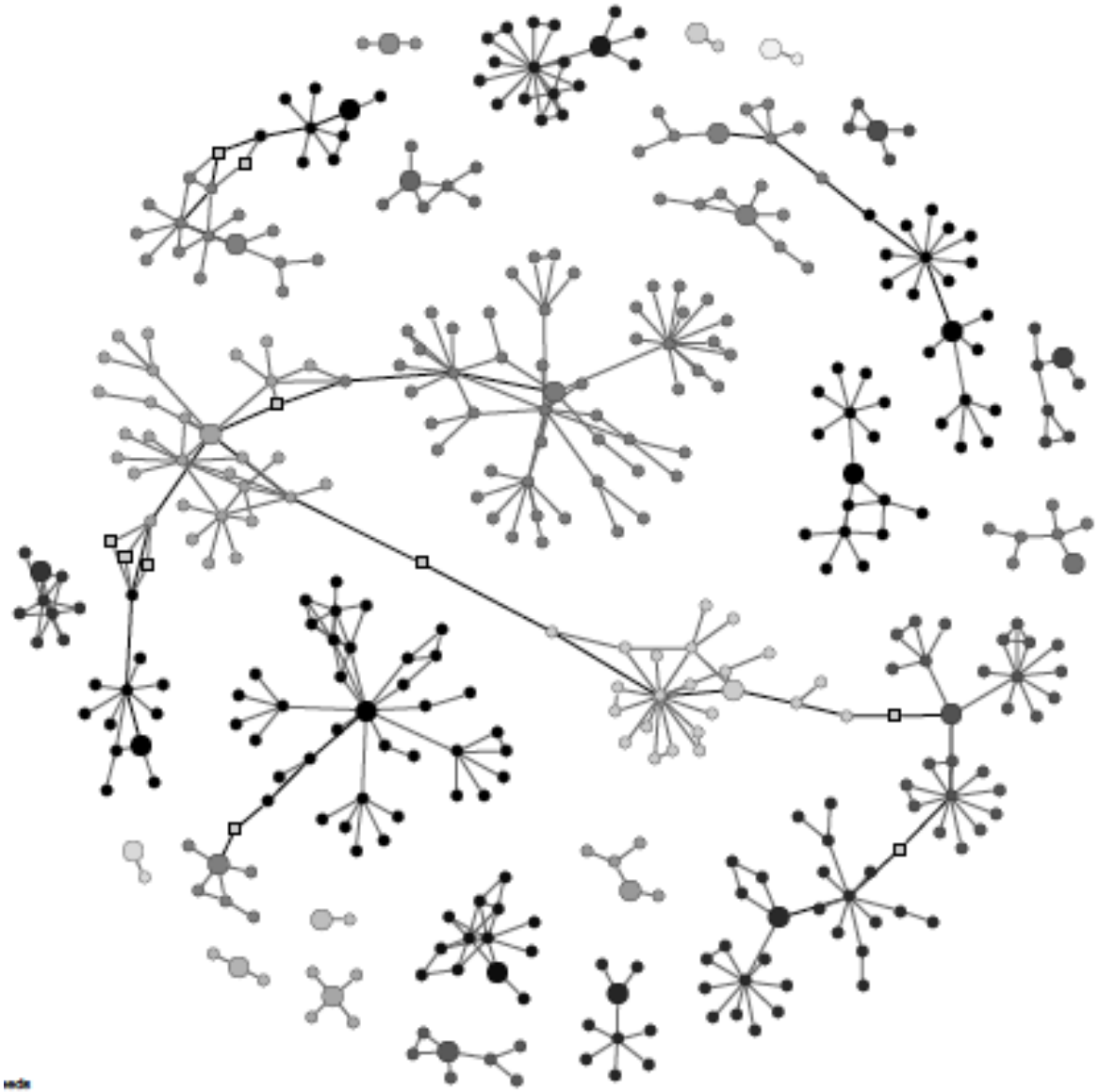
Algorithms

- Speed up search for convergence
  - With-in day replanning as a short-cut
- Demonstrate (unique) convergence of both approaches
- Explicit models of choice set construction
- Maintenance of variance in MATSim
- Integration of social networks and of their dynamics
- Choice models with general similarity structures (space, schedule, social space)

Social networks, e.g. Current snowball sample



Social networks, e.g. Linked ego-centric networks



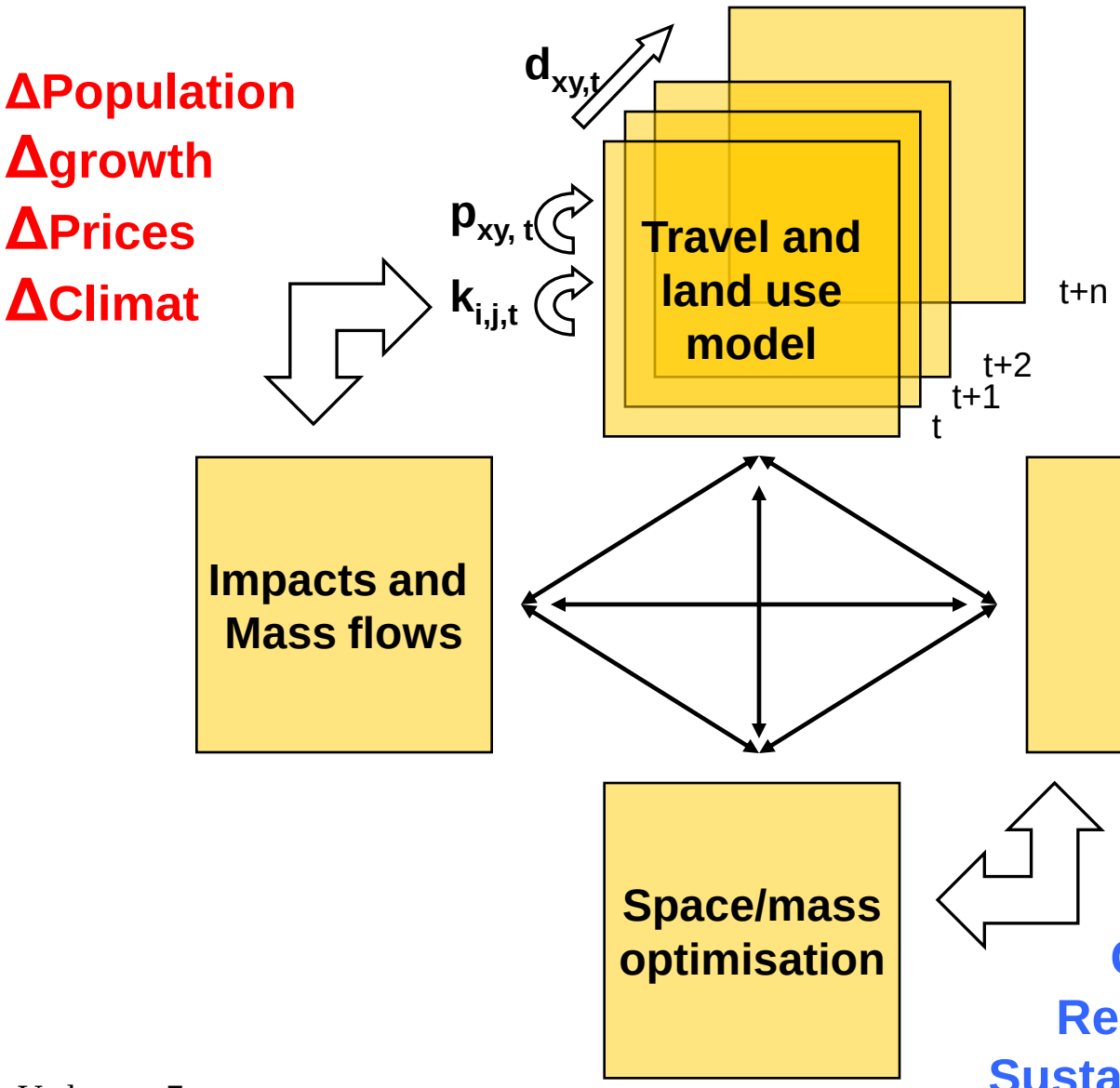
Agents

- Demographics development
  - Migration
  - Residential moving
- Developers
  - Mass optimisation
- Stores and service providers
  - Location choice
  - Capacity choice
- Environmental services

Diversified MATSims for S, M, L

Within-day rescheduling	Time horizon	
	One-day	Open-ended multiple days
Yes	MATSim& (Short-term control; evacuation and events)	[CIRST] (Learning; longer-time horizon demand shifts, impacts of events)
No	MATSim (SUE; project evaluation)	MATSim+ (Learning; Supply-side and demographic adaptations)

Integration of land use (optimisation)



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