Input Uncertainty in the Albatross Model System

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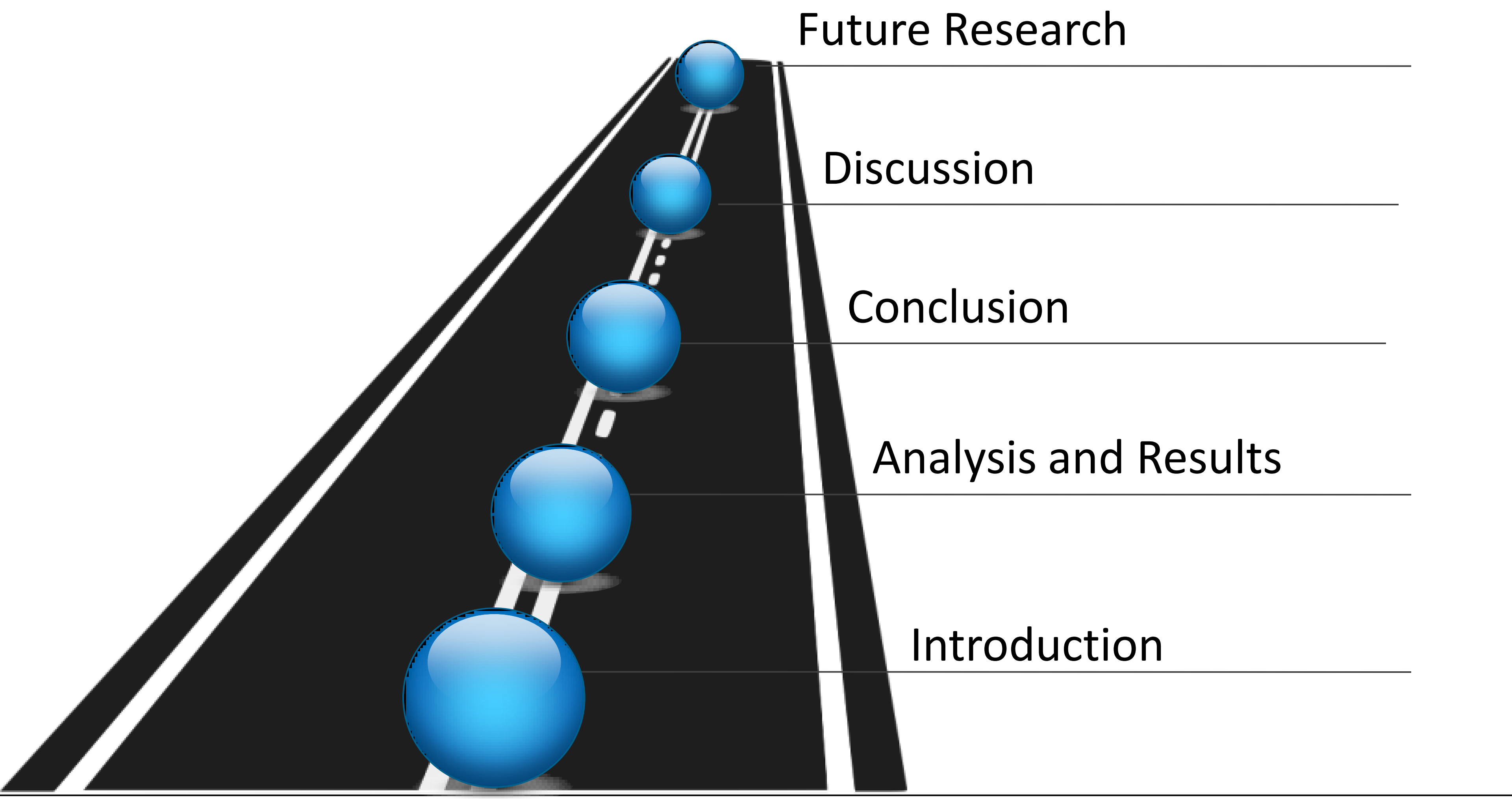
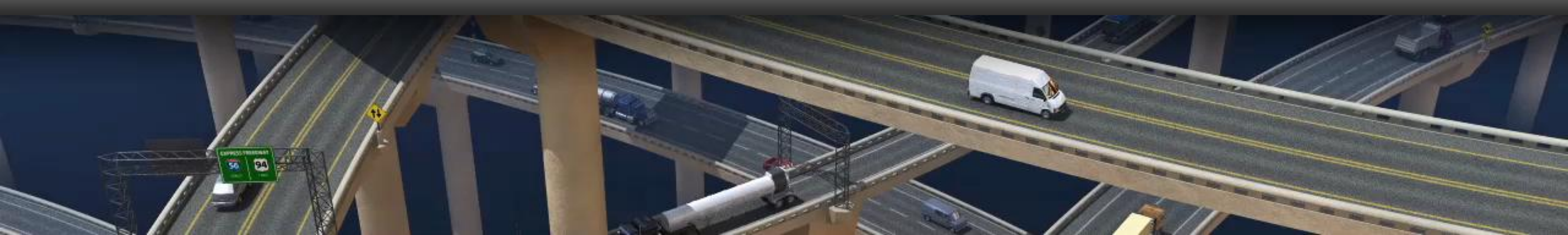


Introduction

Introduction – State of the Art

Development and application of models of travel demand:

- Collect travel survey data
-Model developing : Discrete choice, rule- based…
- Estimate
    - trip generation
    - transport mode and destination choice
    - Derive OD-matrices
    - Assign to network to generate traffic flows
- Formulate planning scenarios
- Convert planning variables into the explanatory variables of the model
- Use estimated parameters to predict set of performance indicator variables
- Apply formal multi-criteria analysis or cost-benefit analysis to choose best policy



We assume data are correct, but in reality they likely are not.

We assume we have perfect knowledge (model is correct), but in reality it is likely not.

We assume we have data about all influential variables, but in reality we likely have not.

We assume that the future will unfold as described in the scenarios, but in reality it likely will not.

WE ASSUME A DETERMINISTIC SYSTEM AND GENERATE A DETERMINISTIC FORECAST, BUT URBAN – TRANSPORTATION SYSTEMS ARE STOCHASTIC AND THE BEST WE CAN DO IS TO GENERATE PROBABILISTIC FORECASTS.

Introduction – Uncertainty Analysis

- Create (a fraction of) the synthesized population
- In case of data uncertainty:
  - Assume multivariate distribution of uncertainty
  - Use Monte Carlo draws to sample realizations
- In case of model uncertainty
  - Discrete choice models: Monte Carlo draws from error distributions
  - Rule-based models: Monte Carlo draws from probabilistic decision trees
- In case of both data and model uncertainty: combination and study the contribution of different sources.
- Run model multiple times (10 – 100) with these inputs

Introduction – Uncertainty Analysis

Collect relevant generated output (performance indicators, OD matrices, traffic flows, etc.)

- Calculate uncertainty in these forecasts
    - Coefficient of variation: st.dev. / mean

- Decomposition of uncertainty by socio-demographic variables, spatial areas, temporal episodes, OD-pairs, links, etc.

Analysis and Results

Analysis - Procedure

1

Create synthetic population and

Use fraction for further uncertainty analysis.

2

Use Monte Carlo sampling and run the Albatross model system multiple times.

3

Perform analyses on the generated outcomes to quantify the amount and nature of uncertainty

Albatross

Multi-agent, rule-based activity based model developed for the Dutch Ministry of Transport for scenario evaluation.

It predicts which activities are conducted where, when, for how long, with whom and the transportation mode involved (Arentze and Timmermans, 2000, 2004, 2008).

Albatross uses different types of constraint: Institutional constraint, temporal constraint, space constraint …

Speed of the car affect different facets of individual activity-travel patterns such as: possible location that can be reached within individual available time window for doing that activity or transport modes that can be used to reach the locations for doing that activity.

Analyses

Uncertainty analysis of the Albatross model system regarding uncertain speed in some crucial links.

“Basisnetwork” is a national data base. Start and end coordinate of the links and average speed of the car on that link is represented.

Study area: Rotterdam metropolitan area (2nd largest in the Netherlands)

Statistics in 2005:

- population 600,000:
- households 280,000:
- fraction: 10%

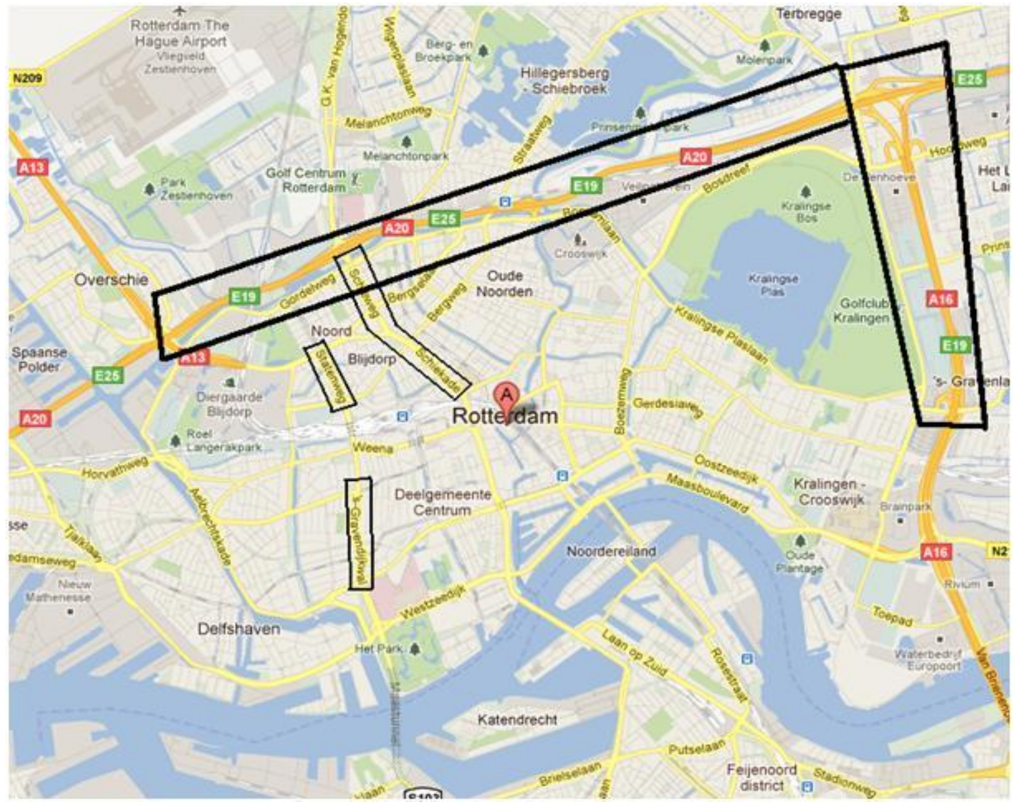
Albatross run 20 times.

Analysis

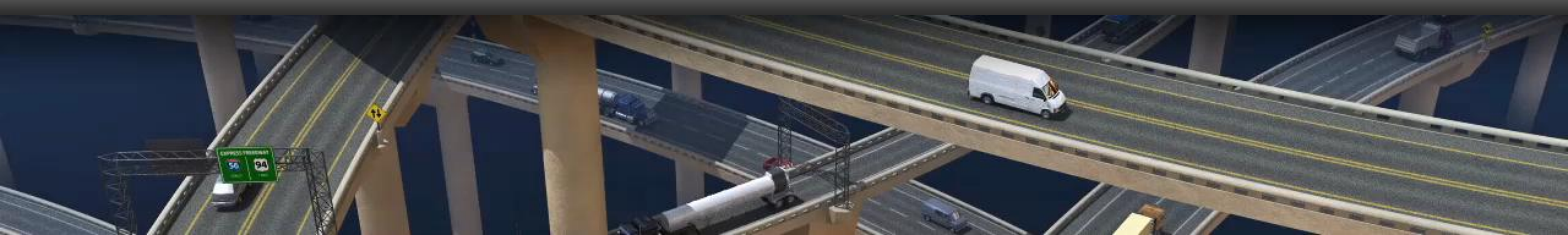
Input uncertainty

- expert elicitation and empirical measurement of uncertainty in speed in selected links

Link ID	*Average Speed in km*	*St. dev.*
A16	80-100	8-10
A20	90-100	9-10
Gravendijkwal	20-40	4-8
Statenweg	15-40	3-8
Schieweg	15-30	3-6
Schiekade	20-30	4-6



Probability distribution function
With relevant mean and st.dev
speed.



Analysis

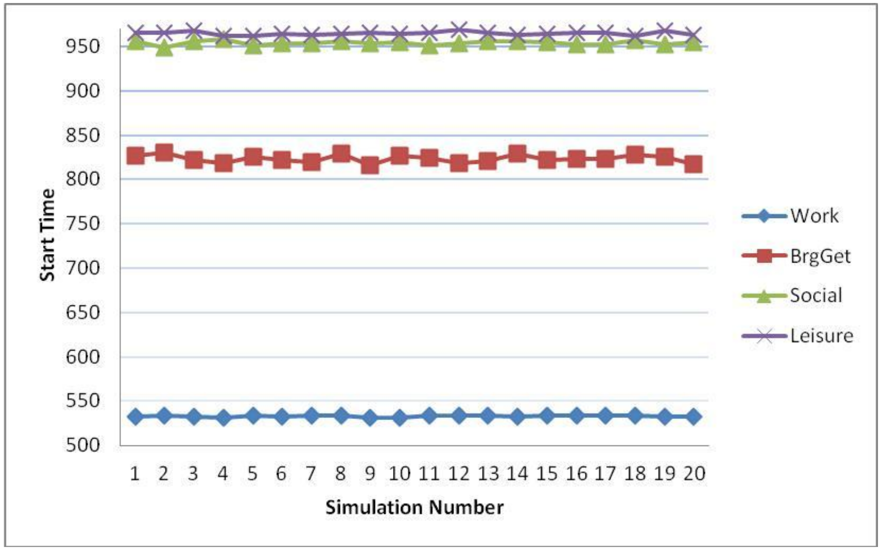
What is the effect of uncertain travel times on activity participation?

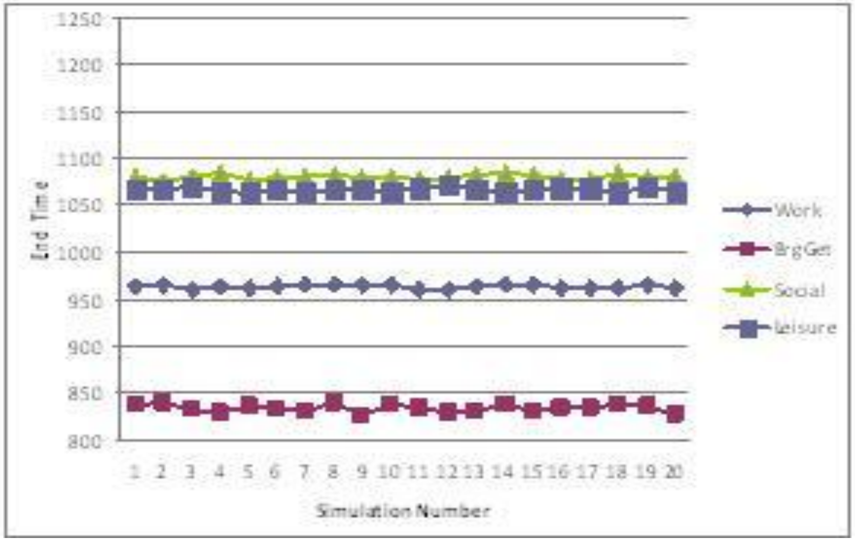
number of act	Mean no of people	Std. deviation	CV (Std.Mean)
0 activities	15224	104.56	0.0069
1 activities	8844	93.14	0.0105
2 activities	4516	43.68	0.0097
3 activities	2277	44.97	0.0197
4 activities	1079	32.07	0.0297
5 activities	481	22.14	0.0460
6 activities	204	11.57	0.0567
7 activities	85	5.14	0.0603
8 activities	31	4.94	0.1609
9 activities	10	2.4	0.2462
10 activities	5	1.39	0.2808

CV increases with increasing number of activities.

Analysis

What is the effect of uncertain travel times on start and end of the activities?





variation in start and end times of activities is relatively large.

3 min for work
14 min for BrgGet

Analysis

What is the effect of uncertain travel time on the duration of activities?

	Work	***Bring/ get***	***Social***	***Leisure***
Average	430,5	9,8	126,7	102,2
Max	433,7	10,0	128,8	103,7
Min	427,1	9,6	125,7	100,8
CV	0,005	0,013	0,007	0,008

Work is least affected. CV=0.50%
BrgGet is most affected. CV= 1.3%

Analysis

What is the effect of uncertain travel times on transport mode choice?

Mode choice proportions	Car Driver	Slow	Public	Car Passenger
Average	0,385	0,433	0,070	0,111
Std	0,002	0,003	0,001	0,001
CV	0,006	0,006	0,014	0,009

Coefficient of variation is the highest for Public transport and lowest for Car driver and Slow mode.

Conclusion

Conclusions

uncertainty in car speed affects the start and the time mostly in absolute terms and activity participation in a relative sense (CV) at least in this study.

Results indicate that the degree of variation tends to differ between mandatory and flexible activities.

Discussion

Discussion

Uncertainty in travel times was only implemented for a certain corridor in the study area and consequently not all individuals face this uncertainty

The behavioral mechanisms in Albatross kept constant. Assuming that in short run people do not adopt to uncertain speed. If it continued then they might structurally adapt their departure time.

Future Research

Future research agenda

Spatial variability analysis.

The effect of uncertainty in speed at the individual level.

Examine the effect of travel time variability on different segments of the population.

Questions?
More Information?

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