

Part I
**Albatross: overview of the model, ongoing work and
research agenda**

Albatross project team

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Presentation outline

- Overview of the Albatross project
- Characteristics of the model
- Modeling approach
- Ongoing work
- A research agenda

Overview of the ALBATROSS project

Background and Objectives

- Albatross was developed for the Dutch Ministry of Transportation (1997 - 2007)
- Aim 1: Explore potentials of activity-based approach to travel demand modeling
- Aim 2: Explore potentials of a rule-based model of individual activity scheduling decisions

Stages in model development

- Version 1
 - A limited study area (data collection: 3,000 person-days)
 - Activity skeletons taken as observed
- Version 2
 - Upscaling to national level (pooled data set: 10,000 person-days)
 - Activity skeletons are generated
 - Population synthesis
- Version 3
 - Parametric Action Decision Trees
- Version 4
 - Re-estimated on national travel survey data (MON 2004: 45,000 person-days)

Validation tests carried out

- Goodness-of-fit of the model on activity diary data
- Comparison with utility-based models
- Spatial transferability study
- Sensitivity analysis and face validity tests
- External validation tests
 - comparison with national trip and time-use databases

Characteristics of the model

Characteristics of the model

- Predicts in a coherent fashion:
 - Which activities are conducted, with whom, how long, when, where, transport mode, trip chaining
- Considers a household-day as the unit of analysis
 - Interactions between individuals within households
 - Scheduling decisions
 - Car availability
- Takes a full set of constraints into account
 - Household constraints
 - Space-time constraints
 - Institutional constraints
 - Situational constraints

Main characteristics of the model (cont'd)

- Uses a detailed classification of activities

- Paid work
- School
- Voluntary work
- Bring/get persons
- Other non-leisure fixed

Fixed

-
- Daily shopping
 - Non-daily shopping
 - Service related
 - Social activities
 - Leisure activities

Flexible

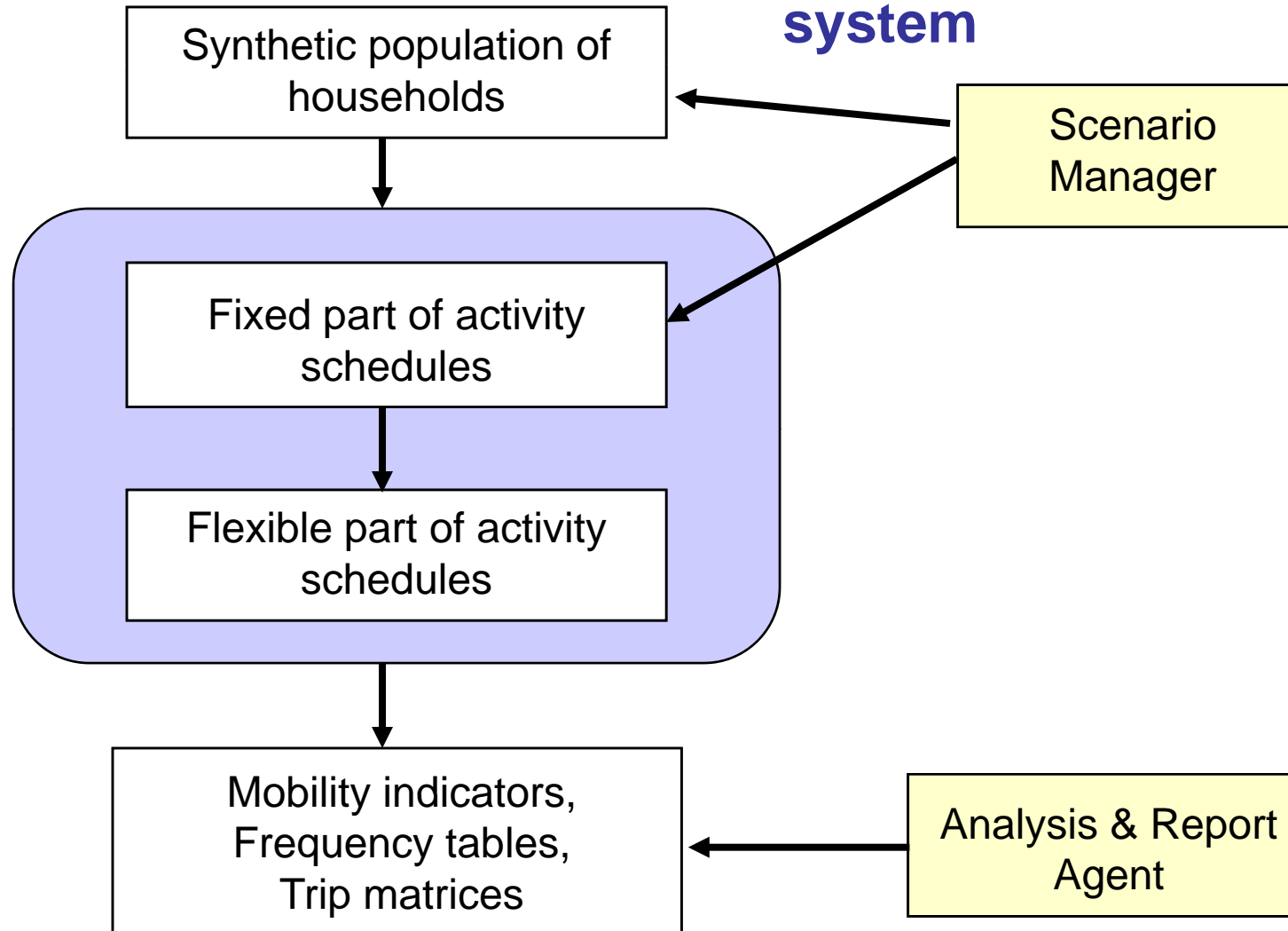
-
- Sleep
 - Ohter in-home

In-home

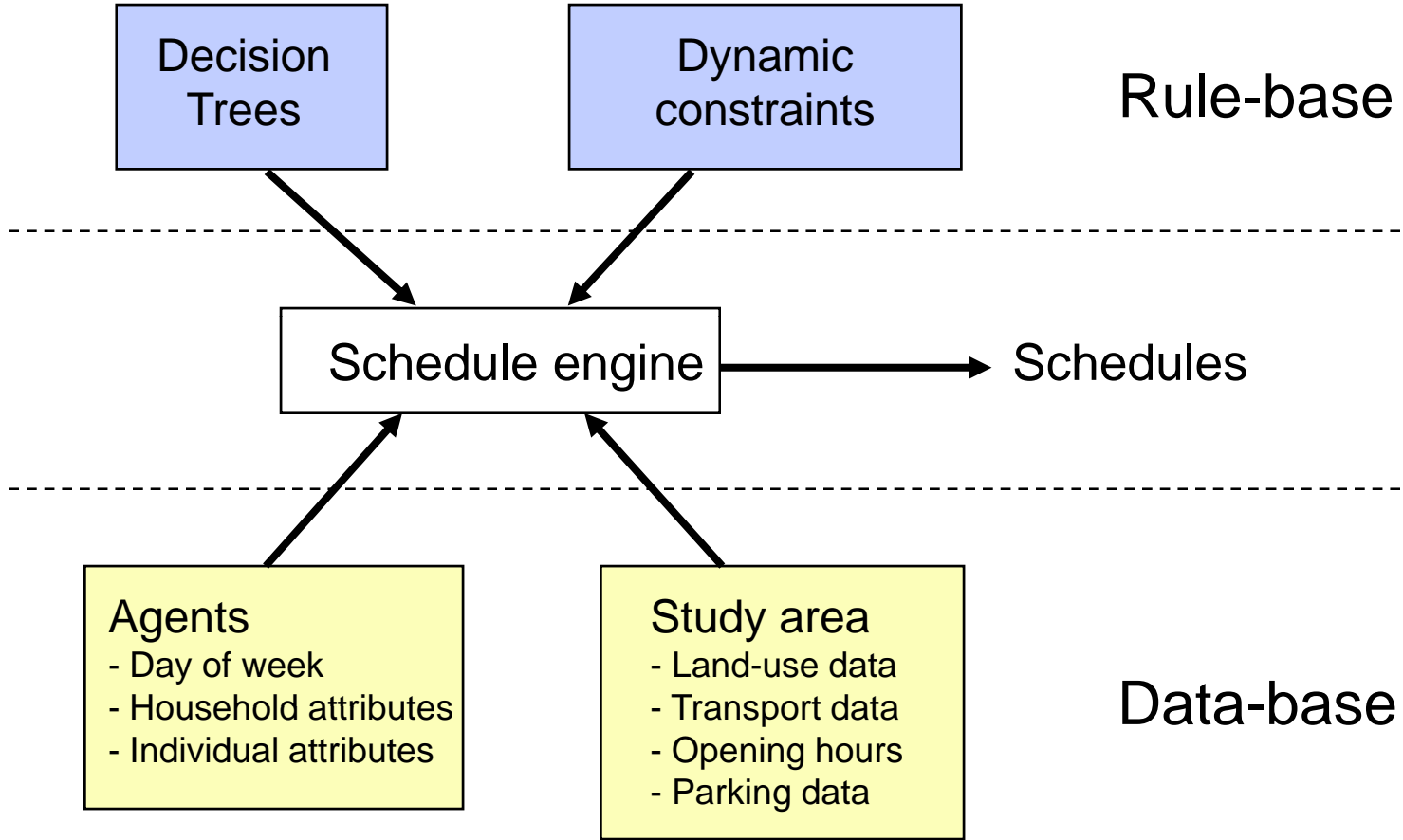
Characteristics of the model (cont'd)

- It schedules activities and travel episodes on a continuous time scale
- Does not generate the activity schedules of children
- Does not simulate traffic (the implementation of the schedules)

ALBATROSS model system



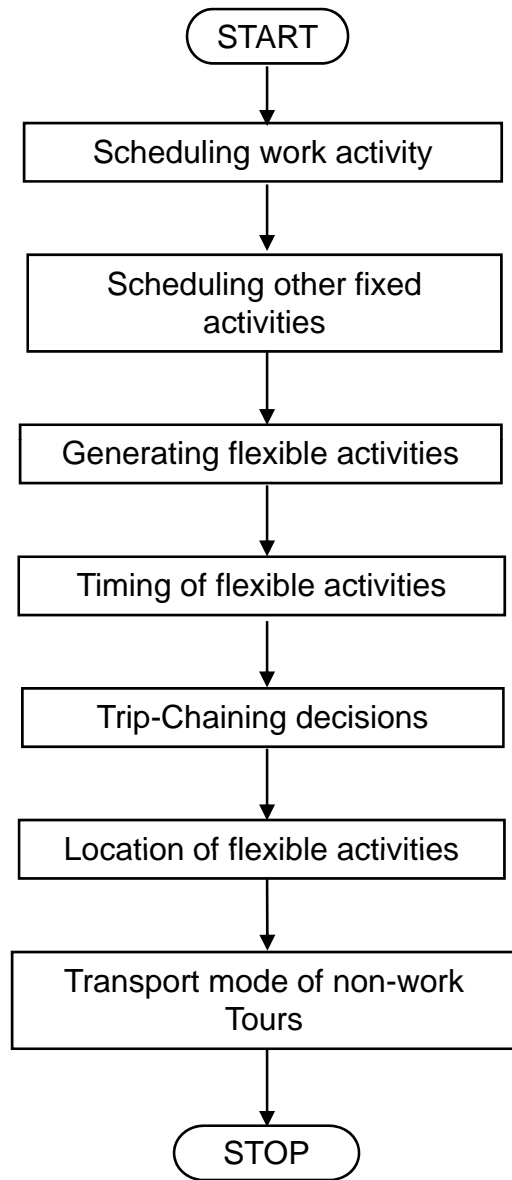
The Scheduler



Modeling approach

- The process model
 - Decision trees
- Generating agents

Process model in main lines



episodes, Start time, Duration, Location, transport mode

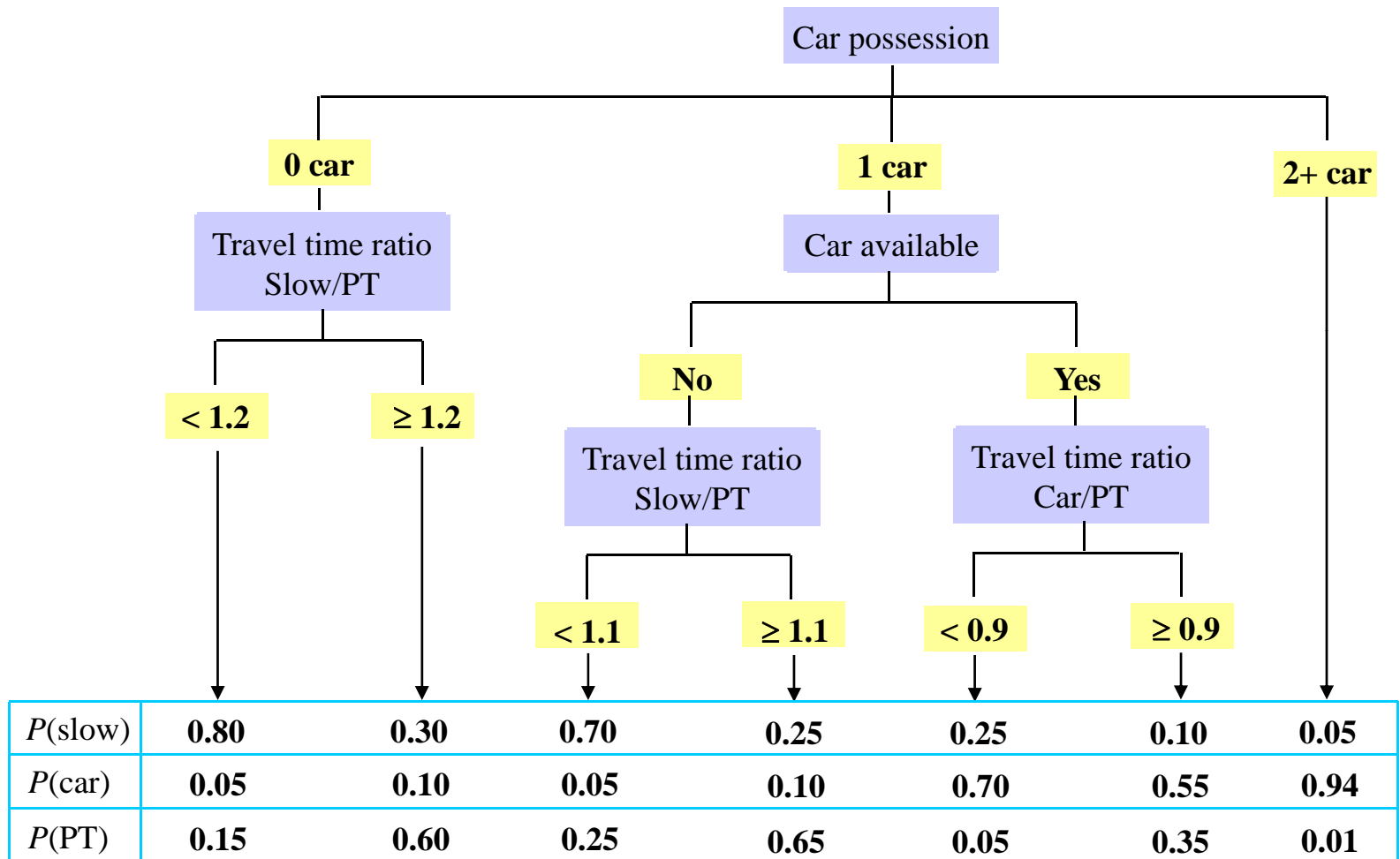
episodes, Duration, Start time, Location, Link with work, Location

episodes, Duration

In total 27 decision steps and 27 decision trees

In total 1687 decision rules derived from data

Simple example of a decision tree: discrete choice



Example of an empirically derived decision tree

Mode choice, Part 1

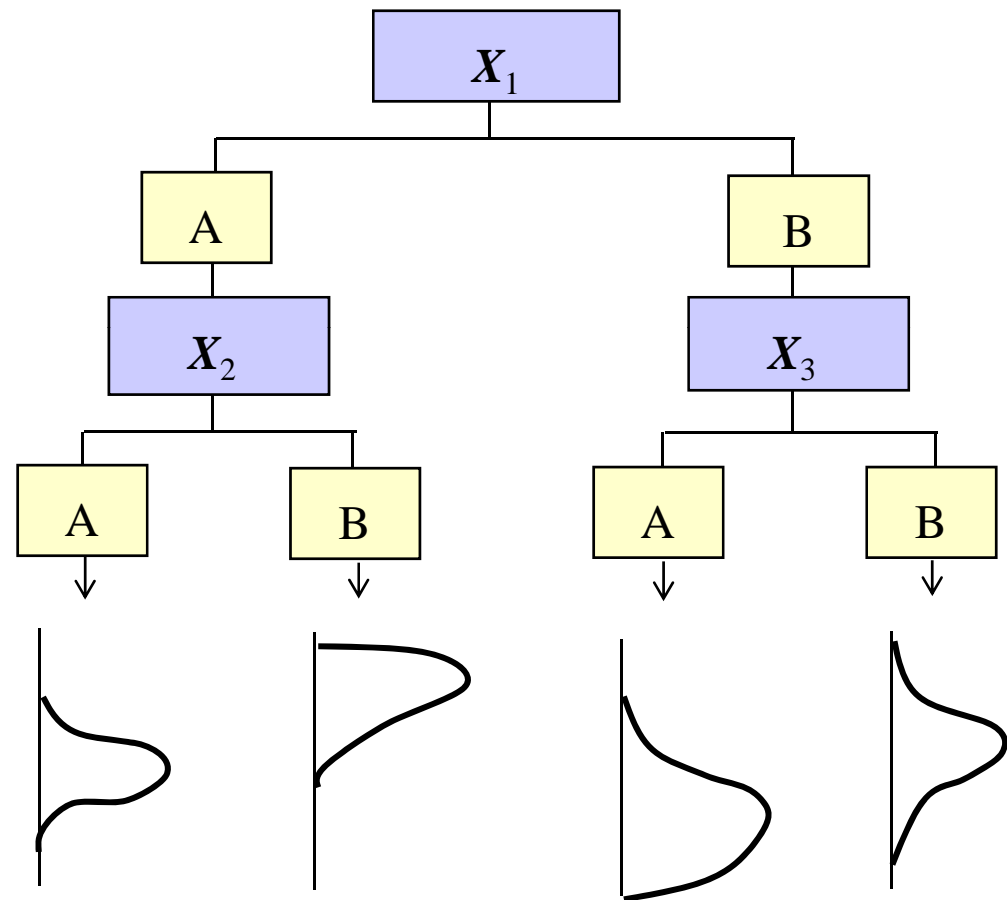
Urb	-	-	-	-	-	-	-	-	-	-	0,2,3,4	1	-	-	-	-	-	-	-	-
Comp	-	-	-	-	0,3,1	2,4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEC	-	0,3,1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ncar	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	0	0
Gend	-	-	-	-	0	0	0	0	0	0	0	0	1	1	1	0	0	1	-	-
Driver	0	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1
wstat	-	0,1	0,1	2	-	-	-	-	-	-	-	-	-	0,1	2	-	-	-	-	-
Pwstat	-	-	-	-	0,1	0,1	0,1	2	2	2	-	-	-	-	-	-	-	-	-	-
Nsec	-	-	-	-	0-3	0-3	5-4	-	0-3	5-4	-	-	-	-	-	-	-	-	-	-
Adur1	-	-	-	-	0	0	0	0	0	0	1,2	1,2	-	-	-	0	1,2	-	-	-
Cbrget	-	-	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	-	-
Dist	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Pstat	-	-	-	-	-	-	-	-	-	-	-	-	0	1,3,2	1,3,2	-	-	-	-	-
slow	0.99	0.95	0.87	0.78	0.85	0.95	0.70	0.94	0.87	0.96	0.85	0.71	0.72	0.87	0.79	0.80	0.65	0.55	0.97	0.76
car	0.00	0.03	0.11	0.21	0.14	0.02	0.29	0.05	0.13	0.04	0.12	0.16	0.27	0.13	0.19	0.16	0.29	0.42	0.00	0.16
pub	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.04
pass	0.01	0.03	0.02	0.01	0.01	0.02	0.01	0.01	0.00	0.00	0.04	0.12	0.00	0.00	0.02	0.03	0.05	0.04	0.02	0.04
N	255	222	109	97	144	149	142	150	157	235	523	161	235	260	295	250	170	227	108	198
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20

Goodness of fit of decision trees (discrete choice)

DT id	DT label	nmin	ncond	nalt	nobs	nleaf	e_0	e	e_{incr}	c
3	Work/school	84	21	2	8455	49	0.506	0.772	0.538	0.593
5	# of work episodes	37	22	2	3757	20	0.640	0.670	0.083	0.303
9	fixed activity	90	38	2	35008	114	0.797	0.829	0.157	0.373
10	# of fix. activity episodes	40	38	4	4003	24	0.471	0.524	0.101	0.196
12	Fix act. on work trip	30	38	5	2656	39	0.422	0.488	0.114	0.578
14	L same as previous	55	33	2	5579	54	0.518	0.625	0.222	0.432
15	L municipality. in/out	90	29	2	18758	105	0.512	0.625	0.277	0.468
16	L municipality order	79	43	5	7932	63	0.229	0.304	0.097	0.525
17	L municipality nearest	79	38	2	7932	55	0.503	0.727	0.451	0.560
18	L municipality distance band	42	43	6	4279	67	0.168	0.331	0.196	0.715
19	L zone order	90	40	4	17782	127	0.260	0.385	0.169	0.577
20	L zone distance band	90	47	5	9510	68	0.258	0.422	0.221	0.672
21	Mode to work	36	39	4	3665	51	0.381	0.590	0.338	0.659
22	flexible activity	90	49	2	62164	204	0.672	0.734	0.190	0.405
23	With whom flex. act.	90	49	3	12899	86	0.364	0.500	0.214	0.552
24	Duration flex. act.	90	51	3	12899	71	0.342	0.389	0.071	0.356
25	Start time flex. Act.	90	63	6	12709	87	0.174	0.335	0.195	0.693
26	Trip chaining	90	48	4	11107	46	0.484	0.785	0.584	0.801
27	Mode to non-work	90	38	4	9523	56	0.425	0.607	0.317	0.614

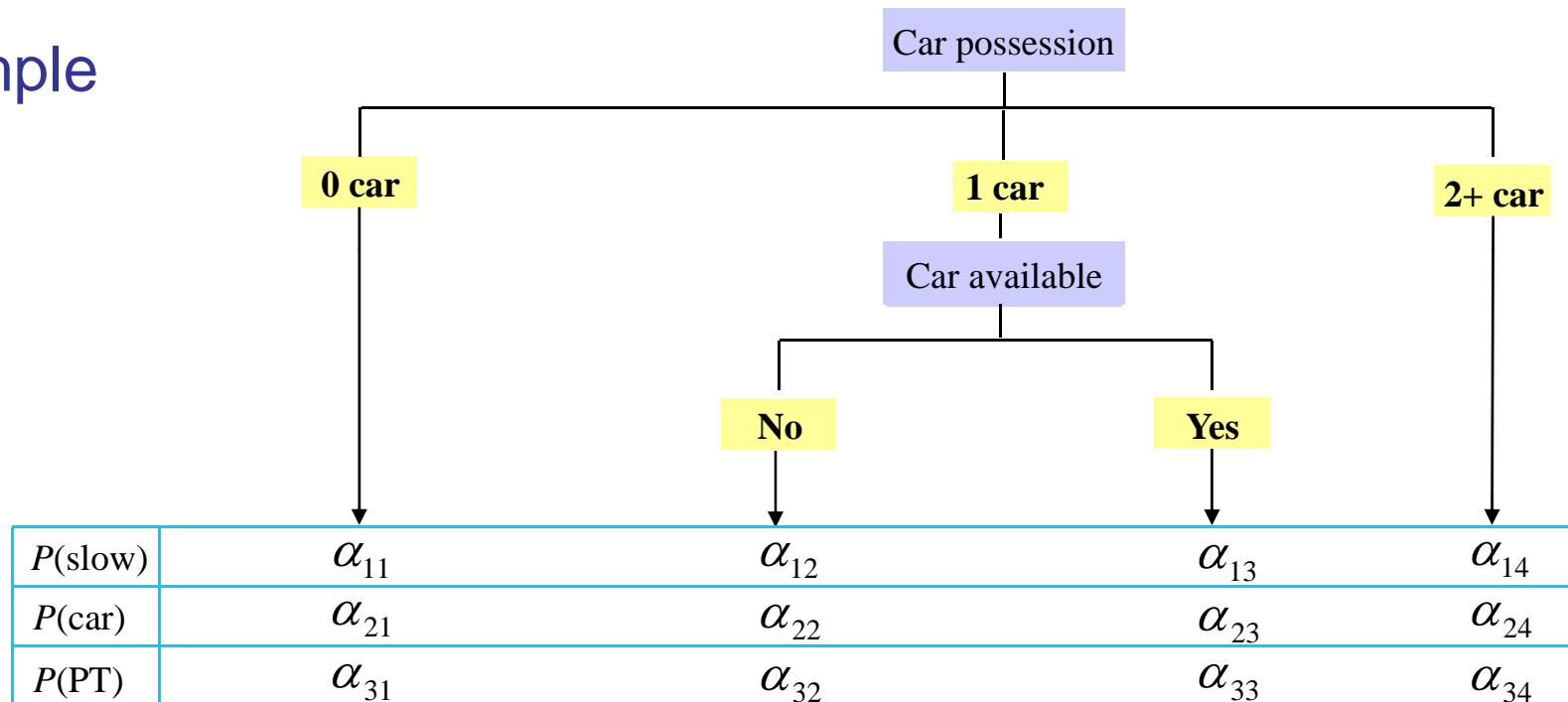
Extension of the technique: Continuous Action Decision Trees

Example



Extension of the technique: Parametric Action Decision Trees (PADT)

Example



$$P_{ijk} = \frac{\exp(\alpha_{jk} + \beta T_{ij} + \delta C_{ij})}{\sum_{j'} \exp(\alpha_{j'k} + \beta T_{ij'} + \delta C_{ij'})}$$

Implementation of PADTs in Albatross

- The model is sensitive for travel times and travel costs
 - Activity generation
 - Trip chaining
 - Location choice
 - Transport mode choice
- Decision tree induction
 - Induce a decision tree using a conventional method (N cases)
 - Estimate a logit model for each leaf node (N_k cases)
- The model reproduces known price elasticities and cross-elasticities

Generating agents

- Socio-demographics
 - Household type (marital and work status, 5 levels)
 - Income class (4 levels)
 - Age youngest child (4 levels)
 - Age oldest member (4 levels)
 - # of cars
 - Person gender
 - Person work status (3 levels)
 - Person car driver (2 levels)

Generating agents (cont'd)

- Data sources
 - Demographic data per zone (1308 zones)
 - Household sample data
- Iterative Proportional Fitting of a multiway attribute table (552,960 cells)
- Households are generated simultaneously using a newly developed technique of relation matrices
- Population characteristics may differ according to region and urban-density

Conclusions and future work

Some conclusions

- Albatross is one of the first operational activity scheduling models and one of the most comprehensive of its kind
- The PADT technique to model decision behavior combines the strengths of rule-based and parametric choice models
 - Segmentation on socio-economic variables and discrete attributes of choice alternatives and context
 - Sensitivity to travel time and travel cost consequences of scheduling options
- The model is applicable on a national scale
- First serious applications are being carried out

Ongoing work – developments of the model

- Refining the process model and decision trees to better account for interactions between persons within households
- Incorporating the activity schedules of children
- Linking with emission model
- Transfer to other countries

A research agenda

- Activity generation is a weak point of existing AB models
 - Dynamic activity generation – longitudinal activity patterns
- Social activity generation and social influence
 - Explicit modeling of social networks and social interactions
- Dynamic micro-simulation
 - Within-day replanning
 - Experience based learning