ANTONIN : updating and comparing a transport model for the Paris region

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Structure of the presentation

- Introduction
- Main characteristics of ANTONIN (transport model in Ile de France)
- Why an update?
- Reestimation of the models
ANTONIN : main characteristics

- ANTONIN = ANalyse des Transports et de l’Organisation des Nouvelles Infrastructures
- ANTONIN is a multimodal modelling framework to predict trips in the Ile de France region
- It is built under a disaggregate modelling framework using multinomial logit models to predict the various choices made by travellers.
- Models were estimated on the results of a household transport survey conducted in 1991 (the Enquête Globale de Transport).
EGT are a household transport surveys

The 2001 survey:
  - sample of 10,500 households
  - 25,000 persons (above 6 years old)
Structure of Antonin

Scenario

Transport networks

Levels of service
Transport networks

The road network

- around 30,000 links
Transport networks

The road network
- around 30,000 links

Public transport networks
- peak and off peak morning periods
- simplification of fare system (ticket and monthly passes only)
13 transport modes combinations

3 individual modes
- car driver
- car passenger
- slow modes

10 public transport combinations
- train with walk access
- train with drive access
- metro with walk access
- metro with drive access
- bus with walk access
- train/metro with walk access
- train/metro with drive access
- train/bus with walk or drive access
- métro/bus with walk or drive access
- train/métro/bus with walk or drive access
Zone data

Ile de France is split in 984 zones (300 for Paris)
EGT data  Zonal data  Scenario  Transport networks  Levels of service

Driver’s licence holding model  Car ownership model

STRUCTURE OF ANTONIN
STRUCTURE OF ANTONIN
Tour frequency model

Home based tours
- Home-work (high income/”cadre”)
- Home-work (low income/”non-cadre”)
- Home-business
- Home-school (children below 18 years)
- Home-education (students above 18 years)
- Home-regular shopping
- Home-other shopping
- Home-social activities

Non-home based tours
- Work-business
- Work/education-others

WorkHomeShoppingChildrenschool = one home to work tour + one v
STRUCTURE OF ANTONIN

_EXPANSION OF THE EGT SAMPLE

- DRIVING LICENCE HOLDING MODEL
- CAR OWNERSHIP MODEL
- TOUR FREQUENCY
- COMBINATION

_SCENARIO

_TRANSPORT NETWORKS

_LEVELS OF SERVICE
The prototypical sample and its expansion

Models are applied to a representative sample of the population of Ile de France, the EGT sample.
The expansion of the "prototypical sample" allows to obtain results at zone level.
Weights are calculated for 35 categories of households in order to:
- keep the structure of the sample
- reach target variables for each zone
STRUCTURE OF ANTONIN
EGT data  Zonal data

Expansion of the EGT sample

Driver’s licence holding model

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Tour generation

Levels of service

Mode and destination choice

Time of day process

Pivot point process

STRUCTURE OF ANTONIN
Principle of the pivot point process

- only changes in results of the model between the base scenario and a future scenario should be applied to an existing origin–destination trip matrix to ensure the best quality of forecast.

ANTONIN uses the EGT matrix

- at the level of “department”
- splits these matrices on the basis of the results of the mode and destination choice model.
- corrective factors are calculated by O-D, focused at the department level, for 3 modes and 3 purposes.

These corrective factors are kept in memory and applied again to results of future scenarios.
STRUCTURE OF ANTONIN

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Assignment

EGT data

Zonal data

Expansion of the EGT sample

Driver’s licence holding model

Car ownership model

Tour frequency

Combination
### Results for modal split (comparison with EGT 2001)

<table>
<thead>
<tr>
<th>Mode</th>
<th>EGT 01</th>
<th>CAR 15,761</th>
<th>710,3%</th>
<th>Car driver 24</th>
<th>12,203%</th>
<th>Car passenger 3,51</th>
<th>3,52%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trips per day in millions</td>
<td>34,50</td>
<td>34,49</td>
<td>0,0%</td>
<td>12,20</td>
<td>12,24</td>
<td>0,3%</td>
<td>0,3%</td>
</tr>
<tr>
<td>Trips using rail</td>
<td>6,45</td>
<td>6,52</td>
<td>1,1%</td>
<td>2,63</td>
<td>2,39</td>
<td>10,1%</td>
<td></td>
</tr>
<tr>
<td>Trips using metro but not rail</td>
<td>2,22</td>
<td>2,23</td>
<td>0,2%</td>
<td>1,84</td>
<td>1,67</td>
<td>-9,5%</td>
<td></td>
</tr>
<tr>
<td>Trips using bus only</td>
<td>3,51</td>
<td>3,52</td>
<td>0,2%</td>
<td>12,20</td>
<td>12,24</td>
<td>0,3%</td>
<td>0,3%</td>
</tr>
</tbody>
</table>
## Results for origin/destination daily matrices (comparison with EGT 2001)

<table>
<thead>
<tr>
<th></th>
<th>Paris</th>
<th>Inner suburbs</th>
<th>Outer suburbs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public transport trips</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car trips</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Three main objectives

- Make the use of the model easier
- Enhance the methodology
- Take advantage of the improvements of modelling softwares and computer environment
Methodological issues of the update

The general structure remain unchanged
- disaggregate modelling
- the tour generation for a whole day approach
- the mode and destination choice model
- the pivot point procedure

What will be changed or improved
- reestimation of the models based on EGT 2001 results
- new public transport passes ownership model
- introduction of a margin constraint in the core of the pivot point process for home to work tours
- improving the modelling of non home based trips
Data issues of the update

Increase of the number of zones

Work on data in order

☐ to delete variables that are not available easily for future years

☐ to automatize the creation of public transport network data
Computer environment issues of the update

The current version of ANTONIN works within DOS using programs written in 16-bit Borland Pascal as well as TP+ / VIPER batch scripts.

- DOS programs are being converted to Windows programs.
- Modules using TP+ / Viper scripts are being transferred to CUBE Voyager.
Antonin model re-estimation

Update of choice models using updated data for 2001/02:

- EGT survey
- PT networks (rail and bus modes)
- Car network
- Zonal data (population, employment, etc)

Models to be updated =>
STRUCTURE OF ANTONIN

EGT data ➔ Zonal data ➔ Scenario ➔ Transport networks

Expansion of the EGT sample ➔ Driver’s licence holding model ➔ Car ownership model ➔ Tour frequency model ➔ Combination ➔ Mode and destination choice ➔ Time of day process ➔ Pivot point process ➔ Assignment

Tour generation

Levels of service
Scenario

Transport networks

Tour generation

Levels of service

Mode and destination choice

Time of day process

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Expansion of the EGT sample

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Car ownership model

Pass ownership model

Tour frequency model

Combination

NEW STRUCTURE OF ANTONIN
Driver’s licence holding

% Licence holding 15+

Observations:

- Gender differences reduced
- Change in female licence holding dominates overall
Driver’s licence holding - Males

Observations:
- Saturation at 93%
- Stable 30-75 yr
- Comparing years:
  - Lower rates < 30 yr
  - Clear cohort effects for 65+
Driver’s licence holding - Females

Observations:
Saturation at 79%
‘Stable’ 30-60 yr
Comparing years:
Higher rates 50+
Clear cohort effects for 45+
Driver’s licence holding - Main effects

Gender:
- Saturation level female is much lower than male
- At saturation level (2001): Female 30-60 vs. male 30-75 years

Gender & Age:
- Steep decline (-50%) down from saturation level for older female groups vs. only –10% for male
- Female licence holding rates still catching up with those for male (trend continuation: next 15-20 years)

Cohort model useful, mainly for female licence holding
Driver’s licence holding - Estimation

Modelling licence holding in household:
- Head of household, partner or both
- Other adults in household

Estimation approach:
- Re-estimate existing (EGT91) model specification using EGT01
- Improve specification by adding/replacing EGT01 variables
Driver’s licence holding – Head/Partner

Re-estimation of existing specification:
- More sensitive to: Grande Couronne
- Equally sensitive to: High education, full time, gender, Paris
- Less sensitive to: age >65, working
- Confirms with more homogeneous distribution of licence holding over population

Improving specification, additional effects found:
- Household size
- Education (secondary: highschool)
- Female >60 year, replaces general >60 coefficient
- Age <20 years (both genders)
Driver’s licence holding – Other adults

Re-estimation of existing specification:
- Similar coefficients found
- More sensitive to: age<20, Grande Couronne
- Equally sensitive to: High education, working, head has licence, Paris, income
- Less sensitive to: Male, age > 65

Improving specification, additional effects found:
- Household size
- Partner of head of household has licence
- Age > 75 years
Car ownership

Characteristics:

- Stable in Paris, growth mainly in Grand Couronne
- Households without car mainly in Paris (>50%)

Depends on household licence holding:

- 1 licence (46%)
  - 31% 0 cars (15%)
  - 69% 1 car (55%)

- 2+ licences (54%)
  - 43% 1 car (55%)
  - 57% 2+ cars (30%)
Car ownership – 0/1 car with 1 licence

Re-estimation of existing specification:

- Similar coefficients found
- Equally sensitive to almost all variables: gender, education, age>65, #children, region, remaining disp. income, parking cost
- Less sensitive to: more workers in household

Improving specification by:

- Remaining disposable income: minimum fixed car costs
- More workers => student
- Age > 75 years
Re-estimation of existing specification:

- Similar coefficients found
- More sensitive to: Grand Couronne
- Equally sensitive to: age > 65, #workers, Paris, remaining disp. income, parking cost
- Less sensitive to: gender, #children, #adults

Improving specification by:

- Remaining disposable income: minimum fixed car costs
- Gender, #children, #adults erased
- Age 65+ => Age 40-59 and Age > 75 years
- #licences
Base fare system:

- Tickets: single or “Carnet” (10)
- Passes: free travel between rings (zones) around Paris: Carte Orange (subsidized 50% by employer)
Public Transport passes - 2

Other reductions possible:

- Children < 4 years: free
- Children 4 – 10 years: half price tickets
- Age 11 – 26 (scholar/student): Imagine’R pass (year), free travel (weekdays) between C.O. zones, lower price than C.O.
- Low income/65+ (various)

Pass / ticket use in PT:

- Carte Orange 55 %
- Carte Imagine’R 16 %
- Full price tickets 14 %
- Half price tickets 3 %
- Other 12 %

Personal Pass Ownership:

- No pass 70 %
- Carte Orange 20 %
- Carte Imagine’R 6 %
- Other 4 %
Public Transport Passes Model

PT pass ownership for 11-64 years, alternatives:
- No pass
- Carte Orange
- Carte Imagine’R (11-26 years only)

Variables included:
- Occupation (workerCO +, studentIR +)
- Licence holding (-)
- Car competition in household (cars/licences) (-)
- Age, gender (female +)
- Residence region, Paris (+)
NEW STRUCTURE OF ANTONIN
Tour frequency

Models for 10 purposes, split in:

- 0/1+: make any tour?
- Stop/Repeat: make another tour?
Tour frequency – 0/1+: make any tour?

Re-estimating existing specification:
- Generally similar coefficients
- Work related purposes: Grand Couronne = Petite Couronne
- Commute, lower effects: age >55 (cadre), gender (non-cadre)
- Shopping/other: definition changed, main effects unchanged

Improving specification:
- PT pass ownership: Significant improvement
- Education: no education (+), home/working (-)
- Shopping: non-working(+) ; regular: Paris(+), GC(-)
- Social/Other; #children (+), Paris(+)
Tour frequency – S/R: another tour?

Re-estimating existing specification:
- Generally similar coefficients
- Work related purposes: Grand Couronne = Petite Couronne
- Business, education: constant only
- Shopping/other: definition changed; shopping vars changed

Improving specification:
- PT pass ownership: Significant improvement
- Business: income (-), licence (+)
- Education: 2ry school education (+)
NEW STRUCTURE OF ANTONIN

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Zonal data

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Next steps

Main steps to be taken:

- Re-estimation mode x destination choice models
- Implementation
- Validation
- Transfer for use by STIF