Some validation tests of the OTM, ver. 5.0

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Presentation outline:

1. Introduction to the model
2. Base year 2004 validation
    - Travel distances and trip rates
    - Model elasticities
    - Assignment results
3. Back casting to the year 2000
4. Conclusions

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Introduction to the model

The OTM is a tactical traffic model for the Greater Copenhagen Area, where the model's first version was built in 1996 with the main objective to forecasts the future demand for metro's phases 1 and 2.

The model's fourth version was built in summer 2000. OTM 4 was broadly applied in a number of road and public transport infrastructure projects, one of them being the Metro City Ring project.

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Introduction to the model

Model criticism

Validation of the model structure and model forecasts (Vuk & Overgaard 2003, and Vuk & Overgaard 2006) was carried out due to the fact that the model over-predicted passenger volumes in the new metro line (phases 1 and 2).

The articles had pointed out certain areas of possible model improvements. Although we found many explanations for over-predictions, the quality of travel matrices was questioned.

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Introduction to the model

A group of clients headed by the Ministry of Transport decided to fund a project to improved the model and matrices.

General purposes:

- Reduce uncertainty of the OTM model
- Obtaining data to describe traffic patterns better
- Use data from the metro in the matrices
- Use of the matrices to obtain better knowledge on the transport system
- Re-estimate and recalibrate the traffic model

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Introduction to the model

The direct reason that initiated the start of the OTM 5.0 project was the wish to be able to reduce the uncertainty related to demand forecasts for the future use of the Metro City Ring.

Figur 1.
Det samlede banenet i den indre del af hovedstadsområdet med en Cityring over Frederiksberg.

Introduction to the model

Some definitions:

1. The OTM covers the Greater Copenhagen Area.

2. The OTM is a traffic model for both personal and goods transport.

3. The OTM is a workday model, i.e. weekends are omitted.

4a. The OTM is a tour/trip model, i.e. the activity chains are simplified into tours and trips.

4b. The OTM person travel model has six model segments (sub-models), defined by travel purposes. The model segments are executed independently of each other.

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Travel distances

Person trips, ´000

	HW	HE	HS	HO	nHO	BS	Total
Car driver	550	40	396	621	378	192	2.177
Car passenger	133	77	202	444	173	52	1.081
Public Transport	277	118	126	211	123	32	887
Bicycle	252	184	179	289	152	25	1.081
Walk	51	89	311	349	163	12	975
Total	1.263	508	1.214	1.914	989	313	6.201

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Travel distances

Trip length (zone-to-zone trips x zone-to-zone dist. / tot. trips), km

	HW	HE	HS	HO	nHO	BS	Total
Car driver	15.8	10.8	7.8	9.5	10.4	12.7	11.2
Car passenger	14.2	7.7	7.9	9.7	10.1	12.6	10.0
Public Transport	14.7	10.6	8.2	9.3	10.7	7.7	11.2
Bicycle	5.2	4.1	3.3	4.1	3.9	4.0	4.2
Walk	2.6	2.4	2.2	2.5	2.1	2.1	2.3
Total	12.7	6.4	5.8	7.4	8.0	11.1	8.4

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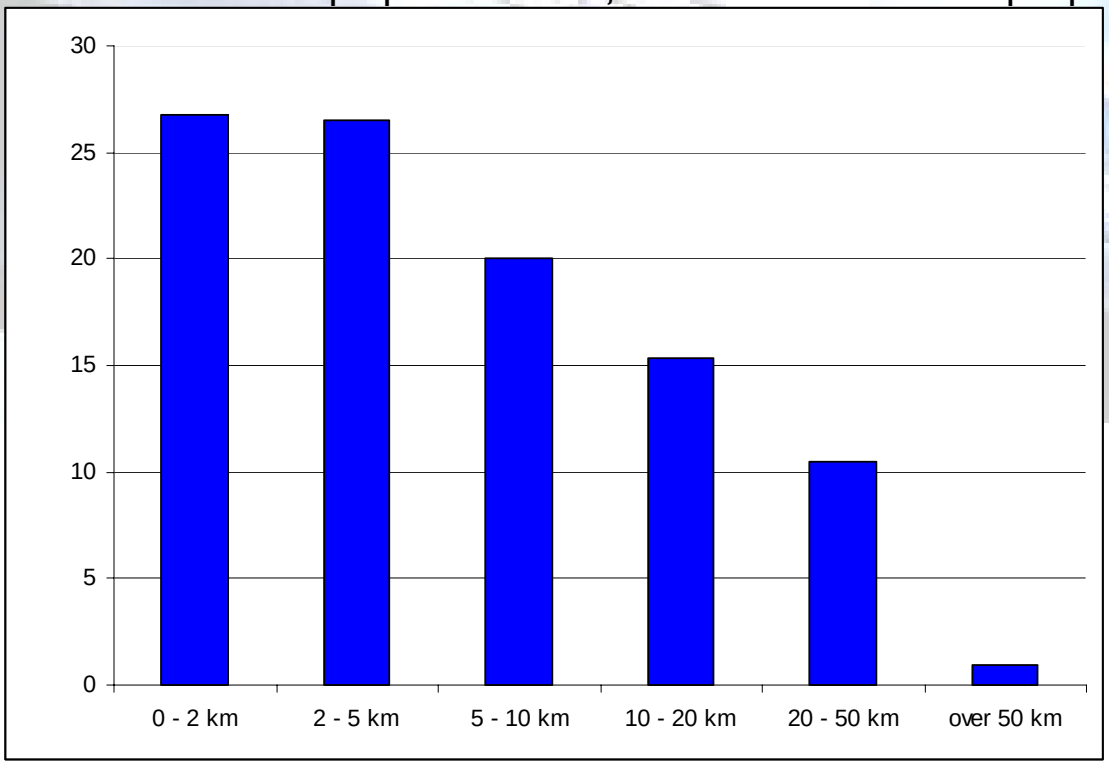
Travel distances

Distribution of trips per distance, all modes and travel purposes, %



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Travel distances

Day person-km (trips x length / population), km

	HW	HE	HS	HO	nHO	BS	Total
Car driver	4.8	0.2	1.7	3.2	2.2	1.3	13.4 (47%)
Car passenger	1.0	0.3	0.9	2.4	1.0	0.4	5.9 (21%)
Public Transport	2.2	0.7	0.6	1.1	0.7	0.1	5.4 (19%)
Bicycle	0.7	0.4	0.3	0.6	0.3	0.1	2.5 (9%)
Walk	0.1	0.1	0.4	0.5	0.2	0.0	1.2 (4%)
Total person-km per day	8.8 (31%)	1.8 (6%)	3.8 (13%)	7.8 (27%)	4.4 (16%)	1.9 (7%)	28.5 (100%)

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Trip rates

The observed trip rate in the TU 2000 GCA data was 3.1 trips/person/day

The observed trip rate in the TU 2005 GCA data was 3.2 trips/person/day

The OTM 5.0 calculated trip rate (matrix trip sum / population) is 3.3 trips/person/day

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Elasticities – all purposes

Cost elasticity, all travel purposes

	Car	PT	Bicycle	Walk
Car	-0.10	+0.09	+0.07	+0.06
Public Transport	+0.06	-0.42	+0.09	+0.07

Travel time elasticity, all purposes

	Car	PT	Bicycle	Walk
Car	-0.15	+0.18	+0.13	+0.08
Public Transport	+0.04	-0.26	+0.06	+0.03

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Elasticities - commuters

Cost elasticity, commuters

	Car	PT	Bicycle	Walk
Car	-0.13 *(-0.10)*	+0.11	+0.06	+0.02
Public Transport	+0.08	-0.33 *(-0.42)*	+0.11	+0.05

Travel time elasticity, commuters

	Car	PT	Bicycle	Walk
Car	-0.24 *(-0.15)*	+0.21	+0.14	+0.06
Public Transport	+0.06	-0.27 *(-0.26)*	+0.08	+0.03

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Elasticities – private trips

Cost elasticity, private trips

	Car	PT	Bicycle	Walk
Car	-0.10 *(-0.10)*	+0.08	+0.08	+0.06
Public Transport	+0.05	-0.52 *(-0.42)*	+0.08	+0.08

Travel time elasticity, private trips

	Car	PT	Bicycle	Walk
Car	-0.13 *(-0.15)*	+0.14	+0.11	+0.08
Public Transport	+0.03	-0.26 *(-0.26)*	+0.04	+0.03

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Elasticities – business trips

Cost elasticity, business trips

	Car	PT	Bicycle	Walk
Car	-0.03 *(-0.10)*	+0.06	+0.09	+0.12
Public Transport	+0.02	-0.10 *(-0.42)*	+0.13	+0.05

Travel time elasticity, business trips

	Car	PT	Bicycle	Walk
Car	-0.09 *(-0.15)*	+0.24	+0.30	+0.36
Public Transport	+0.03	-0.26 *(-0.26)*	+0.02	+0.02

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Assignment results

Number of boardings by public transport modes, observed vs. calculated, '000

PT modes	Observed 2004	Calculated 2004	% difference
Bus	629	671	7
Metro	125	130	4
S-tog	320	325	2
Regional train	144	153	6
Lokalbaner	18	18	0
Total	1.236	1.297	5

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Assignment results

Public transport trips across the Harbour corridor, observed vs. calculated, 2004

PT modes	Observed 2004	Calculated 2004	% difference
Knippelsbro	14.610	15.212	4
Metro	59.526	56.983	-4
Langebro	20.527	26.000	27
Sjællandsbroen	3.058	4.337	42
Kalvebodbanen	25.202	28.707	14
Kalvebod bro	654	523	-20
Total	123.577	131.762	7

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Assignment results

Car traffic across the Harbour corridor, observed vs. calculated, 2004

	Observed 2004	Calculated 2004	% difference
Knippelsbro	34.568	35.762	3
Langebro	67.971	72.193	6
Sjællandsbroen	57.158	51.211	-10
Kalvebod bro	90.158	91.681	2
I alt	249.855	250.847	0

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Assignment results, metro boardings, 2004

Metro Station	Observed 2004	Calculated 2004	Absolute difference	Relative difference
Vanløse	8.050	9.300	1.254	16%
Flintholm	4.080	4.560	479	12%
Lindevang	3.580	4.220	645	18%
Solbjerg	5.500	5.960	459	8%
Frederiksberg	10.410	11.270	859	8%
Forum	7.040	7.360	319	5%
Nørreport	30.840	31.790	949	3%
Kongens Nytorv	15.210	15.360	150	1%
Christianshavn	11.070	10.580	-493	-4%
Islands Brygge	5.610	5.970	357	6%
DR Byen	1.850	2.080	229	12%
Sundby	460	650	186	40%
Bella Center	1.640	1.890	252	15%
Ørestad	5.230	5.140	-90	-2%
Vestamager	390	410	20	5%
Amagerbro	7.110	6.850	-257	-4%
Lergravsparken	6.450	6.270	-180	-3%
Total	124.520	129.660	5.136	4%

Back casting to 2000 - Assignment results

Trips per average workday in 2000 and 2004, '000

	2000	2004	% difference
Car driver	2,007	2,179	8.6
Car passenger	1,050	1,084	3.2
Public transport	947	889	-6.1
Bicycle	1,073	1,081	0.7
Walk	967	975	0.8
Total	6,044	6,208	2.7

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Back casting to 2000 - Assignment results

Car traffic across the Harbour corridor, observed vs. calculated, 2000

	Counted 2000	Modelled 2000	Abs. difference	% difference
Knippelsbro	34,600	35,144	514	1
Langebro	68,500	65,643	-2,857	-4
Sjællandsbroen	51,100	42,686	-8,414	-16
Kalvebod bro	76,900	79,042	2,142	3
Total	231,100	222,485	-8,615	-4

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Conclusions (1)

- Car elasticities are in general lower than the PT elasticities.
- Car users are more sensitive to changes in travel time than to changes in driving costs.
- Public transport users are more sensitive to changes in fares then to changes in travel time.
- Elasticities differ with respect to travel purpose.

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Conclusions (2)

- 2004 model assignment results for public transport modes give on an overall level a difference of only up to 7% to the counted boardings.

- Similarly, the 2004 model assignment results for car traffic over the Harbour corridor differ from the counted traffic by only +/- 10%.

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Conclusions (3)

- Back casting to 2000 shows that the total traffic rose from 2000 to 2004, car traffic increased sharply, and accordingly the public transport decreased.

- The 2000 model assignment results for car traffic over the Harbour corridor differ from the counted traffic by only +/- 4%, with exception of Sjællandsbroen.

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