Forecasting Travel Time Reliability in Road Transport

a new model for The Netherlands

ITF/ OECD Roundtable on quantifying the socio-economic benefits of transport
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Significance

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Reliability incorporated in CBA

- In The Netherlands, transport projects and policies are ex-ante evaluated by CBA

- Since 2004, extra benefits are added to account for reliability
  - 25% of travel time benefits due to reduced congestion
  - Only for road projects

- However this does **not** evaluate consequences of policies that especially affect travel time **variability**

- From the start this method was meant to be replaced by a better method

Capturing travel time reliability in CBA

We need :

- Value of travel time reliability

  ➡ **Recent VTTS and VTTRS study for The Netherlands (2013)**

- Model to forecast travel time reliabilities
  - with & without an infrastructure project / policy

  ➡ **This study**

- Model to predict changes in user behaviour
  - Route choice / mode choice / departure time choice

  ➡ **Future challenge**

Towards a new model for The Netherlands

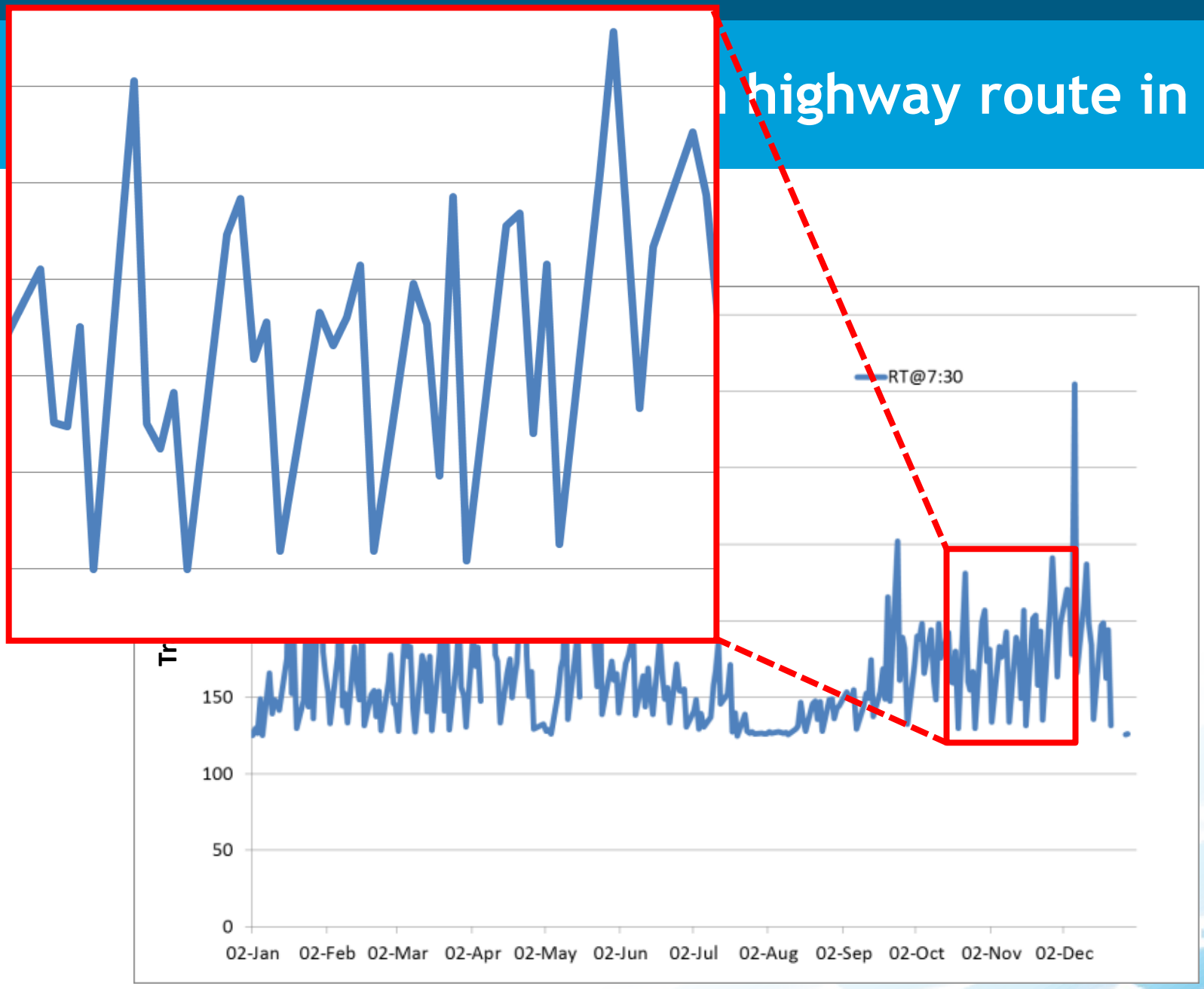
- A project was started in 2013 to adapt the Dutch national and regional transport models to capture reliability
- Objective was to find a (new) empirical relation between reliability of car travel times and other variables available in the transport model
- The improved modelling to forecast travel time variability will be implemented in Dutch policy making
- Incorporating consequences of policies affecting travel time reliability into CBA encourages proper consideration of options

Deriving an empirical relation for travel time reliability

Methodology (1)

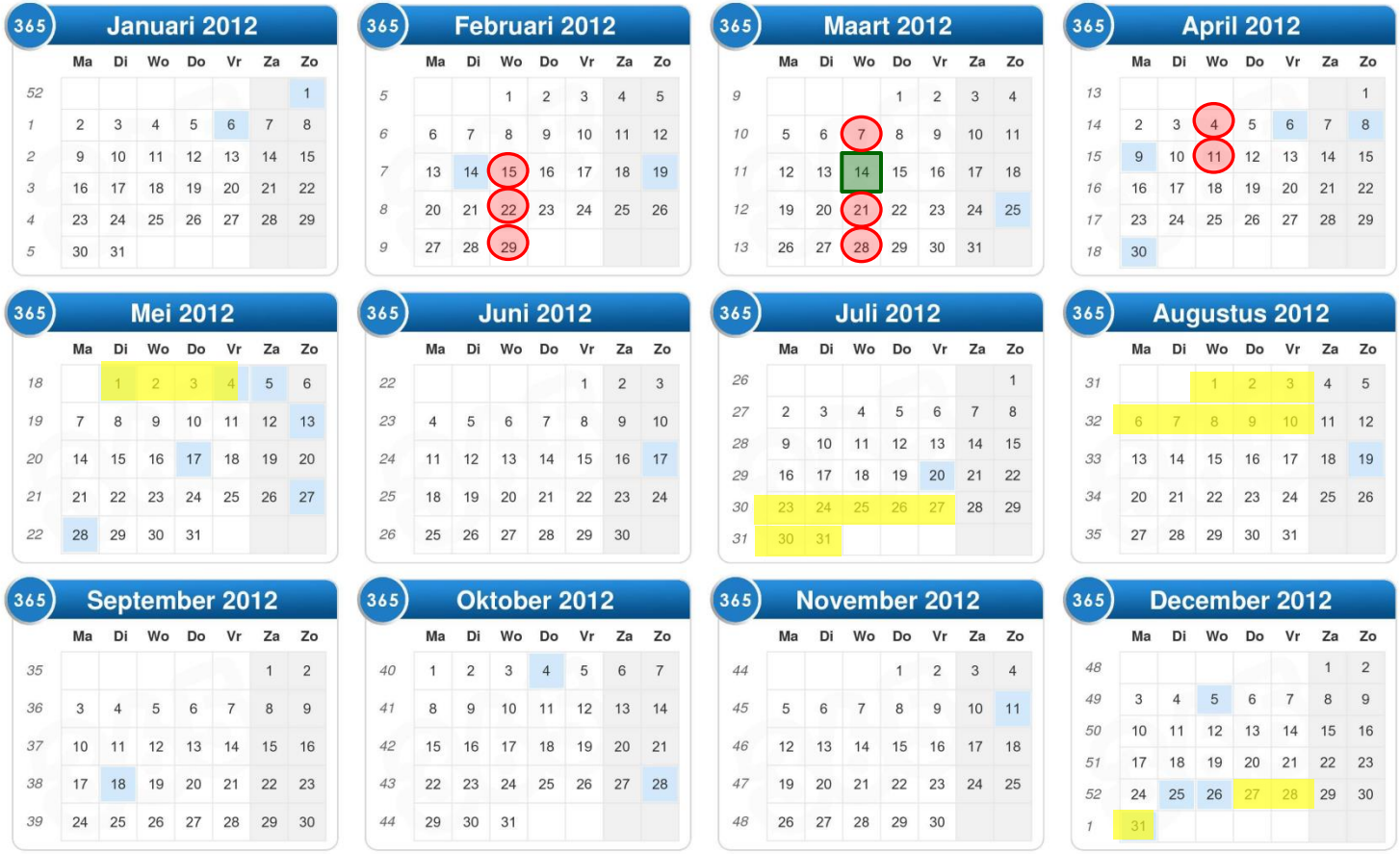
- In the Netherlands, travel time reliability is defined as the standard deviation of the distribution of all possible deviations from the expected travel time
  - Practical considerations
  - Consistent with VTTRS study
  - Viewpoint of the traveller
- This is approached by compiling the travel-time distribution of all mean travel times on a number of days when departing at the same time
  - Door-to-door
  - Including a correction for the expected travel time
  - Excluding outliers

highway route in 2012



Travel time expectation

- We assume that the expected travel time is equal to the average travel time of the same day in the four weeks before and after



Januari 2012

	Ma	Di	Wo	Do	Vr	Za	Zo
52							1
1	2	3	4	5	6	7	8
2	9	10	11	12	13	14	15
3	16	17	18	19	20	21	22
4	23	24	25	26	27	28	29
5	30	31					

Februari 2012

	Ma	Di	Wo	Do	Vr	Za	Zo
5			1	2	3	4	5
6	6	7	8	9	10	11	12
7	13	14	15	16	17	18	19
8	20	21	22	23	24	25	26
9	27	28	29				

Maart 2012

	Ma	Di	Wo	Do	Vr	Za	Zo
9				1	2	3	4
10	5	6	7	8	9	10	11
11	12	13	14	15	16	17	18
12	19	20	21	22	23	24	25
13	26	27	28	29	30	31	

April 2012

	Ma	Di	Wo	Do	Vr	Za	Zo
13							1
14	2	3	4	5	6	7	8
15	9	10	11	12	13	14	15
16	16	17	18	19	20	21	22
17	23	24	25	26	27	28	29
18	30						

Mei 2012

	Ma	Di	Wo	Do	Vr	Za	Zo
18		1	2	3	4	5	6
19	7	8	9	10	11	12	13
20	14	15	16	17	18	19	20
21	21	22	23	24	25	26	27
22	28	29	30	31			

Juni 2012

	Ma	Di	Wo	Do	Vr	Za	Zo
22					1	2	3
23	4	5	6	7	8	9	10
24	11	12	13	14	15	16	17
25	18	19	20	21	22	23	24
26	25	26	27	28	29	30	

Juli 2012

	Ma	Di	Wo	Do	Vr	Za	Zo
26							1
27	2	3	4	5	6	7	8
28	9	10	11	12	13	14	15
29	16	17	18	19	20	21	22
30	23	24	25	26	27	28	29
31	30	31					

Augustus 2012

	Ma	Di	Wo	Do	Vr	Za	Zo
31			1	2	3	4	5
32	6	7	8	9	10	11	12
33	13	14	15	16	17	18	19
34	20	21	22	23	24	25	26
35	27	28	29	30	31		

September 2012

	Ma	Di	Wo	Do	Vr	Za	Zo
35						1	2
36	3	4	5	6	7	8	9
37	10	11	12	13	14	15	16
38	17	18	19	20	21	22	23
39	24	25	26	27	28	29	30

Oktober 2012

	Ma	Di	Wo	Do	Vr	Za	Zo
40	1	2	3	4	5	6	7
41	8	9	10	11	12	13	14
42	15	16	17	18	19	20	21
43	22	23	24	25	26	27	28
44	29	30	31				

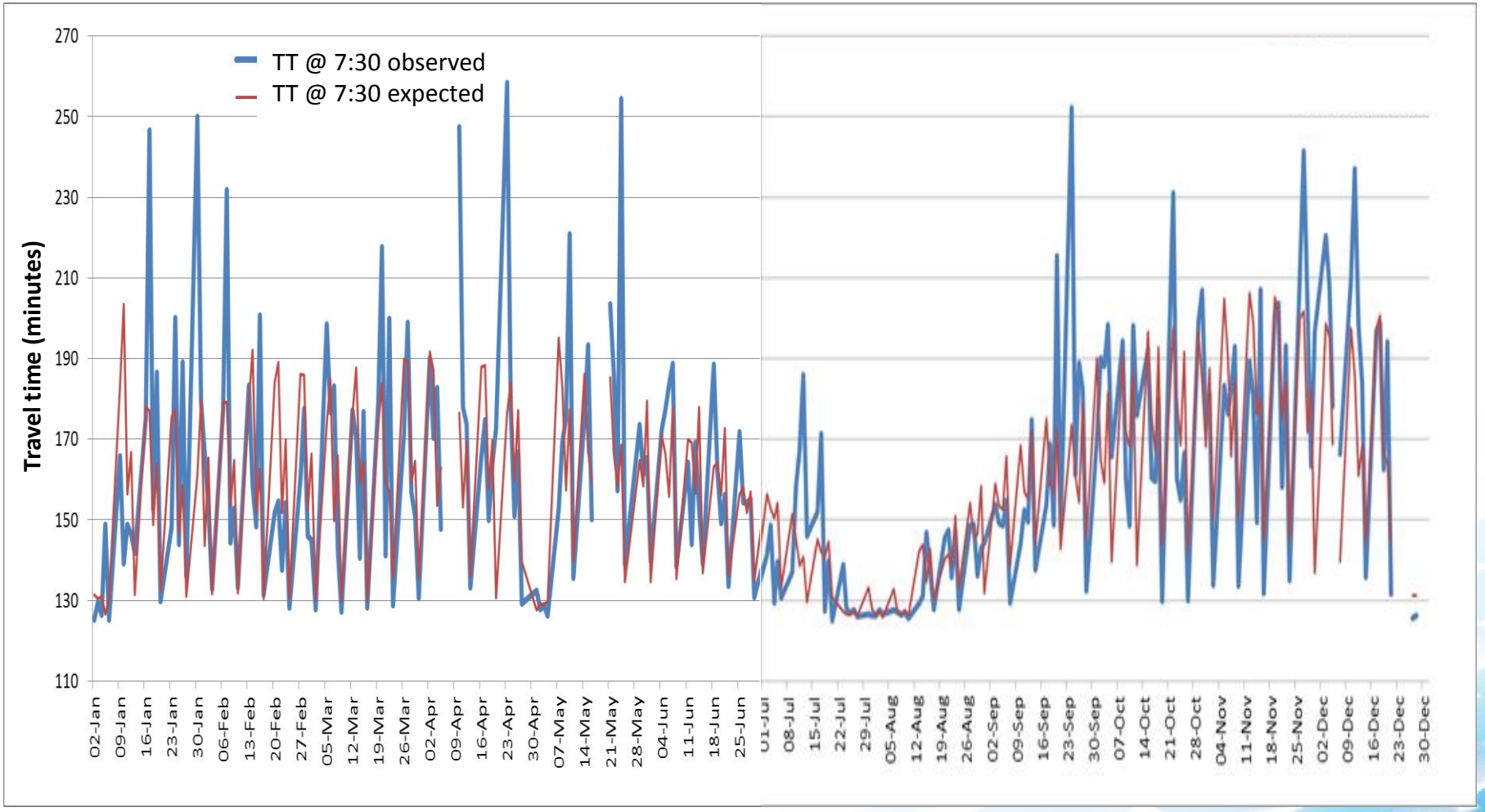
November 2012

	Ma	Di	Wo	Do	Vr	Za	Zo
44				1	2	3	4
45	5	6	7	8	9	10	11
46	12	13	14	15	16	17	18
47	19	20	21	22	23	24	25
48	26	27	28	29	30		

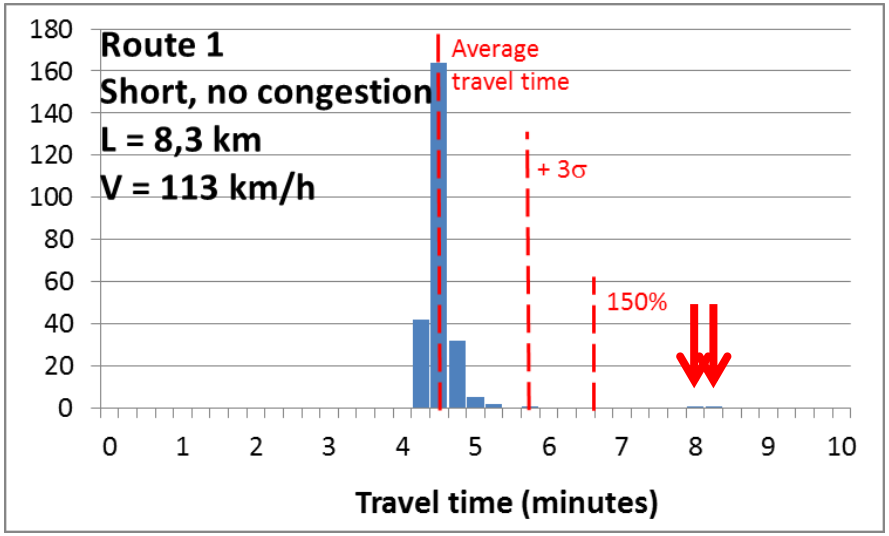
December 2012

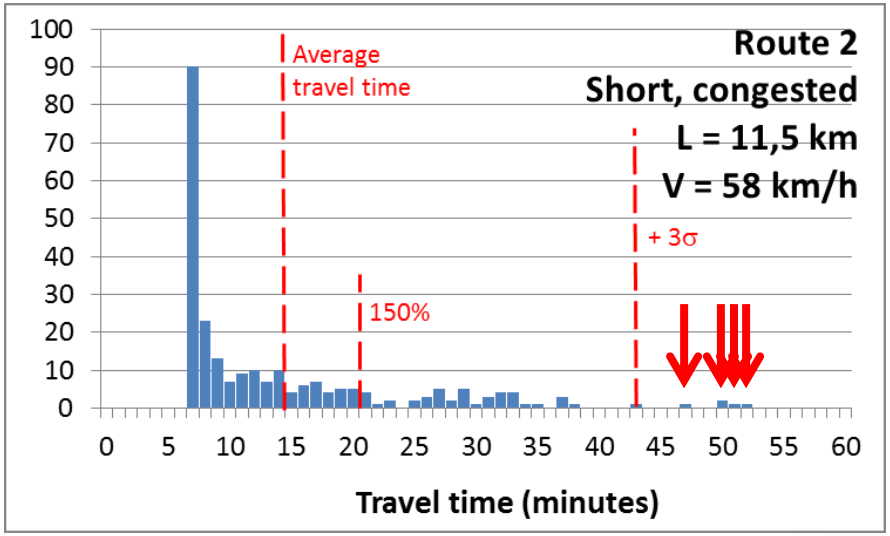
	Ma	Di	Wo	Do	Vr	Za	Zo
48						1	2
49	3	4	5	6	7	8	9
50	10	11	12	13	14	15	16
51	17	18	19	20	21	22	23
52	24	25	26	27	28	29	30
1	31						

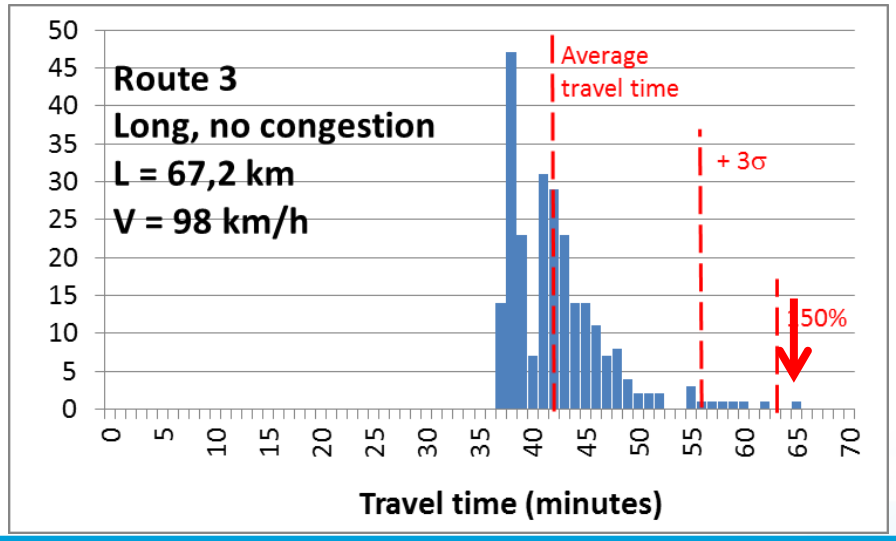
Travel time expectation vs. observed

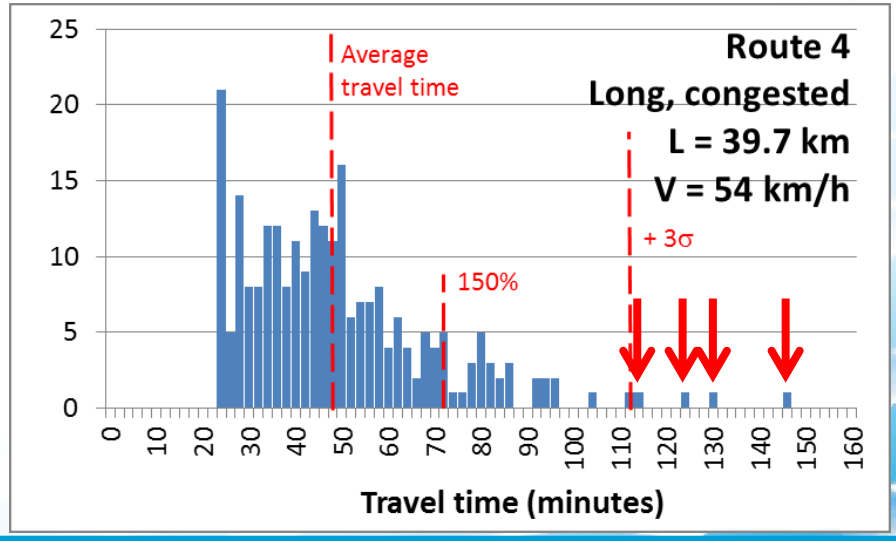


Exclusion of outliers





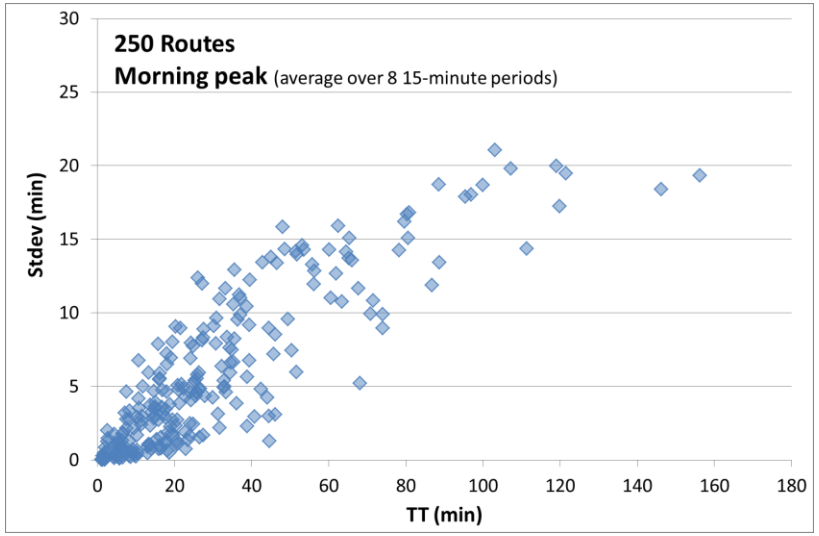


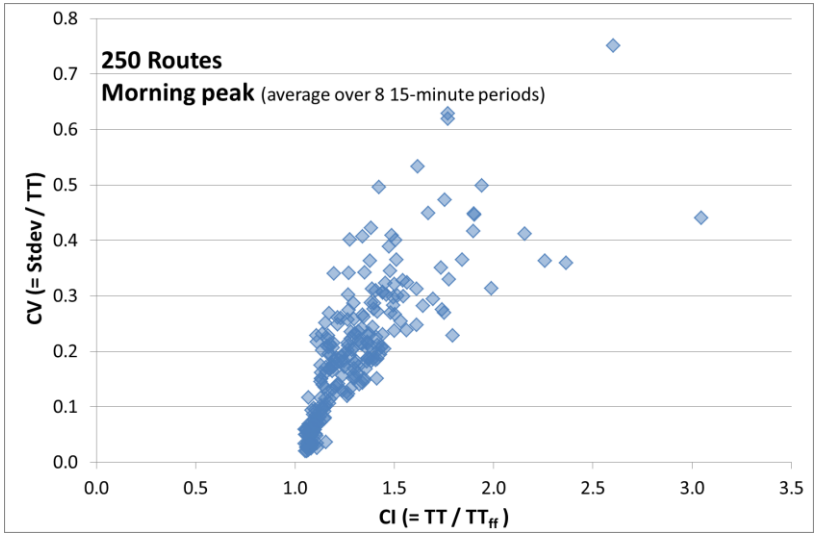


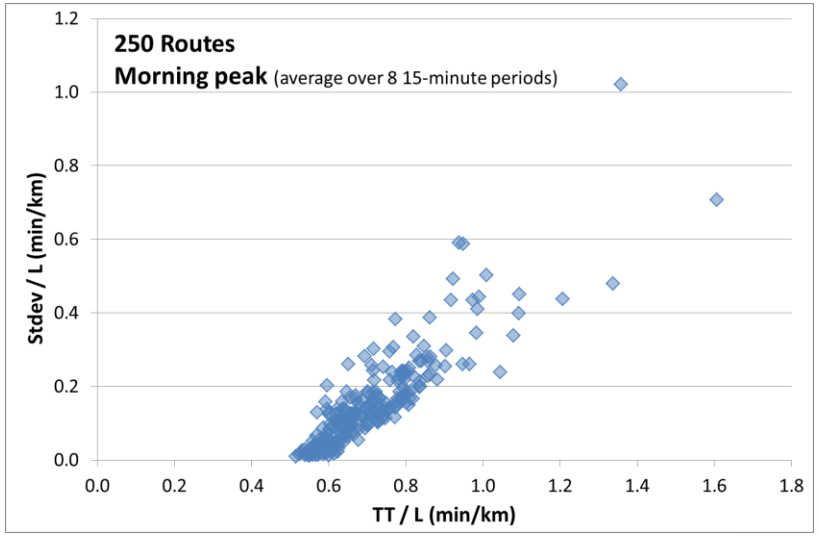
Methodology (2)

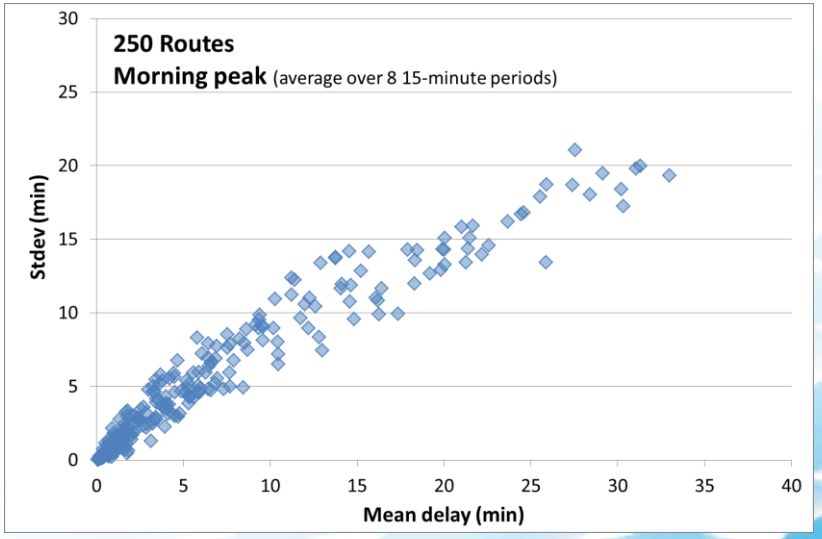
- Use an empirical relation between standard deviation and other parameters available in the transport models to forecast reliability
  - Relation with travel time, mean delay, intensity, etc.
  - Post-processing

Reliability data for highways

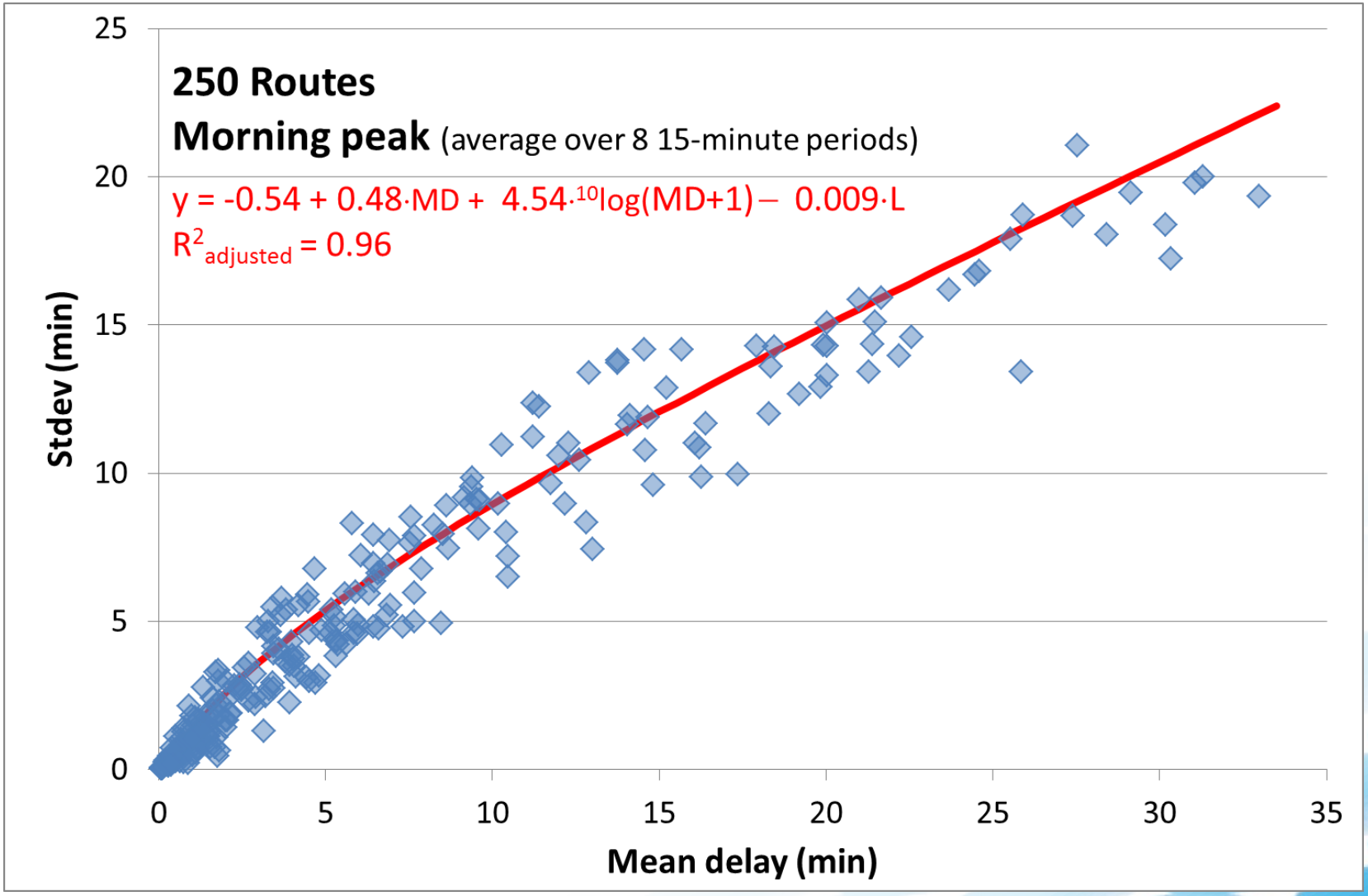




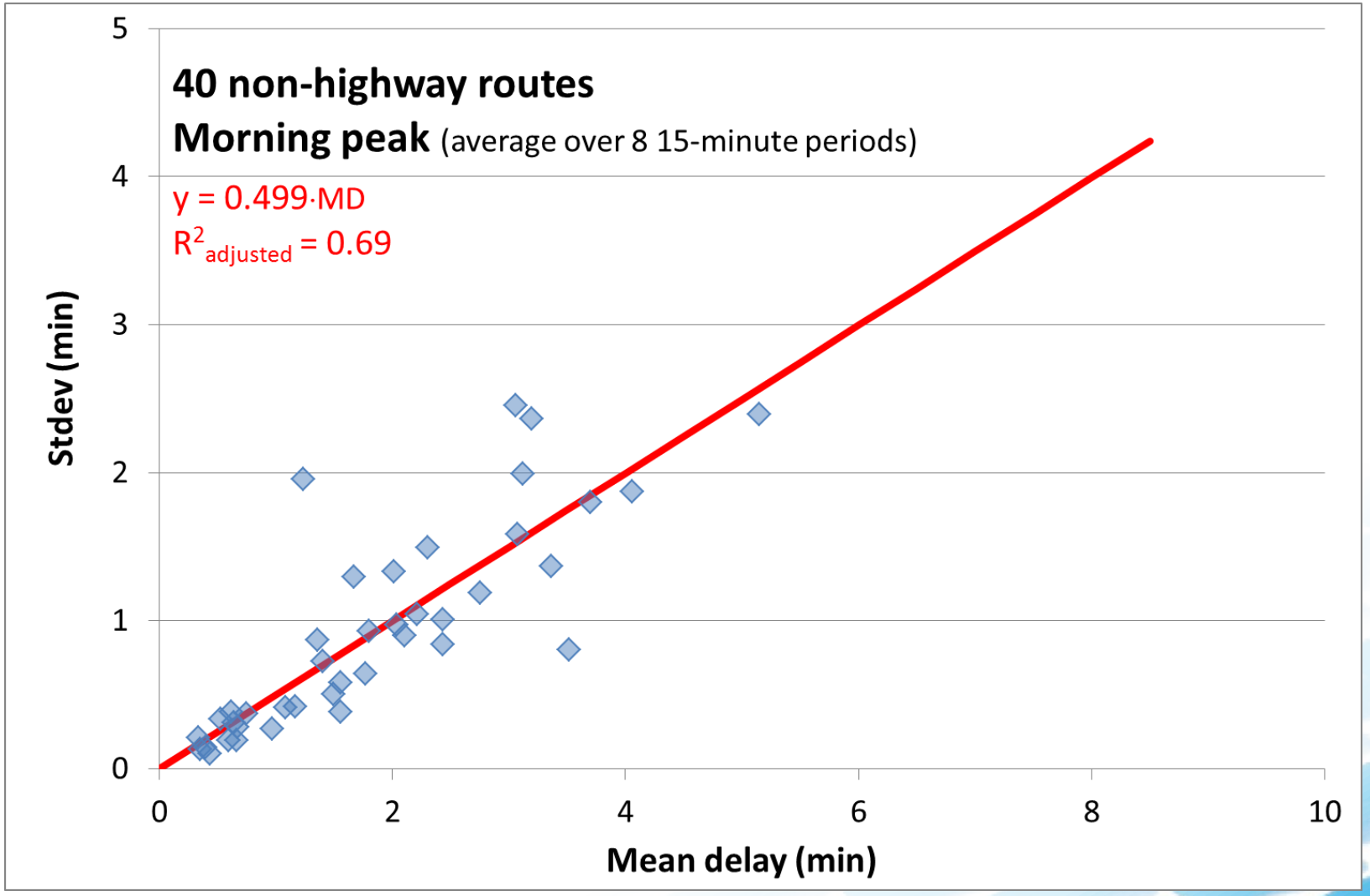




Best empirical relation for highways



Best empirical relation for other roads

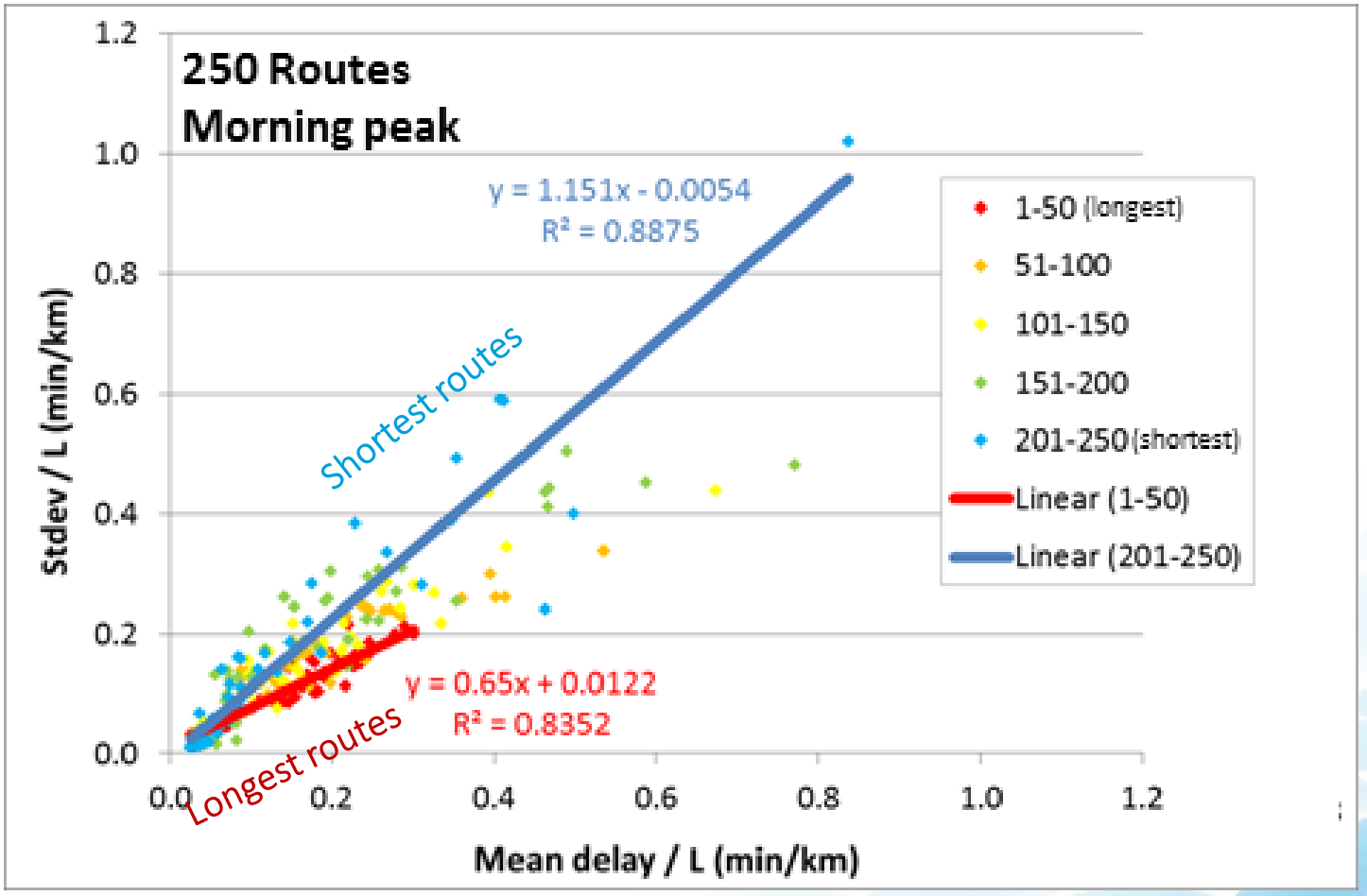


What to remember (1)

- Use consistent definitions
  - Valuation of reliability
  - Empirical relation for reliability
  - Transport model application
- Functional form of the empirical relation depends on type of road
- For Dutch highways, a combination of a linear and a logarithmic function works well
- Coefficients are significantly different between time-of-day periods
- No distinction made (yet) for freight traffic

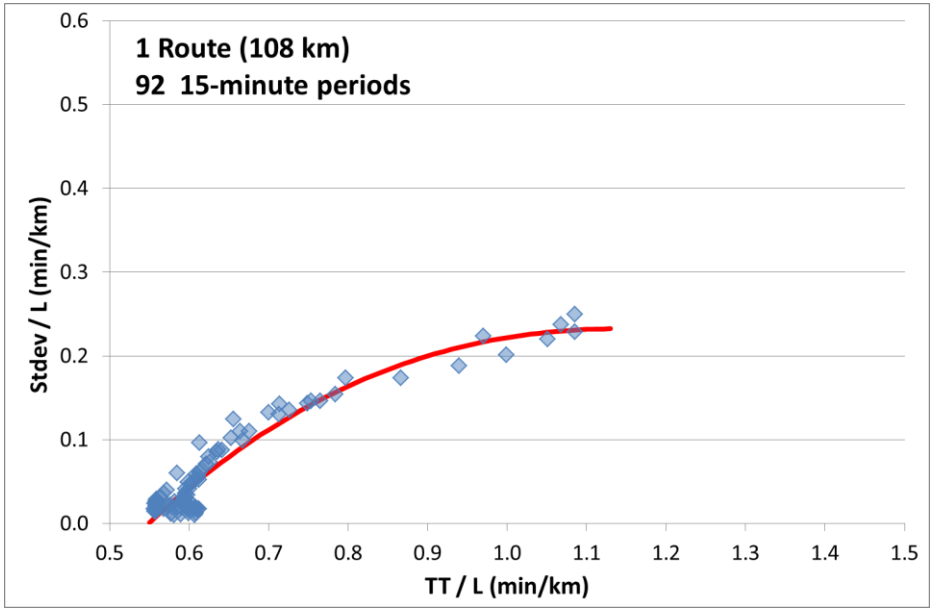
What to remember (2)

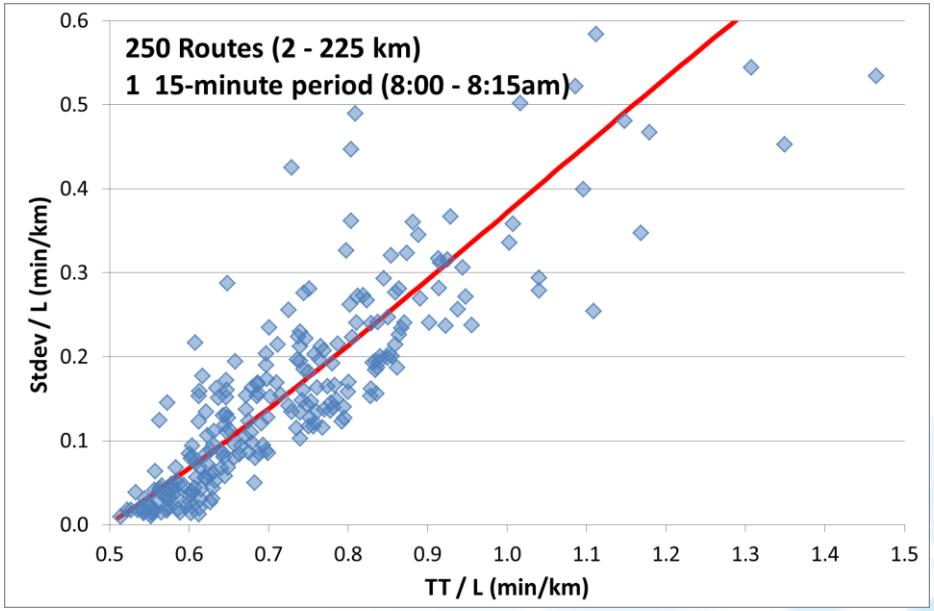
- The marginal rate of reliability depends on length of the route



What to remember (3)

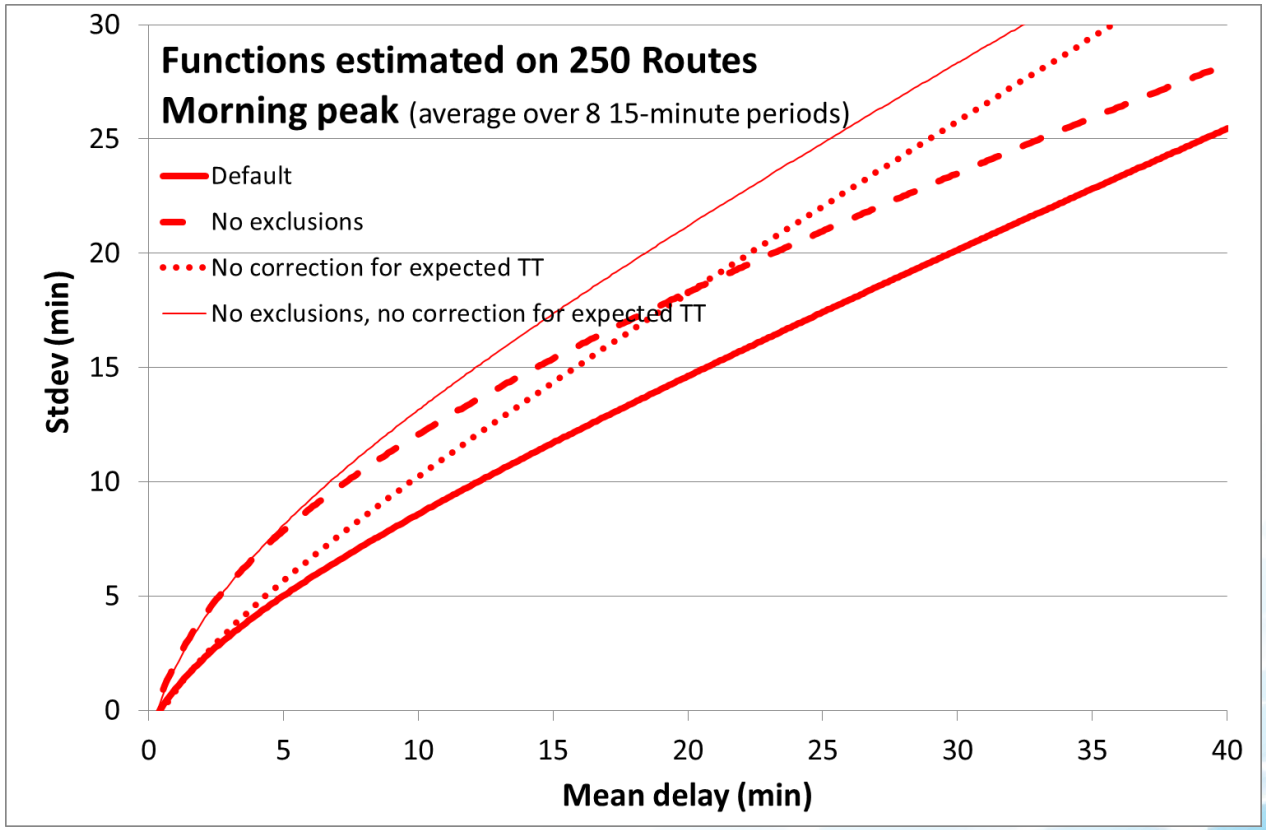
- The variation of standard deviation **by routes** may follow a different relation than the variation **by 15-minute periods**





What to remember (4)

- Outlier-exclusion and expected-travel-time-correction have a major impact on the coefficients, not on the functional form
  - Be careful when comparing coefficients from different studies

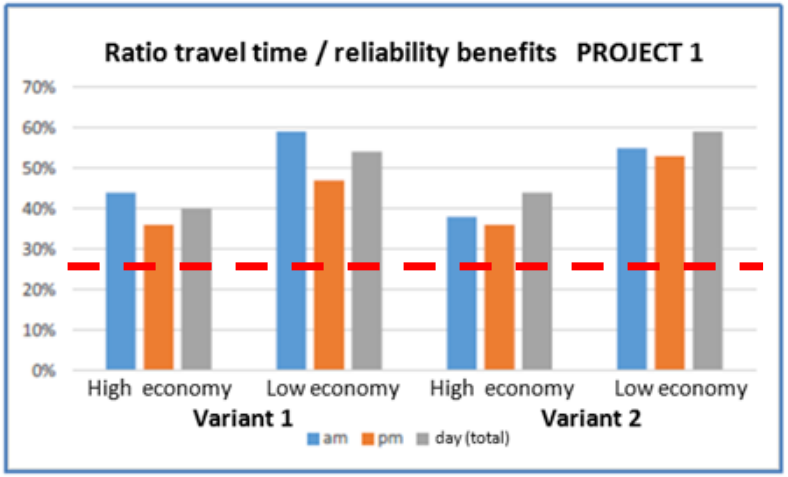


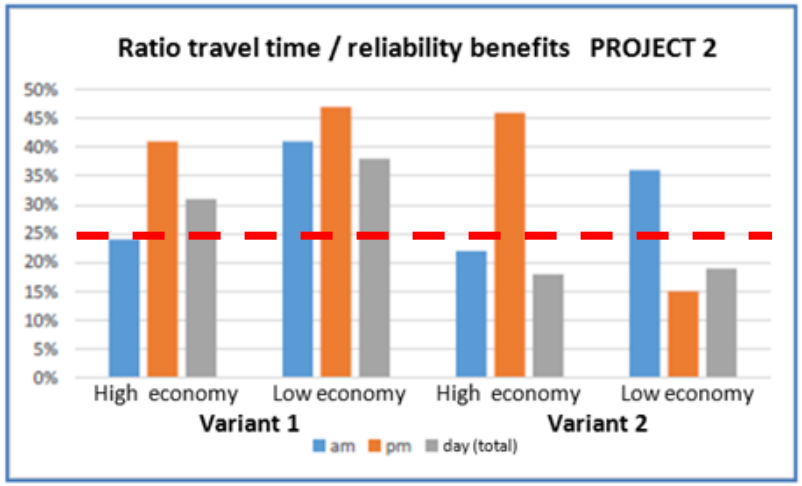
Implications for CBA

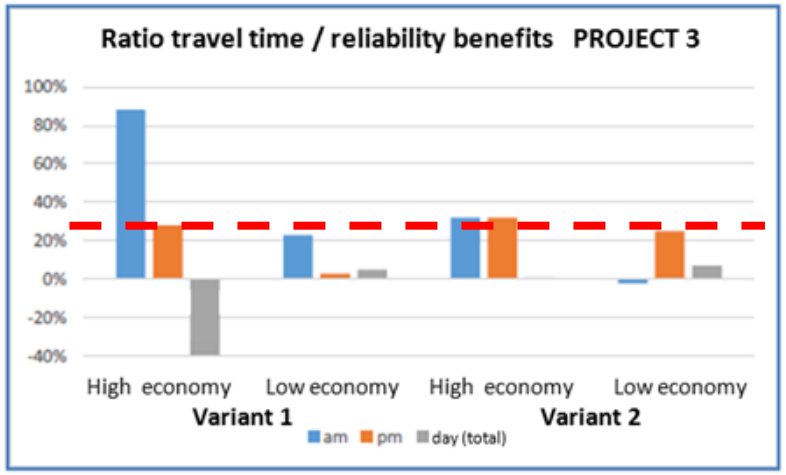
Implications for CBA

- Current practice: 25% of travel time benefits due to reduced congestion
- New instrument: benefits depends on
  - Type of travel time gain
    - shorter route versus reduction of congestion
  - Type of road
    - Highways versus other roads
  - Length of the route
  - Local maximum speed
    - Mean delay is defined with respect to maximum speed
- Test: reliability benefits are (roughly) between 15% and 60% of travel time gains

Test results







Future steps

Short term:

- Develop a similar methodology for public transport
- Expansion for non-highway routes

Long term:

- Study of specific policies that affect unreliability
  - changing the maximum speed or ramp metering
- Feed-back loop in the transport model
  - Changes in reliability should lead to changes in choice behaviour
- Study of robustness / extreme events