Young Researchers Seminar 2013

Lyon, France, June 5-7, 2013

Laboratoire d'Economie des Transports
Unité Mixte de Recherche du CNRS n° 5593
Université Lumière Lyon 2 - ENTPE

TRANSPORT RESEARCH CENTRE

Difference between the expected numbers of accidents for various types of intersection arrangements in Prague

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ECTRI
European Conference of Transport Research Institutes

FERSI
Road Safety Research

Introduction

On Czech roads in 2012 almost 700 people died. Among all accidents:

- 34 % were fatal
- 54 % ended with severe injuries
- 59 % ended with slight injuries
- 71 % happened in urban areas

Where should be countermeasures used?

Which road parameters have the biggest influence on the road safety?

Rank	The most tragic causes of traffic accidents	
1	failure to adjust speed transport technical condition of the road (arrangement)	110
2	opposite driving	92
3	distracted driver	82
4	failure to adjust speed to road conditions (wet, ice,...)	55
5	failure to adjust speed to vehicle and load properties	35
6	**not giving priority modified by traffic sign**	**24**
7	not giving priority to pedestrian on crossing	23
8	mismanagement driving	22
9	other kind of speeding	22
10	collision with opposite driving vehicle during overtaking	22

Difference between the expected numbers of accidents for various types of intersection arrangements in Prague

Method

- Statictical road safety modelling
  - the use of different time periods
  - two types of intersections
- Similar study: Bauer and Harwood (2000)
  - differences in significant variables for 3-leg and 4-leg intersections
- State of the art: Reurings et al., 2005
  - disaggregated models better than agregated

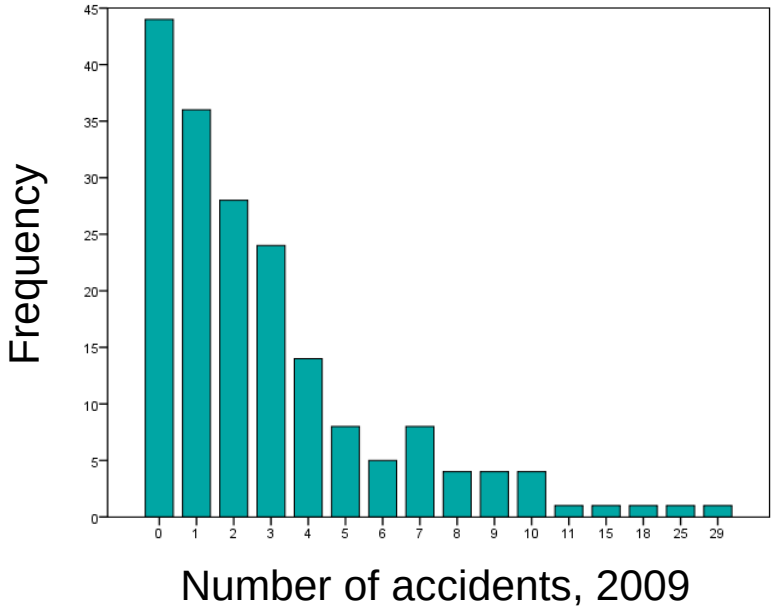
Main objectives

- Which intersection parameters have the biggest influence on the road safety?
- Is there significant difference in the results depending on the length of period?
- Is it good to combine different intersection type or not?

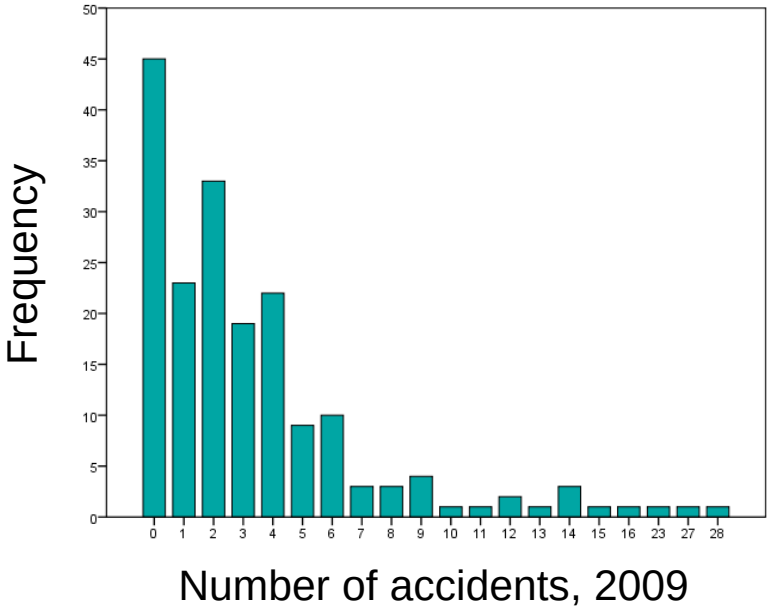
Variables

194 intersections in Prague were used for this study.

- Dependent variable
  - Accident data – years 2009, 2010, regardless on their consequences



Number of accidents, 2009

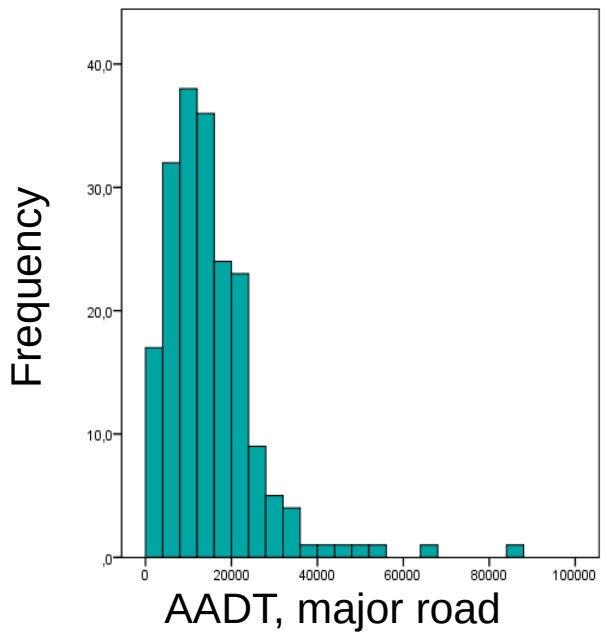


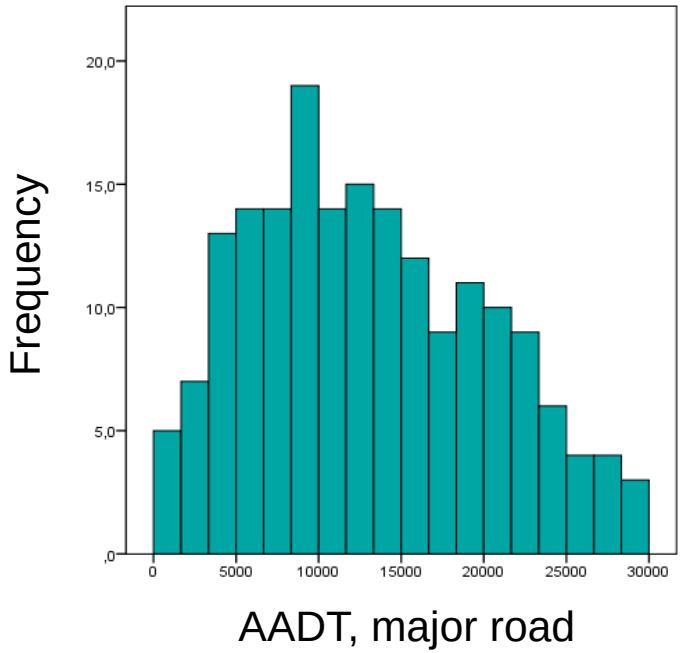
Number of accidents, 2009

Variables

- Exposure data
  - AADT on major and minor road
  - Percentage of heavy goods vehicles

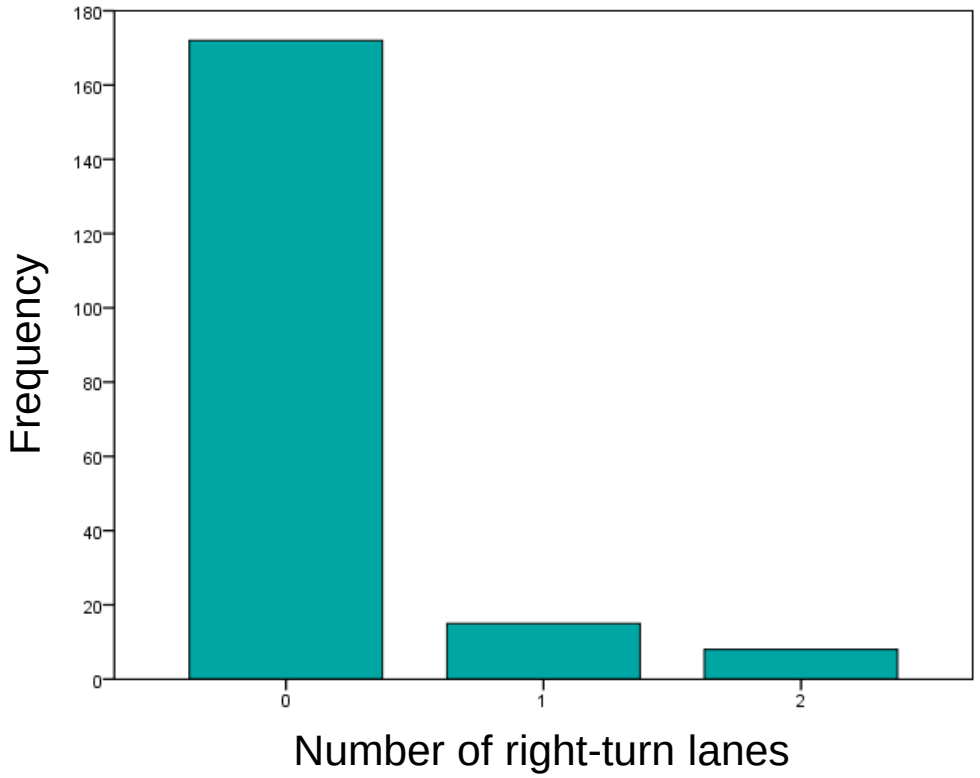
(data collected for both years)





Variables

- Road characteristics
  - Number of legs
  - Left turn restriction
  - Legs with trams, percentage of tram traffic
  - Traffic islands
  - Priority
  - Pedestrian crossings
  - ~~Number of rigth-turn lanes~~



Model form

Fairly common form *)

- Generalised linear model
- Negative binomial distribution
- General model form

$$ACC = \beta_0 \cdot AADT_mj^{\beta_1} \cdot AADT_mi^{\beta_2} \cdot e^{\sum \beta_i \cdot x_i}$$

Where

- ACC
- $AADT_mj$
- $AADT_mi$

– traffic volumes on majorand minor road

- β_i – estimated parameters
- x_i – other explanatory variables

*) Brüde & Larsson,1993; Miau & Lord, 2003; Persaud et al., 2003

Final versions of model – 3 leg intersections

Variable		2009			2010			2009-2010		
Abbreviation		Estim. Value	95 % Confid. Interval	Sig.	Estim. Value	95 % Confid. Interval	Sig.	Estim. Value	95 % Confid. Interval	Sig.
Intercept		-7.974	[-10.90;-5.05]	0.000	-8.067	[-10.60;-5.53]	0.000	-7.074	[-9.53;-4.62]	0.000
ln(AADT_mj)		0.670	[0.36;0.98]	0.000	0.480	[0.24;0.72]	0.000	0.594	[0.33;0.86]	0.000
ln(AADT_mi)		0.303	[0.12;0.48]	0.001	0.469	[0.30;0.64]	0.000	0.327	[0.17;0.49]	0.000
P_HGV		-	-	-	0.560	[0.02;0.10]	0.004	4.350	[-0.20;8.89]	0.061
TRAM	Y	0.568	[0.16;0.97]	0.006	0.489	[0.09;0.89]	0.016	0.798	[0.41;1.18]	0.000
	N	0.000			0.000	-	-	0.000	-	-
CROSS	Y	-	-	-	0.392	[0.01;0.78]	0.047	-	-	-
	N	-	-	-	0.000	-	-	-	-	-
		ODP		0.514	ODP		0.431	ODP		0.552

Higher number of accidents with pedestrians in 2010?
Not possible to confirm from the available accident data.

Difference between the expected numbers of accidents for various types of intersection arrangements in Prague

Final versions of model – 4 leg intersections

Variable		2009			2010			2009-2010		
Shortcut		Estim. Value	95 % Confid. Interval	Sig.	Estim. Value	95 % Confid. Interval	Sig.	Estim. Value	95 % Confid. Interval	Sig.
Intercept		-3.626	[-6.71;-0.55]	0.021	-2.530	[-5.12;0.06]	0.056	-3.887	[-7.13;-0.65]	0.019
ln(AADT_mj)		0.321	[-0.01;0.63]	0.044	0.209	[-0.07;0.49]	0.147	0.410	[0.09;0.73]	0.013
ln(AADT_mi)		0.274	[0.12;0.43]	0.000	0.222	[0.08;0.37]	0.003	0.276	[0.14;0.41]	0.000
P_HGV		-0.078	[-0.14;-0.02]	0.007	-0.061	[-0.12;0.00]	0.059	-7.930	[-13.50;-2.36]	0.005
P_TRAM		-	-	-	-	-	-	0.044	[0.01;0.08]	0.019
TRAM	Y	0.497	[0.08;0.91]	0.019	0.576	[0.14;1.01]	0.009	-	-	-
	N	0.000			0.000	-		-	-	-
LEFT	Y	-	-	-	0.643	[0.21;1.08]	0.004	0.496	[0.10;0.89]	0.013
	N	-	-	-	0.000			-	-	-
PRIOR	B	-	-	-	-0.483	[-1.07;0.10]	0.106	-	-	-
	S	-	-	-	0.000	-	-	-	-	-
		ODP		0.432	ODP		0.345	ODP		0.431

Difference between the expected numbers of accidents for various types of intersection arrangements in Prague

Final versions of model – all together

Variable		2009			2010			2009-2010		
Shortcut		Estim. Value	95 % Confid. Interval	Sig.	Estim. Value	95 % Confid. Interval	Sig.	Estim. Value	95 % Confid. Interval	Sig.
Intercept		-6.241	[-8.37;-4.11]	0.000	-4.925	[-6.86;-2.99]	0.000	-4.832	[-6.62;-3.05]	0.000
ln(AADT_mj)		0.534	[0.31;0.76]	0.000	-0.375	[0.12;0.57]	0.000	0.488	[0.29;0.68]	0.000
ln(AADT_mi)		0.295	[0.18;0.41]	0.000	0.310	[0.19;0.43]	0.000	0.264	[0.16;0.37]	0.000
LEGS	3	-0.391	[-0.68;-0.10]	0.008	-0.404	[-0.69;-0.12]	0.006	-0.382	[-0.65;-0.12]	0.005
	4	0.000	-	-	0.000	-	-	0.000	-	-
TRAM	Y	0.580	[0.28;0.88]	0.000	0.640	[0.34;0.94]	0.000	0.635	[0.37;0.90]	0.000
	N	0.000	-	-	0.000	-	-	0.000	-	
LEFT	Y	-	-	-	0.327	[0.03;0.63]	0.000	-	-	-
	N	-	-	-	0.000	-	-	-	-	-
PRIOR	B	-	-	-	-0.315	[-0.69;0.056]	0.10	-	-	-
	S	-	-	-	0.000	-	-	-	-	-
		ODP		0.526	ODP		0.495	ODP		0.560

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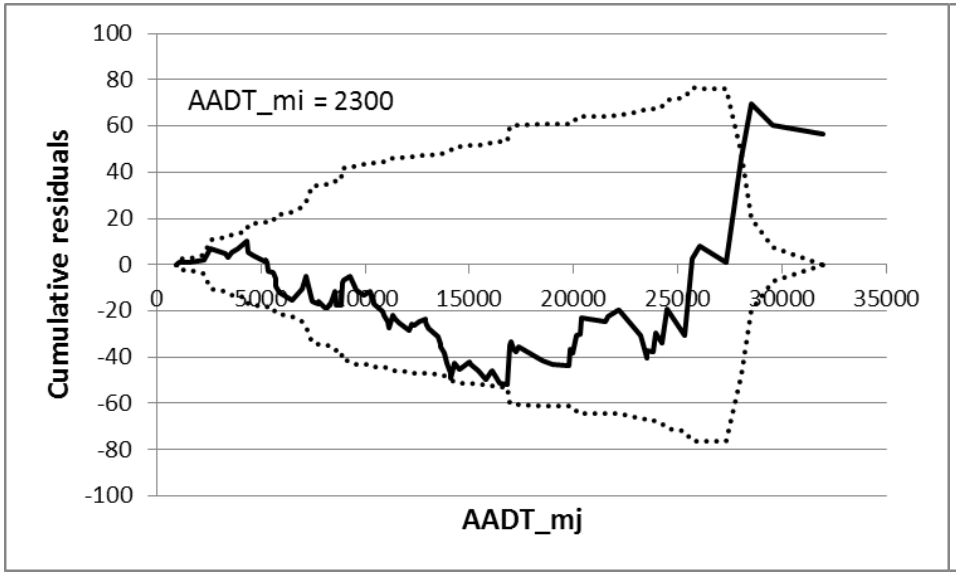
Cumulative residuals

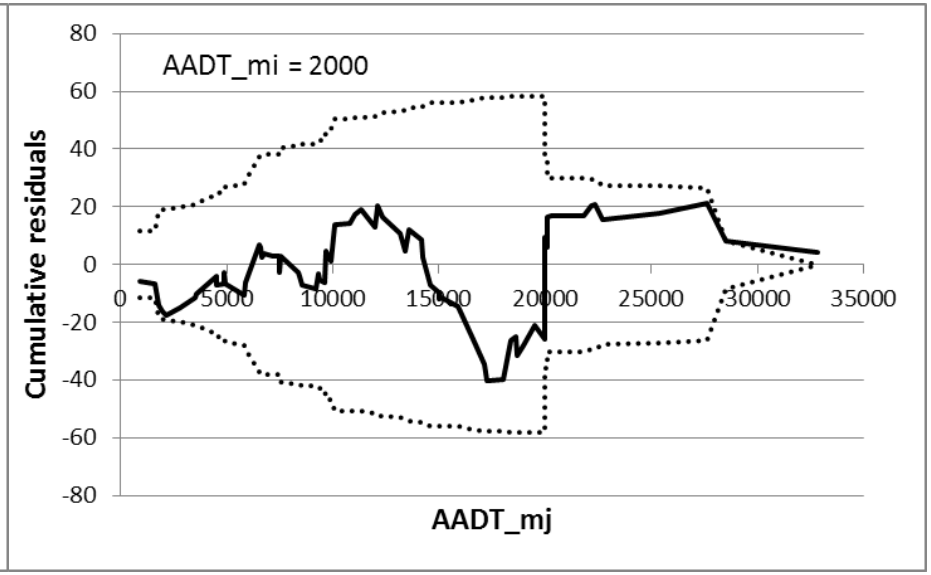
3 leg intersections

$$ACC = e^{-7.074} \cdot AADT_{mj}^{0.594} \cdot AADT_{mi}^{0.327} \cdot e^{4.350 \cdot p_HGV + 0.798 \cdot TRAM}$$

4 leg intersections

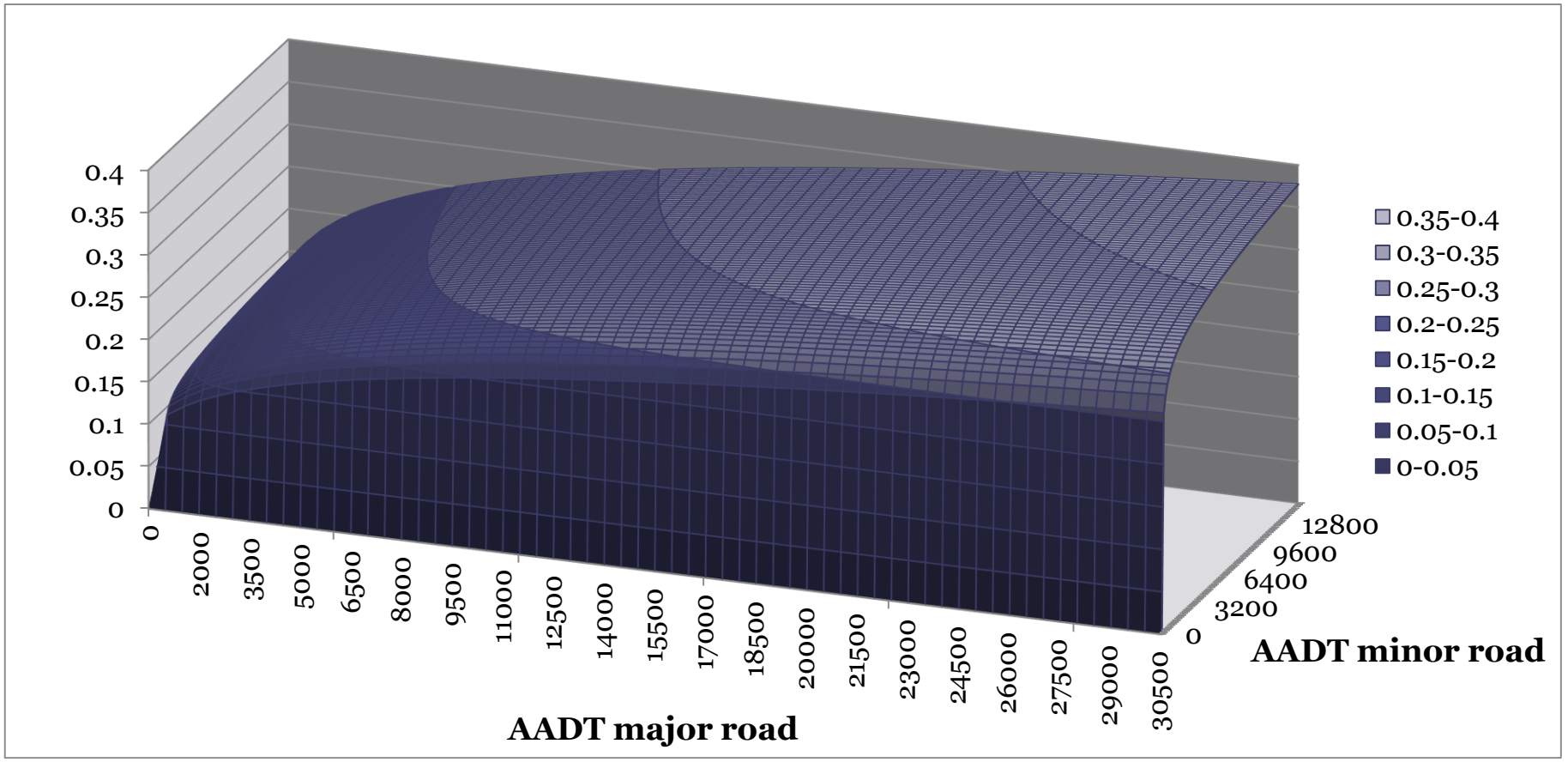
$$ACC = e^{-3.887} \cdot AADT_{mj}^{0.410} \cdot AADT_{mi}^{0.276} \cdot e^{-7.930 \cdot p_HGV + 0.044 \cdot p_TRAM + 0.496 \cdot LEFT}$$





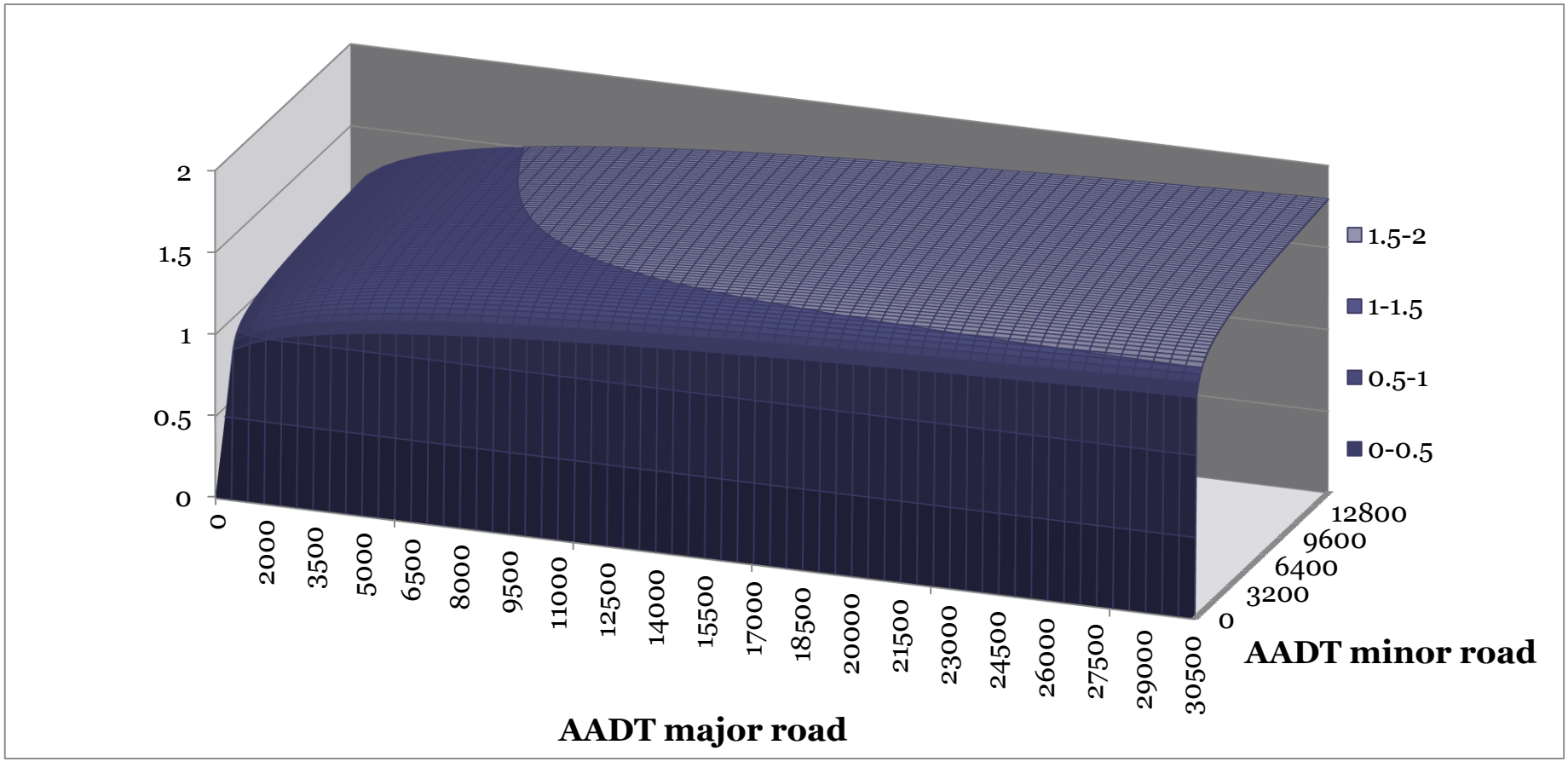
Difference between the expected numbers of accidents for various types of intersection arrangements in Prague

Expected annual accident frequency 3-leg intersections



Difference between the expected numbers of accidents for various types of intersection arrangements in Prague

Expected annual accident frequency 4-leg intersections



Difference between the expected numbers of accidents for various types of intersection arrangements in Prague

Conclusions

- Which intersection parameters have the biggest influence on the road safety?
  - AADT on major and minor roads
  - Percentage of HGV
  - Presence of tram traffic and its relationship to AADT (percentage)
  - Left turn restrictions

Conclusions

- Is there significant difference in the results depending on the length of period?
  - In short period – some variables are significant without explanation
  - Longer period seems to be better
    - no changes in methodology
    - very long period can be influenced by changes in vehicle fleet, etc.

Conclusions

- Is it good to combine different intersection type or not?
  - Model of each of intersection type seems to be more reliable, overdispersion parameter is lower

Overdispersion parameter			
	2009	2010	2009-2010
3-leg	0.514	0.431	0.552
4-leg	0.432	0.345	0.431
all	0.526	0.495	0.560

Thank you for your attention

The article was prepared within the project no.TA01031303
supported by the Technology Agency of the Czech Republic.

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