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Investigating the correlation of mobile phone use with trip characteristics recorded through smartphone sensors

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Introduction

- Accurate **monitoring of driver behaviour** has scientific and technical requirements
- The Internet of Things (IoT) constantly offers new opportunities and features to monitor and analyse driver behaviour through:
  - Wide use of smartphones and social media
  - Effective data collection and handling
  - Big Data Analysis

Research Scope

- Identify the **critical driving parameters** that affect mobile phone use while driving using data from:
  - Smartphone devices
  - Naturalistic driving experiments

- Examine whether driving characteristics, recorded by smartphones, affect and can therefore predict the use of **mobile phone during driving**

Trip parameters

- **Driving behaviour** characteristics
  - Speeding
  - Harsh braking/ acceleration/ cornering
  - Seatbelt use
  - Mobile phone use

- **Travel behaviour** characteristics
  - Total distance
  - Road network type
  - Risky hours driving
  - Trip frequency
  - Vehicle type

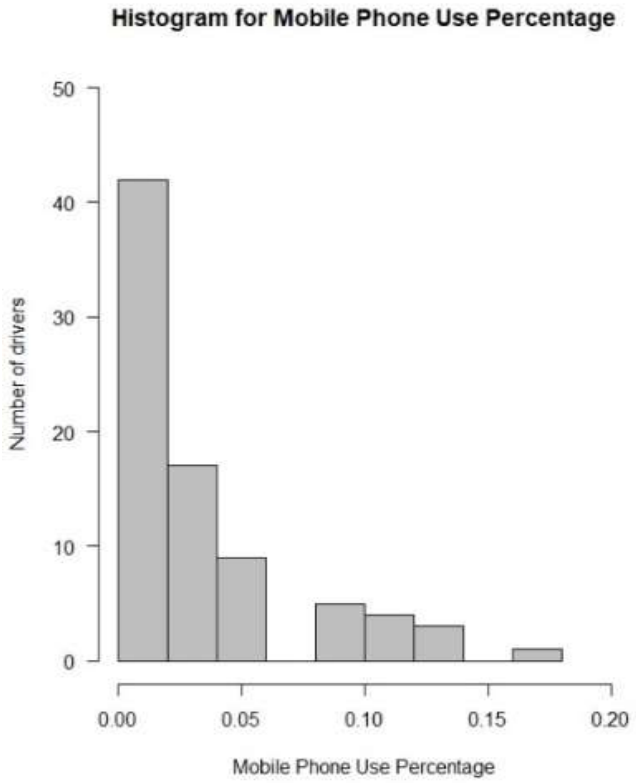
Smartphone data collection (1/2)

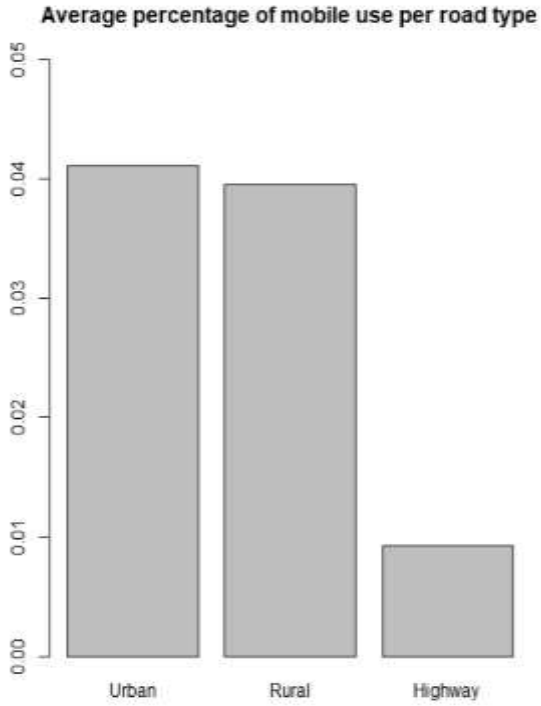
- A **mobile application** to record user's driving behaviour (automatic start / stop)
- A variety of **APIs** is used to read mobile phone sensor data
- Data is transmitted from the mobile App to the **central database**
- **Data are stored** in a sophisticated database where they are managed and **processed**

Smartphone data collection (2/2)

- **Indicators are designed using**:
  - machine learning algorithms
  - big data mining techniques
- The **database analyzed** was in .csv format
  - Drivers' trips are stored per row, the characteristics of which are stored in each column's variables
- During the 2-months timeframe of the experiment **11.987 trips** from a sample of **100 car drivers** have been recorded

Descriptive statistics

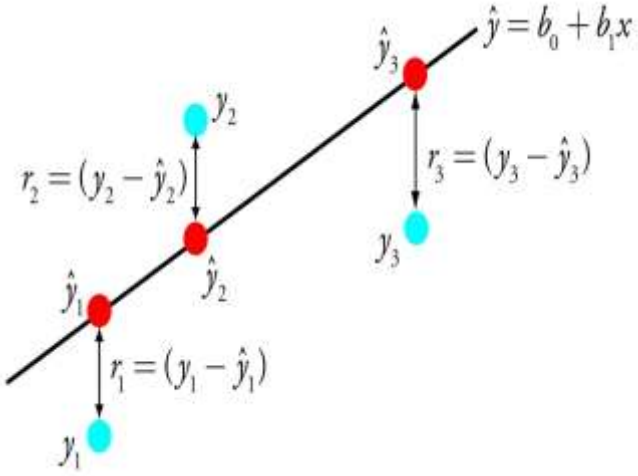




The average percentage of mobile use of the sample collected on a **driver basis**

The average percentage of mobile use **per road type**

Theoretical Background



- The examined variable is used as a binary regarding the entire trip in a form of **yes/no use of mobile phone**
- Therefore, **binary logistic regression** is selected as the appropriate analysis method
- Introduction of **random effects** to capture different driving behaviors and extend the models to **Mixed Binary Regression Models**

Results (1/3)

Mixed Binary Regression Models

Parameter	Overall Model		Urban Road		Rural road		Highways	
	B	P-value	B	P-Value	B	P-value	B	P-value
Intercept	-1.613	<0.001	-2.313	<0.001	-2.752	<0.001	-6.457	<0.001
Trip Distance	0.051	<0.001	0.182	<0.001	0.095	<0.001	0.025	<0.001
Workday	0.174	0.003	0.176	0.005	0.174	0.008	-	-
Morning Rush	-0.354	<0.001	-0.385	<0.001	-0.44	<0.001	-0.704	<0.001
Afternoon Rush	-	-	0.121	0.046	0.127	0.045	-	-
Average Speed	-0.010	<0.001	-0.007	0.017	0.008	<0.001	0.037	<0.001
Random effect (variance of random intercept)	1.475	<0.001	1.515	<0.001	1.472	<0.001	1.763	<0.001
Number of obs	11398		11398		11398		11398	
Number of drivers	82		82		82		82	
AIC	10888.3		9517.6		9002.0		1637.7	

Results (2/3)

- **Trip distance** increases the odds of mobile phone use during the trip; the effect appears to be higher in urban areas, less in rural and the least in highways
- **Driving on workdays** compared to driving on weekends also increases the odds of mobile phone use
- **Driving during morning rush hours** (06:00-10:00) compared to the rest of the day decreases the odds of using the mobile phone during the trip

Results (3/3)

- On the contrary, **driving during afternoon rush hours** (16:00-20:00) increases the odds of using the mobile phone while driving.
- **Average speed per trip** was found to be negatively associated with the odds of mobile phone use on all road types and in urban areas
- However, when driving in **rural areas and highways**, it seems that the higher the average speed the higher the odds of mobile phone use

Conclusions

- The parameters of trip distance, workday and afternoon rush are statistically significant and **positively correlated with the use of mobile phone**
- Average speed and morning rush are statistically significant and **negatively correlated** with the use of mobile phone
- Future research should also focus on the improvement of the accuracy of the models, by **exploring more variables and alternative modelling techniques**

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