RAPTOR: Software Application for Predicting Collision Hotspots and Evaluating Site-based Road Safety Interventions

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Joining the dots: How data delivers insight and innovation

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Background

2003: Northumbria Safety Camera Partnership
- Site selection, data reporting to DfT, site evaluation

2006/08: Health impacts study of mobile safety cameras
- Focus on actual scheme effects after confounding effects of RTM and trend
- Algorithms for evaluating interventions

2010: Focus on ‘research impact’

2012: Industrial collaboration with PTV Group
- Development of hotspot prediction algorithms

2015: Implementation in software applications

2017: Software now accessible to practitioners
Perceived safety problem at a location(s) on the road network (hotspot identification) → Implement intervention strategy → Monitor impact (scheme evaluation)

COLLISION DATA

...but prone to confounding factors of regression-to-mean and general accident trends
Observed counts at individual sites are due to....

Total observed frequency (100%)

- SAFETY
- RTM
- TREND

Prevailing level of site safety

Confounding factors

Variation over time and between sites
Problems for evaluation and prediction (site selection)

Collisions per year

Time

Blip?

Negative trend?
Problems for evaluation

How much of any observed change is due to:
- Our scheme?
- RTM?
- Trend?
Problems for prediction (site selection)
Accounting for RTM and Trend

RTM

◦ Ignore it – assume it don’t exist
◦ Four Time Period (FTP) method
◦ Bayesian techniques (Empirical or Full)

Trend

◦ Ignore it
◦ Network-wide and site-specific trends
◦ Recent observations versus observations further back in time
Why are confounding factors a problem?

Cause ‘noise’ in the collision count data

For hotspot identification:

- False positives: identifying and treating sites as hotspots when they are not – collision rate would have reduced anyway; an issue of ‘wasted’ resources

- False negatives: not treating a genuinely unsafe site; impact for future collision rates

For scheme evaluation:

- Believing that our schemes are being more effective than they actually are – value for money issues and ‘misguided’ future decisions
Key features of RAPTOR Package

Three key functions:
- Hotspot prediction
- Scheme evaluation
- (Contributory factors analysis)

RTM
- ....
- .....  

Trend
- Variance inflation (more weight on more recent observations)
- Weighted combination of network and site-specific trends
How good are the hotspot predictions?

- **Halle**
  - $r = 0.858$
  - MSE = 5.969
  - sd(error) = 2.386

- **Northumbria**
  - $r = 0.919$
  - MSE = 3.248
  - sd(error) = 1.777
RAPTOR Demonstration

Data requirements

- Hotspot prediction and scheme evaluation
- **Dependent variable:** Collision/casualty counts in discrete time periods (e.g. months, quarters or years) for each site
- **Independent variables:** Static site data (e.g. speed limit; road type; road class, urban/rural); dynamic site data (e.g. flow; average speeds) for each time period for each time period
Screenshots

If needed.....
Current and Future Demonstrations/Applications

• Northumbria (NSRI); Suffolk (cyclist collisions); North Yorkshire County Council and North Yorkshire Police

• Halle, Germany; National Technical University of Athens, Greece

• Florida Department of Transport (seasonal effects); Texas A & M University

• China and S Korea (via Monash University); Guyana Ministry of Public Infrastructure

• World Resources Institute (US, Mexico, Turkey, India, Brazil, China…)

• Abu Dhabi Police; University of Dammam, Saudi Arabia;

• Training courses in Rio, Brazil in 2015 and Bolivia, 2016 with WRI/PTV Group

• On-line demo (login required)

• Software tool
Early Example of Scheme Evaluation
http://bmjopen.bmj.com/content/2/6/e001304?ct

Statistical Methodology


Papers Aimed at Road Safety Practitioners

Oral Presentations and Posters to Road Safety Academics, Practitioners and Policy Makers


Thorpe, N. (2016) Issues with Interpreting Collision Data: How to Manage Confounding Factors when Identifying Collision Hotspots and Evaluating Road Safety Interventions. WRI/PTV/Newcastle University International Road Safety Research and Training Workshop, 28/11/16-2/12/16, Santa Cruz, Bolivia


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