The use of crowdsourced cycling data for cycling analyses (Strava)

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• Large benefits (e.g., reduced congestion and emissions, improved health, etc)

• Quite a lot of car trips are short trips (<2km)

• Transport Scotland wants 10% of journeys to be made by bicycle by 2020; with cities responsible for achieving this
Several interventions have been applied (e.g., four cycling infrastructure investments before, during and after the Commonwealth Games)

Understanding cycling behaviour and evaluating the effectiveness of interventions are difficult due to the lack of data.

Manual/Automatic counts take place on specific links/points, but these are expensive and hence infrequent.
1) Can crowdsourced cycling data be utilised for cycling behaviour studies?

2) Where commuting cyclists travel and what are influential factors for their route choice?

3) Do the new cycling infrastructure investments in Glasgow produce effective impacts?
Data and variables

- 2013-2016 Strava data
  
  Data are provided as:
  
  - Origins and destinations with route information (at output area level)
  - Minute-by-minute link counts of cycling flows
  - Information about waiting times at junctions
  - Aggregate demographic information

- Manual counts of cyclists from a cordon count carried out in Glasgow in 2013-2015 (38 locations, 2 days per year)

- Glasgow cycling infrastructure data
Data and analytical approach

Research question 1

• Data: 2013-15 Strava data and 2013-15 cordon count data
• Analyses: Correlation analysis and simple linear regression

\[ y_i \sim N(\alpha + \beta_{\text{Strava}_{\text{cyc}}}x_{\text{stava}_{\text{cyc}i}}, \sigma), \]

for \( i = 1, ..., 684 \) (38 locations * 3 time periods * 2 days * 3 years)

\( y_i \): # cyclists from cordon counts;

\( x_{\text{stava}_{\text{cyc}i}} \): # of Strava cycling trips
Research question 2

- Data: 2016 Strava data

- Analyses:
  - Compare the routes taken by commuting cyclists with the route they would take if they minimised their travel distance in the city of Glasgow (traffic assignment model)
  - Use Google Maps and local knowledge
Research question 3

• Data: 2013-15 Strava data and cycling infrastructure data
• Analysis: Fixed effect Poisson panel regression

\[
\log \lambda_{it} = \beta_{infra1} x_{new infra1} + \\
\beta_{infra2} x_{new infra2} + \beta_{infra3} x_{new infra3} + \\
\beta_{infra4} x_{new infra4} + \mu_i + \tau_t, \quad \text{for } i = 1, \ldots, 13309 \text{ (output area)} \& \text{for } t = 1, \ldots, 36 \text{ (month)}
\]

\( \lambda_{it} \): # Strava cycling trips in area i in month t  
\( \mu_i \& \tau_t \): an out-area-specific effect and series of month fixed effects, respectively
Results

**Correlation (# of cordon count vs. # of Strava count) and linear regression analysis (Research Q1)**

<table>
<thead>
<tr>
<th>Level of aggregation</th>
<th>Sample size</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hourly</td>
<td>3192</td>
<td>0.781</td>
</tr>
<tr>
<td>AM peak, PM peak, off-peak</td>
<td>684</td>
<td>0.861</td>
</tr>
<tr>
<td>One day</td>
<td>228</td>
<td>0.882</td>
</tr>
<tr>
<td>Two days</td>
<td>114</td>
<td>0.887</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Regression</th>
<th>Estimate</th>
<th>SE</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>32.43</td>
<td>2.34</td>
<td>&lt;2e-16</td>
</tr>
<tr>
<td># Strava trips</td>
<td>12.35</td>
<td>0.28</td>
<td>&lt;2e-16</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td></td>
<td>0.74</td>
<td></td>
</tr>
</tbody>
</table>
Results

Comparison between shortest routes and actual routes (Research Q2)
Comparison between shortest routes and actual routes (Research Q2)

Difference between observed flows and predicted flows
Why less popular? (Research Q2)

- Bus stops, traffic lights with a pedestrian crossing, street parking, no cycling infra
Why less popular? (Research Q2)

This road has cycling infrastructure

- Shared cycle/bus lane, street car parking, built environments (derelict properties – this area is one of the most deprived areas with a high crime rate)
### Results

**Fixed effects Poisson panel regression (Research Q3)**

<table>
<thead>
<tr>
<th>Overall effect</th>
<th>Separate effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimate</strong></td>
<td><strong>SE</strong></td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>New Infrastructure (yes= 1)</td>
<td>0.01</td>
</tr>
<tr>
<td>Routes to Cathkin 1</td>
<td></td>
</tr>
<tr>
<td>Routes to Cathkin 2</td>
<td></td>
</tr>
<tr>
<td>South West City Way</td>
<td></td>
</tr>
<tr>
<td>West City Way/Connect 2</td>
<td></td>
</tr>
</tbody>
</table>
Thank you. Any questions?