How to get from Avalon to Berhampore: commuting and car ownership decisions in Wellington, NZ

Toby Daglish\textsuperscript{1}, Mairéad de Róiste\textsuperscript{2} and Yiğit Sağlam\textsuperscript{3}

\textsuperscript{1}NZISCR, \textsuperscript{2}VUW, \textsuperscript{3}NZISCR, VUW

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This project

- Goal: to explain how households make the joint decision:
  - How many vehicles should your household own?
  - How to get to work?
  - Where to live?

- Uses Ministry of Transport HTS survey data.

- Brings together Econometrics (Toby, Yiğit) and Geography (Mairéad).

- One research assistant (Richard Law) and a summer scholarship student (Tom Pettit – funded by Wellington City Council).

- Has considerable scope to be extended and to answer some interesting policy questions.
Survey data

- Surveyed meshblocks centroids
- Meshblock centroids
- Surveyed meshblocks

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Avalon to Berhampore
Pedestrian and non-car routes
Residential roads
Collector roads
Arterial roads
Major roads
Motorway
Pedestrian Route

Elevation change for pedestrian route

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Avalon to Berhampore
Public transport

Map showing the public transport network between Wellington and Avalon to Berhampore.

Key:
- Bus stops
- Bus
- Home
- Modelled bus
- Car
- Work
- Pedestrian
- Bicycle
Commuting Modes

- **Car or Motorcycle**
- **Bicycle**
- **Bus**
- **Pedestrian**

Maps showing commute modes from Avalon to Berhampore.
Discrete-Choice Logit Models

- Model individuals making a choice between alternatives.
- Individuals receive *utility* from different choices.
- Individuals make choices which give them the highest utility.
- Utility from a choice may be related to:
  - Characteristics of a choice (e.g. how long does it take to get to work if I walk?).
  - Characteristics of an individual (e.g. I am a year older).
  - Characteristics of an individual (e.g. I don’t have a drivers licence, how does that affect my utility from driving?).
Discrete Choices

- Commuting mode:
  - Active Transport – Walking over short distances, cycling over longer distances (22.5 minute penalty on cycling).
  - Driving.
  - Public Transport – Walking to station or driving to station if station has park and ride (10 minute penalty for PT with driving).

- PT and AT modes had to be combined, since otherwise, our sample would have too few observations e.g. for cycling.

- Similarly, we had to combine numbers of cars, since there were few instances with zero cars.
Household car ownership

One or more cars per license holder (proportion)

- 0.00 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
Participants who commute by active transport

Active transport commuters (proportion)
- 0.00 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
Participants who commute by car

Commuters by car (proportion)

- 0.00 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
Participants who commute by public transport

Commuters by public transport (proportion)

- ○ 0.00 - 0.20
- ■ 0.21 - 0.40
- ● 0.41 - 0.60
- ● 0.61 - 0.80
- ■ 0.81 - 1.00

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Avalon to Berhampore
What variables are used in our analysis?

List of predictors:

- **Alternative-specific variables:**
  - *Time taken*: commuting time,
  - *Cost*: cost of commuting,
  - *Distance*: distance of commute,

- **Alternative-invariant variables:**
  - *Workers, Non-workers*: number of adults in the HH who do/do not have a main job,
  - *DT*: dummy variable (= 1 if work location is in the downtown),
  - *Sub 30 min walk*: dummy variable (= 1 if time taken to walk to work is less than 30 minutes).
  - *Income 100K+:* dummy variable (= 1 if income $100 000 or more).
  - *Women*: dummy variable (= 1 if female).
  - *Single women*: dummy variable (= 1 if female living alone).
  - *No licence*: dummy variable (= 1 if person has no drivers licence).
  - *Age*: age of individual,
## Regression Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coeff.</th>
<th>T-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time taken</td>
<td>-0.05708</td>
<td>-5.5716</td>
</tr>
<tr>
<td>Time taken(^2)</td>
<td>7.2471e-05</td>
<td>2.2644</td>
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<tr>
<td>Cost</td>
<td>-0.025598</td>
<td>-4.0394</td>
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<tr>
<td>Distance</td>
<td>-0.00010238</td>
<td>-1.9979</td>
</tr>
<tr>
<td>Non workers * High</td>
<td>-0.30527</td>
<td>-3.3676</td>
</tr>
<tr>
<td>Workers * High</td>
<td>-0.43202</td>
<td>-4.3497</td>
</tr>
<tr>
<td>DT * Drive</td>
<td>-2.7233</td>
<td>-13.645</td>
</tr>
<tr>
<td>Sub 30 min walk * AT</td>
<td>1.3005</td>
<td>4.4017</td>
</tr>
<tr>
<td>Income 100K+ * Cost</td>
<td>0.007695</td>
<td>0.88764</td>
</tr>
<tr>
<td>Single Women * High * PT</td>
<td>-0.038886</td>
<td>-0.097077</td>
</tr>
<tr>
<td>Single Women * High * AT</td>
<td>0.91621</td>
<td>2.0676</td>
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<tr>
<td>Women * High * PT</td>
<td>0.69926</td>
<td>2.9714</td>
</tr>
<tr>
<td>Women * High * AT</td>
<td>0.42929</td>
<td>1.3882</td>
</tr>
<tr>
<td>No licence * Drive</td>
<td>-1.9952</td>
<td>-6.226</td>
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<tr>
<td>Const. (Low, Drive)</td>
<td>-0.28839</td>
<td>-0.47633</td>
</tr>
<tr>
<td>Const. (Low, PT)</td>
<td>-0.10019</td>
<td>-0.18154</td>
</tr>
<tr>
<td>Const. (High, AT)</td>
<td>-0.062689</td>
<td>-0.10089</td>
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<tr>
<td>Const. (High, Drive)</td>
<td>1.6618</td>
<td>2.7052</td>
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<tr>
<td>Const. (High, PT)</td>
<td>-0.87604</td>
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<tr>
<td>Age (Low, Drive)</td>
<td>0.02927</td>
<td>2.3056</td>
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<tr>
<td>Age (Low, PT)</td>
<td>-0.0019557</td>
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<tr>
<td>Age (High, AT)</td>
<td>0.015878</td>
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<tr>
<td>Age (High, Drive)</td>
<td>0.040076</td>
<td>3.4696</td>
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<tr>
<td>Age (High, PT)</td>
<td>0.036056</td>
<td>2.608</td>
</tr>
</tbody>
</table>

**Table:** Discrete choice model

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Avalon to Berhampore
Regression Results (contd.)

- Commute times are very important for individuals (but marginally less so for longer commutes).
- Working downtown is a disincentive to driving.
- Larger households have economies of scale in car ownership.
- Active transport is very popular for short (walkable) distances.
- Single women often own cars but don’t use them to commute.
- Women will use PT even when a car is available (high, PT).
- Most people like (high, drive) combination.
- Older commuters more likely to choose (low, Drive), (high, PT) or (high, Drive).
- Not (as) important: number of children, income, ethnicity.
Methodology

- Consider the effects of commute times on property prices.
- Specifically: examine public transport travel times to Cuba Street & Manner’s Mall.
- Control for a range of things that may affect prices:
  - Number of bedrooms.
  - Vintage of house.
  - Vegetation coverage (dense, sparse, none).
## Results

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<tr>
<th>Variable</th>
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<th>T-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherent Home Value</td>
<td>$172,110.00</td>
<td>2.555</td>
</tr>
<tr>
<td>Each Weekday PT Service</td>
<td>$186.90</td>
<td>2.854</td>
</tr>
<tr>
<td>Each Weekend PT Service</td>
<td>-$183.82</td>
<td>-1.612</td>
</tr>
<tr>
<td>Additional minute to Cuba Mall(via PT)</td>
<td>-$6,708.30</td>
<td>-15.081</td>
</tr>
<tr>
<td>% point of no vegetation(Urban Retail Proxy)</td>
<td>-$129.71</td>
<td>-0.610</td>
</tr>
<tr>
<td>% Point of dense vegetation</td>
<td>$402.86</td>
<td>1.666</td>
</tr>
<tr>
<td>Each bedroom</td>
<td>$210,990.00</td>
<td>11.044</td>
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<tr>
<td>Meshblock Structure Age - 1890s</td>
<td>$80,055.00</td>
<td>1.896</td>
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<tr>
<td>Meshblock Structure Age - 1900s</td>
<td>-$31,622.00</td>
<td>-1.077</td>
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<tr>
<td>Meshblock Structure Age - 1910s</td>
<td>-$1,007.00</td>
<td>-0.032</td>
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<tr>
<td>Meshblock Structure Age - 1920s</td>
<td>-$22,491.00</td>
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<td>Meshblock Structure Age - 1930s</td>
<td>-$26,691.00</td>
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<td>Meshblock Structure Age - 1940s</td>
<td>-$108,670.00</td>
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<td>Meshblock Structure Age - 1950s</td>
<td>-$145,880.00</td>
<td>-5.531</td>
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<td>Meshblock Structure Age - 1960s</td>
<td>-$141,100.00</td>
<td>-5.556</td>
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<td>Meshblock Structure Age - 1970s</td>
<td>-$123,060.00</td>
<td>-4.603</td>
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<td>Meshblock Structure Age - 1980s</td>
<td>-$126,170.00</td>
<td>-3.967</td>
</tr>
<tr>
<td>Meshblock Structure Age - 1990s</td>
<td>-$52,027.00</td>
<td>-1.536</td>
</tr>
</tbody>
</table>

**Table:** House values in Wellington City and Lower Hutt
People like:

- Being close to downtown (as measured by commute times). Improving commute times improves house values.
- Being on the city fringe (dense vegetation).
- Very old houses or very new houses (but not old-ish houses).
Extensions: Modelling

- Currently working on the residential location decision.
  * Challenging, because choice set expands by $\approx 200$ area units the household could live in.
  * Currently have preliminary commute times, implementing choice model.
Alternative residential locations

- Home
- Alternative ‘home’
- Work

Legend:
- Alternative area unit 1
- Alternative area unit 2
- Alternative area unit 3
- Alternative area unit 4
- Original route
- Alternatives routes
Extensions: Modelling (contd.)

- Breaking choice between individual and household.
  - e.g. individuals can commute by different modes, but household has common location/car ownership,
  - Update the model so the distribution of alternatives for individuals in the same HH can be combined to determine the HH car ownership level.
Extensions: Data

▶ Parking issues:
  * Currently controlled by a “Downtown Driving” variable.
  * Modelling parking accessibility?

▶ Travel issues:
  * Commute times are “optimistic” given rush-hour performance. Delays for intersections?
  * Data on actual top speeds during peak hours? Fuel efficiency?
  * Wait times for buses/trains?
Potential Applications

- How do changing commute times affect household mode choice?
  * Widening roads (improves driving) versus more frequent/faster public transport.

- How do petrol price changes affect car ownershipemode choice?