# Advanced modelling of commuter choice model and work from home during COVID-19 restrictions in Australia

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ITLS

# INTRODUCTION

This research is part of iMOVE Cooperative Research Centre (CRC) research projects 1-031 and 1-034 with Transport and Main Roads, Queensland (TMR), Transport for New South Wales (TfNSW) and WA Department of Transport (WADoT) on Working from Home and Implications for Revision of Metropolitan Strategic Transport Models. The findings reported are those of the authors and are not the positions of TfNSW or TMR; but approval to present these findings is appreciated.

# INTRODUCTION

- COVID-19 has had serious implications in the world → businesses around the world have had to adapt quickly to this new normality → work from home (WFH)
- Attitudes, perceptions and beliefs are likely to be playing a very important role on individual choice process and behaviour towards WFH and commuting
- This study estimates a hybrid choice model to identify underlying attitudes that influence the decision to WFH
- Data collected in Australia during late 2020 to understand the implications of COVID-19 in the transport network around Australia

# INTRODUCTION

- Each day of the week, respondents have up to three alternatives: not to work, WFH or commute to work (in different modes of transport)

- Hypotheses:

    1. The attitude towards **WFH** plays a significant role in their daily work decision

    2. The level of concern over the use of public transport and/or workplace affects their daily work decision

# DATA

# DATA

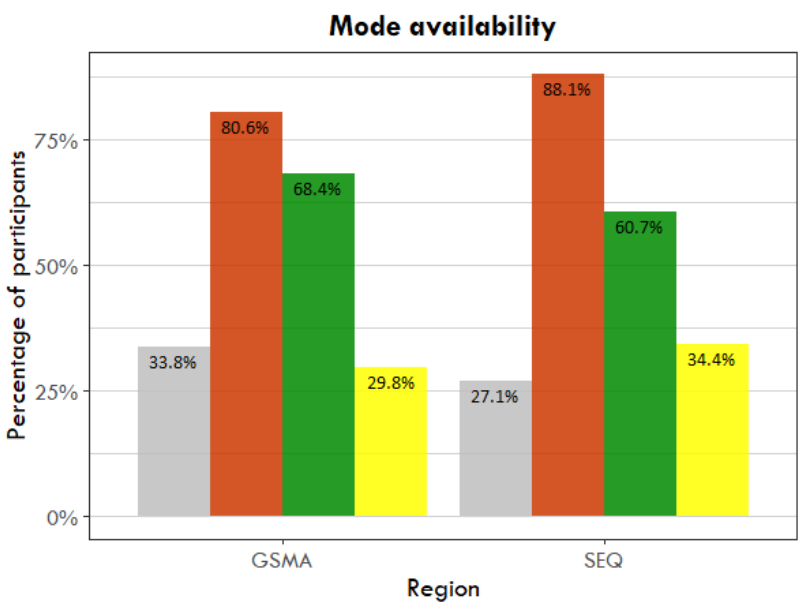
- Data was collected in Queensland (QLD) and New South Wales (NSW), Australia using an online survey, including workers and non-workers in metropolitan and regional areas

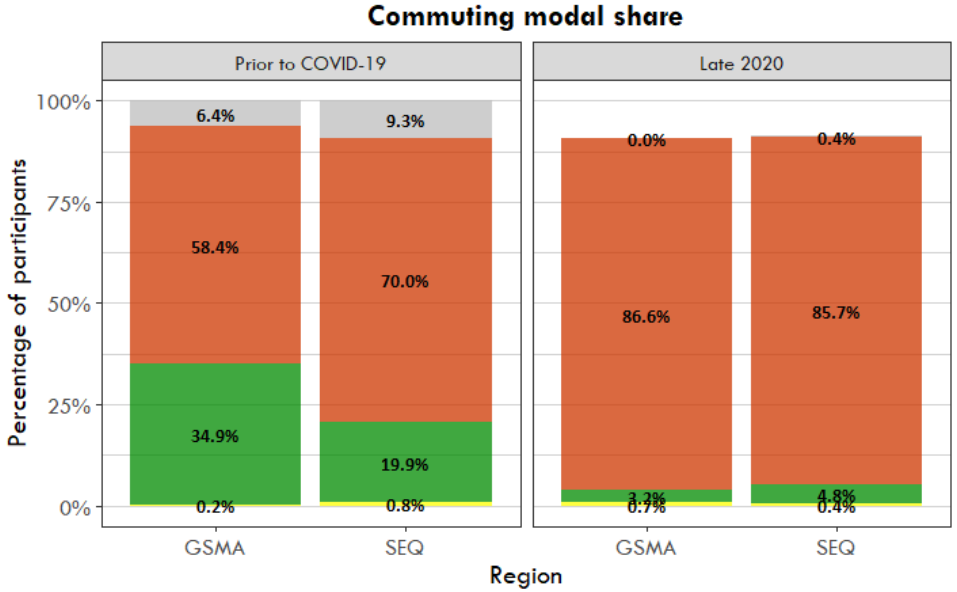
- This study will only include workers in **metropolitan areas:** GSMA in NSW and SEQ in QLD

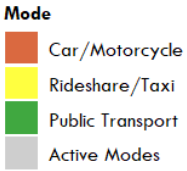
| Mean (standard deviation) | SEQ | GSMA |
|---|---|---|
| Age (years old) | 39.62 (13.27) | 40.45 (13.50) |
| Gender female (0,1) | 72% | 59% |
| Income ('00AUD$) personal | 72.68 (43.34) | 81.42 (56.08) |
| Number of children in household | 0.99 (1.27) | 1.16 (1.38) |
| Number of adults in household | 1.75 (1.05) | 1.66 (1.01) |
| Number of cars per person in household | 0.72 (0.37) | 0.60 (0.35) |
| Distance from home to work (kms) | 20.05 (40.68) | 19.33 (25.82) |

| Mean (standard deviation) | SEQ | GSMA |
|---|---|---|
| Number of days worked prior to COVID-19 | 4.58 (0.97) | 4.59 (1.11) |
| Number of days WFH prior to COVID-19 | 0.85 (1.61) | 0.86 (1.58) |
| Number of days worked last week | 4.52 (1.18) | 4.52 (1.33) |
| Number of days WFH last week | 1.36 (1.97) | 1.80 (2.18) |

# DATA

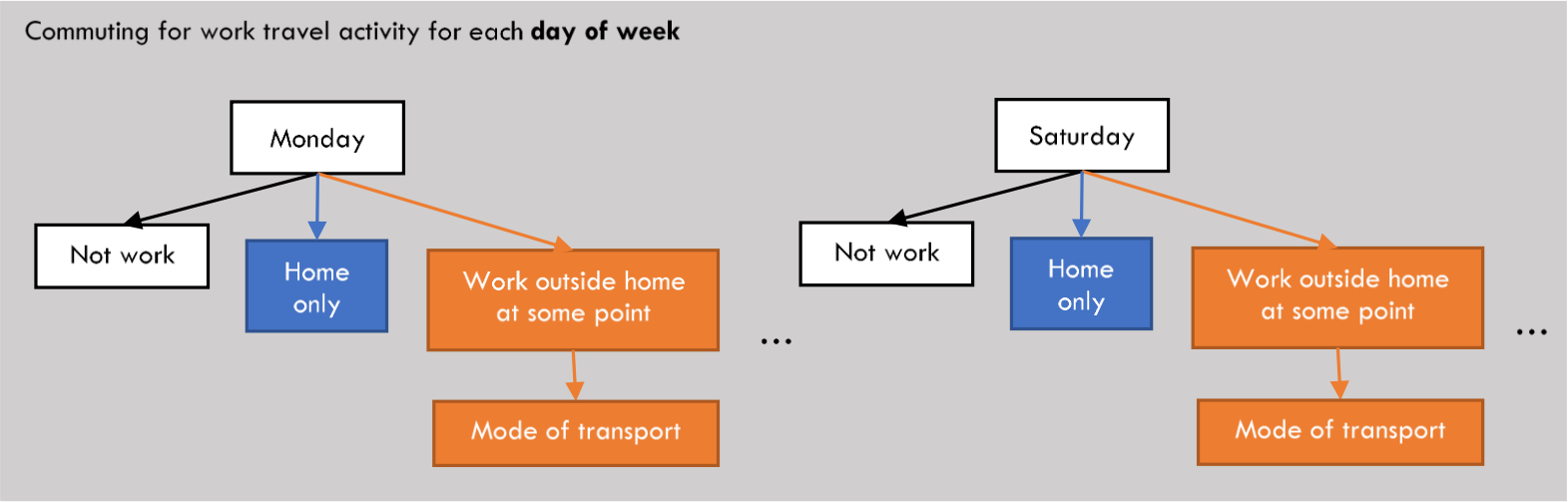

Mode availability
Percentage of participants
75%
50%
25%
0%
80.6%
68.4%
33.8%
29.8%
88.1%
60.7%
27.1%
34.4%
GSMA
SEQ
Region


Commuting modal share
Prior to COVID-19
Late 2020
Percentage of participants
100%
75%
50%
25%
0%
6.4%
58.4%
34.9%
0.2%
9.3%
70.0%
19.9%
0.8%
0.0%
86.6%
3.3%
0.7%
0.4%
85.7%
4.8%
0.4%
GSMA
SEQ
GSMA
SEQ
Region


Mode
Car/Motorcycle
Rideshare/Taxi
Public Transport
Active Modes

# METHODOLOGY

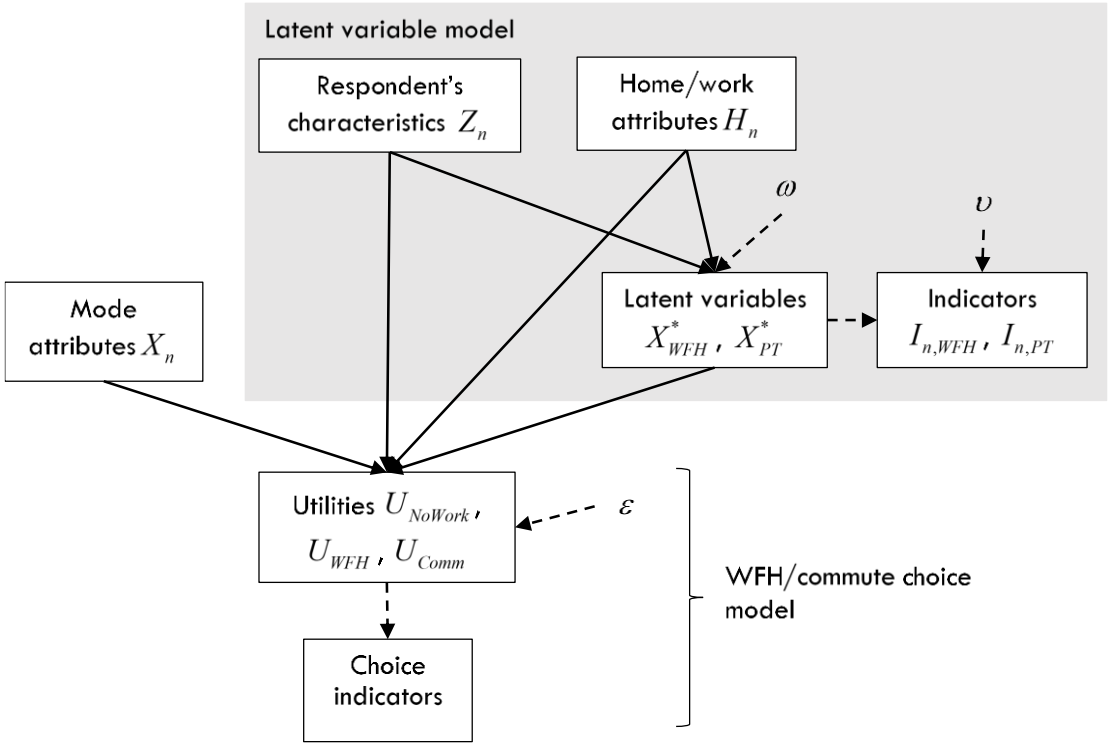
# METHODOLOGY




| Altij | Description |
|---|---|
| 1 | Not work |
| 2 | Work from home only |
| 3 | Work outside home - car driver |
| 4 | Work outside home - car passenger |
| 5 | Work outside home - taxi/rideshare |
| 6 | Work outside home - train |

| Altij | Description |
|---|---|
| 7 | Work outside home - bus |
| 8 | Work outside home - light rail |
| 9 | Work outside home - ferry |
| 10 | Work outside home - walk |
| 11 | Work outside home - bicycle |
| 12 | Work outside home - motorcycle |

# METHODOLOGY



# METHODOLOGY

In this study, two latent variables will be considered:

- WFH lovers → $X^*_{WFH}$
- Concerned about public transport (PT) and workplace due to COVID-19 → $X^*_{PT}$

The structural equations of the latent variables are expressed as follows:

$$X^*_n = \sum_j \theta_j \cdot Z_{qj} + \sum_i \theta_i \cdot H_{qi} + \omega_n$$

Error term

Attribute *j* of respondent *q*

Home or work attribute *i*

The measurement equations of the latent variables used in this study are linear, as follows:

$$I_n = \alpha_0 + \alpha_1 \cdot X^*_n + \upsilon_n$$

Error term

# METHODOLOGY

The utility function of the no work, WFH and commute alternatives can be expressed as follows:

$$U_{NoWork} = \beta_0 + \sum_j \beta_j \cdot Z_{qj} + \varepsilon_{NoWork}$$

$$U_{WFH} = \beta_0 + \sum_j \beta_j \cdot Z_{qj} + \sum_i \beta_i \cdot H_{qi} + \beta_{WFH} \cdot X^*_{WFH} + \beta_{PT} \cdot X^*_{PT} + \varepsilon_{WFH}$$

$$U_{Commute_m} = \beta_0 + \sum_j \beta_j \cdot Z_{qj} + \sum_i \beta_i \cdot H_{qi} + \sum_k \beta_k \cdot X_{mk} + \varepsilon_{Commute_m}$$

Latent variable WFH lover

Latent variable concerned about PT and workplace

Mode *m* attribute *k*

# METHODOLOGY

The latent variables structural equations and the WFH/commute choice model are estimated **simultaneously**

- The error term in the structural equations, cannot be assumed as independent from the choice model error term → Serial correlation

➢ Include an agent effect for each latent variable in the model specification that appears in the models.

# INDICATORS LATENT VARIABLE WFH LOVERS

| Acronym | Question |
|---|---|
| WFHPrdM | How productive do you think you have been in the last week whilst working from home?* |
| WkSpace | I have appropriate space to work from home |
| BalPdUnP | I am able to find a balance between paid work and unpaid work (e.g. housework, yard work, childcare) |
| BalTime | I am able to find a balance between time spent on work and time spent not working |
| WFHSuc | I have everything I need to be able to work from home successfully |
| ReqEqu | I still require equipment / technology to be able to complete work from home as well as I would like |
| WFHpos | Working from home has been a positive experience for me |
| WFHLikM | I would like to work from home more often in the future |
| WFHlFlex | I would like to have more flexible starting and finishing times in the future |
| ComlesBT | I would commute at less busy times in the future if I could |

*Scale: A lot less productive (1), A little less productive (2), About the same (3), A little more productive (4), A lot more productive (5)

**Scale: Strongly disagree (1), Disagree (2), Somewhat disagree (3), Neither agree nor disagree (4), Somewhat agree (5), Agree (6), Strongly agree (7)

# INDICATORS LATENT VARIABLE PT CONCERN

| Acronym | Question |
|---|---|
| ACvConc | Imagine you had to catch public transport tomorrow, what would be your level of concern about hygiene be? |
| ACvCoNUs | Imagine you had to catch public transport tomorrow, what would be your level of concern about the number of people using public transport? |
| WkEnvCnc | How concerned are you today about Covid-19 and work, given the environment that you normally work in (i.e. before Covid-19)? |

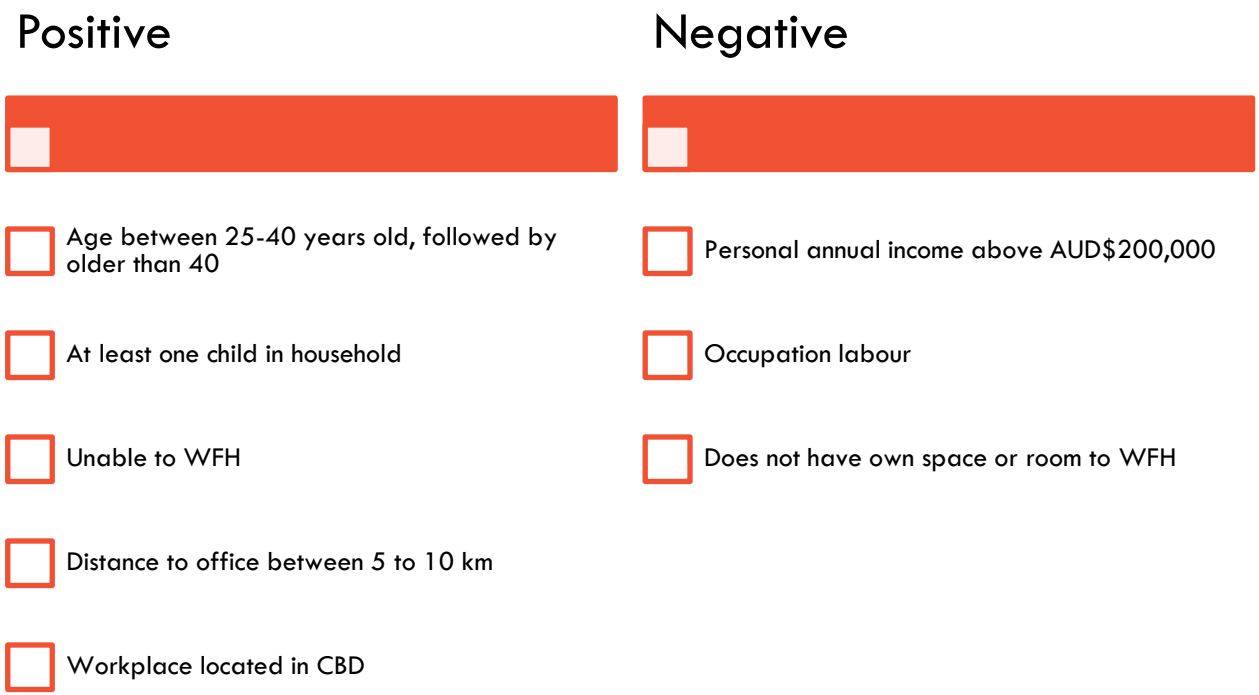
*Scale: Not at all concerned (1), Slightly concerned (2), Somewhat concerned (3), Moderately concerned (4), Extremely concerned (5)

# RESULTS

# RESULTS: LATENT VARIABLE WFH LOVERS

| Description | Mean | T-Value |
|---|---|---|
| Intercept | -0.636 | -7.550 |
| Age between 25 and 40 years old (1,0) | 0.332 | 6.740 |
| Age older than 40 years old (1,0) | 0.295 | 5.850 |
| Personal income above AUD$200,000 (1,0) | -0.699 | -7.750 |
| At least one child in household (1,0) | 0.091 | 3.420 |
| Able to work from home (1,0) | -0.636 | -7.550 |
| Has own space or room to work from home (1,0) | 0.564 | 16.200 |
| Occupation clerical and administration (1,0) | 0.306 | 6.720 |
| Occupation professional (1,0) | 0.188 | 4.910 |
| Occupation labourer (1,0) | -0.692 | -7.770 |
| Occupation manager (1,0) | 0.085 | 1.990 |
| Distance from home to the office between 5 to 10 km (1,0) | 0.140 | 4.780 |
| Workplace located in CBD (1,0) | 0.153 | 5.260 |
| Workplace located in Brisbane (1,0) | 0.709 | 4.690 |
| Workplace located in Gold Coast (1,0) | 0.697 | 4.450 |
| Workplace located in Illawara (1,0) | -0.111 | -1.710 |
| Workplace located in Sunshine Coast (1,0) | 0.763 | 4.630 |
| Workplace located in New South Wales (1,0) | 0.604 | 4.040 |
| Individual-specific error component | 0.591 | 22.300 |
| Individual-specific error component associated with WFH structural equation | 0.086 | 2.470 |

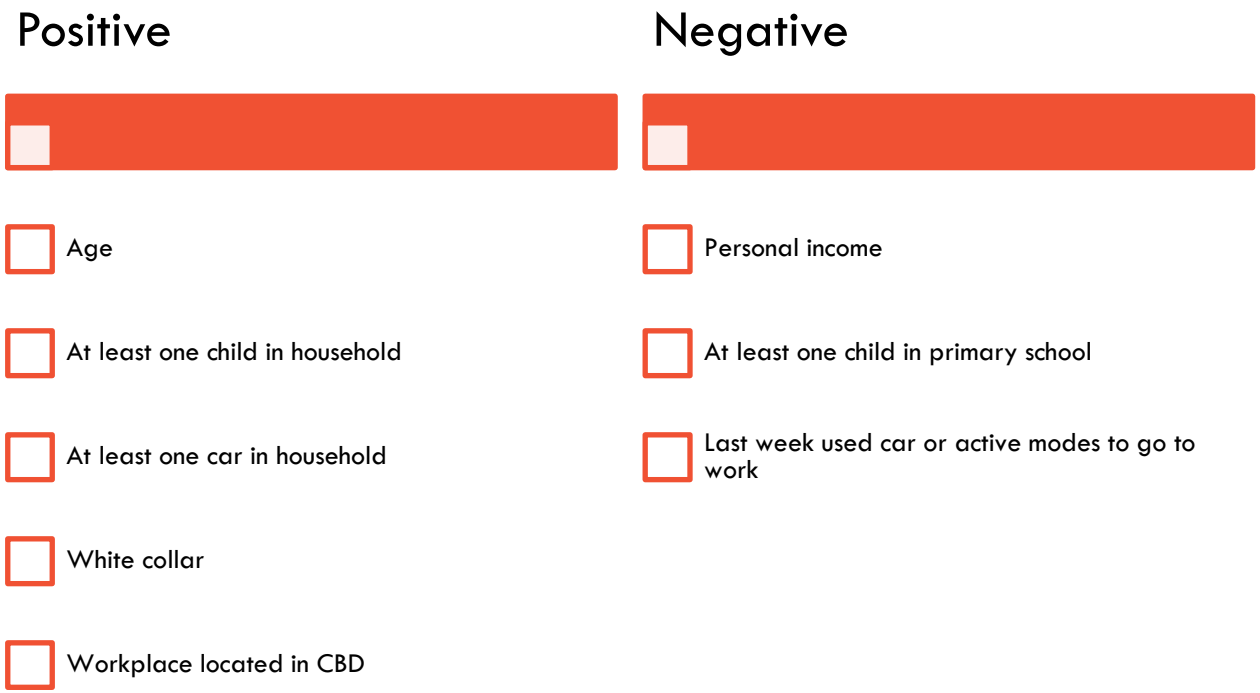
# RESULTS: LATENT VARIABLE WFH LOVERS



# RESULTS: LATENT VARIABLE PT CONCERN

| Description | Mean | T-Value |
|---|---|---|
| Intercept | -0.206 | -0.731 |
| Age between 25 and 40 years old (1,0) | 0.325 | 2.040 |
| Age older than 40 years old (1,0) | 0.435 | 2.650 |
| Personal income between AUD$10,000 and $20,000 (1,0) | -0.437 | -3.960 |
| Personal income above AUD$20,000 (1,0) | -0.983 | -2.910 |
| At least one child in household (1,0) | 0.398 | 3.650 |
| At least one child in primary school (1,0) | -0.106 | -0.987 |
| At least one car in household (1,0) | 0.544 | 6.480 |
| Occupation white collar (1,0) | 1.160 | 8.040 |
| Last week used bicycle or walked to go to work (1,0) | -1.720 | -6.880 |
| Last week used car to go to work (1,0) | -0.503 | -2.550 |
| Workplace located in CBD (1,0) | 0.533 | 3.810 |
| Workplace located in Central Coast (1,0) | 1.080 | 5.630 |
| Workplace located in Illawara (1,0) | -0.758 | -2.740 |
| Workplace located in Newcastle (1,0) | -0.601 | -2.420 |
| Workplace located in Sunshine Coast (1,0) | -0.081 | -0.363 |
| Workplace located in New South Wales (1,0) | 0.845 | 6.140 |
| Individual-specific error component | 3.430 | 16.400 |
| Individual-specific error component associated with WFH structural equation | 1.220 | 12.900 |

# RESULTS: LATENT VARIABLE PT CONCERN



# RESULTS: CHOICE MODEL

| Description | Alternative | Mean | T-Value |
|---|---|---|---|
| Alternative specific constant WFH | WFH | -2.990 | -10.200 |
| Alternative specific constant commute by car driver | Car driver | 0.323 | 2.950 |
| Alternative specific constant commute by car pax | Car pax | -1.290 | -11.100 |
| Alternative specific constant commute by taxi/rideshare | Taxi/Rideshare | -3.040 | -9.110 |
| Alternative specific constant commute by train | Train | -0.719 | -5.660 |
| Alternative specific constant commute by bus | Bus | -1.250 | -9.940 |
| Alternative specific constant commute by light rail | Light rail | -1.080 | -4.000 |
| Alternative specific constant commute by ferry | Ferry | -1.860 | -3.120 |
| Alternative specific constant commute walking | Walking | -0.038 | -0.207 |
| Alternative specific constant commute by bicycle | Bicycle | -0.979 | -4.390 |
| Alternative specific constant commute by motorcycle | Motorcycle | -1.150 | -4.300 |
| Female (1,0) | No Work | 0.329 | 4.580 |
| Number of individuals per household | WFH | 0.249 | 5.300 |
| Number of cars per person in household | WFH | 0.318 | 2.780 |
| In-vehicle travel time (mins) | All modes | -0.003 | -2.090 |
| Travel time active modes (mins) | Walking and bicycle | -0.026 | -6.050 |
| Access, egress and waiting time (mins) | Train, Bus, Light Rail and Ferry | -0.006 | -3.060 |
| Cost (AUD$) | All modes except walking and bicycle | -0.019 | -5.340 |
| Workplace located in CBD (1,0) | WFH | 0.617 | 3.350 |
| Workplace located in Newcastle (1,0) | WFH | -1.030 | -3.030 |
| Workplace located in Illawara (1,0) | WFH | -1.130 | -2.890 |
| Workplace located in New South Wales (1,0) | WFH | 1.500 | 8.410 |
| Monday (1,0) | WFH | 3.330 | 17.100 |
| Tuesday (1,0) | WFH | 3.230 | 16.700 |
| Wednesday (1,0) | WFH | 3.100 | 16.100 |
| Thursday (1,0) | WFH | 3.100 | 16.000 |
| Friday (1,0) | WFH | 3.050 | 15.800 |
| Latent variable WFH lovers | WFH | 2.840 | 14.700 |
| Latent variable PT concern | WFH | -0.945 | -59.500 |
| Individual-specific error component associated with WFH latent variable | WFH | 0.086 | 2.470 |
| Individual-specific error component associated with PT latent variable | WFH | 3.430 | 16.400 |

# RESULTS: CHOICE MODEL

## No Work

- Female (+)

## Work from Home

- Number of individuals per household (+)
- Number of cars per person in household (+)
- Workplace located in CBD
- Monday > Tuesday > Wednesday/Thursday > Friday (++ > +)
- WFH lover (+)
- PT concern (-)

## Commute

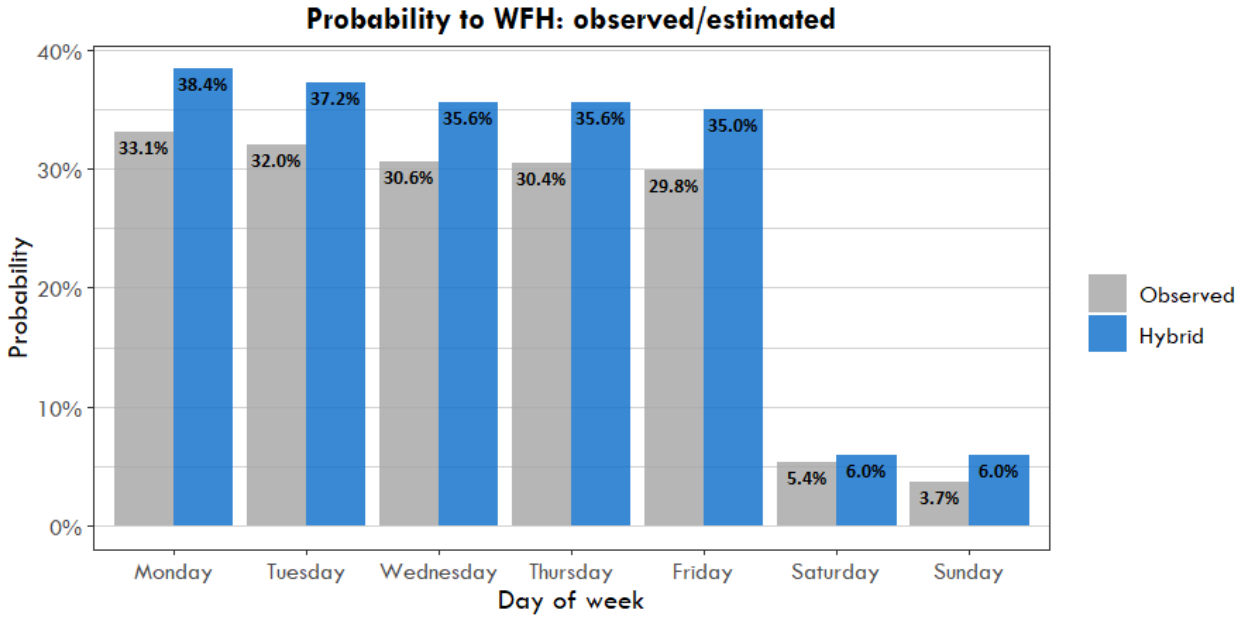
- Cost (-)
- Travel time (-)
- Access, egress, waiting time (-)

# RESULTS: CHOICE MODEL GOODNESS OF FIT

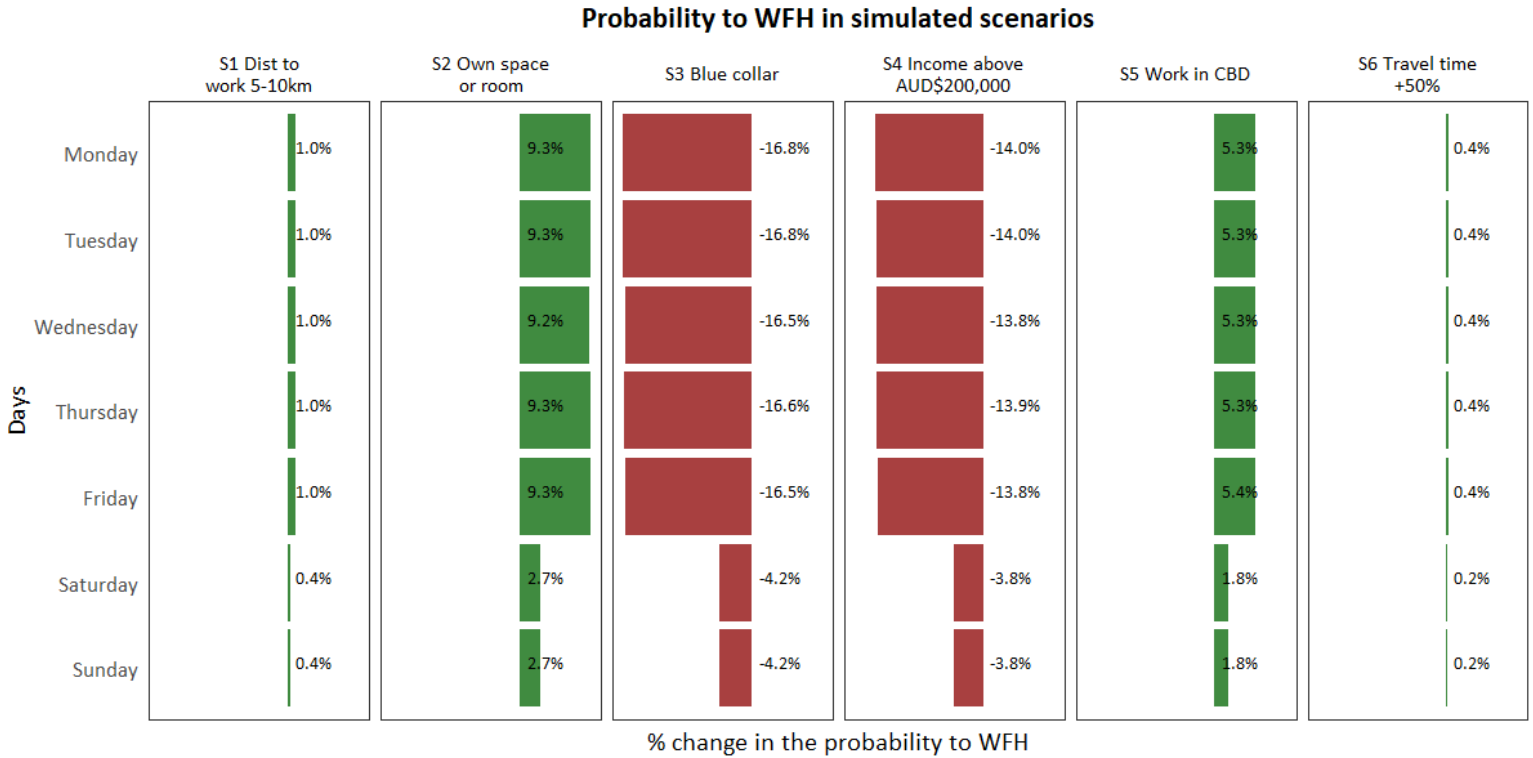
| | MNL | Hybrid Model | Hybrid Model – Choice model part only |
|---|---|---|---|
| Sample size | 4,518 | 4,518 | 4,518 |
| Number of parameters | 36 | 110 | 31 |
| Log-Likelihood | -5,011.37 | -47,645.74 | -4,865.04 |
| AIC/n | 2.23 | 21.14 | 2.17 |

# PROBABILITY TO WORK FROM HOME

# WFH PROBABILITY: BASE SCENARIO



# WFH PROBABILITY: SIMULATED SCENARIOS



# CONCLUSION AND NEXT STEPS

# CONCLUSION

- Results show that there is a significant influence of the attitude towards work from home (WFH) and the level of concern towards public transport and the workplace
- There is a positive relationship between the probability to WFH and being WFH lover, suggesting that people that WFH more seem comfortable with this decision
- There is a negative relationship between the probability to WFH and a higher level of PT concern, suggesting that people that work outside home are more concerned about the use of PT and going to their workplace
- Results show the existence of serial correlation between the structural equations and the choice models → significant error components
- More work needs to be done to understand the relationship between WFH lovers and level of concern towards PT and workplace

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