# Identifying main drivers for students and staff members' mode choice or to work/study from home: A case study in Australia

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## SHORT SUMMARY

Universities are major trip attractors and generators in large cities, and they have a significant influence in the transport network particularly in high-density areas. The trips to and from university campus are made by staff, students and visitors, with an important daily rotation of people (e.g., students that leave early, arrive later, etc.). In this study, we aim to improve our understanding of the trips made to the University of Sydney campuses, one of the largest universities in Australia, how individuals (namely, staff and students) choose to study/work from home and their modes of transport used since the start of COVID-19. We have collected two sets of data in 2022 from a survey which was answered by both staff and students at the University of Sydney. A mixed logit model is estimated to understand the motivations and main drivers to work/study from home or to choose different modes of transport when attending campus.

**Keywords:** University travel choices; sustainable modes of transport; work/study from home; staff and student behaviour; choice modelling

# 1. INTRODUCTION

Since the start of COVID-19 in early 2020, the world has seen major changes in daily life. Different strategies from relevant authorities have led to different outcomes and impacts across numerous activities. Businesses, schools and universities have had to quickly adapt to this new normality by offering their employees and students the possibility to work and study from home. This quick adaptation has proven to have some benefits from the point of view of employers and employees who have stated they prefer to work from home (WFH) more often in the future (Beck & Hensher, 2021). The pandemic and the varied government strategies have had major impacts on commuting behaviour; at the start of the pandemic we saw a significant reduction in congestion around the city; however, since the start of 2022 we have seen levels of congestion that are close to pre-pandemic levels and, in some areas, even worse. Transport studies carried out in different cities around the world have shown that the use of public transport has decreased significantly, and, in their majority, these trips seem to have moved to car use (Balbontin et al., 2021; Hensher et al., 2022). This is a big setback for public transport where confidence has been slow to build back (Beck et al., 2022) and, more generally, for sustainable transport, which represents an important concern for transport authorities and government.

Universities are major trip attractors and generators in large cities, and they have a significant influence in the transport network particularly in high-density areas. The trips to and from university campus are made by staff, students and visitors, with an important daily rotation (e.g., students that leave early, arrive later, etc.). Despite the significant influence that universities have in the transport network, there is limited information on how trips to and from university campus are made, which modes of transport are preferred and why, and the effects that COVID-19 has had and will likely have in the medium to long-term in travel behaviour to campus. For the last three years, the University of Sydney, which is one of the largest universities in Australia with approximately 83,000 staff and students[1], has been offering a hybrid teaching model for a larger number of its courses, where students have face-to-face and online classes. However, it is moving to face-to-face classes exclusively towards mid-2023. The hybrid model is also being implemented for staff members, who are allowed to work from home for the whole or part of the week, when their role allows for it. However, there is still limited knowledge about the preferences towards working from home and towards studying from home (SFH), and how these have affected staff and students travel behaviour, principally in tertiary education.

In this study, we aim to improve our understanding of the trips made to the University of Sydney campuses, how often individuals (namely, staff and students) choose to study/work from home, and their modes of transport used since the start of COVID-19. We have collected two sets of data in 2022 from a survey which was completed by both staff and students. A mixed logit model is estimated to understand the motivations and main drivers to work/study from home or to choose different modes of transport when attending campus. The next section presents the data, followed by the methodology and model results and discussion. This short paper is finalised with the main conclusions.

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[1] To put this in perspective, this figure would make the University of Sydney the 23rd largest city in Australia (behind Mackay whose population is 85,000 and above Rockhampton with a population of 80,200). It would be the 5th largest city in New South Wales behind Sydney, Newcastle, Wollongong, and Albury-Wodonga. It is larger than Wagga Wagga (57,000) and almost double the size of Orange (42,000).

## 2. DATA

The data used in this study was collected using an online survey in two waves. The first one was collected in May-June 2022 and the second one October-November 2022; a period where there existed no restrictions on movement but the University still offered education within the hybrid-format. The results discussed here only include students and staff members of the University of Sydney who lived in Sydney at the time of completing the survey. Table 1 represents some general descriptive statistics of the sample for both waves, separated by staff and students. As expected, the income and age of staff is significantly higher than students. Results show that students tend to live in households with more members – but slightly less children, and more cars/drivers licences available. Results in Table 1 show that in Wave 1, the total number of days/week studied from home last week (2.58) are higher than pre-COVID levels (1.86); and for staff members the increase is even higher, with an average of 2.3 days worked from home last week relative to 0.62 pre COVID-19. In Wave 2, the proportion of days worked / studied home is virtually unchanged from Wave 1 for students (previously 2.58, now 2.60) and has decreased slightly for staff (previously 2.31, now 2.15).

**Table 1: General descriptive statistics students and staff - mean (standard deviation) - Waves 1 and 2**

|  | Student | | Staff | |
|---|---|---|---|---|
|  | **Wave 1** | **Wave 2** | **Wave 1** | **Wave 2** |
| Age (years) | 24.23 (7.31) | 23.51 (6.10) | 43.29 (11.43) | 43.28 (11.49) |
| Gender female (1,0) | 75% | 65% | 70% | 70% |
| Personal annual income (000AUD$) | 22.08 (25.77) | 24.00 (33.74) | 125.17 (61.84) | 125.29 (58.97) |
| Number of cars available in household | 1.57 (1.23) | 1.38 (1.68) | 1.35 (0.84) | 1.36 (0.90) |
| Number of people living in same household | 3.48 (2.40) | 3.82 (11.63) | 2.75 (1.28) | 2.85 (1.32) |
| Number of children in household | 0.52 (0.80) | 0.44 (1.16) | 0.57 (0.86) | 0.65 (0.93) |
| Number of drivers' license in household | 2.33 (1.34) | 2.34 (8.84) | 1.90 (0.85) | 1.93 (0.88) |
| Total number of weekly days worked/studied last week | 5.48 (1.41) | 5.59 (1.40) | 4.97 (0.94) | 4.97 (0.91) |
| Total number of weekly days worked/studied from home last week | 2.58 (1.90) | 2.60 (1.82) | 2.31 (1.61) | 2.15 (1.59) |
| Total number of weekly days worked/studied from campus last week | 2.06 (1.69) | 2.13 (1.61) | 2.44 (1.63) | 2.66 (1.56) |
| Total number of weekly days worked/studied partly from home and campus last week | 0.84 (1.31) | 0.86 (1.38) | 0.21 (0.65) | 0.16 (0.58) |
| Total number of weekly days worked/studied before COVID-19 | 5.82 (1.29) | 6.03 (1.31) | 5.11 (0.88) | 5.14 (0.94) |
| Total number of weekly days worked/studied from home before COVID-19 | 1.86 (1.65) | 2.46 (1.91) | 0.63 (1.16) | 0.68 (1.26) |
| Total number of weekly days worked/studied from campus before COVID-19 | 3.20 (1.77) | 2.70 (1.77) | 4.30 (1.29) | 4.35 (1.36) |
| Total number of weekly days worked/studied partly from home and campus before COVID-19 | 0.76 (1.42) | 0.87 (1.45) | 0.17 (0.67) | 0.12 (0.52) |
| Considered moving residence on the basis of a change in your activity travel pattern as a result of COVID-19 (1,0) | 29% | 26% | 27% | 23% |
| Total number of respondents | **133** | **1,171** | **496** | **364** |

Figure 1 shows work/study behaviour for each day of the week, and Figure 2 shows the mode chosen to go to the campus. Results show that students are more likely to study partly from campus and from home than staff members (with Wave 2 mirroring Wave 1), and they are also more likely to do some study during the weekends than staff members. Regarding the modes used, staff

members are currently much more likely to use their car to go to campus, and students are more likely to use public transport and active modes. Staff appear to have increased their car use compared to pre-COVID. Compared to students, car use amongst staff is picking up quite rapidly compared to pre-COVID, while use of active modes remains static. These results reveal the behavioural differences between staff members and students.
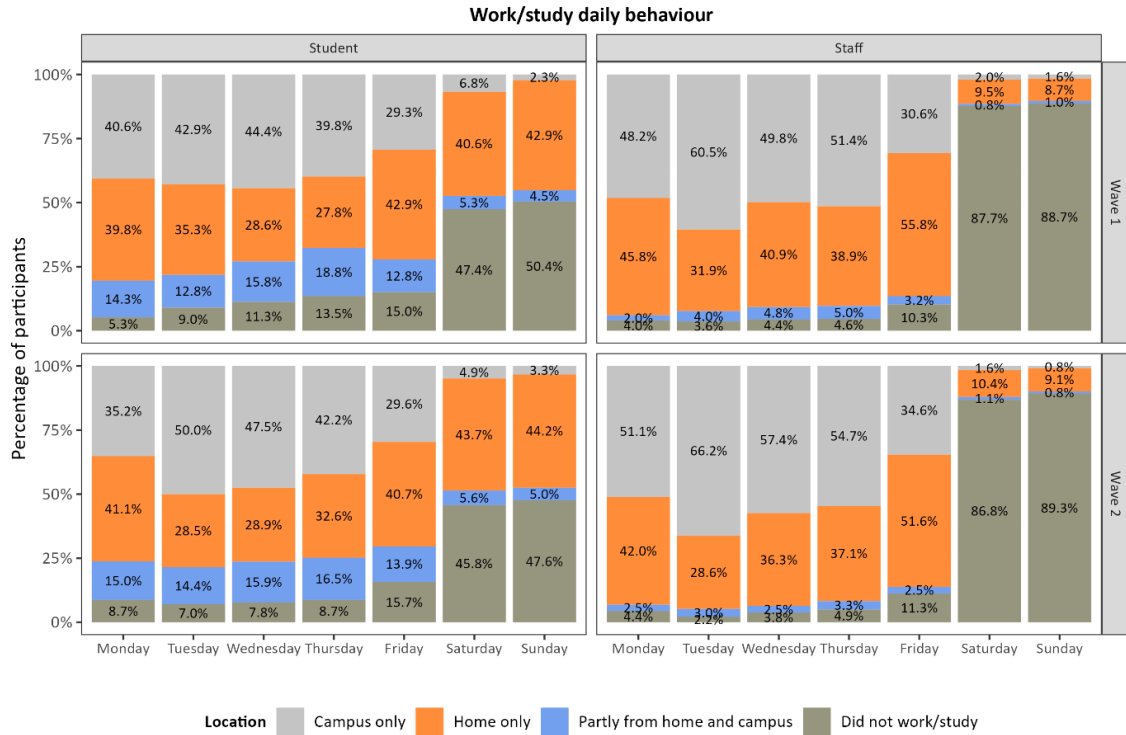


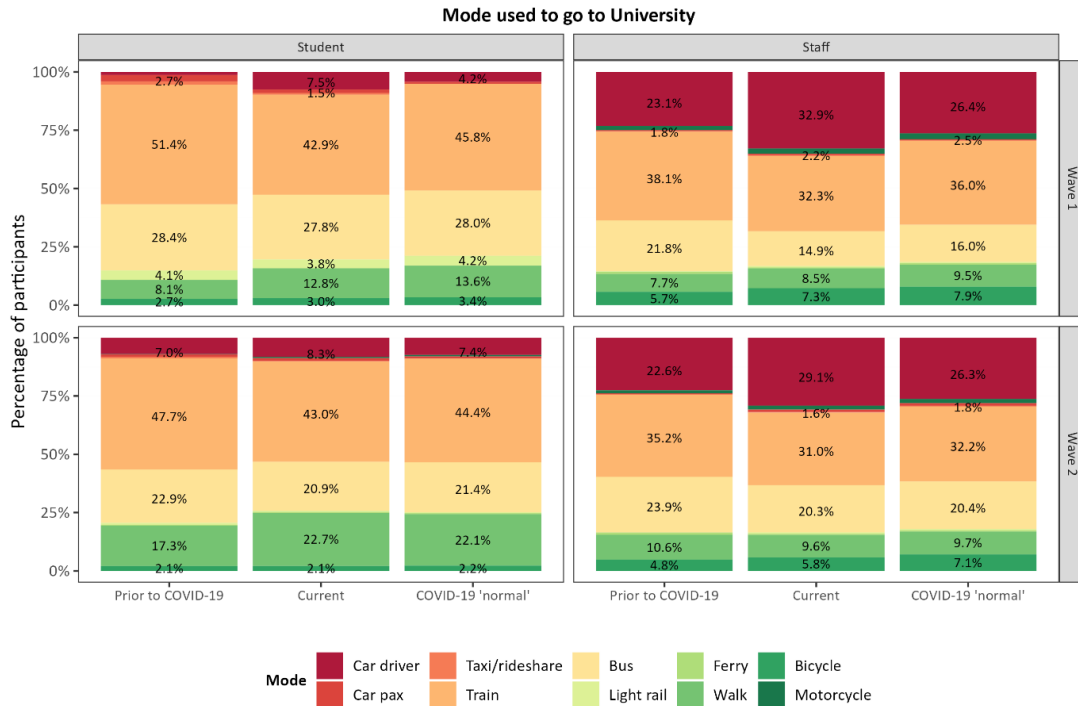**Figure 1: Work/study daily behaviour**



**Figure 2: Mode used to go to University**

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In terms of activities which influence the decision to come into the university, Figure 3 shows that in both Waves 1 and 2, students are motivated to come to campus to participate in face-to-face classes or attend a class or feel that they learn more effectively when on campus relative to the start of the pandemic. They are also interested in building networks and meeting new people. Staff come to campus to participate in face-to-face discussion and also for a change from WFH with a very similar pattern reported in both waves (Figure 3).
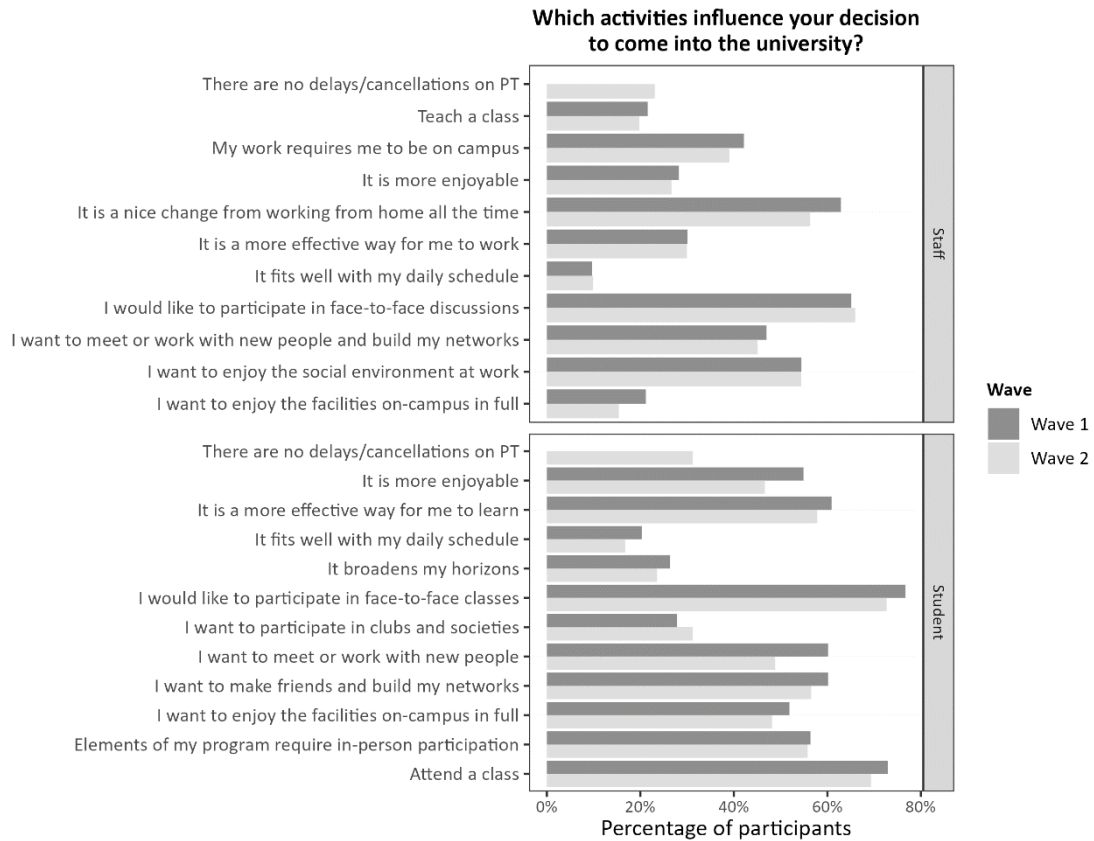


**Figure 3: Which activities influence your decision to come into the university?**

## 3. METHODOLOGY

A mixed logit model was estimated to identify the main drivers for students and staff members to decide where to work/study each day of the week. The modelling framework is presented in Figure 4. The decisions were represented by twelve alternatives, which are given in Table 2.
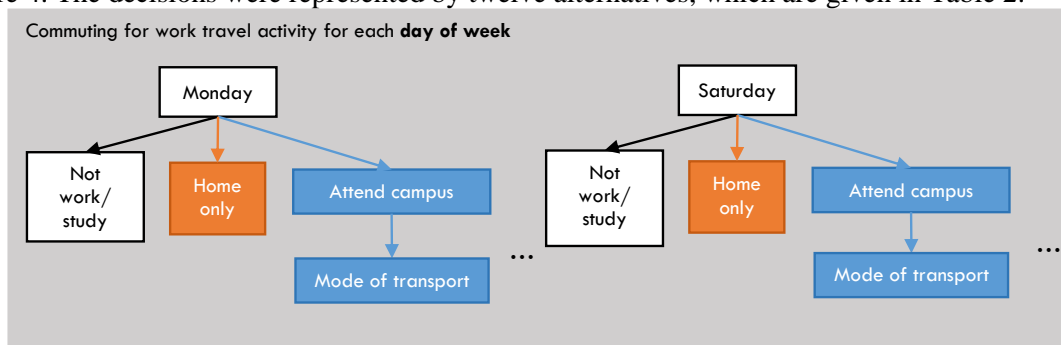


**Figure 4: Modelling framework**

**Table 2: Alternative numbers per day of week**

| Monday - Sunday | |
|---|---|
| **Alternative** | **Description** |
| 1 | Not work/study |
| 2 | Work/study from home only |
| 3 | Attending campus - car driver |
| 4 | Attending campus - car passenger |
| 5 | Attending campus - taxi/rideshare |
| 6 | Attending campus - train |
| 7 | Attending campus - bus |
| 8 | Attending campus - light rail |
| 9 | Attending campus - ferry |
| 10 | Attending campus - walk |
| 11 | Attending campus - bicycle |
| 12 | Attending campus - motorcycle |

The utility function of the WFH/SFH alternative, is expressed as follows:

$$U_{WFH/SFH} = \beta_{WFH/SFH} + \sum_j \beta_j \cdot Z_{qj} + \sum_i \beta_i \cdot H_{qi} + \varepsilon_{WFH/SFH} \tag{1}$$

where $Z_{qj}$ represents characteristic $j$ of respondent $q$ (e.g., age, gender, income); $H_{ni}$ represents attribute $i$ of the home or work of respondent $q$ (e.g., distance to campus, activities that influence decision to attend campus); $\varepsilon$ represents the error term; and $\beta$ are the estimated parameters associated with each attribute. The survey included different activities that could influence a participant's decision to attend campus. They were grouped into different categories, as shown in Table 3. The utility function for the alternatives to attend campus commuting by mode $m$ is given by:

$$U_{Campus_m} = \beta_{Campus_m} + \sum_j \beta_j \cdot Z_{qj} + \sum_i \beta_i \cdot H_{qi} + \sum_k \beta_k \cdot X_{mk} + \varepsilon_{Campus_m} \tag{2}$$

where $X_{mk}$ represent attribute $k$ that describes mode $m$ (e.g., travel time, fare/cost). The utility function of the *no work* alternative is expressed in equation (3):

$$U_{NoWork} = \beta_{NoWork} + \sum_j \beta_j \cdot Z_{qj} + \varepsilon_{NoWork} \tag{3}$$

It is important to note that respondents provided responses on the choice made each day of the 7-day week, and hence there are 7 choice sets per respondent. To recognise this, the error terms account for the panel structure of the data, i.e., varying across individuals but the same within individuals. The model results include those parameter estimates that were statistically significant with a 95% confidence level.

**Table 3: Categories for activities that influence participants decision to attend campus**

| Description | Staff/Student | Category |
|---|---|---|
| I would like to participate in face-to-face classes | Student | Attend university because of classes/work |
| Attend a class | Student | Attend university because of classes/work |
| Elements of my program require in-person participation | Student | Attend university because of classes/work |
| It is a more effective way for me to learn | Student | Attend university because of classes/work |
| It is more enjoyable | Student | Attend university for social activities |
| I want to enjoy the facilities on-campus in full | Student | Attend university because of facilities or fits within my daily schedule |
| I want to meet or work with new people | Student | Attend university for social activities |
| I want to make friends and build my networks | Student | Attend university for social activities |
| It broadens my horizons | Student | Attend university for social activities |
| I want to participate in clubs and societies | Student | Attend university for social activities |
| It fits well with my daily schedule (e.g., childcare in or close to campus; my gym is close to campus) | Student | Attend university because of facilities or fits within my daily schedule |
| There are no delays/cancellations on public transport | Student | Attend university when there are no delays/cancellations on PT |
| I would like to participate in face-to-face discussions | Staff | Attend university because of classes/work |
| Teach a class | Staff | Attend university because of classes/work |
| My work requires me to be on campus | Staff | Attend university because of classes/work |
| It is a more effective way for me to work | Staff | Attend university because of classes/work |
| It is more enjoyable | Staff | Attend university for social activities |
| I want to enjoy the facilities on-campus in full | Staff | Attend university because of facilities or fits within my daily schedule |
| I want to meet or work with new people and build my networks | Staff | Attend university for social activities |
| I want to enjoy the social environment at work | Staff | Attend university for social activities |
| It is a nice change from working from home all the time | Staff | Attend university because it is a nice change from home all the time |
| It fits well with my daily schedule (e.g., childcare in or close to campus; my gym is close to campus) | Staff | Attend university because of facilities or fits within my daily schedule |
| There are no delays/cancellations on public transport | Staff | Attend university when there are no delays/cancellations on PT |

## 4. RESULTS AND DISCUSSION

Preliminary model results are presented in Table 4, which combine Waves 1 and 2. All the parameter estimates are statistically significant at the 95% confidence level. Travel times and costs (including fuel costs) have a negative parameter estimate, as expected, and the value of travel time savings will be discussed below. Interestingly, the distance from home to campus has a very significant influence on the probability to use the train, suggesting that staff and students who live further away from campus are likely to use the train to go to campus.

**Table 4: MML Model Results**

| Description | Alternative | Mean (t-value) |
|---|---|---|
| Alternative specific constant no work (base) | No work | - |
| Alternative specific constant WFH | WFH/SFH | 0.27 (6.32) |
| Alternative specific constant commute by car driver | Car driver | 0.61 (4.28) |
| Alternative specific constant commute by car pax | Car pax | -1.15 (5.08) |
| Alternative specific constant commute by taxi/rideshare | Taxi/Rideshare | -1.06 (1.70) |
| Alternative specific constant commute by train | Train | -0.50 (3.83) |
| Alternative specific constant commute by bus | Bus | -0.14 (1.15) |
| Alternative specific constant commute by light rail | Light rail | 0.09 (0.38) |
| Alternative specific constant commute by ferry | Ferry | 0.38 (1.24) |
| Alternative specific constant commute walking | Walking | -0.86 (3.70) |
| Alternative specific constant commute by bicycle | Bicycle | -1.52 (6.23) |
| Alternative specific constant commute by motorcycle | Motorcycle | 0.66 (3.03) |
| Travel time (mins) | Car driver, pax and motorcycle | -0.02 (2.73) |
| Travel time (mins) | Public transport modes | -0.01 (3.47) |
| Travel time active modes (mins) | Active modes | -0.001 (1.95) |
| Fuel cost (AUD$) | Car driver | -0.06 (2.05) |
| Fare (AUD$) | Taxi/Rideshare | -0.05 (2.11) |
| Fare (AUD$) | Public transport modes | -0.19 (5.88) |
| Distance from home to work (kms) | Train | 0.05 (10.98) |
| Female (1,0) | WFH/SFH | -0.19 (3.45) |
| Personal income staff ('000$AUD) | WFH/SFH | 0.00 (3.43) |
| Personal income students ('000$AUD) | WFH/SFH | 0.00 (3.96) |
| Monday (1,0) | WFH/SFH | 0.58 (10.61) |
| Wednesday (1,0) | WFH/SFH | 0.13 (2.32) |
| Thursday (1,0) | WFH/SFH | 0.23 (4.02) |
| Friday (1,0) | WFH/SFH | 0.75 (13.73) |
| Attend university for social activities - students (1,0) | Car driver, pax and motorcycle | -0.38 (2.83) |
| Attend university because of facilities or fits within my daily schedule - students (1,0) | Car driver, pax and motorcycle | 0.50 (3.84) |
| Attend university when there are no delays/cancellations on PT - students (1,0) | Car driver, pax and motorcycle | -0.77 (4.44) |
| Attend university because of work - staff (1,0) | Car driver, pax and motorcycle | 0.63 (5.23) |
| Attend university for social activities - staff (1,0) | Car driver, pax and motorcycle | -0.33 (3.37) |
| Attend university when there are no delays/cancellations on PT - staff (1,0) | Car driver, pax and motorcycle | -1.11 (4.64) |
| Attend university because it is a nice change from home all the time - staff (1,0) | Car driver, pax and motorcycle | -0.38 (3.94) |
| Attend university because of classes - students (1,0) | Active modes | 1.41 (5.95) |
| Attend university for social activities - students (1,0) | Active modes | 0.27 (2.50) |
| Attend university because of facilities or fits within my daily schedule - students (1,0) | Active modes | 0.32 (3.48) |
| Attend university because of work - staff (1,0) | Active modes | 0.53 (2.28) |
| Attend university for social activities - staff (1,0) | Active modes | 0.78 (4.91) |
| Attend university because of facilities or fits within my daily schedule - staff (1,0) | Active modes | 0.37 (2.69) |
| Standard error | Public transport modes | 1.37 (27.82) |
| Standard error | No work | 0.62 (16.35) |
| *Number of parameters* | | *40* |
| *Log-likelihood equal shares L(0)* | | *-20,097.11* |
| *Log-likelihood at convergence* | | *-18,028.33* |
| *AIC/n* | | *2.778* |

Results show that students that attend campus mainly for social activities are more likely to use active modes and less likely to use motorised private modes, relative to the other alternatives. Students that attend campus mainly because of classes, are more likely to use active modes; and those that go for the facilities/fits within their daily schedules are more likely to use private motorised vehicles, followed by active modes. Staff members that attend campus mainly due to work are more likely to use car, followed by active modes; and those that attend due to social activities are more likely to use active modes and less likely to use the car. When there are no cancellations/delays with public transport, both staff and students are less likely to use private motorised modes.

The value of travel time savings (VTTS in $/person hour) estimates for car, public transport and taxi/rideshare are presented in Table 5. The value for car driver aligns with what is obtained from the broader population of commuters but is lower than expected for public transport (which is expected to be around $5/person hour). This might be due to the fact that we are combining students and staff members and incorporating activities to attend campus which might have a significant influence on the VTTS, which is being analysed in more detail at the moment. The results presented in this short paper are preliminary, and we are currently working on understanding all the explanatory variables that might be explaining daily decisions to WFH/SFH or attend campus, providing separation of parameters between staff and students.

**Table 5: Value of travel time savings results**

| Value of travel time savings (AUD$/person hour) | Mean | Std Error |
|---|---|---|
| **Car driver** | 16.74 | 22.13 |
| **Public transport** | 1.99 | 1.16 |
| **Taxi/Rideshare** | 20.18 | 15.66 |

With this model, we are also able to estimate elasticities, which represent the percentage change in the probability to choose an alternative given percentage changes in the explanatory variables, *ceteris paribus*. The elasticity estimates for this preliminary model are presented in Figure 5. The results show that the distance from home to campus has the greatest influence on the probability to choose train: if a student or staff member lives 10% closer to campus, they are 9.4% less likely to choose the train. A student that goes to campus because of classes is 80% more likely to use the bicycle and 72% more likely to walk than a student that is not motivated to go to campus because of class. As mentioned above, the model presented in this report is an initial model and more needs to be done to obtain a final model.
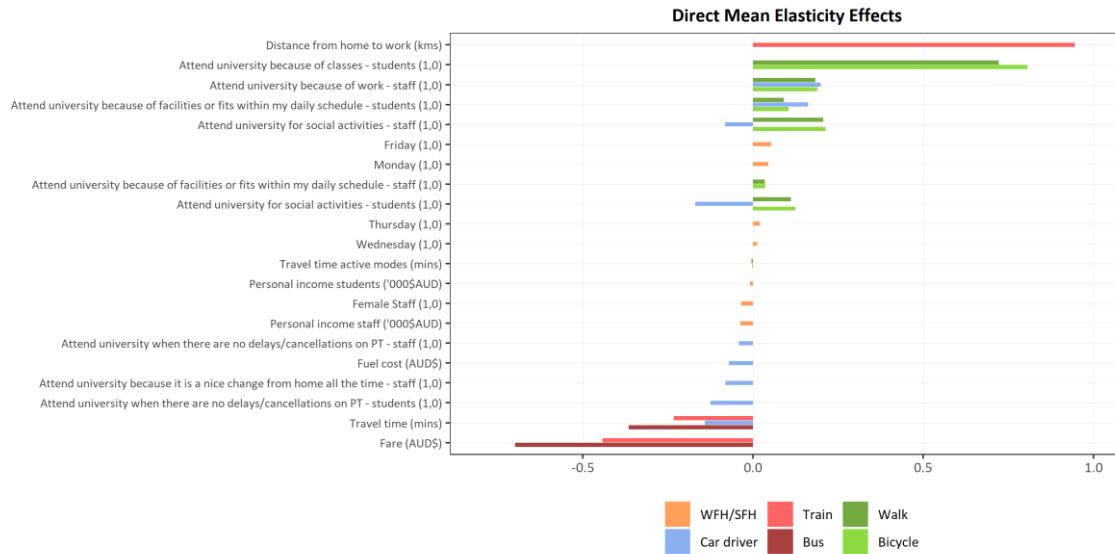


**Figure 5: Elasticity results**

## 5. CONCLUSIONS

This study aims to understand staff and students' preferences to work/study from home or to attend university campus using different modes of transport. The data is collected in two waves of data for staff and students that work/study at the University of Sydney, Australia. A mixed

logit is estimated to understand preferences for each day of the week. Results are preliminary, and initial findings suggest the importance of the distance from home to campus, fare, activities such as classes or work-related or social. Results suggest that those that live further away are more likely to use the train, while students that attend campus for social activities are more likely to use active modes and less likely to use car driver as their main mode of transport. These initial fundings are encouraging as they are suggesting important drivers that should be considered when creating University travel demand management programmes to incentivise return to campus by sustainable modes of transport.

## 6. ACKNOWLEDGEMENTS

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