**MATH3831 Statistical methods for social and market research**

Term 2, 2021

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# Project 2 – Questionnaire design and analysis

Please include this cover sheet with your group submissions.

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Signed: Miraal Khan Date: 10.08.21

Signed: Zihao Yu Date: 10.08.21

Signed: Jaslin Feng Date: 10.08.21

Signed: Date:

## 1. Abstract

*"UNSW students' attitude towards online learning and the possible underlying factors that influence their attitude"*. Given the current Covid-19 crisis, the prevailing discussions behind the attitudes of students towards online learning is mired in a plethora of interleaving factors including, but not limited to, stable internet, suitable devices/convenience, concentration, supportive course coordinators, sufficient resources and the students' underlying demographics. Countless debates and opinions have discovered many factors that may affect one's attitude towards this topic depending on their individual experiences and environment. Hence it is quite difficult to comment on all UNSW students however as the survey results show, there are certain factors which are widely influential towards one's attitude. After removing incomplete or improperly filled questionnaires submitted through various platforms, a total of 92 participants' responses were used for factor analysis. The scale was made up of five factors as indicated above and have concluded that UNSW students have a mediocre attitude towards online learning and more underlying factors are needed to be discovered via more detailed questionnaires.


## 2. Introduction

In early 2020, UNSW students were forced to take online learning due to the serious situation of COVID-19. Online learning seems to be the best way for students to continue their studies. Online learning requires students to have the confidence to study independently and to be able to evaluate their own learning results (Basaran & Yalman,2020). In online learning, the more confident the students are, the more likely they are to engage in voluntary learning activities and interact more actively with the classes, thus increasing their online learning satisfaction (Martin et al.,2020). In addition, online learning means that learners have more freedom, so the ability of self-management and self-monitoring of individuals appears to be of great importance. If students cannot effectively control their own behaviours, they will not be fully engaged in the online course learning, which will eventually lead to the reduction of students' satisfaction with online learning. Therefore, it is of great significance to study the online learning satisfaction of UNSW students from the aspects of interaction, self-regulating learning, and internet self-efficacy to improve the teaching quality of online learning. Therefore, based on literature investigation, this study summarises the underlying factors that may affect UNSW students' attitude with online learning and conducts a survey and research on UNSW students through questionnaire surveys.

## 3. Method

In this study, a scale was developed to determine UNSW students' attitude towards online learning and the possible underlying factors that influence their attitudes. In the study, factor analysis and cluster analysis were applied to the data collected in the scale development process, in order to support the judgement of this study. Data were collected using an online, self-completion survey, by posting it through social media platforms.

### 3.1 Data collection process

A questionnaire was made by Google Forms and sent to those students to evaluate their distance learning experience during the quarantine. The questionnaire was sent to different online platforms such as Facebook groups, Arc society forum as well as our fellow UNSW colleagues. All participants were asked to fill out the survey. The collected data were downloaded to a computer through excel program and was subjected to an error debugging process. After this process the data were uploaded to the SPSS program and analysis was made.

### 3.2 Participants

There were 92 participants who are currently studying at UNSW who filled out the questionnaire form. Among the 92 participants, 28 students were from Third Year, 26 students were from Second Year, 25 students were from Fourth Year, 10 students were from First Year and 3 students were from Fifth Year (see Table). All participants in the study were on a voluntary basis and anonymous.

| Grade | Frequency | Percentages (to 2.d.p) |
|---|---|---|
| First Year | 10 | 10.87 |
| Second Year | 26 | 28.26 |
| Third Year | 28 | 30.43 |
| Fourth Year | 25 | 27.17 |
| Fifth Year | 3 | 3.26 |
| Total | 92 | 100 |

### 3.3 Research instruments

The researchers developed a questionnaire to elicit UNSW students' attitude towards online learning. The questionnaire has three sections. The first section includes the key question of interest which is done by using semantic differential scale. The second section includes 2 broad questions and considers the 6 underlying factors that influence their attitude with rank ordering scale and Likert scale ranging from "Strongly disagree" to "Strongly agree". The last section aimed to collect demographic information about grades, field of study, time of commute to UNSW, living situation and employment status.

### 3.4 Data analysis

First of all, an analysis on the reliability of our collected data. By using SPSS, we calculated the alpha value of Cronbach Alpha. For the 10 items, we got Cronbach's alpha value (0.705), which suggests that the items have relatively internal consistency reliability according to what Kline, 1993 [Lecture slides] suggests. Additionally, responses to the second question on effectiveness of online learning has 0.7004067 correlation with responses to the first question. The high correlation indicates that our survey has a meritorious reliability as well as convergent validity. Hence, we proceed with our analysis and interpretation of the results . Recall the aim of the survey that was conducted was to determine the overall attitude towards online learning by UNSW students and the feasible factors that affect their attitude. In such cases all current UNSW students were subjected to the survey with questions mainly revolving around the respondent's online learning environment and the resources available to them. After retrieving our collected data and generating excel sheets, we first utilised RStudio and SPSS to generate visualized data analysis to discuss the overall current UNSW students' attitude towards online learning by assessing the Sample mean and variance. And then, we make judgment on the listed factor question in our survey based on respondents' answers. Data plots, factor analysis and cluster analysis were used in different sections to derive the best output analysis. Detailed analysis procedure will be shown below.

# 4. Results

## 4.1 Introduction

Our survey provides a broad analysis into attitudes towards online learning and analysis is conducted on the possible underlying factors. Team judgement was utilised in constructing the survey with five questions based on the possible factors influencing the attitude towards online learning. A further six questions were asked in regards to the respondent's demographic factors. As such, the analysis is conducted in the following three sections with the first section conducting broad analysis on all current UNSW students' attitude, the second section exploiting possible factors given their interval scale identity and the third section delving deeper into demographic analysis given the non scale identity of the questions.

## 4.2 Overlook on UNSW students' attitude

We would like to infer UNSW students' overall attitude towards online learning based on our sample. According to our collected data, it is obvious that the majority of our sampled respondents neither like nor dislike online learning. By assuming the randomness and representativeness of our sample, we can presume that current UNSW students are having neutral attitudes and mild opinions on online learning online learning, whilst there exist certain advantages and disadvantages to different UNSW students.


### 4.3.1 Possible underlying factors

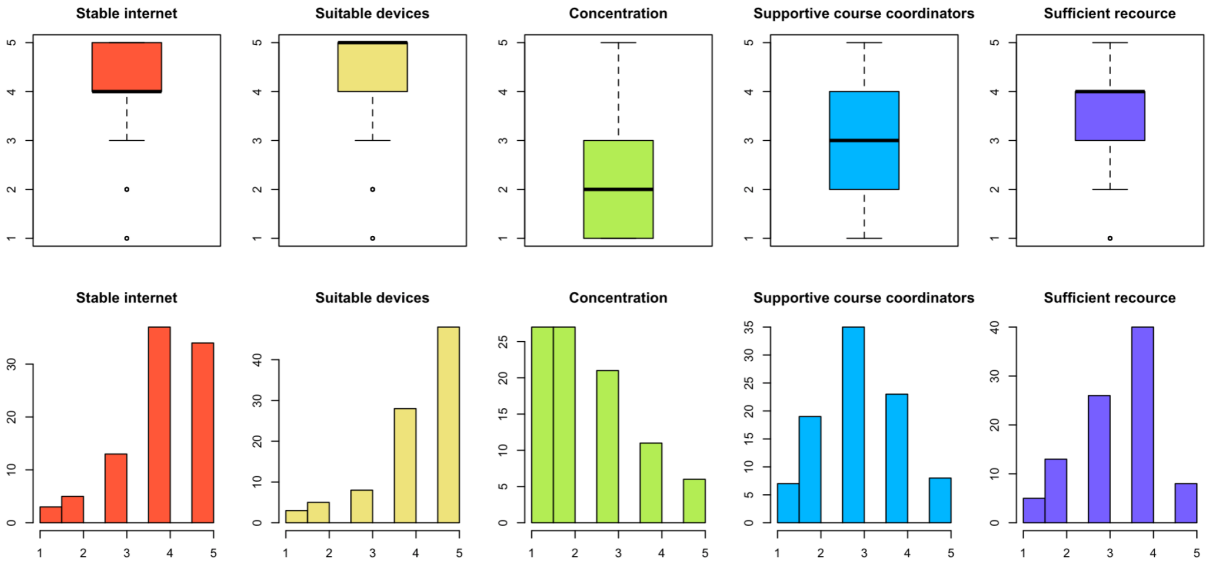
By assessing the correlation between responses to question four to question eight and the major question on attitude. We can tell that all of the questioned factors are positively correlated with the topic of our interest.

| | Q.1 and Q.4 | Q.1 and Q.5 | Q.1 and Q.6 | Q.1 and Q.7 | Q.1 and Q.8 |
|---|---|---|---|---|---|
| Correlation | 0.1421834 | 0.1272007 | 0.526711 | 0.2834535 | 0.2072161 |

In other words, based on our data we can conclude that the five factors that we selected are possible underlying factors that influence UNSW students' attitude towards online learning. In this following section, we would like to use principal component analysis and cluster analysis to substantively interpret our data.

### 4.3.2 Raw analysis on factor questions

Based on our received results, it is obvious that students have different opinions on different underlying factors.




[From left to right, the diagrams correspond to question four to eight]

Majority of our respondents tend to have access to stable internet and suitable devices that allow them to study online, whilst there eight out of ninety-two respondents disagreed with them having stable internet and suitable devices. At the same time, many of our respondents set forth their under-achieving concentration, mediocre support from university and above-mediocre amount of resources. Overall, the collected data depicts that only responses to question seven are non-skewed and all questions have positively correlated responses.

| *Correlation* | Internet | Device | Focus | Coordinator | Resource |
|---|---|---|---|---|---|
| Internet | 1 | | | | |
| Device | 0.72397368 | 1 | | | |
| Focus | 0.3327783 | 0.22048025 | 1 | | |
| Coordinator | 0.44898768 | 0.39672835 | 0.53059882 | 1 | |
| Resource | 0.40918172 | 0.42307095 | 0.3390669 | 0.65623417 | 1 |

In order to exploit the importance of each factor, we proceed to analysis our results with factor analysis and cluster analysis in the following,

### 4.3.3 Principal component analysis

After confirming the design of our questionnaire and sampled results satisfy the assumptions and data considerations for factory analysis [Appendix 4.3.1 PCA assumption]. We then access our collected data with RStudio to construct a factor analysis.

By using RStudio princomp command, we generated the following results:

Importance of components:

**Total Variance Explained**

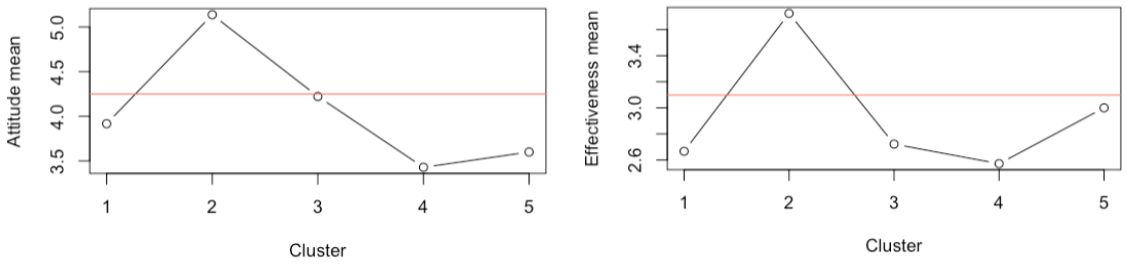
| | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| Component | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.811 | 56.224 | 56.224 | 2.811 | 56.224 | 56.224 |
| 2 | .969 | 19.385 | 75.609 | | | |
| 3 | .656 | 13.117 | 88.726 | | | |
| 4 | .303 | 6.051 | 94.777 | | | |
| 5 | .261 | 5.223 | 100.000 | | | |

Extraction Method: Principal Component Analysis.

Despite the low correlation between respondents' attitude towards online learning and their responses to our questions. First factor contributes the most to our underlying concept of interest. We should have factor analysis with only one loading factor. Our one factor PCA model is said to be the most explanatory and the only factor worth including in the model according to latent roots criterion. However, because the variance of the second factor is close enough to one and our sample is very likely to be biased, we may choose to have a two factor model. Furthermore, due to the high possibility of accessing biased sampled populations, we do not further interpret our data with principal component analysis. In the other word, the linear model derived by factor analysis can not be guaranteed to be practically precise. [Appendix 4.3.2 Loadings derived with RStudio code]
Therefore, we can conclude that we can have a one or two factor PCA model based on our judgment.

### 4.3.4 Cluster analysis

Next, we decided to further analyse the sampled populations for subsequent inference. In regards to the limitations of the target population, the simple randomly sampled population is not guaranteed to be objective and hence representative of all current UNSW students. Nevertheless, it can be assumed that the sample satisfies the representativeness and multicollinearity in order to proceed with cluster analysis. A such hierarchical clustering is utilised, with the number of clusters set to five.




The red line indicates the overall sample mean.

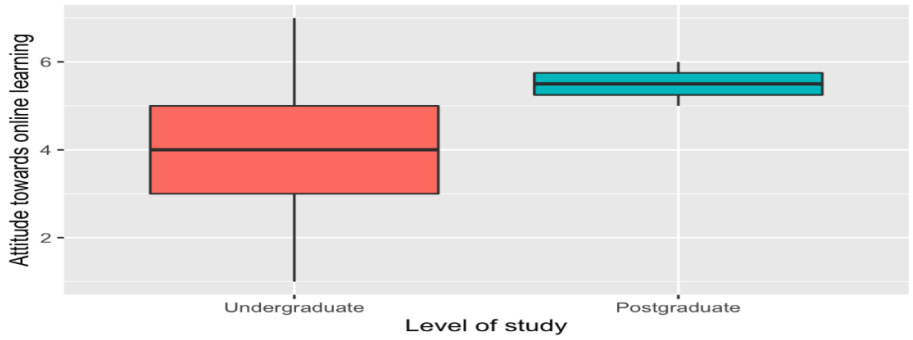
By observing the results generated by using RStudio, 92 responses were allocated into the 5 clusters [Appendix 4.3.3 cluster dendrogram][Note: The 77$^{th}$ observation is an outlier and is excluded for analysis in this part]. The corresponding responses were assessed for attitudes and opinions on the effectiveness of online learning and the underlying possible factors. From the sample, it can be inferred that students in cluster 2 had the most positive attitude towards online learning and in comparison students in cluster 4 had the most negative attitude. After extracting the second and fourth clusters, the following results were derived: [Appendix 4.3.4 Cluster and R code]

| | Question 4 | Question 5 | Question 6 | Question 7 | Question 8 |
|---|---|---|---|---|---|
| Cluster 2 | 4.586207 | 4.689655 | 3.793103 | 3.965517 | 3.896552 |
| Cluster 4 | 1.571429 | 1.571429 | 1.428571 | 2 | 1.857143 |
| Sample average | 4.021739 | 4.228261 | 2.369565 | 3.065217 | 3.358696 |

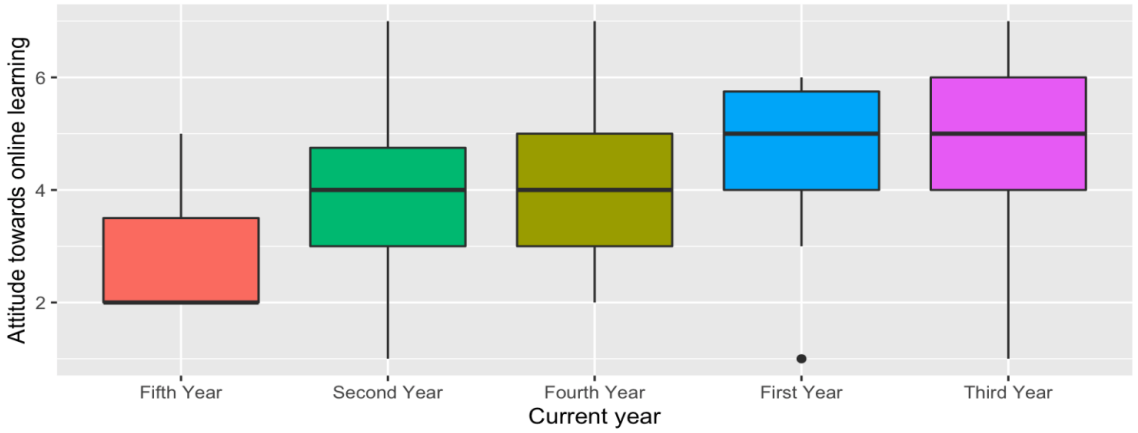
As a result, from the cluster analysis displayed for cluster 4, it can be derived that respondents were experiencing a difficult time in accessing stable internet connections, having suitable devices and being able to concentrate. Comparatively, respondents in cluster 2 were the opposite and had a generally more positive attitude. We may suspect that having a stable internet and suitable device are the most significant factors and the most desirable for students to have a decent online learning experience.

**4.4 Demographic analysis**

Due to the significant low response rates for postgraduate, research and non-award students, these sub-groups of the level of study were removed from analysis.

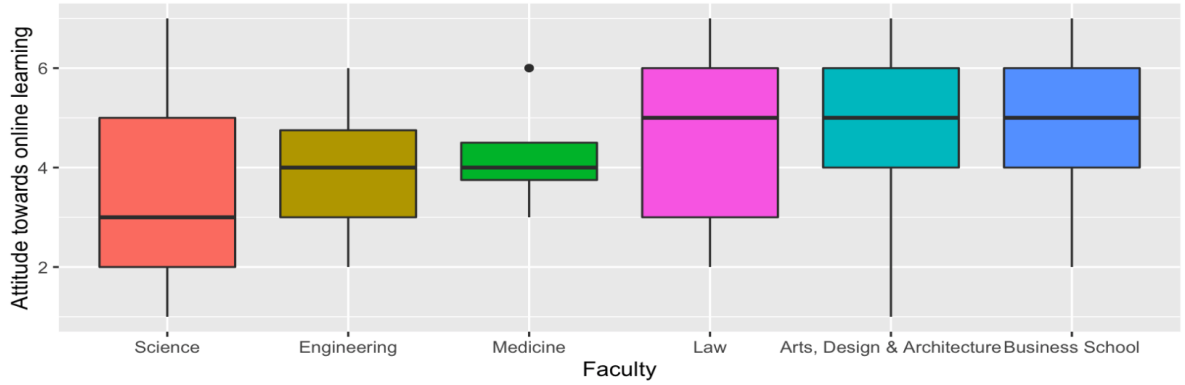



When measuring the attitude of UNSW towards online learning given their current year of study, it can be noted that the median for students in their first and third years was the same, and had the same variability. Given the median is '5' and the median for students in their fourth and second years is '4', it can be shown that there is a neutral to a slightly positive attitude towards online learning. With normal distribution and consistent dispersion of data, we can note that a student's year of study doesn't have a large effect on their attitude towards online learning. However this is in contrast to the fifth year's with their median at '2' reflecting a negative experience, and this could be due to those students spending a greater time with in-person university for their earlier years and comparing it with their current experiences.



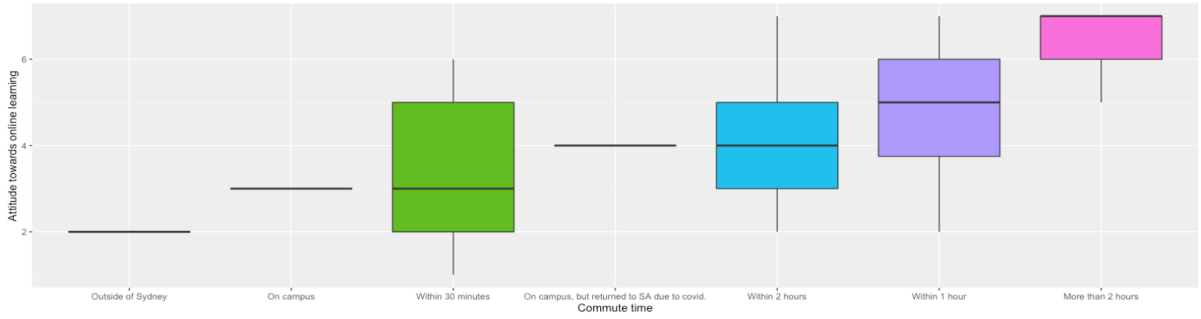

In the analysis of students' attitude towards online learning against the faculty they are in, it can be noted that students in Arts, Design & Architecture, Business and Engineering faculties have normal distributions. With a deeper view, engineering students have a median of 4 reflecting that there is a neutral experience whilst the other two faculties have students reflecting a median of 5, generally depicting a positive perspective. In contrast, students in the Science faculty have a positively skewed distribution but it's noteworthy to mention that

their median is ‘3’ demonstrating a slightly negative attitude and this could be due to most of these students not being able to participate in their practical labs and classes. Similarly, students studying medicine also have a positive distribution, whilst the Law faculty represents a negative distribution. Despite a positive median, it can be inferred that most students have a generally negative attitude.

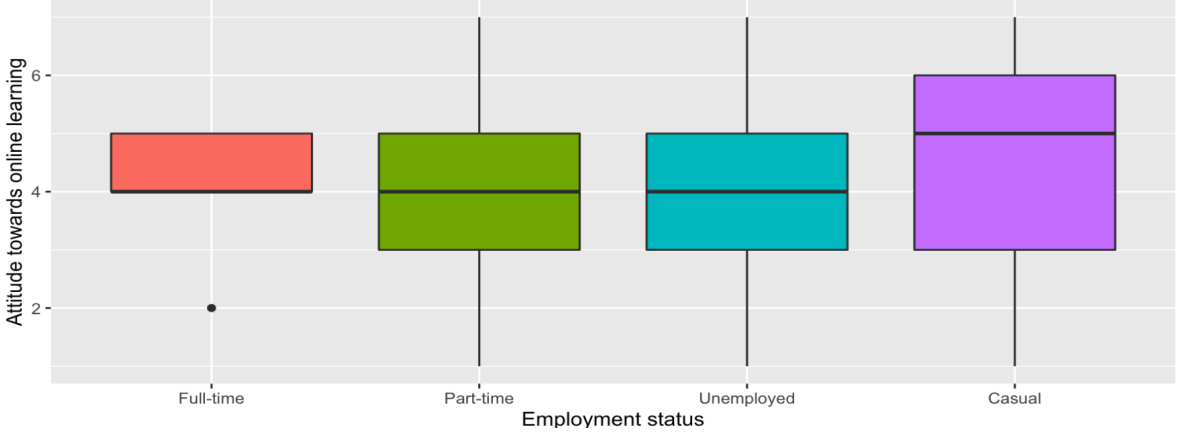



Due to the lack of responses for those students living in accomodation, university accommodation or colleges, it is difficult to make note of their attitudes and will not generally depict UNSW student’s attitude to online learning.

Similarly for those students who have to commute, we were unable to gather a substantial amount of responses, however it can be shown that students living within two hours of UNSW have mild attitudes whilst those with a commute greater than two hours have a positive attitude.




Given the employment status for students, both students who are either unemployed or are on a part-time basis have normal distributions with a neutral median of ‘4’. This depicts that they have a mild attitude towards online learning given their employment status, whilst students who have a casual employment status have a generally positive median despite the negative distribution. This may be due to difficulties in online learning around their work schedules. Due to the low number of samples collected for those students who work full-time, 5.43%, we can not make a conclusive judgement in the attitude of those students.



### 4.5 Conclusion

We can conclude that based on our research, UNSW students have a mediocre attitude towards online learning. As above, we have discussed several possible underlying factors and their significance. However, there may be many more underlying factors which may substantially influence the attitudes of UNSW students in online learning. For a further analysis we may need to delve deeper beyond our sample responses and designed questionnaire.

## 5. Discussion

### 5.1 Comparison with Existing Literature

The results from the survey predominantly agree with the findings from existing literature. In particular, the most influential factors of having access to a stable internet and suitable electronic devices are attributable to a student's attitude towards online learning, which were consistent with the results shown in multiple studies.

Similar to Valenta, Therriault, Dieter and Mrtek's (2019) study, the proportion of respondents who recognised the benefits of convenience in learning, specifically including their stable internet connection, was the main reason for the positive attitudes towards online learning. The second most popular being participants seeing much benefit and few drawbacks in having access to suitable devices. In contrast, in Peytcheva-Forsyth, Yovkova and Aleksieva (2018) study, suggests that the studied group of students were homogeneous in terms of frequency of internet usage and all of them use it often regardless of the access technology. This suggests despite access to technology students still had positive attitudes towards online learning since most had great access to the internet.

In regard to demographics we analysed the concept of a UNSW student's major affecting its attitude towards online learning. Esther Smidt et al. (2021) found that there was a visible link between the students choice of major and their attitudes towards online learning. According to her study, the majority of students who partook in degrees that involved using resources that were not readily available in their home climate significantly impacted their attitude on having a negative experience towards online learning. This resonates with our findings where students who majored in Science and Medicine reflected median 3 possibly due to lack of available resources including labs and practicals.

Furthermore, Roumiana Peytcheva-Forsyth et al. (2018) suggested that unlike the demographic factors which are relevant to the students' attitudes, the form of education (full-time/part-time) is irrelevant to them. This contrasts to our results which exemplified unemployed/part time students experiencing a mild attitude while casuals employed a positive, possibly due to the freedom of working shifts around their study timetable. However the discrepancies between the two studies is highly due to the fact of the low number of samples collected from full-timers, not being able to visualise the entire picture.

### 5.2 Response Rate

The total number of responses received for those that completed the survey was 92. The true response rate is difficult to verify as all responses remained anonymous, resulting in the inability to observe who viewed the survey after seeing it and who did not access it. Additionally, the response rate of the survey after sending it to suitable peers was 100% (i.e. no rejections). However, given that a snowball method was utilised, the response rate, again,

is difficult to verify. Given that the baseline target was to obtain 15 responses for each group member, amounting 90 responses, we have calculated our response rate as follows:

$$\frac{Total\ Responses\ Received}{Baseline\ Target} = \frac{92}{90} = 102.2\%.$$

For simplicity, the response rate has been calculated based on the baseline target of responses.

**5.3 Surveying Difficulties**

The major occurring difficulties that were encountered during the process of creating our questionnaire include the limited number of questions available to ask to create a time efficient (for both participant and our team) and easy analysable report. This includes factors such as ambiguous wording which allows us to efficiently rectify any non-standard errors that may occur when responses are being completed. Due to the structure of our questionnaire being strictly scale based or option based, limited the risk of misinterpretation on behalf of the respondents from qualitative feedback. However few participants have suggested the confusion that was being created with students who felt they fit in multiple options while the questionnaire being designed not to and hence may create biased results. These issues were minimal, easily resolved through the subsequent data preparation and are an expected hurdle of any survey process.

The single most pressing issue in the analysis and interpretation of the results was the inadequate and possibly biased sample size. Through completing the first stage of this study we expected to receive the majority of our survey responses coming from UNSW related Facebook groups however the actual response through this medium was only 20. Having the initial plan of surveying 60 random associates that we are familiar with who go to UNSW through messaging them personally, required us to increase this amount to 73. This in turn decreased the risk of inherent bias within the sample space of the Facebook group chat due to the assumption that volunteer surveys are popular mostly among students who have very strong beliefs about the attitudes towards online learning. However with all the team members being in either their third or last years, the data presented has a clear bias towards third and fourth year students as well as business school and engineering disciplines with only 7 doing law and 4 doing medicine. As such it is quite difficult to study the effect of the differences within majors and years towards their attitude of online learning and hence not being able to generate an accurate representation of this demographic factor.

**5.4 Recommandation**

An important recommendation that the team can provide is thoroughly planning out how survey responses want to be collected. Ideally, an in-person face to face sampling method would be best and social media to be used as a backup method as this would help in ensuring that all survey participants understand the questions being asked. Further, this would decrease any misinterpretations of the questions. Moreover, if a larger sample size can be obtained, utilising a stratified sample will prove to be more effective. Much of the research conducted into existing literature was done after the survey questions had been released. To potentially conduct the survey better with more direct questions, our team recommends that some form of preliminary research be completed into the topic before the creation of the survey. This will ensure all members better understand how to go about creating the survey, and then more research later on to understand how the results of the survey can be interpreted.

## 6. References

Basaran, B., & Yalman, M. (2020). Examining University Students' Attitudes towards Using Web-Conferencing Systems in Distance Learning Courses: A Study on Scale Development and Application. Knowledge Management & E-Learning, 12(2), 209–230. https://eric.ed.gov/?id=EJ1263133

Martin, F., Stamper, B., & Flowers, C. (2020). Examining Student Perception of Readiness for Online Learning: Importance and Confidence. Online Learning, 24(2), 38–58. https://eric.ed.gov/?id=EJ1260328

Valenta, A., Therriault, D., Dieter, M. and Mrtek, R., 2019. IDENTIFYING STUDENT ATTITUDES AND LEARNING STYLES IN DISTANCE EDUCATION. *Online Learning*, 5(2).

Peytcheva-Forsyth, R., Yovkova, B. and Aleksieva, L., 2018. Factors affecting students' attitudes towards online learning - The case of Sofia University.

Files.eric.ed.gov. 2021. [online] Available at: <https://files.eric.ed.gov/fulltext/EJ1080350.pdf> [Accessed 10 August 2021].

# Appendices

### 4.3.1 PCA assumption

| Assumption and data consideration | Result |
|---|---|
| Sample size | Satisfies rule of thumb; Lack of sample is omitted according to assignment marking criteria |
| Normality | Omitted |
| Outliers | Doesn't exist |
| Linearity | All factor questions are designed to be answered in uniform interval scales |
| Multicollinearity and singularity | |
| Factorability | Most of the elements in the correlation matrix are over 0.3. |

### 4.3.2 Loadings derived by using RStudio

Call:

princomp(x = data[, 7:11], cor = TRUE)

Standard deviations:

| Comp.1 | Comp.2 | Comp.3 | Comp.4 | Comp.5 |
|---|---|---|---|---|
| 1.6766576 | 0.9845064 | 0.8098477 | 0.5500578 | 0.5110279 |

5 variables and 92 observations.

Importance of components:

| | Comp.1 | Comp.2 | Comp.3 | Comp.4 | Comp.5 |
|---|---|---|---|---|---|
| Standard deviation | 1.6766576 | 0.9845064 | 0.8098477 | 0.55005783 | 0.51102795 |
| Proportion of Variance | 0.5622361 | 0.1938506 | 0.1311707 | 0.06051272 | 0.05222991 |
| Cumulative Proportion | 0.5622361 | 0.7560867 | 0.8872574 | 0.94777009 | 1.00000000 |

Loadings:

Comp.1 Comp.2 Comp.3 Comp.4 Comp.5

I.have.access.to.stable.internet.connection.while.accessing.online.learning. 0.470 0.458 0.261 0.167 0.688

I.have.access.to.suitable.devices.to.meet.the.requirements.for.online.learning 0.446 0.569 -0.167 -0.667

I.am.able.to.stay.focused.and.concentrated.throughout.all.my.online.courses. 0.369 -0.542 0.675 -0.332

I.feel.supported.by.my.course.coordinators..lecturers.and.tutors.through.online.platforms. 0.487 -0.363 -0.211 0.741 -0.191

The.courses.I.am.undertaking.have.provided.me.resources.to.help.me.learn.online 0.456 -0.202 -0.653 -0.533 0.201

| | Comp.1 | Comp.2 | Comp.3 | Comp.4 | Comp.5 |
|---|---|---|---|---|---|
| SS loadings | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Proportion Var | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Cumulative Var | | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 |

I.have.access.to.stable.internet.connection.while.accessing.online.learning.

I.have.access.to.stable.internet.connection.while.accessing.online.learning.

1.0000000

I.have.access.to.suitable.devices.to.meet.the.requirements.for.online.learning

0.7239737

I.am.able.to.stay.focused.and.concentrated.throughout.all.my.online.courses.

0.3327783

I.feel.supported.by.my.course.coordinators..lecturers.and.tutors.through.online.platforms.

0.4489877

The.courses.I.am.undertaking.have.provided.me.resources.to.help.me.learn.online

0.4091817

I.have.access.to.suitable.devices.to.meet.the.requirements.for.online.learning

I.have.access.to.stable.internet.connection.while.accessing.online.learning.

0.7239737

I.have.access.to.suitable.devices.to.meet.the.requirements.for.online.learning

1.0000000

I.am.able.to.stay.focused.and.concentrated.throughout.all.my.online.courses.

0.2204803

I.feel.supported.by.my.course.coordinators..lecturers.and.tutors.through.online.platforms.

0.3967283

The.courses.I.am.undertaking.have.provided.me.resources.to.help.me.learn.online

0.4230710

I.am.able.to.stay.focused.and.concentrated.throughout.all.my.online.courses.

I.have.access.to.stable.internet.connection.while.accessing.online.learning.

0.3327783

I.have.access.to.suitable.devices.to.meet.the.requirements.for.online.learning

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I.am.able.to.stay.focused.and.concentrated.throughout.all.my.online.courses.

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The.courses.I.am.undertaking.have.provided.me.resources.to.help.me.learn.online

0.3390669

I.feel.supported.by.my.course.coordinators..lecturers.and.tutors.through.online.platforms.

I.have.access.to.stable.internet.connection.while.accessing.online.learning.

0.4489877

I.have.access.to.suitable.devices.to.meet.the.requirements.for.online.learning

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I.am.able.to.stay.focused.and.concentrated.throughout.all.my.online.courses.

0.5305988

I.feel.supported.by.my.course.coordinators..lecturers.and.tutors.through.online.platforms.

1.0000000

The.courses.I.am.undertaking.have.provided.me.resources.to.help.me.learn.online

0.6562342

The.courses.I.am.undertaking.have.provided.me.resources.to.help.me.learn.online

I.have.access.to.stable.internet.connection.while.accessing.online.learning.

0.4091817

I.have.access.to.suitable.devices.to.meet.the.requirements.for.online.learning

0.4230710

I.am.able.to.stay.focused.and.concentrated.throughout.all.my.online.courses.

0.3390669

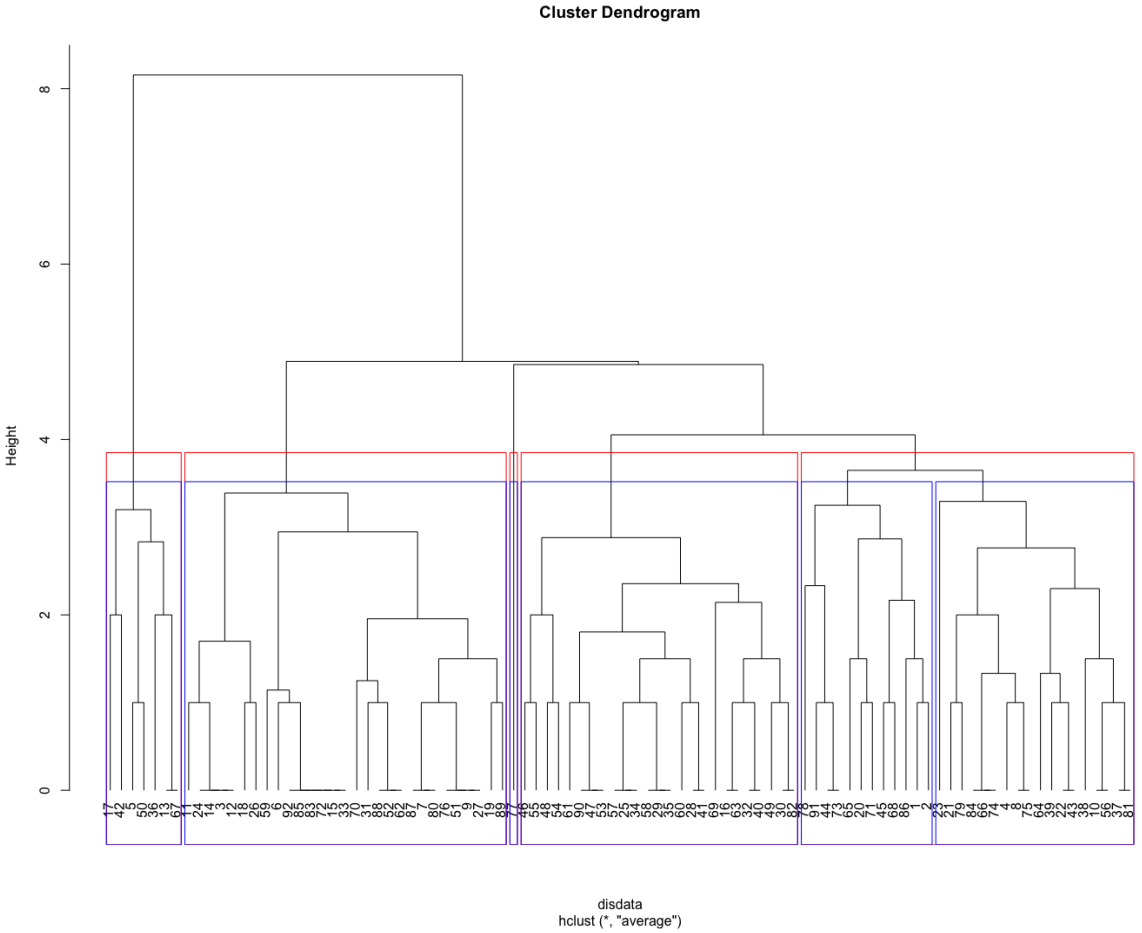
I.feel.supported.by.my.course.coordinators..lecturers.and.tutors.through.online.platforms.

0.6562342

The.courses.I.am.undertaking.have.provided.me.resources.to.help.me.learn.online

1.0000000

### 4.3.3 Cluster Dendrogram




Note: Red box indicates the situation when splitting our sample responses into 5 groups. However, because the 77th response is clearly an outlier. We split sample responses into 6 groups and exclude 77$^{th}$ responses.

**4.3.4 Cluster analysis in detail**

```
#Clustering
disdata <- dist(data[,7:10],"manhattan")#calculate distance matrix
data.clst <- hclust(disdata,"average")
plot(data.clst,hang=-1)#plot a dendrogram
rect.hclust(data.clst,k=5,border = "red")
rect.hclust(data.clst,k=6,border = "blue")
cutree(data.clst,k=6)

#Clusters
cluster1 <- c(1, 2, 20, 44, 45, 65, 68, 71, 73, 78, 86,
        91)
cluster2 <- c(3, 6, 7, 9, 11, 12, 14, 15, 18, 19, 24,
        26, 27, 31, 33, 51, 52, 59, 62, 70, 72, 76,
        80, 83, 85, 87, 88, 89, 92)
cluster3 <- c(4, 8, 10, 21, 22, 23, 37, 38, 39, 43, 56,
        64, 66 ,74 ,75 ,79 ,81, 84)
cluster4 <- c(5, 13, 17, 36, 42, 50, 67)
cluster5 <- c(16, 25, 28, 29, 30, 32, 34, 35, 40, 41, 46
        ,47, 48, 49, 53, 54, 55, 57, 58, 60, 61 ,63,
        69, 82, 90)
clu1 <- data[cluster1,]
clu2 <- data[cluster2,]
clu3 <- data[cluster3,]
clu4 <- data[cluster4,]
clu5 <- data[cluster5,]
attitudemean <- mean(data$What.is.your.attitude.towards.online.learning.)
xtemp1  <- 1:5
ytemp1  <- c(mean(clu1[,2]),mean(clu2[,2]),mean(clu3[,2]),mean(clu4[,2]),mean(clu5[,2]))
xtemp2  <- 1:5
ytemp2  <- c(mean(clu1[,3]),mean(clu2[,3]),mean(clu3[,3]),mean(clu4[,3]),mean(clu5[,3]))

#cluster mean diagram
par(mfrow(2,2),mar=c(1, 1, 3, 2))
```

```
plot
plot(xtemp1,ytemp1,"b",xlab="Cluster",ylab="Attitude mean")
abline(h=attitudemean,col="tomato")
plot(xtemp2,ytemp2,"b",xlab="Cluster",ylab="Effectiveness mean")
abline(h=mean(data$Online.learning.has.proven.to.be.effective.towards.my.academic.perfor
mance.),col="tomato")

#cluster factor mean comparison
ttemp <- 7:11
for(i in ttemp){print(mean(clu2[,i]))}
for(i in ttemp){print(mean(clu4[,i]))}

# clu2 represents cluster 2
# clu4 represents cluster 4
```

| Timestamp | What is your attitude towards online learning? | Online learning has proven to be effective towards my academic performance. | How would you rank online learning, face to face learning or hybrid learning? With 1 being the best and 3 being the worst. [Online learning] |
|---|---|---|---|
| 8/2/21 21:40 | 5 | 4 | 3 |
| 8/3/21 21:48 | 5 | 4 | 3 |
| 8/4/21 10:41 | 2 | 3 | 3 |
| 8/4/21 10:42 | 5 | 2 | 2 |
| 8/4/21 10:52 | 5 | 5 | 1 |
| 8/4/21 11:02 | 4 | 3 | 3 |
| 8/4/21 11:26 | 5 | 3 | 3 |
| 8/4/21 11:27 | 6 | 4 | 2 |
| 8/4/21 11:48 | 6 | 4 | 2 |
| 8/4/21 12:26 | 3 | 2 | 3 |
| 8/4/21 12:49 | 5 | 5 | 2 |
| 8/4/21 13:49 | 4 | 3 | 1 |
| 8/4/21 16:53 | 3 | 1 | 3 |
| 8/4/21 16:57 | 7 | 5 | 1 |
| 8/4/21 16:58 | 6 | 4 | 3 |
| 8/4/21 17:00 | 5 | 3 | 3 |
| 8/4/21 17:01 | 1 | 1 | 3 |
| 8/4/21 17:02 | 7 | 5 | 1 |
| 8/4/21 17:13 | 6 | 5 | 1 |
| 8/4/21 17:18 | 5 | 4 | 2 |
| 8/4/21 17:33 | 6 | 4 | 3 |
| 8/4/21 17:37 | 6 | 4 | 3 |
| 8/4/21 17:56 | 4 | 3 | 3 |
| 8/4/21 19:13 | 7 | 5 | 1 |
| 8/4/21 19:16 | 4 | 3 | 1 |
| 8/4/21 19:51 | 7 | 5 | 1 |
| 8/4/21 19:51 | 4 | 2 | 1 |
| 8/4/21 20:13 | 3 | 5 | 3 |
| 8/4/21 21:30 | 4 | 1 | 1 |
| 8/4/21 21:45 | 2 | 2 | 3 |
| 8/4/21 21:53 | 5 | 4 | 2 |
| 8/4/21 21:53 | 2 | 2 | 1 |
| 8/4/21 21:53 | 6 | 4 | 1 |
| 8/4/21 21:55 | 2 | 2 | 1 |
| 8/4/21 21:56 | 2 | 1 | 3 |
| 8/4/21 21:56 | 4 | 2 | 2 |
| 8/4/21 21:59 | 4 | 4 | 3 |
| 8/4/21 22:01 | 2 | 2 | 3 |
| 8/4/21 22:02 | 5 | 3 | 3 |
| 8/4/21 22:04 | 5 | 4 | 2 |
| 8/4/21 22:05 | 3 | 3 | 1 |
| 8/4/21 22:08 | 2 | 3 | 3 |
| 8/4/21 22:16 | 3 | 1 | 3 |
| 8/4/21 22:16 | 4 | 1 | 1 |
| 8/4/21 22:20 | 1 | 1 | 3 |
| 8/4/21 22:22 | 4 | 4 | 2 |
| 8/4/21 22:41 | 5 | 3 | 2 |
| 8/4/21 22:44 | 1 | 2 | 3 |
| 8/4/21 23:02 | 6 | 4 | 3 |
| 8/4/21 23:23 | 5 | 2 | 2 |
| 8/5/21 8:12 | 4 | 4 | 1 |
| 8/5/21 8:52 | 4 | 2 | 3 |
| 8/5/21 9:37 | 2 | 3 | 3 |
| 8/5/21 10:02 | 7 | 5 | 1 |
| 8/5/21 10:14 | 4 | 4 | 1 |
| 8/5/21 10:23 | 4 | 1 | 1 |
| 8/5/21 10:32 | 3 | 2 | 3 |
| 8/5/21 12:37 | 2 | 2 | 3 |
| 8/5/21 12:50 | 6 | 4 | 2 |
| 8/5/21 14:25 | 6 | 4 | 3 |
| 8/5/21 14:33 | 5 | 4 | 1 |
| 8/5/21 14:34 | 3 | 3 | 1 |
| 8/5/21 14:44 | 4 | 4 | 2 |
| 8/5/21 14:53 | 5 | 2 | 2 |
| 8/5/21 15:00 | 5 | 2 | 1 |
| 8/5/21 15:12 | 5 | 4 | 3 |
| 8/5/21 15:15 | 4 | 4 | 3 |
| 8/5/21 15:42 | 2 | 2 | 1 |
| 8/5/21 15:53 | 2 | 3 | 2 |
| 8/5/21 16:24 | 3 | 3 | 3 |
| 8/5/21 16:28 | 3 | 3 | 3 |
| 8/5/21 16:31 | 6 | 4 | 1 |
| 8/5/21 16:37 | 7 | 4 | 2 |
| 8/5/21 16:37 | 3 | 2 | 1 |
| 8/5/21 17:08 | 5 | 4 | 3 |
| 8/5/21 17:09 | 6 | 4 | 1 |
| 8/5/21 18:37 | 5 | 3 | 3 |
| 8/5/21 18:41 | 2 | 1 | 3 |
| 8/5/21 18:53 | 4 | 2 | 1 |
| 8/5/21 19:35 | 5 | 3 | 2 |
| 8/5/21 19:49 | 3 | 2 | 3 |
| 8/5/21 19:50 | 3 | 1 | 3 |
| 8/5/21 19:55 | 6 | 4 | 2 |
| 8/5/21 19:57 | 3 | 3 | 3 |
| 8/5/21 20:12 | 5 | 4 | 3 |
| 8/5/21 22:06 | 3 | 2 | 1 |
| 8/5/21 22:51 | 3 | 1 | 1 |
| 8/5/21 23:47 | 6 | 4 | 2 |
| 8/6/21 0:25 | 6 | 4 | 2 |
| 8/6/21 0:47 | 4 | 4 | 2 |
| 8/6/21 1:16 | 5 | 4 | 2 |
| 8/6/21 1:18 | 5 | 4 | 1 |

| How would you rank online learning, face to face learning or hybrid learning? With 1 being the best and 3 being the worst. [Face to Face Learning] | How would you rank online learning, face to face learning or hybrid learning? With 1 being the best and 3 being the worst. [Hybrid Learning] | I have access to stable internet connection while accessing online learning. |
|---|---|---|
| 1 | 2 | 3 |
| 2 | 1 | 3 |
| 1 | 2 | 5 |
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| 2 | 1 | 1 |
| 1 | 2 | 4 |
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| 2 | 1 | 4 |
| 3 | 1 | 5 |
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| 3 | 2 | 3 |
| 3 | 2 | 5 |
| 2 | 3 | 4 |
| 3 | 1 | 5 |
| 2 | 3 | 4 |
| 1 | 3 | 3 |
| 2 | 3 | 4 |

| I have access to suitable devices to meet the requirements for online learning | I am able to stay focused and concentrated throughout all my online courses. | I feel supported by my course coordinators, lecturers and tutors through online platforms. | The courses I am undertaking have provided me resources to help me learn online |
|---|---|---|---|
| 3 | 2 | 2 | 4 |
| 4 | 2 | 2 | 1 |
| 5 | 5 | 5 | 4 |
| 4 | 3 | 3 | 4 |
| 2 | 2 | 2 | 2 |
| 4 | 4 | 5 | 4 |
| 5 | 3 | 4 | 4 |
| 4 | 3 | 3 | 4 |
| 5 | 3 | 3 | 4 |
| 4 | 1 | 2 | 3 |
| 5 | 4 | 5 | 4 |
| 5 | 5 | 5 | 5 |
| 2 | 1 | 2 | 1 |
| 5 | 5 | 5 | 5 |
| 4 | 4 | 4 | 3 |
| 5 | 2 | 4 | 4 |
| 1 | 1 | 1 | 1 |
| 5 | 5 | 4 | 4 |
| 5 | 4 | 3 | 3 |
| 5 | 2 | 1 | 3 |
| 3 | 3 | 3 | 3 |
| 5 | 3 | 2 | 2 |
| 2 | 3 | 2 | 2 |
| 5 | 5 | 5 | 5 |
| 5 | 2 | 3 | 3 |
| 5 | 3 | 2 | 3 |
| 5 | 1 | 4 | 4 |
| 4 | 1 | 3 | 5 |
| 1 | 2 | 1 | 3 |
| 5 | 3 | 2 | 3 |
| 4 | 1 | 3 | 4 |
| 4 | 1 | 1 | 2 |
| 4 | 2 | 2 | 3 |
| 5 | 1 | 3 | 4 |
| 5 | 1 | 2 | 4 |
| 5 | 2 | 4 | 4 |
| 2 | 2 | 3 | 3 |
| 5 | 3 | 3 | 4 |
| 5 | 3 | 4 | 4 |
| 5 | 1 | 3 | 3 |
| 5 | 1 | 1 | 1 |
| 5 | 2 | 2 | 2 |
| 4 | 1 | 2 | 2 |
| 5 | 2 | 3 | 3 |
| 5 | 1 | 3 | 3 |
| 4 | 4 | 4 | 4 |
| 4 | 2 | 3 | 3 |
| 5 | 2 | 3 | 4 |
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| 5 | 2 | 5 | 5 |
| 5 | 3 | 3 | 3 |
| 5 | 2 | 2 | 3 |
| 4 | 4 | 4 | 4 |
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| 3 | 2 | 5 | 4 |
| 5 | 1 | 3 | 3 |
| 3 | 3 | 3 | 4 |
| 5 | 3 | 4 | 4 |
| 4 | 2 | 2 | 2 |
| 5 | 1 | 4 | 3 |
| 4 | 4 | 4 | 4 |
| 4 | 2 | 3 | 3 |
| 4 | 4 | 4 | 4 |
| 3 | 2 | 1 | 3 |
| 5 | 3 | 4 | 3 |
| 5 | 3 | 4 | 4 |
| 5 | 4 |  | 4 |
| 5 | 1 | 3 | 2 |
| 3 | 1 | 3 | 4 |
| 4 | 4 | 4 | 4 |

| What is your current level of study at UNSW? | What is your current year at UNSW? | Faculty of your degree: | How long is your commute to UNSW? | What is your current living situation? | What is your current employment status? |
|---|---|---|---|---|---|
| Undergraduate | Third Year | Business School | Within 2 hours | Living with family and friends | Part-time |
| Undergraduate | Fourth Year | Science | Within 1 hour | Living with family and friends | Unemployed |
| Undergraduate | Second Year | Business School | Outside of Sydney | Living alone | Full-time |
| Undergraduate | Second Year | Business School | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Third Year | Engineering | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Fourth Year | Engineering | Within 2 hours | Living with family and friends | Part-time |
| Undergraduate | Fourth Year | Engineering | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Third Year | Business School | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | Fourth Year | Business School | Within 2 hours | Living with family and friends | Part-time |
| Undergraduate | Third Year | Engineering | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | Third Year | Arts, Design & Architecture | Within 1 hour | Living with family and friends | Unemployed |
| Undergraduate | Third Year | Engineering | Within 2 hours | Living with family and friends | Part-time |
| Undergraduate | Third Year | Engineering | Within 1 hour | Living with family and friends | Part-time |
| Undergraduate | Third Year | Arts, Design & Architecture | Within 2 hours | Living with family and friends | Unemployed |
| Undergraduate | Fourth Year | Business School | Within 30 minutes | Living alone | Casual |
| Undergraduate | Fourth Year | Business School | Within 1 hour | Living with family and friends | Part-time |
| Undergraduate | Second Year | Science | Within 30 minutes | Living with family and friends | Unemployed |
| Undergraduate | Fourth Year | Business School | More than 2 hours | Living alone | Part-time |
| Undergraduate | Third Year | Arts, Design & Architecture | Within 30 minutes | Living with family and friends | Unemployed |
| Postgraduate | Fourth Year | Science | Within 1 hour | Living with family and friends | Unemployed |
| Undergraduate | Third Year | Business School | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | Fourth Year | Arts, Design & Architecture | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | Second Year | Arts, Design & Architecture | Within 1 hour | Living with family and friends | Unemployed |
| Undergraduate | Fourth Year | Law | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | Fourth Year | Engineering | Within 30 minutes | Living with family and friends | Casual |
| Undergraduate | Third Year | Science | More than 2 hours | Living alone | Part-time |
| Undergraduate | Second Year | Science | Within 2 hours | Living with family and friends | Unemployed |
| Undergraduate | Fourth Year | Science | Within 30 minutes | Living alone | Unemployed |
| Undergraduate | Third Year | Medicine | Within 1 hour | Living with family and friends | Part-time |
| Undergraduate | Fifth Year | Law | Within 2 hours | Living with family and friends | Unemployed |
| Undergraduate | Second Year | Business School | Within 2 hours | Living with family and friends | Part-time |
| Undergraduate | Second Year | Business School | Within 1 hour | Living with family and friends | Part-time |
| Undergraduate | First Year | Law | Within 1 hour | Living with family and friends | Unemployed |
| Undergraduate | Fifth Year | Science | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Third Year | Engineering | Within 30 minutes | Living alone | Unemployed |
| Undergraduate | Second Year | Arts, Design & Architecture | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Second Year | Business School | Within 30 minutes | Living alone | Casual |
| Undergraduate | Second Year | Engineering | Within 1 hour | Living with family and friends | Unemployed |
| Undergraduate | First Year | Science | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | First Year | Arts, Design & Architecture | Within 30 minutes | accommodation | Unemployed |
| Undergraduate | Second Year | Arts, Design & Architecture | Within 30 minutes | Living alone | Casual |
| Undergraduate | Fourth Year | Engineering | Within 30 minutes | Living with family and friends | Casual |
| Undergraduate | Second Year | Arts, Design & Architecture | Within 30 minutes | Living with family and friends | Unemployed |
| Undergraduate | Second Year | Medicine | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | First Year | Arts, Design & Architecture | Within 30 minutes | Living with family and friends | Casual |
| Undergraduate | Third Year | Engineering | Within 30 minutes | Campus accommodation | Unemployed |
| Undergraduate | First Year | Business School | Within 30 minutes | Living with family and friends | Casual |
| Undergraduate | Third Year | Science | Within 30 minutes | Living alone | Part-time |
| Undergraduate | First Year | Business School | Within 30 minutes | Living with family and friends | Casual |
| Undergraduate | Second Year | Business School | Within 2 hours | Living with family and friends | Unemployed |
| Undergraduate | Fourth Year | Business School | Within 1 hour | Living with family and friends | Unemployed |
| Undergraduate | First Year | Business School | On campus, but returned to SA due to covid. | Living with family and friends | Unemployed |
| Undergraduate | Fourth Year | Engineering | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Second Year | Business School | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | First Year | Engineering | Within 2 hours | Living with family and friends | Part-time |
| Undergraduate | Second Year | Engineering | Within 2 hours | Living alone | Casual |
| Undergraduate | Second Year | Engineering | On campus | College | Unemployed |
| Undergraduate | Second Year | Science | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | Third Year | Arts, Design & Architecture | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Third Year | Arts, Design & Architecture | Within 1 hour | Living with family and friends | Unemployed |
| Undergraduate | Second Year | Business School | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | Fourth Year | Medicine | Within 30 minutes | Living with family and friends | Casual |
| Undergraduate | Third Year | Engineering | Within 2 hours | Living with family and friends | Full-time |
| Undergraduate | Third Year | Arts, Design & Architecture | More than 2 hours | Living with family and friends | Casual |
| Undergraduate | Third Year | Business School | Within 1 hour | Living with family and friends | Full-time |
| Undergraduate | Third Year | Law | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Second Year | Business School | Within 2 hours | Living with family and friends | Part-time |
| Undergraduate | Second Year | Business School | Within 2 hours | Living with family and friends | Part-time |
| Undergraduate | Fourth Year | Engineering | Within 2 hours | Living with family and friends | Part-time |
| Undergraduate | Fourth Year | Business School | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Third Year | Science | Within 2 hours | Living with family and friends | Part-time |
| Undergraduate | Third Year | Business School | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | Third Year | Business School | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Second Year | Science | Within 1 hour | Living alone | Unemployed |
| Undergraduate | Second Year | Business School | Within 2 hours | Living with family and friends | Unemployed |
| Undergraduate | First Year | Engineering | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Third Year | Engineering | Within 1 hour | Living with family and friends | Unemployed |
| Undergraduate | Fourth Year | Science | Within 30 minutes | Living with family and friends | Casual |
| Undergraduate | Fourth Year | Arts, Design & Architecture | Within 1 hour | Living with family and friends | Full-time |
| Undergraduate | Fifth Year | Science | Within 1 hour | Living with family and friends | Full-time |
| Undergraduate | First Year | Science | Within 2 hours | Living with family and friends | Unemployed |
| Undergraduate | Fourth Year | Business School | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | Third Year | Law | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Fourth Year | Law | Within 1 hour | Living with family and friends | Part-time |
| Undergraduate | Second Year | Business School | Within 2 hours | Living with family and friends | Casual |
| Undergraduate | Second Year | Engineering | Within 2 hours | Living with family and friends | Part-time |
| Undergraduate | Second Year | Law | Within 2 hours | Living with family and friends | Casual |
| Postgraduate | Fourth Year | Medicine | Within 30 minutes | Living with family and friends | Casual |
| Undergraduate | Third Year | Business School | Within 1 hour | Living with family and friends | Part-time |
| Undergraduate | Third Year | Arts, Design & Architecture | Within 1 hour | Living with family and friends | Casual |
| Undergraduate | Fourth Year | Engineering | Within 2 hours | Living with family and friends | Unemployed |
| Undergraduate | Fourth Year | Engineering | Within 2 hours | Living with family and friends | Casual |