ZEIT3607 -Transport Planning and Engineering
Project Brief

Introduction

This document explains the requirements and assessment details of project 1 ZEIT3607. This project is a group project. Groups must be smaller than 3 members. Groups cannot change during the semester. The purpose of the project is familiarising students with the basic theories and methods in transport planning process.

This brief presents the data structure, recommended software packages, the process of data analysis, format of the repot and submission date.

Support and assistance

Groups are advised to self-monitor their progress on the project and seek assistance if needed. Groups are encouraged to discuss their progress during the tutorials. If further assistance is needed, groups can ask for consultation with the course coordinator.

Aims and Scope

The aim of this study is estimating the travel demand for the City Campus commuters. The required dataset is obtained from, a (hypothetical) travel survey from the students and staff at the ADFA Campus. As a transport planner, your responsibility is to

- Evaluate different proposals to accommodate for the future transport needs of City Campus
- Provide recommendations on merits of each proposal
- Conduct sensitivity analysis and examine the robustness of your analysis

To that end, you need to undertake the following tasks

- Develop a modelling framework to estimate future transport demand for City Campus
- Calibrate the models in the developed framework using the provided data and other resources
- Investigate the reliability of the models, and
- Predict the future transport demand under different scenarios,

Study Region

The destination of interest in this project is The City Campus Site. Commuters are expected to travel to City campus from the following seven regions (Canberra region is partitioned into 7 zones of)

- Belconnen
- Gungahlin
- Inner North
- Inner South
- Woden
- Weston Creek
- Tuggeranong
- Queanbeyan

Time horizon

The base year in this project is 2020 and the target year is 2040. Assume the travel survey is conducted in the base year and the proposals are to be evaluated for the target year.

Data

The main dataset for this project is obtained from a (hypothetical) travel survey of students and staff at UNSW Canberra in the base year. In this survey, commuters' trips to the ADFA campus are collected during a randomly selected teaching-period representative week. The dataset also includes commuters' sociodemographic attributes. The results are stored in two separate master data files. **Each group will be provided with a list of students and staff IDs. Groups must extract the relevant records from the master files. Each group will have a unique dataset to work with.**

Below you can find more details about these datasets.

Student Data

- ID: A unique code to identify individuals
- PGRD/UGRD: specifying whether studying at postgraduate or undergraduate level
- Gender: specifying the gender with two levels of Male and Female
- Admit Term Descrip: Specifying when the student has started his/her program.
- School: Specifying the school for the primary program in which the student is enrolled. It has four levels of:
  - SEIT: School of Engineering & IT,
  - HASS: School of Humanity and Social Sciences,
  - BUS: School of Business,
  - SCI: School of Science.
- Day: Day of week
- Entrance: Time period arriving at the university
- Exit: Time period departing from the university

Staff Data

- Identifier: A unique code to identify individuals,
- Full/Part: Specifying whether working on fulltime or part time basis.
- Job Title: Specifying the role of individuals. The levels for this field are:
  - Admin
  - Associate Professor
  - Director
  - Executive
  - Lecturer
  - Professor
  - Research Fellow
  - Senior Lecturer
  - Technical support
- Level: Specifying the employment level according to the contract. For more information you can check the UNSW Human Resources webpage for academics and professional staffs. Note that levels for academics are determined by {A, B, C, D, E} and for professionals are determined by {1, 2, 3, 4, 5, 6, 7, 8}
- School: Specifying the employee's school. The levels for this field are:
  - SEIT: School of Engineering & IT,
  - HASS: School of Humanity and Social Sciences,
  - BUS: School of Business,
  - SCI: School of Science.
- Day: Day of week
- Entrance: Time period arriving at the university
- Exit: Time period departing from the university

Analysis

As the transport planner in this project, your responsibility is to estimate the future demand of commuters' parking spaces for the City Campus. The client is interested to know number of required carparks under different scenarios. To answer this question, you need a systematic approach to relate number of future staff/students and their attributes to the demand for carpark.

1. Modelling framework

- The modelling framework is a flowchart explaining the roadmap of your analysis. It should be detailed enough to allow the client to follow your logic.
- To develop a detailed modelling framework, you need to identify relevant variables and their relationships (for instance you can start by carpark demand depends on number of car users travelling to the campus, their arrival time, their departure time, etc.)
- The list of identified variables should include the parameters of the proposals, otherwise the outcome of the framework will not be sensitive towards the proposals.
- Draw a schematic diagram to connect the variables. Identify exogenous (the ones that their values are given and will be the input to the framework), and endogenous variables (the ones that their values are not give and will be determined in the framework)
- The output of this section includes the framework, the list of input and output variables, the list of required models, and a thorough discussion about the details of the variables and models.

2. Data analysis

- Familiarise yourself with the survey data. Check the definition of variables, calculate the mean, standard deviations and frequency tables.
- Identify the variables that are essential to your modelling framework.
- Investigate the relationships between variables and make modifications to your framework if needed.
- Use visual aids to present your findings.
- Make sure you explain and justify your findings.
- Prepare a list of the parameters and variables needed in your framework that cannot be obtained from the survey data. For these parameters you need to
    - If possible, revise your framework
    - If not, explore other data sources
    - If no other data source is available for that, make reasonable assumptions and justify your assumption
- The output of this section includes a data-driven approach to identify significant relationships between variables. You need to justify the identified relationships by explaining potential reasons to support the relationship.

3. Model calibration

- List all the models (connections) in the modelling framework.
- Decide about the nature of the model. This can be a simple assumption or a sophisticated mathematical equation. Justify your choice.
- Explain the required data to calibrate the models identified in the previous step.
- Calibrate the models.

- Validate the models.
- Discuss any shortcoming or unexpected outcome.
- The output from this section includes a list of calibrated models and proper justification on the findings.

4. Proposal evaluation

- Use the modelling framework developed in step 1, and the models calibrated in step 3 to estimate the transport demand for the City Campus.
- Compare the proposals against each other and discuss their advantages and disadvantages.
- Sort the proposals accordingly and explain your findings.
- Check the robustness of the ranking by conducting sensitivity analysis on the parameters.
- Provide your recommendations and discuss the limitations of your approach.

Proposals

The City Campus planning team considers three alternatives for commuters' transport infrastructure. Your responsibility as the transport planner is to compare the advantages and disadvantages of these alternatives and provide recommendations to the planning team.

Free parking

Currently, the parking facilities at the ADFA campus are free for the staff and students. The planning team has proposed this alternative to maintain the fairness between commuters' to ADFA and City Campuses.

Parking Pricing

Parking pricing refers to direct charges for using a parking space. This alternative is proposed as the planning team believe efficient parking pricing can provide benefits such as reducing traffic congestion, and energy consumption. The proposed pricing scheme for the City Campus is a daily flat rate of 5 dollars per entry.

OnDemand Transport

On Demand Transport (ODT) is a flexible public transport service designed to improve connections to transport hubs and popular destinations like shopping centres or hospitals. This proposal suggests providing ODT for the City Campus. The expected travel times for this service are as shown below.

Table 1 – Travel time details for ODT in the target year

Zone	ODT (min)		
	Minimum	**Maximum**	**Mean**
Belconnen	20	31	23
Gungahlin	38	49	43
Inner North	16	24	20
Inner South	14	26	21
Woden	22	36	30
West Creek	24	39	31
Tuggeranong	35	57	49
Queanbeyan	27	41	34

The operation cost for this system is covered by selling tickets to the users. The estimated cost for using this service is estimated to be 50 percent higher than the cost of using public transport.

Hint: Since the performance of this mode is similar to public transport, it is reasonable to use the same utility function for it when calculating modal split.

Additional resources

In addition to the survey data, the following information is also made available to you by the client. You do not necessarily need to utilise all these information, but some of these information can support your modelling framework. On the other hand, please note that this is not a comprehensive list of information to support all possible modelling frameworks. Therefore, you may not find everything you need to support your framework here and you may need to explore other sources for that.

Estimated number of students and staff

The number of students and staff in the City Campus are expected to reach 5000 and 700 respectively.

The city campus is designed to serve higher number of postgraduate students. It is expected that the portion of postgraduate and undergraduate students to be 60% and 40% respectively. To enhance gender diversity, it is expected that number of male and female students are relatively equal in all programs. The programs provided in the City Campus will be 40% similar to the programs currently provided in SEIT, 20% similar to HASS, 20% to BUS and 20% to SCI.

Regarding the personnel, the City Campus is expected to higher 80% of its employees on fulltime contracts and 20% on part time contracts. The job title decomposition is expected to comprise 10% admin, 10% executive, 5% director, 5% professor, 5% associate professor, 15% senior lecturer, 15% lecturer, 25% research fellow and 10% technical support.

Trip distribution model

From an earlier study on UNSW commuters travel behaviour the following details about trip distribution are available.

- A singly constrained gravity model in the form of the following equation can suitably model commuters' trip distribution.

$$T_{ij} = \alpha P_i A_j F_{ij}$$

  In this model,
  T_{ij}: number of trips from origin i to destination j,
  P_i: population at i,
  A_j: trip attraction at j,
  F_{ij}: Friction factor representing the impedance for traveling from i to j

- The model must satisfy total trip attractions.
- The friction factor is defined as below.

$$F_{ij} = \frac{d_{ij}^{-\theta}}{\theta}$$

  In this equation,

d_{ij}: is the generalised cost for travelling from i to j

θ: is the parameter of the model

- From previous studies, the value of θ is estimated to be 0.41 when the generalised cost is assumed to be distance, and it is estimated to be 0.32 when the generalised cost is shortest travel time.

Mode choice model

From an earlier study on UNSW commuters travel behaviour the following details about trip distribution are available.

- The modes for travelling to the ADFA campus are auto, public transport and active modes (cycling and walking). An earlier study on travellers' mode choice suggests the following utility function for these modes:

$$U_{Auto} = -0.25\,TT_{Auto} - 0.11Cost_{Auto}$$
$$U_{PT} = -0.26 - 0.15TT_{PT} - 0.13Cost_{PT} - 0.01Reliability_{PT}$$
$$U_{Active} = 0.1 - 0.67Distance$$

  In this model, cost is measured in dollars, travel time in minutes and distance in kilometre. reliability is defined as the difference between maximum and minimum of travel time, divided by the average travel time:

$$Reliability = \frac{TT^{Max} - TT^{Min}}{TT^{mean}}$$

Supplementary datasets

- The base year travel times by auto and public transport are expected to increase by 15 percent in the target year.
- A one-way public transport trip costs \$3.22 and \$1.66 for staff and students.
- The out of packet costs for travel by car is estimated to be 35 cent/kilometre.

In addition to the travel survey, the following datasets about the road network, public transport performance and the future estimations for population and employment in the region may be useful in this project.

Table 2 - Number of trips from the town centres to the ADFA Campus in 2020

Zone	Weekly Trips to ADFA Campus
Belconnen	850
Gungahlin	420
Inner North	900
Inner South	650
Woden	300
West Creek	250
Tuggeranong	350
Queanbeyan	280

Table 3 – Population of the town centres, in the past, and its projection from the future

Zone	2016	2020	2040
Belconnen	97244	100040	152452
Gungahlin	69926	83167	87507
Inner North	54350	58702	91597
Inner South	26425	27618	38530
Woden	34446	34551	56363
West Creek	22093	20611	26268
Tuggeranong	85137	82649	90178
Queanbeyan	58119	61031	78756

Table 4 – Average distance from the town centres to ADFA Campus and City Campus

Zone	Distance to City Campus (km)	Distance to ADFA Campus (km)
Belconnen	13.30	14.3
Gungahlin	14.91	17.2
Inner North	5.70	6.1
Inner South	6.00	8.2
Woden	11.00	15.6
West Creek	15.90	15.9
Tuggeranong	19.40	22.7
Queanbeyan	14.70	13.9

Table 5 –The mean, minimum, and maximum values of travel time from the town centres to the City Campus Site during the morning peak period in the base year

Zone	Auto (min)			Public Transport (min)		
	Minimum	**Maximum**	**Mean**	**Minimum**	**Maximum**	**Mean**
Belconnen	12	22	17	31	38	33
Gungahlin	23	35	31	51	71	62
Inner North	8	14	12	23	34	29
Inner South	9	14	12	19	33	27
Woden	10	18	15	36	56	49
West Creek	15	28	23	32	47	42
Tuggeranong	19	35	29	48	72	64
Queanbeyan	16	30	25	34	49	44

Table 6 –The mean, minimum, and maximum travel times from the town centres to the ADFA Campus during the morning peak period in the base year

Zone	Auto (min)		
	Minimum	**Maximum**	**Mean**
Belconnen	22	40	31
Gungahlin	16	24	21
Inner North	7	12	10
Inner South	10	16	14
Woden	12	22	18
West Creek	14	26	21
Tuggeranong	22	40	33
Queanbeyan	12	22	18

Deliverables

This project is worth 50% of the final mark. Groups' performance is evaluated based on submitted reports. The progress report is worth 25% and the final report is worth 25% of the final mark.

Groups must submit their reports on Moodle along with a set of supporting materials they have developed during the project. The reports must be submitted on Moodle as a PDF file.

Late submission is accepted but a penalty of 5% will be applied for every day of late submission. Submissions after 10 days delay are not accepted. In this case, all members of the group will receive a mark of zero.

Supporting materials include excel spreadsheets, R scripts, or any other files that are developed to execute the calculations in the project. The supporting materials will not receive a mark separate from the reports, but if supporting materials are not submitted, the report will not be assessed, and all members of the group will receive a mark of zero.

Groups will be evaluated based on the submitted final report. Members will receive individualised marks according to their contribution to the project. For the final submission, group reports must include a one-pager "members contribution" section for every member to explain their contribution to the project. The "members contribution" is a part of the group report and while every member will draft his/her own members contribution section, all members must review and agree on this section before submission.

The members contribution section must start with the following table. Each member should clarify his/her contribution to each of the following items. The contributions for each member should add up to 100.

Table 7 –members contribution table

Section	Member 1 contribution	Member 2 contribution	Member 3 contribution
Report Drafting	X1	Y1	Z1
Developing modelling Framework	X2	Y2	Z2
Analysing data	X3	Y3	Z3
Calibrating models	X4	Y4	Z4
Project Evaluation	X5	Y5	Z5
Sum	100	100	100

The details of each report are provided in the following table.

Table 8 –Deliverables details

Report	Items to be covered	Details
Progress report	Modelling framework Data Analysis	A maximum ten-pager report (excluding the cover page and reference page if necessary) presenting the progress made on the specified items
Final report	Modelling framework Data Analysis Model Calibration Project Evaluation	A concise report on the findings and project evaluations. The report should not exceed 30 pages (excluding the cover page, table of contents and reference page if necessary).

Marking rubric

The following table shows the marking rubric for project 1.

Table 9 –Marking rubric

Performance criteria	Fail (<50%)	Pass (50 to 65)	Credit (65 to 75)	Distinction (75 to 85)	High Distinction (>85)	Weight in progress report	Weight in final report
Overall organisation of the report	Unorganised structure and illogical sequence of information, missing of at least one essential components. Critical tables and figures are missing from the report. Major inconsistency in formatting. Details are often missing.	Reasonably organised structure and sequence of information, sufficient materials presented in most sections. Poor utilisation of figures and tables. Minor inconsistency in formatting. Details are sometimes missing.	Well organised structure, easy to follow and logical sequence of information, sufficient materials presented in all sections. Good balance of figures, tables and discussions. Negligible inconsistency in formatting. Details are rarely missing.	Very well organised structure a good logical sequence of information, sufficient materials presented in all sections. Figures and tables support the discussions. Professional reporting style.	Excellently organised structure, highly logical sequence of information, facilitating reader's understanding, sufficient materials are presented in all sections. Excellent use of professionally designed figures and tables to reinforce the discussions.	20	20
Modelling framework	The framework is missing critical components. The connections are not logical.	Essential components are covered but the connections are not logical/justified. The process is poorly described. The framework consists of several unnecessary simplifying assumptions	The framework covers all essential components. Connections are logical and sufficiently explained. Number of simplifications are relatively low	A comprehensive list of output variables is listed, and a logically sound process is introduced to connect them to the input variables. The provided resources are well utilised in the framework.	In addition to a well-justifying framework with all the necessary components, additional resources are explored to enhance the accuracy and robustness of the framework.	40	10
Data analysis	Insufficient analysis. Essential relationships are not investigated. Cases of miss-leading discussions	Provided data sources are sufficiently explored, but some of the significant relationships are not identified.	Provided data sources are sufficiently explored, the significant relationships are identified, but not behaviourally justified	Provided data sources are sufficiently explored, the significant relationships are identified, sufficiently discussed, and behaviourally justified. However, the report contains cases of inefficient analysis	Provided data sources are sufficiently explored, the significant relationships are identified, sufficiently discussed, and behaviourally justified. Presented analysis are concise and efficient in communicating the key findings	40	20
Model calibration	Limited technical content included in report, limited grasp of subject matter knowledge demonstrated, at least one major technical fault found	Adequate technical content included in report, sufficient knowledge of subject matter demonstrated, a small number of minor technical faults found	Strong technical content included in report, good knowledge of subject matter demonstrated, technical faults found are minor	Very strong technical content included in report, thorough understanding knowledge of subject matter demonstrated, no technical fault found	Technical content included in report well exceeds normal requirement, some extensions of knowledge of subject matter created	-	25
Project evaluation	Shallow analysis of demand for transport infrastructure. Major inconsistency with the modelling framework. Analysis for at least one of the options is not provided	Adequate outcome achieved but the comparison and conclusion are limited and/or not well justified	All alternatives are sufficiently analysed and compared against each other using a comprehensive list of criteria. Insufficient analysis on the robustness and reliability of the results.	The analysis and comparison of alternatives are detailed and comprehensive. Strong arguments supported by the findings are made to sort the alternatives. Adequate analysis on the robustness and reliability of the results.	Excellent analysis and comparison of alternatives. Strong arguments supported by the findings are made to sort the alternatives. Robustness of the findings is sufficiently examined and an in-depth discussion on the comparison provided	-	25