Decision-aid methodologies in transportation – Transport modelling module – Project description

1 Context and data

The canton Vaud is planning to perform an extended traffic model analysis in the greater area around Lausanne to understand (i) the current traffic demand and (ii) the implications of certain scenarios on the traffic demand and their impact on the road network. To that end, the following data has been collected:

- Data in Geopackage format that represent the zones, links and nodes of the study area (in 00_Geopackages folder). Use this data to generate your traffic network as in the class lab.

- data_for_modelling_zones_model.csv.csv (in 01_Household_data folder): This is a data set that includes information from a sample in the area. The main information is the number of daily trips per household by trip type:
    - HBW: Home-based work trips per day (Count_HBW_hh)
    - HBE: Home-based education trips per day (Count_HBE_hh)
    - HBO: Home-based other trips per day (Count_HBO_hh)
    - NHB: Non-home-based trips per day (Count_NHB_hh)

- data_for_modelling_pop.csv (in 01_Household_data folder): Data regarding the population of the study area

- Some reference data from the study area that provide information regarding the relationship between Production–Attraction and Origin–Destination format per trip type by zone e.g., PA_vectors_HBW (in 02_Reference_data folder).

- Some reference origin-destination matrices in the study area per trip type e.g., OD_type_HBW.csv (in 02_Reference_data folder)

- df_Lausanne_estimation.csv (in 03_Mode_choice_data): Data collected for mode choice between 1. car and 2. public transport (pt)

- impedance_OD_Lausanne (in 03_Mode_choice_data): Data that includes values of travel time and travel cost between zones in the study area.

2 Base year scenario tasks

Using the available data, conduct the following analysis:

1. Use the data_for_modelling_zones_model.csv data and estimate three linear regression models, one per trip type (HBW, HBE, and HBO) by choosing appropriate explanatory variables:
    - Discuss the interpretation and significance of the parameter estimates of each model. Are the parameter values consistent with your expectations? (**6 points**)
2. Use the results from your linear regression models with the data_for_modelling_pop.csv to get forecasts of the trip productions per type per household in the population (**3 points**)
3. Use the productions from step 2 with the Attractions in OD_type csv files to adjust the attractions of your base year scenario (**2 points**)
4. Use the df_Lausanne_estimation.csv to estimate a logit model for choices between car and public transport (use only time and cost as explanatory variables in your utility specification)
    - Estimate different logit models per trip type (HBW, HBE, HBO) (**3 points**)
    - Discuss the interpretation and significance of all the parameter estimates of each model. Are the parameter values consistent with your expectations? (**3 points**)
5. Use the results of your logit models combined with the impedance_OD_Lausanne to:
    - Obtain the share of cars between all zone OD pairs (**2 points**)
    - Obtain the generalised cost between all zone OD pairs (**2 points**)
6. Use the Productions and Attractions from your linear regression model combined with the generalised costs from step 5 and generate a full OD matrix by estimating the gravity model with the Hyman method (**6 points**). Keep in mind the following:
    - Convert the Production–Attraction format to Origin–Destination format. (**1 point**)
    - Convert daily trips to morning peak (7AM – 9AM) trips (**1 point**). Assume that:
        - 30% of total HBW trips take place between this time window
        - 30% of total HBE trips take place between this time window
        - 10% of total HBO trips take place between this time window
    - Different OD matrices are required per trip type
    - Sanity check: The number of origin trips, destination trips and total trips in the OD matrix should be the same number
    - Tip: Do not ‘round’ the number of trips yet. Do it when you compute the total OD matrix with all trips combined.
7. Prepare the data for network assignment:
    - Add non-home-based trips. Assume that these trips represent 35% of the total trips.
    - Consider the modal split shares and keep in your OD matrices only the car shares (by trip purpose). (**1 point**)
        - Comment: Do not run a logit model on NHB trips. Simply assume that 90% take place by car.
    - Convert the OD trips to vehicles by assuming an occupancy rate of 1.2 people per car (by trip purpose). (**1 point**)
    - Convert the vehicle trips from a two-hour window into a one-hour window. (**1 point**)
    - Prepare the total OD matrix.

8. Perform the network assignment:
    - Consider that 15% of the network capacity is occupied by other background flows and 85% for cars. Explain how you implemented this. (**1 point**)
    - Perform the network assignment using the Frank–Wolfe algorithm. For the BPR function use the values $\alpha = 0.15$ and $\beta = 4$.
    - Comment on the results: (**5 points**)
        - Is there a congestion problem in the area? Use the congested time per link and VoC values for your answer. What is the proportion of links that perform below the capacity in the examined time window?
        - Locate the 20 most congested links, generate and plot a new layer with these (If not possible all at the same time, then one example screenshot only).
        - Provide a table with the 20 congested links based on congestion time. Also report the VOC for these links.
        - Note: congested time is a time that we multiply to the free flow time to get the travel time under congestion for our scenario.

General comments:

- Transforming the Geopackages into an AequilibraE project is not graded.
- Generate 5–10 connectors from each centroid to the main road network in your AequilibraE project. Set the searching distance to 3000m.
- Once you set up an AequilibraE project that works (e.g. test if you can get shortest paths, you can see the connectors created etc.) make a copy of it before running any assignment, in case something goes wrong at a later stage.
- At the assignment stage you may notice some links with 0 length. If you have these then replace the value to 0.1 or some other small value.

3 Future scenario tasks

The local authorities expect an increase in the population of the area. The new population information can be found in data_for_modelling_zones_model_scenario.csv (in 01_Household_data folder).

1. Use the data_for_modelling_pop_scenario.csv to perform the traffic analysis for the future household population (Not all 8 steps are necessary to be repeated). Respond to each of the questions as you did in the base year scenario and explain which steps from the base year analysis you did not repeat and why. How is the situation now in the 20 congested links from the base scenario? Are the new 20 more congested links different than the base scenario? (**24 points**)
2. The city of Lausanne is thinking about converting links 15077, 15078, 21397, 21398, 23662, 23663, 23664, 23665, 32360, 32361 (link_id value) to a pedestrian street. If this intervention takes place, what are going to be the implications in the performance of the network during the morning peak hours? (**6 points**)
    - Visualise them in your project (provide a screenshot of the area) – 1 point
    - Discuss the implications on traffic performance – 5 points
        - When discussing the implications, you can examine the difference between the 20 most congested links between the two future scenario tasks

- Also examine how the traffic is changed around the closed links e.g., pick 5 links in the area around and examine if there is any notable difference.

4 Deliverables

Please provide a report with your responses to each of the requested tasks. Keep your responses brief but comprehensive. There is no need to provide any code unless requested. Please send your reports to evangelos.paschalidis@epfl.ch by July 4th, 23:59.