42178 – Transport System Analysis E21

Portfolio exercise IV

Exercise 1

We are as consultants asked to construct a transport model for commuters in the city of Labtown.

The following things are known.

- The city is divided into 20 zones.
- 50% of the population commutes every day from every zone.
- Each commuter is assumed to produce one work tour (home->work->home) per day. Hence, we do not need to consider trip generation.

Task 1 – implement the model

Based on the application data, the model structure, and the parameters you are asked to implement the model. Open the application data in Excel and calculate the following;

- The mode choice utility function.
- The conditional mode choice probabilities $P_i(m|d)$ for each representative person (indexed by the zone i) and each destination d for all modes m.
- The destination choice utility function.
- Destination choice probabilities $P_i(d)$ for each representative person i and each destination d.
- The joint probability $P_i(m,d)$ of mode and destination for each person i.

Hint: Refer to the formulas for the Nested Logit Model Section 8.2.

Now, based on the implemented model you are supposed to calculate the.

- Average mode shares for the population.

Result:

	Walk	Bike	Car	Car pass.	PT
Average market share without pop weight	0.037	0.136	0.629	0.090	0.108
Average market shares in the population	0.040	0.141	0.627	0.106	0.085

Task 2 – Calculate OD matrices and calibrate the model

Based on the model, which is tour based, calculate the corresponding OD matrices for all modes. Since we do the exercise in Excel it is difficult to calculate OD(i,j)=GA(i,j)+GA(j,i). It is OK just to approximate this by OD(i,j)=2*GA(i,j). If you can manage in Excel it is also OK to do the correct sum. If you do it the easy way you should explain in your report why this is not entirely correct.

Based on the observed OD matrix, you are now asked to evaluate whether the model replicates the market shares of the observed OD matrix. If not, you are asked to calibrate the model so that the mode-choice shares are identical to the market shares of the OD matrix. The observed market shares can be found in the help section below. One iteration is enough. You should report how well your model replicates the observed shares.

Hint: Apply algorithm 15.1.

Result:

	Walk	Bike	Car	Car pass.	PT
Modelled market shares	0.040	0.141	0.627	0.106	0.085
Calibration constant	-0.008	0.009	-0.007	-0.188	0.217
Calibrated market shares	0.040	0.142	0.624	0.088	0.106

Task 3 – Analyse model sensitivity

Evaluate the model sensitivity with respect to cost and time attributes for trips. Hence, fill-in elasticities in the white cells in the Table below. This can be done using either your modelled GA matrices or OD matrices. You decide what you prefer. Please comment on the elasticities. Do you find them realistic relative to each other?

Results converted into elasticities:

	CC + 10%	**CT + 10%**	**PC + 10%**	**PT + 10%**
Walk	0.20	0.26	0.07	0.04
Bike	0.20	0.27	0.07	0.04
Car driver	-0.15	-0.09	0.09	0.06
Car passenger	0.29	-0.43	0.09	0.06
Public	0.30	0.41	-0.74	-0.43

Exercise 2

Task 1 – Apply the model for policy analysis using pivoting

It is considered whether to introduce a new pricing policy for public transport. This policy involves that every trip, irrespectively of the length will be priced 10 DKK. Apply pivoting to predict the effects of this policy in terms of demand changes.

Hint: refer to Section 16.4.

Result:

	Walk	Bike	Car	Car pass.	PT
Relative change from base OD to scenario OD	-0.044	-0.038	-0.050	-0.054	0.403

Task 2 – Cost-benefit analysis of the PT price reduction policy

The transport organisation in Labtown would like to know whether the PT price reduction in task 4 is valuable to the society. As input for a cost-benefit analysis, they therefore ask you to calculate the consumer surplus of this policy and compare the consumer surplus to the loss in ticket revenues. To calculate the consumer surplus, you may use rule of a half, see 18.8 in the book.

You may assume that the social value of travel time (SVTT) for all modes is equal to 70 DKK/hr and the social value of access egress time to be 1.5*SVTT.

NB. It is OK not to consider the feedback of the travel time change due to fewer cars on the mode choice but you are welcome to comment on this in the report.

Results:

Consumer surplus	352081.3
Ticket revenue loss	114668.8

Task 3 – Cost-benefit analysis with feedback

In this task, you are asked to take into account feedback mechanisms within Labtown. The elasticity tells you how car travel time reacts to reduced car demand. This allows you to recalculate market shares and redo the cost-benefit analysis.

Results:

Consumer surplus	401458.8
Ticket revenue loss	119563.8