



Modelling Choices in Transportation

Component: MVWING 2027 - 5.20

Basic information

Master's program	Verkehrswirtschaftsingenieurwesen
Module	MVWING 2027 – 5.20 Modelling Choices in Transportation Wahlpflicht
Recommended semester:	1st/3rd semester
Module duration:	1 semester
Frequency:	Every semester in the winter semester
Teaching format:	Lecture/exercise
Workload:	3 SWS / 180 hours
Proof:	Written exam / 60 minutes Ungraded study work: written examination
Credits	6
Repeatability:	twice

Lecturers

Lectures:	Dr.-Ing. Leonard Arning
Support:	Nils Lukas Harder, MSc. (LuFG Radverkehr) Raum: HD 34
Contact person:	Dr.-Ing. Leonard Arning E-Mail: arning.leonard@gmail.com Nils Lukas Harder, MSc. (LuFG Radverkehr) Raum: HD 34 E-mail: harder@uni-wuppertal.de

Learning objectives/learning outcomes – overview

Content and learning objectives:

Discrete choice models are similar to other statistical regression models, but represent discrete, i.e. 'either-or' decisions. They are used in transport models in particular to determine choice probabilities for individuals or groups of people, for example in ownership, destination, mode or route selection. They are also used to analyse the choice behaviour and preferences of travellers, for example the following questions: Is there a causal relationship between gender and mode choice? How much of a diversion are cyclists willing to take in order to use a cycle highway?

In the exercise, students apply the theory from the lecture in practice using example data sets. Using suitable software, e.g. the Python package Pandas Biogeme, they interactively develop their own choice model with utility functions for a data set and a cycling-specific question, which they then evaluate and interpret. As part of the exercise and written assignment, students provide and use peer feedback, critically reflect on their own work results and complete the report independently with the support of the course throughout the semester.

Learning outcome:

Students know the purposes of discrete choice models in general and in particular in cycling science as well as the mathematical functioning of different types of models. Students are able to judge what data is needed and used for discrete choice models. They are able to develop a model structure and utility functions for a

specific problem and interpret the model results. Students can use a programming language (for example Python) in data management and processing and are proficient in quantitative analysis and reporting methods.

Examination

Written exam (exam; 60 minutes).

Moodle

All materials for the course will be posted on Moodle. Moodle will also be used to communicate information and any possible changes during the semester.

Dates 2026

First lecture: 19.10.2026 / Last lecture: 25.01.2027 / Exam: TBA

The lectures and exercises take place on Mondays from 4:00 p.m. to (at the latest) 8:00 p.m. in HD 01.15 (CIP lab).

Schedule 2026/27 winter semester

The exercise usually takes place directly after the lecture in the same room. Thus, there is one weekly slot of $3 \times 45 = 135$ minutes for both the lecture and the exercise in a combined block. The schedule may be adjusted during the semester if necessary.

Any material not completed during the exercise should be made up independently before the next session. This applies in particular to progress on the project work (e.g., "target by Exercise 1," etc.).

Date	Content
19.10.2026	Lecture 1: Overview of the course, motivation behind DCM (Discrete Choice Modeling), connection to transport models (Visum, etc.) and analysis, review of linear regression.
	Exercise 1: Install Anaconda, test code for linear regression—relationship between the share of public transport infrastructure and modal split of cities.
26.10.2026	Lecture 2: Introduction to the reasoning behind DCM/Logit (utility definition, utility maximization, illustrative example). Data sources. Discussion of causality vs. correlation (referring back to Exercise 1).
	Exercise 2: Data cleaning and data visualization.
02.11.2026	Lecture 3: Derivation, properties, and example of the binary logit model.
	Exercise 3: Binary logit test model (bike vs. car, depending on trip length and share of bike lanes) as an introduction to Biogeme.
(9.11.2026)	No lecture/exercise
16.11.2026	Lecture 4: Interpretation of parameters: significance, signs, elasticities, etc. Issue of transferability between models.
	Exercise 4: Interpretation of parameters from the previous exercise; calculation of the value of design (VOD) of bike lane availability.
23.11.2026	Lecture 5: Categorical variables, interactions, non-linear parameters, generalization to multinomial logit.
	Exercise 5: Distribution of the project assignment (mode choice model). Start working on the project model with the proper dataset.

30.11.2026	Lecture 6: Model development; goodness-of-fit measures, comparison of model variants, sample size, plausibility checks.
	Exercise 6: Work on the project. Target by Exercise 6: Data cleaned, first test model estimated.
07.12.2026	Lecture 7: Data (reminder: SP/RP, representativeness, variance, etc.); Red Bus Blue Bus problem, Nested Logit, likelihood-ratio test for deciding whether to use NL.
	Exercise 7: Work on the project.
14.12.2026	Lecture 8: Practical examples and special features of macro-level modeling stages (residential location choice, purchase choice, destination choice, mode choice, route choice).
	Exercise 8: Work on the project.
21.12.2026, 28.12.2026	Christmas break
04.01.2027	Lecture 9: Special aspects of bicycle traffic modeling (personal attitudes, influencing factors for mode and route choice, conventional bike vs. e-bike); current topics in bicycle modeling (PLUG-IN, GPS data).
	Exercise 9: Work on the project. Target by Exercise 9: At least two Nested Logit variants tested.
11.01.2027	Lecture 10: Mathematics behind parameter estimation. Simulation (parameters → data instead of data → parameters) using Biogeme.
	Exercise 10: Work on the project.
18.01.2027	Lecture 11: Generalization of DCM: Random Utility Models, Probit, Mixed Logit (may be shortened or skipped if time is tight or review is needed).
	Exercise 11: Work on the project. Target by Exercise 11: Model development completed.
25.01.2027	Lecture 12: Outlook: DCM vs. machine learning, etc.
	Exercise 12: Interpretation of results.
01.02.2027	Lecture 13: Review and exam preparation, reserve.
	Exercise 13: Troubleshooting before submission. Submission approximately one week later (in time for exam eligibility).