Master Seminar — Summer Semester 2025

Focus: OSCM und Business Analytics

23. Januar 2025

General Information

- The scope of the written report should be between 14 and 16 pages.
- The software packages GAMS, R, Julia, Rust, KNIME or Python can be used for programming.
- Participation in all (group-specific and joint) seminar dates is mandatory.
- We recommend from experience to use the LATEX typesetting system for writing the thesis.
- On request, we are happy to offer an appointment to discuss the basics of working with LATEX.

Provided Documents

- Guideline for scientific work: https://www.bwl.uni-hamburg.de/vw/service/downloads/vw-richtlinie.pdf
- LATEXtemplate seminar paper: https://sharelatex.gwdg.de/read/fpksszdrfqnt
- LAT_EXtemplate presentation: https://sharelatex.gwdg.de/read/qgrqymppwthg#c672c4

Preliminary Meeting

- The preliminary meeting with the assignment of topics will take place for all participants on **Thursday**, **January 23, 2025, from 19:00 to 20:00** in room 2029 at Moorweidenstraße 18, 20148 Hamburg.
- Please look at the list of topics beforehand. During the preliminary meeting, we will assign the topics and discuss the approximate procedure for this seminar.

Group Work

- The tasks are to be worked on in groups. The plan is to have a group size of two students. If possible, the students should preferably belong to different degree programs.
- Please note that each participant must submit their individual seminar paper.

Intermediate Presentations

• At least three appointments must be held with the supervisor during the seminar. The appointments can be arranged individually as a group or together with the other groups. During these appointments, 15-minute interim presentations must be given to provide information on the progress of the work.

- Unless otherwise agreed with the supervisor, the following dates apply for the meetings: April 11, 2025, May 09, 2025, and June 06, 2025, each from 18:00 to 20:00.
- First presentation: Overview of the subject and literature as well as presentation of the problem, the corresponding solution approach and the further procedure.
- Second presentation: Overview of any implemented solutions and initial results, discussion of the next steps.
- Third presentation: Reading sample of one text page and formally correct bibliography. Please submit the reading sample two weeks before the presentation so that the supervisors have time to correct it.

Submission of the Seminar Paper

- Please hand in the thesis by 15.06.2025, 23:59 at the latest.
- For the submission, we need the digital version of the work as well as <u>all</u> created files in a ZIP file by e-mail to our secretariat (lvp.bwl@uni-hamburg.de).

Final Presentations

- The final presentations will take place in presence at the University of Hamburg.
- Friday, June 20, 2025, 16.00 to 22.00, Moorweidenstraße 18, Room 2029.
- Saturday, June 21, 2025, 09.00 to 17.00, Moorweidenstraße 18, Room 2029
- Please submit the final presentation slides by e-mail to the secretariat (lvp.bwl@uni-hamburg.de) by June 19, 2024, 23.59.
- Duration of the final presentation: 25 minutes presentation + 25 minutes discussion.
- The presentations will be held as a group.
- Oral participation in the presentations of the other groups will be evaluated.
- All presentations must be prepared for the first date; the actual assignment will be made at short notice.

Contact

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- Fiona Sauerbier: fiona.sauerbier@uni-hamburg.de

List of Topics

You can work on the following topics as part of your seminar paper. We are very open to your topic ideas, so please feel free to contact us and suggest a topic.

1. Simulation-based location planning versus optimization (Rienks)

Location planning is a fascinating yet challenging task, especially when considering multiple potential designs for a new location. Traditional optimization methods can sometimes struggle with the complexity of these problems, making simulation-based approaches an exciting alternative. Instead of directly solving the optimization problem, simulation can use the choice pattern of actual potential customers to find the best location and its design.

In this seminar, you'll explore and critically compare these two approache types using provided datasets. Your goal will be to evaluate their effectiveness across varying levels of model complexity.

Haase, Knut (2009). Discrete location planning

2. Instance Space Analysis for location planning (Rienks)

Instance space analysis goes beyond traditional performance metrics like accuracy or R^2 by providing a deeper understanding of algorithmic quality. This method is particularly valuable for data analysis and machine learning, as it enables the visualization of how well different algorithms perform across varying types of problems.

In this seminar, you'll use instance space analysis to study the effectiveness of location planning algorithms. By designing test datasets with different complexities, you'll map and interpret the strengths and weaknesses of these algorithms. This topic not only strengthens your analytical skills but also introduces you to advanced tools for algorithm evaluation.

De Coster, A., Musliu, N., Smith-Miles, K. (2022). Algorithm selection and instance space analysis for curriculum-based course timetabling

Haase, Knut (2009). Discrete location planning

3. Comparison of the MNL, MXL and NL Model (Rienks)

If you've taken the Choice-Based Optimization (CBO) course, this seminar is your chance to dive deeper into advanced discrete choice models. The Multinomial Logit (MNL), Mixed Logit (MXL), and Nested Logit (NL) models each have unique strengths and limitations in capturing decision-making behavior.

In this seminar, you'll compare these models using a sample dataset, highlighting their theoretical differences and practical applications. By the end of this seminar, you'll have a clearer understanding of when and why to use each model, equipping you with tools for advanced decision modeling.

Train, Kenneth E (2009). Discrete choice methods with simulation

4. Optimization of Library Logistics through Periodic Route Planning (Vlćek)

This seminar topic deals with the development and implementation of a periodic vehicle routing problem (PVRP) for optimizing book deliveries. The goal is to implement a heuristic for solving the PVRP in a freely selectable programming language.

- Optimization of regular library deliveries
- Consideration of vehicle capacities, time constraints, and delivery frequencies
- Integration of spatial and temporal planning dimensions

The implementation should enable testing various scenarios and analyzing the effects of different parameters on route optimization. Students gain practical experience in implementing optimization algorithms and learn to handle complex routing problems.

5. Multi-criteria Optimization of Student Mobility for Study Abroad Semesters (Vlćek)

This seminar topic deals with developing an optimization system for automated assignment of students to available study abroad positions.

- Consideration of multiple constraints (study program, grades, language)
- Balancing hard and soft preferences
- Development of a fair assignment algorithm

The system should enable fair and efficient distribution while considering both hard constraints and soft preferences. The implementation should be flexible to evaluate various optimization criteria. Students deepen their understanding of multi-criteria optimization problems and develop practical skills in implementing matching algorithms.

6. Development of Compactness Metrics for Heterogeneous District Structures (Vlćek)

This seminar topic focuses on developing methods to optimize the compactness of districts composed of differently shaped basic units.

- Development of an algorithm for defining compactness metrics
- Optimization of district allocation
- Handling irregular shapes and sizes

The system should be applicable to various areas, such as determining electoral districts, administrative areas, or service regions. The implementation enables enforcing compactness in systems and evaluating different metrics based on this. Students develop expertise in geometric algorithms and spatial optimization.

7. Demand-based Parking Space Management through Dynamic Pricing Algorithms (Vlćek)

This seminar topic deals with developing a dynamic pricing system for urban parking spaces.

- Real-time price adjustment
- Integration of historical data and current demand
- Optimization of utilization and revenue

The system should promote efficient utilization of parking spaces while maximizing revenue and minimizing traffic load. The implementation enables testing various pricing strategies and analyzing their effects. Students gain practical experience in developing dynamic pricing algorithms and real-time data processing. 8. AI-supported Forecasting Models for Waste Management and Resource Planning (Vlćek)

This seminar topic focuses on developing a forecasting system for optimizing waste processing in waste incineration plants.

- Prediction of arrival times, quantities, and qualities
- Consideration of seasonal fluctuations and regional characteristics
- Automatic detection of relevant influencing factors

The developed system should enable more efficient resource planning in disposal facilities and contribute to improving processing procedures. The implementation should be flexible to evaluate various forecasting models and examine the effects of different parameters on prediction accuracy. Students deepen their knowledge in machine learning and time series analysis.

9. Data-driven Demand Planning for Sustainable Cafeteria Catering (Vlćek)

This seminar topic deals with developing a forecasting system for optimizing meal planning in university cafeterias.

- AI-based demand forecasting for various dishes
- Integration of influencing factors (weather, events, lecture times)
- Minimization of food waste

The system should consider seasonal trends, lecture times, and special events to derive optimal order quantities. The implementation enables the integration of various influencing factors and evaluation of their effects on forecast accuracy. Students develop competencies in processing various data sources and implementing prediction models.

10. Emergent Behavior Patterns in LLM-based Multi-agent Systems (Vlćek)

This seminar topic deals with developing a simulation system for human movement behavior using LLM-controlled agents.

- Graph-based modeling of movement spaces
- LLM-controlled decision-making of agents
- Analysis of emergent behavior patterns

The system should simulate smaller scenarios such as students' daily routines and identify emergent behavior patterns. The implementation enables testing different environmental parameters and analyzing their influence on movement patterns. Students acquire in-depth knowledge in developing multi-agent systems and integrating LLMs.

11. AI-supported Causal Analysis of Stock Prices Using News (Vlćek)

This seminar topic focuses on developing a system for automated analysis and explanation of historical stock price movements using Large Language Models (LLMs).

- Linking news sources with price developments
- Identification of relationships between news and price movements
- Generation of comprehensible explanations for price movements

The system should consider various news sources and ensure the quality of generated explanations through appropriate evaluation methods. The implementation enables comparing different stock prices and evaluating their progression by linking them with relevant information. The project enables connecting modern AI technologies with financial market analysis. Students develop practical skills in natural language processing and financial market analysis.

12. Development of Adaptive LLM Tutors for Personalized Learning (Vlćek)

This seminar topic focuses on developing chatbots for interactive support of the learning process in higher education.

- Development of an interactive question-answer system
- Integration of teaching materials as knowledge base
- Pedagogically meaningful assistance without direct solution disclosure

The system should be able to answer comprehension questions, explain concepts, and guide students through a guided learning process. The implementation should support various didactic approaches and improve the quality of interactions through continuous feedback. Students gain practical experience in working with Large Language Models and their integration into educational applications.

13. Development of an AI-based Information System for Examination Regulations

This seminar paper focuses on developing a specialized chatbot that uses RAG (Retrieval-Augmented Generation) to leverage examination regulations as a strict knowledge base and provide students with precise information.

- Development of a chatbot using examination regulations as the sole source of knowledge
- Integration of RAG for source-based and traceable response generation
- Implementation of mechanisms to prevent misinformation or unauthorized interpretations

The system should be capable of understanding natural language questions about examination regulations and answering them exclusively with information contained within the regulations. The implementation must ensure that no statements are made beyond what is specified in the examination regulations. Students gain practical experience in working with Large Language Models, RAG systems, and their responsible integration.

14. Image-based People Counting and Movement Analysis Using Deep Learning (Vlćek)

This seminar topic deals with developing a system for automated detection and analysis of people movements in public spaces using computer vision.

- Implementation of deep learning models for person detection
- Tracking of movement patterns and dwell times
- Privacy-compliant aggregation and visualization of results

The system should process camera images in real-time while counting people and analyzing their movement patterns. The implementation enables evaluating various deep learning architectures and comparing their accuracy under different conditions. Special focus is placed on privacy-compliant processing of image data. Students develop practical skills in computer vision, deep learning, and real-time data processing.

15. Location analysis of customers of a brewery (Sauerbier/Rienks)

Have you ever wondered what makes certain locations thrive while others struggle? In this seminar, you'll work with a real-world dataset from a Swiss brewery, covering three years of sales data. Your task is to analyze this data to uncover patterns and insights about location characteristics and their impact on success. If possible, current delivery routes should also be identified. In addition to the data analysis, a suitable model for a demand forecast is to be estimated. This hands-on topic provides an excellent opportunity to apply data analysis techniques to real

business problems. By the end of this seminar, you'll have valuable experience in turning raw data into actual information.

16. Case Study: Estimation of transportation mode choice using the MXL model (Sauerbier)

This paper presents a theoretical analysis of the MXL model. In particular, the estimation methods for this model will be explained and discussed. Additionally, an MXL model will be estimated using the Swiss Metro data set, and the results will be compared with those obtained from an MNL estimation. For this purpose, estimates from the literature may be replicated.

You, Linlin, Junshu He, Juanjuan Zhao, and Jiemin Xie. 2022. "A Federated Mixed Logit Model for Personal Mobility Service in Autonomous Transportation Systems" Systems 10, no. 4: 117. Bierlaire, Michel, Kay Axhausen, and Georg Abay. "The acceptance of modal innovation: The case of Swissmetro." Swiss transport research conference. 2001.

17. Estimation Methods (Sauerbier)

In this paper, alternative estimation methods for maximum log-likelihood estimation will be derived from the literature. For this purpose, examples from the literature may be used, or a simple data set can be selected for illustrative implementations. The aim of the paper is to provide an overview of the methods, including an example for each, an explanation of their advantages and disadvantages, and a recommendation on when the model should be used.

18. Analyzing Mode Choice Using the Swiss Metro Dataset (Sauerbier)

This seminar thesis analyzes and processes the Swiss Metro dataset. The goal is to identify and critically evaluate existing model estimations from the literature. Based on these findings, opportunities for improvement will be developed and tested. Additionally, an MNL model for mode choice will be estimated using the dataset.

Bierlaire, Michel & Axhausen, Kay & Abay, Georg. (2001). The acceptance of modal innovation: The case of Swissmetro.

19. Analyzing Mode Choice Using the Apollo Swiss Route Choice Dataset (Sauerbier)

This seminar thesis analyzes and processes the Swiss Route Choice dataset. The goal is to identify and critically evaluate existing model estimations from the literature. Based on these findings, opportunities for improvement will be developed and tested. Additionally, an MNL model for mode choice will be estimated using the dataset.

Axhausen, Kay. (2003). The impact of tilting trains in Switzerland: a route choice model of regional- and long distance public transport trips.

20. Analyzing Mode Choice Using the Apollo Mode Choice Dataset (Sauerbier)

This seminar paper analyzes and processes the Apollo Mode Choice dataset. The goal is to identify and critically evaluate existing model estimations from the literature. Based on these findings, opportunities for improvement will be developed and tested. Additionally, an MNL model for mode choice will be estimated using the dataset

Stephane Hess, David Palma, Apollo: A flexible, powerful and customisable freeware package for choice model estimation and application, Journal of Choice Modelling, Volume 32, 2019

21. Analyzing Mode Choice Using the Dresden School Dataset (Sauerbier)

This seminar paper analyzes and processes the Dresden School dataset. The goal is to identify and critically evaluate existing model estimations from the literature. Based on these findings, opportunities for improvement will be developed and tested. Additionally, an MNL model for mode choice will be estimated using the dataset.

Sven Müller, Stefan Tscharaktschiew, Knut Haase, Travel-to-school mode choice modelling and patterns of school choice in urban areas, Journal of Transport Geography, Volume 16, Issue 5, 2008