Master Seminar — Summer Semester 2026

Focus: OSCM und Business Analytics

29. Januar 2026

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`
- LaTeXtemplate 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 29, 2026, 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.

- 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 14.06.2026, 23:59 at the latest.
- For the submission, we need the digital version of the work and all 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 person at the University of Hamburg.
- Friday, June 19, 2026, 16.00 to 22.00, Moorweidenstraße 18, Room 2029.
- Saturday, June 20, 2026, 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 18, 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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- Dr. Tobias Vlcek: tobias.vlcek@uni-hamburg.de
- Simon Rienks: simon.rienks@uni-hamburg.de
- 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. **Empirical Analysis and Modeling of Company-Related Order Data (Rienks/Sauerbier)**
   For the seminar, a comprehensive dataset from a real corporate environment is provided, containing numerous transactions, customer information, and product data over many years. The data offers exciting insights into developments, behavioral patterns, and trends and provides an ideal foundation for applying modern methods from business analytics, machine learning, and operations research in practice. The goal of the seminar is to develop data-driven approaches based on selected research questions, conduct sound analyses, and create innovative solutions for real-world challenges.

a) **Predictive Analytics**
Predictive analytics uses historical data to estimate future behavior and upcoming developments as accurately as possible. In the context of order and customer data, this method enables well-founded strategic decision-making and targeted planning of resources. In this seminar, you will explore different methods for forecasting future order quantities as well as estimating individual purchase probabilities and customer lifetime value. You will combine classical time series models with modern machine learning approaches and compare their performance. You will learn how to develop forecasting models, evaluate them, and interpret their results. This topic provides practical skills in working with predictive models and demonstrates how companies can anticipate future developments based on data.

b) **Churn Prediction**
Churn prediction deals with the question of which customers are likely to stop ordering in the future. It is a key component of customer relationship management, as it enables companies to identify at-risk customers early and take targeted retention measures. In this seminar, you will develop models to predict churn probability based on historical order, activity, and customer data. You will apply various classification methods, compare their performance, and analyze the most important factors influencing churn behavior. In addition, you will discuss actionable recommendations derived from the model results. This topic provides in-depth knowledge in predictive modeling and illustrates how data-driven analyses can actively contribute to improving customer relationships.

c) **Customer Segmentation**
Customer segmentation aims to structure heterogeneous customer bases into meaningful groups to better understand patterns, needs, and potential. It is a central tool in marketing, sales, and strategic business planning. In this seminar, you will apply various clustering methods to real order, revenue, and product data and develop a model to classify customers according to activity and value contribution. By analyzing the identified segments, you will gain insights into high-value customers and potential cross-selling opportunities. This topic provides essential skills in unsupervised learning and demonstrates how data-based segmentation supports companies in targeted customer engagement.

d) **Forecasting and Inventory Planning**
Forecasting and inventory planning combine statistical forecasting methods with classical and modern techniques from Operations Research. The goal is to stock products in such a way that demand is reliably met without causing unnecessary costs. In this seminar, you will create demand forecasts for products or product groups and derive safety stocks. You will then use optimization models such as the EOQ model or stochastic approaches to determine order quantities efficiently. This topic provides solid knowledge of the interaction between forecasting and optimization and illustrates how companies can make robust and economically sound decisions through data-based inventory planning.

e) **Dashboarding and Data Storytelling**
Dashboarding and data storytelling combine analytical precision with clear, comprehensible communication. The aim is to prepare complex data in such a way that it provides decision-makers with quick orientation and makes key insights visible. In this seminar, you will develop interactive dashboards for exploring the comprehensive dataset. You will visualize trends, customer segments, and demand cycles and design representations that enable intuitive analysis. At the same time, you will create a data storytelling concept that presents the insights gained in a structured, clear, and targeted manner. This topic provides practical skills in visualization, information design, and data-driven communication.

2. **Image Recognition in Crowd Management (Sauerbier)**:
Selection of an Application and Methodology, Detailed Method Description with a Focus on Fine-Tuning and Qualitative Improvements Based on the Application Example.

Each group selects a concrete application in crowd management (e.g., people counting, crowd density estimation, movement tracking, person classification or detection, speed estimation). The group then defines the methodology, explains it in detail, and focuses on fine-tuning during implementation. A pre-trained neural network (e.g., YOLO) can be used as a foundation. Qualitative changes and optimizations should be demonstrated based on the chosen example.

Possible Applications:

- People counting: Automatic counting of individuals in a scene
- Crowd density estimation: Determining the number of people in a specific area (e.g., a room or open space)
- Movement tracking: Tracking individuals in a video
- Person classification/detection: e.g., detecting specific behaviors or age groups
- Estimating person speed: Analyzing movement dynamics in the scene
- Group or cluster detection in crowds
- Detection and analysis of waiting times or flow patterns
- Prediction of spontaneous crowd gatherings or overcrowding

Methodological Aspects:

- Type of neural network: CNN, RNN, R-CNN, YOLO, Mask R-CNN, transformer-based models, etc.
- Activation functions: ReLU, Leaky ReLU, GELU, Swish
- Network depth: Number of layers, layer types (e.g., residual blocks)
- Loss functions: Cross-entropy, IoU-based losses, focal loss
- Optimization algorithms: Adam, SGD, RMSProp, learning-rate schedulers
- Data augmentation: Rotation, scaling, brightness, contrast adjustments
- Regularization: Dropout, batch normalization, L1/L2
- Annotation & data quality: Manual labeling, bounding-box quality
- Transfer learning & tuning: Use of pre-trained models, layer adaptation

Optional Extensions:

- Comparison of different models with respect to accuracy and speed
- Impact of fine-tuning on detection quality in various scenarios
- Robustness under poor image conditions
- Hyperparameter optimization
- Visualization of movements and speeds

3. **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

4. **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

5. **Comparison of the MNL, MXL, NL and Probit 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), Nested Logit (NL) and Probit 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

6. **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.

7. **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.

8. **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.

9. **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.

10. **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.

11. **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

12. **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

13. **Police Service Simulation for Evaluating Locations, Districts, and Dispatching Rules (Vlćek)**

    This seminar topic focuses on the development of a simulation model for strategic planning of police resources.

    - Implementation of an event-based simulation model for police operations
    - Evaluation of various scenarios (location relocations, district boundaries, ...)
    - Analysis of performance metrics such as response times and utilization

    The system should enable the simulation of various strategic decisions in advance and assess their impact on operational performance. The implementation requires the integration of spatial data and the modeling of stochastic incident demands. Students gain practical experience in developing simulation models and applying OR methods.

14. **Optimization of Shift Patterns and Personnel in Police Services (Vlćek)**

    This seminar topic focuses on the development of an optimization model for planning shift patterns for police forces.

    - Modeling of labor law and collective agreement regulations as constraints
    - Development of a multi-criteria objective function (deployment coverage, fairness, ...)
    - Implementation of a solution method for shift pattern optimization

    The model should consider generic officer profiles while integrating hard constraints (rest periods, maximum working hours) as well as preferences (preferred shift times, balanced workload). The implementation enables the analysis of various shift models and their effects on personnel availability. Students deepen their knowledge in mixed-integer optimization and develop practical programming skills.

15. **Literature Review on Geo-Based Crime Prediction (Vlćek)**

    This seminar topic focuses on the systematic analysis of scientific literature on spatial forecasting methods for crime.

    - Systematic research on machine learning methods for crime prediction
    - Analysis of spatial and temporal modeling approaches
    - Critical examination of ethical implications and potential biases

    The work should compare various approaches to geo-based crime prediction, from classical hot-spot analyses to modern deep learning methods. A particular focus lies on the critical reflection of ethical aspects such as algorithmic fairness and the risk of reinforcing existing inequalities. Students develop expertise in evaluating prediction models and their societal implications.

16. **Shift Scheduling for Rehabilitation Clinics with Room and Patient Assignments (Vlćek)**

    This seminar topic focuses on the development of an integrated planning system for rehabilitation clinics.

    - Modeling of the simultaneous assignment of staff, rooms, and patients
    - Consideration of individual therapy plans and qualification requirements
    - Development of an optimization procedure under complex constraints

    The system should enable efficient utilization of therapy resources while considering patient-specific treatment plans. The implementation requires the integration of various planning dimensions (time, room, staff, patients) into a consistent model. Students gain practical experience in solving complex scheduling problems and develop competencies in applying optimization methods.

17. **Graph-Based RAG Systems Using Communication Data (Vlćek)**

    This seminar topic focuses on the development of a retrieval-augmented generation system using knowledge graphs derived from communication data.

    - Extraction and modeling of knowledge graphs from email and messaging data
    - Integration of graph retrieval methods into LLM-based systems
    - Development of context-aware query and response mechanisms

    The system should extract the connections between people, topics, and temporal relationships from communication threads and make them available for LLM-supported queries. The implementation requires the combination of natural language processing, graph databases, and large language models. Students gain practical experience in developing modern RAG architectures and processing unstructured communication data.

18. **Emergent Behavioral Patterns in LLM-Based Multi-Agent Systems (Vlćek)**

    This seminar topic focuses on the development and analysis of multi-agent systems in which LLM-controlled agents interact with each other and generate emergent behavioral patterns.

    - Development of a multi-agent framework with LLM-controlled actors
    - Analysis of emergent behaviors through agent interaction
    - Evaluation of various coordination and communication mechanisms

    The system should investigate the emergence of complex behavioral patterns from simple interaction rules while simulating various scenarios such as social dynamics or market mechanisms. The implementation enables the comparison of different LLM configurations and agent architectures. Students acquire sound knowledge in the development of multi-agent systems, the integration of large language models, and the analysis of emergent phenomena.

19. **Evacuation Planning for Large Events Using Network Flow Optimization (Vlćek)**
    This seminar topic focuses on the development of an optimization model for planning evacuation scenarios at large events.

    - Modeling of the event venue as a capacity network with bottlenecks
    - Implementation of algorithms for calculating optimal evacuation routes
    - Analysis of various scenarios (partial evacuation, full evacuation, blocked exits)

    The system should calculate evacuation times for various configurations and identify critical bottlenecks. The implementation enables testing of various event scenarios and analysis of the effects of capacity changes or route closures. Students gain practical experience in network flow optimization and develop competencies in applying OR methods for safety planning.

20. **Route Optimization in Warehouses Through Analysis of Orders (Vlćek)**
    This seminar topic focuses on the optimization of storage locations and picking routes based on product correlations in order data.

    - Analysis of order data to identify frequently co-ordered products
    - Development of an optimization model for storage location assignment
    - Simulation and comparison of various storage strategies regarding path lengths

    The system should identify product clusters from historical order data and derive optimal storage placements from them. The implementation combines pattern recognition methods with optimization procedures for storage location assignment. Students gain practical experience in combining data analysis and operations research as well as in applying clustering and assignment algorithms in warehouse logistics.

21. **Literature Overview on UAV Tracking (Vlćek)**
    The increasing deployment of unmanned aerial vehicles (UAVs) in commercial, governmental, and private applications has created an urgent need for effective traffic monitoring and control systems. As drone operations expand into urban environments and shared airspace, ensuring safe and efficient integration with manned aviation becomes a critical challenge.

    - Investigation of methods for detecting, identifying, and tracking drones in airspace, including cooperative systems (e.g., Remote ID, ADS-B) and non-cooperative approaches (e.g., radar, RF detection, optical sensors)
    - Examination of communication architectures, command and control links, and autonomous navigation systems that enable safe drone operations
    - Review of system architectures and frameworks for managing drone traffic, including regulatory concepts

    This seminar thesis aims to provide a comprehensive literature analysis examining the current state of research in drone traffic monitoring and control. Students should systematically review and evaluate existing scientific publications, technical reports, and regulatory documents to identify established approaches, emerging technologies, and open research questions in this field.

22. **Strategic Placement of Parcel Lockers in Hamburg-Eimsbüttel under the Threshold Luce Model (Prof. Haase)**

    The district of Hamburg-Eimsbüttel is characterized by a high population density, a vibrant mix of residential and commercial areas, and a high volume of e-commerce deliveries. Logistics providers face the challenge of establishing a cost-effective network of self-service parcel lockers to reduce ll-ast-mile"delivery costs while competing with traditional home delivery and existing pickup points. Traditional location models often assume that customers consider all available options equally (Standard Multinomial Logit Model). However, empirical evidence suggests that customers only consider a limited choice set.Äccording to the Threshold Luce Model (TLM), a customer will only consider a parcel locker if its attractiveness (determined by proximity, accessibility, and safety) is not significantly lower than the best available alternative.
    Lin, Y., Wang, Y., Lee, L. H., Chew, E. P. (2022). Profit-maximizing parcel locker location problem under threshold Luce model. Transportation Research Part E: Logistics and Transportation Review, 157, 102541.

23. **Predictive Location Analytics for Urban Logistics (Prof. Haase)**

    Logistics providers (DHL, Amazon, Hermes) strategically place lockers in high-density urban areas. This project investigates which urban factors (population, transit, retail) statistically drive the current spatial concentration of lockers in Hamburg. Instead of individual choice modeling, we use a spatial-econometric approach to analyze supply density across the city.

    - GIS-Analysis (QGIS): Create a 500m x 500m grid of Hamburg. Assign the number of existing lockers (from OSM) and urban features (population, POIs, HVV stops) to each grid cell.
    - Statistical Modeling: Implement a Poisson Regression or Negative Binomial Model to explain the locker count per cell.
    - Advanced Modeling: Test for Overdispersion (variance ¿ mean). If present, students must apply a Negative Binomial Model to account for urban clustering.
    - Evaluation: Identify LLogistics Deserts"by comparing the model's predicted density with actual locations to find untapped market potential.

    Research Questions: Which urban features are the most significant predictors of locker density in Hamburg? Does the Negative Binomial model significantly improve the fit compared to a Poisson model? Where are the geographical gaps between predicted demand and current supply?