Masterseminar - Summersemester 2024

Focus: OSCM und Business Analytics

22. Dezember 2023

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:
  `PLACEHOLDER`

Preliminary Meeting

- The preliminary meeting with the assignment of topics will take place for all participants on **Wednesday, January 31, 2024, from 16:00 to 18:00** in room 2029 at Moorweidenstraße 18.
- Please have a 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 group size of two students. If possible, the students should preferably belong to different degree programs.
- Please note that**each participant must submit their own seminar paper**.

Intermediate Presentations

- At least three appointments must be held with the supervisor during the course of 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 17, 2024, May 15, 2024, and June 12, 2024, 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 three text pages and formally correct bibliography. Please submit the reading sample one week before the presentation so that the supervisors have time to correct it.

Submission of the Seminar Paper

- Please hand in the thesis by 15.06.2024, 23:59 at the latest.
- For the submission we need the digital version of the work as well as sämtliche 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 21, 2024, 16.00 to 22.00, Moorweidenstraße 18, Room 2029.
- Saturday, June 22, 2024, 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 20, 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.

List of Topics

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

1. **Site planning for the placement of solar parks**

   This project focuses on the development of site planning strategies for the placement of solar parks. The aim is to use a self-selected mathematical model to identify optimal locations that both maximize the efficiency of energy production and take into account environmental and socio-economic factors. The work involves analyzing geographical, climatic and environmental data to determine suitable locations for solar parks. The results of this project could help drive the development of renewable energy by providing sound, data-driven recommendations for solar farm siting.

2. **Site planning for the installation of charging stations for electric vehicles in an urban area**

   This project is dedicated to strategic site planning for the installation of charging stations for electric vehicles in urban areas. The aim is to identify optimal locations that both maximize accessibility and take into account the urban infrastructure and traffic flows. The work includes the analysis of traffic patterns, population density and existing energy infrastructures. A model will be developed and applied to suggest new locations for charging stations based on this data while taking economic aspects into account. The results of this study can provide important insights for the planning and implementation of a sustainable charging infrastructure for electric vehicles. They can help to promote electromobility in urban areas and thus take an important step towards more environmentally friendly and efficient urban transportation systems.

3. **Choice of location for electric vehicle charging stations based on user preferences**

   This project deals with the siting of electric vehicle charging stations, with a focus on considering user preferences. The aim is to understand which factors are most important to electric vehicle owners when using charging stations and how these insights can be integrated into site planning. The work involves the collection and analysis of data on user preferences, including aspects such as accessibility, charging times, cost, proximity to activity centers and availability of ancillary services. Empirical social research methods, such as surveys and focus groups, will be used to gain a detailed understanding of users' needs and wishes. Another part of the project is the implementation of a multinomial logit model to analyze the location choice of electric vehicle charging stations based on user preferences. The results of this study can provide important insights into the optimization of the charging infrastructure for electric vehicles and can help to promote the acceptance and use of electric vehicles.

4. **Image recognition and segmentation in agriculture**

   Agriculture is affected by the climate crisis like no other economic sector. For this reason, state-of-the-art analysis methods are sometimes used in combination with the use of drones to maximize farmers' productivity.
   The aim of this paper is to create an optimization model for the automated planning of drone flights. The trade-off to lies in the possible resolution of the images and the area to be covered.

5. **Image recognition and segmentation in crowd management**

   At large events, there are always incidents in which many people die. The problem is that as soon as a certain density is exceeded, crowds stop organizing themselves and chaos breaks out. Live monitoring of densities is necessary to prevent these limits from being exceeded. One way of monitoring is to recognize images of people, count them and divide the image sections according to their densities.
   The aim of this paper is to examine the methods of image recognition and segmentation and to apply them to a data set in order to achieve the objectives described above.
   Cheng H.D., Jiang X.H., Sun Y., Jingli Wang (2001). Color image segmentation: advances and prospects, Pattern Recognition, 34(12), 2259-2281.
   Haase, K., Kasper, M., Koch, M., Müller, S. "A Pilgrim Scheduling Approach to Increase Safety During the Hajj". Operations Research 67. (2019): S. 376-406.

6. **Instance Space Analyse**

   Instance space analysis makes it possible to understand the quality of algorithms better than statistical measures such as accuracy, cross entropy or R^2. It is therefore an important tool in data analysis and machine learning that offers the possibility to go deep into the analysis of data. This field of research enables the examination of data points in a multidimensional space in order to recognize their relationships and structures. Through applications in areas such as cluster analysis and dimensionality reduction, instance space analysis provides a solid approach to understanding and evaluating complex data sets. The seminar paper on this topic is intended to replicate an existing paper by one of the leading researchers in this field and thus develop this field.
   De Coster, A., Musliu, N., Smith-Miles, K. (2022). Algorithm selection and instance space analysis for curriculum-based course timetabling

7. **Decision trees as an optimization problem**

   Machine learning methods and artificial intelligence often suffer from the problem that structural weaknesses in the data set used for learning also lead to structural weaknesses in the model. The result can be a discriminatory or even racist model.
   One possible approach to solving this problem is to reformulate these methods as an optimization model, which allows a ban on discrimination to be introduced as a constraint.
   In this seminar paper, this will be done using the example of decision trees.
   Verwer and Zhang (2017). Learning decision trees with flexible constraints and objectives using integer optimization

8. **Evaluation of the new S-Bahn Hamburg route network**

   In December 2023, the S-Bahn network in Hamburg was fundamentally restructured. The aim of this project is to check whether the set goals have been achieved and to shed light on various aspects related to this restructuring through a model-based comparison between the previous and current state of the S-Bahn network. Students will have the opportunity to familiarize themselves with advanced modelling techniques in order to carry out a detailed analysis of the changes on the lines. The focus is not only on the changed lines, but also on the effects on mobility and efficiency.

9. **Simulation of Metro Systems**

   This project deals with the development and application of a simulation of a rail-based public transportation system. The aim is to program a simulation that can analyze and evaluate the performance, efficiency, and effects of different operating strategies under realistic conditions. The simulation should represent a part of the Hamburg metro system, especially the new U5, and be able to depict vehicle movements and passenger flows with given timetables. The application should enable realistic and practical representations. The results could provide decision-makers in traffic planning and control with valuable data and analyses, enabling them to make informed decisions to improve public transportation.

10. **Simulation of Emergency Service Operations to Assess Response Time**

    This project is dedicated to the development of a simulation in a programming language of choice for analyzing and assessing the operational procedures and response times in ambulance service operations. The goal is to gain a detailed understanding of the dynamics of rescue procedures and, in the long term, identify potentials for optimization. At the core of the project is the simulation of realistic, self-created scenarios of rescue operations, in order to investigate various factors and conditions that influence response time. These include, among others, the geographical distribution of emergency services, traffic patterns, communication channels, and the availability of resources. The simulation aims to provide realistic insights into the processes and enable the systematic evaluation of different strategies to improve response time. This project has the potential to contribute to the enhancement of the responsiveness of emergency services. Furthermore, it offers important insights into the abstraction and simulation of real-life processes that are also significant in other problem areas.

11. **Route and Timetable Generation for Central Libraries to Supply Local Libraries**

    This project focuses on optimizing route and timetable designs for central libraries to ensure the most efficient supply of the latest media to local libraries. The core of the project is the creation of a mathematical model that represents the legally permissible distribution of books from a central library to local libraries. The model is intended to optimize both route planning and the schedule of deliveries. Special emphasis is placed on the application of operations research methods to generate efficient and practical solutions. The project provides important insights into the optimization of logistics processes, which are significant not only for libraries but also for other industries. Furthermore, the project offers the opportunity to link theoretical knowledge in applied logistics with real-world challenges.

12. **Forecasting Long-Term Weather Data with LSTM Models**

    The subject of the seminar paper is the application of Long Short-Term Memory (LSTM) models for forecasting long-term weather data. The objective is to analyze the complexity of weather dynamics and to examine whether LSTM networks can recognize and predict temporal patterns in extensive meteorological data. The main focus is on creating a model that opens up a perspective for long-term weather forecasts. The project requires a critical engagement with theoretical concepts and practical applications in the field of machine learning. It offers the opportunity to develop important competencies in data analysis and modeling.