Service Operations Research Seminar HWS 2025 (OPM 781)

"Current Topics in Service Operations Management Research"

General Information:

1. The goal of this seminar is to introduce participants to conducting applied scientific research in the field of (service) operations management. Also, the seminar aims at practicing presentation skills, such as speaking with clarity, confidence and connection.

2. The master thesis prepares students for writing their M.Sc./Diploma Thesis primarily at the Chair of Service Operations Management, but OPM781 also qualifies you formally for writing a master thesis at any other chair in the Operations Area.

3. The offered topics are presented below and designed to be explored by a single student based on the fundamental literature. Each participant will present his/her findings in a written report (about 20 pages) as well as in an in-class presentation (~20 min), followed by a discussion (~10 min).

4. The **application procedure** for this seminar is combined with those for the seminars of the Chair of Production Management (OPM 761), the Chair of Logistics (OPM 701) and the Chair of Procurement (OPM 791). Students can apply for topics from all chairs by joining the ILIAS application group and completing the online form provided there. Topics labeled with "L" refer to the Chair of Logistics (OPM 701), topics labeled with "P" refer to the Chair of Production Management (OPM 761), topics labeled with "B" refer to the Chair of Procurement (OPM 791) and topics **labeled with "S"** refer to the **Chair of Service Operations Management (OPM 781)**. The **assignment of topics** to students will be preference-based through ILIAS. To better match topic and student background, applicants for OPM 781 may in addition send a CV and official grades overview by post to the chair or by e-mail sekretariat.som@uni-mannheim.de with subject "OPM 781 Seminar Application".[1]

5. The **application period** starts on **May 2nd** and ends on **May 16th, 2025**.

6. **Admission** to the seminar is **binding** and will be confirmed by E-mail by **May 23rd, 2025,** at latest.

[1] Data protection: Please note that a breach of confidentiality and the unauthorized access by third parties cannot be excluded when transmitting an unencrypted email. Note on data protection: The submitted documents will be returned only if an envelope with sufficient postage is included. Otherwise they will be destroyed after the application process according to the requirements of the data protection law. Electronic applications will be deleted accordingly.

7. A **kick-off meeting** for all participants will be held on Tuesday, **May 27th at 12:00 in SO322**. During this meeting, general guidelines for conducting scientific work will be discussed.

8. The latest **submission** date for the written report incl. appendices is **November 5th (2025),** For submission, please …

    a. **Upload your report** (Word- / Latex-document and PDF) via Task "Upload of final Thesis & Calculations/Software Output" in the OPM781 ILIAS group. If you have multiple files (e.g. a pdf and some Excel analysis), please upload all in a single zip file.

    b. **Submit a hard copy** at our secretary’s office (Mon-Thu before noon) or at your thesis supervisor. Please make an appointment for submitting the hard copy.

9. The **final presentations** of the seminar participants will be held by default in the **regular presentation session** on **November 26th**, in room SO 318. A **fast-track presentation track** may be offered to students who desire to start with their master thesis early based on their request. Attendance is mandatory for all presentations on your own presentation date.

10. In addition, we will offer an **optional mock-up presentation** session one week before the regular final presentations, i.e., on **November 19th**. Here, participants can practice their final presentation and get tips on structure, content and presentation style risk-free without being graded – if they want to. In the kick-off meeting, we will provide some guidance and resources on how to train your presentation skills upfront, such as speaking with clarity, confidence and connection.

11. Please **upload your final presentation slides** (ppt and PDF) on Task "Upload of Final Presentation" in the ILIAS group **one day before the presentation**, latest by **18:00 pm**.

12. The final grade for the seminar is composed of the following components: Written report (60%), presentation (30%), contribution to discussion of your own topic and of potentially other topics presented on the same date (10%).

13. For questions concerning the seminar contact us by email at sekretariat.som@uni-mannheim.de

Seminar topics

Please note:
The amount of recommended literature does NOT indicate more or less workload! Every thesis will contain some literature review, and more recommendations maybe helpful for this. Also, your supervisor may have more recommendations for you, in particular, if the initial list of recommended references for a topic is short.

<u>Table of Contents</u>

<u>Topic S01: Smart "Predict, then Optimize"</u>

Real-world optimization problems generally require a combination of predictive analytics and prescriptive analytics (optimization). The prediction or estimation task and the optimization task are commonly two distinct stages carried out sequentially in a so-called predict-then-optimize approach (see, e.g., Bertsimas and Kallus, 2020; Qi and Shen, 2022):

- Prediction stage: The prediction task typically comes first, where statistical or machine learning models are used to make point predictions or distributional estimates of unknown parameters relevant to the decision problem, such as cost, demand, or supply levels. Although typically not framed as an optimization task, the estimation itself is also based on an optimization model that aims to minimize the error between the predicted values and the actual outcomes. For example, ordinary least squares regression minimizes the sum of squared errors, which is an optimization problem.
- Optimization Stage: Once the predictions are made, the final optimization model is solved to determine the best decisions based on the forecasted values. This model typically aims to maximize or minimize a specific objective function, subject to various constraints.

The sequential predict-then-optimize framework has been widely employed in theory and practice. It is straightforward and modular, allowing separate model improvements and easy implementation with off-the-shelf prediction and optimization tools. However, building the predictive model without considering how the predictions will be used in the optimization step also bears some disadvantages. In particular, the sequential optimization may result in suboptimal decisions since the predictive model is not optimized for the downstream decision problem. Therefore, improving prediction accuracy in a classical sense may adversely affect the optimization outcomes (see, e.g.; Qi and Shen, 2022).

Due to the above mentioned limitations of the classical predict then-optimize approach, more integrative approaches have recently gained increasing interest in the literature (see, e.g., Qi and Shen, 2022 for a recent review). For example, instead of predicting the input parameters for the optimization model in the classical way, some researchers have suggested to optimize the prediction model directly with respect to the objective of the final downstream decision (see, e.g., Elmachtoub and Grigas, 2022). In this so-called Smart Predict-then-Optimize (SPO) approach, the ultimate optimization objective and even constraints are incorporated into the error function used during the prediction phase, such that the predictive model minimizes the decision-making error rather than a purely statistical prediction error.

The objectives of this thesis are to:

- review and classify the literature on approaches aiming to integrate prediction and optimization, and discuss pros and cons compared to the classic predict-then-optimize approach;
- focus on a selected model (e.g., Elmachtoub and Grigas, 2022), and discuss it in detail, including a critical assessment of assumptions and limitations;

- identify future research opportunities for integrating prediction and optimization.

Selected Literature Recommendations:

Elmachtoub, A. N., & Grigas, P. (2022). Smart "predict, then optimize". Management Science, 68(1), 9–26

Qi, M., & Shen, Z.-J. (2022). Integrating prediction/estimation and optimization with applications in operations management. In Tutorials in operations research: Emerging and impactful topics in operations (pp. 36–58). INFORMS

Topic S02: Discrete Choice vs. Machine Learning Demand Models in Revenue Management, Pricing and Assortment Optimization

Developing a practical approach for many operations problems typically involves two key steps. First, managers choose a demand model based on historical sales data. Then, this model informs an optimization problem guiding crucial decisions like inventory, pricing, and assortments. Traditionally, the operations and revenue management fields favor simple demand models with explicit relationships between product features (e.g., price) and demand, for example discrete choice models like the multinomial logit (MNL) model. These models allow for easy estimation and formulation of optimization problems. However, the recent rise of machine learning (ML) offers an alternative approach. Algorithms like gradient-boosted decision trees and neural networks excel at predicting demand patterns, potentially outperforming simpler models in accuracy and capturing customer behavior nuances. Furthermore, considering the wide availability of user-friendly open-source machine learning software packages, it's not surprising that many recommendation systems in industry rely on advanced machine learning models. Given this context, a natural question arises: If cutting-edge machine learning models can indeed outperform choice models in accurately predicting customer purchasing patterns, why would managers still opt for the latter? Some findings e.g. by Feldman et al. (2022) suggest that while accurate predictions are crucial, they alone do not ensure profitable operational decisions based on these estimates. Equally important is the sophistication of the subsequent optimization problem in capturing key operational trade-offs.

The objectives of this thesis are to:

- provide an introduction into discrete choice and ML models and their estimation methods;
- review and classify studies that compare the performance of classical choice models (such as MNL) vs. ML models with regard to suitable performance criteria;
- discuss the study by Feldman et al. (2022) in detail with respect to data, models, methodology, results, managerial implications, and limitations.

Selected Literature Recommendations:

Feldman, J., Zhang, D. J., Liu, X., & Zhang, N. (2022). Customer choice models vs. machine learning: Finding optimal product displays on Alibaba. Operations Research, 70(1), 309-328.

Topic S03: Driving Change: Leveraging Analytics for Sustainable Freight Transportation

The global population, currently estimated at 7.6 billion, is projected to increase by roughly 50% by 2100, as forecasted by the United Nations Department of Economic and Social Affairs. This growth will amplify the demand for freight transport, which is fundamental not only for economic growth but also for ensuring social welfare. Freight, moved by multiple modes of transport—road, rail, sea, and air—serves as a critical link in global supply chains. Despite advances in efficiency and distribution, the environmental impact of freight transportation remains substantial. Greenhouse gas emissions, fuel consumption, and pollution associated with transport have spurred an urgent need for more sustainable logistics practices. Here, analytics has a significant role to play, offering powerful tools for enhancing both the sustainability and efficiency of freight transportation.

The objectives of this thesis are to:

- identify and analyze the primary challenges faced by the freight transportation sector in transitioning to greener practices, including issues related to emissions reduction, regulatory compliance, infrastructure limitations, and cost implications;
- review and classify the literature for models, tools, and technologies available for optimizing green freight logistics;
- discuss the role that analytics has played and may play in the future towards greener freight transportation, along with its limitations;
- discuss future research opportunities and practice needs.

Selected Literature Recommendations:

Bektaş, T., Ehmke, J. F., Psaraftis, H. N., & Puchinger, J. (2019). The role of operational research in green freight transportation. European Journal of Operational Research, 274(3), 807-823.

Moghdani, R., Salimifard, K., Demir, E., & Benyettou, A. (2021). The green vehicle routing problem: A systematic literature review. Journal of Cleaner Production, 279, 123691.

McKinsey & Co. (2024). Decarbonizing logistics: Charting the path ahead. https://www.mckinsey.com/capabilities/operations/our-insights/decarbonizing-logistics-charting-the-path-ahead

<u>Topic S04: Strategic Optimization in Ride-Hailing Operations: Leveraging Analytics and AI to Navigate Challenges and Explore Opportunities</u>

The ride-hailing industry, represented by companies like Uber and Lyft, has transformed urban transportation. Despite its growth, profitability remains elusive due to high operational costs, regulatory challenges, and intense competition. This thesis will investigate the strategic operations of ride-hailing services, focusing on the challenges they face and how analytics and artificial intelligence (AI) can provide solutions to enhance profitability.

The objectives of this thesis are to:

- examine the Operational Strategies: Analyze the current operational strategies employed by leading ride-hailing companies, including pricing models, fleet management, and customer acquisition;
- identify Key Challenges: Discuss the primary challenges hindering profitability in ride-hailing operations, such as market saturation, driver retention, regulatory compliance, and competition from traditional taxi services;
- role of Analytics and AI: Investigate how analytics and AI can improve ride-hailing operations. This includes dynamic pricing strategies, demand forecasting, route optimization, rider-driver matching algorithms, and customer experience enhancement. Evaluate the potential impact of adopting advanced analytics and AI on key performance indicators, such as operational efficiency, customer satisfaction, and overall profitability;
- future Opportunities: Discuss future research opportunities as well as potential innovations in the ride-hailing sector, including the integration of autonomous vehicles and new business models that leverage analytics for improved operational decision-making.

Selected Literature Recommendations:

Azagirre, X., Balwally, A., Candeli, G., Chamandy, N., Han, B., King, A., ... & Zamoshchin, A. (2024). A better match for drivers and riders: Reinforcement learning at Lyft. INFORMS Journal on Applied Analytics, 54(1), 71-83.

Özkan, E. (2020). Joint pricing and matching in ride-sharing systems. European Journal of Operational Research, 287(3), 1149-1160.

Sawhney, M., Shah, B., Yu, R., Rubtsov, E., & Goodman, P. (2020). Uber: Applying machine learning to improve the customer experience (Product No. KE1161-PDF-ENG).

Topic S05: A Review of Integrated Learning and Optimization Approaches

Many operational decisions—from inventory control to pricing and logistics—depend on uncertain parameters that must be estimated from data. Traditionally, such problems are addressed in a two-step framework: first, parameters are predicted using machine learning or statistical models, and second, an optimization model is solved using these predictions. This predict-then-optimize approach is intuitive and modular but may lead to suboptimal decisions when the predictive model does not account for how its outputs affect the optimization task. In recent years, a new stream of research has emerged to integrate prediction and optimization more tightly, aiming to improve decision quality rather than just prediction accuracy. This seminar provides an overview of the main approaches in this area:

- Predict-then-Optimize with Decision-Focused Learning: Methods like Smart Predict-then-Optimize (SPO) introduce loss functions that reflect downstream decision performance rather than traditional prediction error.
- One-Step Integrated Models: Recent work proposes to embed learning directly into the optimization problem, removing the boundary between prediction and decision-making (e.g., Ban & Rudin, 2019). These models often use machine learning (including deep learning) to learn directly from data what decisions to make.

The seminar will discuss these paradigms, compare their benefits and trade-offs, and provide insights into where and how integration can offer significant improvements over traditional sequential methods.

The objectives of this thesis are to:

- review recent methods integrating prediction and optimization, focusing on their conceptual differences, solution quality, and computational complexity;
- explain the Smart Predict-then-Optimize (SPO) framework, highlighting the decision-focused loss function and its improvements over traditional approaches;
- compare performance trade-offs between two-step and integrated approaches, especially under limited data or model misspecification;
- evaluate the challenges of solving these models, considering non-convexity, and data availability and so on.

Selected Literature Recommendations:

Elmachtoub, A. N., & Grigas, P. (2022). Smart “Predict, then Optimize”. Management Science.

Bertsimas, D., & Kallus, N. (2020). From predictive to prescriptive analytics. Management Science.

Ban, G.-Y., & Rudin, C. (2019). The big data newsvendor: Practical insights from machine learning. Operations Research.

Qi, M., & Shen, Z.-J. (2022). Integrating prediction/estimation and optimization. INFORMS Tutorials.

<u>Topic S06: Improving Product Return Programs for Remanufacturing: Strategies for Effective Core Acquisition</u>

As companies increasingly adopt circular economy strategies, remanufacturing has become a crucial approach to reduce waste and reclaim product value. A central challenge in remanufacturing is securing a steady supply of high-quality used products—called “cores.” Return programs such as buy-back schemes, take-back incentives, or voluntary collection programs play a key role in this process.

This thesis explores how companies in industries like electronics, automotive, and home appliances design and implement product return programs. It analyzes common challenges such as return quality variability, consumer participation, and reverse logistics complexity. To support the academic foundation, the student will conduct a literature review of operations research models addressing product return and core acquisition. The review will focus on model structures, decision variables (e.g., return volume, inspection strategies), and common assumptions (e.g., predictable behavior, uniform quality), and critically assess their alignment with practical realities.

The objectives of this thesis are to:

- investigate industry practices for core acquisition in remanufacturing;
- identify operational and behavioral challenges in managing return flows;
- review and analyze OR models on product acquisition and reverse logistics;
- discuss the gap between theoretical assumptions and real-world implementation;
- provide recommendations for designing more effective and realistic return programs.

Selected Literature Recommendations:

Guide, V. D. R., & Van Wassenhove, L. N. (2001). Managing product returns for remanufacturing. Production and Operations Management, 10(2), 142–155.

Daniel, R., Guide, V., & Van Wassenhove, L. (2000). Product acquisition management: Current industry practice and a proposed framework. Production and Operations Management, 9(2), 148–162.

Mutha, A., & Pokharel, S. (2016). Managing demand uncertainty through core acquisition in remanufacturing. International Journal of Production Economics, 175, 35–49.

Bansal, S., Guide, V. D. R., & Naumov, S. (2024). Closed-loop supply chains with product remanufacturing: Challenges and opportunities. Journal of Operations Management, 70(2), 184–189.

Kianpour, K., Jusoh, A., Asghari, M., & Mahdiraji, H. A. (2017). Factors influencing consumers’ intention to return end-of-life electronics. Journal of Cleaner Production, 149, 495–505.

<u>Topic S07: Evaluating the Performance of MNL and MMNL Choice Models in Assortment Optimization and Product Line Selection</u>

Assortment optimization and product line selection are crucial strategic decisions for firms aiming to align product offerings with consumer preferences. These decisions are typically modeled using discrete choice frameworks such as the Multinomial Logit (MNL) and Mixed Multinomial Logit (MMNL) models, each capturing customer behavior with varying degrees of complexity and realism.

Under the MNL model, optimal assortments can often be computed efficiently using convex optimization techniques. A notable example is provided by Chen and Hausman (2000), who examined a joint pricing and assortment selection problem. Their formulation as a nonlinear binary integer program could be relaxed without loss of optimality due to the problem's favorable structural properties, allowing the relaxed solution to remain integral and globally optimal. However, the MNL model assumes homogeneous consumer preferences, which may not accurately reflect real-world behavior. The MMNL model addresses this by incorporating preference heterogeneity, most probably offering a better empirical fit. Despite its advantages, the MMNL-based assortment problem is computationally intractable and can only be solved exactly for small problem sizes using mixed-integer linear programming (MILP) formulations.

This seminar examines how much solution quality is lost when an MNL model is used as an approximation for an MMNL model?

The objectives of this thesis are to:

- explore recent work on assortment optimization and product line selection under MNL and MMNL models;
- utilize parameter estimates from a relevant empirical study (e.g., Keane & Wasi, 2013) to formulate and solve the problem under both MNL and MMNL frameworks;
- quantify the performance bias introduced by using a single-segment MNL model instead of MMNL.

Selected Literature Recommendations:

Chen, K. D., & Hausman, W. H. (2000). Mathematical properties of the optimal product line selection problem using choice-based conjoint analysis. Management Science, 46(2), 327–332.

Keane, M., & Wasi, N. (2013). Comparing alternative models of heterogeneity in consumer choice behavior. Journal of Applied Econometrics, 28(6), 1018–1045.

Schön, C. (2010). On the optimal product line selection problem with price discrimination. Management Science, 56(5), 896–902.

Topic S08: Solving the Assortment Optimization Problem under the MMNL Model: Comparing Big-M Linearization and Conic Optimization Approaches

Product line selection and assortment optimization are among the most critical strategic decisions firms face, as they directly impact customer satisfaction, operational efficiency, and profitability. While broader assortments can attract a wider range of consumers, they also raise production, inventory, and logistical costs. Therefore, identifying an optimal assortment that balances consumer preferences and operational constraints is essential. When customer choice is modeled using the Mixed Multinomial Logit (MMNL) model, which captures heterogeneity in preferences, the optimization task becomes significantly more complex compared to the traditional MNL model. Under MMNL, the assortment optimization problem is known to be computationally challenging, especially when subject to capacity or cardinality constraints.

This seminar compares two prominent solution approaches that have been developed to tackle the MMNL-based assortment problem. Big-M Linearization (MILP) is the classical approach reformulates the probabilistic utility functions into a mixed-integer linear program using binary decision variables and Big-M constants. While widely used, this method is often computationally intensive and prone to scalability and numerical issues. Conic Optimization introduces a conic integer programming formulation that leverages the structure of MMNL utilities to develop a more tractable conic mixed-integer optimization model. This approach enables faster solution times and better scalability, particularly when solved using modern optimization solvers that support second-order cone programming. This seminar aims to compare the computational performance of these two formulations using synthetic instances of varying sizes and complexity, highlighting the trade-offs in tractability, scalability, and implementation.

The objectives of this thesis are to:

- review the literature on assortment optimization under the MMNL model;
- implement two solution approaches for the MMNL assortment problem:
    - Big-M MILP formulation
    - Conic integer optimization (Sen et al., 2018)
- compare the solution times and performance using commercial solvers across different problem sizes;
- discuss practical implications and identify promising directions for applying these methods in real-world settings.

Selected Literature Recommendations:

Sen, A., Atamtürk, A., & Kaminsky, P. (2018). A conic integer optimization approach to the constrained assortment problem under the mixed multinomial logit model. Operations Research, 66(4), 994–1003.

Schön, C. (2010). On the optimal product line selection problem with price discrimination. Management Science, 56(5), 896–902.

Topic S09: Political Engineering: Optimizing Election Strategies

In democratic systems, political parties play a crucial role in shaping policy, mobilizing voters, and structuring political competition. Yet, the success of a political party is not solely determined by its ideological stance or the popularity of its leaders. Increasingly, scholars and strategists are turning their attention to the concept of political engineering. This approach raises important questions: Can the performance or appeal of a political party be systematically improved through strategic intervention? What tools or mechanisms are most effective in enhancing a party's electoral success? And to what extent can political engineering reshape the competitive dynamics of a political system without undermining democratic principles?

Despite growing interest in these questions, the field of political engineering remains largely qualitative in nature. While there is a vast body of research on voter behavior, party systems, and electoral outcomes, relatively few studies have attempted to formalize these dynamics using mathematical or computational models. Cochran et al. (2014) explored the application of operations research to the problem of defining the political strategy for a candidate in a U.S. Presidential election. They designed a model with binary decision variables for different positions in order to optimize the total votes.

The objectives of this thesis are to:

- present the model of Cochran et al. (2014) in detail, including a critical assessment of assumptions and limitations;
- discuss whether or not it could be adapted for another voting system, e.g. the German elections;
- suggest improvements, changes, data for such an adaption (optional);
- identify future opportunities and challenges for integrating optimization models into political engineering.

Selected Literature Recommendations:

Cochran, J.J., Curry, D.J., Radhakrishnan, R. et al. Political engineering: optimizing a U.S. Presidential candidate's platform. Ann Oper Res 215, 63–87 (2014). https://doi.org/10.1007/s10479-012-1189-z

Cochran, J.J. David J. Curry, Frankenstein for President, Significance 9 (5), 18–22 (2012), https://doi.org/10.1111/j.1740-9713.2012.00602.x

Murray, A. T. (2016). Maximal Coverage Location Problem: Impacts, Significance, and Evolution. International Regional Science Review, 39(1), 5–27. https://doi.org/10.1177/0160017615600222

Topic S10: Integrating ESG Considerations into Product and Supply Chain Design: Measurement and Impact at the Product Level

Environmental, Social, and Governance (ESG) considerations are becoming increasingly important for businesses as they strive to align with sustainability goals, regulatory requirements, and consumer expectations. While ESG performance is typically measured at the corporate or industry level, there is a growing need to integrate these principles into product and supply chain design. Companies are facing increasing pressure to ensure that their products are not only financially viable but also environmentally responsible throughout their lifecycle. This thesis aims to explore how ESG factors can be incorporated into product and supply chain decisions and how ESG performance can be effectively measured at the product level.

The objectives of this thesis are to:

- to investigate how ESG considerations influence product and supply chain design;
- to identify key ESG metrics from the literature and discuss to what extent they can be applied at the product level and where you see challenges in ESG data collection and measurement at a granular level;
- to propose a structured modeling approach for assessing ESG performance in product and supply chain design, including an academic example.

Selected Literature Recommendations:

Dai, T., & Tang, C. (2022). Frontiers in Service Science: Integrating ESG Measures and Supply Chain Management: Research Opportunities in the Postpandemic Era. Service Science (Hanover, Md.), 14(1), 1–12.

Kaplan, R. S., & Ramanna, K. (2021). Accounting for climate change. Harvard Business Review, 99(6), 120–131.

Andreou, N., & Besharov, M. (2022). Rethinking how we measure companies on social and environmental impact. MIT Sloan Management Review, 64(1), 1–4.

Tundys, B., Kędzia, G., Wiśniewski, T., & Zioło, M. (2024). Sustainable Supply Chains 2.0 : Towards Environmental, Social, and Economic Resilience. Cham.

Yen, B., Chow, N., Wang, N. Wong, N.& Choi, B. (2024). Cathay Pacific: Balancing Inherent Risks and ESG Concerns. HKU Business School.

Topic S11: Operations Research for a Start-Up Selling a Deposit System for Dry Food

CU Mehrweg is a start-up from Mannheim that offers a reusable system for dry food. Similar to deposit bottles, food manufacturers are provided with durable plastic boxes to use as packaging for their products. The pre-packed boxes are then sold in supermarkets with an additional deposit fee. The empty boxes can be returned at existing deposit machines in the supermarket. Afterwards the boxes are cleaned before being transported back to the manufacturer and going through the cycle again. There are various uncertainties within this cycle, particularly with regard to product acceptance and return rates, both in terms of time and quantity. These uncertainties can be countered using methods from operations management.

The objectives of this thesis are to:

- review the literature on approaches aiming to address uncertainty in supply chains and optimization;
- elaborate how some of these approaches could be used for CU Mehrweg;
- focus on a selected model and discuss it in detail, including a critical assessment of assumptions and limitations;
- identify future opportunities and challenges for integrating operations research methods into the CU Mehrwegsystem.

Selected Literature Recommendations:

Datta, P. P., & Christopher, M. G. (2011). Information sharing and coordination mechanisms for managing uncertainty in supply chains: a simulation study. International Journal of Production Research, 49(3), 765–803. https://doi.org/10.1080/00207540903460216

Xiao, C., Petkova, B., Molleman, E., & van der Vaart, T. (2019). Technology uncertainty in supply chains and supplier involvement: the role of resource dependence. Supply Chain Management, 24(6), 697–709. https://doi.org/10.1108/SCM-10-2017-0334

Zhou, G., Gu, Y., Wu, Y., Gong, Y., Mu, X., Han, H., & Chang, T. (2020). A systematic review of the deposit-refund system for beverage packaging: Operating mode, key parameter and development trend. Journal of Cleaner Production, 251, 119660. https://doi.org/10.1016/j.jclepro.2019.119660

Topic S12: Artificial Intelligence in Retail Operations Management

In recent years, artificial intelligence (AI) has profoundly transformed retail operations, reshaping how businesses interact with customers, manage supply chains, and optimize internal processes. This transformation is particularly visible in Germany, where major retailers like Aldi and Lidl—each with annual revenues exceeding €100 billion—rank among the country's ten largest companies. Supermarkets, for instance, are increasingly adopting mobile apps to collect real-time shopper data, fuelling the development of advanced AI models. However, the path toward full AI integration is not without challenges: ambitious initiatives like Amazon Go, which sought to eliminate cashiers through AI-driven video surveillance, have struggled to meet expectations, underlining the complexity of applying AI at scale.

This thesis will introduce the core tasks of retail operations management for both offline retailers such as Lidl and Aldi as well as online retailers and platforms such as OTTO and Zalando. Furthermore, it will explore how AI-driven technologies can enhance these activities. By compiling a structured overview of AI use cases in retail operations, based on a comprehensive review of academic and industry literature, the study aims to identify both current applications and emerging opportunities. It will also discuss the key challenges that AI poses for retail operations managers, including technological, ethical, and organizational hurdles. Finally, the thesis will outline future trends, offering insights into how AI is likely to shape the evolution of retail operations in the coming years.

The objectives of this thesis are to:

- introduce and explain the core tasks of retail operations management and highlight their significance;
- review and classify existing AI-driven technologies that are applied to retail operations, based on academic and industry literature;
- compile a structured overview of AI use cases in online and offline retail operations management;
- discuss the key challenges posed by AI integration in retail operations, including technological, ethical, and organizational aspects;
- outline future trends in AI for retail operations management, offering insights into how the field is likely to evolve.

Selected Literature Recommendations:

Caro, F., Kök, A. G., & Martínez-de-Albéniz, V. (2020). The Future of Retail Operations. Manufacturing & Service Operations Management, 22(1), 47–58.

Dogru, A. K., & Keskin, B. B. (2020). AI in operations management: Applications, challenges and opportunities. Journal of Data, Information and Management, 2(2), 67–74.

Gupta, S., Modgil, S., Bhattacharyya, S., & Bose, I. (2022). Artificial intelligence for decision support systems in the field of operations research: review and future scope of research. Annals of Operations Research, 308(1), 215-274.

Topic S13: Challenges, and Opportunities in Managing Omnichannel Retail Operations

Omnichannel retail seamlessly integrates a retailer's physical stores, online shops, mobile apps, social media platforms, and other sales and marketing channels into a unified customer experience. It enables customers to move smoothly between channels — for example, by researching a product online, purchasing it in-store, and later receiving customer support via a mobile app. Prominent examples of companies successfully implementing omnichannel strategies include Apple, IKEA, and Zara. While omnichannel retail offers significant opportunities — such as richer customer data that can inform optimization models to reduce costs, increase revenues, and improve service quality — it also presents substantial challenges for operations management. Key issues include managing complex inventory systems across multiple channels, handling increased logistical demands for order fulfillment, and meeting heightened customer expectations regarding speed, flexibility, and service consistency. This thesis aims to introduce and clearly distinguish the concepts of multichannel and omnichannel retail. It will explain the core processes of retail operations management and highlight key differences in operational practices among traditional brick-and-mortar retailers, online retailers, and omnichannel retailers. Furthermore, the thesis will review recent literature that integrates omnichannel and multichannel considerations into optimization models for retail decision-making. Finally, it will discuss the major operational challenges associated with implementing omnichannel strategies and explore how the proliferation of omnichannel retailing is likely to shape the future evolution of retail operations.

The objectives of this thesis are to:

- introduce and clearly distinguish the concepts of multichannel and omnichannel retail;
- explain the core processes of retail operations management and highlight key differences between traditional, online, and omnichannel retailers;
- review and classify existing literature that incorporates multichannel and omnichannel considerations into optimization models for retail decision-making;
- discuss the major operational challenges associated with omnichannel strategies;
- outline future trends in omnichannel retailing and offer insights into how these developments will shape the evolution of retail operations.

Selected Literature Recommendations:

Caro, F., Kök, A. G., & Martínez-de-Albéniz, V. (2020). The Future of Retail Operations. Manufacturing & Service Operations Management, 22(1), 47–58.

Hense, J., & Hübner, A. (2022). Assortment optimization in omni-channel retailing. European Journal of Operational Research, 301(1), 124–140.

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Topic S14: Data-Driven Revenue Management – Recent Advances and Selected Models

Revenue management (RM) has become a vital strategy for firms across various industries, aiming to predict consumer behavior and optimize product availability and prices to maximize revenue or profit. With the advent of data-driven decision-making and the emergence of new industries such as internet advertising, cloud computing, and e-commerce, there has been a growing demand for innovative RM models, frameworks, algorithms, and policies. In response to this demand, researchers have been focusing on advancing RM methodologies, particularly in accommodating RM to emerging industries and leveraging data-driven approaches. This includes the development of advanced personalized pricing and assortment models, exploration of RM strategies in industries with reusable resources, and the proposal of network RM and end-to-end decision-making techniques, etc.

The objectives of this thesis are to:

- review and classify existing data-driven approaches in RM and specify the recent advances, published in leading academic journals, such as INFORMS journals, European Journal of Operational Research, Production and Operations Management, Journal of Operations Management, Journal of Revenue and Pricing Management;
- delve into several model-free approaches, which are in a subset of data-driven approaches and do not assume any specific distribution of consumer valuation, with the focus on their model, advantages, limitations, and applications;
- identify future research opportunities for model-free approach in revenue management.

Selected Literature Recommendations:

Chen, N., Cire, A. A., Hu, M., & Lagzi, S. (2023). Model-free assortment pricing with transaction data. Management Science, 69(10), 5830-5847.

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Topic S15: Applications of Machine Learning in Pricing and Assortment Optimization

In today's highly competitive and data-driven marketplace, firms face increasing pressure to make smart and timely decisions about what products to offer and at what prices. Two of the most critical levers in driving profitability, customer satisfaction, and operational efficiency are pricing and assortment optimization. Assortment optimization focuses on selecting the right mix of products to offer, balancing customer preferences, inventory constraints, and business goals. Traditional demand models for pricing and assortment optimization often rely on strong assumptions and offer limited flexibility when modeling real-world consumer behavior. However, real-world decision-making involves large assortments with many interrelated products, heterogeneous and dynamic customer preferences, and frequent changes in market conditions, inventory, and competition, etc. Machine learning demand models offer powerful alternatives by capturing nonlinear and complex patterns in customer choice, handling high-dimensional data, enabling real-time and adaptive pricing and assortment decisions, and improving accuracy in forecasting and personalization, etc.

The objectives of this thesis are to:

- review the state-of-the-art applications of machine learning in pricing and assortment optimization as published in leading academic journals, such as INFORMS journals, European Journal of Operational Research, Production and Operations Management, Journal of Operations Management, Journal of Revenue and Pricing Management;
- analyze selected applications in detail, focusing on the data and contexts, models, methodologies, key findings, managerial implications, and limitations;
- identify future research opportunities for machine learning in pricing and assortment optimization.

Selected Literature Recommendations:

Li, T., Wang, C., Wang, Y., Tang, S., & Chen, N. (2024). Deep reinforcement learning for online assortment customization: A data-driven approach. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4870298.