UNIVERSITY OF MANNHEIM
Business School

CHAIR OF SERVICE OPERATIONS MANAGEMENT
Prof. Dr. Cornelia Schön

Bachelor Thesis FSS 2026

"Current topics in Service Operations Management"

Topic B01: Decision Trees – Review and Application to the Case of Observation Unit at Montanaro

Decision trees are a class of supervised learning methods used for classification and regression. They model the relationship between an outcome variable and a set of explanatory variables by recursively partitioning the feature space into increasingly homogeneous subgroups. They have been widely adopted in many fields, including engineering (e.g., fault diagnosis and failure classification), marketing (e.g., customer segmentation and churn prediction), and healthcare (e.g., clinical risk stratification and triage decision support). Their main advantage is interpretability: The resulting decision rules can be directly communicated and implemented in practice.

The objective of the thesis is to review decision trees in terms of their model structure, splitting criteria (e.g., Gini impurity and entropy for classification), stopping rules and pruning methods to avoid overfitting, performance evaluation measures (e.g., accuracy, precision/recall, ROC-AUC), and applications. Furthermore, in the second part of the thesis, decision trees shall be applied to the case of the observation unit at Montanaro, a 260-bed hospital in a medium-sized U.S. city.

In the case study, Dr. Erin Kelly was responsible for managing a 23-bed observation unit (OU) at Montanaro Hospital, which serves as a transition space for patients needing short-term observation and treatment after visiting the emergency department. Not all patients requiring observation are placed in the OU—factors like the availability of beds or the patient's medical needs could lead to their placement in an inpatient ward. If a patient's stay in the OU exceeds 48 hours, medical professionals will reassess the patient's condition to determine if an extend-ed stay in the inpatient ward is necessary. Montanaro's OU admitted, on average, 44 patients per week for observation, of which 45% were later transferred to inpatient care. At the same time, 115 observation-level patients were placed in inpatient wards due to a lack of OU bed capacity or exclusion from the unit based on diagnosis. Dr. Kelly felt it was necessary to reevaluate the patient placement rules for her unit. Based on the dataset provided by OU, how should a decision tree be developed to produce new patient placement rules?

Basic Literature:

Pachamanova, D., Tilson, V., & Dwyer-Matzky, K. (2022). Case—A data-driven approach to improving hospital observation unit operations. INFORMS Transactions on Education, 22(3), 188-194 (data will be provided by the chair).

James G., Witten D., Hastie T., & Tibshirani R. (2021), An introduction to statistical learning (ISLR, 2nd ed.), Chapter on tree-based methods.

Han, J., Kamber, M., & Pei J. (2006). Data Mining: Concepts and techniques. Morgan kaufmann, 340(1), 94104-103205, Chapter on Classification: Basic concepts.

Topic B02: Neural Networks – Review and Application to the Case of Scholastic Travel Company

Neural networks are a broad class of machine-learning models designed to learn complex relationships between inputs and outputs directly from data. They consist of interconnected layers of computational units (“neurons”) that transform input variables through weighted combinations and nonlinear activation functions. By stacking multiple layers, neural networks can represent rich nonlinear patterns and interactions without requiring the analyst to pre-specify the functional form. Owing to this flexibility, neural networks have been widely applied across domains such as engineering (e.g., signal processing and fault detection), marketing (e.g., customer analytics and demand prediction), and healthcare (e.g., risk assessment and medical decision support). While they are often less interpretable than simpler models, they can deliver strong predictive performance when sufficient data and appropriate regularization are available.

The objective of the thesis is to review neural networks in terms of their model structure, training procedures (e.g., backpropagation and gradient-based optimization), loss functions (e.g., cross-entropy), regularization methods (e.g., weight decay, dropout, early stopping), and performance evaluation measures (e.g., accuracy, precision/recall, ROC-AUC), as well as selected applications. Furthermore, in the second part of the thesis, neural networks shall be applied to the case of Scholastic Travel Company.

In the case study, David Powell, the new data analyst for Scholastic Travel Company (STC), took charge of a customer retention program in the spring of 2013, which centered around a new data-driven initiative. In less than two weeks, contract renewal opportunities would open for customers who had taken a trip with STC in 2012. David's supervisor, Blackford, had given him a dataset containing all the available information about the previous year’s clients. Blackford was optimistic that David could build models to predict whether or not customers would rebook with STC in 2013. With this model, Blackford hoped to create a more targeted marketing strategy, saving costs and improving the company's yield by focusing on specific segments of the client population. Based on the dataset provided by STC, how should a neural network be applied to predict which customer would rebook with STC in 2013?

Basic Literature:

Ovchinnikov, A. (University of Virginia, 2018), https://hbsp.harvard.edu/product/UV7579-PDF-ENG (case study will be provided by the chair)

James G., Witten D., Hastie T., & Tibshirani R. (2021), An introduction to statistical learning (ISLR, 2nd ed.), Chapter on deep learning.

Géron, A. (2022). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow. O'Reilly Media, Inc..

Topic B03: Queuing Analysis – Review and Application to Baria Planning Solutions

Queueing analysis is a fundamental tool in operations management for studying systems in which demand arrives over time and must be processed by limited resources. It provides a structured framework to analyze congestion, delays, and resource utilization in service and production systems such as call centers, healthcare operations, and supply chains. By modeling key elements such as arrival processes, service-time distributions, routing, and system capacity, queueing analysis helps firms understand the trade-offs between efficiency and service quality, as well as the role of variability in shaping system performance. In relatively simple settings, analytical queueing formulas can be used to derive performance measures such as waiting times, queue lengths, utilization, and service levels. In more complex, multi-stage systems, discrete-event simulation provides a flexible complementary approach by explicitly tracking stochastic arrivals, service completions, routing, and resource constraints. Both methods are useful for studying variability propagation, that is, how variability generated at upstream stages amplifies delays downstream, and for identifying bottlenecks and evaluating process improvements.

The objective of the thesis is to review queueing analysis with variability propagation in terms of its modeling primitives (e.g., arrival processes, service-time distributions, routing, and resource capacity), key performance measures (e.g., waiting time, queue length/WIP, and service level), and methodological tools for capturing and diagnosing variability propagation in multi-stage systems. Furthermore, in the second part of the thesis, queueing analysis shall be applied to the Baria Planning Solutions case.

In the Baria Planning Solutions case, the Sales Support process operates as a multi-stage workflow in which requests arrive overtime and must pass through several teams with finite capacity. The system exhibits strong demand seasonality and heterogeneous processing times, creating congestion and long turnaround times. The proposed thesis will conduct a simulation-based (or analytical formula-based) queueing analysis to evaluate the current Sales Support process and illustrate how variability drives delays and how variability propagates across stages. It will also propose suggestions for improving the Sales Support process and evaluate the performance of these suggestions.

Basic Literature:

Wheelwright S. C., Schmidt W. (2011). Baria Planning Solutions, Inc.: Fixing the sales process. https://hbsp.harvard.edu/product/4568-PDF-ENG (case study will be provided by the chair)

Cachon, G. & Terwiesch, C. (2011): Matching supply with demand, 3rd edition, McGraw-Hill.

Hopp, W. J., & Spearman, M. L. (2011). Factory physics. Waveland Press. Chapter on variability basics.

Topic B04: 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 the 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
- Analyse 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

Basic Literature:

Li, T., Wang, C., Wang, Y., Tang, S., & Chen, N. (2026). Deep reinforcement learning for online assortment customization: A data-driven approach. Production and Operations Management, 35(2), 665-684.

Chen, Z. Y., Fan, Z. P., & Sun, M. (2023). Machine learning methods for data-driven demand estimation and assortment planning considering cross-selling and substitutions. INFORMS Journal on Computing, 35(1), 158-177.

Gabel, S., & Timoshenko, A. (2022). Product choice with large assortments: A scalable deep-learning model. Management Science, 68(3), 1808-1827.

Topic B05: Consumer Return Behavior in Remanufacturing: Implications for Product Acquisition and Return Program Design

Remanufacturing has become an important strategy for reducing waste and recovering value from used products. A key challenge in remanufacturing is acquiring enough returned products, or "cores," from consumers. In the operations research literature, return flows are often modeled in simplified ways. However, empirical studies show that consumer return behavior is shaped by a broad set of factors, including monetary and non-monetary incentives, convenience, product characteristics, and consumer heterogeneity. This raises the question of how well existing models reflect real return behavior in practice. This thesis examines consumer return behavior in remanufacturing and its implications for product acquisition and return program design. The student will review remanufacturing models that incorporate return flows and compare their assumptions with empirical findings on end-of-use product returns. The thesis will analyze the gap between modeling assumptions and observed behavior, and discuss how firms can design more effective return programs and acquisition strategies in remanufacturing contexts

The objectives of the thesis are to:

- Review how remanufacturing models represent consumer returns and return rates.
- Examine empirical findings on consumer return behavior in remanufacturing and related circular economy settings.
- Analyze the gap between model assumptions and empirical evidence.
- Discuss implications for product acquisition and return program design.
- Provide recommendations for improving the behavioral realism of remanufacturing research.

Basic Literature:

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.

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.

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

Toktay, L. B., Wein, L. M., & Zenios, S. A. (2000). Inventory management of remanufacturable products. Management Science, 46(11), 1412–1426.

Topic B06: Latent Class Segmentation in Choice-Based Conjoint Analysis: Model Selection and the Number of Segments

Choice-based conjoint analysis is widely used to study customer preferences and support product and pricing decisions. Since consumers often differ strongly in their preferences, latent class analysis is a useful method for identifying distinct customer segments. A key challenge, however, is determining the appropriate number of segments. In practice, this choice depends not only on statistical measures such as AIC and BIC, but also on interpretability, segment size, and managerial usefulness. As a comparison, cluster analysis can also be used for segmentation, but it differs from latent class analysis in its assumptions, estimation logic, and typical application.
This thesis examines latent class segmentation in choice-based conjoint analysis with a focus on model selection and the determination of the number of segments. The student will review the main principles of latent class models, briefly compare them with cluster analysis, and discuss the differences between the two approaches in terms of application and interpretation. The thesis will then analyze the main criteria used to select the number of segments and evaluate latent class solutions in applied conjoint studies.

The objectives of the thesis are to:

- Review the main principles of latent class segmentation in conjoint analysis.
- Briefly compare latent class analysis with cluster analysis and discuss their different applications.
- Examine criteria for determining the number of segments.
- Compare statistical fit measures and practical considerations in model selection.
- Provide recommendations for applied conjoint research.

Basic Literature:

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. Structural equation modeling: A multidisciplinary Journal, 14(4), 535-569.

Paetz, F., Hein, M., Kurz, P., & Steiner, W. J. (2019). Latent class conjoint choice models. Marketing: ZFP–Journal of Research and Management, 41(H. 4), 3-20..

Vermunt, J. K., & Magidson, J. (2016). Technical guide for Latent GOLD 5.1: basic, advanced, and syntax. Statistical Innovations. Inc., Belmont Google Scholar.

Wedel, M., & Kamakura, W. A. (2000). Market segmentation: Conceptual and methodological foundations. Springer Science & Business Media.

Topic B07: Artificial Intelligence and Sustainable Operations: Opportunities, Risks, and Trade-Offs in Supply Chains and Decision-Making

Artificial intelligence is increasingly used in operations and supply chain management to support forecasting, inventory decisions, logistics planning, and resource allocation. In these areas, AI can contribute to sustainability by improving efficiency, reducing waste, and enabling better operational decisions. At the same time, AI also raises sustainability concerns, including energy use, digital infrastructure requirements, and rebound effects from broader deployment. This creates an important question for operations research: can AI make operations more sustainable overall, or do its benefits come with significant environmental and managerial trade-offs?
This thesis examines the relationship between artificial intelligence and sustainability from an operations and supply chain perspective. The student will review how AI is applied in areas such as demand forecasting, logistics optimization, inventory management, and sustainable supply chain planning, and compare these benefits with the environmental and organizational challenges associated with AI adoption. The goal is to provide a balanced overview of whether AI supports sustainable operations or creates new sustainability problems that firms must manage carefully.

The objectives of the thesis are to:

- Review the main applications of AI in operations and supply chain management.
- Examine how AI can support sustainability through better forecasting, routing, inventory, and resource allocation.
- Analyze the environmental and managerial risks linked to AI adoption.
- Discuss trade-offs between operational efficiency and the sustainability footprint of AI systems.
- Provide recommendations for the responsible use of AI in sustainable operations.

Basic Literature:

Bashir, N., Donti, P., Cuff, J., Sroka, S., Ilic, M., Sze, V., Delimitrou, C., & Olivetti, E. (2024). The climate and sustainability implications of generative AI. In An MIT exploration of generative AI. MIT.

Culot, G., Podrecca, M., & Nassimbeni, G. (2024). Artificial intelligence in supply chain management: A systematic literature review of empirical studies and research directions. Computers in Industry, 162, 104132.

Zejjari, I., & Benhayoun, I. (2024). The use of artificial intelligence to advance sustainable supply chain: Retrospective and future avenues explored through bibliometric analysis. Discover Sustainability, 5, 174.

Topic B08: Customer Value of AI in Products and Services: Preferences, Willingness to Pay, and Implications for Design

Artificial intelligence is increasingly embedded in products and services through features such as personalization, recommendations, explainability, privacy controls, and AI-based customer interaction. For firms, an important question is whether customers actually value these features. Research shows that customer responses depend on the type of AI feature and the context of use. For example, customers may be willing to pay for explainable AI in some settings, while privacy, trust, and the role of human involvement also shape preferences.
This thesis examines how customers value AI-related features in products and services and what this means for design decisions. The student will review literature on customer preferences for AI-enabled offerings, focusing on factors such as transparency, explainability, privacy, automation, and human support. The thesis will also discuss how preferences vary across products, services, and customer segments, and what this means for firms deciding whether AI should replace, support, or complement human involvement. The goal is to provide a clear overview of when AI creates customer value and how companies can design AI-enabled offerings more effectively.

The objectives of the thesis are to:

- Review the main AI-related attributes that influence customer preferences in products and services.
- Examine what the literature says about willingness to pay for AI-related features such as explainability, privacy, and automation.
- Analyze how customer responses differ across product and service contexts.
- Discuss when customers prefer AI-based versus human-supported offerings.
- Provide recommendations for product and service design based on customer value of AI features.

Basic Literature:

Chen, C., Tian, A. D., & Jiang, R. (2024). When post hoc explanation knocks: Consumer responses to explainable AI recommendations. Journal of Interactive Marketing, 59(3), 234–250.

Song, M., Xing, X., Duan, Y., Cohen, J., & Mou, J. (2022). Will artificial intelligence replace human customer service? The impact of communication quality and privacy risks on adoption intention. Journal of Retailing and Consumer Services, 66, 102900.

Wien, A. H., & Peluso, A. M. (2021). Influence of human versus AI recommenders: The roles of product type and cognitive processes. Journal of Business Research, 137, 13–27.

Topic B09: Revenue Management and Pricing in the Chemical Industry

Revenue Management and pricing (RMP) strategies are critical in the chemical industry, where fluctuating raw material costs, regulatory constraints, and demand volatility pose significant challenges. Unlike industries with perishable inventory, chemical companies must manage bulk production, long lead times, and contract-based B2B pricing. Understanding how RMP principles can be applied to optimize demand management decisions in face of resource constraints is essential for improving profitability and competitiveness. The thesis shall first provide a general overview on RMP in the chemical industry and second, analyze a related case study on Eastman Chemical Company. Some year ago, Eastman had created a new specialty plastic, Tritan, which demonstrated heat resistance and durability properties that might allow Eastman to compete in the lucrative polycarbonate plastics market. Development of this product was a major breakthrough for both Eastman and the broader chemical industry. The Eastman specialty plastics team had to contend with numerous challenges, however, before producing Tritan at full scale. First, Eastman had to commercialize a completely new material that only had been produced in the lab; second, the team had to develop a supply chain to manufacture a new component (monomer) and a new product (polymer) simultaneously; and finally, it had to analyze market entrance options given capacity constraints. Thus, the specialty plastics team faced several dilemmas: who should be the initial launch partners, given Eastman's limited manufacturing capacity, and how aggressively should Eastman price Tritan, given that price would drive demand in the launch markets and in new markets?

The objectives of the thesis are to:

- Review the literature on RMP approaches in the chemical industry, including the Newsvendor model, and analyze key challenges, such as cost volatility, supply-demand imbalances, and long-term contracts.
- Assess successful real-world RMP implementation in the chemical sector.
- Analyze the Eastman Tritan case study based on the Newsvendor model (or extensions) and provide recommendations on how to enter the market.

Basic Literature:

Porteus, E. L. (2008). The newsvendor problem. In D. Chhajed & T. J. Lowe (Eds.), Building intuition: Insights from basic operations management models and principles (Vol. 115, pp. 115-134). Springer Science & Business Media.

Raz, G., Kraft, T., & Elias, A. (2013). Eastman Tritan (Case No. UV6748). Darden Business School. including the video interviews Lucian Boldea, VP for Specialty Plastics, and Chris Killian, VP of Technology.

Zatta, D., & Kolisch, R. (2014). Profit impact of revenue management in the process industry. Journal of Revenue and Pricing Management, 13, 483-507.

Topic B10: Choice-Based Capacity Allocation in Airline Revenue Management

With new aircraft frequently costing over $ 100 million, it is critical for airlines to maximize their utilization. For this, there are two main decisions to be made: 1. Which aircraft to assign to each flight, 2. How many tickets to sell for each itinerary? These decisions are interdependent, as the size of the assigned aircraft determines how many tickets can be sold. Furthermore, if there is little demand for a route, it should not be assigned a large aircraft, as its seating capacity can be used more profitably elsewhere. Therefore, different optimization models have been developed to integrate schedule design and fleet assignment with demand modeling. One such approach is the Sales-Based Linear Program (SBLP) by Yan et al. (2022), which provides a compact modeling framework compatible with various demand models, such as the General Assignment Model (GAM) and the Multinomial Logit Model (MNL).
This thesis introduces the concept of discrete choice modelling and aims to explore recent advancements in integrated demand modeling and fleet assignment models.

The objectives of the thesis are to:

- Provide an introduction into discrete choice models
- Identify and analyze key challenges in integrated demand, schedule design, and fleet assignment models
- Explain the SBLP Model by Yan et al. (2022) in detail, including limitations and improvement opportunities. You do not need to discuss the decomposition approach to solving the problem
- Identify gaps and directions for future research

Basic Literature:

Yan, C., Barnhart, C., & Vaze, V. (2022). Choice-based airline schedule design and fleet assignment: A decomposition approach. Transportation Science, 56(6), 1410-1431.

Krömer, M. M., Topchishvili, D., & Schön, C. (2024). Sustainable airline planning and scheduling. Journal of Cleaner Production, 434, 139986.

Lohatepanont, M., & Barnhart, C. (2004). Airline schedule planning: Integrated models and algorithms for schedule design and fleet assignment. Transportation science, 38(1), 19-32.

Wei, K., Vaze, V., & Jacquillat, A. (2020). Airline timetable development and fleet assignment incorporating passenger choice. Transportation Science, 54(1), 139-163.

Topic B11: Sustainability Considerations in Airline Schedule Design

Flight shame, or Flugscham in German, is a growing phenomenon that refers to the discomfort people feel when choosing to fly, knowing it is the most environmentally harmful way to travel. Pressure is also coming from regulators, with the European Union's Emission Trading Scheme (ETS) set to be enforced more strictly by 2027. Additionally, fuel accounts for 30 % of total operating costs, making it a financial priority for airlines. Therefore, sustainability considerations play a crucial role across the various Airline Planning and Scheduling (APS) steps, and numerous optimization models have been developed in recent literature. This thesis will conduct a comprehensive literature review of state-of-the-art optimization models that integrate sustainability into the strategic APS process. Furthermore, it will examine how effective regulatory measures can be implemented to reduce the aviation sector's negative environmental impact while allowing airlines to remain profitable.

The objectives of the thesis are to:

- To analyze current challenges and environmental impacts associated with traditional airline operations.
- Review the literature on integrated APS optimization models, including sustainability considerations
- Examine one model in detail, including limitations and improvement opportunities
- Analyze the effectiveness of environmental regulatory measures and provide further recommendations to make the industry more sustainable

Basic Literature:

Krömer, M. M., Topchishvili, D., & Schön, C. (2024). Sustainable airline planning and scheduling. Journal of Cleaner Production, 434, 139986.

Jalalian, M., Gholami, S., & Ramezanian, R. (2019). Analyzing the trade-off between CO2 emissions and passenger service level in the airline industry: Mathematical modeling and constructive heuristic. Journal of Cleaner Production, 206, 251-266.

Parsa, M., Nookabadi, A. S., Flapper, S. D., & Atan, Z. (2019). Green hub-and-spoke network design for aviation industry. Journal of Cleaner Production, 229, 1377-1396.

McKinsey & Company (2023): Decarbonizing aviation: Executing on net-zero goals, https://www.mckinsey.com/industries/aerospace-and-defense/our-insights/decarbonizing-aviation-executing-on-net-zero-goals

Topic B12: Designing Seamless Air-Rail Travel Products

Air travel and rail are often treated as competitors on short–medium distances. But increasingly, they can also be complemented when rail acts as an airport feeder, allowing travelers to replace short-haul flights with rail segments while keeping long-haul connectivity. When designing integrated Air-Rail Travel products, it is essential to correctly estimate passenger preferences for service features such as travel time, frequency, and baggage handling to ensure a competitive alternative to driving or short-haul flights. To this end, a variety of discrete choice models have been developed to quantify the importance of individual attributes across different customer groups. This thesis aims to review the literature on intermodal air-rail travel and examine how seamless products can be designed. Furthermore, it will examine how competition changes under pressure from regulators to improve sustainability metrics.

The objectives of the thesis are to:

- Review the literature on intermodal air–rail travel and define core product attributes
- Compare different modeling approaches, including customer heterogeneity, choice set formation, and stated versus revealed preference data
- Examine how sustainability considerations and regulatory pressure are incorporated in air–rail demand studies (e.g., CO_2 information, carbon pricing, short-haul substitution), and discuss implications for competition and modal shift
- Identify research gaps and propose recommendations for future research and for transportation providers on designing competitive, customer-oriented, and sustainable air–rail product offerings.

Basic Literature:

Behrens, C., & Pels, E. (2012). Intermodal competition in the London–Paris passenger market: High-Speed Rail and air transport. Journal of Urban Economics, 71(3), 278-288.

Román, C., & Martín, J. C. (2014). Integration of HSR and air transport: Understanding passengers' preferences. Transportation Research Part E: Logistics and Transportation Review, 71, 129-141.

Avogadro, N., Cattaneo, M., Paleari, S., & Redondi, R. (2021). Replacing short-medium haul intra-European flights with high-speed rail: Impact on CO2 emissions and regional accessibility. Transport Policy, 114, 25-39.

Topic B13: Capacity Control and Pricing in Air Cargo: A Literature Review

Although the air cargo industry has become increasingly important for global supply chains, research in revenue management (RM) for cargo shipments still lags behind passenger RM. One reason is that the selling process is more complex: cargo capacity is sold through both long-term contracts and short-term spot market bookings. While spot-market cargo RM shares some similarities with passenger RM, several characteristics prevent a direct transfer of passenger methods. In particular, cargo capacity is typically two-dimensional (weight and volume) rather than one-dimensional (seats). In addition, capacity is often uncertain before departure (e.g., because passenger baggage and payload are prioritized for combination carriers or due to weather-related take-off weight limits), and shipment weight and volume requirements may not be known precisely at booking. Finally, cargo customers typically care less about routing complexity than passengers, as long as the shipment is delivered reliably and on time at an attractive price. As a result, much of the literature focuses on single-leg and network capacity allocation under independent demand assumptions (with and without overbooking), while choice-based models and dynamic pricing have received comparatively less attention

The objectives of the thesis are to:

- Review and classify the literature on air cargo RM and discuss differences to airline passenger RM
- Review relevant empirical studies from the literature that model and estimate demand response or customer choice as a function of different determinant attributes of cargo offerings
- Discuss whether capacity allocation or dynamic pricing is the more suitable RM approach to cargo RM, considering opportunities, challenges, and limitations of moving from capacity allocation to dynamic pricing in the air cargo business

Basic Literature:

Amaruchkul, K., Cooper, W. L., & Gupta, D. (2007). Single-leg air-cargo revenue management. Transportation science, 41(4), 457-469.

Barz, C., & Gartner, D. (2016). Air cargo network revenue management. Transportation Science, 50(4), 1206-1222.

Becker, B., & Dill, N. (2007). Managing the complexity of air cargo revenue management. Journal of Revenue and Pricing Management, 6(3), 175-187.

Feng, B., Li, Y., & Shen, Z. J. M. (2015). Air cargo operations: Literature review and comparison with practices. Transportation Research Part C: Emerging Technologies, 56, 263-280.

Topic B14: 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 the 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

Basic Literature:

Abdallah, T., Farhat, A., Diabat, A., & Kennedy ,S. (2012). Green supply chains with carbon trading and environmental sourcing: Formulation and life cycle assessment. Applied Mathematical Modelling, 36 (9), 4271-4285.

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.

Topic B15: Suitability of Conjoint Analysis in Reflecting Private Equity Investment Decisions

The private equity industry is an important segment of the financial sector and focuses on the acquisition, development, and subsequent exit of non-listed companies. Investment decisions in private equity are typically made under substantial uncertainty and involve trade-offs between multiple financial and non-financial criteria. These decisions are often based on intuition, experience, and qualitative judgment. One methodological framework to study the influence of different criteria on decision-making is conjoint analysis. It allows the decomposition of complex decisions into individual attributes and enables the estimation of their relative importance based on stated preference data. Despite this seeming fit, conjoint analysis has so far been used only rarely to study investment decision-making in the private equity context.

The objectives of the thesis are to:

- introduce the methodology of conjoint analysis and outline its basic principles and application;
- provide a brief introduction to the private equity industry and typical decision criteria used by investors;
- present the paper by Block et al. (2019) and its use of conjoint analysis in the private equity context;
- critically discuss the suitability of conjoint analysis for (private equity) investments decision;
- develop own extensions and suggestions for improving the methodological and conceptual approach used in the existing literature.

Basic Literature:

Block, J., Fisch, C., Vismara, S., & Andres, R. (2019). Private equity investment criteria: An experimental conjoint analysis of venture capital, business angels, and family offices. Journal of Corporate Finance (Amsterdam, Netherlands), 58, 329–352.

Paleit, S., Riar, F. J., Hülsbeck, M., & Hack, A. (2025). Family firm perceptions and investment decisions: An experimental conjoint analysis of private equity investors. Journal of Family Business Strategy, 16(3), 100672.

Rao, V. R. (2014). Applied conjoint analysis (2014th ed.). Berlin, Heidelberg: Springer.

Topic B16: Prescribing Personalized Medical Treatments – A Literature Review

Personalized medicine aims to tailor medical treatments to individual patients, with the potential to significantly improve outcomes for a wide range of diseases such as cancer, diabetes, and cardiovascular conditions. In this context, operations research can contribute to better, more transparent, and data-driven decision-making, ultimately supporting improved patient outcomes. At the same time, designing personalized treatments is challenging due to several factors, including patient heterogeneity, limited and noisy data, and the need to account for dynamic and long-term treatment effects. Recent advances increasingly combine machine learning with optimization techniques to address these challenges, enabling more flexible, adaptive, and scalable approaches to personalized decision-making.
This thesis will explore how operations research and machine learning methods can be applied to personalized medicine. It will explain the key challenges in this domain. Building on this foundation, the thesis will review methodological literature on personalized treatment design, with a particular focus on optimization-based approaches and their integration with machine learning methods. The core part of the thesis will provide a structured overview of prescriptive approaches to personalized medicine. The thesis will also discuss the strengths and limitations of existing approaches, particularly with respect to their practical applicability in healthcare settings. Finally, it will identify open research gaps and will outline promising directions for future research at the intersection of operations research, machine learning, and healthcare.The objectives of the thesis are to:

- Introduce the concept of personalized medicine
- Explain key challenges in personalized treatment design
- Review and classify methodological literature on personalized medicine, with a focus on optimization-based and machine learning approaches
- Discuss strengths and limitations of approaches from the reviewed literature
- Identify open research gaps and outline future research directions

Basic Literature:

Bertsimas, D., Dunn, J., & Mundru, N. (2019). Optimal Prescriptive Trees. INFORMS Journal on Optimization, 1(2), 164–183.

Du, J., Gao, S., & Chen, C.-H. (2024). A Contextual Ranking and Selection Method for Personalized Medicine. Manufacturing & Service Operations Management, 26(1), 167–181.

Keyvanshokooh, E., Zhalechian, M., Shi, C., Van Oyen, M. P., & Kazemian, P. (2025). Contextual Learning with Online Convex Optimization: Theory and Application to Medical Decision-Making. Management Science, 71(12), 10442–10464.

Lee, E. K., Wei, X., Baker-Witt, F., Wright, M. D., & Quarshie, A. (2018). Outcome-Driven Personalized Treatment Design for Managing Diabetes. Interfaces, 48(5), 422–435.

Topic B17: Price Optimization in Retail Gasoline Markets: Models, Market Dynamics, and Regulatory Constraints

Fuel prices are among the most visible and politically sensitive prices in modern economies. In Germany, there are renewed political calls to reassess gasoline price regulation amid rising tensions surrounding the Iran War and the closure of the Strait of Hormuz, which could significantly impact global oil supply. Retail gasoline markets are characterized by oligopolistic competition, high price transparency, and frequent price adjustments. From an operations management perspective, these features make gasoline markets a particularly relevant setting for price optimization.
This thesis introduces the key characteristics of retail gasoline markets and outlines the regulatory environment in Germany and selected international markets (e.g. USA, Austria, …). Building on this foundation, it provides a structured review of recently proposed price optimization models relevant to gasoline markets. The thesis then discusses the strengths and limitations of existing approaches, particularly in light of changing regulatory constraints. Finally, it identifies open research gaps and outlines directions for future research in gasoline price optimization.

The objectives of the thesis are to:

- Introduce key characteristics of retail gasoline markets
- Explain the regulatory environment of gasoline pricing in Germany and selected international markets (e.g. USA, Austria, …)
- Review empirical findings on gasoline prices describing dynamics of the retail gasoline market
- Review and classify price optimization models relevant to gasoline markets
- Discuss the strengths and limitations of existing price optimization approaches
- Identify open research gaps and outline future research directions

Basic Literature:

Assad, S., Clark, R., Ershov, D., & Xu, L. (2024). Algorithmic Pricing and Competition: Empirical Evidence from the German Retail Gasoline Market. Journal of Political Economy, 132(3), 723–771.

Birge, J. R., Chan, T. C. Y., Pavlin, J. M., & Zhu, I. Y. (2022). Spatial Price Integration in Commodity Markets with Capacitated Transportation Networks. Operations Research, 70(3), 1739–1761.

Haucap, J., & Müller, H. C. (2012). The Effects of Gasoline Price Regulations: Experimental Evidence (Working Paper No. 47). DICE Discussion Paper.

Phillips, R. L. (2021). Pricing and Revenue Optimization: Second Edition. Stanford University Press.

Topic B18: Revenue Management in the Cruise Industry

The cruise industry has become one of the fastest-growing segments within the travel and leisure sector, combining transportation, accommodation, and entertainment into a single integrated product. At the same time, it operates under complex operational constraints, including fixed and highly perishable capacity, long booking horizons, and significant demand uncertainty. These characteristics make the industry a natural candidate for revenue management (RM) applications. This thesis aims to systematically review revenue management approaches in the cruise industry by linking industry characteristics, empirical evidence, and optimization models.

The thesis will introduce the cruise industry and the fundamentals of revenue management, highlighting the key features that distinguish cruise RM from other travel and leisure industries. Building on this foundation, it will review empirical evidence on the effectiveness of revenue management in the cruise industry. It will then provide a structured review and classification of optimization models used in cruise RM, including dynamic programming approaches, choice-based models, and integrated pricing frameworks. The thesis will critically evaluate the strengths and limitations of these approaches, particularly with respect to their practical applicability. Finally, it will identify open research gaps and outline promising directions for future research in cruise revenue management.

The objectives of the thesis are to:

- Introduce the cruise industry and the fundamentals of revenue management
- Explain how revenue management in the cruise industry differs from revenue management in other travel and leisure industries
- Review empirical evidence on the effects of revenue management on the cruise industry
- Review and classify optimization models used for revenue management in the cruise industry
- Discuss the strengths and limitations of existing revenue management approaches
- Identify open research gaps and outline future research directions

Basic Literature:

Ayvaz-Cavdaroglu, N., Gauri, D. K., & Webster, S. (2019). Empirical Evidence of Revenue Management in the Cruise Line Industry. Journal of Travel Research, 58(1), 104–120.

Beck, J., Harvey, J., Kaylen, K., Sala, C., Urban, M., Vermeulen, P., Wilken, N., Xie, W., Iliescu, D., & Mital, P. (2021). Carnival Optimizes Revenue and Inventory Across Heterogenous Cruise Line Brands. INFORMS Journal on Applied Analytics, 51(1), 26–41.

Maddah, B., Moussawi-Haidar, L., El-Taha, M., & Rida, H. (2010). Dynamic cruise ship revenue management. European Journal of Operational Research, 207(1), 445–455.

Sun, X., Jiao, Y., & Tian, P. (2011). Marketing research and revenue optimization for the cruise industry: A concise review. International Journal of Hospitality Management, 30(3), 746–755.

Topic B19: Capacity Allocation in Canal Operations: The Case of the Panama Canal

The Panama Canal is one of the world's most important transportation infrastructures, enabling ships to avoid long detours and substantially reduce travel times. At the same time, canal operations are constrained by limited lock capacity, fluctuating demand for transit slots, and the large amount of freshwater required for each ship passage. These challenges have become especially relevant in recent years, as droughts and declining reservoir levels have repeatedly forced the Canal Authority to reduce the number of ships allowed to transit the canal. As a result, canal operators face difficult trade-offs between water conservation, service levels, waiting times, and revenue generation.
This thesis examines how water scarcity affects queueing and capacity allocation in canal operations, with a particular focus on the Panama Canal. The student will review how the canal's booking and transit system works, explain how lock operations consume water and create capacity constraints, and analyze how drought-related restrictions affect waiting times, service levels, and ship prioritization. The thesis may also include a descriptive analysis of publicly available data on transit volumes, waiting times, vessel categories, draft restrictions, or water levels.

The objectives of the thesis are to:

- Describe the operational characteristics of the Panama Canal and explain how its booking and lock system works.
- Explain how water use, lock capacity, and transit demand create congestion and queueing.
- Examine how water shortages affect transit capacity, waiting times, and service levels.
- Review how the Panama Canal allocates scarce transit slots, for example through booking systems, auctions, and draft restrictions.
- Discuss the trade-offs between water conservation, congestion reduction, customer service, and revenue generation.
- Compare the Panama Canal with other canal systems, such as the Suez Canal and the Kiel Canal, and explain how differences in lock systems, elevation changes, and water requirements create different operational challenges.
- Search for related academic (especially operations management) literature.
- Optionally conduct a descriptive analysis of publicly available Panama Canal data, such as transit volumes, waiting times, draft restrictions, or vessel categories.

Basic Literature:

Golak, J., Grigoriev, A., van Lent, F. & van der Zanden, T. (2025). Optimizing Periodic Operations for Efficient Inland Waterway Lock Management. Available on arXiv: https://doi.org/10.48550/arXiv.2506.17743

Panama Canal Authority annual reports, water management reports, and operational updates on draft restrictions, transit limits, booking systems, and waiting times (see their website)

Note: A large number of media articles on the subject can easily be found. The search of related operations management literature is explicitly part of the project.

Topic B20: GenAI in Operations and Supply Chain Management: A Literature Review of Recent Research

Generative artificial intelligence (GenAI) has rapidly emerged as one of the most important new technologies in business. While many firms are experimenting with tools such as ChatGPT, Copilot, and Gemini, recent academic research has increasingly examined GenAI not only as a tool for writing and coding, but also as a research topic in operations and supply chain management. Much of this literature is still at an early stage and focuses on conceptual frameworks, emerging applications, and future research opportunities.

This thesis reviews the recent literature on GenAI in operations and supply chain management, with a particular focus on publications in leading operations management, operations research, and supply chain journals. The student will identify the main themes that have emerged in the literature, classify the types of GenAI applications studied so far, and discuss both the opportunities and the limitations of GenAI in the context of research in operations management. The thesis will also evaluate which aspects the available literature focuses on, such as operational efficiency, decision support, forecasting, human-AI collaboration, and supply chain resilience.

The objectives of the thesis are to:

- Identify the main application areas of GenAI in operations, such as forecasting, procurement, logistics, manufacturing, and supply chain risk management.
- Classify the existing literature according to methodological approaches, such as conceptual papers, empirical studies, case studies, analytical models, optimization models, and review papers.
- Discuss opportunities and limitations of GenAI in research on operations management.
- Identify trends and outline future research directions for GenAI in operations and supply chain management.

Basic Literature:

Shalpegin, T., Browning, T. R., Kumar, A., Shang, G., Thatcher, J., Fransoo, J. C., Holweg, M., & Lawson, B. (2025). Generative AI and empirical research methods in operations management. Journal of Operations Management Forum, 71: 578-587.

Kumar, N., Bharadwaj, R., Santhanam, R. & Kumar, S. (2025). Leveraging Generative AI in Operations and Supply Chain Management – Opportunities and Challenges in Research and Practice. SSRN Working Paper.

Boone, T., Fahimnia, B., Ganeshan, R., Herold, D. M. & Sanders, N. R. (2025). Generative AI: Opportunities, challenges, and research directions for supply chain resilience. Transportation Research Part E, 199, 104-135.

Zhou, Q. & Sheu J.-B. (2025). The use of Generative Artificial Intelligence (GenAI) in operations research: Review and future research agenda. Journal of the Operational Research Society.

Bahroun, Z., Saihi, A., As'ad, R. & Tanash, M. (2025). A systematic analysis of generative artificial intelligence for supply chain transformation. Supply Chain Analytics, 13: 100188

Topic B21: Water Scarcity in Operations Management: A Literature Review

Water scarcity and droughts have become major operational challenges for firms, governments, and supply chains. Agriculture and many industries depend heavily on freshwater availability, and climate change is increasing the frequency and severity of water shortages in many regions. As a result, researchers have increasingly started to study how water scarcity affects operational decisions. At the same time, many closely related contributions continue to appear in the hydrology and water-resources literature, where analytical and optimization models for water allocation and drought management have a longer tradition.
This thesis reviews how water scarcity and related freshwater constraints have been studied in leading operations journals (such as OR, MS, M&SOM, POM, EJOR), with selected connections to the hydrology and water-resources literature. The student will identify the main operational settings in which water plays an important role, such as irrigation, reservoir and groundwater management, industrial water use, and supply chain water stress. The thesis will also classify the literature by research method, including optimization, simulation, analytical modeling, and empirical research. The goal is to provide a structured overview of the current state of the literature and to identify promising opportunities for future research at the intersection of water and operations management.

The objectives of the thesis are to:

- Review water-related research in leading operations management journals.
- Identify selected related work in the hydrology and water-resources literature that helps contextualize the operations literature.
- Identify the main operational settings in which water scarcity is studied.
- Classify the literature according to methodological approaches.
- Examine how water-related operational problems differ across settings such as agriculture, industrial operations, utilities, and supply chains.
- Identify research gaps and outline future research opportunities for operations management.

Basic Literature:

Cole, D., Narayanan, S., Connors, E., Tewari, M., & Onda, K. (2023). Water stress: Opportunities for supply chain research. Production and Operations Management.

Sönmez, E., Ata, B., & Heeren, D. (2026). Dynamic Irrigation Management Under Weather Uncertainty and Soil Heterogeneity. Manufacturing & Service Operations Management.

Dawande, M., Gavirneni, S., Mehrotra, M., & Mookerjee, V. (2013). Efficient Distribution of Water Between Head-Reach and Tail-End Farmers in a Canal Irrigation System. Manufacturing & Service Operations Management, 15(2), 165-341.

Muthulingam, S., Dhanorkar, S., Corbett, Ch. (2021). Does Water Scarcity Affect Environmental Performance? Evidence from Manufacturing Facilities in Texas. Management Science, 68(4), 2377-3174.

Park, J., & Bayraksan, G. (2023). A Multistage Distributionally Robust Optimization Approach to Water Allocation Under Climate Uncertainty. European Journal of Operational Research.