Service Operations Research Seminar FSS 2024 (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. It thereby 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.

2. There are two types of offered topics – individual topics and team-based topics.

    a. **Individual topics:** Those topics are designed to be explored by a single student based on the fundamental literature provided. The topics are described below. Each participant with an individual topic 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).

    b. **Team-based topics:** Participants will work in teams of (usually) two on a real/realistic operations-related decision problem, based on a company case study. The objective of the thesis is to understand the company's problem and data, and recommend a solution based on a suitable methodological approach from the literature. Each team will present its findings in a written report (about 30-40 pages) as well as in an in-class presentation (~40 min), followed by a discussion (~20 min).

    Note: although prepared in group work, a team assignment is still an individual academic achievement of the team members. In general, all team members should be involved in all tasks and contribute to solving the assignment. If team members do not contribute equally, grades may differ, and you can specify who performed which task to what extent in joint statement of contribution (form available from the chair).

3. 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). 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 to soma@mail.uni-mannheim.de with subject "OPM 781 Seminar Application".[1]

4. The **application period** starts on **November 10th** and ends on **November 24th, 2023**.

5. The **assignment of topics** to students/teams will be preference-based. For team topics, team formation will be done by the chair, but if you have mutual preferences about who you want to be on the team with, please let us know by email and we will consider this.

6. **Admission** to the seminar is **binding** and will be confirmed by E-mail by **December 1st, 2023** at latest.

7. A **kick-off meeting** for all participants will be held on **Wednesday, December 6th,** at **10:15 - 11:45** in room **SO 318**. During this meeting, general guidelines for conducting scientific work will be discussed.

8. The latest **submission** date for the written report incl. appendices is **April 30th (2024),** 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. Student **presentations** will be held by default in the **regular presentation** session on **May 14th (2024), in room SO 318**. A **fast-track presentation** may be offered to students who desire to start with their master thesis early in FSS24 based on their request. Attendance is mandatory for all presentations on your own presentation date.

    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**.

[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.

10. 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%).

11. For questions concerning the seminar contact us by email at soma@mail.uni-mannheim.de

Seminar topics

Please note:
The amount of recommended literature does not indicate more or less workload. Your supervisor may have more recommendations for you.

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Topic S01: Waiting Time in Service Operations Management – Introduction and Application to the Case Study of Singapore Changi Airport

In service settings, waiting time is one of the key influencing factors on customer satisfaction and thus regularly in focus of research and management. Analyzing impact factors on waiting time or optimizing processes to reduce it are just some of the related topics that service operations management deals with. This discipline uses a broad range of methods like simulations or optimization models to find solutions in the best interest of customer and company. A case study that illustrates this very well is the one of Singapore Changi Airport.

The case study takes the perspective of Hamidah Hassan, who works at SATS, a provider of gateway services at Changi Airport. SATS has a symbiotic relationship with Changi Airport Singapore and Singapore Airlines. Hamidah is in charge of the operations at the check-in counter. As passenger traffic at Changi Airport increases, the lengthening waiting lines threaten to impair customer perceptions of the airline and airport. In order to implement an efficient solution, she has to balance her cost of operations against the cost of waiting for passengers and the service level agreement with the airport authority.

The objectives of this thesis are to:

- Introduce waiting time management as part of service operations management and highlight its importance and complexity from a company perspective;
- Formulate a linear integer problem to solve the issue presented in the case study (ignoring any uncertainty);
- Implement the problem in excel, solve it, and interpret the results;
- Perform a sensitivity analysis with regards to the key parameters given in the case study;
- Now considering uncertainty, perform the simulation analyses described in part B of the case study.

Basic Literature:

Moosa, S., Sesdhadri, S., Rodrigues, B., & Chan, C. W. (2015). Singapore Changi Airport: Check-in to a world class experience. (To be provided by the chair)

Topic S02: Activity Sequencing and Selection for Service Design

Putting customer experience at the heart of service design has become a governing principle of today's experience economy. Echoing this principle, the article by Li et al. (2022) addresses a service designer's problem of how to select and sequence activities in designing a service package. Empirical literature shows an ideal sequence often entails an interior peak; that is, the peak (i.e., highest-utility) activity is placed neither at the beginning nor the end of the package. Theoretic literature, by contrast, advocates placing the peak activity either at the beginning or at the end. The article in focus bridges this gap by developing a theory accounting for interior peaks and modeling the activity sequencing and selection problem as a nonlinear optimization problem. It also provides managerial implications for activity sequencing and selection.

The objectives of this thesis are to:

- explain the problem addressed by the paper and motivate its relevance;
- position the paper in the corresponding stream of scientific literature, and provide a literature review for it;
- explain model and methodology incl. the underlying theory and examples for practical implications;
- critically assess the paper's contribution to theory and practice, discuss its limitations, and provide a future outlook.

Basic Literature:

Li, Y., Dai, T., & Qi, X. (2022). A theory of interior peaks: Activity sequencing and selection for service design. Manufacturing & Service Operations Management, 24(2), 993-1001.

Topic S03: Product Price, Quality, and Service Decisions under Consumer Choice Models

Product price, quality, and ancillary service are among the most important factors consumers consider when making a purchase decision. Meanwhile, they are also seen as effective instruments for firms to achieve market segmentation. The article by Wang and Cui (2022) presents an integrated framework to study a firm's joint decisions on product price, quality, and service duration in a variety of monopolistic and competitive scenarios. For this purpose, the authors adopt the widely used multinomial logit model and the nested logit model to study consumers' choice behavior and employ mixed-integer optimization and game theory to conduct analyses.

The objectives of this thesis are to:

- explain the problem addressed by the paper and motivate its relevance;
- position the paper in the corresponding stream of scientific literature, and provide a literature review for it;
- explain model and methodology incl. the underlying theory and examples for practical implications;
- critically assess the paper's contribution to theory and practice, discuss its limitations, and provide a future outlook.

Basic Literature:

Wang, R., Ke, C., & Cui, S. (2022). Product price, quality, and service decisions under consumer choice models. Manufacturing & Service Operations Management, 24(1), 430-447.

Topic S04: Literature Review on Impact of Consumer Search on Assortment Planning and Pricing

For many products, consumers are uncertain about the price, functionality, durability, and tastes before physically looking at or experiencing them. To resolve these uncertainties, they visit multiple stores and websites and consult friends for fit information, during which the cost involved is named as search cost (or evaluation cost, discrimination cost, shop cost). Driven by this phenomenon, early studies explored the impact of the consumer search on pricing. Recently, researchers integrated this behavior in assortment planning. Cachon et al. (2005) consider consumer search process (e.g., parallel search, sequential search) in a monopolistic assortment setting, and later extended it to a competitive and non-overlapping symmetric assortment setting, respectively. Sun and Gilbert (2019) examine how search cost affects the competitive assortment types (i.e., overlapping or not). Moreover, the concept of "consideration set" is raised to follow the reality that consumers have limited ability in search breadth and has received much academical attention (e.g., Wang and Sahin 2018).

The objectives of this seminar thesis are to:

- review the literature on assortment planning (or product line design) and pricing with consumer search;
- summarize the results in terms of the impact of consumer search process (e.g., parallel search, sequential search) and search cost on the assortment planning, price, profit, and consumer surplus;
- provide open research gaps and future trends.

Basic Literature:

Cachon, G. P., Terwiesch C., & Xu Y. (2005). Retail assortment planning in the presence of consumer search. Manufacturing & Service Operations Management, 7(4), 330-346.

Sun, H., & Gilbert, S. M. (2019). Retail price competition with product fit uncertainty and assortment selection. Production and Operations Management, 28(7), 1658-1673.

Wang, R. & Sahin, O. (2018). The impact of consumer search cost on assortment planning and pricing. Management Science, 64(8), 3649-3666.

Topic S05: Nonlinear Programming for Alibaba Price Optimization and Product Recommendations

A nonlinear programming problem is one where some of the constraints or the objective function are nonlinear. Nonlinear programming is widely applied in multi-product multi-resource pricing, assortment planning, stochastic resource allocation, etc. Deng et al. (2023) provide an example: Alibaba, one of the world's largest e-commerce platforms, applied an evolutionary algorithm (Črepinšek et al. 2013) to its multiproduct pricing problem which is a nonlinear problem and whose objective is to determine the promotional prices for a set of products to maximize the total revenue while maintaining a target profit margin. Furthermore, Alibaba integrated this price optimization into its product recommendations.

The objectives of this seminar thesis are to:

- provide a brief introduction of nonlinear programming, including the standard model, typical applications, difficulties with nonlinearities, and optimality conditions;
- describe the pricing problem that Alibaba faced in Deng et al. (2023);
- elaborate how this pricing problem is solved by Alibaba and how the price optimization is integrated into product recommendations, including the optimization problem, technique, and results;
- critically assess the contribution of Alibaba to the practice and discuss other possible ways to solve the pricing problem that Alibaba faced.

Basic Literature:

Deng, Y., Zhang, X., Wang, T., Wang, L., Zhang, Y., Wang, X., ... & Peng, X. (2023). Alibaba realizes millions in cost savings through integrated demand forecasting, inventory management, price optimization, and product recommendations. INFORMS Journal on Applied Analytics, 53(1), 32-46.

Črepinšek, M., Liu, S. H., & Mernik, M. (2013). Exploration and exploitation in evolutionary algorithms: A survey. ACM Computing Surveys, 45(3), 1-33.

Topic S06: Consumer Preference for Remanufactured Products

Product line design decisions are important decisions at the interface of marketing and operations that are very costly to implement and change, and are determinant for market success. In order to systematically support decision-making in this area, a number of predictive consumer behavior models (in particular based on conjoint and discrete choice analysis, see e.g. Sawtooth Software 2023) and prescriptive mathematical programming models for optimal product (line) design based on customer preference data have been developed in the last decades. In these models, a product is considered to be a bundle of buyer-relevant attributes and their levels, respectively.

In recent years sustainability has become more important and consumers have been increasingly interested in purchasing remanufactured products due to their lower prices and concerns in environmental issues. Remanufactured products are normally developed by collecting and recovering previously sold new products. Then, they are usually labelled as remanufactured and/or refurbished products and sold at lower prices with reduced environmental and social impacts.

Conjoint analysis is used to determine part-worth utilities of sustainability attributes; and typical product attributes for remanufactured products include the product's CO2 footprint reduction, quality, warranty, price and so on compared to new products.

The objectives of this thesis are to …

- introduce conjoint analysis as a tool for measuring consumer preferences for certain attribute levels;
- review the empirical literature which examine consumer preferences on remanufactured products considering economic, environmental and social attributes;
- provide open research gaps and future trends.

Basic Literature:

Aydin, R., & Mansour, M. (2023). Investigating sustainable consumer preferences for remanufactured electronic products. Journal of Engineering Research, 11(1), 100008.

Ovchinnikov, A. (2011). Revenue and cost management for remanufactured products. Production and Operations Management, 20(6), 824-840.

Sawtooth Software (2023): Choice-Based Conjoint (CBC) Analysis, https://sawtoothsoftware.com/conjoint-analysis/cbc, last accessed on Sept. 4th, 2023

Topic S07: Implications of Take-back Regulations on the Remanufacturing Industry

Take back regulations like Extended Producer Responsibility (EPR) are policies that require manufacturers to take responsibility for the environmental impacts of their products throughout the entire product life cycle, including after the product has reached the end of its useful life. They encourage the design of products that are more sustainable, durable, and easily recyclable and remanufacturable, leading to a more circular economy and reduced environmental impact.

Remanufacturing is the production of like-new products using components retrieved from previously used products in addition to new components. There are different aspects in the literature on remanufacturing that influence the efficiency and the environmental benefits of that. For example, remanufacturing activity comes from independent remanufacturers (IR), the original equipment manufacturers (OEM) that put the product on the market in the first place, or both. Several interesting research questions arise: How do individual and collective producer responsibility schemes compare? Does regulation always reduce environmental impact? Are regulations slowing down the introduction of new products? And so on.

The objectives of this thesis are to …

- review the literature of EPR and its influence on the remanufacturing industry;
- investigate the challenges of implementing regulations and its effect on OEM profit;
- provide open research gaps and future trends.

Basic Literature:

Atasu, A., & Boyaci, T. (2010). Take-back legislation and its impact on closed-loop supply chains. Wiley Encyclopedia of Operations Research and Management Science. DOI, 10, 9780470400531.

Esenduran, G., Kemahlıoğlu-Ziya, E., & Swaminathan, J. M. (2017). Impact of take-back regulation on the remanufacturing industry. Production and Operations Management, 26(5), 924-944.

Gupt, Y., & Sahay, S. (2015). Review of extended producer responsibility: A case study approach. Waste Management & Research, 33(7), 595-611

Topic S08: Flight Schedule Design under Customer Choice

The task of the schedule design (SD) is to assign frequencies and departure times for specific routes by choosing from a set of proposed flights while aiming for the highest possible profit. Schön (2008) states that the schedule in combination with the fare conditions is the main criterion for passengers to choose an airline; similarly, Barnhart and Cohn (2004) call it the "single most important product of an airline". These arguments underline on one hand the large impact of the schedule on profitability but on the other hand, suggest to include customer behavior in the modelling approach to account for the market side. All these influences make the subproblem so complex that airlines are still challenged by using models for their schedule design and rely on a manual approach.

The objectives of this thesis are to …

- introduce schedule design models and compare the most important models;
- discuss a selected recent state-of-the-art model in detail;
- create an academical example in Excel (optional);
- provide open research gaps and future trends.

Basic Literature:

Barnhart, C., & Cohn, A. (2004). Airline schedule planning: Accomplishments and opportunities. Manufacturing & service operations management, 6, 3-22.

Barnhart, C., & Vikrant, V. (2016). Airline Schedule Optimization, in: Belobaba, P., Odoni, A., & Barnhart, C. (Eds.). The global airline industry. John Wiley & Sons.

Schön, C. (2008). Integrated airline schedule design, fleet assignment and pricing. DSOR-Beiträge zur Wirtschaftsinformatik, 5, 73-88.

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

Topic S09: Machine Learning for the Crew Scheduling Problem

The crew scheduling problem for airlines and railways is one of the toughest challenges in integer programming due to the sheer size of feasible solutions as well as complex regulations and flight time limitations, which need to be considered in every solution. A common method in the literature is Column Generation. The technique consists of an interacting master- and subproblem. In the masterproblem, the "price" of each to be covered leg is determined; the subproblem uses these prices to identify a new combination of legs and delivers it as new component of a feasible solution to the masterproblem. This process is very complex and requires many iterations. Machine learning has the potential to generate better subproblem solutions and thus decrease the number of required iterations but the use of this technique results in other challenges, which are tackled by recent literature.

The objectives of this thesis are to …

- introduce the crew scheduling problem and the underlying basic assumptions;
- summarize the use of machine learning in the field;
- discuss a specific model with machine learning in detail (optional);
- provide open research gaps and future trends.

Basic Literature:

Gattermann-Itschert, T., Poreschack, L. M., & Thonemann, U. W. (2023). Using Machine Learning to Include Planners' Preferences in Railway Crew Scheduling Optimization. Transportation Science, 57(3), 796-812.

Heil, J., Hoffmann, K., & Buscher, U. (2020). Railway crew scheduling: Models, methods and applications. European Journal of Operational Research, 283(2), 405-425.

Kasirzadeh, A., Saddoune, M., & Soumis, F. (2017). Airline crew scheduling: models, algorithms, and data sets. EURO Journal on Transportation and Logistics, 6(2), 111-137.

Tahir, A., Quesnel, F., Desaulniers, G., El Hallaoui, I., & Yaakoubi, Y. (2021). An improved integral column generation algorithm using machine learning for aircrew pairing. Transportation Science, 55(6), 1411-1429

Topic S10: Scheduling in Sports Leagues

Schedules of professional sport leagues are a huge challenge due to many requirements, multiple parallel competitions (such as cup rounds, national team games, and sharing of infrastructure with other teams), and a huge public interest. Also, a fair assignment needs to be considered while fulfilling the sometimes-conflicting objectives from different stake holders such as players, clubs, fans, sponsors and the media. This problem may be tackled with Integer Programming techniques as Kendall et al. (2010) show.

The objectives of this thesis are to …

- introduce the scheduling problem for sports leagues including requirements and objectives from different stake holders;
- provide an overview of recent models in the literature and explain one model in detail;
- create an academical example (optional);
- provide open research gaps and future trends.

Basic Literature:

Bartsch, T., Drexl, A., & Kröger, S. (2006). Scheduling the professional soccer leagues of Austria and Germany. Computers & Operations Research, 33(7), 1907-1937.

Durán, G., Guajardo, M., & Sauré, D. (2017). Scheduling the South American Qualifiers to the 2018 FIFA World Cup by integer programming. European Journal of Operational Research, 262(3), 1109-1115.

Kendall, G., Knust, S., Ribeiro, C. C., & Urrutia, S. (2010). Scheduling in sports: An annotated bibliography. Computers & Operations Research, 37(1), 1-19.

Krumer, A. (2019). Testing the effect of kick-off time in the UEFA Europa League. European Sport Management Quarterly, 1-14.

Topic S11: Demand Forecast with Machine Learning in the Aviation Industry

Demand forecasting models are essential tools in supply chain and operations management. The aim is to predict future demand for products or services based on historical data, external factors, and various modeling techniques. In general, two main categories of models are common in practice. Firstly, time series models which base their forecast prediction on historical demand data and assume that the future will follow patterns observed in the past. Examples include moving averages and exponential smoothing. Secondly, causal models such as machine learning (ML) techniques use a wide range of features, including historical demand data and additional data sources, to make predictions. They are more flexible and can capture complex relationships in the data. Examples include decision trees, random forests, and neural networks.

In the recent work from Dodin et al. (2023), the authors discuss the challenges in forecasting aftermarket demand for business aircraft spare parts. They highlight the difficulties with intermittent demand patterns, and they apply five types of ML forecasting models. The models showed superiority on real world data from Bombardier to a traditional time series model, which is currently in use by that firm. The ML-based forecasting system has been successfully deployed to forecast over 1 billion Canadian dollars in aftermarket demand regularly.

The objectives of this thesis are to …

- provide an introduction into forecasting models, distinguish between time series models and causal models, in particular ML techniques;
- give an overview which models have been predominantly used in recent years for managing inventory;
- describe the problem that Dodin et al. (2023) face;
- elaborate how this problem is solved by Dodin et al. (2023), including the data used, the forecasting models, and the results;
- explain one ML technique used by Dodin et al. (2023) in detail and explain what other models could have been used for the same product category (rotatable or expendable);
- critically assess the contribution of Dodin et al. (2023) to theory and practice and discuss any gaps.

Basic Literature:

Dodin, Pierre; Xiao, Jingyi; Adulyasak, Yossiri; Alamdari, Neda Etebari; Gauthier, Lea; Grangier, Philippe et al. (2023): Bombardier Aftermarket Demand Forecast with Machine Learning. INFORMS Journal on Applied Analytics, Article inte.2023.1164. DOI: 10.1287/inte.2023.1164.

Topic S12: Customer Choice Behavior for Vehicle Content Optimization at GM

The Franz Edelman Award recognizes and celebrates outstanding achievements in the practice of operations research and analytics. It is often considered the highest honor in the field. It is awarded annually by INFORMS (the Institute for Operations Research and the Management Sciences), which is a professional society dedicated to the advancement of operations research and analytics. In 2022 General Motors' (GM) was one of the finalists for the use of Vehicle Content Optimization (VCO), a strategy that involves optimizing the packaging and pricing of over 100 customer-facing features in GM vehicles. These decisions significantly impact the customer experience and GM's business outcomes. The features are categorized as standard, optional, or unavailable on various trim levels, resulting in a vast solution space with numerous combinations.

Customer demand for the VCO is modelled with the help of discrete choice models. There are several popular methods to estimate and apply discrete choice models. In Wu-Smith et al. (2023), the authors highlight the unique challenges they face and how to overcome them. For example, the authors notices that customers behave noncompensatory, meaning that customers only consider products with specific acceptable criteria. In addition, they managed the independence of irrelevant alternatives problem which is a common property if a multinominal logit model is used.

The objectives of this thesis are to:

- provide an introduction into discrete choice models and their estimation methods;
- give an overview which demand models are used in recent years in the automotive industry;
- describe the problem that Wu-Smith et al. (2023) face;
- elaborate how this problem is solved by Wu-Smith et al. (2023), focus on the discrete choice models, there extensions and estimation methods;
- explain the Bayesian Markov-Chain Monte Carlo estimation procedure in detail and explain what other methods could have been used;
- critically assess the contribution of Wu-Smith et al. (2023) to theory and practice and discuss any gaps.

Basic Literature:

Wu-Smith, Peiling; Keenan, Philip T.; Owen, Jonathan H.; Norton, Andrew; Kamm, Kelly; Schumacher, Kathryn M. et al. (2023): General Motors Optimizes Vehicle Content for Customer Value and Profitability. INFORMS Journal on Applied Analytics 53 (1), pp. 59–69. DOI: 10.1287/inte.2022.1144.

Topic S13: The Newsvendor Model – Review and Application to the New Product Launch of Eastman's Tritan Specialty Plastic

Eastman Chemical Company is an American chemical company globally producing a broad range of advanced specialty materials, chemicals and fibers for everyday purposes. Founded in 1920 and based in Kingsport, Tennessee, the company now has more than 50 manufacturing sites worldwide with ~14,000 employees and sales revenue of approximately $10.5 billion in 2021. The development of Tritan, a new specialty plastics, was a major breakthrough for both Eastman and the broader chemical industry. However, the launch of the new product was quite challenging, and the Eastman specialty plastics team had to develop a convincing market introduction and production strategy 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: how should Eastman allocate its limited manufacturing capacity among the initial launch partners, and how aggressively should Eastman price Tritan, given that price would drive demand in the launch markets and in new markets?

To answer those questions, Eastman sought for analytics-oriented decision support. In fact, an extension of the classical Newsvendor model could be used to help making those decisions in a more systematic way. The newsvendor model is a mathematical model with a wide range of applications, e.g., to determine optimal inventory levels in operations management or optimal booking levels in airline revenue management. The basic model is typically characterized by a perishable product with uncertain demand and a fixed price whose order size is to be determined. It assumes the situation faced by a newspaper vendor who must decide how many copies of the day's paper to stock in the face of uncertain demand and knowing that unsold copies will be worthless at the end of the day. The basic newsvendor model has been extended in many ways, e.g. by considering multiple products simultaneously or integrating pricing decisions.

The objective of the thesis is to understand Eastman's situation, analyze the given data, model and implement the decision problem, as well as recommend and defend a solution, based on a suitable Newsvendor model extension. This should include providing a sound theoretical foundation by reviewing the basic Newsvendor problem, its mathematical structure and solution methods, selected extensions and applications.

Basic Literature:

Gal Raz, Tim Kraft and Allison Elias. (2013), Eastman Tritan, Darden Business School, https://hbsp.harvard.edu/product/UV6748-PDF-ENG (case study will be provided by the chair)

Porteus, Evan L. "The newsvendor problem." In: Chhajed, D., & Lowe, T. J. (Eds.). Building intuition: insights from basic operations management models and principles (Vol. 115). Springer Science & Business Media, Boston, MA, 2008, Chapter 7

Topic S14: The Newsvendor Model – Review and Application to the New Product Launch of Eastman's Tritan Specialty Plastic (Team Project)

This topic is a team-based project and the description of this topic can be found in the individual project topic S13.

The objectives of this seminar thesis are to satisfy all objectives of the topic S13 and additionally to:

- give a comprehensive literature overview on suitable Newsvendor extensions;
- derive an alternative recommendation for Eastman by implementing an alternative solution method like the LP approximation to the original stochastic problem;
- compare the performance of each strategy through a simulation.

Basic Literature:

Gal Raz, Tim Kraft and Allison Elias. (2013), Eastman Tritan, Darden Business School, https://hbsp.harvard.edu/product/UV6748-PDF-ENG (case study will be provided by the chair)

Petruzzi, N. C., & Dada, M. (1999). Pricing and the newsvendor problem: A review with extensions. Operations research, 47(2), 183-194.

Porteus, Evan L. "The newsvendor problem." In: Chhajed, D., & Lowe, T. J. (Eds.). Building intuition: insights from basic operations management models and principles (Vol. 115). Springer Science & Business Media, Boston, MA, 2008, Chapter 7

Qin, Y., Wang, R., Vakharia, A. J., Chen, Y., & Seref, M. M. (2011). The newsvendor problem: Review and directions for future research. European Journal of Operational Research, 213(2), 361-374.

Turken, N., Tan, Y., Vakharia, A. J., Wang, L., Wang, R., & Yenipazarli, A. (2012). The multi-product newsvendor problem: Review, extensions, and directions for future research. In: Choi, T.-M. (Ed.): Handbook of newsvendor problems – Models, Extensions and Applications, Springer, 3-39.

Topic S15: Real-World Analytics for Sustainable Product Design (Team Project)

Product design decisions are important decisions at the interface of marketing and operations that are very costly to implement and change and are determinant for market success. In order to systematically support decision-making in this area, a number of mathematical programming models for optimal product (line) design based on customer preference data from conjoint analyses have been developed in the last four decades. In these optimization models, a product is defined to be a set of attributes where each attribute can have different levels. The objective is to configure the products and prices such that profit is maximized given the products' costs and customers' willingness to pay.

In many industries today, product design increasingly requires integrating economic objectives with environmental thinking - driven by raising ecological concerns, regulatory pressures, and the potential to create a marketing edge through sustainable operations. 'Green' design is particularly challenging since it should not only embrace a product's key features from a consumer perspective but also all underlying supply chain processes that determine a product's 'greenness'.

For example, computer manufacturers have made various efforts aimed at reducing the environmental impact of products at all stages of their life cycles, from design to disposal. Firms need to decide if they design their products (and the underlying supply chain) for repair, remanufacturing, and/or recyclability, or if they invest into labels like Energy Star, certifying that the computer requires 25% - 40% less than conventional models by using the most efficient components and better managing energy use when idle.[2] Various empirical studies show that "green" product attributes increase consumer willingness-to-pay and may pay off the efforts on the supply chain side if higher prices can be charged.

The thesis' main task is to assume the role of a product development team who is in charge of designing a new product in a market where demand for more environmentally-friendly products is increasing (focus should be either on electronics or fashion). For assessing if the new product is not only environmentally but also economically viable, a conjoint analysis is to be performed. The conjoint data can then be used as input to a quantitative product design model that allows to derive recommendations, thus answer the following questions:

- Is there any additional willingness-to-pay of customers for the selected green attributes? What evidence does the empirical literature provide? What type of green attributes are most preferable from a consumer's and a designer's perspective?
- What are the implications for optimal product design?
- Optional: what are the implications for supply chain design? How does the cost structure change for producing the green product features and how can the additional cost be systematically incorporated into the product design decision?

As a base, the thesis should include providing a sound theoretical foundation by reviewing

1.) the current literature on empirical conjoint studies involving green features in the selected product category,

2.) a selected conjoint-based product design model that can suitably be applied in your own analysis.

[2] https://www.energystar.gov/products/computers, accessed on October 31st, 2023.

This thesis is a team-based project where participants will work in teams of two students.

Basic Literature:

Dobson, G., & Kalish, S. (1993). Heuristics for pricing and positioning a product-line using conjoint and cost data. Management Science, 39(2), 160-175.

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Orme, B. K. (2006). Getting started with conjoint analysis: strategies for product design and pricing research.

Steiner, W. J., & Hruschka, H. (2002). A probabilistic one-step approach to the optimal product line design problem using conjoint and cost data. Review of Marketing Science Working Paper, 441.

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Topic S16: The Newsvendor Model – Review and Application to ReCellular's Closed-Loop Remanufacturing Decisions (Team Project)

ReCellular was a large cellphone remanufacturer and ranked among the top five firms in this domain in the United States. A substantial part of its business was focused on acquiring used cellphones, remanufacturing them, and selling them to other businesses. The demand for remanufactured cellphones was uncertain. Before the demand is realized, used cellphones were acquired; after it is realized, acquired used cellphones were remanufactured. Excess quantities of used cellphones were often salvaged at a loss. To deal with the risk of unsatisfied demand for remanufactured cellphones and excess inventory of used cellphones, ReCellular acquired used cellphones in different quality conditions: high-quality, medium-quality, low-quality. High-quality phones were phones that were lightly used and required very little remanufacturing effort but were expensive to acquire. Low-quality phones were phones that were extremely worn out and often had broken parts. Although such phones were very cheap to acquire, remanufacturing them would be expensive. For medium-quality phones, the acquisition cost and remanufacturing cost was in between the high- and low-quality ones. All used cellphones were remanufactured to the same specification, sold at the same price, and customers could not tell if the remanufactured cellphone was of high, medium, or low quality before remanufacturing. ReCellular needed to determine how many used cellphones in each quality grade to acquire to meet the uncertain demand, based on the trade-off between the acquisition cost and remanufacturing cost.

In fact, an extension of the traditional Newsvendor model could be used to make the above decision. The newsvendor model is a mathematical model with a wide range of applications, e.g., to determine optimal inventory levels in operations management or optimal booking levels in airline revenue management. The basic model is typically characterized by a perishable product with uncertain demand and a fixed price whose order size is to be determined. It assumes the situation faced by a newspaper vendor who must decide how many copies of the day's paper to stock in the face of uncertain demand and knowing that unsold copies will be worthless at the end of the day. The basic newsvendor model has been extended in many ways, e.g. by considering multiple inventory types or integrating pricing decisions.

The objective of the thesis is to understand ReCellular's situation, analyze the given data, model and implement the decision problem, as well as recommend and defend a solution, based on a suitable Newsvendor model extension. This should include providing a sound theoretical foundation by reviewing the basic Newsvendor problem, its mathematical structure and solution methods, selected extensions and applications.

This thesis is a team-based project where participants will work in teams of two students.

Basic Literature:

Guide, V. D. R., Neeraj, K., Newman, C., & Van Wassenhove, L. N. (2005). Cellular telephone reuse: The ReCellular Inc. case. In: Flapper S. D. P., van Nunen, J. A. E.E., & Van Wassenhove, L. N. (Ed.): Managing closed-loop supply chains, Springer, 151-156.

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