Service Operations Research Seminar FSS 2023 (OPM 781)

"Current Topics in Service Operations Management Research"

General Information:

1. The goal of this seminar is to introduce participants to conducting scientific research. It thereby prepares students for writing their M.Sc./Diploma Thesis. The seminar is geared towards students intending to write their Thesis at the Chair of Service Operations Management.

2. Each participant will be assigned one of the topics listed below. The task then is to identify the main issues addressed by the paper, explain its methodology, including potential quantitative models, position it in the corresponding stream of scientific literature, and critically assess the paper's contribution to the literature as well as to practice. Each participant presents their findings in a written report (about 20 pages) as well as in a presentation (20 min + 10 min discussion).

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 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 11th** and ends on **November 25th**, 2022.

5. **Admission** to the seminar is **binding** and will be confirmed by E-mail by **December 2nd, 2022.**

[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.

6. A **kick-off meeting** for all participants will be held on **Wednesday**, **December 7th, 2022, at 10:15 – 11:45** in **SO318**. During this meeting, general guidelines for conducting scientific work will be discussed.

7. Each student has **eight weeks** to complete the Seminar Thesis. This timeframe can individually be set **between the kick-off day and May 12th, 2023** (Note: May 12th is the latest submission date).

8. To start the eight weeks completion time, please follow these **four steps**:
    a. Go to the **ILIAS Group** "OPM 781 Research Seminar"
    b. Select the **Test** "Seminar Thesis_[YOUR NAME]",
    c. Follow the **instructions of the Test**,
    d. The eight weeks completion time **will start automatically after finishing the test**.

9. On your individual submission date, you have to…
    a. **Upload your report** (Word- / Latex-document and PDF) via Task "Upload of final Thesis & Calculations/Software Output" in the ILIAS group.
    b. *If applicable:* ***Upload your software-output*** *(in a single zip file*) via Task " Upload of final Thesis & Calculations/Software Output" in the ILIAS group.
    c. **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.

10. Student **presentations** will be held by default in the **regular presentation** session on **May 24st (2023), in room SO 318**.
    A **fast-track presentation** session on **April 19th (2023)**, may be offered to students who desire to start with their master thesis early (with seminar thesis submission deadline on **April 7th,** 2023). Attendance is mandatory for all presentations on your own presentation date.

    Please **upload your 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 – no changes allowed afterwards. The chair's laptop will be used to show the presentations during class.

11. The report and the presentations can be delivered either in English or in German.

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

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

Seminar topics

Topic overview

Topic S01: A Staffing Optimization Model to Balance the Risk-Efficiency Trade-Off

When designing a service offering, the underlying service operations must be aligned to deliver the promised or targeted service. Hereby, service providers face several operational decisions on how to design the service system. Different Operations Research approaches aim at supporting service providers in their decision making. Mathematical models can help to balance trade-offs, such as minimizing costs associated with the service delivery system while fulfilling basic service requirements. These requirements could, e.g., be certain staffing levels that must be met to secure the service provision.

Such an example is provided in the following paper: Kekre et al. (2009) develop a simulation optimization model for a commercial bank to address the risk and efficiency trade-off inherent to the check-clearing operations. Continued growth of electronic payments require banks to operate the check-clearing house efficiently, keeping personnel costs at a reasonable level while reducing the risk of delayed checks. The staffing model gives recommendation for a strategic downsizing program for the check-processing workforce.

The objectives of this thesis are to:

- explain the problem addressed in the paper and motivate its relevance,
- position the paper in the corresponding stream of scientific literature,
- explain the model and methodology incl. necessary theory and, if applicable, incl. some academic example/ implementation,
- and critically assess the paper's contribution to theory and practice, and discuss any gaps.

Basic Literature:

Kekre, S., Secomandi, N., Sönmez, E., & West, K. (2009). OM practice—balancing risk and efficiency at a major commercial bank. *Manufacturing & service operations management*, 11(1), 160-173.

Topic S02: An Investigation into the Effect of Green Servitization on Productivity

Servitization is a current trend in manufacturing towards more service-oriented business models. Thereby, manufacturers enhance their portfolio of services offered, which are centered around or directly involve the physical products they traditionally produce. It is hence a common measure for business model innovation in the manufacturing industry.

By moving from selling physical goods towards selling services, companies benefit from more regular cash inflows and closer customer interaction. Literature suggests that servitization improves the economic performance of firms, e.g., measured by productivity. Studies like Opazo-Basáez et al. (2018) link servitization to sustainability initiatives in the automotive industry by studying 228 firms in 21 countries. By adapting service capabilities, firms aim at sustainable development which does not harm the firm's competitiveness. Research insights in this area promise to have great ecoconscious impact on the automotive industry and society as a whole.

The objectives of this thesis are to:

- explain the problem addressed in the paper and motivate its relevance,
- position the paper in the corresponding stream of scientific literature,
- explain the model and methodology incl. necessary theory and, if applicable, incl. some academic example/ implementation,
- and critically assess the paper's contribution to theory and practice and discuss any gaps.

Basic Literature:

Opazo-Basáez, M., Vendrell-Herrero, F., & Bustinza, O. F. (2018). Uncovering productivity gains of digital and green servitization: Implications from the automotive industry. *Sustainability*, 10(5), 1524.

Topic S03: Choice-Based Revenue Management: Estimation and Optimization

Discrete choice models are used to describe, explain, and predict a choice from a set of two or more discrete alternatives, such as choosing among several commute modes, buying a car among numerous models. They operate under the assumption that people, faced with a discrete set of options, choose the one with the maximal benefit. In business, researchers and practitioners use these models to examine consumer demand, predict competitive responses, and design pricing strategy and product lines.

Vulcano et al. (2010) study the practicality and effectiveness of discrete choice models in airline revenue management. Specifically, they assess to what extent discrete choice models can be estimated well using readily available airline data and measure the revenue improvement that choice-based revenue management could bring in a sample of test markets.

The objectives of this thesis are to:

- explain the problem addressed in Vulcano et al. (2010) and motivate the relevance,
- position Vulcano et al. (2010) in the corresponding stream of scientific literature,
- explain the model and methodology in Vulcano et al. (2010), including the theory, the estimation method, and the implementation,
- critically assess the contribution of Vulcano et al. (2010) to the theory and practice and discuss any gaps.

Basic Literature:

Vulcano, G., Van Ryzin, G., & Chaar, W. (2010). OM practice—choice-based revenue management: An empirical study of estimation and optimization. *Manufacturing & Service Operations Management,* 12(3), 371-392.

Topic S04: Reciprocating Integer Programming for Birchbox Product Assortment

An integer programming problem is one where decision variables are constrained to be integer values. A variant of it is mixed-integer programming problem where some decision variables are not discrete. Mixed-integer programming is widely applied in production planning, scheduling, territorial partitioning, telecommunication networks, etc. Lustig et al. (2021) provide an example: A firm called Birchbox, to determine the products that will be send to different subscribers every month, created a mixed-integer programming formulation which is improved by Princeton Consultants using the Reciprocating Integer Programming technique.

The objectives of this thesis are to:

- provide a brief introduction into integer programming, including the standard model, typical applications, and solution methods,
- describe the problem that Birchbox faced in Lustig et al. (2021),
- elaborate how this problem is solved by Princeton Consultants in Lustig et al. (2021), including the redefined optimization problem, technique, and results,
- critically assess the contribution of Princeton Consultants to the theory and practice, and discuss other possible ways to solve the problem that Birchbox faced.

Basic Literature:

Lustig, I., Randall, P., & Randall, R. (2021). Formulation matters: Reciprocating integer programming for Birchbox product assortment. *INFORMS Journal on Applied Analytics,* 51(5), 347-360.

Topic S05: Choice-Based Dynamic Pricing for Vacation Rentals

Optimal product pricing is a major challenge for companies, as for most products customers demand is strongly dependent on the price. Former scholars developed choice models to capture demand dependent on product attributes (like color, price, size) to predict customer behavior. The multinominal logit model (MNL) is one of the most famous discrete choice model, as it has a good prediction in many fields combined with desirable mathematical properties.

Practitioners have to perform a variety of tasks to conduct current state-of-the-art methods. The paper of Wang et al. (2021) demonstrates how to get data, how to forecast market prices, design an optimization model and solved it with a non-linear optimization solver. The authors were able to improve the expected revenue between 3.5 % and 5.2 % for a major vacation rentals company.

The objectives of this thesis are to:

- explain the problem addressed in Wang et al. (2021) and motivate the relevance,
- position the paper from Wang et al. (2021) in the optimization stream of scientific literature,
- explain the models and methodologies in Wang et al. (2021) used. Pay special attention to the discrete choice model, nonlinear optimization model, and the implementation.
- critically assess the contribution of Wang et al. (2021) to theory and practice and discuss any gaps.

Basic Literature:

Wang Y. et al. (2021). Choice-Based Dynamic Pricing for Vacation Rentals. *INFORMS Journal on Applied Analytics* 51(6):450-462. https://doi.org/10.1287/inte.2021.1075

Topic S06: A Decision Support System for Brewery Production Planning

Many real-world decisions are bounded to integer numbers. Prescriptive analytics helps to solve such challenging decisions. Integer programming (IP) problem is a type of problem, which tackles the difficulties caused by the integer requirement. IP models are applied in almost all business functions and industries from assortment, production, supply chain to chemistry or telecommunication. Past researcher found efficient ways to solve IPs and MIPs, which also allows some variables to be continuous. The work of Mickein, Koch and Haase (2022) uses methods from operations to optimize the production planning process of a brewery. The authors showed that the chosen approach is not limited to their specific environment but can be adopted to new use cases.

The objectives of this thesis are to:

- provide a brief introduction into (mixed) integer programming, typical applications, and current state-of-the-art solution methods,
- describe the problem that Mickein et al. (2022) face,
- elaborate how this problem is solved by Mickein et al. (2022), including the optimization problem, the presented heuristic, technique, and results,
- either implement a simplified model into Excel and test its computational limits, or discuss potential changes to the approach to reduce the solution time,
- critically assess the contribution of Mickein et al. (2021) to theory and practice and discuss any gaps.

Basic Literature:

Mickein M., Koch M., Haase K. (2022). A Decision Support System for Brewery Production Planning at Feldschlösschen. *INFORMS Journal on Applied Analytics 52(2):158-172.*
https://doi.org/10.1287/inte.2021.1101

Topic S07: Harnessing Product Substitution Information to Rationalize SKUs at Intcomex

Product line selection or assortment optimization is one of the main challenges of companies. Choosing the assortment individually based on their revenue potential and purchase price is suboptimal and incorporating costs incurred over the product's life cycle, such as inventory and obsolescence, as well as customer behavior to identify substitution patterns, is an important component of assortment planning. Due to the rapidly expanding size of its product line, Intcomex, a global distributor of IT products, experienced severe supply chain pressure. Bernales et al. (2017) proposed a model-based, data-driven, and optimization-based approach to help Intcomex in its assortment planning. Based on this methodology, an optimal portfolio of products is determined based on customer demand and product substitutability and 18 percent increase is reported in profits of the company.

The objectives of this thesis are to:

- explain the problem addressed in Bernales et al. (2017) and motivate the relevance,
- position the paper from Bernales et al. (2017) in the optimization stream of scientific literature,
- explain the models and methodologies in Bernales et al. (2017) used in both predictive and prescriptive terms,
- critically assess the contribution of Bernales et al. (2017) to theory and practice and discuss any gaps.

Basic Literature:

Bernales, P. J., Guan, Y., Natarajan, H. P., Gimenez, P. S., & Tajes, M. X. A. (2017). Less is more: Harnessing product substitution information to rationalize SKUs at intcomex. *Interfaces*, 47(3), 230-243.

Topic S08: Assortment Planning of Automotive Products with Considerations for Economic and Environmental Impacts of Technology Selection

A manufacturer's assortment is the set of products that the company builds and offers to its customers. A company must trade off sales revenue and product offering costs when planning its assortment. Another factor that can affect the assortment is environmental considerations. About 14 % of greenhouse gas emissions are caused by transportation. Taghavi et al. (2014) propose a modeling framework that seeks to identify the optimal assortment for a manufacturer of configurable products (particularly automobiles), accounting for environmental considerations (Corporate Average Fuel Economy (CAFE) requirements, greenhouse gas emissions related to the production of the fuel used to power the vehicle, etc.). A mixed-integer programming framework is used to formulate the model's economic and environmental requirements.

The objectives of this thesis are to:

- explain the problem addressed in Taghavi et al. (2014) and motivate the relevance,
- position the paper from Taghavi et al. (2014) in the optimization stream of scientific literature,
- explain the models and methodologies in Taghavi et al. (2014) used,
- critically assess the contribution of Taghavi et al. (2014) to theory and practice and discuss any gaps.

Basic Literature:

Taghavi, A., & Chinnam, R. B. (2014). Assortment planning of automotive products with considerations for economic and environmental impacts of technology selection. *Journal of Cleaner Production*, 70, 132-144.

Topic S09: Crew Scheduling for Longhaul Operations in Airtravel

To organize daily operations, airlines have 4 planning stages to distribute the available resources such as aircraft and crews to activities such as flights and maintenance events. The last step is usually the Airline Crew Scheduling Problem, in which crew members are assigned to specific flights in a planning period with the objective to have the cost minimizing solution. This problem has received much attention due to the high savings potential of crew cost; generally, it is solved in two sequential steps called crew pairing and crew assignment to better manage complexity and following the process of first minimizing the schedule costs and then satisfying crew members. Similar processes can be found for railways and other transport industries.

While there have been many contributions discussing the needs of shorthaul operations, Luo, Dashora, & Shaw (2015) point out that there are different requirements for longhaul operations such as crew strength depending on duty length, separation of crew members within a duty, and pairings only containing two legs. These factors are complicating the problem but the few numbers of legs resulting fewer number of feasible combinations simplify the problem compared to its shorthaul sibling.

The objectives of this thesis are to:

- explain the problem addressed by Luo, Dashora & Shaw (2015) and motivate its relevance,
- position the paper in the corresponding stream of scientific literature by providing a literature review,
- explain the model and introduce the methodology incl. necessary theory (academical example is optional), and
- critically assess the paper's contribution to theory and practice, and discuss any gaps.

Basic Literature:

Luo, X., Dashora, Y., & Shaw, T. (2015). Airline crew augmentation: decades of improvements from sabre. *Interfaces*, 45(5), 409-424.

Topic S10: Safety Performance Indicators for Airline Fatigue Risk Management

Crew scheduling is one of the most difficult problems in Operations Research. A contributing factor is the extensive set of flight time limitations by regulators, airlines, and unions. In the past, these rules have been quite strict but also not always been successful in avoiding fatigue. In the recent development of "Fatigue Risk Management", the aim is to measure the actual fatigue and mitigate it with more flexible measures instead of blindly trusting those rules.

A major challenge in these fatigue management systems remains to measure fatigue and its impact correctly during daily operations. Therefore, specific safety performance indicators (SPI) are designed in order to identify rosters which could result in a fatigue hazard. These measures might be objective facts such as "Time awake at duty start" or subjective perceptions such as sleepiness on the Karolinska-Sleepiness-Scale. As challenge remains to identify the best set of SPIs in order to identify the fatigue hazards and find mitigation actions.

The objectives of this thesis are to:

- explain the problem addressed by Gander et al. (2014) and motivate its relevance,
- position the paper in the corresponding stream of scientific and practical literature by providing a literature review,
- explain the model and introduce the methodology, the results, and the take-aways for practitioners,
- critically assess the paper's contribution to theory and practice and discuss any gaps.

Basic literature:

Gander, P. H., Mangie, J., Van Den Berg, M. J., Smith, A. A. T., Mulrine, H. M., & Signal, T. L. (2014). Crew fatigue safety performance indicators for fatigue risk management systems. *Aviation, space, and environmental medicine*, 85(2), 139-147.

Topic S11: Product Price, Quality, and Service Secisions 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 S12: 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.