Service Operations Research Seminar FSS 2022 (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. 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]

3. The **application period** starts on **November 12th** and ends on **November 26th**, 2021.

4. **Admission** to the seminar is **binding** and will be confirmed by E-mail by **December 3rd, 2021.**

5. Each participant admitted to OPM 781 will explore one of the research topics listed below – based on the fundamental literature provided. Each participant presents 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).

6. A **kick-off meeting** for all participants will be held on **December 8th, 2021 at 10:15am** via **ZOOM** (please access the link here: https://portal2.uni-mannheim.de:443/portal2/pages/startFlow.xhtml?_flowId=showRoomDetail-flow&roomId=6547&roomType=3&context=showRoomDetails&navigationPosition=organisa

[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.

tion,searchroom). 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 6th, 2022** (Note: May 6th 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 18th, 2022, starting at 10:15 in room SO 318** (only if on-campus operations have been resumed at the University).
    A **fast-track presentation** session on **March 23rd (2022)**, may be offered to students who desire to start with their master thesis early in FSS22 (with thesis submission deadline on **March 4th**, 2022). 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

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

Topic overview

Topic S01: Customer response measurement on the trade-off of responsiveness and customization

In today's fast-moving world, responsiveness in form of process speed constantly gains importance and many service providers aim at improving their process speeds to reduce customer waiting time. Yet, there is an operational trade-off, as responsiveness often reduces flexibility of the process. As such, customers can either ask for a very fast or a very customized service. Increased customization clearly prolongs the service process as the service provider needs to address the specific customer needs. In case of a rather unspecific customer demand, the service can be provided much quicker. Process speed is thereby directly linked to the flexibility level of the operations. Service providers must hence handle this so-called customization-responsiveness squeeze appropriately. For example, regression or Conjoint Analysis are suitable methods to determine the customer response or satisfaction on the trade-off of responsiveness or waiting time and customization.

This seminar thesis focuses on the existing works on this matter. A literature review should be conducted to review and compare the literature regarding the methodological approaches and reported results, clearly stating the used keywords and databases. Special attention should be paid to conjoint analysis and the banking industry. In the end, the thesis should summarize the findings and provide guidance for practitioners to evaluate the importance of this trade-off in the respective area.

The objectives of this thesis are to:

- conduct a literature review of existing works about customer response measurement on the trade-off of responsiveness and customization,
- provide an overview of the methodological approaches and the results of the identified studies,
- and give recommendations on the trade-off of customization and process speed for different service operations.

Basic Literature:

McCutcheon, D. M., Raturi, A. S., & Meredith, J. R. (1994). The customization-responsiveness squeeze. Sloan Management Review, 35(2), 89-99.

Wang, G., Wang, J., Ma, X., & Qiu, R. G. (2010). The effect of standardization and customization on service satisfaction. Journal of Service Science, 2(1), 1-23.

Kalantari, H.D. and Johnson, L. (2018). Australian customer willingness to pay and wait for mass-customised products. Asia Pacific Journal of Marketing and Logistics, 30(1), 106-120.

Topic S02: A Critical Review of the simod approach for automated discovery of simulation models

Process Mining (PM) is a structured approach to discover process models from process execution data, so-called event logs. Based on these event logs, the process model can be created, compared to the normative process model for conformance checking, and used for extending the current process model. Besides, PM can be used to support other methodologies, like simulation. Combining PM and business process simulation (BPS) offers many potentials, as PM provides an unbiased data source as compared to the traditionally used interviews to collect data and input parameters. Existing research has hence proposed different approaches to combine PM and BPS algorithmically. One of these approaches for automated discovery of simulation models is Simod proposed by Camargo, Dumas, and González-Rojas (2020).

A combination of PM and BPS offers many advantages, as e.g. time-intensive interviews become unnecessary. However, the input required for BPS is not always easily extractable from the event logs or PM analysis. Various challenges in this area have been identified. The aim of this thesis is to explain and critically review the Simod Approach to identify which challenges at the interface of PM and BPS it can or cannot address.

The objectives of this thesis are to:

- explain the Simod approach for automated discovery of BPS models;
- critically review which challenges at the interface of PM and BPS Simod can or cannot address;
- provide an overview of open challenges when combining PM and BPS.

Basic Literature:

Camargo, M., Dumas, M., & González-Rojas, O. (2020). Automated discovery of business process simulation models from event logs. Decision Support Systems, 134, 113284.

Jadrić, M., Pašalić, I. N., & Ćukušić, M. (2020). Process Mining Contributions to Discrete-event Simulation Modelling. Business Systems Research: International journal of the Society for Advancing Innovation and Research in Economy, 11(2), 51-72.

Rozinat, A., Mans, R. S., Song, M., & van der Aalst, W. M. (2009). Discovering simulation models. Information systems, 34(3), 305-327.

Topic S03: Optimization models incorporating network effects

Consumer purchase decision are dependent on different aspects of a product. First, there are attributes like color, size or price that are directly influenceable by the firm's decision maker. Other attributes like reputation, recommendations or network effect are much more difficult to influence. Network effect describes a behavior, where people value an item dependent on the products sales. This effect can take different forms and is mainly distinguished into global network effect and local network effect.

To utilize network effect, companies can use this aspect to optimize sales. Choice models, like the multinominal choice model (MNL), are often used to describe customer purchase behavior. Wang (2020) showed that it can be beneficial to sell a product below its marginal costs, in order to stimulate other sales of more profitable products. Wang and Wang (2017) incorporated network effects to optimize assortment planning using MNL.

The objectives of this thesis are to:

- review basic literature to network effect and used discrete choice models. Distinguish thereby between global and local network effect;
- give an overview over existing literature incorporating network effects in optimization models;
- comment, if companies should incorporate network effects in their decision-making process and what difficulties they may face from an optimization point of view;
- provide academic examples from the industry where network effects are incorporated into decision making (optional);
- and implement one optimization model (optional).

Basic Literature:

Wang, R., & Wang, Z. (2017). Consumer Choice Models with Endogenous Network Effects. Management Science, 63(11), 3944–3960. https://doi.org/10.1287/mnsc.2016.2520

Wang, R. (2020). On the assortment optimization with endogenized market size. Operations Research Letters, 48(5), 682–686. https://doi.org/10.1016/j.orl.2020.07.011

Qi, W., Liu, X., Luo, X., & Zhang, Z.-L. (2020). Product Line Optimization Considering Network Effects. IEEE Systems Journal, 1–11. https://doi.org/10.1109/JSYST.2020.3035093

Topic S04: Optimal pricing for products with network effects

The price of the product is one of the most important attributes. This can be seen, as price optimization has a huge impact on increasing profits. According to a Harvard Business Review article, a price improvement of 1% leads on average to increased operating profit of 11,1% (based on 2453 companies and assuming no loss of volume). Products that are more valued from customers if sales of the product are high, encounter a network effect. This effect can take different forms and is mainly distinguished into global network effect and local network effect. Finding the optimal price is in particular difficult, as the sales of a product are dependent on the sales of the same product, which leads to an equilibrium condition.

Former scholars analyzed different aspects of product pricing. E.g., Cheng & Tang 2010 have shown that it could be beneficial to offer a product for free to boost the sales of a different product. Recent papers analyst problems with multiproduct pricing (Nosrat et al. (2021) and Qi et al. (2020)).

The objectives of this thesis are to:

- review and systematically summarize the literature on product pricing with network effects,
- highlight and explain one or two state-of-the-art pricing models with an example from practice,
- provide open research gaps and future trends and
- implement one pricing model (optional).

Basic Literature:

Cheng, H. K., & Tang, Q. C. (2010). Free trial or no free trial: Optimal software product design with network effects. European Journal of Operational Research, 205(2), 437–447. https://doi.org/10.1016/j.ejor.2010.01.014

Nosrat, F., Cooper, W. L., & Wang, Z. (2021). Pricing for a product with network effects and mixed logit demand. Naval Research Logistics (NRL), 68(2), 159–182. https://doi.org/10.1002/nav.21943

Qi, W., Liu, X., Luo, X., & Zhang, Z.-L. (2020). Product Line Optimization Considering Network Effects. IEEE Systems Journal, 1–11. https://doi.org/10.1109/JSYST.2020.3035093

Topic S05: Discrete choice estimation in travel and tourism using virtual reality

The choice between different transport modes for a trip can be characterized as a discrete choice situation, as the best travel option is selected by customers. These decisions can be modelled with discrete choice models; their most prominent functional specification is the multinomial choice model (MNL). An underlying assumption of the models is the possible decomposition of the product or service in attributes with different levels, where each attribute level is connected to a particular partial utility.

Datasets for choice estimation are created by choice tasks in which the preferred alternative has to be identified. Traditionally, these alternatives are represented by a specification of chosen attribute levels in text format. Recently, the emergence of virtual reality has also been used in choice model experiments by modeling a visualization of alternatives. While these options do provide various possibilities for stated preference experiments or even the direct sale channel during the booking process, they have not been used in many studies or sales channels of travel & tourism.

The objectives of this thesis are to:

- to briefly introduce the MNL and similar discrete choice models;
- to provide an overview of empirical studies measuring the utility choice behavior of travel & tourism;
- to discuss the use of virtual reality for travel & tourism applications; and
- to provide open research gaps and future trends in the intersection of discrete choice, travel, and tourism.

Basic Literature:

Dijkstra, J., Van Leeuwen, J., & Timmermans, H. (2003): Evaluating design alternatives using conjoint experiments in virtual reality. Environment and Planning B: Planning and Design, 30(3), 357-367.

Garrow, L. (2010): Discrete choice modelling and air travel demand: Theory and applications. Farnham, Surrey; Burlington, Vt.: Ashgate.

Kemperman, A. (2021): A review of research into discrete choice experiments in tourism: Launching the Annals of Tourism Research Curated Collection on Discrete Choice Experiments in Tourism. Annals of Tourism Research, 87, 103-137.

Mokas, I., Lizin, S., Brijs, T., Witters, N., & Malina, R. (2021): Can immersive virtual reality increase respondents' certainty in discrete choice experiments? A comparison with traditional presentation formats. Journal of Environmental Economics and Management, 109, 102-509.

Topic S06: Integrated airline crew scheduling

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.

Integrated crew scheduling is the idea of combining both crew scheduling problems again to achieve a lower overall cost and to consider employee preferences earlier. These models are challenged by the large problem size due to the combinatorial nature of the problem; multiple solution techniques have been identified such as improvements of column generation, colony ant optimization or genetic algorithms to name a few.

The objectives of this thesis are to:

- introduce the crew scheduling problem and the disadvantage of the sequential approach,
- summarize integrated crew scheduling models
- to discuss a specific integrated crew scheduling in detail,
- to provide open research gaps and future trends.

Basic Literature:

Barnhart, C., Cohn, A. M., Johnson, E. L., Klabjan, D., Nemhauser, G. L., & Vance, P. H. (2003): Airline crew scheduling. In Handbook of transportation science (pp. 517-560). Springer, Boston, MA.

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.

Lin, D. Y., & Tsai, M. R. (2019): Integrated crew scheduling and roster problem for trainmasters of passenger railway transportation. IEEE Access, 7, 27362-27375.

Zeighami, V., & Soumis, F. (2019): Combining Benders' Decomposition and Column Generation for Integrated Crew Pairing and Personalized Crew Assignment Problems. Transportation Science, 53(5), 1479-1499.

Topic S07: Should companies introduce new models of products or avoid technological obsolescence?

In light of several recent developments, companies are forced to rethink their product design approaches. One of the most pressing developments is the increase of environmental challenges. This development has an impact on individuals and their preferences, which translates to changes in customer demand for products. Hence, companies are forced to review their product design strategies in order to not fall behind.

During product design, many decisions have to be made that affect both, the economic as well as the environmental performance of the respective product. One of the decisions is regarding "physical obsolescence" of the product, i.e., what the referred death date of the product should be (e.g., after 2 years in use). More specifically, the relevant question is how durable the product should be.

The objectives of this thesis are to:

- briefly introduce the topic of physical obsolescence and, if applicable, different types of physical obsolescence;
- briefly review the industries, where physical obsolescence most likely seems to appear.
- briefly discuss potential consequences of physical obsolescence for the environment.
- propose, how physical obsolescence could be modelled in a product line design model in a two-period setting (see, for example, Bulow 1986). For an exemplary product line design model, see Schön (2010).

Basic Literature:

Bulow, J. (1986). An economic theory of planned obsolescence. The Quarterly Journal of Economics, 101(4), 729-749.

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

Slade, G. (2009). Made to break: Technology and obsolescence in America. Harvard University Press.

Wang, R., Ke, C., & Cui, S. (2021). Product price, quality, and service decisions under consumer choice models. Manufacturing & Service Operations Management.

Topic S08: Should companies aim for more durable products or practice physical obsolescence?

In light of several recent developments, companies are forced to rethink their product design approaches. One of the most pressing developments is the increase of environmental challenges. This development has an impact on individuals and their preferences, which translates to changes in customer demand for products. Hence, companies are forced to review their product design strategies in order to not fall behind.

During product design, many decisions have to be made that affect both, the economic as well as the environmental performance of the respective product. One of the decisions is regarding "physical obsolescence" of the product, i.e., what the referred death date of the product should be (e.g., after 2 years in use). More specifically, the relevant question is how durable the product should be.

The objectives of this thesis are to:

- briefly introduce the topic of physical obsolescence and, if applicable, different types of physical obsolescence;
- briefly review the industries, where physical obsolescence most likely seems to appear;
- briefly discuss potential consequences of physical obsolescence for the environment;
- propose, how physical obsolescence could be modelled in a product line design model in a two-period setting (see, for example, Bulow 1986). For an exemplary product line design model, see Schön (2010).

Basic literature:

Bulow, J. (1986). An economic theory of planned obsolescence. The Quarterly Journal of Economics, 101(4), 729-749.

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

Slade, G. (2009). Made to break: Technology and obsolescence in America. Harvard University Press.

Wang, R., Ke, C., & Cui, S. (2021). Product price, quality, and service decisions under consumer choice models. Manufacturing & Service Operations Management.

Topic S09: Conventional discrete choice models and two-stage choice models

Choice models are widely used in different fields for capturing people's choice behavior. Random Utility Maximization (RUM) models are among the most famous ones. In RUM models, customers are assumed to be entirely rational and choose the product that maximizes their utility (Train 2009). Multinomial logit model, mixed multinomial logit model, etc. are among the RUM models. The limitations of RUMs, such as the requirement to satisfy the regularity rule and sometimes the Independence of Irrelevant Attributes (IIA), have led to their inability to accurately model people's behavior and contextual effects. Two-stage or consideration set-based choice models have gained more attention because of their ability to overcome previously mentioned limitations. In these models, at the first stage, people construct a consideration set, which is a subset of the offered set, and it will be done based on people's partial rationality and lack of knowledge. In this step, the uncertainty about utilities is not resolved, and people use some heuristics to construct the consideration set. By assuming partial rationality, consideration-based choice models are removed from RUM models. Then, in the second step, individuals are regarded as rational and choose the most desirable alternative from the consideration set.

The objectives of this thesis are to:

- review and systematically summarize the literature on two-stage choice models,
- review the literature regarding the way consideration sets are constructed and how choice behavior is mathematically described,
- discuss the integration of consideration set-based choice models in product line selection optimization problem as an application (optional).

Basic Literature:

Ahumada, A., & Ülkü, L. (2018): Luce rule with limited consideration. Mathematical Social Sciences, 93, 52-56.

Echenique, F., & Saito, K. (2019): General luce model. Economic Theory, 68(4), 811- 826.

Hauser, J. R. (2014): Consideration-set heuristics. Journal of Business Research, 67(8), 1688-1699.

Train, K. E. (2009): "Discrete Choice Methods with Simulation", Cambridge, Second Edition. The book can be downloaded from http://eml.berkeley.edu/books/choice2.html

Wang, R. (2021): The Threshold Effects on Consumer Choice and Pricing Decisions. Available at SSRN 3765711.

Topic S10: Product line design and selection problem

Nowadays, designing product lines is among the most critical strategic decisions of firms and industries in this competitive era. On the one hand, a firm's success and survival depend on customer satisfaction, and consumers often have heterogeneous preferences and tastes. So, only by offering a sufficiently differentiated product portfolio, different customer needs can be satisfied. On the other hand, implementing or changing the product line could be too costly.

Deterministic and probabilistic choice models are two categories of choice models used in literature to model customer behavior. The problem of finding the optimal product line is mostly difficult and intractable for real-sized problems. Bertsimas and Mišić (2019) developed a novel solution algorithm, based on Bender's decomposition, to solve the problem efficiently under first-choice rule and Belloni et al., (2008) has made a complete review on heuristic methods. In term of probabilistic models, Chen and Hausman (2000) analyzed the product line, and price selection (PLPS) problem when consumer choice behavior is given by a single-segment aggregated MNL model and lower and upper bounds restrict product line length. The authors show that the problem can be solved efficiently by standard convex or fractional programming methods. In the case of heterogeneous consumer preferences, the discrete finite mixture MNL model might be empirically more adequate to represent customer choice behavior. However, the resulting product line and price selection problem under MMNL choice is NP-hard (Bront et al. (2009) for the uncon- strained case), and only under assumptions (such as personalized pricing) efficiently solvable (Schön 2010). Steiner & Hruschka (2000) and Kraus & Yano (2003) are other examples of product line de- sign/selection problems under probabilistic choice models, using heuristic methods to solve the problem.

The objectives of this thesis are to:

- review the PLD/PLS literature and provide a meaningful classification regarding type of the choice model, underlying assumptions, problem formulations, and solution methods,
- discuss instance sizes that are solvable and typical running times under different algorithms,
- discuss one of the solution methods with more details, for example, the Benders decomposition in Bertsimas and Mišić (2019).

Basic Literature:

Belloni, A., Freund, R., Selove, M., & Simester, D. (2008): Optimizing product line designs: Efficient methods and comparisons. Management Science, 54(9), 1544-1552.

Bertsimas, D., & Mišić, V. V. (2019): Exact first-choice product line optimization. Operations Research, 67(3), 651-670.

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

Kraus, U. G., & Yano, C. A. (2003): Product line selection and pricing under a share-of-surplus choice model. European Journal of Operational Research, 150(3), 653-671.

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

Steiner, W. J., & Hruschka, H. (2000): A probabilistic one-step approach to the optimal product line design problem using conjoint and cost data. Review of Marketing Science Working Paper, 441.