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Bachelorarbeitsthemen - BWL

FSS 2025

1. **Virtual waiting in service operations**

   The concept of virtual waiting is used in airports, amusement parks, call centers. After the registration at arrival, the customer can leave the queue and does not have to wait in line. The customer returns to the queue at a specified point in time. The advantage for the customers is that they can use their time more effectively.

   The objective of the thesis is to give an overview over such virtual waiting options in service operations based on literature or business applications. Possible applications of this concept have to be described in detail. The specific assumptions and rules of the virtual waiting system should be described, compared with each other, and critically assessed.

   Literature: De Lange et al. (2013)

2. **Applications of queueing systems with impatient clients in service operations**

   Queueing systems are used in various service systems, such as call centres, health care, emergency services, and repair facilities. In many of these service systems, customers leave the queue before being served (e.g. abandonment or balking) due to a lack of patience. However, different applications result in different queueing models, since some applications have specific characteristics that should be modeled (e.g. limited waiting room due to COVID-19 regulations).

   The goal of the thesis is to conduct a literature review and compare different real world applications for queueing systems. Existing literature should be critically assessed and compared with respect to characteristics of considered application areas. Moreover, the impact of impatience and the resulting managerial insights should be discussed extensively.

   Literature: Koole and Mandelbaum (2002)

3. **Impact of customer behavior on call center capacity**

   The interaction between a company and its customers has a significant impact on a company reputation. Therefore, call centers are of high importance as the first point of contact for customers. If a call center fails to provide satisfactory service or customers are faced with long waits, customers are likely to call again later (retrial calls). These issues negatively impact call centers' profits. Therefore, call center managers have to

reduce retrials with efficient capacity decisions, without overshooting their operational costs.

The goal of the thesis is to conduct a literature review about customer behavior in call centers, and their impact on call center capacity. The existing literature on empirical impatience and retrial behavior should be critically assessed and compared with respect to the assumptions about the statistical data set, the data analysis method, and the resulting managerial insights for optimal capacity decisions.

Literature: Hu et al. (2022); Akşin et al. (2013)

4. **Design and control of healthcare operations**

   Healthcare systems throughout the world are under pressure to widen access, improve efficiency and quality of care. They strive to balance utilization with timely and high-quality care. As an example, emergency departments offer care to patients who present without prior appointment. However, nearly half of emergency departments operate at or above capacity, leading to long patient waiting times. The stochastic and time-dependent nature of arrival and handling of patients make such systems hard to analyze and optimize. Queueing theory can be used to analyze such systems under basic assumptions.

   The goal of the thesis is to conduct a literature review about stochastic healthcare operations with retrials (before or after service). Existing literature should be critically assessed and compared by describing different applications, the specific assumptions on the considered optimization problems (objective, constraints, ...). Moreover, the resulting managerial insights should be discussed extensively.

   Literature: Yom-Tov and Mandelbaum (2014); Keskinocak and Savva (2020)

5. **Optimal design of liquefied natural gas terminals**

   In the current environment of rising energy prices and demand from rapidly growing economies, maintaining a stable and reliable energy supply is crucial. However, limited new discoveries and investments from the supply side have led to tight, volatile, and unpredictable energy markets. Importing liquefied natural gas (LNG) offers a solution. LNG is natural gas cooled to -162°C, transforming it into a liquid, reducing its volume by approximately 600 times and facilitating easier and more cost-effective storage and transportation across long distances. Additionally, LNG is a cleaner alternative to other fossil fuels, significantly lowering carbon emissions. Therefore, the design and operation of LNG terminals, where LNG is received and re-gasified, are vital for effective operations.

   The goal of the thesis is to conduct a literature review about the design and operation of LNG terminals. The importance of LNG terminals and the key differences of LNG to alternative energy resources has to be discussed. Existing literature should be critically assessed and compared by describing the specific assumptions, modelling of uncertainties (e.g. price uncertainty), and optimization problems (objective, constraints, ...). Moreover, the resulting managerial insights should be discussed extensively.

   Literature: Lai et al. (2011); Özelkan et al. (2008)

6. **An Overview on the Games Used for Teaching Operations Management**

   Using simulated games has been proven to be one of the most effective ways when it comes to teaching operations management. In most of these games, practice decision making in practical but simulated situations.

   The goal of this bachelor thesis is to provide an overview of the research papers proposing manufacturing related games for teaching operations management. The student must classify the games based on the decision problem behind them and explain them in detail providing insights into how much effort it takes for them to be implemented in a real class. A critical assessment of the games and their practical relevance concludes this thesis.

   Literature: Lewis and Maylor (2007)

7. **Application of time-dependent queueing in health care facilities and emergency departments**

   Various service industries face time-dependent arrivals. In addition, the total number of available servers and hence the total processing capacity can be also be time-dependent.

   The goal of this thesis is to provide a comprehensive overview of the recent publications on the application of time-dependent queueing systems in service systems in health-care facilities and emergency departments. The reviewed articles must be classified based on their assumptions, application area, performance evaluation measures, and assumptions on the optimization problem (if applicable), i.e., input data, decisions, objective functions, etc. The thesis must also provide an overview of the managerial insights mentioned in the reviewed research papers. A critical assessment of the literature and suggestions for future research concludes this thesis.

   Literature: Schwarz et al. (2016); Andersen et al. (2019)

8. **Emergency Department Staffing**

   In staffing problems, decision makers try to determine the optimal number of staff to employ during a certain time period. In deterministic scenarios, optimal staffing levels can often be determined accurately. However, if the underlying system exhibits stochastic behavior, e.g., uncertainty in customer arrivals or service times, the task of staffing becomes more complex. This is especially relevant in emergency departments. In case of unexpected high demand, low staffing levels can lead to long waiting times and low quality of service. On the other hand, high staffing levels can be costly. An important question is which goal to pursue in such optimization problems, e.g., whether to minimize expected costs, minimize the probability of delay, or other performance measures. Also, different constraints could be imposed on the solution.

   This thesis should provide an overview of the literature regarding the optimization of staffing in emergency departments. The underlying problems should be classified based on the underlying model assumptions. The utilized objective function(s) and constraints should be explained in detail. Moreover, the optimization problems must be classified with respect to the dimensions of the variability cube (Stolletz and Tan, 2024). A critical assessment of the presented literature concludes this thesis.

   Literature: de Vericourt and Jennings (2011)

9. **Shift Scheduling: Prescriptive Analysis for Fair Schedules**

   When doing workforce planning, managers are often confronted with different challenges. Besides creating feasible schedules, fairness considerations are relevant. Employees want to be treated in a fair manner - but as fairness can be a subjective topic, the question is which objective to pursue. Some basic intuition could be: Treating all employees the same. But this might be neither feasible nor optimal nor desired by the employees. Another base policy could be to ask employees to rate shifts (a lower rating thereby indicating a higher preference), and then minimizing the sum of assigned preferences ratings. This could lead to situations in which many employees get their highest preference, while few others get a very low preference. Thus, the literature regarding scheduling considers a variety of measures and objectives to incorporate fairness into their models.

   This thesis analyzes an optimization model incorporating fairness aspects into the shift scheduling of physicians. The mixed-integer linear programming model (MIP) proposed by Stolletz and Brunner (2012) should be described and briefly positioned within the existing body of literature. The model will be implemented using an optimization tool (student's choice) such as Python's DoCPLEX, GAMS, or AMPL. A sensitivity analysis will be conducted, focusing on parameters like minimum and maximum shift length to assess their impact on optimal shift scheduling and provide managerial insights into shift scheduling under fairness considerations.

   Literature: Stolletz and Brunner (2012)

   Prerequisite: Familiarity with mixed integer programming model implementation on platforms such as Python-docplex, GAMS, AMPL, etc.

10. **Quality Issues in Batch Production**

    In many production setting, machines have to be set up before the actual production can start, incurring setup costs and reducing the effective production time. Producing products in batches (lots) rather than single units is in many cases a cost effective method, especially when the planning horizon consists of multiple periods. The classical lot-sizing problem needs to be extended when quality problems in production have to be considered. For example, not all produced units can be sold at full price due to quality issues, and rework might be necessary to sell them, or the products have to be disposed.

    This thesis should provide an overview of the literature regarding the topic of quality control when deciding about the size of production lots in the lot-sizing model. The underlying problems should be classified based on the underlying model assumptions and the utilized objective function(s) and constraints should be explained. Thereby, the assumptions about quality made in the literature should be discussed in detail. Moreover, the optimization problems must be classified with respect to the dimensions of the variability cube (Stolletz and Tan, 2024). A critical assessment of the presented literature concludes this thesis.

    Literature: Metzker et al. (2023)

11. **Circular Economy Lot-Sizing Problems**

    To reduce resource consumption and emissions, many countries are increasingly focusing on the concept of a circular economy, i.e., an economy in which products are not scraped after their use phase, but re-used. E.g., single components or raw materials can be extracted from smartphones, or full products could be refurbished and sold (at a discount). The use of old products can be considered as a production capacity, which has to be integrated into the production planning of manufacturers. For those companies, remanufacturing can also help to reduce costs, as raw material consumption can be decreased, but also comes with additional costs, such as sorting products by their quality. Furthermore, different products can share the same base components, so called parts commonality, increasing the flexibility of the production system. E.g., returned units of product A can be scrapped, and some components can be used to manufacture products of type B. Authors as Ji et al. (2016) consider such capacitated lot-sizing problems with remanufacturing options and parts commonality, assuming that all parameters are known in advance, i.e., that the problem is deterministic. In cases of, e.g., contracts between vendors and OEMs, this can be a reasonable assumption.

    The thesis should provide an overview of the literature regarding the topic of deterministic capacitated lot-sizing problems with a remanufacturing option with parts commonality. The underlying problems should be classified based on the underlying model assumptions. The utilized objective function(s) and constraints should be explained in detail. Moreover, the optimization problems must be classified with respect to the dimensions of the variability cube (Stolletz and Tan, 2024). A critical assessment of the presented literature concludes this thesis.

    Literature: Ji et al. (2016)

12. **Timing the Market - Self-scheduling in Energy Generation**

    Electricity is often traded at spot markets. The price that an energy producer receives at these spot markets for each kWh generated, is highly time-dependent and stochastic, i.e., it depends on the time of the day/season, and the exact price cannot be determined beforehand. Energy producers face the challenge of so-called self-scheduling, i.e., to decide on the optimal time-dependent volumes of electricity generation in order to maximize their profit or to minimize their costs. Furthermore, there are various constraints: Long-term contracts, daily demand, ramp-up times of power units, unknown or restricted capacities, etc. This is especially relevant in case of renewable energy, such as wind energy, where volumes are uncertain, or hydro power, where the power output in a given hour influences the output in another.

    The thesis should provide an overview of optimization problems dealing with self-scheduling in power generation. The underlying objectives and constraints should be explained in detail. Furthermore, the presented models should be classified based on their assumptions and critically assessed. The variability discussed in these papers should also be classified, according to Stolletz and Tan (2024).

    Literature: Varkani et al. (2011); Stolletz and Tan (2024)

13. **Sustainable Production in Closed-Loop Supply Chains with Remanufacturing**

    Manufacturers that produce different products often have some shared capacity across these products (machines, staff, etc.), limiting the number of manufactured products per period. In many cases, product-specific setups have to conducted before production can start. To satisfy demand and minimize inventory and setup costs, managers have to decide about when to manufacture which product. Classical models assume that demand has to be satisfied by newly manufactured products. However, due to sustainability and cost considerations, manufacturers increasingly incorporate the remanufacturing of old products into their production process. Customers might return used product, which then can be remanufactured.

    This thesis analyzes a lot-sizing model with product returns and remanufacturing. The mixed-integer linear programming model (MIP) proposed by Sahling (2013) should be described and briefly positioned within the existing body of literature. The model will be implemented using an optimization tool (student's choice) such as Python's DoCPLEX, GAMS, or AMPL. A sensitivity analysis will be conducted, focusing on parameters like the number of returned items and demand for the different products to assess their impact on closed-loop supply chains and provide managerial insights into sustainable manufacturing.

    Literature: Sahling (2013)

    Prerequisite: Familiarity with mixed integer programming model implementation on platforms such as Python-docplex, GAMS, AMPL, etc.

14. **Integrating Machine Learning and Optimization for Lot Sizing under Yield Uncertainty**

    In modern manufacturing systems, especially in high-tech industries like semiconductor production, yield uncertainty presents a significant challenge in production planning. The proportion of good-quality items (yield) resulting from a production process is often random and influenced by a large number of observable features, such as process settings, environmental conditions, or material properties. This uncertainty complicates the task of deciding how much to produce in order to meet demand while minimizing costly overproduction or shortages. As manufacturing environments become increasingly complex and data-rich, combining traditional optimization methods with modern machine learning techniques offers a promising avenue for developing robust, data-driven decision-making frameworks.

    In this thesis, students will conduct a literature review on data-driven inventory and lot sizing models under yield uncertainty and time dependent demand. The existing literature should be critically assessed and systematically classified based on the proposed methodologies and the specific assumptions underlying the optimization problems, such as objectives, constraints, and other modelling considerations. Particular attention should be given to the assumptions related to lot sizing, which must be discussed in detail. Furthermore, recent studies that integrate predictive models into lot sizing and planning under uncertainty should be thoroughly examined.

    Literature: Bibak and Karaesmen (2025), Ban and Rudin (2019)

15. **Rational retrial queues: models, applications, insights**

Queueing systems are used in various service systems, such as call centres, health care, emergency services, and repair facilities. In many of these service systems, customers may not be able to enter the system due to insufficient system capacity (blocking). Moreover, these blocked users may re-enter the system at a later time point. Queueing literature usually assume that customer behaviour is exogenous (following a predetermined behaviour) and focus on performance evaluation of the system. Rational queueing theory on the other hand studies the strategic behaviour of customers and operators in queueing systems. By analyzing a queueing system from a game-theoretic perspective, one can gain interesting and applicable operational insights.

The goal of the thesis is to give an overview about rational retrial queues, i.e. rational queues that incorporate retrials. Existing literature should be critically assessed and compared by describing different models, applications, specific characteristics, and resulting optimization models (objective, constraints, ...). Moreover, the impact of different strategic behaviour and the resulting managerial insights should be discussed extensively.

Literature: Kerner and Shmuel-Bittner (2020); Cui et al. (2019)

Literatur

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