

Bachelorarbeitsthemen - BWL

FSS 2023

1. Cutoff service levels in operations management

The management of operations in warehousing, transportation and manufacturing is driven by service levels with respect to on-time delivery. In service level agreements, typically, so-called cutoff service levels (also known as Next Scheduled Deadline (NSD)) are widely used in industry and retail operations. For example, based on a cut-off time and a deadline, a certain target percentage of orders received until the cut-off time have to be processed until the deadline.

The objective of this thesis is to provide an overview of planning models that consider cutoff service levels used in logistics and manufacturing. The student is expected to describe the assumptions of respective evaluation models and optimization models from the literature.

Literature: Doerr and Gue (2013), Çeven and Gue (2015)

2. Characteristics and applications of retrial queues

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, impatient users may join the system at a later time point again (retrials). Moreover, assumed distributions and specific characteristics of the queueing model depend on the specific applications. For example, time-dependent arrivals are observed in airport security lines.

The goal of the thesis is to conduct a literature review about retrial queues. Existing literature should be critically assessed and compared by describing different applications, specific characteristics, and resulting optimization models (objective, constraints, ...). Moreover, utilized problem sets for different applications should be reviewed and described.

Literature: Aguir et al. (2008); Tran-Gia and Mandjes (1997)

3. 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)

4. **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 and focus on performance evaluation of the system. However, in classical queueing theory, one assumes that customers follow a predetermined behaviour. 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)

5. **Assessing Emergency Capacity in Healthcare**

Hospital emergency departments are obligated to stabilize and treat incoming patients who have immediate or life-threatening illness or injury, regardless of the impact on hospital operations. However, bed shortages often occur, which can compromise the ability of hospitals to adequately accommodate emergency patients. Healthcare planners have to plan for bed availability to manage demand changes and surges. This is a particular challenge in times of increasing urbanization, rising numbers of natural disasters and pandemics. Decision makers rely on various bed shortage metrics to plan bed utilization and ensure quality patient care.

This Bachelor topic is intended to provide a comprehensive and detailed overview of the latest bed shortages metrics based on the basic paper. The different metrics should be compared, analyzed and the respective advantages and disadvantages identified.

Literature: Xie et al. (2022)

6. **The newsvendor problem under consideration of risk**

A classical and crucial building block of stochastic inventory theory is the newsvendor

problem. In this problem, a newsvendor decides how much to stock of a perishable product, e.g. a newspaper, for a single selling period, facing random demand. If the actual demand exceeds inventory, the vendor suffers lost revenue, while in the contrary case, disposal or holding costs are incurred. The objective function is generally to either maximize expected profit or minimize expected cost. However, this is often insufficient if the decision maker is risk averse, i.e., concerned about the accumulation of the risk effects and high demand uncertainty.

This topic is intended to provide a comprehensive and topical overview of the newsvendor problem considering risk based on the model provided by Gotoh and Takano (2007). The different formulations and variants should be compared, analyzed and the respective advantages and disadvantages identified. Elaborating on research gaps is also an important part of the thesis.

Literature: Gotoh and Takano (2007)

7. Lifeline infrastructures under disruptions

Disruptions within lifeline systems such as energy, healthcare or water supply can have far-reaching impact on societies. Lifeline systems are often considered as a network consisting of nodes and arcs, where nodes can represent components or actors, e.g. power plants or hospitals, and arcs can represent connections between node pairs for conveying service flows. In order to be better prepared for disruptions caused by natural disasters or unexpected accidents, it is of utmost importance to identify and strengthen the most critical nodes of the network. This can be done by an optimization problem that involves finding the set of nodes whose deletion maximally degrades network connectivity, i.e., causes maximum disruption.

This topic focuses on the challenges of securing lifeline networks by identifying their critical nodes. The critical node detection model proposed by Ventresca et al. (2018) as an integer optimization model, should be analyzed, implemented and critically evaluated on the basis of an own chosen example. Knowledge of a standard optimization solver such as Gurobi or Cplex is required to implement the model and perform sensitivity analyses.

Literature: Ventresca et al. (2018)

8. Literature review on queues with various service disciplines

In service operations, usually, customers in a queue are served in a first-come-first-serve (FCFS) order. However, in production systems, the sequence of the items being processed is less restricted and managers can choose sequencing methods that fit their operation best.

Despite service rules such as shortest-processing-time-first (SPT) being capable of drastically reducing waiting times in many settings, there has been comparatively fewer studies focusing on analyzing them and most of the literature on queues considers FCFS as the default setting.

The objective of this project is reviewing the studies that analyze queues controlled with various service disciplines. One of the aims of the project is comparing the available studies in terms of their assumptions and the managerial insights they derive. The main service disciplines of interest are service-in-random-order (SIRO), last-come-first-serve (LCFS), shortest-processing-time-first (SPT) and longest-processing-time-

first (LPT). However, other commonly used or newly developed service disciplines are in the scope of the project as well.

Literature: Mönch et al. (2012), Hyytiä et al. (2011)

9. Literature review on dynamic-stochastic production networks

Often in production systems, a part has to go through various machines for its production to complete. Also, depending on specifics of each part, it might need to visit different machines than other parts in the system. For these reasons, networks of queues can be a good mathematical device for modelling production systems with uncertainty.

Given that in practice, many of these systems involve time-dependent processes, e.g. due to production capacity being driven by the availability of workers which is not uniform during all hours of a day, there is a need for analysis of time-dependent queueing networks.

Given this background, the aim of this project is reviewing the literature about the analysis of time-dependent queueing networks, specially with a focus on identifying the specifics and assumptions of the models related to each application and the managerial insights derived for them.

Literature: Van Brummelen et al. (2018), Kopats and Matalytski (2020)

10. Application of machine learning in production control

The recent success of machine learning methods in various fields has motivated many studies that investigate the application of machine learning in operations management. More specifically, in the area of production control, there has been attempts at using the tools developed for standard machine learning problems for optimizing various aspects of production systems.

In this project, the main aim is preparing a comprehensive review of the literature on the application of machine learning in production control that categorizes the applications, places the solution methods in the already defined machine learning categories e.g. supervised/unsupervised, classification/regression and identifies the possible application areas that have not been explored.

Literature: Li and Olafsson (2005), Priore et al. (2001)

11. Dynamic and stochastic service systems in airport terminals

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 airport terminals, such as check-in counters, security checks, departure lounges, and baggage claim facilities. 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); Rodríguez-Sanz et al. (2021)

12. **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)

13. **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)

14. **Personnel Scheduling with Full-Time and Part-Time Employees**

Personnel Scheduling is an important task in various industries such as service, health care and logistics. On an operational level the workforce needs to be scheduled efficiently, while on a strategic level, decisions about how many workers should be employed to cope with the expected demand are made. This becomes particularly interesting, when a heterogenous workforce, i.e., full- and part-time employees, perhaps with different wage rates and proficiencies, is considered.

The aim of this thesis is to give an overview on the optimization models considering full- and part-time employees in personnel scheduling problems. The student is expected to classify the papers based on their underlying optimization problems, i.e. the assumptions, input data, decisions, objective(s) and constraints. Further, the managerial insights gained from the papers should be discussed.

Literature: Eitzen et al. (2004)

15. **Shift Design for Efficient Personnel Scheduling in Hospitals**

While there is a recent trend towards flexibility of working times, there are still many

industries where demand needs to be met at a certain time. E.g. in hospitals, it needs to be ensured that there are enough doctors and nurses to care for the patients at any time of the day. Therefore, the employees need to be told when to start/end work each day. The problem of deciding on a set of shifts to use for scheduling the employees such that the demand is covered in each time period of the working day is called shift design (or shift scheduling).

The aim of this thesis is to give an overview on current methods and regulations of shift design in hospitals. In a second step, the student is expected to classify the papers based on the underlying aim and the constraints taken into consideration. Further, the managerial insights gained from the papers should be discussed.

Literature: Nilssen et al. (2010)

16. Efficiency in Personnel Scheduling - Meeting the Required Staffing Level

Personnel scheduling has a major impact on (cost) efficiency in many industries. In particular, the service sector such as health, transport, call centers and the retail trade heavily rely on an efficiently scheduled workforce. A possible aim when creating a schedule is to neither have more nor less employees scheduled than needed in each period of the planning horizon. However, this problem of staffing is faced by constant challenges e.g. seasonality (time-dependent variability) or the number of sick-leaves of scheduled employees (stochastic variability).

The aim of this thesis is to provide a literature overview on the optimization models aiming to minimize the amount of over- and/or understaffing in personnel scheduling. The student is expected to classify the papers according to the underlying optimization problem (i.e. assumptions, objective(s), constraints), the area of application as well as the kind of variability considered. Further, the managerial insights gained from the papers should be discussed.

Literature: Alvarez (2020)

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