OPM 761 – Research Seminar Production Management

Spring Term 2026

The goal of this seminar is to introduce the participants to conduct scientific research. Thereby, it prepares the students for the writing of their Master's thesis. The seminar is geared towards students intending to write their thesis at the Chair of Production Management.

Participants will explore one of the topics listed below. They will review and critically assess the corresponding scientific literature and present their findings in a written report (18 to 22 pages) as well as in an in-class presentation (15 - 20 min + 20 min discussion). Each participant is also expected to critically assess the presentations of the other students in the ensuing discussion.

Applications will be accepted from **November 8th, 2025** until **November 22nd, 2025**. Admission to the seminar will be confirmed by e-mail at latest on November 30th, 2025 and must be reconfirmed by the participant at the kick-off meeting.

The **Kick-off meeting** will be held on **December 1st, 2025** between 12:00 and 13:30 (CET). During this meeting, an introduction to scientific writing and presentations for term papers will be given.

A brief session on introduction to Overleaf and LaTeXwill also be offered. The time and date of this session will be decided in the Kick-off meeting among the interested students.

The **written reports** have to be submitted by Monday, **March 2nd, 2026** in the following formats:

- Two-fold hard copy version.
- Electronic version including a copy of the references cited in the report and auxiliary information (tables, data, programming code, etc.).

The **presentations** will be held as a blocked session during between **9th and 13th of March 2026**. Attendance at all presentations is mandatory.

The final grade for the seminar is composed of the following components: Written report (60%), presentation (30%), and contribution to the discussion (10%).

There is a joint application process for all seminars offered by the chairs of the Area Operations Management. In the spring term 2026, this includes the following seminars:

- **OPM 741:** Applied Seminar Supply Chain Management
  Chair of Logistics and Supply Chain Management, Prof. Dr. Moritz Fleischmann
  (Topics labeled with "L"),
- **OPM 760:** Project Seminar Operations Analytics,
  Chair of Production Management, Prof. Dr. Raik Stolletz
  (Topics labeled with "P"),
- **OPM 761:** Research Seminar Production Management,
  Chair of Production Management, Prof. Dr. Raik Stolletz
  (Topics labeled with "P"),

- **OPM 781:** Research Seminar Service Operations Management
  Chair of Service Operations Management, Prof. Dr. Cornelia Schön
  (Topics labeled with "S"),
- **OPM 792:** Applied Seminar Procurement
  Endowed Chair of Procurement, Prof. Dr. Christoph Bode
  (Topics labeled with "B").

Detailed information on the seminar topics and the link to the online registration tool are available on the home pages of the respective chairs. In their applications, students can indicate up to five preferred topics from all seminars.

In addition, applicants for OPM 761 must send an email with (1) CV, (2) official B.Sc. and M.Sc. grades overviews, and (3) the list of courses in the Area Operations that you are currently enrolled in to opm761@uni-mannheim.de. For any further question concerning the seminar please also contact the chair via opm761@uni-mannheim.de.

P6 – Impacts of Rework Policies on Lot-size in a Tool Manufacturing Company with Imperfect Production

Objectives: In manufacturing systems such as tool production, semiconductor, textile, and chemical industries, rework requirements are common, as production processes are rarely perfect and a certain proportion of the produced items exhibit low quality. Variability in machine performance, material properties, and human operations often results in imperfect products that must be reworked, rejected, or sold at a reduced value. The decisions regarding qualification, rejection, or rework are typically based on inspection reports generated by quality control departments. Moreover, inspection and quality assurance activities consume additional time and resources, thereby affecting overall productivity and inventory levels. Traditional Economic Order Quantity (EOQ) and Economic Production Quantity (EPQ) models, however, overlook these imperfections by assuming that all produced items are of perfect quality and that inspection activities have no time or cost implications.

The objective of this seminar thesis is to review and critically analyze the literature on lot-sizing models that incorporate imperfect production, rework, and inspection. The thesis should classify existing models according to their underlying assumptions, decision variables, and cost structures, and examine how rework and inspection affect optimal lot sizes, total costs, and, more broadly, the overall decision-making process. The concluding section should offer a critical assessment of the current state of research and highlight potential future directions, such as stochastic model extensions or applications within modern Industry 4.0 environments.

Prerequisites: Knowledge in optimization models (e.g., OPM 561, 662)

Basic Papers: Ullah and Kang (2014)

> **Abstract**: The economic order quantity and economic production quantity models are the most commonly used inventory models in production environments for the calculation of optimum lot size. However, these models are based on the unrealistic assumption that every process produces good quality products every time. Moreover, the impact of inspection is neglected in all extended inventory control models involving work in process inventory. By taking both imperfect production and lot size inspection into consideration, this paper presents a more realistic approach for the modelling of optimum lot size and total cost with a focus on the work in process inventory. A mathematical model is derived for optimum lot size based on the minimisation of the average cost. Our approach incorporates the effect of rework, rejects and inspection on work in process inventory. The significant effect of imperfect production and inspection on optimum lot size is evaluated via numerical examples. In comparison to existing models, the proposed model is a more generalised and flexible form of inventory model for independent demands.

P7 – Creating Robust Workforce Schedules under Uncertainty

Objectives: In service systems, the number of customers arriving often depends on the time of day. When creating shift schedules, managers have to consider this time-dependency in order to match supply and demand. In addition, customer demand is in most cases stochastic, i.e., the exact number of customers arriving to the system is not exactly known ex ante. If more workers are assigned than were actually (ex-post) needed, significant costs are incurred from this overstaffing. On the other hand, assigning less workers than actually needed leads to understaffing, and with it the revenues and the quality of service suffers. Some service systems are defined as flexible, e.g., such as in the base paper of Mattia et al. (2017), where two classes of employees exist, where the first class is serving customers and the second class is usually working on customer-unrelated tasks in the back office. However, they can also be used to serve customers by moving them to the front of the office where customer contact takes place. This flexibility is used in case that understaffing occurs, i.e., when the number of scheduled first class employees does not suffice to serve the actual customer demand. Robust optimization can be utilized to solve this shift scheduling problem when incorporating stochastic customer demand. Mattia et al. (2017) minimize the maximum expected costs for reallocating employees from the back office to the front office over all possible realizations of customer demand.

The goal of this seminar thesis is to provide a comprehensive overview of the recent publications on robust optimization models for personnel scheduling under uncertainty. The reviewed articles should be classified and compared according to their assumptions, objectives, and the methods used to ensure robust results. A critical assessment of the literature and suggestions for future research concludes this thesis.

Prerequisites: Knowledge in optimization models (e.g., OPM 561, 662)

Basic Papers: Mattia et al. (2017)

> **Abstract**: We study the shift scheduling problem in a multi-shift, flexible call center. Differently from previous approaches, the staffing levels ensuring the desired quality of service are considered uncertain, leading to a two-stage robust integer program with right-hand-side uncertainty. We show that, in our setting, modeling the correlation of the demands in consecutive time slots is easier than in other staffing approaches. The complexity issues of a Benders type reformulation are investigated and a branch-and-cut algorithm is devised. The approach can efficiently solve real-world problems from an Italian call center and effectively support managers decisions. In fact, we show that robust shifts have very similar costs to those evaluated by the traditional (deterministic) method while ensuring a higher level of protection against uncertainty.

P8 – Balancing Speed and Costs in Service Systems

Objectives: Queueing systems are analyzed in a multitude of context: Call centers, traffic, airports, healthcare, restaurants, and customer services in general. One lever for the performance of such a system is the service rate, i.e., how many customers per time unit can be served. The service rate can be increased by, e.g., speeding up services, simplifying processes, and on the other hand reduced by additional up- and cross-selling, or by putting more diligence into the service. A higher service rate decreases congestion, and thus waiting. However, a higher service rate can come with other costs. E.g., in the so-called quality-speed trade-off literature it can also lower the value of the service provided to the customer. Depending on the business application, literature assumes different components in the objective function, such as waiting costs, revenues depending on the service rate, costs in the service rate, etc.

The goal of this seminar thesis is to provide a detailed overview, classification, and comparison of different objective functions in the queueing literature with decisions on the service rate. The underlying motivation of the objective functions should be explained. Moreover, the optimization problems should be classified with respect to the dimensions of the variability cube (Stolletz and Tan, 2024). Relevant applications and managerial insights, as well as structural similarities and differences between the considered objective functions should be identified. A critical assessment of the literature concludes this thesis.

Prerequisites: Basic knowledge in stochastic modelling (e.g., OPM 561)

Basic Papers: Anand et al. (2011), Stolletz and Tan (2024)

> **Abstract**: In many services, the quality or value provided by the service increases with the time the service provider spends with the customer. However, longer service times also result in longer waits for customers. We term such services, in which the interaction between quality and speed is critical, as customer-intensive services. In a queueing framework, we parameterize the degree of customer intensity of the service. The service speed chosen by the service provider affects the quality of the service through its customer intensity. Customers queue for the service based on service quality, delay costs, and price. We study how a service provider facing such customers makes the optimal "quality–speed trade-off." Our results demonstrate that the customer intensity of the service is a critical driver of equilibrium price, service speed, demand, congestion in queues, and service provider revenues. Customer intensity leads to outcomes very different from those of traditional models of service rate competition. For instance, as the number of competing servers increases, the price increases, and the servers become slower.

P9 – Managing Elective Care with Two Classes of Customers

Objectives: In many service systems customers are heterogeneous. For elective care, i.e., for healthcare treatments that are neither urgent nor required, different customers could exhibit different attributes. This could be the willingness to pay, customer's patience or the desired quality. The former is directly related to the price, while the latter might be affected by the speed at which the service is conducted. In the mentioned system, managers can decide on both the price and the speed. The quality-speed literature assumes that the quality of service is increasing in the service time, i.e., the more diligence is put into serving a customer, the higher the provided value. Price and speed thus influence how many customers will join a system and seek service. The arrivals to such systems as well as the actual service times are often stochastic. Queueing models are used to describe these systems. To reflect heterogeneous customers, it can be assumed that a share q of customers is of type A, while the remaining $(1 - q)$ are of type B, or that customer's preferences are uniformly distributed over some range.

In this seminar thesis, a detailed overview, classification and comparison of the quality-speed tradeoff literature assuming heterogeneous demand in healthcare systems should be provided. Structural differences to models in which heterogeneous servers are assumed should be highlighted. Moreover, the optimization problems should be classified with respect to the dimensions of the variability cube (Stolletz and Tan, 2024).

Prerequisites: Basic knowledge in stochastic variability (e.g., OPM 561)

Basic Papers: Ni et al. (2013), Stolletz and Tan (2024)

> **Abstract**: In many customer-intensive services, the perceived quality of service decreases in the speed of service. Usually, an increase in service speed induces different marginal reductions in quality for heterogeneous customers. To bring insight into the managerial implications of this difference, we classify customers in terms of intensity parameters, and investigate the behavior of each class of customers in a queueing framework. The optimal service speed and price are derived to maximize service provider's revenue. Our results demonstrate that no class is always attractive to the provider, and thus there are usually several combinations of service price and speed reaching the same maximal revenue. Moreover, under some mild conditions, the provider could gain more revenue by treating different classes with discrimination than by adopting uniform treatment.

P10 – Overview of optimization models in call center staffing

Objectives: In many service systems, staffing drives both costs and service quality by ensuring that the right number of employees are available for various processes. A call center for example, might aim to minimize personnel cost while ensuring a certain service level. One example could be to consider the negative impacts on waiting time or customer abandonments.

The goal of this research seminar is to provide a comprehensive overview of utilized optimization models for time-dependent staffing in call centers. Existing literature should be critically assessed and compared by describing the utilized optimization models (objective, constraints, ...). Relevant trade-offs (e.g. balancing cost savings and lost sales) and managerial findings presented in literature should be presented and discussed.

Prerequisites: Knowledge in variability and optimization models (e.g. OPM 561)

Basic Paper: Defraeye and Van Nieuwenhuyse (2016); Stolletz and Tan (2024)

Abstract: Many service systems display nonstationary demand: the number of customers fluctuates over time according to a stochastic—though to some extent predictable—pattern. To safeguard the performance of such systems, adequate personnel capacity planning (i.e., determining appropriate staffing levels and/or shift schedules) is often crucial. This paper provides a state-of-the-art literature review on staffing and scheduling approaches that account for nonstationary demand. Among references published during 1991–2013, it is possible to categorize relevant contributions according to system assumptions, performance evaluation characteristics, optimization approaches and real-life application contexts. Based on their findings, the authors develop recommendations for further research.

P11 – Impact of customer behavior on call center capacity

Objectives: 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 this research seminar 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.

Prerequisites: Knowledge in variability and stochastic systems (e.g. OPM 561)

Basic Paper: Brown et al. (2005); Hu et al. (2022)

Abstract:

A call center is a service network in which agents provide telephone-based services. Customers who seek these services are delayed in tele-queues. This article summarizes an analysis of a unique record of call center operations. The data comprise a complete operational history of a small banking call center, call by call, over a full year. Taking the perspective of queueing theory, we decompose the service process into three fundamental components: arrivals, customer patience, and service durations. Each component involves different basic mathematical structures and requires a different style of statistical analysis. Some of the key empirical results are sketched, along with descriptions of the varied techniques required. Several statistical techniques are developed for analysis of the basic components. One of these techniques is a test that a point process is a Poisson process. Another involves estimation of the mean function in a nonparametric regression with lognormal errors. A new graphical technique is introduced for nonparametric hazard rate estimation with censored data. Models are developed and implemented for forecasting of Poisson arrival rates. Finally, the article surveys how the characteristics deduced from the statistical analyses form the building blocks for theoretically interesting and practically useful mathematical models for call center operations.

References

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Brown, L., Gans, N., Mandelbaum, A., Sakov, A., Shen, H., Zeltyn, S., and Zhao, L. (2005). Statistical analysis of a telephone call center: A queueing-science perspective. *Journal of the American statistical association*, 100(469):36–50.

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