University of Bremen

– **Faculty 3** –

Courses

Winter Semester 2024/2025

M.Sc. Industrial Mathematics & Data Analysis

M.Sc. Mathematics

M.Sc. Mathematik

M.Sc. Technomathematik

July 2024

This brochure summarizes almost all courses and lectures of the Master's programs Industrial Mathematics & Data Analysis, Mathematics, Mathematik (German-language), and Technomathematik (German-language) for the winter semester 2024/2025. Further information can be found in the Course Catalog of the University of Bremen. There you will find, among other things, the language, the assignments to the individual modules, and the course codes. These information and all details can also be found in Stud.IP.

As you can see in the Course Catalog or in Stud.IP, all courses are usually assigned with an area of focus or specialization. This can also be found for all courses via *Fields of study* in Stud.IP. For the M.Sc. Industrial Mathematics & Data Analysis, these are **Data Analysis** as well as **Industrial Mathematics**. For the M.Sc. Mathematics and the M.Sc. Mathematik, these are **Algebra**, **Analysis**, **Numerical Analysis**, and **Statistics/Stochastics**.

At this point we would like to refer to the Arrival Guide for general questions as well as to Offers for International Students and Living on Campus for answers regarding living, housing, financial help, and scholarships.

Contact

Academic Advisory Office - Mathematics

Place to go for questions on study programs, planning, recognition of credits and exam results, study abroad, and examination regulations. Also responsible for the design of this brochure.

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Contents

General Studies

Alphabetical ordering and the lecturers are responsible for the content of the descriptions

Advanced Topics in Image Processing – The Beauty of Variational Calculus

Course Code: 03-M-SP-39

Prof. Dr. Peter Maaß, Dr. Matthias Beckmann, Dr. Pascal Fernsel

Contact: pmaass@uni-bremen.de

Description

This lecture is motivated by basic tasks in image processing such as denoising and segmentation. These tasks can be mathematically formulated as minimization problems in a function space setting. Hence, we will start with introducing the necessary concepts of functions spaces and appropriate notions of convergence. The target of the first half of the lecture is the so-called direct method of variational calculus. We will proof the relevant theorem, which establishes the existence of a solution of such minimization problems, and – equally important – we demonstrate the failure of this approach if the analytical requirements are not satisfied. The second half of the lecture is devoted to an analysis of the famous ISTA algorithm (iterated soft thresholding algorithm) for approximating a solution of such minimization problem. At the end of the lecture we come back to applications and demonstrate the beauty of variational calculus with selected applications in image processing.

Prerequisites

Basics from B.Sc. courses in Mathematics (analysis/calculus, linear algebra, numerical analysis) and basic programming skills. All analytical concepts which are needed beyond the three semester course on analysis/calculus of the Bachelor program will be introduced.

Area of Specialization

- Data Analysis
- Industrial Mathematics
- Numerical Analysis

Structure

The course, comprising 4+2 hours per week, is split into a lecture series (two lectures a 2h each week) and accompanying exercise classes (one class a 2h each week). Exercise sheets be assigned for homework and the students are requested to present their solutions during the exercise classes.

Examination and Formalities

It is necessary to solve the provided exercise sheets and actively participate in the exercise classes. The final exam will be in form of an oral exam after the lecture period.

List of Literature

- G. Aubert, P. Kornprobst, Mathematical Problems in Image Processing, Springer, 2. Edition, 2006
- K. Bredies, D. Lorenz, Mathematical Image Processing, Birkhäuser, 2018

Convex Analysis and Optimization

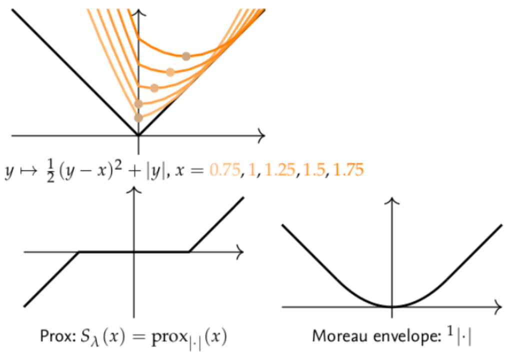
Course Code: 03-M-SP-35

Prof. Dr. Dirk Lorenz

Contact: d.lorenz@uni-bremen.de

Description

Convex analysis deals with convex sets in $\mathbb{R}^d$ and convex functions from $\mathbb{R}^d$ to $\mathbb{R}$. The notion of convexity (for sets: Lines connecting points inside a set are inside the set), may sound unspectacular at first sight, but it has numerous consequences. A very far-reaching consequence is that besides the definition from within, there is also an equivalent description from without: A set is convex if it is the intersection of all half-spaces which contain the set. Convexity is also central in optimization; just consider the basic fact that any local minimum of a convex function is necessarily global. The above mentioned duality also has implications for convex optimization as it often allows to formulate a dual problem to a given problem which can be useful for the solution of the problem. A basic example is the problem of finding the orthogonal projection of a point onto a convex set: One way to describe this is that we want to find the point inside the convex set that is closest to a given point. A dual description is that we want to find a hyperplane separation the point from the set which is farthest away from the given point. The projection can be found where this hyperplane touches the set.



In this lecture we will learn topics of convex calculus, such as separation theorems, (sub)differentiability of convex functions, convex conjugation, proximal mappings. We will learn about basic algorithms like gradient descent and the proximal point method but also about more recent developments like splitting methods and accelerations.

Prerequisites

Analysis 1 and 2, Linear Algebra 1 (specifically multivariate calculus, abstract vector spaces, matrices, linear systems)

Area of Specialization

- Data Analysis
- Industrial Mathematics
- Numerical Analysis

List of Literature

- Convex Analysis, R. Tyrrell Rockafellar, Princeton University Press, 1970
- Convex Analysis, Dirk Lorenz, Lecture Notes, https://www.tu-braunschweig.de/iaa/personal/lorenz/lehre/skripte

Finite Elements - Selected Chapters

Course Code: 03-M-SP-38

Prof. Dr. Andreas Rademacher

Contact: arademac@uni-bremen.de

Description

Finite element methods are a mathematical elegant way to discretize partial differential equations. In this lecture, various special topics are presented and discussed, whereby the specific topics are selected in consultation with the students:

- Multigrid methods
- Mixed finite element methods
- Adaptive finite element methods based on dual weighted error estimators
- Domain decomposition
- Methods for nonlinear partial differential equations
- Methods for time dependent partial differential equations (Heat and wave equation)
- Methods for contact problems
- Methods for optimal control problems

Prerequisites

You should have basic knowledge of the finite element method.

Area of Specialization

- Data Analysis
- Industrial Mathematics
- Numerical Analysis

Structure

There will be two lectures per week and an accompanying tutorial with weekly homework.

Examination and Formalities

The active participation in the exercises is expected. In the end there will be an oral exam.

List of Literature

Will be announced in the lectures.

Mathematical Concepts of Risk Management (Statistics III)

Course Code: 03-M-SP-28

Prof. Dr. Thorsten Dickhaus

Contact: dickhaus@uni-bremen.de

Description

The specific topics of the course are:

- Mathematical-statistical models of risk
- Multivariate statistical models, copula functions
- Estimation and simulation techniques
- Basics of time series models and their analysis
- Introduction to extreme value theory
- Applications (using the statistics software `R`)

The course "Statistics III" is the canonical entry point for an M. Sc. thesis in the area of specialization of (mathematical) statistics. Statistical methods are of utmost importance for all quantitative sciences, and they provide the basis for data science.

Prerequisites

No formal prerequisites, but solid knowledge in measure-theoretic probability theory and in basic concepts of mathematical statistics (estimation, testing, confidence regions, etc.) is required to understand the material.

Area of Specialization

- Data Analysis
- Statistics/Stochastics

Structure

The course consists of four hours of lecture plus two hours exercise class per week.

Examination and Formalities

Upon successful completion, 9 ECTS credit points will be awarded for this course. Solutions to exercise sheets have to be handed in on a weekly basis. The final examination will be in oral form.

List of Literature

We will mainly follow the exposition in the following textbook. McNeil, A. J., Frey, R., Embrechts, P. (2005). Quantitative risk management. Concepts, techniques, and tools. Princeton, NJ: Princeton University Press. Further literature will be mentioned and referenced at the appropriate occasions.

Mathematical Foundations of Data Analysis

Course Code: 03-M-MDAIP-1

Prof. Dr. Dirk Lorenz

Contact: d.lorenz@uni-bremen.de

Description

This lecture covers several basic methods for standard tasks in data analysis and image processing. A non-exclusive and non-exhaustive list of methods: dimension reduction, clustering, filters, frequency analysis, morphological methods... We will develop the mathematical theory that underlies these methods since this is the basis for thorough understanding and proper execution of the methods. Moreover, we will deal with the practical implementation of the methods and apply them to solve problems such as image denoising, image deblurring, or music identification.
This lecture should enable you to take a deeper dive into image and data analysis and prepares you to follow recent developments in the field. If you want to understand the inner working of image compression with JPEG or music recognition with tools like Shazam, come to this lecture!

Prerequisites

Analysis 1-2 (including limits, integration, differentiation, all multivariate, preferably also Analysis 3, namely basics in measure theory), Linear Algebra 1-2 (including abstract vector spaces, norms and inner product spaces, matrix decompositions), Numerics 1 and the ability to implement mathematical methods in software (we will use Python) are needed. Some background in Functional Analysis would be helpful.
Part I of the book "Mathematics for Machine Learning" from below covers most of the prerequisitives of the course.

Area of Specialization

- Numerical Analysis

List of Literature

- Mathematical Image Processing; Kristian Bredies and Dirk Lorenz, Birkhäuser, 2018, https://link.springer.com/book/10.1007/978-3-030-0

1458-2

- Mathematics for Machine Learning; Marc Peter Deisenroth, A. Aldo Faisal, and, Cheng Soon Ong, Cambridge University Press, 2020, https://mml-book.com.
- Foundations of Data Science; Avrim Blum, John Hopcroft, Ravindran Kannan, Cambride University Press, 2020, https://doi.org/10.1017/9781108755528 and https://home.ttic.edu/~avrim/book.pdf

Numerical Methods for Partial Differential Equations

Course Code: 03-M-NPDE-1

Prof. Dr. Alfred Schmidt

Contact: alfred.schmidt@uni-bremen.de

Description

Partial differential equations are a main component in the modelling of physical, chemical or biological phenomena in several spatial dimensions or in space and time. They also often occur in mathematical problems in geometry or calculus of variations. The lecture deals with the discretisation of partial differential equations and the estimation of the error between continuous and discrete solution. In particular, the finite element method is introduced and investigated, with special consideration of modern adaptive algorithms. We will first discuss the application of the method to stationary elliptic problems. Later also time-dependent problems will be considered. The connection of theory, numerical analysis and implementation is particularly important. Facts from the theory of partial differential equations are usually only quoted. Based on special application-oriented chapters of the lecture, the numerical algorithms are to be implemented in programming tasks under guidance.

Prerequisites

You need a good knowledge of analysis, linear algebra, and numerical mathematics. Some knowledge of functional analysis is advantageous. Programming skills in Octave/Matlab are needed for the practical exercises. A list of desirable previous knowledge is provided in Stud.IP.

Area of Specialization

- Numerical Analysis

Structure

There are two lectures and one exercise session per week. Every week an exercise sheet is published with theoretical and, if applicable, practical tasks.

Examination and Formalities

For the award of the course credit, 50% of the possible points must be achieved in both theoretical and practical exercises. After the lecture period, oral examinations take place on dates to be agreed upon.

List of Literature

Online you find several Lecture Notes on Numerical Methods for PDEs, which contain most of the subjects which will be presented in the module, for example: https://www-users.cse.umn.edu/~arnold/8445.f11/notes.pdfhttps://www.wias-berlin.de/people/john/LEHRE/NUM_PDE_FUB/num_pde_fub.pdfhttps://ocw.mit.edu/courses/16-920j-numerical-methods-for-partial-differential-equations-sma-5212-spring-2003/pages/lecture-notes/

Spectral Geometry of Hyperbolic Surfaces

Course Code: 03-M-SP-37

Dr. Claudio Meneses

Contact: meneses@math.uni-kiel.de

Description

The first part of this course will focus on introducing the spectral theory of automorphic Laplace–Beltrami operators associated to Fuchsian groups of the first kind, as well as their generalisations involving a choice of unitary representation of the latter. The course will then culminate with an overview of several relations to moduli theory and the classical theory of automorphic forms (i.e., the *Kronecker limit formulas*), in connection to the *Ray–Singer analytic torsion*, as well as the *Quillen metric* arising in index theory. This final part should be understood as an invitation to the analytic theory of moduli spaces. A detailed syllabus will be available in due time.
Please sign in into the Stud.IP group early on if you are interested in this course. You can deregister at any time.

Prerequisites

Solid mathematical knowledge in real and complex analysis to the extent of a bachelor's degree in mathematics is expected. Knowledge of the rudiments of topology and differential geometry of surfaces will be beneficial but otherwise the course will be as self-contained as possible. An effort will be made to adapt the level of discussion of background material to the previous knowledge of the participants.

Area of Specialization

- Analysis

Structure

The course consists of 4 weekly hours of lectures together with a weekly meeting (1 hour) for discussions of material. Further office hours could be scheduled by appointment. Check in Stud.IP for date and time of first meeting.

Examination and Formalities

Oral examination at the end of the term.

Advanced Communication Analysis

Course Code: 03-M-AC-22

Prof. Dr. Anke Pohl

Contact: apohl@uni-bremen.de

Description

AC Analysis is a seminar for Master's students. We discuss advanced, modern topics in the area of analysis. AC Analysis consists of a collection of standalone topics (for 1-3 participants each) that fit into a joined theme. The precise topics for Winter Semester 2024/25 will be decided upon with the participants. Suggestions are welcome! The topic can be based on recent journal articles or on textbook literature. This structure offers you the opportunity to prepare your contribution during the summer if you want. The course can serve as a basis for master theses. Please sign in into the Stud.IP group early on to facilitate organization. You can deregister at any time.

Prerequisites

Solid mathematical knowledge to the extent of a bachelor's degree in mathematics.

Area of Specialization

- Analysis

Structure

Weekly presentations of material by participants. Check in Stud.IP for date and time of first meeting.

Examination and Formalities

Presentation (ca. 70 min) of a subtopic and written report/exposition. Presentation and report are graded separately. You need to obtained passing grades in both parts. The course grade is the arithmetic mean of these two grades.

List of Literature

References will be provided via Stud.IP.

Advanced Numerical Methods for Partial Differential Equations

Course Code: 03-M-AC-28

Prof. Dr. Alfred Schmidt

Contact: alfred.schmidt@uni-bremen.de

Description

Many models from applications lead to nonlinear partial differential equations or systems of partial differential equations (PDEs). Their solution as well as aspects of optimization typically demand for numerical methods. In the winter term 2024/25 we will especially look at finite element methods for models with weak formulation of boundary conditions, in fluid dynamics, and engineering applications from milling and grinding processes.

Prerequisites

Advantageous will be a good knowledge of analysis and numerical methods, as well as some proficiency in numerical methods for partial differential equations, which is typically taught in the lectures of the same name. Especially, previous knowledge about mathematical aspects of finite element methods (FEM) will be beneficial.

Area of Specialization

- Industrial Mathematics
- Numerical Analysis

Structure

Successful conclusion of the seminar demands an oral presentation of about 60 minutes plus discussion and a written elaboration about the subject of the talk. A preliminary discussion of available subjects will be offered in the first week of the lecture period, but subjects can be assigned later, too. Just get in touch with the organizer.

Examination and Formalities

Successful conclusion of the seminar demands an oral presentation of about 60 minutes plus discussion and a written elaboration about the subject of the talk.

Exponential Families

Course Code: 03-M-AC-27

Prof. Dr. Thorsten Dickhaus

Contact: dickhaus@uni-bremen.de

Description

The specific topics of the seminar are:

- One-parameter exponential families
- Multi-parameter exponential families
- Parametrizations of exponential families
- Maximum likelihood estimation in exponential families
- Empirical Bayes estimation strategies for exponential families
- Generalized linear models based on exponential families
- Confidence intervals in exponential families, bootstrap
- Miscellaneous further topics

Prerequisites

No formal prerequisites, but solid knowledge in measure-theoretic probability theory is required to understand the material.

Area of Specialization

- Statistics/Stochastics

Structure

The seminar consists of one session (of 90 minutes length) per week.

Examination and Formalities

Upon successful completion, three to six ECTS credit points will be awarded for this seminar. The exact number of credit points depends on the study program in which the candidates are enrolled. Students are expected to work themselves into a topic, to give a talk and to write a term paper on that topic, and to participate actively in the discussions of the other presentations.

List of Literature

A list of relevant literature will be provided electronically via Stud.IP.

Geometry of Polynomials

Course Code: 03-M-AC-30

Dr. Eugenia Saorín Gómez

Contact: esaoring@uni-bremen.de

Description

The study of the geometry of univariate polynomials has roots in the pioneering work of Gauss in the early 19th century and has been advanced by numerous distinguished mathematicians over the years. Despite its long-standing history, this field continues to present intriguing challenges and notable conjectures. In the realm of polynomial geometry, the behaviour of the polynomial sequences arising in mathematical frameworks such as orthogonal polynomials, convex geometry, potential theory, and the theory of entire functions or random matrices. Polynomials can be viewed in various ways, such as functions, by studying their coefficients, and by analyzing their roots. The unique aspect of polynomial geometry lies in the interplay between the perspectives of function, coefficients, and roots. As an example, hyperbolic polynomials represent a natural class where this interaction is particularly fruitful, as they exhibit log concavity as functions, their coefficients share discrete concavity properties, and their roots do not lie in specific regions in Euclidean space. The objective of this course is to explore the properties of certain families of polynomials arising from geometrical contexts. As an example, polynomials with log-concave (and log-convex) coefficients, real-rooted polynomials including real stable and hyperbolic polynomials, within the framework of combinatorial questions, geometric and probabilistic scenarios, and, eventually, algorithmic challenges. We will examine some recent significant findings and deliberate on certain unresolved issues, with the aim of participants to gain a deep understanding of these mathematical entities. The aim is for attendees to develop a strong familiarity with these concepts and establish links between the various fields under consideration.

Prerequisites

A strong foundation in mathematics, equivalent to a bachelor's degree level.

Area of Specialization

- Algebra

Structure

The seminar is conceived to take place weekly, consisting of presentations by the participants. Depending on the number of participants, the presentations by participants may be completed with presentations by the lecturer and external experts on the subject.

Examination and Formalities

The exam consists of a presentation (of about 60 min) along with a written assignment on a topic within the framework of the seminar.

List of Literature

Will be available on Stud.IP

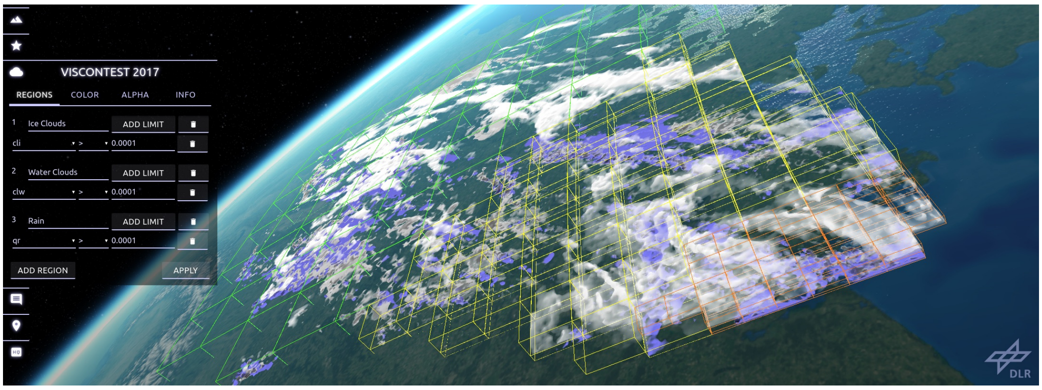
High-Performance Visualization

Selected publications from the field of
visualization of large scientific datasets

Course Code: 03-M-AC-2

Prof. Dr. Andreas Gerndt

Contact: gerndt@uni-bremen.de



Description

The seminar deals with the mathematical basics of scientific visualization and covers methods for parallel post-processing of large scientific datasets. A wide variety of scientific applications make use of such data. On the one hand, they are generated by simulations on high-performance computers (e.g., to support climate research or to predict airflow around aircraft wings). But they can also be generated by measurements e.g. by Earth observation missions. In order to obtain meaningful information for visualization, these enormously large raw data must first be processed. For a subsequent explorative analysis, real-time interactive methods are needed, which in turn rely on highly parallel and efficient approaches. The seminar therefore addresses current trends in scientific visualization. Outstanding publications by leading scientists will be selected, covering topics ranging from multi-resolution extraction of topology features to parallel acceleration methods for volume rendering in virtual working environments.

Prerequisites

The seminar is open to students from the fields of mathematics, computer science or from other relevant domains (such as geosciences or aerodynamics). Previous participation in the lecture "High-Performance Visualization" would be helpful. However, this is not a prerequisite. Knowledge in Computer Graphics or High-Performance Computing (HPC) might also be helpful.

Area of Specialization

- Data Analysis
- Industrial Mathematics
- Numerical Analysis

Times and Formalities

In the introductory session, selected publications from the field of scientific visualization will be presented. The students can then choose one of the papers. By Christmas, the underlying basic literature is to be researched. In the further course of the semester, the topic will then be prepared and a seminar paper of approximately 20 pages will be written. At the end of the semester, the papers will be presented. Depending on the number of participants, the presentations will take place in individual or block sessions. Students are expected to present the elaborated topics in 45-minute talks. The presentation and paper should preferably be in English. Seminar paper and presentation will be used for a performance evaluation. For questions and support, contact persons for the respective topics are available throughout the semester. The supervision will take place mainly online.

List of Literature

- A. C. Telea, "Data Visualization – Principles and Practice", 2. Edition, CRC Press, 2015
- E. W. Bethel, H. Childs, C. Hansen, "High Performance Visualization", CRC Press, 2013
- W. Schroeder, K. Martin, B. Lorensen, "The Visualization Toolkit", 4. Edition, Kitware, 2006

- C. Hansen, C. Johnson, "The Visualization Handbook", Elsevier Academic Press, 2005

Reading Course Algebra

Course Code: 03-M-RC-ALG

Prof. Dr. Dmitry Feichtner-Kozlov

Contact: dfk@math.uni-bremen.de

Description

Independent study of selected topics of the mathematical area algebra using monographs and research articles.
The goal of the course is to familiarize students with selected topics in the area specialization algebra via books, articles and other specialized literature. This will take place under the guidance of an independent teaching assistant in algebra and related areas (as well as geometry or topology).

Structure

Beside your self-study, there will be regular meetings to discuss the in an informal or formal manner. Also written reports are mandatory and the course may include an introduction to in-depth fundamentals. This should ideally be used to familiarize the student with topics related to a Master's thesis.
You choose your supervisor; the coordinator, Prof. Dmitry Feichtner-Kozlov will be happy to advise you. You should first discuss the topic of the reading course with the supervisor. This person should then contact the coordinator and agree on the content.

Area of Specialization

Algebra

Examination and Formalities

Successful participation will be certified upon request at the end of the Reading Course by the coordinator in consultation with the supervisor.
Please also refer to the module description in the module handbook. Supervision by a university lecturer, or a research assistant from the ALTA Institute is professionally obvious.
All further achievements (typically a written paper and a longer presentation) will be agreed upon as part of the supervision.

Reading Course Analysis

Course Code: 03-M-RC-ANA

Prof. Dr. Anke Pohl

Contact: apohl@uni-bremen.de

Description

In the Reading Course Analysis we learn an advanced, modern topic in the area of analysis. The precise topic for Summer semester 2024 will be decided upon with the participants. Suggestions are welcome! The topic can be based on recent journal articles or textbook literature. The reading course can serve as a basis for master theses. Please sign in into the Stud.IP group early on if you are interested in this reading course in order to contribute to the discussion on the topic. You can deregister at any time.

Prerequisites

Solid mathematical knowledge to the extent of a bachelor's degree in mathematics. Choice of material and level of discussion of background material will be adapted to the previous knowledge of the participants.

Strucutre

Weekly assignments of reading material, weekly meetings for discussions and presentations of material by participants. Check in Stud.IP for date and time of first meeting.

Area of Specialization

Analysis

Examination and Formalities

Active participation (reading material, presentations and discussions), written exposition of selected material

Literature

References will be provided via Stud.IP.

Reading Course Numerical Analysis

Course Code: 03-M-RC-NUM

Lecturers of the ZeTeM

Contact: bueskens@uni-bremen.de, knauer@uni-bremen.de

Description

Students study special topics of numerical analysis in this reading course. The aim is a self-study of selected topics on the basis of textbooks, scientific articles or other monographs. The course may also include an introduction into other associated topics or to special software (e.g. Alberta, WORHP). In addition, aspects of scientific work will be discussed, e.g. obtaining relevant literature, correct citation, or structure of a scientific article. All this is done under the supervision of a lecturer from the ZeTeM. In addition to the self-study, there will be regular meetings with the supervisor to discuss the topics in an informal or formal way and also written reports on a regular basis are mandatory. The topic will be discussed with the supervisor and, ideally, it is already into the direction of a future Master's thesis.

Prerequisites

Basic knowledge from a mathematical Bachelor's degree, in particular from the modules Algebra, Analysis 1-2, Linear Algebra, Numerical Analysis 1, Numerical Analysis 2, and also programming skills can be beneficial.

Structure

The lecture will be held in English.

Area of Specialization

Numerical Analysis

Examination and Formalities

Will be communicated during the lecture. Academic achievement(s): Yes For example: Regular and successful processing of exercises and active participation in the tutorial.

Literature

Depending on the topic to be worked on and independent research for suitable specialized literature.

Reading Course Statistics/Stochastics

Course Code: 03-M-RC-STS

Prof. Dr. Werner Brannath, Prof. Dr. Thorsten Dickhaus

Contact: brannath@uni-bremen.de

Description

The aim of the reading course is to introduce the students to specific topics that may be relevant for the Master's thesis, using mainly original English-language literature (scientific articles and reference books). The participants are expected to work independently (with the advice of their supervisors) on the topic, give a lecture on it and prepare an term paper. Prof. Brannath and Prof. Dickhaus will announce topics for lectures in the first meeting and Stud.IP. If you are interested in topics of other lecturers (e.g. Marc Keßeböhmer, Vanessa Didelez, Iris Pigeot or Marvin Wright), please contact these lecturers directly, ideally before our first meeting. Students can also consider their own suggestions for topics, but they must also discuss these with one of the lecturers from Stochastics or Statistics (as potential Master's thesis supervisors) best before the first meeting. The assignment of the topics as well as the scheduling of all lectures will take place in the first meeting.

Prerequisites

Subject-related prerequisites are basic knowledge of stochastics and statistics, as taught e.g. in the lectures "Stochastics" and "Basics of Mathematical Statistics" at the University of Bremen.

Structure

The Reading Course Stochastics/Statistics will take place in the form of a seminar. Dates and topics will be determined in a preliminary meeting at the beginning of the semester. The day and time of this meeting will be announced via Stud.IP, latest a week before the semester starts. Registration at Stud.IP is therefore a necessary prerequisite for participation.

Area of Specialization

Statistics/Stochastics

Examination and Formalities

See module description.

Introduction to **R**

Course Code: 03-M-GS-7

Prof. Dr. Werner Brannath, Eike Voß

Contact: brannath@uni-bremen.de, evoss@uni-bremen.de

Description

The course focuses on the basics of **R**, including its core functions and syntax, so that students can gain a comprehensive understanding of the language. It is designed for students who have a fundamental understanding of programming and a basic understanding of statistics. No prior experience with **R** is required, making this course a great starting point for those looking to learn a new (statistical) programming language. Students will learn how to conduct descriptive and exploratory data analyses by engaging in hands-on activities and practice working with real-world data sets. This practical approach helps students see the real-world applications of **R** and provides a solid foundation for further study in data analysis and programming. Whether you are a beginner looking to get started with **R** or simply looking to refresh your skills, this course is designed to help you reach your goals.

Prerequisites

Fundamental understanding of programming and basic knowledge in statistics.

List of Literature

- Introductory Statistics with R, P. Dalgaard, 2008
- R for Data Science, H. Wickham, 2017

Modelle und Mathematik

Course Code: 03-M-GS-42

Dr. Ronald Stöver

Contact: stoever@uni-bremen.de

Description

In dieser Veranstaltung werden *einfache* mathematische Modelle vorgestellt und untersucht, durch die technische oder naturwissenschaftliche Prozesse beschrieben werden. Dabei werden die in anderen Veranstaltungen (Lineare Algebra 1, Analysis 1) erworbenen Kenntnisse auf konkrete Probleme angewendet. Die Modelle werden dann mit dem Computer simuliert.
Beispiele: Wachstumsprozesse, Räuber-Beute-Modelle
Diese Veranstaltung ist keine Vorlesung sondern wird Plenumscharakter haben, deshalb ist die aktive Teilnahme der Studierenden hier besonders wichtig. Verlauf und Inhalte können richten sich nach ihren Wünschen. Der Kurs dient auch als Forum, in dem allgemeine Fragen zum Studium, zur Berufspraxis, zur Mathematik und vielem mehr gestellt und beantwortet werden können.

Prerequisites

Interesse und Motivation
Dieser Kurs richtet sich insbesondere an Erstsemester aus allen mathematischen Studiengängen (und an mathematisch Interessierte aus anderen Studiengängen), die Interesse an Modellierung und angewandter Mathematik haben.

Structure

Siehe Veranstaltungsbeschreibung.

Examination and Formalities

Es können 3 CP im Bereich General Studies (Fachergänzende Studien oder Freie Wahl) erworben werden, dafür ist die erfolgreiche Teilnahme an einer Miniklausur in der letzten LV-Woche nötig.