Karlsruhe Institute of Technology

Economathematics (M.Sc.)

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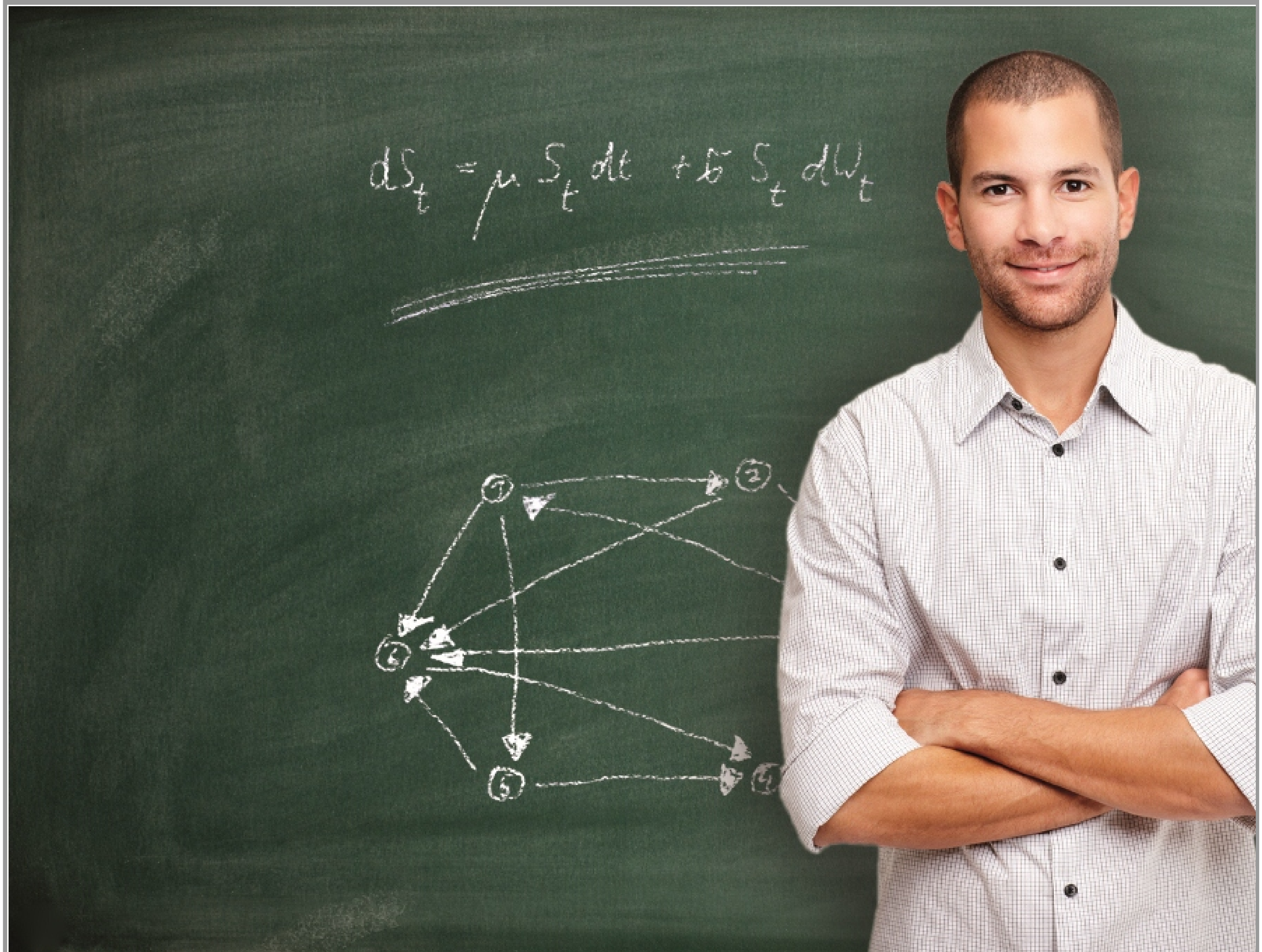
Department of Mathematics



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Fakultät für
Wirtschaftswissenschaften

Department of Economics and Business
Engineering
Karlsruhe Institute of Technology (KIT)
76128 Karlsruhe
www.wiwi.kit.edu

Fakultät für
Mathematik

Department of Mathematics
Karlsruhe Institute of Technology (KIT)
76128 Karlsruhe
www.math.kit.edu

Contact: modul@wiwi.kit.edu
daniel.hug@kit.edu

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Contents

Studienplan für den Masterstudiengang Wirtschaftsmathematik an der Universität Karlsruhe (TH)

Fakultäten für Mathematik und Wirtschaftswissenschaften
Version vom 22. März 2010

Vorbemerkung

Dieser Studienplan soll die Studien- und Prüfungsordnung des Masterstudiengangs Wirtschaftsmathematik ergänzen, erläutern und den Studierenden konkrete Beispiele zur Organisation des Studiums aufzeigen.

1 Ausbildungsziele

Der Masterstudiengang Wirtschaftsmathematik vermittelt

- die vielfältigen interdisziplinären Verzahnungen von Mathematik und Wirtschaftswissenschaften in Theorie und Praxis,
- die Fähigkeit zur mathematischen Modellbildung für wirtschaftswissenschaftliche Problemstellungen sowie zur Interpretation der mathematischen Resultate für die jeweils untersuchte Anwendung,
- fundierte Kenntnisse praxisrelevanter mathematischer Methoden in den Bereichen Stochastik und Optimierung,
- breite Kenntnisse in mathematischen und wirtschaftswissenschaftlichen Fächern sowie spezielle fachliche Vertiefungen bis hin zur aktuellen Forschung,
- die Fähigkeit zum wissenschaftlichen Arbeiten auf dem Gebiet der Wirtschaftsmathematik,
- die Fähigkeit zur Lösung von Anwendungsproblemen mit Computerhilfe,
- die Fähigkeit, sich selbständig in neue Gebiete einzuarbeiten.

2 Gliederung des Studiums

Die Lehrveranstaltungen werden in Form von Modulen abgehalten, wobei die meisten Module aus mindestens einer Vorlesung (mit oder ohne Übung) oder einem Seminar bestehen. Jedes Modul schließt mit einer Leistungskontrolle ab. Der durchschnittliche Arbeitsaufwand wird in Leistungspunkten (LP) gemessen. Im Allgemeinen werden Module benotet. Die Note geht in die Endnote ein. Die Masterarbeit besteht aus einem eigenen Modul

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mit 30 LP. Insgesamt müssen im Masterstudium 120 LP erworben werden, etwa gleichmäßig verteilt auf vier Semester.

Der Masterstudiengang Wirtschaftsmathematik basiert auf den beiden Fächern *Mathematik* und *Wirtschaftswissenschaften*, die von den jeweiligen Fakultäten angeboten werden. Es müssen Module aus beiden Fächern in dem im Folgenden beschriebenen Rahmen belegt werden.

Fach Mathematik

Es gibt die folgenden vier mathematischen Gebiete:

1. Stochastik
2. Angewandte und Numerische Mathematik/Optimierung
3. Analysis
4. Algebra und Geometrie

Es müssen mindestens 36 LP erworben werden, wobei jeweils 8 LP aus den Gebieten Stochastik, Angewandte und Numerische Mathematik/Optimierung sowie Analysis kommen müssen. Die restlichen 12 LP müssen durch beliebige Prüfungen aus den genannten vier mathematischen Gebieten nachgewiesen werden.

Fach Wirtschaftswissenschaften

Es müssen je 18 LP aus den beiden Gebieten

1. Finance - Risikomanagement - Managerial Economics
2. Operations Management - Datenanalyse - Informatik

erworben werden.

Seminare

Des weiteren müssen zwei Seminarmodule über je 3 Leistungspunkte abgelegt werden, jeweils eines aus den beiden Fächern Mathematik und Wirtschaftswissenschaften.

Wahlbereich und Schlüsselqualifikationen

Weitere 12 LP sind flexibel zu erbringen. Insbesondere ist dadurch die Möglichkeit der fachlichen Vertiefung zur Vorbereitung der Masterarbeit gegeben. Mindestens 8 der 12 LP müssen aus den oben genannten mathematischen und wirtschaftswissenschaftlichen Gebieten oder aus einem Berufspraktikum kommen. Mindestens 3 LP sind durch Schlüsselqualifikationen zu erbringen.

Masterarbeit

Die Masterarbeit wird in der Regel im vierten Semester geschrieben und ist mit 30 LP versehen. Sie kann in beiden beteiligten Fakultäten betreut werden und soll nach Möglichkeit

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ein für die Wirtschaftsmathematik inhaltlich und methodisch relevantes Thema behandeln. Voraussetzung ist eine angemessene Vertiefung im Themenbereich der Arbeit.

Fach Mathematik		**Fach Wirtschaftswissenschaften**
Stochastik **(8 LP)**	**Analysis** **(8 LP)**	**Finance - Risikomanagement – Managerial Economics** **(18 LP)**
Angewandte und Numerische Math. / Optimierung **(8 LP)**	**WP** **(12 LP)**	**Operations Management - Datenanalyse - Informatik** **(18 LP)**
Seminar (3 LP)		**Seminar (3 LP)**
Wahlbereich und Schlüsselqualifikationen (12 LP)		
Masterarbeit (30 LP)		

3 Festlegung des Studienprofils (Schwerpunktbildung)

Im Masterstudiengang Wirtschaftsmathematik wird eines der drei möglichen Studienprofile *Financial Engineering & Actuarial Sciences* oder *Operations Research* oder *Klassische Wirtschaftsmathematik* gewählt. Während im letzten Profil eine maximale Flexibilität bei der Zusammenstellung der Module besteht, erfolgt bei den beiden anderen Studienprofilen durch die Wahl von Modulen aus bestimmten Bereichen eine Schwerpunktbildung. Im Folgenden werden Umfang und Inhalt für die einzelnen Studienprofile spezifiziert. Weitere zur Profilbildung zugelassene Module und Vorlesungen werden gegebenenfalls zu Semesterbeginn bekannt gegeben. Dies betrifft insbesondere die von der Fakultät für Mathematik angebotenen Module. Auf Antrag des Studierenden kann das Studienprofil in das Diploma Supplement aufgenommen werden.

3

Studienprofil Financial Engineering & Actuarial Sciences

Im Studienprofil *Financial Engineering & Actuarial Sciences* werden Vorlesungen aus moderner Stochastik und Analysis der Fakultät für Mathematik kombiniert mit methodenorientierten Vorlesungen aus dem finanzwirtschaftlichen und aktuar-wissenschaftlichen Angebot der Fakultät für Wirtschaftswissenschaften. Die besondere Rolle der Stochastik in diesem Studiengang wird durch die verbindliche Wahl von 16 LP aus diesem Gebiet unterstrichen. Die folgenden Module sind bei diesem Studienprofil insbesondere zugelassen:

Stochastik (16 LP)

Finanzmathematik in stetiger Zeit	8 LP
Asymptotische Stochastik	8 LP
Brownsche Bewegung	4 LP
Generalisierte Regressionsmodelle	4 LP
Steuerung stochastischer Prozesse	4 LP
Zeitreihenanalyse	4 LP

Angewandte u. Numerische Mathematik/Optimierung (8 LP)

Optimierung und optimale Kontrolle für Differentialgleichungen	4 LP
Numerische Methoden für Differentialgleichungen	8 LP
Steuerung stochastischer Prozesse	4 LP

Analysis (8 LP)

Funktionalanalysis	8 LP
Stochastische Differentialgleichungen	8 LP
Klassische Methoden für partielle Differentialgleichungen	8 LP

Finance - Risikomanagement – Managerial Economics (18 LP)

F1 (Finance)	9 LP
F2 (Finance)	9 LP
F2 & F3 (Finance)	18 LP
Insurance: Calculation and Control	9 LP
Application of Actuarial Sciences I	9 LP
Application of Actuarial Sciences II	9 LP
Mathematical and Empirical Finance	9 LP
Insurance Statistics	9 LP

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Operations Management - Datenanalyse - Informatik (18 LP)

Informatik	9 LP
Methodische Grundlagen des OR	9 LP
Mathematische Optimierung	9 LP
Stochastische Methoden und Simulation	9 LP
Stochastische Modellierung und Optimierung	9 LP

Studienprofil Operations Research

Im Studienprofil *Operations Research* werden Vorlesungen der modernen Optimierung und des Hochleistungsrechnens aus der Fakultät für Mathematik kombiniert mit methoden-orientierten Vorlesungen des Operations Research und der Datenanalyse aus der Fakultät für Wirtschaftswissenschaften. Die folgenden Module sind bei diesem Studienprofil insbesondere zugelassen:

Stochastik (8 LP)

Asymptotische Stochastik	8 LP
Brownsche Bewegung	4 LP
Generalisierte Regressionsmodelle	4 LP
Perkolation	4 LP
Steuerung stochastischer Prozesse	4 LP
Analyse von Lebensdauern	4 LP

Angewandte u. Numerische Mathematik/Optimierung (8 LP)

Optimierung und optimale Kontrolle für Differentialgleichungen	4 LP
Paralleles Rechnen	5 LP
Numerische Optimierungsmethoden	8 LP
Steuerung stochastischer Prozesse	4 LP

Analysis (8 LP)

Funktionalanalysis	8 LP
Variationsrechnung	8 LP
Klassische Methoden für partielle Differentialgleichungen	8 LP
Kontrolltheorie	4 LP
Spieltheorie	4 LP

Finance - Risikomanagement – Managerial Economics (18 LP)

Entscheidungs- und Spieltheorie	9 LP

Diese Vorlesung ist für das Studienprofil verpflichtend. Weitere Vorlesungen aus diesem Gebiet können beliebig aus der Liste im Studienprofil *Klassische Wirtschaftsmathematik* gewählt werden.

Operations Management - Datenanalyse - Informatik (18 LP)

Informatik	9 LP
Business Applications and OR	9 LP
Market Analysis	9 LP
Methodische Grundlagen des OR	9 LP
Mathematische Optimierung	9 LP
Anwendungen des OR	9 LP
OR im Supply Chain Management und Health Care Management	9 LP
Stochastische Methoden und Simulation	9 LP
Stochastische Modellierung und Optimierung	9 LP

Studienprofil Klassische Wirtschaftsmathematik

Im Studienprofil *Klassische Wirtschaftsmathematik* besteht die größte Freiheit bei der Wahl der Module. Insbesondere sind fast alle Vorlesungen der Fakultät für Mathematik zugelassen. Das aktuelle Angebot kann dem Modulhandbuch entnommen werden. Hier einige Beispiele

Stochastik (8 LP)

Finanzmathematik in stetiger Zeit	8 LP
Asymptotische Stochastik	8 LP
Räumliche Stochastik	8 LP
Stochastische Geometrie	8 LP
Brownsche Bewegung	4 LP
Generalisierte Regressionsmodelle	4 LP
Perkolation	4 LP
Analyse von Lebensdauern	4 LP
Zeitreihenanalyse	4 LP
Steuerung stochastischer Prozesse	4 LP
Mathematische Statistik	4 LP
Nichtparametrische Statistik	4 LP
Computerintensive Methoden der Statistik	4 LP

Angewandte u. Numerische Mathematik/Optimierung (8 LP)

Optimierung und optimale Kontrolle für Differentialgleichungen	4 LP
Paralleles Rechnen	5 LP
Numerische Optimierungsmethoden	8 LP
Steuerung stochastischer Prozesse	4 LP
Numerische Methoden für Differentialgleichungen	8 LP
Einführung in das Wissenschaftliche Rechnen	8 LP
Löser für lineare und nichtlineare Gleichungssyteme	6 LP
Wavelets	8 LP
Bildgebende Verfahren in der Medizintechnik	8 LP
Numerische Methoden für zeitabhängige PDGLn	8 LP
Variationsrechnung	8 LP
Kontrolltheorie	4 LP

Analysis (8 LP)

Funktionalanalysis	8 LP
Variationsrechnung	8 LP
Klassische Methoden für partielle Differentialgleichungen	8 LP
Kontrolltheorie	4 LP
Spieltheorie	4 LP
Stochastische Differentialgleichungen	8 LP
Computerunterstützte analytische Methoden für Rand- und Eigenwertprobleme	8 LP
Evolutionsgleichungen	8 LP
Fourieranalysis	8 LP
Rand- u. Eigenwertprobleme	8 LP
Integralgleichungen	8 LP
Stabilitäts- und Kontrolltheorie für Evolutionsgleichungen	8 LP
Spektraltheorie	8 LP
Inverse Probleme	8 LP

Die weiteren Leistungspunkte in der Mathematik können auch aus dem Gebiet Algebra und Geometrie stammen.

Algebra und Geometrie (8 LP)

Algebra	8 LP
Algebraische Zahlentheorie	8 LP
Riemannsche Geometrie	8 LP
Diskrete Geometrie	8 LP
Konvexe Geometrie	8 LP
Algebraische Geometrie	8 LP
Geometrie der Schemata	8 LP
Geometrische Gruppentheorie	8 LP
Lie-Gruppen und Lie-Algebren	8 LP
Symmetrische Räume	8 LP
Geometrische Maßtheorie	8 LP
Graphen und Gruppen	8 LP

Finance - Risikomanagement – Managerial Economics (18 LP)

F1 (Finance)	9 LP
F2 (Finance)	9 LP
F2 & F3 (Finance)	18 LP
Insurance: Calculation and Control	9 LP
Application of Actuarial Sciences I	9 LP
Application of Actuarial Sciences II	9 LP
Mathematical and Empirical Finance	9 LP
Insurance Statistics	9 LP
Entscheidungs- und Spieltheorie	9 LP
Operational Risk Management I	9 LP
Operational Risk Management II	9 LP
Unternehmensführung	9 LP

Operations Management - Datenanalyse - Informatik (18 LP)

Informatik	9 LP
Business Applications and OR	9 LP
Market Analysis	9 LP
Methodische Grundlagen des OR	9 LP
Mathematische Optimierung	9 LP
Anwendungen des OR	9 LP
OR im Supply Chain Management und Health Care Management	9 LP
Stochastische Methoden und Simulation	9 LP
Stochastische Modellierung und Optimierung	9 LP

4 Modulinhalte

Im Fach Mathematik entsprechen die Modulnamen den Vorlesungsnamen, während sich im Fach Wirtschaftswissenschaften in der Regel verschiedene Vorlesungen zu einem Modul kombinieren lassen. Im Folgenden findet man eine Liste der Vorlesungen, die zu einzelnen, ausgewählten Modulen gehören.

Module im Gebiet Finance - Risikomanagement – Managerial Economics

F1 (Finance) (9 LP)

Asset Pricing (4.5 LP), Derivate (4.5 LP), Valuation (4.5 LP)

F2 (Finance) (9 LP) und F2 & F3 (Finance) (18 LP)

Asset Pricing (4.5 LP), Börsen (1.5 LP), Corporate Financial Policy (4.5 LP), Derivate (4.5 LP), Festverzinsliche Titel (4.5 LP), Finanzintermediation (4.5 LP), Geschäftspolitik der Kreditinstitute (3 LP), Internationale Finanzierung (3 LP), Interne Unternehmensrechnung (4.5 LP), Kreditrisiken (4.5 LP), Marktmikrostruktur (3 LP), Valuation (4.5 LP)

Das Modul F2 beinhaltet dabei Vorlesungen im Umfang von 9 LP und das Modul F2&F3 Vorlesungen im Umfang von 18 LP. Bei der Wahl der Module bestehen folgende Einschränkungen: Das Modul F1 ist die Voraussetzung für die Module F2 und F2&F3. In den Modulen F2 und F2&F3 dürfen die Lehrveranstaltungen *Asset Pricing*, *Derivate* und *Valuation* nur gewählt werden, soweit nicht bereits im Modul F1 gewählt.

Mathematical and Empirical Finance (9 LP)

Stochastic Calculus and Finance (5 LP), Financial Time Series and Econometrics (4.5 LP), Advanced Econometrics of Financial Markets (4.5 LP), Portfolio and Asset Liability Management (4.5 LP), Finanzmärkte und Banken (4.5 LP), Bankmanagement und Finanzmärkte, Ökonometrische Anwendungen (4.5 LP)

Das Modul wird aus der Vorlesung *Stochastic Calculus and Finance* und einer weiteren Vorlesung zusammengesetzt.

Insurance: Calculation and Control (9 LP)

Insurance Models (5 LP), Insurance Game (4 LP)

Insurance Statistics (9 LP)

Insurance Statistics (9 LP)

9

Applications of Actuarial Sciences I und II (9 oder 18 LP)

Life and Pensions (4.5 LP), Reinsurance (4.5 LP), Insurance Optimization (4.5 LP), Saving Societies (4.5 LP)

Beim Modul *Applications of Actuarial Sciences I und II* besteht die Möglichkeit, zwei (9 LP) oder sämtliche (18 LP) Vorlesungen zu wählen.

Operational Risk Management I (9 LP)

Enterprise Risk Management (4.5 LP), Risk Communication (4.5 LP), International Risk Transfer (2.5 LP), Public Sector Risk Management (2.5 LP)

Operational Risk Management II (9 LP)

Multidisciplinary Risk Research (4.5 LP), Risk Management of Microfinance and Private Households (4.5 LP), Public Sector Risk Management (2.5 LP), Projekt Work in Risk Research (4.5 LP)

Entscheidungs- und Spieltheorie (9 LP)

Spieltheorie I (4.5 LP), Spieltheorie II (4.5 LP), Wohlfahrtstheorie (4.5 LP), Ökonomische Theorie der Unsicherheit (4.5 LP), Auktionstheorie (4.5 LP)

Strategische Unternehmensführung und Organisation (9 LP)

Organisationstheorie (5 LP), Modelle strategischer Führungsentscheidungen (5 LP), Wertorientierte Instrumente der strategischen Konzernführung (4 LP), Unternehmensführung und Strategisches Management (4 LP), Organisationsmanagement (4 LP)

Module im Gebiet Operations Management - Datenanalyse - Informatik

Methodische Grundlagen des OR (9 LP)

Nichtlineare Optimierung I (4.5 LP), Nichtlineare Optimierung II (4.5 LP), Globale Optimierung I (4.5 LP), Globale Optimierung II (4.5 LP), Stochastische Entscheidungsmodelle I (4.5 LP), Standortplanung und strategisches Supply Chain Management (4.5 LP)

Pflicht in diesem Modul: mindestens eine der Veranstaltungen
Globale Optimierung I und *Nichtlineare Optimierung I*

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Mathematische Optimierung (9 LP)

Gemischt-ganzzahlige Optimierung I (4.5 LP), Gemischt-ganzzahlige Optimierung II (4.5 LP), Spezialvorlesung zur Optimierung I (4.5 LP), Spezialvorlesung zur Optimierung II (4.5 LP), Standorttheorie (4.5 LP), Graphentheorie (4.5 LP), Software-Praktikum: OR-Modelle II (4.5 LP), Nichtlineare Optimierung I (4.5 LP), Nichtlineare Optimierung II (4.5 LP), Globale Optimierung I (4.5 LP), Globale Optimierung II (4.5 LP)

Anwendungen des OR (9 LP)

Standortplanung und strategisches Supply Chain Management (4.5 LP), Taktisches und operatives Supply Chain Management (4.5 LP), Software-Praktikum: OR-Modelle I (4.5 LP), Simulation I (4.5 LP), Globale Optimierung I (4.5 LP)

Pflicht in diesem Modul: mindestens eine der Veranstaltungen *Standortplanung und strategisches Supply Chain Management* und *Taktisches und operatives Supply Chain Management*

OR im Supply Chain Management und Health Care Management (9 LP)

Standortplanung und strategisches Supply Chain Management (4.5 LP), Taktisches und operatives Supply Chain Management (4.5 LP), Operations Research im Supply Chain Management (4.5 LP), Operations Research im Health Care Management (4.5 LP), Arbeitsorganisation und Arbeitsumfeld im Krankenhaus (2 LP), Praktikum: Health Care Management (mit Fallstudien) (7 LP), Software-Praktikum: OR-Modelle II (4.5 LP), Software-Praktikum: Simulation (4.5 LP), Software-Praktikum: SAP APO (4.5 LP)

Stochastische Methoden und Simulation (9 LP)

Stochastische Entscheidungsmodelle I (4.5 LP), Simulation I (4.5 LP), Simulation II (4.5 LP), Nichtlineare Optimierung I (4.5 LP), Taktisches und operatives Supply Chain Management (4.5 LP)

Pflicht in diesem Modul: mindestens eine der Veranstaltungen *Stochastische Entscheidungsmodelle I* und *Simulation I*

Stochastische Modellierung und Optimierung (9 LP)

Stochastische Entscheidungsmodelle I (4.5 LP), Stochastische Entscheidungsmodelle II (4.5 LP), Qualitätsmanagement I (4.5 LP), Qualitätsmanagement II (4.5 LP), Optimierung in einer zufälligen Umwelt (4.5 LP), Simulation I (4.5 LP), Simulation II (4.5 LP), OR-nahe Modellierung und Analyse realer Probleme (Projekt) (4.5 LP)

Zu jedem der drei Module *Mathematische Optimierung*, *OR im Supply Chain Management und Health Care Management* und *Stochastische Modellierung und Optimierung* kann nach Absprache mit dem jeweiligen Modulkoordinator eine Veranstaltung aus einem der anderen beiden Module oder eine der Veranstaltungen *Spieltheorie I* und *Spieltheorie II* anerkannt werden.

Market Analysis (9 LP)

Datenanalyse und OR (5 LP), Moderne Marktforschung (5 LP), Ergänzungsveranstaltungen, evtl. e-Business und e-Marketing

Business Applications and OR (9 LP)

Unternehmensplanung und OR (5 LP), Marketing und OR-Verfahren (5 LP), Ergänzungsveranstaltungen, evtl. Marketing und Innovation, Entrepreneurship und Marketing

Informatik (9 LP)

Algorithmen für Internetanwendungen (5 LP), Angewandte Informatik II - Informatiksysteme für eCommerce (4 LP), Angewandte Informatik I - Modellierung (4 LP), Complexity Management (5 LP), Computational Economics (5 LP), Datenbanksysteme (5 LP), Datenbanksysteme und XML (5 LP), Dokumentenmanagement und Groupwaresysteme (4 LP), Effiziente Algorithmen (5 LP), Intelligente Systeme im Finance (5 LP), Semantic Web Technologies I (5 LP), Semantic Web Technologies II (5 LP), Knowledge Discovery (5 LP), Enterprise Architecture Management (5 LP), Naturinspirierte Optimierungsverfahren (5 LP), Organic Computing (5 LP), Softwaretechnik: Qualitätsmanagement (5 LP), Softwaretechnik (6 LP), Strategisches Management der betrieblichen Informationsverarbeitung (5 LP), Verteilte Datenbanksysteme: Basistechnologie für eBusiness (5 LP), IT-Komplexität in der Praxis (3 LP), Service-oriented Computing 1 (5 LP), Wissensmanagement (5 LP), Reifegradmodelle für die Software- und Systementwicklung (4 LP), Spezialvorlesung Effiziente Algorithmen (5 LP), Spezialvorlesung Betriebliche Informationssysteme (5 LP), Spezialvorlesung Wissensmanagement (5 LP), Spezialvorlesung Komplexitätsmanagement (5 LP), Spezialvorlesung Software- und Systemsengineering (5 LP)

Bei Interesse an Informatik kann man im Bereich Wirtschaftswissenschaften Veranstaltungen aus dem Modul Informatik, dem Vertiefungsmodul Informatik oder dem Wahlpflichtmodul Informatik auswählen. Eine sinnvolle Kombination besteht dabei je nach gewünschter Ausrichtung aus einer der Kernvorlesungen Algorithmen für Internetanwendungen, Angewandte Informatik I, Angewandte Informatik II, Complexity Management, Datenbanksysteme, Service-oriented Computing I, Softwareengineering und Wissensmanagement, kombiniert mit jeweils geeigneten Ergänzungsveranstaltungen. In der Mathematik kann man diese Module z.B ergänzen durch die Module Diskrete Geometrie, Paralleles Rechnen, Bildgebende Verfahren in der Medizintechnik.

5 Modulüberschneidungen

Bei bestimmten Modulen ist die inhaltliche Überschneidung sehr groß. Daher gelten folgende Ausschlussregeln:

- Die Module *Insurance Statistics* und *Generalisierte Regressionsmodelle* können nicht gleichzeitig eingebracht werden.
- Falls das Modul *Markov-Ketten* aus dem Bachelor Mathematik eingebracht wird, dann kann in den Modulen *Stochastische Methoden und Simulation* und *Stochastische Modellierung und Optimierung* keine der Veranstaltungen *Stochastische Entscheidungsmodelle I und II* eingebracht werden.
- Falls das Modul *Numerische Optimierungsmethoden* eingebracht wird, dann kann in den Modulen *Methodische Grundlagen des OR* und *Mathematische Optimierung* keine der Veranstaltungen *Nichtlineare Optimierung I und II* eingebracht werden.
- Falls das Modul *Finanzmathematik in stetiger Zeit* eingebracht wird, dann kann im Modul *Mathematical and Empirical Finance* die Veranstaltung *Stochastic Calculus and Finance* nicht eingebracht werden.
- Falls das Modul *Spieltheorie* eingebracht wird, dann kann in den Modulen *Entscheidungs- und Spieltheorie*, *Mathematische Optimierung*, *OR im Supply Chain Management und Health Care Management* und *Stochastische Modellierung und Optimierung* die Veranstaltung *Spieltheorie I* nicht eingebracht werden.

6 Schlüsselqualifikationen

Teil des Studiums ist auch der Erwerb von Schlüssel- und überfachlichen Qualifikationen. Zu diesem Bereich zählen überfachliche Veranstaltungen zu gesellschaftlichen Themen, fachwissenschaftliche Ergänzungsangebote, welche die Anwendung des Fachwissens im Arbeitsalltag vermitteln, Kompetenztrainings zur gezielten Schulung von Soft Skills sowie Fremdsprachentraining im fachwissenschaftlichen Kontext.

Der Masterstudiengang Wirtschaftsmathematik an den Fakultäten für Mathematik und Wirtschaftswissenschaften zeichnet sich durch einen außergewöhnlich hohen Grad an Interdisziplinarität aus. Mit der Kombination aus mathematischen und wirtschaftswissenschaftlichen Fächern ist die Zusammenführung von Wissensbeständen verschiedener Disziplinen integrativer Bestandteil des Studiengangs. Interdisziplinäres Denken in Zusammenhängen wird dabei in natürlicher Weise gefördert. Darüber hinaus tragen auch die Seminarveranstaltungen des Masterstudiengangs mit der Einübung wissenschaftlich hochqualifizierter Bearbeitung und Präsentation spezieller Themenbereiche wesentlich zur Förderung der Soft Skills bei. Die innerhalb des Studiengangs integrativ vermittelten Schlüsselkompetenzen lassen sich dabei den folgenden Bereichen zuordnen:

Basiskompetenzen (soft skills)

1. Teamarbeit, soziale Kommunikation und Kreativitätstechniken (z.B. Arbeit in Kleingruppen, gemeinsames Bearbeiten der Hausaufgaben und Nacharbeiten des Vorlesungsstoffes)
2. Präsentationserstellung und –techniken
3. Logisches und systematisches Argumentieren und Schreiben (z.B. in Übungen, Seminaren, beim Ausarbeiten der Vorträge und Verfassen der Hausaufgaben)
4. Strukturierte Problemlösung und Kommunikation

Praxisorientierung (enabling skills)

1. Handlungskompetenz im beruflichen Kontext
2. Kompetenzen im Projektmanagement
3. Betriebswirtschaftliche Grundkenntnisse
4. Englisch als Fachsprache

Orientierungswissen

1. Vermittlung von interdisziplinärem Wissen
2. Institutionelles Wissen über Wirtschafts- und Rechtssysteme
3. Wissen über internationale Organisationen
4. Medien, Technik und Innovation

Neben der integrativen Vermittlung von Schlüsselqualifikationen ist der additive Erwerb von Schlüsselqualifikationen im Umfang von mindestens drei Leistungspunkten vorgesehen. Lehrveranstaltungen, welche die nötigen Kompetenzen vermitteln, sind im Modul für Schlüsselqualifikationen zusammengefasst und werden regelmäßig in der entsprechenden Modulbeschreibung des Modulhandbuchs zum Masterstudiengang Wirtschaftsmathematik aktualisiert und im Internet bekannt gegeben. Diese Liste ist mit dem House of Competence abgestimmt.

2 Helpful information

Module Handbook

The programme exists of several **subjects** (e.g. business administration, economics, operations research). Every subject is split into **modules** and every module itself exists of one or more interrelated **courses**. The extent of every module is indicated by credit points (CP), which will be credited after the successful completion of the module. Some of the modules are **obligatory**. According to the interdisciplinary character of the programme, a great variety of **individual specialization and deepening possibilities** exists for a large number of modules. This enables the student to customize content and time schedule of the programme according to personal needs, interest and job perspective. The **module handbook** describes the modules belonging to the programme, their structure and extent (in CP), their dependencies, their learning outcomes, their learning control and examinations. Therefore it serves as a necessary orientation and as a helpful guide throughout the studies. The module handbook does not replace the **course catalogue**, which provides important information concerning each semester and variable course details (e.g. time and location of the course).

Begin and completion of a module

Every module and every course is allowed to be credited only once. The decision whether the course is assigned to one module or the other is made by the student at the time of signing in for the corresponding exam. The module is **succeeded**, if the general exam of the module and/or if all of its relevant partial exams have been passed (grade min 4.0).

General exams and partial exams

The module exam can be taken in a general exam or several partial exams. If the module exam is offered as a **general exam**, the entire content of the module will be reviewed in a single exam. If the module exam exists of **partial exams**, the content of each course will be reviewed in corresponding partial exams. The registration for the examinations in the bachelor programme takes place online via the self-service function for students. The following functions can be accessed on `https://studium.kit.edu` by means of the access information of the student card (FriCard):

- Sign in and sign off exams
- Retrieve examination results
- Print transcript of records

For students of the master programme the registration currently takes place at the **advisory service** of the faculty or at the respective institutes.

Repeating exams

Principally, a failed exam can repeated only once. If the **repeat examination** (including an eventually provided verbal repeat examination) will be failed as well, the **examination claim** is lost. Requests for a second repetition of an exam require the approval of the examination committee. A request for a second repetition has to be made without delay after loosing the examination claim.

Bonus accomplishments and additional accomplishments

Bonus accomplishments can be achieved on the basis of entire modules or within modules, if there are alternatives at choice. Bonus accomplishments can improve the module grade and overall grade by taking into account only the best possible combination of all courses when calculating the grades. The student has to declare a Bonus accomplishment as such at the time of registration for the exams. Exams, which have been registered as Bonus accomplishments, are subject to examination regulations. Therefore, a failed exam has to be repeated. Failing the repeat examination implies the loss of the examination claim.
Additional accomplishments are voluntarily taken exams, which have no impact on the overall grade of the student and can take place on the level of single courses or on entire modules. It is also mandatory to declare an additional accomplishment as such at the time of registration for an exam. Up to 2 modules with a minimum of 9

CP may appear additionally in the certificate. After the approval of the examination committee, it is also possible to include modules in the certificate, which are not defined in the module handbook. Single additional courses will be recorded in the transcript of records. Courses and modules, which have been declared as bonus accomplishments, can be changed to additional accomplishments.

Further information

More detailed information about the legal and general conditions of the programme can be found in the examination regulation of the programme.

Used abbreviations

LP/CP	Credit Points/ECTS	Leistungspunkte/ECTS
LV	course	Lehrveranstaltung
RÜ	computing lab	Rechnerübung
S	summer term	Sommersemester
Sem.	semester/term	Semester
SPO	examination regulations	Studien- und Prüfungsordnung
SQ	key qualifikation	Schlüsselqualifikationen
SWS	contact hour	Semesterwochenstunde
Ü	excercise course	Übung
V	lecture	Vorlesung
W	winter term	Wintersemester

3 Actual Changes

Important changes are pointed out in this section in order to provide a better orientation. Although this process was done with great care, other/minor changes may exist. Please also check our updates on http://www.wiwi.kit.edu/lehreMHB.php#mhb_aktuell.

MATHMWBWLFBV1 - Finance 1 (S. 110)

Anmerkungen

The module has been renamed to *Finance 1*.

MATHMWBWLFBV2 - Finance 2 (S. 111)

Anmerkungen

The module has been renamed to *Finance 2*.

MATH4BWLFBV11 - Finance 3 (S. 113)

Anmerkungen

From winter term 2010/11 on this new module replaces the old module *F2&F3 (Finance)* [WW4BWLFBV3].
The module has been renamed to *Finance 3*.

MATHMWBWLFBV2 - Insurance: Calculation and Control (S. 114)

Anmerkungen

The ECTS have been changed.

MATHMWBWLFBV9 - Operational Risk Management I (S. 118)

Anmerkungen

The courses *Multidisciplinary Risk Research* [2530328], *Risk Communication* [2530395], *Risk Management of Microfinance and Private Households* [26354] and *Project Work in Risk Research* [2530393] are offered irregularly. For further information, see: http://insurance.fbv.uni-karlsruhe.de
The course *Public Sector Risk Management* [2530355] has been re-included to the module in summer term 2011.

MATHMWBWLFBV10 - Operational Risk Management II (S. 119)

Anmerkungen

The courses *Multidisciplinary Risk Research* [2530328], *Risk Communication* [2530395], *Risk Management of Microfinance and Private Households* [26354] and *Project Work in Risk Research* [2530393] are offered irregularly. For further information, see: http://insurance.fbv.uni-karlsruhe.de
The course *Public Sector Risk Management* [2530355] has been re-included to the module in summer term 2011.

MATHMWVWL10 - Decision and Game Theory (S. 120)

Anmerkungen

The modules and and lectures of Prof. Berninghaus will be held in summer term 2011 for the last time. All examinations have to be finished within this summer term.

2511402 - Intelligent Systems in Finance (S. 205)

Anmerkungen

The content of the lecture will permanently be adapted to actual developments. This can be the cause to changes of the described contend and schedule.
The course “Intelligent Systems in Finance” will not be offered any more from summer term 2016 on. The examination will be offered latest until summer term 2015 (repeaters only).

2511400 - Complexity Management (S. 158)

Anmerkungen

The content of the lecture will permanently be adapted to actual developments. This can be the cause to changes of the described contend and schedule.
The course “Complexity Management” will not be offered any more from summer term 2016 on. The examination will be offered latest until summer term 2015 (repeaters only).

2530393 - Project Work in Risk Research (S. 276)

Anmerkungen

This course is offered in the spring term 2011.
This course is normally offered each semester. For further information, see: http://insurance.fbv.uni-karlsruhe.de
To attend the course please register at the secretary of the chair of insurance science.

2530303 - Insurance Statistics (S. 202)

Anmerkungen

This course belongs to the modules "*Applications of Actuarial Sciences I*" and "*Applications of Actuarial Sciences II*". It doesn't belong to module "*Insurance Statistics*" anymore.
The number of ECTS credits and of hours per week have been reduced.

2530308 - Car Insurance (S. 217)

Anmerkungen

This course *Car Insurance* is newly included in summer term 2011.

N.N. - Pensions (S. 263)

Anmerkungen

This course *pensions* replaces part of *Life and Pensions* [2530310].

N.N. - Life Insurance (S. 265)

Anmerkungen

This course *life insurance* replaces part of *Life and Pensions* [2530310].

4 Modules

4.1 Modules of Mathematics

Module: Riemannian Geometry [MATHMWAG04]

Coordination: Enrico Leuzinger
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
1036	Riemannian Geometry (p. 284)	4/2	W	8	E. Leuzinger

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1+2
Introduction into Geometry and Topology

Learning Outcomes
Introduction to the concepts of Riemannian Geometry

Content

- manifolds
- Riemannian metrics
- affine connections
- geodesics
- curvature
- Jacobi fields
- length metrics
- curvature and topology

Module: Algebra [MATHMWAG05]

Coordination: Frank Herrlich
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAG05	Algebra (p. 140)	4/2	W	8	F. Herrlich, S. Kühnlein, C. Schmidt, G. Weitze-Schmithüsen

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1+2
Introduction into Algebra and Number Theory

Learning Outcomes

- Concepts and methods of algebra
- Preparation to seminars and further courses in algebraic geometry and number theory

Content

- Fields:
  field extensions, Galois theory, cyclotomic fields
- Valuations:
  valuation rings, extension of values, local fields
- Dedekind domains:
  integral ring extensions, normal closure, noetherian rings

Module: Discrete Geometry [MATHMWAG06]

Coordination: Daniel Hug
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
1535	Discrete Geometry (p. 167)	4/2	W/S	8	D. Hug

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1+2

Learning Outcomes
The students

- know fundamental combinatorial properties and results about convex polytopes, geometric graphs and packings,
- understand metric, combinatorial and graph theoretic arguments and apply these in modified form.

Content

- Combinatorial Properties of Convex Sets
- Convex Polytopes
- Geometric Graphs
- Algorithmic Problems
- Packing and Covering
- Lattices

Module: Convex Geometry [MATHMWAG07]

Coordination: Daniel Hug
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
1044	Convex Geometry (p. 216)	4/2	W/S	8	D. Hug

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1-3

Learning Outcomes
The students

- know fundamental properties of convex sets and convex functions and apply these to related problems,
- are familiar with fundamental geometric and analytic inequalities and their applications to geometric extremal problems,
- know selected integral formulas for convex sets and the required results on invariant measures.

Content
1. Convex Sets
1.1. Combinatorial Properties
1.2. Support and Separation Properties
1.3. Extremal Representations
2. Convex Functions
2.1. Basic Properties
2.2. Regularity
2.3. Support Function
3. Brunn-Minkowski Theory
3.1. Hausdorff Metric
3.2. Volume and Surface Area
3.3. Mixed Volumes
3.4. Geometric Inequalities
3.5. Surface Area Measures
3.6. Projection Functions
4. Integralgeometric Formulas
4.1. Invariant Measures
4.2. Projection and Section Formulas

Module: Geometric Measure Theory [MATHMWAG08]

Coordination: Daniel Hug
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
1040	Geometric Measure Theorie (p. 192)	4/2	W/S	8	D. Hug

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1-3

Learning Outcomes
The students

- know fundamental results and techniques of proof of geometric measure theory,
- know examples of applications of methods of geometric measure theory and apply these methods.

Content

- Measure and integral
- Covering Theorems
- Hausdorff Measures
- Differentiation of Measures
- Lipschitz Functions and Rectifiability
- Area and Coarea Formula
- Currents
- Applications

Module: Algebraic Number Theory [MATHMWAG09]

Coordination: Claus-Günther Schmidt
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAG09	Algebraic Number Theory (p. 142)	4/2	W/S	8	S. Kühnlein, C. Schmidt

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Algebra

Learning Outcomes
Introduction to the structures and methods in Algebraic Number Theory

Content
Algebraic number fields,
Minkowski theory,
finiteness of the class group,
Dirichlet's unit theorem,
local fields

Module: Algebraic Geometry [MATHMWAG10]

Coordination: Frank Herrlich
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAG10	Algebraic Geometry (p. 141)	4/2	W/S	8	F. Herrlich, S. Kühnlein

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Algebra

Learning Outcomes
Familiarity with the basic concepts of algebraic geometry and the appropriate algebraic tools

Content
Hilbert's base theorem, Nullstellensatz, affine and projective varieties, morphisms and rational maps. nonsingular varieties, algebraic curves, Riemann-Roch theorem

Module: Geometry of Schemes [MATHMWAG11]

Coordination: Frank Herrlich
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAG11	Geometry of Schemes (p. 189)	4/2	W/S	8	F. Herrlich, S. Kühnlein

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Algebraic Geometry

Learning Outcomes
Familiarity with the language of sheaves and schemes; applications to algebraic geometry

Content
Sheaves of modules;
affine schemes;
varieties and schemes;
morphisms;
cohomology of schemes

Module: Geometric Group Theory [MATHMWAG12]

Coordination: Gabriela Weitze-Schmithüsen
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAG12	Geometric Group Theory (p. 190)	4/2	W/S	8	G. Weitze-Schmithüsen

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Introduction into Algebra and Number Theory
Introduction into Geometry and Topology

Learning Outcomes
Understanding of the interplay between geometry and group theory

Content
Group actions on graphs;
Cayley graphs;
Word problems for groups;
Gromov hyperbolic spaces;
action of hyperbolic groups on metric spaces

Module: Lie Groups and Lie Algebras [MATHMWAG13]

Coordination: Oliver Baues
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAG13	Lie Groups and Lie Algebras (p. 220)	4/2	W/S	8	O. Baues

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Introduction into Geometry and Topology

Learning Outcomes
Introduction to Lie groups and Lie algebras, preparation to seminars and further courses in algebra and geometry

Content
basic notions, special classes of Lie groups and Lie algebras, structure theory, additional and advanced topics

Module: Metric Geometry [MATHMWAG15]

Coordination: Enrico Leuzinger
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAG15	Metric Geometry (p. 230)	4/2	W	8	E. Leuzinger

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Introduction into Geometry and Topology

Learning Outcomes
Introduction to metric geometry
preparation to research in the field of geometry

Content
classical geometries,
length spaces,
CAT(0)-spaces,
Gromov-hyperbolic spaces
quasi-isometries,
word problem und isoperimetric inequalities

Module: Plane Algebraic Curves [MATHMWAG16]

Coordination: Frank Herrlich
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Once	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAG16	Plane Algebraic Curves (p. 169)	4/2	W/S	8	F. Herrlich

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Introduction into Algebra and Number Theory
Introduction into Geometry and Topology

Learning Outcomes
Algebraic techniques for the study of geometric properties of plane curves, basic knowledge of plane algebraic curves

Content
Rings of polynomials, affine curves, singular points, tangents, intersection multiplicity,
projective curves, Bezout's theorem, topology of projective curves,
elliptic curves, regular functions, function field

Module: Graphs and Groups [MATHMWAG17]

Coordination: Frank Herrlich
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAG17	Graphs and Groups (p. 197)	4/2	W/S	8	F. Herrlich, G. Weitze-Schmithüsen

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Introduction into Algebra and Number Theory
Introduction into Geometry and Topology

Learning Outcomes
Various relations between graph and group theory,
familiarity with concepts like Cayley graph and group actions on graphs

Content
Graphs and trees, Cayley graphs, free groups, fundamental group of a graph, free products, amalgams, graphs of groups, Bass-Serre theory, p-adic numbers, Bruhat-Tits tree, discontinuous groups

Module: Moduli Spaces of Curves [MATHMWAG18]

Coordination: Frank Herrlich
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAG18	Modul Spaces of Curves (p. 235)	4/2	W/S	8	F. Herrlich

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Algebraic Geometry

Learning Outcomes
Familiarity with algebraic classification problems, the concept of a family depending on an algebraic parameter, acquaintance with concepts of modern algebraic geometry

Content
Classification of elliptic curves, moduli spaces of plane curves,
coarse and fine moduli spaces, canonical embedding of curves,
Hilbert schemes, first steps in geometric invariant theory

Module: Symmetric Spaces [MATHMWAG19]

Coordination: Enrico Leuzinger
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAG19	Symmetric Spaces (p. 338)	4/2	W	8	E. Leuzinger

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Introduction into Geometry and Topology

Learning Outcomes
Introduction to the theory of symmetric spaces

Content
homogeneous spaces,
symmetric spaces,
locally symmetric spaces

Module: Integral Geometry [MATHMWAG20]

Coordination: Daniel Hug
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAG20	Integral Geometry (p. 203)	4/2	W/S	8	D. Hug

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Convex Geometry

Learning Outcomes
The students

- know basic results about invariant measures and apply these to global and local integral geometric results,
- are familiar with typical techniques of proof for integral geometric results,
- know examples of applications of integral geometric results to convex geometry and to stochastic geometry.

Content

- Invariant Measures
- Curvature Measures
- Local Kinematic Formula
- Crofton Formula
- Projection and Sum Formulas
- Integralgeometric Formulas for Cylinders
- Extension to Polyconvex Sets
- Translative Integral Geometry

Module: Class Field Theory [MATHAG21]

Coordination: Claus-Günther Schmidt
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
Klassenkörpertheorie	Class Field Theory (p. 212)	4+2		8	C. Schmidt

Learning Control / Examinations
written or oral exam

Conditions
It is recommended to attend the following modules previously:

Algebraic number theory

Learning Outcomes
Advanced study of number theoretic structures

Content
Adels and Ideles,
classification of Galois extensions with abelian Galois group,
reciprocity law

Module: Arithmetic of Elliptic Curves [MATHAG22]

Coordination: Claus-Günther Schmidt
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
ArellKurv	Arithmetic of Elliptic Curves (p. 148)	4+2		8	C. Schmidt

Learning Control / Examinations
written or oral exam

Conditions
It is recommended to attend the following modules previously:

Algebraic Number Theory

Learning Outcomes
Advanced study in arithmetic geometry

Content
Algebraic curves,
elliptic curves over finite fields, over local fields, and global fields,
Mordell-Weil group

Module: Modular Forms [MATHAG23]

Coordination: Claus-Günther Schmidt
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
Modulformen	Modular Forms (p. 234)	4+2		8	C. Schmidt

Learning Control / Examinations
written or oral exam

Conditions
It is recommended to attend the following modules previously:

Function Theory

Learning Outcomes
Introduction to a modern area of algebraic and analytic number theory

Content
Cusp forms and Eisenstein series,
Hecke operators,
Petersson scalar product,
Atkin-Lehner theory of new forms

Module: Advanced Geometric Group Theory [MATHAG24]

Coordination: Gabriela Weitze-Schmithüsen
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
GGTIIVorl	(p. 191)	4+2		8	F. Herrlich, G. Weitze-Schmithüsen

Learning Control / Examinations
Oral Examination
Grade: Grade of the oral examination

Conditions
Geometric Group Theory (recommendation)

Learning Outcomes
Familiarity with some centreal objects and constructions of geometric group theory.

Content

Module: Buildings [MATHAG25]

Coordination: Enrico Leuzinger
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
VGebäude	Buildings (p. 185)	4+2		8	E. Leuzinger

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Module: Functional Analysis [MATHMWAN05]

Coordination: Roland Schnaubelt
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
FunkAna	Functional Analysis (p. 182)	4/2	W	8	G. Herzog, C. Schmoeger, R. Schnaubelt, L. Weis

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1-3

Learning Outcomes
Introduction into functional analytic concepts and methods

Content

- metric spaces (topological concepts, compactness)
- continuous linear operators on Banach spaces (principle of uniform boundedness, open mapping theorem)
- dual spaces, representation theorems theorem of Hahn-Banach, weak convergence, reflexivity
- distributions, weak derivatives, Fourier transform, theorem of Plancherel, Sobolev spaces in L^2, partial differential equations with constant coefficients

Module: Integral Equations [MATHMWAN07]

Coordination: Frank Hettlich
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics, Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
IG	Integral Equations (p. 204)	4/2	S	8	T. Arens, F. Hettlich, A. Kirsch

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1-3

Learning Outcomes
The students can

- formulate and classify integral equations,
- discuss existence and uniqueness of integral equations,
- reformulate models based on applications by integral equations.

Content

- Riesz and Fredholm theory,
- Fredholm und Volterra integral equations of second kind,
- applications in potential theory,
- convolution equations

Module: Classical Methods for Partial Differential Equations [MATHMWAN08]

Coordination: Michael Plum
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
KMPD	Classical Methods for Partial Differential Equations (p. 213)	4/2	W	8	M. Plum, W. Reichel, R. Schnaubelt, L. Weis

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1-3

Learning Outcomes

Content

Module: Boundary Value Problems and Eigenvalue Problems [MATHMWAN09]

Coordination: Wolfgang Reichel
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
RUEP	Boundary Value Problems and Eigenvalue Problems (p. 280)	4/2	S	8	M. Plum, W. Reichel, R. Schnaubelt, L. Weis

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1-3
Differential Equations and Hilbert Spaces

Learning Outcomes
Profound understanding of concepts and methods in partial differential equations particularly for boundary and eigenvalue problems.

Content

- examples of boundary and eigenvalue problems from physics
- maximum principles for second order equations
- Sobolev spaces
- weak formulation of linear elliptic boundary value problems of second order
- Lax-Milgram lemma
- coercivity
- Fredholm alternative for boundary value problems
- eigenvalue theory for weakly formulated elliptic eigenvalue prblems

Module: Spectral Theory [MATHMWAN10]

Coordination: Lutz Weis
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
SpekTheo	Spectral Theory (p. 316)	4/2	S	8	G. Herzog, C. Schmoeger, R. Schnaubelt, L. Weis

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1-3
Functional Analysis or Differential Equations and Hilbert Spaces

Learning Outcomes
A deepened understanding of functional analytic concepts and methods in the context of spectral theory.

Content

- Closed operators on Banach spaces
- spectrum und resolvent
- compact operators und Fredholm alternative
- Dunford's functional calculus, spectral projections
- Unbounded selfadjoint operators on Hilbert spaces
- Spectral Theorem
- Operators defined by forms
- Applications to partial differential equations

Module: Computer-Assisted Analytical Methods for Boundary and Eigenvalue Problems [MATHMWAN11]

Coordination: Michael Plum
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN11	Computer-Assisted Analytical Methods for Boundary and Eigenvalue Problems (p. 162)	4/2	W/S	8	M. Plum

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis
Boundary Value Problems and Eigenvalue Problems

Learning Outcomes

Content

Module: Evolution Equations [MATHMWAN12]

Coordination: Roland Schnaubelt
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN12	Evolution Equations (p. 174)	4/2	W/S	8	R. Schnaubelt, L. Weis

Learning Control / Examinations
exam:
written or oral exam after each semester
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis

Learning Outcomes
The students understand the basic ideas and concepts of the operatortheoretic approach to evolution equations. They can apply these concepts to partial differential equations.

Content
strongly continuous operator semigroups and their generators,
generation theorems and wellposedness,
analytic semigroups,
inhomogeneous and semilinear Cauchy problems,
perturbation theory,
introduction to stability and spectral theory of operator semigroups,
applications to partial differential equations

Module: Game Theory [MATHMWAN13]

Coordination: Wolfgang Reichel
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
4	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN13	Game Theory (p. 325)	2/1	W/S	4	M. Plum, W. Reichel

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
None.

Learning Outcomes
Students know the foundations of the theory of non-cooperative games and their equilibria on an exemplary basis.

Content
2-person zero-sum games,
von Neumann-Morgenstern theory,
n-personen zero-sum games,
mixed extension,
Nash equilibria,
theorem of Nikaido-Isoda

Module: Fourier Analysis [MATHMWAN14]

Coordination: Lutz Weis
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN14	Fourier Analysis (p. 181)	4/2	W/S	8	R. Schnaubelt, L. Weis

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis or Differential Equations and Hilbert Spaces

Learning Outcomes
An understanding of function and differential equation in the Fourier representation (”frequency domain”), treatment of singular integrals.

Content

- Fourier series
- Fourier transform on L_1 and L_2
- Tempered distributions and their Fourier transform
- Explizit solutions of the Heat-, Schrödinger- and Wave equation in R^n
- the Hilbert transform
- the interpolation theorem of Marcinkiewicz
- Singular integral operators
- the Fourier multiplier theorem of Mihlin

Module: Spaces of Functions and Distributions [MATHMWAN15]

Coordination: Lutz Weis
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN15	Spaces of Functions and Distributions (p. 183)	4/2	W/S	8	M. Plum, W. Reichel, R. Schnaubelt, L. Weis

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis or Differential Equations and Hilbert Spaces

Learning Outcomes
A deeper understanding of the basic concepts of modern analysis and its applications: generalized derivatives and functions, spaces of generalized functions including spaces of measures.

Content

- Distributions and the calculus of distributions
- Fourier transform of distributions
- Sobolev spaces and weak derivatives
- Application to differential equations
- the representation theorem of Riesz for the dual of continuous functions
- convergence of measures

Module: Complex Analysis II [MATHMWAN16]

Coordination: Christoph Schmoeger
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN16	Complex Analysis II (p. 184)	4/2	W/S	8	G. Herzog, M. Plum, W. Reichel, C. Schmoeger, R. Schnaubelt, L. Weis

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Complex Analysis

Learning Outcomes
The students expand their knowledge of the module Complex Analysis.

Content
- infinite products
- Mittag-Leffler theorem
- Montel's theorem
- Riemann mapping theorem
- conformal mappings
- univalent (schlicht) functions
- automorphisms of some domains
- harmonic functions
- Schwarz reflection principle
- regular and singular points of power series

Module: Models of Mathematical Physics [MATHMWAN17]

Coordination: Wolfgang Reichel
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN17	Models of Mathematical Physics (p. 231)	4/2	W/S	8	M. Plum, W. Reichel

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Analysis 1-3

Learning Outcomes
Students are able to understand the modelling of basic physical phenomena and to describe mathematically the most important properties of the model.

Content
reaction-diffusion models
wave phenomena
Maxwell's equations and electrodynamics
Schrödinger's equation and quantum dynamics
Navier-Stokes equation and fluid dynamics
elasticity
surface tension

Module: Control Theory [MATHMWAN18]

Coordination: Roland Schnaubelt
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
4	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN18	Control Theory (p. 215)	2/1	W/S	4	R. Schnaubelt, L. Weis

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1-3

Learning Outcomes
The students understand the basic ideas and concepts of control theory at the end of the module. They can apply these ideas and the relevant methods in the framework of ordinary differential equations.

Content
linear ordinary differential equations with control: controllability and observability,
stabilizability and detectability,
transfer functions,
realization theory,
quadratic optimal control,
introduction into nonlinear control

Module: Nonlinear Evolution Equations [MATHMWAN19]

Coordination: Roland Schnaubelt
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	**Cycle**	**Duration**
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN19	Nonlinear Evolution Equations (p. 239)	4/2	W/S	8	R. Schnaubelt, L. Weis

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Evolution Equations
Functional Analysis

Learning Outcomes
The students understand the basic ideas and concepts of functional analytic approaches to nonlinear evolution equations at the end of the module.

Content
semilinear equations,
quasilinear parabolic equations,
gradient systems,
Lyapunov functions,
invariant manifolds,
nonlinear Schrödinger equations

Module: Potential Theory [MATHMWAN20]

Coordination: Andreas Kirsch
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN20	Potential Theory (p. 267)	4/2	W/S	8	T. Arens, F. Hettlich, A. Kirsch, W. Reichel

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis
Complex Analysis

Learning Outcomes
The student is able to illustrate the notions of potential theory in theory and with examples. He can sketch the proofs of the main results and knows the relationship to the methods and results of complex analysis.

Content
Properties of harmonic functions
Existence and uniqueness results for the boundary value problems for the Laplace- and Poisson equation
Green's function for the ball
spherical harmonics

Module: Boundary Value Problems for Nonlinear Differential Equations [MATHMWAN21]

Coordination: Wolfgang Reichel
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN21	Boundary Value Problems for Nonlinear Differential Equations (p. 281)	4/2	W/S	8	M. Plum, W. Reichel

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis
Classical Methods for Partial Differential Equations
Boundary Value Problems and Eigenvalue Problems

Learning Outcomes
Students are familiar with methods which allow to prove existence of solutions of typical classes of nonlinear elliptic and/or parabolic boundary value problems.

Content
method of sub- and supersolutions
existence via fixed point methods
variational methods
bifurcation theory

Module: Spectral Theory of Differential Operators [MATHMWAN22]

Coordination: Michael Plum
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN22	Spectral Theory of Differential Operators (p. 317)	4/2	W/S	8	M. Plum

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis
Classical Methods for Partial Differential Equations
Boundary Value Problems and Eigenvalue Problems

Learning Outcomes

Content

Module: Stability and Control Theory for Evolution Equations [MATHMWAN23]

Coordination: Roland Schnaubelt
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN23	Stability and Control Theory for Evolution Equations (p. 328)	4/2	W/S	8	R. Schnaubelt, L. Weis

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis
Evolution Equations
Spectral Theory

Learning Outcomes
The students understand the basic ideas and concepts of the qualitative theory of evolution equations at the end of the module.

Content
stability concepts, dichotomy, spectral theory of operator semigroups,
criteria for stability and dichotomy,
linearized stability,
observability, controllability, stabilizability and detectability for operator semigroups,
transfer functions

Module: Stochastic Differential Equations [MATHMWAN24]

Coordination: Lutz Weis
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN24	Stochastic Differential Equations (p. 331)	4/2	W/S	8	R. Schnaubelt, L. Weis

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis or Differential Equations and Hilbert Spaces

Learning Outcomes
Integrating analytical and stochastic methods in the treatment of dynamical systems in a random environment.

Content

- Brownian motion
- Martingales and Martingal inequalities
- Stochastic integrals and Ito's formula
- Existence and uniqueness of solutions for systems of stochastic differential equations
- Perturbation and stability results
- Application to equations in financial mathematics, physics and engineering
- Connection with diffusion equations and potential theory

Module: Calculus of Variations [MATHMWAN25]

Coordination: Wolfgang Reichel
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN25	Calculus of Variations (p. 342)	4/2	W/S	8	A. Kirsch, M. Plum, W. Reichel

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis
Classical Methods for Partial Differential Equations
Boundary Value Problems and Eigenvalue Problems

Learning Outcomes
Students know the basic problems of the calculus of variations and are able to formulate variational problems by themselves. They know techniques to prove existence of solutions to variational problems and in special cases they can compute these solutions.

Content
one dimensional variational problems
Euler-Lagrange equation
necessary and sufficient criteria
multidimensional variational problems
direct methods in the calculus of variations
existence of critical points of functionals

Module: Scattering Theory [MATHMWAN26]

Coordination: Frank Hettlich
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN26	Scattering Theory (p. 337)	4/2	W/S	8	T. Arens, F. Hettlich, A. Kirsch

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis

Learning Outcomes
The student can prove and apply basic results on solutions of the Helmholtz equation in interior and exterior regions. Knowledge on uniqueness and existence of scattering problems by integral equations and by variational approaches are essential. Thus the aim of this course will be on a comprehensive expertise in modelling, in establishing existence of, and in handling solutions of scattering problems and closely related boundary value problems.

Content
Helmholtz equation and elementary solutions,
Green's representation theorems,
radiation conditions,
existence and uniqueness of scattering problems,
far field pattern

Module: Inverse Scattering Theory [MATHMWAN27]

Coordination: Andreas Kirsch
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics, Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN27	Inverse Scattering Theory (p. 211)	4/2	W/S	8	T. Arens, F. Hettlich, A. Kirsch

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis

Learning Outcomes
The student is able to illustrate the important notions of inverse scattering theory in theory and with examples. He is able to sketch the proofs of the main results and knows the principal differences and difficulities compared to the theory of direct scattering problems.

Content
Direct scattering problems
Uniqueness of the inverse scattering problem
Factorization Method
Iterative methods

Module: Maxwell's Equations [MATHMWAN28]

Coordination: Andreas Kirsch
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHAN28	Maxwell's Equations (p. 228)	4/2	W/S	8	T. Arens, F. Hettlich, A. Kirsch

Learning Control / Examinations
exam: written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis

Learning Outcomes
The student is able to illustrate the notions of the theory of Maxwell's equations with examples. He can sketch the proofs of the main results and knows the relationship to simpler differential equations (e.g. Helmholtz equation).

Content
Maxwell's equations in integral and differential form
Special cases (E-Mode, H-Mode)
Boundary value problems

Module: Nonlinear Functional Analysis [MATHAN29]

Coordination: Gerd Herzog
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
3	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
NichtlinFA	Nonlinear Functional Analysis (p. 240)	2		3	G. Herzog

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Module: Asymptotics of evolution equations [MATHAN30]

Coordination: Roland Schnaubelt, L. Weis
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Analysis

ECTS Credits	Cycle	Duration
3	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
AsEvolGl	Asymptotics of evolution equations (p. 150)	2		3	R. Schnaubelt, L. Weis

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Module: Numerical Methods for Differential Equations [MATHMWNM03]

Coordination: Willy Dörfler
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
8	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
NMDG	Numerical Methods for Differential Equations (p. 245)	4/2	W	8	W. Dörfler, V. Heuveline, A. Rieder, C. Wieners

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Analysis 1+2
Linear Algebra 1+2
Programming: Introduction into Computer Science
Numerical Mathematics 1+2

Learning Outcomes
The students know basic methods and algorithms to solve differential equations. All aspects from modelling to questions of stability and convergence will be considered.

Content
1. Initial value problems
1.1. Introduction
1.2. Explicit timestepping
1.3. Timestep control
1.4. Extrapolation
1.5. Multistep methods
1.6. Implicit Timestepping
1.7. Stability
2. Boundary value problems
2.1. Finite difference methods
2.2. Variational methods
3. Introduction into numerical methods for PDEs
3.1. Elliptic Equations
3.2. Parabolic Equations (1-D)
3.3. Hyperbolic Equations (1-D)

Module: Introduction into Scientific Computing [MATHMWNM05]

Coordination: Willy Dörfler
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
8	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
EWR	Introduction into Scientific Computing (p. 171)	3/3	S	8	W. Dörfler, V. Heuveline, A. Rieder, C. Wieners

Learning Control / Examinations
exam:
written or oral exam or practical
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Analysis 1+2
Linear Algebra 1+2
Programming: Introduction into Computer Science
Numerical Mathematics 1+2
Numerical Methods for Differential Equations

Learning Outcomes
The students know the basic methods and algorithms of scientific computing. The focus is on modelling and the algorithmic realisation. They learn techniques to judge the quality of the simulations.

Content
1. Elliptic Equations
1.1. Finite differences
1.2. Finite elements
1.3. Mixed Methods
2. Parabolic Equations
2.1. Linear examples
2.2. Monotone equations
2.3. Singularly perturbed equations
2.4. The basic equations in fluid dynamics
3. Hyperbolic Equations
3.1. Finite differences / Finite Volumes for conservation laws
3.2. Characteristics
3.3. Finite element methods for the wave equation

Module: Inverse Problems [MATHMWNM06]

Coordination: Andreas Kirsch
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
8	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
IP	Inverse Problems (p. 210)	4/2	W	8	T. Arens, F. Hettlich, A. Kirsch, A. Rieder

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1-3
Functional Analysis

Learning Outcomes
The students

- are able to discern well-posed from ill-posed problems,
- know regularization strategies.

Content

- linear equations of the first kind
- ill-posed problems
- theory of regularization
- iterative methods
- applications

Module: Finite Element Methods [MATHMWNM07]

Coordination: Willy Dörfler
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
8	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM07	Finite Element Methods (p. 180)	4/2	W	8	W. Dörfler

Learning Control / Examinations
exam:
written exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Numerical Methods for Differential Equations

Learning Outcomes
The students are able to

- establish a discretisation for a partial differential equation,
- predict the convergence behaviour and verify it numerically,
- understand the implementation techniques.

Content

1. Finite Difference Methods
2. Linear and quadratic finite elements
3. Implementational Aspects
4. Error estimates (Energy norm)
5. Interpolation estimates
6. Quadrature error and boundary approximation
7. Error estimates (L^2- und L^∞-Norm)
8. Nonconforming elements

Module: Parallel Computing [MATHMWNM08]

Coordination: Vincent Heuveline
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
5	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM08	Parallel Computing (p. 262)	2/2	W/S	5	V. Heuveline, J. Weiß

Learning Control / Examinations
prerequisite:
weekly work assignments in practice,
exam:
written or oral exam
Marking:
grade of exam

Conditions
None.

Learning Outcomes
- Basic skills in parallel computing
- Overview over scientific computing on massively parallel computers
- experiences in programming paradigms (theoretical and practical)
- scaleable implementation of simple applied problems

Content
- Introduction and motivation (scalar product, sorting, PDEs)
- Computer architecture and storage hierarchy
- measuring performance
- programming paradigms: MPI and Open MPI
- parallel solvers for linear systems
- libraries
- load sharing
- Finite difference method for the Laplace problem

Module: Optimization and Optimal Control for Differential Equations [MATHMWNM09]

Coordination: Vincent Heuveline
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
4	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM09	Optimization and Optimal Control for Differential Equations (p. 256)	2/1	S	4	V. Heuveline

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
None.

Learning Outcomes
- to gain an overview on optimal control and modelling
- adequate understanding of the functional analytical frame
- basic skills in solving elliptic and parabolic problems

Content
- Introduction and motivation
- linear-quadratic elliptic problems
- parabolic problems
- optimal control for semilinear elliptic equations
- semilinear parabolic equations

Module: Solution methods for linear and nonlinear equations [MATHMWNM10]

Coordination: Christian Wieners
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
6	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
LLNGS	Solution methods for linear and nonlinear equations (p. 221)	4/0	S	6	W. Dörfler, A. Rieder, C. Wieners

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1-3
Numerical mathemtics 1+2

Learning Outcomes
The students became acquainted with numerical solution methods for linear and nonlinear systems. They learn algorithms, results on convergence, and representative applications.

Content

- Direct solution methods for linear systems
- Iterative methods for linear systems
- Multigrid and domain decomposition methods
- Fixpoint and Newton Methods for nonlinear equations

Module: Foundations of Continuum Mechanics [MATHMWNM11]

Coordination: Christian Wieners
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
3	Once	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM11	Foundations of Continuum Mechanics (p. 198)	2	W/S	3	C. Wieners

Learning Control / Examinations
exam:
written or oral exam

Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Optimization Theory

Learning Outcomes
The students became acquainted with the fundamental results of continuum mechanics. They learn methods and principles of mathematical modeling for solids and fluids.

Content
1. Kinematic foundations
2. Balance equations for static problems, Cauchy theorem
3. Elastic materials
4. Hyperelastic materials
5. Balance equations for dynamic problems, Reynolds theorem
6. Newtonian fluids
7. Non-Newtonion fluids

Module: Numerical Methods in Solid Mechanics [MATHMWNM12]

Coordination: Christian Wieners
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
8	Once	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM12	Numerical Methods in Solid Mechanics (p. 248)	4+2	W/S	8	C. Wieners

Learning Control / Examinations
exam:
written or oral exam

Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Finite Element Methods

Learning Outcomes
The students became acquainted with numerical methods for the approximation of problems in solid mechanics. They learn algorithms, results on convergence, and representative applications.

Content
1. Finite elements for linear elasticity
2. Introduction to plasticity
3. Nonlinear solution methods for incremental plasticity
4. Introduction to the Theory of Porous Media
5. Dynamic problems in solids and porous media

Module: Numerical Methods in Electrodynamics [MATHMWNM13]

Coordination: Willy Dörfler
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
3	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM13	Numerical Methods in Electrodynamics (p. 247)	2	W/S	3	W. Dörfler

Learning Control / Examinations
exam:
written or oral exam

Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Finite Element Methods

Learning Outcomes
The students

- learn to set up mathematical models for electrostatical or electrodynamical problems,
- understand the fundamental problems of the correct approximation,
- are able to describe stable discretisations for the Maxwell equations.

Content

1. Maxwell equations, modelling
2. Boundary and interface conditions
3. Analytical tools
4. The source problem
5. The Maxwell eigenvalue problem
6. Finite Element spaces for Maxwell equations
7. Interpolation estimates

Module: Wavelets [MATHMWNM14]

Coordination: Andreas Rieder
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
Wave	Wavelets (p. 343)	4/2	W/S	8	A. Rieder

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1-3

Learning Outcomes
The students get to know the mathematical properties of the integral and discrete wavelet transform. They will be enabled to employ the wavelet transform as an analytic tool in signal- and image-processing.

Content

- windowed (short time) Fourier transform
- integral wavelet transform
- wavelet frames
- wavelet bases
- fast wavelet transform
- construction of orthogonal and bi-orthogonal wavelets
- applications in signal- and image-processing

Module: Medical imaging [MATHMWNM15]

Coordination: Andreas Rieder
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM15	Medical imaging (p. 154)	4/2	W/S	8	A. Rieder

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis

Learning Outcomes
The students get to know some mathematical models in medical imaging, their properties and their numerical realization (reconstruction algorithms). They will be enabled to apply the learned techniques to similar problems.

Content
- models of computerized tomography (X-ray, impedance, etc.)
- sampling and resolution
- ill-posedness and regularization
- reconstruction algorithms

Module: Mathematical Methods in Signal and Image Processing [MATHMWNM16]

Coordination: Andreas Rieder
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM16	Mathematical Methods in Signal and Image Processing (p. 226)	4/2	W/S	8	A. Rieder

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Functional Analysis

Learning Outcomes
The students get to know the essential mathematical tools of signal- and image-processing and their properties. They will be enabled to handle these tools adequately and to discuss the obtained results with competence.

Content
- digital and analog systems
- integral Fourier transform
- sampling and resolution
- discrete and fast Fourier transform
- non-uniform sampling
- anisotropic diffusion

Module: Multigrid and Domain Decomposition Methods [MATHMWNM17]

Coordination: Christian Wieners
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
3	Once	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM17	Multigrid and Domain Decomposition Methods (p. 229)	2	W/S	3	C. Wieners

Learning Control / Examinations
exam:
written or oral exam

Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Finite Element Methods

Learning Outcomes
The students became acquainted with multigrid and domain decomposition methods. They learn algorithms, results on convergence, and representative applications.

Content
1. The two-grid method
2. Classical multigrid theory
3. Additive subspace correction method
4. Multiplicative subspace correction method
5. Multigrid methods for saddle point problems

Module: Numerical Methods in Mathematical Finance [MATHMWNM18]

Coordination: Christian Wieners
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
8	Once	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM18	Numerical Methods in Mathematical Finance (p. 249)	4/2	W/S	8	C. Wieners

Learning Control / Examinations
exam:
written or oral exam

Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Numerical Methods for Differential Equations

Learning Outcomes
The students became acquainted with numerical methods for applications in mathematical finance. They learn algorithms, results on convergence, and representative applications.

Content
1. Introduction
2. Pseudo random numbers
3. High-dimensional quadrature
4. Numerical integration of stochastic differential equations
5. Numerical evaluation of the Black-Scholes equation
6. Numerical approximation of the Black-Scholes equation
7. Finite element approximation of the Black-Scholes equation
8. Numerical approximation of american options

Module: Adaptive Finite Element Methods [MATHMWNM19]

Coordination: Willy Dörfler
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
3	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM19	Adaptive Finite Element Methods (p. 138)	2	W/S	3	W. Dörfler

Learning Control / Examinations
exam:
written or oral exam

Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Finite Element Methods

Learning Outcomes
The students

- understand the gains and the limits of adaptive methods,
- are able to choose a suitable method in applications,
- understand the implementation techniques.

Content

1. Necessity of adaptive methods
2. Residual error estimator
3. Implementational aspects
4. Functional error estimators
5. Optimality of the adaptive method
6. *hp* finite elements

Module: Numerical Methods for Time-Dependent PDE [MATHMWNM20]

Coordination: Willy Dörfler
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
8	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM20	Numerical Methods for Time-Dependent PDE (p. 246)	4/2	S	8	W. Dörfler

Learning Control / Examinations
exam:
written or oral exam

Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Finite Element Methods

Learning Outcomes
The students are able to

- establish a discretisation for a timedependent partial differential equation,
- predict the convergence behaviour and verify it numerically,
- understand the implementation techniques.

Content

1. Numerical methods for parabolic equations
2. Numerical methods for hyperbolic equations
3. Adaptive timestepping methods

Module: Numerics of Ordinary Differential Equations and Differential-Algebraic Systems [MATHMWNM21]

Coordination: Tobias Jahnke
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
8	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
NGDG	Numerics of Ordinary Differential Equations and Differential-Algebraic Systems (p. 244)	4/2	S	8	W. Dörfler, T. Jahnke, I. Lenhardt, M. Neher, A. Rieder, C. Wieners

Learning Control / Examinations
exam:
written or oral exam

Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Linear Algebra 1+2
Analysis 1+2
Numerical Mathematics 1+2
Numerical Methods for Differential Equations

Learning Outcomes
The students understand in which applications ordinary differential equations and differential-algebraic equations occur. They know how to construct numerical methods to solve such problems, and how to analyze the accuracy, stability, and efficiency of these methods.

Content
1. Motivation: In which applications do ordinary differential equations and differential-algebraic equations appear?

2. Analysis of ordinary differential equations (summary): higher-order differential equations, systems of ODEs, existence and uniqueness of solutions, perturbations of the initial value

3. Numerical methods for initial value problems

3.1 Reminder/summary: explicit and implicit methods, Runge-Kutta methods, consistency, stability, order, stiff differential equations, stability domains, A-stability, L-Stability, algebraic stability

3.2 Extrapolation methods (only if this has not already been covered in the module “Numerical Methods for Differential Equations”)

3.3 Rosenbrock methods, collocation methods (Gauss, Radau)

3.4 Multistep methods (Adams, Predictor-Corrector, BDF), order of multistep methods, Dahlquist Barrier

3.5 Optional: further topics such as, e.g.,
(a) exponential integrators
(b) Symplectic methods for Hamiltonian systems, geometric numerical integration, (near-)preservation of first integrals over long times
(c) Splitting methods and composition methods
(d) Magnus methods
(e) Order stars

(f) B-series
(g) General linear methods

4. Differential-algebraic systems

4.1 Singular perturbation problems and Index 1 problems

4.2 Differential-algebraic equations of higher index

Module: Numerical Methods in Fluid Mechanics [MATHMWNM24]

Coordination: Vincent Heuveline
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
3	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM24	Numerical Methods in Fluid Mechanics (p. 250)	2	W	3	V. Heuveline

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
None.

Learning Outcomes
- insight into models and physical assumptions to flow
- application of FEM to flow problems
- understanding of numerical incompressibility

Content
- Energy and Stress
- Introduction to FEM (scalar)
- Approximating Vector functions
- Equations of Fluid Motion
- Steady Navier-Stokes Equations (NSE)
- Approximating steady flow
- Time-dependent NSE
- Approximating the time-dependent NSE
- Turbulent flow

Module: Numerical Optimization Methods [MATHMWNM25]

Coordination: Christian Wieners
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Applied and Numerical Mathematics

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHNM25	Numerical Optimization Methods (p. 251)	4/2	W/S	8	V. Heuveline, C. Wieners

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Optimization Theory

Learning Outcomes
The students became acquainted with numerical methods for constrained and unconstrained optimization problems. They learn algorithms, results on local and global convergence, and representative applications.

Content
1. General unconstrained minimization methods
2. Newton method
3. Inexact Newton method
4. Quasi Newton method
5. Nonlinear cg iteration
6. Trust region methods
7. Interor point methods
8. Penalty methods
9. Active set strategies
10. SQP methods
11. Non-smooth optimization

Module: Stochastic Geometry [MATHMWST06]

Coordination: Daniel Hug
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Algebra/Geometry, Stochastics

ECTS Credits	Cycle	Duration
8	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST06	Stochastic Geometry (p. 334)	4/2	W/S	8	D. Hug, G. Last

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Probability Theory
Convex Geometry or Spatial Stochastics

Learning Outcomes
The students

- know the fundamental geometric models in stochastic geometry,
- are familiar with properties of Poisson processes of geometric objects,
- know examples of applications of models of stochastic geometry.

Content

- Geometric Point Processes
- Random Sets
- Stationarity and Isotropy
- Poisson Processes
- Germ Grain Models
- Boolen Models
- Specific Intrinsic Volumes
- Kontact Distributions
- Random Tessellations

Module: Asymptotic Stochastics [MATHMWST07]

Coordination: Norbert Henze
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
8	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST07	Asymptotic Stochastics (p. 151)	4/2	S	8	N. Henze, C. Kirch, B. Klar

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Probability Theory

Learning Outcomes
Students get acquainted with basic concepts and methods of asymptotic stochastics. They gain an overview over the mathematical methods that are used in asymptotic stochastics.

Content
convergence in distribution, characteristic functions and central limit theorem in d dimensions, extreme value distribtutions, delta method, Glivenko Cantelli theorem, weak convergence in metric spaces, Donsker's theorem, asymptotics of moment and maximum likelihood estimators, asymptotic optimality of estimators, M-estimators, asymptotic confidence regions, likelihood ration tests

Module: Mathematical Finance in Continuous Time [MATHMWST08]

Coordination: Nicole Bäuerle
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
8	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST08	Mathematical Finance in Continuous Time (p. 179)	4/2	S	8	N. Bäuerle, L. Veraart

Learning Control / Examinations
exam:
written or oral exam
Marking:
grad of exam

Conditions
It is recommended to attend the following modules previously:
Probability Theory

Learning Outcomes
The students
– have core skills in modern mathematical finance and can apply them,
– have specific probabilistic techniques,
– are able to make appropriate mathematical models for economic questions.

Content
martingales in continuous time
stochastic integrals for continuous semimartingales
Ito-Doeblin formula
stochastic differential equations
theorem of Girsanov
Black-Scholes modell (no-arbitrage, completeness)
fundamental theorem of Asset Pricing
pricing of derivatives: European, American, Exotic Options
dynamic Portfolio-optimization
interestrate models

Module: Generalized Regression Models [MATHMWST09]

Coordination: Bernhard Klar
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
4	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST09	Generalized Regression Models (p. 188)	2/1	W	4	B. Klar, N. Henze, C. Kirch

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Statistics

Learning Outcomes
Upon completing this module the students know the most important regression models and their properties. They can judge the applicability of these models and interpret the results. They are able to apply the models in the analysis of complex data sets.

Content
Further topics in linear models (design of experiments, model selection), nonlinear models, generalized linear models, mixed models

Module: Brownian Motion [MATHMWST10]

Coordination: Nicole Bäuerle
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
4	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST10	Brownian Motion (p. 156)	2/1	W/S	4	N. Bäuerle, N. Henze, C. Kirch, G. Last, L. Veraart

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Probability Theory

Learning Outcomes
The students
– know properties of the Brownian motion as an example for a stochastic process,
– have specific probabilistic techniques,
– are able to use the Brownian motion as a model for stochastic phenomena.

Content
– path properties of Brownian motion, quadratic variation
– existence
– strong Markov property with applications (reflection principle)
– Donsker's invariance principle

Module: Markov Decision Processes [MATHMWST11]

Coordination: Nicole Bäuerle
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
4	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST11	Markov Decision Processes (p. 224)	2/1	W/S	4	N. Bäuerle, D. Kadelka

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Probability Theory
Optimization Theory

Learning Outcomes
The students
– have core skills in Markov Decision Process Theory and can apply them,
– have specific optimization techniques,
– are able to model practical questions as a Markov Decision Process.

Content
- stochastic dynamic programs with finite horizon, optimality equation
- disconted stochastic dynamic programs with infinite horizon; Howard's policy improvement; value iteration
- partially observed Markov Decision Processes

Module: Control theory of stochastic processes [MATHMWST12]

Coordination: Nicole Bäuerle
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
4	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST12	Stochastic control theory (p. 335)	2/1	W/S	4	N. Bäuerle

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Probability Theory
Mathematical Finance in Continuous Time

Learning Outcomes
The students
– have score skills in modern stochastic control theory and can apply them,
– have specific probabilistic techniques,
– are able to model questions as a stochastic control problem.

Content
• verification technique, Hamilton-Jacobi-Bellman equation
• viscosity solution
• singular control
• Feynman-Kac representation

Module: Percolation [MATHMWST13]

Coordination: Günter Last
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
4	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST13	Percolation (p. 264)	2/1	W/S	4	G. Last

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Probability Theory

Learning Outcomes
The students should become acquainted with basic models of discrete and continuum percolation.

Content

- Percolation on graphs
- Harris-Kesten theorem
- Asymptotics of the cluster size in the subcritical and the supercritical case
- Continuum percolation

Module: Spatial Stochastics [MATHMWST14]

Coordination: Günter Last
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
8	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST14	Spatial Stochastics (p. 279)	4/2	W	8	D. Hug, G. Last

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Probability Theory

Learning Outcomes
The students become familiar with some basic spatial stochastic processes. The focus is put not only on general properties of distributions but also on specific models (Poisson process, Gaussian random fields) important for applications.

Content

- Point processes
- Random measures
- Poisson processes
- Ralm distributions
- Spatial ergodic theorem
- Random fields
- Gaussian fields

Module: Mathematical Statistics [MATHMWST15]

Coordination: Bernhard Klar
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
4	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST15	Mathematical Statistics (p. 227)	2/1	W/S	4	B. Klar, N. Henze, C. Kirch

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Probability Theory

Learning Outcomes
The students become acquainted with fundamental concepts of mathematical statistics; they are capable to apply them to basic problems.

Content
Minimum variance unbiased estimation, BLUE, Cramér-Rao bound, sufficiency, complete statistics, UMP and UMPU tests

Module: Nonparametric statistics [MATHMWST16]

Coordination: Norbert Henze
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
4	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST16	Nonparametric statistics (p. 243)	2/1	W	4	N. Henze, C. Kirch, B. Klar

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Probability Theory
Asymptotic Stochastics

Learning Outcomes
Students get acquainted with basic concepts and models of nonparametric statistics. They are able to judge the applicability of these models and know how to apply these models for the analysis of data sets.

Content
Order statistics, empirical distribution function, quantiles, U-statistics, rank statistics, goodness-of-fit tests

Module: Multivariate statistics [MATHMWST17]

Coordination: Norbert Henze
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
4	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST17	Multivariate statistics (p. 237)	2/1	W	4	N. Henze, C. Kirch, B. Klar

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Probability Theory
Asymptotic Stochastics

Learning Outcomes
Students get acquainted with basic concepts and models of multivariate statistics. They are able to judge the applicability of these models and know how to apply these models for the analysis of data sets.

Content
Multivariate normal distribution, Hotelling's statistic, Wishart distribution, principal components, factor analysis, discriminant analysis, cluster analysis, multidimensional scaling

Module: Time Series Analysis [MATHMWST18]

Coordination: Bernhard Klar
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
4	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST18	Time Series Analysis (p. 349)	2/1	W/S	4	B. Klar, N. Henze, C. Kirch

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
None.

Learning Outcomes
Students know and understand standard models of time series analysis. Based on examples, they know about model selection and validation procedures. They are capable to apply models as well as methods on real and simulated data sets.

Content
Stationarity, autocorrelation, ARMA models, spectral theory, parameter estimation, nonlinear time series

Module: Survival Analysis [MATHMWST19]

Coordination: Bernhard Klar
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
4	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST19	Survival Analysis (p. 144)	2/1	W/S	4	B. Klar, N. Henze, C. Kirch

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
None.

Learning Outcomes
Students will learn the theory and practice of survival analysis, including parametric and nonparametric methods. Based on these concepts, students also perform analyses using statistical software.

Content
Survival distributions, censoring models, Kaplan-Meier estimator, nonparametric comparison of survivor curves, parametric models, maximum likelihood estimation, regression models for survival data

Module: Computer intensive methods in statistics [MATHMWST20]

Coordination: Bernhard Klar
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Stochastics

ECTS Credits	Cycle	Duration
4	Irregular	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
MATHST20	Computer intensive methods in statistics (p. 161)	2/1	W/S	4	N. Henze, C. Kirch, B. Klar

Learning Control / Examinations
exam:
written or oral exam
Marking:
grade of exam

Conditions
It is recommended to attend the following modules previously:
Probability Theory

Learning Outcomes
Students know basic simulation technologies and apply them to statistical questions. They are able to solve such problems by means of suitable computer programs.

Content
random number generation, Monte Carlo-methods, parametric and non-parametric bootstrap and jackknife, statistical learning, statistical optimization agorithms (EM, scoring, Newton), methods used in Bayes statistics

Module: Seminar [MATHMWSE01]

Coordination: Studiendekan/Studiendekanin
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Seminar

ECTS Credits	Cycle	Duration
3	Every term	1

Learning Control / Examinations
Marking:
no grade

Conditions
None.

Learning Outcomes

Content

4.2 Modules of Economics

Module: Finance 1 [MATHMWBWLFBV1]

Coordination: Marliese Uhrig-Homburg, Martin E. Ruckes
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2530550	Derivatives (p. 166)	2/1	S	4.5	M. Uhrig-Homburg
2530212	Valuation (p. 341)	2/1	W	4.5	M. Ruckes
2530555	Asset Pricing (p. 149)	2/1	S	4.5	M. Uhrig-Homburg, M. Ruckes

Learning Control / Examinations
The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
None.

Learning Outcomes
The student

- has core skills in economics and methodology in the field of finance
- assesses corporate investment projects from a financial perspective
- is able to make appropriate investment decisions on financial markets

Content
The courses of this module equip the students with core skills in economics and methodology in the field of modern finance. Securities which are traded on financial and derivative markets are presented, and frequently applied trading strategies are discussed. A further focus of this module is on the assessment of both profits and risks in security portfolios and corporate investment projects from a financial perspective.

Remarks
The module has been renamed to *Finance 1*.

Module: Finance 2 [MATHMWBWLFBV2]

Coordination: Marliese Uhrig-Homburg, Martin E. Ruckes
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2530260	Fixed Income Securities (p. 175)	2/1	W	4.5	M. Uhrig-Homburg
2530214	Corporate Financial Policy (p. 163)	2/1	S	4.5	M. Ruckes
2530240	Market Microstructure (p. 225)	2/0	W	3	T. Lüdecke
2530565	Credit Risk (p. 219)	2/1	W	4.5	M. Uhrig-Homburg
2530210	Management Accounting (p. 209)	2/1	S	4.5	T. Lüdecke
2530555	Asset Pricing (p. 149)	2/1	S	4.5	M. Uhrig-Homburg, M. Ruckes
2530212	Valuation (p. 341)	2/1	W	4.5	M. Ruckes
2530550	Derivatives (p. 166)	2/1	S	4.5	M. Uhrig-Homburg
2530570	International Finance (p. 208)	2	S	3	M. Uhrig-Homburg, Walter
2530299	Business Strategies of Banks (p. 193)	2	W	3	W. Müller
2530296	Exchanges (p. 155)	1	S	1.5	J. Franke
2530232	Financial Intermediation (p. 177)	3	W	4.5	M. Ruckes

Learning Control / Examinations
The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
It is only possible to choose this module in combination with the module *F1 (Finance)* [MATHMWBWLFBV1]. The module is passed only after the final partial exam of *F1 (Finance)*is additionally passed.
The courses *Asset Pricing* [VLAP], *Valuation* [2530212] and *Derivatives* [2530550] can only be chosen if they have not been chosen in the module *F1 (Finance)* [MATHMWBWLFBV1] already.

Learning Outcomes
The student has advanced skills in economics and methodology in the field of modern finance.

Content
The module F2 (Finance) is based on the module F1 (Finance). The courses of this module equip the students with advanced skills in economics and methodology in the field of modern finance on a broad basis.

Remarks
The module has been renamed to *Finance 2*.

Module: F2&F3 (Finance) [MATHMWBWLFBV3]

Coordination: Marliese Uhrig-Homburg, Martin E. Ruckes
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
18	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2530555	Asset Pricing (p. 149)	2/1	S	4.5	M. Uhrig-Homburg, M. Ruckes
2530212	Valuation (p. 341)	2/1	W	4.5	M. Ruckes
2530550	Derivatives (p. 166)	2/1	S	4.5	M. Uhrig-Homburg
2530260	Fixed Income Securities (p. 175)	2/1	W	4.5	M. Uhrig-Homburg
2530565	Credit Risk (p. 219)	2/1	W	4.5	M. Uhrig-Homburg
2530214	Corporate Financial Policy (p. 163)	2/1	S	4.5	M. Ruckes
2530240	Market Microstructure (p. 225)	2/0	W	3	T. Lüdecke
2530210	Management Accounting (p. 209)	2/1	S	4.5	T. Lüdecke
2530232	Financial Intermediation (p. 177)	3	W	4.5	M. Ruckes
2530296	Exchanges (p. 155)	1	S	1.5	J. Franke
2530299	Business Strategies of Banks (p. 193)	2	W	3	W. Müller
2530570	International Finance (p. 208)	2	S	3	M. Uhrig-Homburg, Walter

Learning Control / Examinations
The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
It is obligatory to attend the module *F1 (Finance)* [EE4BWLFBV1].
It is not allowed to choose also the module *F2 (Finance)* [MATHMWBWLFBV2].
The courses *Asset Pricing* [VLAP], *Valuation* [2530212] and *Derivatives* [2530550] can only be chosen if they have not been chosen in the module *F1 (Finance)* [MATHMWBWLFBV1] already.

Learning Outcomes
The student has advanced skills in economics and methodology in the field of finance.

Content
The courses of this module equip the students with advanced skills in economics and methodology in the field of modern finance on a broad basis.

Remarks
From winter term 2010/11 on the module is not being offered any more. Students can still finish it until winter term 2011/12 or swap to the new module *F3 (Finance)* [MATH4BWLFBV11] by written request at the registrar's office.

Module: Finance 3 [MATH4BWLFBV11]

Coordination: Marliese Uhrig-Homburg, Martin E. Ruckes
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
9	Every term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2530555	Asset Pricing (p. 149)	2/1	S	4.5	M. Uhrig-Homburg, M. Ruckes
2530212	Valuation (p. 341)	2/1	W	4.5	M. Ruckes
2530550	Derivatives (p. 166)	2/1	S	4.5	M. Uhrig-Homburg
2530260	Fixed Income Securities (p. 175)	2/1	W	4.5	M. Uhrig-Homburg
2530565	Credit Risk (p. 219)	2/1	W	4.5	M. Uhrig-Homburg
2530214	Corporate Financial Policy (p. 163)	2/1	S	4.5	M. Ruckes
2530240	Market Microstructure (p. 225)	2/0	W	3	T. Lüdecke
2530210	Management Accounting (p. 209)	2/1	S	4.5	T. Lüdecke
2530232	Financial Intermediation (p. 177)	3	W	4.5	M. Ruckes
2530296	Exchanges (p. 155)	1	S	1.5	J. Franke
2530299	Business Strategies of Banks (p. 193)	2	W	3	W. Müller
2530570	International Finance (p. 208)	2	S	3	M. Uhrig-Homburg, Walter

Learning Control / Examinations
The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
It is only possible to choose this module in combination with the module *F1 (Finance)* [MATHMWBWLFBV1] and *F2 (Finance)* [MATHMWBWLFBV2]. The module is passed only after the final partial exams of *F1(Finance) and F2 (Finance)* are additionally passed.
The courses *Asset Pricing* [VLAP], *Valuation* [2530212] and *Derivatives* [2530550] can only be chosen if they have not been chosen in the module *F1 (Finance)* [MATHMWBWLFBV1] or *F2 (Finance)* [MATHMWBWLFBV2] already.

Learning Outcomes
The student has advanced skills in economics and methodology in the field of finance.

Content
The courses of this module equip the students with advanced skills in economics and methodology in the field of modern finance on a broad basis.

Remarks
From winter term 2010/11 on this new module replaces the old module *F2&F3 (Finance)* [MATHMWBWLFBV3].
The module has been renamed to *Finance 3*.

Module: Insurance: Calculation and Control [MATHMWBWLFBV2]

Coordination: Christian Hipp
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
9	Every 2nd term, Summer Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2530300	Insurance Models (p. 200)	2/2	S	6	C. Hipp, Jasmin Berdel, Alireza Edalati
2530372	Insurance Game (p. 199)	2	S	3	C. Hipp, Jasmin Berdel, Alireza Edalati

Learning Control / Examinations
The assessment is carried out as a general written exam (according to Section 4(2), 1 of the examination regulation). In the lecture *Insurance Game* [2530372] there has to be hold an oral presentation by each student as well (according to Section 4(2), 3 of the examination regulation). The examinations are offered every semester. Re-examinations are offered at every ordinary examination date. The assessment procedures are described for each course of the module seperately.
The overall grade of the module consists of the grade of the written exam [80 percent) and the grade of the oral presentation (20 percent).

Conditions
None.

Learning Outcomes

Content

Remarks
The ECTS have been changed.

Module: Applications of Actuarial Sciences I [MATHMWBWLFBV4]

Coordination: Christian Hipp
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2530312	Reinsurance (p. 283)	2	S	3	C. Hipp, Schwehr
2530316	Insurance Optimisation (p. 201)	2/2	W	6	C. Hipp
2530303	Insurance Statistics (p. 202)	2/2	W	6	C. Hipp, Michael Schrempp
2530308	Car Insurance (p. 217)	2/2	S	6	M. Schrempp, A. Edalati
N.N.	Life Insurance (p. 265)	2	W	3	M. Vogt
N.N.	Pensions (p. 263)	2	W	3	C. Hipp, Klaus Besserer

Learning Control / Examinations
The assessment is carried out as partial exams (according to Section 4(2), 1 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
None.

Recommendations
Knowledge in statistics and the module *Insurance: Calculation and Control* [MATHMWBWLFBV2] is an advantage, but not a requirement.

Learning Outcomes

Content

Remarks
"*Life and Pensions*" will be replaced by "*Life Insurance*" und "*Pensions*" from winter term 2011/12 on.
"Saving Societies" will not be offered any more.

Module: Applications of Actuarial Sciences II [WM4BWLFBV5]

Coordination: Christian Hipp
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
9	Every term	2

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2530312	Reinsurance (p. 283)	2	S	3	C. Hipp, Schwehr
2530316	Insurance Optimisation (p. 201)	2/2	W	6	C. Hipp
2530303	Insurance Statistics (p. 202)	2/2	W	6	C. Hipp, Michael Schrempp
2530308	Car Insurance (p. 217)	2/2	S	6	M. Schrempp, A. Edalati
N.N.	Life Insurance (p. 265)	2	W	3	M. Vogt
N.N.	Pensions (p. 263)	2	W	3	C. Hipp, Klaus Besserer

Learning Control / Examinations
The assessment is carried out as partial exams (according to Section 4(2), 1 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
It is only possible to choose this module in combination with the module*Applications of Actuarial Sciences I* [MATHMWB-WLFBV4]. The module is passed only after the final partial exam of*Applications of Actuarial Sciences I* is additionally passed.

Recommendations
Knowledge in statistics and the module *Insurance: Calculation and Control* [MATHMWBWLFBV2] is an advantage, but not a requirement.

Learning Outcomes

Content

Module: Insurance Statistics [MATHMWBWLFBV8]

Coordination: Christian Hipp
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
9	Every 2nd term, Winter Term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2530303	Insurance Statistics (p. 202)	2/2	W	6	C. Hipp, Michael Schrempp

Learning Control / Examinations

Conditions
None.

Recommendations
Knowledge in statistics and the module *Insurance: Calculation and Control* [MATHMWBWLFBV2] is an advantage, but not a requirement.

Learning Outcomes

Content

Module: Operational Risk Management I [MATHMWBWLFBV9]

Coordination: Ute Werner
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2530326	Enterprise Risk Management (p. 173)	3/0	W	4.5	U. Werner
2530328	Multidisciplinary Risk Research (p. 236)	3/0	W/S	4.5	U. Werner
2530353	International Risk Transfer (p. 207)	2/0	S	2.5	W. Schwehr
2530395	Risk Communication (p. 285)	3/0	W/S	4.5	U. Werner
26354	Risk Management of Microfinance and Private Households (p. 286)	3/0	W/S	4.5	U. Werner
2530393	Project Work in Risk Research (p. 276)	3	W/S	4.5	U. Werner, Madalena Salek
2530355	Seminar Public Sector Risk Management (p. 293)	2	S	3	Hochrainer

Learning Control / Examinations
The assessment is carried out as partial exams (according to Section 4(2) of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module separately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
At least 50% of the assessment has to be carried out as a general oral exam or a general written exam (not as seminars).

Recommendations
Interest in interdisciplinary research is assumed.

Learning Outcomes
See German version.

Content
Operational risks of institutions resulting from the interaction of human, technical, and organisational factors (internal risks) as well as from external natural, technical, social or political incidents; specific requirements, legal and economic framework of various risk carriers (private and public households, small and major enterprises), design of strategies and risk management instruments for coping with risks.

Remarks
The courses *Multidisciplinary Risk Research* [2530328], *Risk Communication* [2530395], *Risk Management of Microfinance and Private Households* [26354] and *Project Work in Risk Research* [2530393] are offered irregularly. For further information, see: http://insurance.fbv.uni-karlsruhe.de
The course *Public Sector Risk Management* [2530355] has been re-included to the module in summer term 2011.

Module: Operational Risk Management II [MATHMWBWLFBV10]

Coordination: Ute Werner
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2530326	Enterprise Risk Management (p. 173)	3/0	W	4.5	U. Werner
2530328	Multidisciplinary Risk Research (p. 236)	3/0	W/S	4.5	U. Werner
2530353	International Risk Transfer (p. 207)	2/0	S	2.5	W. Schwehr
2530395	Risk Communication (p. 285)	3/0	W/S	4.5	U. Werner
26354	Risk Management of Microfinance and Private Households (p. 286)	3/0	W/S	4.5	U. Werner
2530393	Project Work in Risk Research (p. 276)	3	W/S	4.5	U. Werner, Madalena Salek
2530355	Seminar Public Sector Risk Management (p. 293)	2	S	3	Hochrainer

Learning Control / Examinations
The assessment is carried out as partial exams (according to Section 4(2), 1-3 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module separately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
At least 50% of the assessment has to be carried out as a general oral exam or a general written exam (not as seminars).

Recommendations
Interest in interdisciplinary research is assumed.

Learning Outcomes
See German version.

Content
Operational risks of institutions resulting from the interaction of human, technical, and organisational factors (internal risks) as well as from external natural, technical, social or political incidents; specific requirements, legal and economic framework of various risk carriers (private and public households, small and major enterprises), design of strategies and risk management instruments for coping with risks.

Remarks
The courses *Multidisciplinary Risk Research* [2530328], *Risk Communication* [2530395], *Risk Management of Microfinance and Private Households* [26354] and *Project Work in Risk Research* [2530393] are offered irregularly. For further information, see: http://insurance.fbv.uni-karlsruhe.de
The course *Public Sector Risk Management* [2530355] has been re-included to the module in summer term 2011.

Module: Decision and Game Theory [MATHMWVWL10]

Coordination: Siegfried Berninghaus, Clemens Puppe
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
9		

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2520525	Game Theory I (p. 326)	2/2	S	4.5	S. Berninghaus
2521369	Game Theory II (p. 327)	2/2	W	4.5	S. Berninghaus
2520517	Welfare Economics (p. 347)	2/1	S	4.5	C. Puppe
2520365	Economics of Uncertainty (p. 252)	2/2	S	4.5	K. Ehrhart
2590408	Auction Theory (p. 152)	2/2	W	4.5	K. Ehrhart, S. Seifert

Learning Control / Examinations
The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
None.

Learning Outcomes

Content

Remarks
The modules and and lectures of Prof. Berninghaus will be held in summer term 2011 for the last time. All examinations have to be finished within this summer term.

Module: Mathematical and Empirical Finance [MATHMWSTAT1]

Coordination: Svetlozar Rachev
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2521331	Stochastic Calculus and Finance (p. 330)	2/1	W	5	S. Rachev
2521359	Financial Time Series and Econometrics (p. 176)	2/1	W	5	S. Rachev
2520381	Advanced Econometrics of Financial Markets (p. 139)	2/1	S	5	S. Rachev
2520357	Portfolio and Asset Liability Management (p. 266)	2/1	S	5	S. Rachev
25350/1	Finance and Banking (p. 178)	2/2	W	5	K. Vollmer
2520355	Bank Management and Financial Markets, Applied Econometrics (p. 153)	2/2	S	5	K. Vollmer

Learning Control / Examinations
The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
The lecture *Stochastic Calculus and Finance* [2521331] is mandatory.

Learning Outcomes

Content

Module: Strategic Corporate Management and Organization [MATHMWUO1]

Coordination: Hagen Lindstädt
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2577904	Organization Theory (p. 261)	2/1	W	6	H. Lindstädt
2577902	Managing Organizations (p. 260)	2/0	W	4	H. Lindstädt
2577908	Modeling Strategic Decision Making (p. 232)	2/1	S	6	H. Lindstädt
2577900	Management and Strategy (p. 340)	2/0	S	4	H. Lindstädt

Learning Control / Examinations
The assessment is carried out as partial written exams (according to Section 4(2), 1 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The examinations are offered every semester. Re-examinations are offered at every ordinary examination date. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
One of the following courses have to be attended: *Managing Organizations* [2577902], *Management and Strategy* [2577900].

Learning Outcomes

Content

Remarks
See German version.

Module: Applications of Operations Research [MATHMWOR5]

Coordination: Stefan Nickel
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Operations Management - Data Analysis - Informatics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2550486	Facility Location and Strategic Supply Chain Management (p. 329)	2/1	S	4.5	S. Nickel
2550488	Tactical and Operational Supply Chain Management (p. 339)	2/1	W	4.5	S. Nickel
2550490	Software Laboratory: OR Models I (p. 311)	1/2	W	4.5	S. Nickel
2550134	Global Optimization I (p. 194)	2/1	W	4.5	O. Stein
2550662	Simulation I (p. 308)	2/1/2	W	4.5	K. Waldmann

Learning Control / Examinations
The assessment is carried out as partial exams (according to § 4(2), 1 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module.
The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
The module can be chosen in the following profiles:

- Operations Research
- Classical business mathematics

At least one of the courses *Facility Location and strategic Supply Chain Management* [2550486] and *Tactical and operational Supply Chain Management* [2550488] has to be taken.

Learning Outcomes
The student

- is familiar with basic concepts and terms of Supply Chain Management,
- knows the different areas of Supply Chain Management and their respective optimization problems,
- is acquainted with classical location problem models (in the plane, on networks and discrete) as well as fundamental methods for distribution and transport planning, inventory planning and management,
- is able to model practical problems mathematically and estimate their complexity as well as choose and adapt appropriate solution methods.

Content
Supply Chain Management is concerned with the planning and optimization of the entire, inter-company procurement, production and distribution process for several products taking place between different business partners (suppliers, logistics service providers, dealers). The main goal is to minimize the overall costs while taking into account several constraints including the satisfaction of customer demands.
This module considers several areas of Supply Chain Management. On the one hand, the determination of optimal locations within a supply chain is addressed. Strategic decisions concerning the location of facilities like production plants, distribution centers or warehouses are of high importance for the rentability of supply chains. Thoroughly carried out, location planning tasks allow an efficient flow of materials and lead to lower costs and increased customer service. On the other hand, the planning of material transport in the context of Supply Chain Management represents another focus of this module. By linking transport connections and different facilities, the material source (production plant) is connected with the material sink (customer). For given material flows or shipments, it is considered how to choose the optimal (in terms of minimal costs) distribution and transportation chain from the set of possible logistics chains, which asserts the compliance of delivery times and further constraints.

Furthermore, this module offers the possibility to learn about different aspects of the tactical and operational planning level in Suppy Chain Management, including methods of scheduling as well as different approaches in procurement and distribution logistics. Finally, issues of warehousing and inventory management will be discussed.

Remarks
The planned lectures and courses for the next three years are announced online (http://www.ior.kit.edu).

Module: Methodical Foundations of OR [MATHMWOR6]

Coordination: Oliver Stein
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Operations Management - Data Analysis - Informatics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2550111	Nonlinear Optimization I (p. 241)	2/1	S	4.5	O. Stein
2550113	Nonlinear Optimization II (p. 242)	2/1	S	4.5	O. Stein
2550134	Global Optimization I (p. 194)	2/1	W	4.5	O. Stein
2550136	Global Optimization II (p. 195)	2/1	W	4.5	O. Stein
2550486	Facility Location and Strategic Supply Chain Management (p. 329)	2/1	S	4.5	S. Nickel
2550679	Markov Decision Models I (p. 332)	2/1/2	W	5	K. Waldmann

Learning Control / Examinations
The assessment is carried out as partial written exams (according to Section 4(2), 1 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
At least one of the lectures *Nonlinear Optimization I* [2550111] and *Global Optimization I* [2550134] has to be examined.

Learning Outcomes
The student

- names and describes basic notions for optimization methods, in particular from nonlinear and from global optimization,
- knows the indispensable methods and models for quantitative analysis,
- models and classifies optimization problems and chooses the appropriate solution methods to solve also challenging optimization problems independently and, if necessary, with the aid of a computer,
- validates, illustrates and interprets the obtained solutions.

Content
The modul focuses on theoretical foundations as well as solution algorithms for optimization problems with continuous decision variables. The lectures on nonlinear programming deal with local solution concepts, whereas the lectures on global optimization treat approaches for global solutions.

Remarks
The planned lectures and courses for the next three years are announced online (http://www.ior.kit.edu).
For the lectures of Prof. Stein a grade of 30 % of the exercise course has to be fulfilled. The description of the particular lectures is more detailed.

Module: Stochastic Methods and Simulation [MATHMWOR7]

Coordination: Karl-Heinz Waldmann
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Operations Management - Data Analysis - Informatics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2550679	Markov Decision Models I (p. 332)	2/1/2	W	5	K. Waldmann
2550662	Simulation I (p. 308)	2/1/2	W	4.5	K. Waldmann
2550665	Simulation II (p. 309)	2/1/2	S	4.5	K. Waldmann
2550111	Nonlinear Optimization I (p. 241)	2/1	S	4.5	O. Stein
2550488	Tactical and Operational Supply Chain Management (p. 339)	2/1	W	4.5	S. Nickel

Learning Control / Examinations
The assessment is carried out as partial written exams (according to Section 4(2), 1 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
None.

Learning Outcomes
The student knows and understands stochastic relationships and has a competent knowledge in modelling, analyzing and optimizing stochastic systems in economics and engineering.

Content
Topics overview:
Stochastic Decision Models I: Markov Chains, Poisson Processes.
Simulation I: Generation of random numbers, Monte Carlo integration, Discrete event simulation, Discrete and continuous random variables, Statistical analysis of simulated data.
Simulation II: Variance reduction techniques, Simulation of stochastic processes, Case studies.

Remarks
The planned lectures and courses for the next three years are announced online (http://www.ior.kit.edu/)

Module: Operations Research in Supply Chain Management and Health Care Management [MATHMWOR8]

Coordination: Stefan Nickel
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Operations Management - Data Analysis - Informatics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2550486	Facility Location and Strategic Supply Chain Management (p. 329)	2/1	S	4.5	S. Nickel
2550488	Tactical and Operational Supply Chain Management (p. 339)	2/1	W	4.5	S. Nickel
2550480	Operations Research in Supply Chain Management (p. 254)	2/1	S	4.5	S. Nickel
2550495	Operations Research in Health Care Management (p. 253)	2/1	S	4.5	S. Nickel
2550493	Hospital Management (p. 218)	2/0	W/S	2	S. Nickel, Hansis
2550498	Practical seminar: Health Care Management (with Case Studies) (p. 274)	2/1/2	W/S	7	S. Nickel
2550497	Software Laboratory: OR Models II (p. 312)	2/1	S	4.5	S. Nickel
n.n.	Software Laboratory: Simulation (p. 314)	2/1	S	4.5	S. Nickel
n.n.	Software Laboratory: SAP APO (p. 313)	2/1	S	4.5	S. Nickel
2550494	Production Planning and Scheduling (p. 275)	2/1	S	4.5	J. Kalcsics

Learning Control / Examinations
The assessment is carried out as partial exams (according to § 4(2), 1 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module.
The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
The module can be chosen in the following profiles:

- Operations Research
- Classical business mathematics

Recommendations
Basic knowledge as conveyed in the module *Introduction to Operations Research* [WI1OR] is assumed.

Learning Outcomes
The student

- is familiar with basic concepts and terms of Supply Chain Management,
- knows the different areas of SCM and their respective optimization problems,
- is acquainted with classical location problem models (in planes, in networks and discrete) as well as fundamental methods for distribution and transport planning, inventory planning and management,
- is familiar with general procedures and characteristics of Health Care Management and the possibilities for adapting mathematical models for non-profit organizations,
- is able to model practical problems mathematically and estimate their complexity as well as choose and adapt appropriate solution methods.

Content

Supply Chain Management is concerned with the planning and optimization of the entire, inter-company procurement, production and distribution process for several products taking place between different business partners (suppliers, logistics service providers, dealers). The main goal is to minimize the overall costs while taking into account several constraints including the satisfaction of customer demands.

This module considers several areas of SCM. On the one hand, the determination of optimal locations within a supply chain is addressed. Strategic decisions concerning the location of facilities as production plants, distribution centers or warehouses are of high importance for the rentability of Supply Chains. Thoroughly carried out, location planning tasks allow an efficient flow of materials and lead to lower costs and increased customer service. On the other hand, the planning of material transport in the context of supply chain management represents another focus of this module. By linking transport connections and different facilities, the material source (production plant) is connected with the material sink (customer). For given material flows or shipments, it is considered how to choose the optimal (in terms of minimal costs) distribution and transportation chain from the set of possible logistics chains, which asserts the compliance of delivery times and further constraints. Furthermore, this module offers the possibility to learn about different aspects of the tactical and operational planning level in Suppy Chain Mangement, including methods of scheduling as well as different approaches in procurement and distribution logistics. Finally, issues of warehousing and inventory management will be discussed.

Health Care Management addresses specific Supply Chain Management problems in the health sector. Important applications arise in scheduling and internal logistics of hospitals.

Remarks

Some lectures and courses are offered irregularly.

The planned lectures and courses for the next three years are announced online (http://www.ior.kit.edu).

Module: Mathematical Programming [MATHMWOR9]

Coordination: Oliver Stein
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Operations Management - Data Analysis - Informatics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
25138	Mixed Integer Programming I (p. 186)	2/1	S	4.5	O. Stein
25140	Mixed Integer Programming II (p. 187)	2/1	W	4.5	O. Stein
25128	Special Topics in Optimization I (p. 323)	2/1	W/S	4.5	O. Stein
25126	Special Topics in Optimization II (p. 324)	2/1	W/S	4.5	O. Stein
2550484	Graph Theory and Advanced Location Models (p. 196)	2/1	W	4.5	S. Nickel
2550497	Software Laboratory: OR Models II (p. 312)	2/1	S	4.5	S. Nickel
2550111	Nonlinear Optimization I (p. 241)	2/1	S	4.5	O. Stein
2550113	Nonlinear Optimization II (p. 242)	2/1	S	4.5	O. Stein
2550134	Global Optimization I (p. 194)	2/1	W	4.5	O. Stein
2550136	Global Optimization II (p. 195)	2/1	W	4.5	O. Stein

Learning Control / Examinations
The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
Upon consultation with the module coordinator, alternatively one lecture from the modules *Operations Research in Supply Chain Management and Health Care Management* [WW4OR5] and *Stochastic Modeling and Optimization* [WW4OR7] or one of the lectures *Game Theory I* [2520525] and *Game Theory II* [2521369] may be accepted.

Learning Outcomes
The student

- names and describes basic notions for advanced optimization methods, in particular from continuous and mixed integer programming, location theory, and graph theory,
- knows the indispensable methods and models for quantitative analysis,
- models and classifies optimization problems and chooses the appropriate solution methods to solve also challenging optimization problems independently and, if necessary, with the aid of a computer,
- validates, illustrates and interprets the obtained solutions,
- identifies drawbacks of the solution methods and, if necessary, is able to makes suggestions to adapt them to practical problems.

Content
The modul focuses on theoretical foundations as well as solution algorithms for optimization problems with continuous and mixed integer decision variables, for location problems and for problems on graphs.

Remarks
The lectures are partly offered irregularly. The curriculum of the next three years is available online (www.ior.kit.edu).
For the lectures of Prof. Stein a grade of 30 % of the exercise course has to be fulfilled. The description of the particular lectures is more detailed.

Module: Stochastic Modelling and Optimization [MATHMWOR10]

Coordination: Karl-Heinz Waldmann
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Operations Management - Data Analysis - Informatics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2550679	Markov Decision Models I (p. 332)	2/1/2	W	5	K. Waldmann
2550682	Markov Decision Models II (p. 333)	2/1/2	S	4.5	K. Waldmann
2550674	Quality Control I (p. 277)	2/1/2	W	4.5	K. Waldmann
25659	Quality Control II (p. 278)	2/1/2	S	4.5	K. Waldmann
25687	Optimization in a Random Environment (p. 255)	2/1/2	W/S	4.5	K. Waldmann
2550662	Simulation I (p. 308)	2/1/2	W	4.5	K. Waldmann
2550665	Simulation II (p. 309)	2/1/2	S	4.5	K. Waldmann
25688	OR-oriented modeling and analysis of real problems (project) (p. 257)	1/0/3	W/S	4.5	K. Waldmann

Learning Control / Examinations
The assessment is carried out as partial written exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module seperately.
The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
None.

Learning Outcomes
The student knows and understands stochastic relationships and has a competent knowledge in modelling, analyzing and optimizing stochastic systems in economics and engineering.

Content
see courses

Module: Informatics [MATHMWINFO1]

Coordination: Hartmut Schmeck, Andreas Oberweis, Detlef Seese, Rudi Studer, Stefan Tai
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Operations Management - Data Analysis - Informatics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2511102	Algorithms for Internet Applications (p. 143)	2/1	W	5	H. Schmeck
2511030	Applied Informatics I - Modelling (p. 146)	2/1	W	4	A. Oberweis, R. Studer, S. Agarwal
2511032	Applied Informatics II - IT Systems for e-Commerce (p. 147)	2/1	S	4	S. Tai
2511400	Complexity Management (p. 158)	2/1	S	5	D. Seese
2511200	Database Systems (p. 164)	2/1	S	5	A. Oberweis, Dr. D. Sommer
2511206	Software Engineering (p. 310)	2/1	W	5	A. Oberweis, D. Seese
2511500	Service Oriented Computing 1 (p. 306)	2/1	W	5	S. Tai
2511300	Knowledge Management (p. 346)	2/1	W	5	R. Studer
2511504	Cloud Computing (p. 157)	2/1	W	5	S. Tai, Kunze
2511202	Database Systems and XML (p. 165)	2/1	W	5	A. Oberweis
2511212	Document Management and Groupware Systems (p. 168)	2	S	4	S. Klink
2511100	Efficient Algorithms (p. 170)	2/1	S	5	H. Schmeck
2511600	Enterprise Architecture Management (p. 172)	2/1	W	5	T. Wolf
2511402	Intelligent Systems in Finance (p. 205)	2/1	S	5	D. Seese
2511404	IT Complexity in Practice (p. 223)	2/1	W	5	D. Seese, Kreidler
2511302	Knowledge Discovery (p. 214)	2/1	W	5	R. Studer
2511214	Management of IT-Projects (p. 222)	2/1	S	5	R. Schätzle
2511210	Business Process Modelling (p. 233)	2/1	W	5	A. Oberweis, M. Mevius
2511106	Nature-inspired Optimisation Methods (p. 238)	2/1	W	5	S. Mostaghim, P. Shukla
2511104	Organic Computing (p. 258)	2/1	S	5	H. Schmeck, S. Mostaghim
2590458	Computational Economics (p. 160)	2/1	W	4,5	P. Shukla, S. Caton
2511216	Capability maturity models for software and systems engineering (p. 282)	2	S	4	R. Kneuper
2511304	Semantic Web Technologies I (p. 287)	2/1	W	5	R. Studer, S. Rudolph, A. Harth
2511306	Semantic Web Technologies II (p. 288)	2/1	S	5	E. Simperl, A. Harth, S. Rudolph, Daniel Oberle
2511308	Service Oriented Computing 2 (p. 307)	2/1	S	5	R. Studer, S. Agarwal, B. Norton
2511208	Software Technology: Quality Management (p. 315)	2/1	S	5	A. Oberweis
25700sp	Special Topics of Efficient Algorithms (p. 319)	2/1	W/S	5	H. Schmeck
SBI	Special Topics of Enterprise Information Systems (p. 318)	2/1	W/S	5	A. Oberweis
KompMansp	Special Topics of Complexity Management (p. 320)	2/1	W/S	5	D. Seese
SSEsp	Special Topics of Software- and Systemsengineering (p. 321)	2/1	W/S	5	A. Oberweis, D. Seese
25860sem	Special Topics of Knowledge Management (p. 322)	2/1	W/S	5	R. Studer
2511602	Strategic Management of Information Technology (p. 336)	2/1	S	5	T. Wolf
2511502	Web Service Engineering (p. 344)	2/1	S	5	C. Zirpins
2511204	Workflow-Management (p. 348)	2/1	S	5	A. Oberweis

25810	Practical Seminar Knowledge Discovery (p. 305)	2	S	4	R. Studer
PraBI	Computing Lab Information Systems (p. 268)	2	W/S	5	A. Oberweis, D. Seese, R. Studer
25700p	Advanced Lab in Efficient Algorithms (p. 269)	3	W/S	4	H. Schmeck
25762p	Computing Lab in Intelligent Systems in Finance (p. 270)	3	W/S	4	D. Seese
25818	Computing Lab in Complexity Management (p. 271)	3	W/S	4	D. Seese
25820	Lab Class Web Services (p. 272)	2	W	4	S. Tai, C. Zirpins
25740p	Ecxercises in Knowlegde Management (p. 273)	3	W/S	4	R. Studer
2511218	n.n. (p. 145)	2/0	W	4	R. Kneuper

Learning Control / Examinations
The assessment is carried out as partial exams (according to Section 4(2) of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. For passing the module exam in every singled partial exam the respective minimum requirements has to be achieved.
The examinations are offered every semester. Re-examinations are offered at every ordinary examination date. The assessment procedures are described for each course of the module seperately.
When every singled examination is passed, the overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
It is only possible to choose a course if the course or a similar one in an other module has not been attended in the Bachelor or Master programme.
One course has to be chosen from the core courses.
Core courses are: *Algorithms for Internet Applications* [2511102], *Applied Informatics I - Modelling* [2511030], *Applied Informatics II - IT Systems for e-Commerce* [2511032], *Complexity Management* [2511400], *Database Systems* [2511200], *Software Engineering* [2511206], *Service-oriented Computing I* [2511500] and *Knowledge Management* [2511300].
It is only allowed to choose one lab.

Learning Outcomes
The student

- has the ability to master methods and tools in a complex discipline and to demonstrate innovativness regarding the methods used,
- knows the principles and methods in the context of their application in practice,
- is able to grasp and apply the rapid developments in the field of computer science, which are encountered in work life, quickly and correctly, based on a fundamental understanding of the concepts and methods of computer science,
- is capable of finding and defending arguments for solving problems.

Content
The thematic focus will be based on the choice of courses in the areas of Effiziente Algorithmen, Betriebliche Informations- und Kommunikationssysteme, Wissensmanagement, Komplexitätsmanagement and Software- und Systems Engineering.

Module: Emphasis in Informatics [MATHMWINFO2]

Coordination: Hartmut Schmeck, Andreas Oberweis, Detlef Seese, Rudi Studer, Stefan Tai
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Operations Management - Data Analysis - Informatics

ECTS Credits	Cycle	Duration
9	Every term	1

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2511102	Algorithms for Internet Applications (p. 143)	2/1	W	5	H. Schmeck
2511030	Applied Informatics I - Modelling (p. 146)	2/1	W	4	A. Oberweis, R. Studer, S. Agarwal
2511032	Applied Informatics II - IT Systems for e-Commerce (p. 147)	2/1	S	4	S. Tai
2511400	Complexity Management (p. 158)	2/1	S	5	D. Seese
2511200	Database Systems (p. 164)	2/1	S	5	A. Oberweis, Dr. D. Sommer
2511500	Service Oriented Computing 1 (p. 306)	2/1	W	5	S. Tai
2511206	Software Engineering (p. 310)	2/1	W	5	A. Oberweis, D. Seese
2511300	Knowledge Management (p. 346)	2/1	W	5	R. Studer
2511202	Database Systems and XML (p. 165)	2/1	W	5	A. Oberweis
2511212	Document Management and Groupware Systems (p. 168)	2	S	4	S. Klink
2511100	Efficient Algorithms (p. 170)	2/1	S	5	H. Schmeck
2511600	Enterprise Architecture Management (p. 172)	2/1	W	5	T. Wolf
2511402	Intelligent Systems in Finance (p. 205)	2/1	S	5	D. Seese
2511404	IT Complexity in Practice (p. 223)	2/1	W	5	D. Seese, Kreidler
2511302	Knowledge Discovery (p. 214)	2/1	W	5	R. Studer
2511214	Management of IT-Projects (p. 222)	2/1	S	5	R. Schätzle
2511210	Business Process Modelling (p. 233)	2/1	W	5	A. Oberweis, M. Mevius
2511106	Nature-inspired Optimisation Methods (p. 238)	2/1	W	5	S. Mostaghim, P. Shukla
2511104	Organic Computing (p. 258)	2/1	S	5	H. Schmeck, S. Mostaghim
2590458	Computational Economics (p. 160)	2/1	W	4,5	P. Shukla, S. Caton
2511216	Capability maturity models for software and systems engineering (p. 282)	2	S	4	R. Kneuper
2511304	Semantic Web Technologies I (p. 287)	2/1	W	5	R. Studer, S. Rudolph, A. Harth
2511306	Semantic Web Technologies II (p. 288)	2/1	S	5	E. Simperl, A. Harth, S. Rudolph, Daniel Oberle
2511308	Service Oriented Computing 2 (p. 307)	2/1	S	5	R. Studer, S. Agarwal, B. Norton
2511208	Software Technology: Quality Management (p. 315)	2/1	S	5	A. Oberweis
SBI	Special Topics of Enterprise Information Systems (p. 318)	2/1	W/S	5	A. Oberweis
25700sp	Special Topics of Efficient Algorithms (p. 319)	2/1	W/S	5	H. Schmeck
KompMansp	Special Topics of Complexity Management (p. 320)	2/1	W/S	5	D. Seese
SSEsp	Special Topics of Software- and Systemsengineering (p. 321)	2/1	W/S	5	A. Oberweis, D. Seese
25860sem	Special Topics of Knowledge Management (p. 322)	2/1	W/S	5	R. Studer
2511602	Strategic Management of Information Technology (p. 336)	2/1	S	5	T. Wolf
2511502	Web Service Engineering (p. 344)	2/1	S	5	C. Zirpins
2511204	Workflow-Management (p. 348)	2/1	S	5	A. Oberweis
PraBI	Computing Lab Information Systems (p. 268)	2	W/S	5	A. Oberweis, D. Seese, R. Studer

25700p	Advanced Lab in Efficient Algorithms (p. 269)	3	W/S	4	H. Schmeck
25762p	Computing Lab in Intelligent Systems in Finance (p. 270)	3	W/S	4	D. Seese
25818	Computing Lab in Complexity Management (p. 271)	3	W/S	4	D. Seese
25810	Practical Seminar Knowledge Discovery (p. 305)	2	S	4	R. Studer
25820	Lab Class Web Services (p. 272)	2	W	4	S. Tai, C. Zirpins
25740p	Ecxercises in Knowlegde Management (p. 273)	3	W/S	4	R. Studer
2511504	Cloud Computing (p. 157)	2/1	W	5	S. Tai, Kunze
2511218	n.n. (p. 145)	2/0	W	4	R. Kneuper

Learning Control / Examinations
The assessment is carried out as two partial exams (according to Section 4(2) of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. For passing the module exam in every singled partial exam the respective minimum requirements has to be achieved.
The examinations are offered every semester. Re-examinations are offered at every ordinary examination date. The assessment procedures are described for each course of the module seperately.
When every singled examination is passed, the overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Conditions
The module *Informatics* [MATHMWINFO1] has to be completed successfully.

Learning Outcomes
The student

- has the ability to master methods and tools in a complex discipline and to demonstrate innovativness regarding the methods used,
- knows the principles and methods in the context of their application in practice,
- is able to grasp and apply the rapid developments in the field of computer science, which are encountered in work life, quickly and correctly, based on a fundamental understanding of the concepts and methods of computer science,
- is capable of finding and defending arguments for solving problems.

Content
The thematic focus will be based on the choice of courses in the areas of Effiziente Algorithmen, Betriebliche Informations- und Kommunikationssysteme, Wissensmanagement, Komplexitätsmanagement and Software- und Systems Engineering.

Module: Seminar [MATHMWSEM02]

Coordination: Oliver Stein
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Finance - Risk Management - Managerial Economics

ECTS Credits	Cycle	Duration
3		

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
2530293	Seminar in Finance (p. 291)	2	W/S	3	M. Uhrig-Homburg, M. Ruckes
SemFBV1	Seminar in Insurance Management (p. 297)	2	W/S	3	U. Werner
SemFBV2	Seminar in Operational Risk Management (p. 298)	2	W/S	3	U. Werner
SemFBV3	Seminar in Risk Theory and Actuarial Science (p. 302)	2	W/S	3	C. Hipp
2577915	Seminar: Management and Organization (p. 304)	2	W/S	3	H. Lindstädt
SemWIOR4	Seminar in Game and Decision Theory (p. 303)	2	W/S	3	S. Berninghaus
SemWIOR3	Seminar in Experimental Economics (p. 300)	2	W/S	3	S. Berninghaus
SemWIOR2	Seminar Economic Theory (p. 345)	2	W/S	3	C. Puppe

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Module: Seminar [MATHMWSEM03]

Coordination: Oliver Stein
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Operations Management - Data Analysis - Informatics

ECTS Credits	Cycle	Duration
3		

Courses in module

ID	Course	Hours per week C/E/T	Term	CP	Responsible Lecturer(s)
SemAIFB1	Seminar in Enterprise Information Systems (p. 289)	2	W/S	4	R. Studer, A. Oberweis, T. Wolf, R. Kneuper
SemAIFB2	Seminar Efficient Algorithms (p. 290)	2	W/S	3	H. Schmeck
SemAIFB3	Seminar Complexity Management (p. 292)	2	W/S	3	D. Seese
SemAIFB4	Seminar Knowledge Management (p. 296)	2	W	4	R. Studer
2590470	Seminar Service Science, Management & Engineering (p. 294)	2	W/S	4	C. Weinhardt, G. Satzger, R. Studer, S. Tai
2550131	Seminar in Continous Optimization (p. 301)	2	W/S	3	O. Stein
2550491	Seminar in Discrete Optimization (p. 299)	2	W/S	3	S. Nickel
SemWIOR1	Seminar Stochastic Models (p. 295)	2	W/S	3	K. Waldmann

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Module: [MATHWMSQ01]

Coordination: Studiendekan/Studiendekanin
Degree programme: Wirtschaftsmathematik (M.Sc.)
Subject: Key Competences

ECTS Credits	Cycle	Duration
3-4		

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

5 Courses

5.1 All Courses

Course: Adaptive Finite Element Methods [MATHNM19]

Coordinators: Willy Dörfler
Part of the modules: Adaptive Finite Element Methods (p. 88)[MATHMWNM19]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Advanced Econometrics of Financial Markets [2520381]

Coordinators: Svetlozar Rachev
Part of the modules: Mathematical and Empirical Finance (p. 121)[MATHMWSTAT1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	en

Learning Control / Examinations
The assessment of this course consists of a written examination (following §4(2), 1 SPO) and of possible additional assignments during the course (following §4(2), 3 SPO).

Conditions
None.

Learning Outcomes
After successful completion of the course students will have attained both knowledge and competency to comprehend the theories behind portfolio management of major financial institutions. Hence students can adapt this understanding to the more specialised needs of the intermediary.

Content
Advanced Econometrics of Financial Markets covers: Forecasting stock return, market microstructure(non-synchronised trading, spread and modelling transactions), “event studies analysis”, capital asset pricing model, multi-factor price models, intertemporal equilibrium models.

Media
transparencies, exercises.

Literature
Campbell, Lo, McKinlay: The Econometrics of Financial Markets. Princeton University Press.

Course: Algebra [MATHAG05]

Coordinators: Frank Herrlich, Stefan Kühnlein, Claus-Günther Schmidt, Gabriela Weitze-Schmithüsen
Part of the modules: Algebra (p. 28)[MATHMWAG05]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Algebraic Geometry [MATHAG10]

Coordinators: Frank Herrlich, Stefan Kühnlein
Part of the modules: Algebraic Geometry (p. 33)[MATHMWAG10]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Algebraic Number Theory [MATHAG09]

Coordinators: Stefan Kühnlein, Claus-Günther Schmidt
Part of the modules: Algebraic Number Theory (p. 32)[MATHMWAG09]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Algorithms for Internet Applications [2511102]

Coordinators: Hartmut Schmeck
Part of the modules: Emphasis in Informatics (p. 133)[MATHMWINFO2], Informatics (p. 131)[MATHMWINFO1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	en

Learning Control / Examinations
The assessment consists of a written exam (60 min) (according to Section 4(2), 1 of the examination regulation) and an additional written examination (called "bonus exam", 45 min) (according Section 4(2), 3 of the examination regulation).
The grade of this course is the achieved grade in the written examination. If this grade is at least 4.0 and at most 1.3, a passed bonus exam will improve it by one grade level (i.e. by 0.3 or 0.4).

Conditions
None.

Learning Outcomes
The students will learn to master methods and concepts of essential algorithms within Internet applications and to develop capabilities for innovative improvements. The course aims at teaching advanced concepts for the design and application of algorithms with respect to the requirements in networked systems. Based on a fundamental understanding of taught concepts and methods the students should be able to select appropriate concepts and methods for problem settings in their future professional life, and - if necessary - customize and apply them in an adequate way. The students will be capable to find appropriate arguments for their chosen approach to a problem setting.
In particular, the student will

- know the structure and elementary protocols of the Internet (TCP/IP) and standard routing algorithms (distance vector and link state routing),
- know methods of information retrieval in the WWW, algorithms for searching information and be able to assess the performance of search engines,
- know how to design and use cryptographic methods and protocols to guarantee and check confidentiality, data integrity and authenticity,
- know algorithmic basics of electronic payment systems and of electronic money.

Content
Internet and World Wide Web are changing our world, this core course provides the necessary background and methods for the design of central applications of the Internet. After an introduction into Internet technology the following topics are addressed: information retrieval in the www, structure and functioning of search engines, foundations of secure communication, electronic payment systems and digital money, and - if time permits - security architectures.

Media
Powerpoint slides with annotations on graphics screen, access to Internet resources, recorded lectures

Literature

- Tanenbaum: Computer Networks, 4th edition, Prentice-Hall 2003.
- Baeza-Yates, Ribeiro-Neto: Modern Information Retrieval. Addison-Wesley, 1999.
- Wobst: Abenteuer Kryptologie : Methoden, Risiken und Nutzen der Datenverschlüsselung, 3rd edition. Addison-Wesley, 2001.
- Schneier: Applied Cryptography, John Wiley, 1996.
- Furche, Wrightson: Computer money : Zahlungssysteme im Internet [Übers.: Monika Hartmann]. - 1. Aufl. - Heidelberg : dpunkt, Verl. für Digitale Technologie, 1997.

Elective literature:

- Further references will be given in the course.

Course: Survival Analysis [MATHST19]

Coordinators: Bernhard Klar, Norbert Henze, Claudia Kirch
Part of the modules: Survival Analysis (p. 107)[MATHMWST19]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: n.n. [2511218]

Coordinators: Ralf Kneuper
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
4	2/0	Winter term	de

Learning Control / Examinations
The assessment of this course is a written or (if necessary) oral examination according to §4(2) of the examination regulation.

Conditions
None.

Learning Outcomes
The students have a full understanding of the foundations of the analysis and management of requirements as part of the development process of software and systems. They know the main terminology and approaches of this topic, and are able to express requirements themselves using different description methods.

Content
The analysis and management of requirements is a central task in the development of software and systems, addressing the border between the application discipline and computer science. The adequate performance of this task has a decisive influence on the whether or not a development project will be successful. The lecture provides an introduction to this topic, using the syllabus for the "Certified Professional for Requirements Engineering" (CPRE) as a guideline.
Lecture structure:
1. Introduction and overview, motivation
2. Identifying requirements
3. Documenting requirements (in natural language or using a modelling language such as UML)
4. Verification and validation of requirements
5. Management of requirements
6. Tool support

Literature
Literature will be given in the lecture.

Course: Applied Informatics I - Modelling [2511030]

Coordinators: Andreas Oberweis, Rudi Studer, Sudhir Agarwal
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
Basic knowledge about the strengths and weaknesses of various modeling approaches including their application areas.

Content
In the context of complex information systems, modelling is of central importance, e.g. – in the context of systems to be developed – for a better understanding of their functionality or in the context of existing systems for supporting maintenance and further development.
Modelling, in particular modelling of information systems, forms the core part of this lecture. The lecture is organized in two parts. The first part mainly covers the modelling of static aspectes, the second part covers the modelling of dynamic aspects of information systems.
The lecture sets out with a definition of modelling and the advantages of modelling. After that, advanced aspects of UML, the Entity Relationship model (ER model) and description logics as a means of modelling static aspects will be explained. This will be complemented by the relational data model and the systematic design of databases based on ER models. For modelling dynamic aspects, different types of petri-nets as well as well as event driven process chains together with their respective analysis techniques will be introduced.

Media
Slides.

Literature

- Bernhard Rumpe. Modellierung mit UML, Springer-Verlag, 2004.
- R. Elmasri, S. B. Navathe. Fundamentals of Database Systems. Pearson Education, 4. Aufl., 2004, ISBN 0321204484.
- W. Reisig. Petri-Netze, Springer-Verlag, 1986.

Elective literature:

- Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, York Sure: Semantic Web - Grundlagen, Springer, 2008 (ISBN 978-3-540-33993-9)
- Staab, Studer: Handbook on Ontologies, Springer, 2003
- J.L. Peterson: Petri Net Theory and Modeling of Systems, Prentice Hall, 1981.
- Franz Baader, Diego Calvanese, Deborah McGuinness, Daniele Nardi, Peter Patel-Schneider. The Description Logic Handbook - Theory, Implementation and Applications, Cambridge 2003.

Course: Applied Informatics II - IT Systems for e-Commerce [2511032]

Coordinators: Stefan Tai
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Summer term	de

Learning Control / Examinations

Conditions
Knowledge of content of the courses *Foundations of Informatics I* [2511010] and *Foundations of Informatics II* [2511012] is expected.

Learning Outcomes
The student learns about IT methods and systems in support of modern electronic commerce. The student should be able to select, asess, design, and apply these methods and systems in a context-sensitive manner.

Content
The course introduces methods and systems in support of electronic commerce, including the topics:

- application architectures (incl. client server architectures)
- document description and exchange (incl. XML)
- enterprise middleware (incl. CORBA, Messaging Middleware, Java Enterprise Edition)
- Web services and SOA

Media
Slides, internet resources.

Literature
Tba in the lecture.

Course: Arithmetic of Elliptic Curves [ArellKurv]

Coordinators: Claus-Günther Schmidt
Part of the modules: Arithmetic of Elliptic Curves (p. 44)[MATHAG22]

ECTS Credits	Hours per week	Term	Instruction language
8	4+2		

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Asset Pricing [2530555]

Coordinators: Marliese Uhrig-Homburg, Martin E. Ruckes
Part of the modules: Finance 2 (p. 111)[MATHMWBWLFBV2], Finance 1 (p. 110)[MATHMWBWLFBV1], Finance 3 (p. 113)[MATH4BWLFBV11], F2&F3 (Finance) (p. 112)[MATHMWBWLFBV3]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	

Learning Control / Examinations

Conditions
None.

Recommendations
We strongly recommend knowledge of the basic topics in investments (bachelor course), which will be necessary to be able to follow the course.

Learning Outcomes
The objective of this course is to become familiar with advanced concepts in asset pricing (in particular the stochastic discount factor model). The second half of the course will put a focus on empirical questions related to the previous part. We strongly recommend knowledge of the basic topics in investments (bachelor course), which will be necessary to be able to follow the course.

Content
This lecture deals with the valuation of risky cash flows. A stochastic discount model and a central equation will be introduced, which form the basis of nearly every valuation model in finance. That includes the valuation of stocks, bonds and derivatives. The first part of the lecture will present the theory, the second part covers empirical questions related to this approach.

Literature
Basic literature

- Asset pricing / Cochrane, J.H. - Rev. ed., Princeton Univ. Press, 2005.
- The econometrics of financial markets / Campbell, J.Y., Lo, A.W., MacKinlay, A.C. - 2. printing, with corrections, Princeton Univ. Press, 1997.

Elective literature

- Investments / Bodie, Z., Kane, A., Marcus, A.J. - 8. ed., McGraw-Hill, 2009.

Course: Asymptotics of evolution equations [AsEvolGl]

Coordinators: Roland Schnaubelt, Lutz Weis
Part of the modules: Asymptotics of evolution equations (p. 72)[MATHAN30]

ECTS Credits	Hours per week	Term	Instruction language
3	2		

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Asymptotic Stochastics [MATHST07]

Coordinators: Norbert Henze, Claudia Kirch, Bernhard Klar
Part of the modules: Asymptotic Stochastics (p. 95)[MATHMWST07]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Auction Theory [2590408]

Coordinators: Karl-Martin Ehrhart, Stefan Seifert
Part of the modules: Decision and Game Theory (p. 120)[MATHMWVWL10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/2	Winter term	de

Learning Control / Examinations
The assessment of this course is a written examination (following §4(2), 1 SPO) of 80 mins.
The exam is offered each semester.

Conditions
None.

Recommendations
We suggest to attend either Game Theory I or Economics of Uncertainty beforehand.

Learning Outcomes
The student

- understands problems of auction design and empirical methods,
- designs and analyzes auction desgins,
- evaluates empirically demo-experiments.

Content
Auction theory is based on game theory. Practical aspects and experiences are also discussed. Main topics are:

- Single- and multi-unit auctions
- procurement auctions
- license auctions
- electronic auctions (e.g. eBay, C2C, B2B)
- and multi-attributive auctions.

Literature

- Berninghaus, S., K.-M. Ehrhart und W. Güth: Strategische Spiele, 2nd extended edition, Springer Verlag, 2006
- Krishna, V.: Auction Theory, Academic Press,2002
- Kräkel, M.: Auktionstheorie und interne Organisation, Gabler Verlag, 1992
- Milgrom, P.: Putting Auction Theory to Work, Cambridge University Press, 2004
- Ausubel, L.M. und P. Cramton: Demand Reduction and Inefficiency in Multi-Unit Auctions, University of Maryland, 1999

Course: Bank Management and Financial Markets, Applied Econometrics [2520355]

Coordinators: Karl-Heinz Vollmer
Part of the modules: Mathematical and Empirical Finance (p. 121)[MATHMWSTAT1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/2	Summer term	de

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Literature

- Bierwag: Duration-Analysis; Managing Interest Rat Risk, 1987
- Andrew Harvey: The Econometric Analysis of Time Series, 2nd. Ed. 1993
- Andrew Harvey: Time Series Models, 2nd. Ed. 1994
- Granger/Newbold: Forecasting Economic Time Series; 2nd. Ed. 1986
- Pindyck, Rubinfeld: Econometric Models and Economic Forecasts, 1998
- B. Rolfes: Gesamtbanksteuerung, 1999

Course: Medical imaging [MATHNM15]

Coordinators: Andreas Rieder
Part of the modules: Medical imaging (p. 84)[MATHMWNM15]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Exchanges [2530296]

Coordinators: Jörg Franke
Part of the modules: F2&F3 (Finance) (p. 112)[MATHMWBWLFBV3], Finance 3 (p. 113)[MATH4BWLFBV11], Finance 2 (p. 111)[MATHMWBWLFBV2]

ECTS Credits	Hours per week	Term	Instruction language
1.5	1	Summer term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
Students learn about current developments regarding organisation of exchanges and securities trading.

Content

- Organisation of exchanges: Changing Zeitgeist - Corporates instead of cooparative structures
- Market models: order driven vs. market maker - Liquidity provision for less frequently traded securities
- Trading systems: The end of an era? - No more need for running traders?
- Clearing: Diversity instead of uniformity - Safety for all?
- Settlement: Increasing importance - Does efficient settlement assure the "value added" of exchanges in the long run?

Literature
Elective literature:
Educational material will be offered within the lecture.

Course: Brownian Motion [MATHST10]

Coordinators: Nicole Bäuerle, Norbert Henze, Claudia Kirch, Günter Last, Luitgard Veraart
Part of the modules: Brownian Motion (p. 98)[MATHMWST10]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Cloud Computing [2511504]

Coordinators: Stefan Tai, Kunze
Part of the modules: Emphasis in Informatics (p. 133)[MATHMWINFO2], Informatics (p. 131)[MATHMWINFO1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
The course introduces concepts, methods, and techniques of Cloud Computing for providing and consuming IT resources, development- and runtime environments, and software applications of all kinds as Web services.

Content
Building on compute and storage virtualization, Cloud Computing provides scalable, network-centric, abstracted IT infrastructure, platforms, and software applications as on-demand services that are billed by consumption. Innovative business models, cost efficiency, and time-to-market are further promises associated with Cloud Computing. The lecture introduces Cloud Computing, covering topics such as:

- Fundamentals: Virtualization, Service-orientation
- Commercial and Open-Source Cloud offerings
- Cloud service engineering
- Web-scale Cloud service architecture
- Cloud service management
- Cloud economics
- Obstacles and opportunities

Literature
Cloud Computing: Web-basierte dynamische IT-Services, von C. Baun, M. Kunze, J. Nimis, S. Tai. Springer-Verlag 2009.

Course: Complexity Management [2511400]

Coordinators: Detlef Seese
Part of the modules: Emphasis in Informatics (p. 133)[MATHMWINFO2], Informatics (p. 131)[MATHMWINFO1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	en

Learning Control / Examinations
The assessment of this course consists of a written examination (60 min) (following §4(2), 1 SPO). The exam will be offered every semester and may be repeated at every ordinary exam date.
Questions are in German and English, answers are possible in German or in English.
In case that only a small number of candidates apply for the examination there will be offered an oral examination according to Section 4(2),1 of the examination regulation.

Conditions
None.

Recommendations
A basic knowledge in informatics is suitable.

Learning Outcomes
Students will be enabled to acquire abilities, methods and instruments in the area of complexity management and learn to use them in an innovative way. The students should be enabled to find arguments for the solution of problems in this area. The basic goal of the lecture is to enable to understand the difficulties to manage complex systems and processes.

Content
Complexity is one of the biggest challenges of our time. Central questions are: - Why humans often fail in complex situations? - What is complexity? -What are reasons for complexity? - Which parameters are essential to control complexity? - How systems have to be designed to reduce their complexity and to enable management of complexity?
The lecture gives a survey on fundamental results and handles the following topics: - Understanding of the difficulties produced by complex systems and complex processes - Foundations: modelling complex systems, complexity theory, descriptive, structural and parametric complexity, dynamic systems, topology, dimension, non-linearity, chaos, randomness and emerging structures, human shortcomings, simulation - Complexity of products and production - Complexity of markets - How to improve complexity management? - Decision support by intelligent use of IT

Media
The slides of the lectures will be provided on the website of the lecture.

Literature

- Franz Reither: Komplexitätsmanagement. Gerling Akademie Verlag, München 1997
- G. Schuh, U. Schwenk: Produktkomplexität managen. Carl Hanser Verlag, München 2001
- Ch. Perrow: Normal Accidents. Living with High-Risk technologies, Basic Books, New York, 1984.
- J.D. Sterman: Business Dynamics, Systems Thinking and Modeling for a Complex World, McGraw-Hill Higher Education, 2000.
- R. G. Downey, M.R. Fellows: Parameterized Complexity. Springer 1999
- Heinz-Otto Peitgen, Hartmut Jürgens, Dietmar Saupe: Chaos and Fractals, Springer-Verlag New York, 1992, 2004 (second edition).
- S. Wolfram: A new kind of Science. Wolfram Media Inc. 2002

Elective literature:

- M.R. Garey, D. S. Johnson: Computers and intractability A guide to the theory of NP-completeness, W. H. Freeman and Company, New York, 1979
- N. Immerman: Descriptive Complexity; Springer-Verlag, New York 1999
- R. Diestel: Graphentheorie, Springer 1996
- J. A. Bondy, U.S.R. Murty: Graph Theory, Springer 2008
- H.D. Ebbinghaus, J. Flum, W. Thomas: Mathematical Logic, Springer-Verlag, New York 1984
- Christos H. Papadimitriou: Computational Complexity, Addison-Wesley, Reading, Massachusetts, 1994
- R. Niedermeier: Invitation to Fixed-Parameter Algorithms, Oxford University Press 2006
- W. Metzler: Nichtlineare Dynamik und Chaos, Teubner Studienbücher Mathematik, Stuttgart 1998

- G. Frizelle, H. Richards (eds.): Tackling industrial complexity: the ideas that make a difference. University of Cambridge, Institute of Manufacturing 2002
- W. Bick, S. Drexl-Wittbecker: Komplexität reduzieren, Konzept. Methoden. Praxis, LOG_X Verlag GmbH, Stuttgart, 2008
- U. Lindemann, M. Maurer, T. Braun: Structural Complexity Management, An Approach for the field of Product Design, Springer-Verlag, Berlin, Heidelberg, 2009
- M. J. North, Ch. M. Macal: Managing Busieness Complexity, Discovering Strategic Solutions with Agent-Based Modeling and Simulation, Oxford University Press 2006
- S. Bornholdt, H. G. Schuster (Eds.): Handbook of Graphs and Networks, From the Genome to the Internet, Wiley-VCH, 2003
- Further references will be given in each lecture.

Remarks
The content of the lecture will permanently be adapted to actual developments. This can be the cause to changes of the described contend and schedule.
The course “Complexity Management” will not be offered any more from summer term 2016 on. The examination will be offered latest until summer term 2015 (repeaters only).

Course: Computational Economics [2590458]

Coordinators: Pradyumn Kumar Shukla, Simon Caton
Part of the modules: Emphasis in Informatics (p. 133)[MATHMWINFO2], Informatics (p. 131)[MATHMWINFO1]

ECTS Credits	Hours per week	Term	Instruction language
4,5	2/1	Winter term	en

Learning Control / Examinations
The assessment of this course is a written examination (following §4(2), 1 SPO) and by submitting written papers as part of the exercise (following §4,(2), 3 SPO).
The total grade for this lecture will consist to 70% of the grade achieved in the written examination and to 30% of the assignments during the exercises.

Conditions
None.

Learning Outcomes
The student

- understands the methods of Computational Economics and applies them on practical issues
- evaluates agent models considering bounded rational behaviour and learning algorithms,
- analyses agent models based on mathematical basics,
- knows the benefits and disadvantages of the different models and how to use them,
- examines and argues the results of a simulation with adequate statistical methods,
- is able to support the chosen solutions with arguments and can explain them.

Content
Examining complex economic problems with classic analytical methods usually requires making numerous simplifying assumptions, for example that agents behave rationally or homogeneously. Recently, widespread availability of computing power gave rise to a new field in economic research that allows the modeling of heterogeneity and forms of bounded rationality: Computational Economics. Within this new discipline, computer based simulation models are used for analyzing complex economic systems. In short, an artificial world is created which captures all relevant aspects of the problem under consideration. Given all exogenous and endogenous factors, the modelled economy evolves over time and different scenarios can be analyzed. Thus, the model can serve as a virtual testbed for hypothesis verification and falsification.

Media

- Lecture slides and exercises as pdf-files.

Literature

- R. Axelrod: "Advancing the art of simulation in social sciences". R. Conte u.a., Simulating Social Phenomena, Springer, S. 21-40, 1997.
- R. Axtel: "Why agents? On the varied motivations for agent computing in the social sciences". CSED Working Paper No. 17, The Brookings Institution, 2000.
- K. Judd: "Numerical Methods in Economics". MIT Press, 1998, Kapitel 6-7.
- A. M. Law and W. D. Kelton: "Simulation Modeling and Analysis", McGraw-Hill, 2000.
- R. Sargent: "Simulation model verification and validation". Winter Simulation Conference, 1991.
- L. Tesfation: "Notes on Learning", Technical Report, 2004.
- L. Tesfatsion: "Agent-based computational economics". ISU Technical Report, 2003.

Elective literature:

- Amman, H., Kendrick, D., Rust, J.: "Handbook of Computational Economics". Volume 1, Elsevier North-Holland, 1996.
- Tesfatsion, L., Judd, K.L.: "Handbook of Computational Economics". Volume 2: Agent-Based Computational Economics, Elsevier North-Holland, 2006.
- Marimon, R., Scott, A.: "Computational Methods for the Study of Dynamic Economies". Oxford University Press, 1999.
- Gilbert, N., Troitzsch, K.: "Simulation for the Social Scientist". Open University Press, 1999.

Remarks
This course is offered in cooperation with the Institute of Applied Informatics and Formal Description Models (AIFB).
Summer Term 2011: The course has been added to the Module [IW3INAIFB5] "*Algorithms and Applications*" and is thus also eligible for 3rd year B.Sc. students majoring in Information Engineering and Management.

Course: Computer intensive methods in statistics [MATHST20]

Coordinators: Norbert Henze, Claudia Kirch, Bernhard Klar
Part of the modules: Computer intensive methods in statistics (p. 108)[MATHMWST20]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Computer-Assisted Analytical Methods for Boundary and Eigenvalue Problems [MATHAN11]

Coordinators: Michael Plum
Part of the modules: Computer-Assisted Analytical Methods for Boundary and Eigenvalue Problems (p. 53)[MATHMWAN11]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Corporate Financial Policy [2530214]

Coordinators: Martin E. Ruckes
Part of the modules: Finance 2 (p. 111)[MATHMWBWLFBV2], F2&F3 (Finance) (p. 112)[MATHMWBWLFBV3], Finance 3 (p. 113)[MATH4BWLFBV11]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	en

Learning Control / Examinations

Conditions
None.

Learning Outcomes
Students are told profound knowledge about appropriate financing of firms.

Content
The course deals with the theory of corporate finance:

- Financing contracts
- Financing capacity
- Issuance of securities
- Capital structure
- Payout policy
- Liquidity management
- Corporate acquisitions and restructurings

Literature
Elective literature:
Tirole, J. (2006): The Theory of Corporate Finance. Princeton University Press.

Course: Database Systems [2511200]

Coordinators: Andreas Oberweis, Dr. D. Sommer
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	de

Learning Control / Examinations
The assessment consists of an 1h written exam in the first week after lecture period.

Conditions
Knowledge of course *Applied Informatics I - Modelling* [2511030] is expected.

Learning Outcomes
Students

- are familiar with the concepts and principles of data base models, languages and systems and their applications,
- can design and model relational data bases on the basis of theoretical foundations,
- are able to ensure an error-free operation and the integrity of the data base and
- know how to handle enhanced data base problems occurring in the enterprises.

Content
Database systems (DBS) play an important role in today's companies. Internal and external data is stored and processed in databases in every company. The proper management and organization of data helps to solve many problems, enables simultaneous queries from multiple users and is the organizational and operational base for the entire working procedures and processes of the company. The lecture leads in the area of the database theory, covers the basics of database languages and database systems, considers basic concepts of object-oriented and XML databases, conveys the principles of multi-user control of databases and physical data organization. In addition, it gives an overview of business problems often encountered in practice such as:

- Correctness of data (operational, semantic integrity)
- Restore of a consistent database state
- Synchronization of parallel transactions (phantom problem).

Media
Slides, Access to internet resources

Literature
Elective literature:

- Schlageter, Stucky. Datenbanksysteme: Konzepte und Modelle. Teubner 1983.
- S. M. Lang, P. C. Lockemann. Datenbankeinsatz. Springer-Verlag 1995.
- Jim Gray, Andreas Reuter. Transaction Processing: Concepts and Techniques. Morgan Kaufmann 1993.

Further literature will be given individually.

Course: Database Systems and XML [2511202]

Coordinators: Andreas Oberweis
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	de

Learning Control / Examinations
The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation in the first week after lecture period.

Conditions
None.

Learning Outcomes
Students know the basics of XML, as well as appropriate data models and are capable of generating XML documents. They are able to use XML database systems and to formulate queries to XML documents. Furthermore, they know to assess the use of XML in operational practice in different application contexts.

Content
Databases are a proven technology for managing large amounts of data. The oldest database model, the hierarchical model, was replaced by different models such as the relational or the object-oriented data model. The hierarchical model became particularly important with the emergence of the Extensible Markup Language XML. XML is a data format for structured, semi-structured, and unstructured data. In order to store XML documents consistently and reliably, databases or extensions of existing data base systems are required. Among other things, this lecture covers the data model of XML, concepts of XML query languages, aspects of storage of XML documents, and XML-oriented database systems.

Media
Slides, access to internet resources.

Literature

- M. Klettke, H. Meyer: XML & Datenbanken: Konzepte, Sprachen und Systeme. dpunkt.verlag 2003
- H. Schöning: XML und Datenbanken: Konzepte und Systeme. Carl Hanser Verlag 2003
- W. Kazakos, A. Schmidt, P. Tomchyk: Datenbanken und XML. Springer-Verlag 2002
- R. Elmasri, S. B. Navathe: Grundlagen der Datenbanksysteme. 2002
- G. Vossen: Datenbankmodelle, Datenbanksprachen und Datenbankmanagementsysteme. Oldenbourg 2000

Course: Derivatives [2530550]

Coordinators: Marliese Uhrig-Homburg
Part of the modules: Finance 1 (p. 110)[MATHMWBWLFBV1], F2&F3 (Finance) (p. 112)[MATHMWBWLFBV3], Finance 3 (p. 113)[MATH4BWLFBV11], Finance 2 (p. 111)[MATHMWBWLFBV2]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
The objective of the Derivatives lecture is to become familiar with financial markets, especially derivatives markets. Traded securities and frequently used trading strategies will be introduced. Furthermore the pricing of derivatives will be derived and their use in risk management will be discussed.

Content
The lecture deals with the application areas and valuation of financial derivatives. After an overview of the most important derivatives and their relevance, forwards and futures are analysed. Then, an introduction to the Option Pricing Theory follows. The main emphasis is on option valuation in discrete and continuous time models. Finally, construction and usage of derivatives are discussed, e.g. in the context of risk management.

Media
Slides, Exercises/Exercise sheets

Literature

- Hull (2005): Options, Futures, & Other Derivatives, Prentice Hall, 6th Edition

Elective literature:
Cox/Rubinstein (1985): Option Markets, Prentice Hall

Course: Discrete Geometry [1535]

Coordinators: Daniel Hug
Part of the modules: Discrete Geometry (p. 29)[MATHMWAG06]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Document Management and Groupware Systems [2511212]

Coordinators: Stefan Klink
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
4	2	Summer term	de

Learning Control / Examinations
The assessment consists of an 1h written exam in the first week after lecture period according to Section 4(2), 1 of the examination regulation).

Conditions
None.

Learning Outcomes
Students master the basics of integration and structure of document management systems (DMS) and know the complete DMS process - from document capture of the archiving until retrieval. Students know how to realize operative workflows. They know which activities are needed to carry out the conceptual design and installation of DMS and they are able to apply a DMS as an archive system, workflow system and retrieval system. Furthermore, they know groupware systems exemplarily and can use them for collaborative tasks.

Content
The lecture gives basics of document management and groupware systems. It covers different system categories, their interaction and their use areas and illustrates this with concrete examples. These include document management in the strict sense, scanning, Document Imaging (acquisition and visualization of scanned documents), indexing, electronic archiving, retrieval of relevant documents, workflow, groupware, and office communications.

Media
Slides, access to internet resources.

Literature

- Klaus Götzer, Udo Schneiderath, Berthold Maier, Torsten Komke: Dokumenten-Management. Dpunkt Verlag, 2004, 358 Seiten, ISBN 3-8986425-8-5
- Jürgen Gulbins, Markus Seyfried, Hans Strack-Zimmermann: Dokumenten-Management. Springer, Berlin, 2002, 700 Seiten, ISBN 3-5404357-7-8
- Uwe M. Borghoff, Peter Rödig, Jan Scheffcyk, Lothar Schmitz: Langzeitarchivierung – Methoden zur Erhaltung digitaler Dokumente. Dpunkt Verlag, 2003, 299 Seiten, ISBN 3-89864-258-5

Elective literature:
Further literature is given in each lecture individually.

Course: Plane Algebraic Curves [MATHAG16]

Coordinators: Frank Herrlich
Part of the modules: Plane Algebraic Curves (p. 38)[MATHMWAG16]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Efficient Algorithms [2511100]

Coordinators: Hartmut Schmeck
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	de

Learning Control / Examinations
The assessment consists of assignments or of a bonus exam (wrt §4 (2), 3 SPO), and a written exam (60 min.) in the week after the end of the lecturing periodwrt (§4 (2), 1 SPO).
If the mark obtained in the written exam is in between 1.3 and 4.0, a successful completion of the assignments or the bonus exam will improve the mark by one level (i.e. by 0.3 or 0.4).
Deviations from this type of assessment are announced at the beginning of this course.

Conditions
credits for the Informatics modules of years 1 and 2.

Learning Outcomes
The student will learn how to use methods and concepts of efficient algorithms and how to demonstrate adequate innovative capabilities with respect to the used methods.
This course emphasizes the teaching of advanced concepts for the design and application of algorithms, data structures, and computer infrastructures in relation to their applicability in the real world. Based on a fundamental understanding of the covered concepts and methods, students should know how to select appropriate concepts and methods for problem settings in their professional life, and, if necessary, to extend and apply them in an adequate form. The students should be enabled to find adequate arguments for justifying their chosen problem solutions.

Content
In a problem oriented way the course presents systematic approaches to the design and analysis of efficient algorithms using standard tasks of information processing as generic examples. Special emphasis is put on the influence of data structures and computer architectures on the performance and cost of algorithms.In particular, the course emphasizes the design and analysis of algorithms on parallel computers and in hardware, which is increasingly important considering the growing presence of multicore architectures.

Media

- powerpoint slides with annotations using a tablet pc
- access to applets and Internet ressources
- lecture recording (camtasia)

Literature
Akl, S.G.: The Design and Analysis of Parallel Algorithms. Prentice-Hall, Englewood Cliffs, New Jersey,1989.
Borodin, Munro: The Computational Complexity of Algebraic and Numeric Problems (Elsevier 1975)
Cormen, Leiserson, Rivest: Introduction to Algorithms (MIT Press)
Sedgewick: Algorithms (Addison-Wesley) (many different versions available)
Elective literature:
will be announced in class

Course: Introduction into Scientific Computing [EWR]

Coordinators: Willy Dörfler, Vincent Heuveline, Andreas Rieder, Christian Wieners
Part of the modules: Introduction into Scientific Computing (p. 74)[MATHMWNM05]

ECTS Credits	Hours per week	Term	Instruction language
8	3/3	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Enterprise Architecture Management [2511600]

Coordinators: Thomas Wolf
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	de

Learning Control / Examinations
The assessment of this course is a written or (if necessary) oral examination according to §4(2) of the examination regulation.

Conditions
None.

Learning Outcomes
Students understand the connection between enterprise strategy, business processes and business objects and IT architecture; they know methods to depict these connections and how they can be developed based on each other.

Content
The following topics will be covered: components of enterprise architecture, enterprise strategy including methods to develop strategies, business process (re)engineering, methods to implement changes within enterprises (management of change)

Media
Slides, access to internet resources.

Literature

- Nolan, R., Croson, D.: Creative Destruction: A Six-Stage Process for Transforming the Organization. Harvard Business School Press, Boston Mass. 1995
- Doppler, K., Lauterburg, Ch.: Change Management. Campus Verlag 1997
- Jacobson, I.: The Object Advantage, Business Process Reengineering with Object Technology. Addison-Wesley Publishing Company, Wokingham England 1994
- Keller, G., Teufel, Th.: SAP R/3 prozessorientiert anwenden. Addison Wesley 1998
- Österle, H.: Business Engineering Bd. 1 und 2. Springer Verlag, Berlin 1995

Course: Enterprise Risk Management [2530326]

Coordinators: Ute Werner
Part of the modules: Operational Risk Management I (p. 118)[MATHMWBWLFBV9], Operational Risk Management II (p. 119)[MATHMWBWLFBV10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	3/0	Winter term	de

Learning Control / Examinations
The assessment consists of oral presentations (incl. papers) within the lecture (according to Section 4 (2), 3 of the examination regulation) and a final oral exam (according to Section 4 (2), 2 of the examination regulation).
The overall grade consists of the assessment of the oral presentations incl. papers (50 percent) and the assessment of the oral exam (50 percent).

Conditions
None.

Learning Outcomes
Learning to identify, to analyse and to assess business risks; this serves as a basis for strategy and policy design regarding risks and opportunities of an enterprise. Introduction to approaches that allow to consider area-specific risk objectives, risk-bearing capacity and risk acceptance.

Content

1. Concepts and practice of risk management, based on decision theory
2. Goals, strategies and policies for the identification, analysis, assessment and management of risks
3. Insurance as an instrument for loss-financing
4. Selected aspects of risk management: e.g. environmental protection, organizational failure and D&O-coverage, development of a risk management culture
5. Organisation of risk management
6. Approaches for determining optimal combinations of risk management measures considering their investment costs and outcomes.

Literature

- K. Hoffmann. Risk Management - Neue Wege der betrieblichen Risikopolitik. 1985.
- R. Hölscher, R. Elfgen. Herausforderung Risikomanagement. Identifikation, Bewertung und Steuerung industrieller Risiken. Wiesbaden 2002.
- W. Gleissner, F. Romeike. Risikomanagement - Umsetzung, Werkzeuge, Risikobewertung. Freiburg im Breisgau 2005.
- H. Schierenbeck (Hrsg.). Risk Controlling in der Praxis. Zürich 2006.

Elective literature:
Additional literature is recommended during the course.

Remarks
To attend the course please register at the secretariy of the chair of insurance science.

Course: Evolution Equations [MATHAN12]

Coordinators: Roland Schnaubelt, Lutz Weis
Part of the modules: Evolution Equations (p. 54)[MATHMWAN12]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Fixed Income Securities [2530260]

Coordinators: Marliese Uhrig-Homburg
Part of the modules: Finance 2 (p. 111)[MATHMWBWLFBV2], F2&F3 (Finance) (p. 112)[MATHMWBWLFBV3], Finance 3 (p. 113)[MATH4BWLFBV11]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Winter term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
The objective of this course is to become familiar with national and international bond markets. Therefore, we first have a look at financial instruments that are of particular importance. Thereafter, specific models and methods that allow the evaluation of interest rate derivatives are introduced and applied.

Content
The lecture deals with both German and international bond markets, which are an important source of funding for both the corporate and the public sector. After an overview of the most important bond markets, various definitions of return are discussed. Based on that, the concept of the yield curve is presented. The modelling of the dynamics of the term structure of interest rates provides the theoretical foundation for the valuation of interest rate derivatives, which is discussed in the last part of the lecture.

Literature

- Bühler, W., Uhrig-Homburg, M., Rendite und Renditestruktur am Rentenmarkt, in Obst/Hintner, Geld-, Bank- und Börsenwesen - Handbuch des Finanzsystems, (2000), S.298-337.
- Sundaresan, S., Fixed Income Markets and Their Derivatives, South-Western College Publising, (1997).

Elective literature:

- Hull, J., Options, Futures, & Other Derivatives, Prentice Hall, Sixth Edition, (2005).

Course: Financial Time Series and Econometrics [2521359]

Coordinators: Svetlozar Rachev
Part of the modules: Mathematical and Empirical Finance (p. 121)[MATHMWSTAT1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	en

Learning Control / Examinations
The assessment of this course consists of a written examination (following §4(2), 1 SPO) and of possible additional assignments during the course (following §4(2), 3 SPO).

Conditions
None.

Learning Outcomes
After successful completion of the course students will have the knowledge and qualification to comprehend the essential models -incl. state of the arts science- in financial econometrics, as well as risk measurement and management.

Content
Financial econometrics is the econometrics of financial markets. It is a quest for models that describe financial time series such as prices, returns, interest rates, financial ratios, defaults, and so on. The economic equivalent of the laws of physics, econometrics represents the quantitative, mathematical laws of economics.

After giving definitions of financial markets' instruments and processes, and a quick overview of basic statistical notions, the present course provides students with valuable tools in regression analysis, modelling univariate time series, ARIMA and ARCH modelling. The stress is always put on the application to financial markets. All illustrations and exercises are based on real market data and situations.

Media
transparencies lecture, exercises

Literature

- Rachev S.T., Mittnik S. Fabozzi F. , Foccardi S., Jasic T. , Financial Econometrics, John Wiley,Finance, 2007
- Rachev S.T., Hsu, J. S. J., Bagasheva B. S., Fabozzi F. J., Bayesian Methods in Finance, John Wiley, Finance, 2007
- Mills: The Econometric Modelling Of Financial Markets. Cambridge University Press.

Course: Financial Intermediation [2530232]

Coordinators: Martin E. Ruckes
Part of the modules: Finance 2 (p. 111)[MATHMWBWLFBV2], F2&F3 (Finance) (p. 112)[MATHMWBWLFBV3], Finance 3 (p. 113)[MATH4BWLFBV11]

ECTS Credits	Hours per week	Term	Instruction language
4.5	3	Winter term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
Students are introduced to the theoretical fundamentals of financial intermediation.

Content

- Arguments for the existence of financial intermediaries
- Bank loan analysis, relationship lending
- Competition in the banking sector
- Stability of the financial system
- The macroeconomic role of financial intermediation

Literature
Elective literature:

- Hartmann-Wendels/Pfingsten/Weber (2006): Bankbetriebslehre, 4. Auflage, Springer Verlag.
- Freixas/Rochet (1997): Microeconomics of Banking, MIT Press.

Course: Finance and Banking [25350/1]

Coordinators: Karl-Heinz Vollmer
Part of the modules: Mathematical and Empirical Finance (p. 121)[MATHMWSTAT1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/2	Winter term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Literature

- Andrew Harvey: The Econometric Analysis of Time Series, 2^{nd} Ed. 1993
- Andrew C. Harvey: Time Series Models, 2nd. Ed.
- Walter Enders: Applied Econometric Time Series, 2^{nd} Ed., 1994
- Granger/Newbold: Forecasting Economic Time Series 2nd. Ed.
- Pindyck/Rubinfeld: Econometric Models and Economic Forecasts, 1998
- Elton/Gruber: Modern Portfolio Theory and Investment Analysis, 1995
- Byrne, Peter, Decision-Making in Property Development, 2^{nd} Ed. 1996

Course: Mathematical Finance in Continuous Time [MATHST08]

Coordinators: Nicole Bäuerle, Luitgard Veraart
Part of the modules: Mathematical Finance in Continuous Time (p. 96)[MATHMWST08]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Finite Element Methods [MATHNM07]

Coordinators: Willy Dörfler
Part of the modules: Finite Element Methods (p. 76)[MATHMWNM07]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Fourier Analysis [MATHAN14]

Coordinators: Roland Schnaubelt, Lutz Weis
Part of the modules: Fourier Analysis (p. 56)[MATHMWAN14]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Functional Analysis [FunkAna]

Coordinators: Gerd Herzog, Christoph Schmoeger, Roland Schnaubelt, Lutz Weis
Part of the modules: Functional Analysis (p. 48)[MATHMWAN05]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Spaces of Functions and Distributions [MATHAN15]

Coordinators: Michael Plum, Wolfgang Reichel, Roland Schnaubelt, Lutz Weis
Part of the modules: Spaces of Functions and Distributions (p. 57)[MATHMWAN15]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Complex Analysis II [MATHAN16]

Coordinators: Gerd Herzog, Michael Plum, Wolfgang Reichel, Christoph Schmoeger, Roland Schnaubelt, Lutz Weis
Part of the modules: Complex Analysis II (p. 58)[MATHMWAN16]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Buildings [VGebäude]

Coordinators: Enrico Leuzinger
Part of the modules: Buildings (p. 47)[MATHAG25]

ECTS Credits	Hours per week	Term	Instruction language
8	4+2		de

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Mixed Integer Programming I [25138]

Coordinators: Oliver Stein
Part of the modules: Mathematical Programming (p. 129)[MATHMWOR9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	de

Learning Control / Examinations
The assessment of the lecture is a written examination (60 minutes) according to §4(2), 1 of the examination regulation.
The examination is held in the semester of the lecture and in the following semester.
Prerequisite for admission to the written examination is attaining at least 30% of the exercise points. Therefore the online-registration for the written examination is subject to fulfilling the prerequisite.
The examination can also be combined with the examination of *Mixed Integer Programming II* [25140]. In this case, the duration of the written examination takes 120 minutes.
In a combined examination of *Mixed Integer Programming I* [25138] and *Mixed Integer Programming II* [25140], upon attaining more then 60% of the exercise points, the grade of the passed examination is improved by a third of a grading step.
In a combined examination of *Mixed Integer Programming I* [25138] and *Mixed Integer Programming II* [25140], upon attaining more then 60% of the computer exercise points, the grade of the passed examination is improved by a third of a grading step.

Conditions
None.

Learning Outcomes
The student

- knows and understands the fundamentals of linear mixed integer programming,
- is able to choose, design and apply modern techniques of linear mixed integer programming in practice.

Content
Many optimization problems from economics, engineering and natural sciences are modeled with continuous as well as discrete variables. Examples are the energy minimal design of a chemical process in which several reactors may be switched on or off, or the time minimal covering of a distance with a vehicle equipped with a gear shift. While optimal points can be defined straightforwardly, for their numerical identification an interplay of ideas from discrete and continuous optimization is necessary.
The lecture treats methods for the numerical solution of optimization problems which depend linearly on continuous as well as discrete variables. It is structured as follows:

- Existence results
- Concepts of linear optimization
- Mixed-integer linear programming (Gomory cuts, Benders decomposition)

Part II of the lecture treats nonlinear mixed integer programs.
The lecture is accompanied by computer exercises in which you can learn the programming language MATLAB and implement and test some of the methods for practically relevant examples.

Literature
Elective literature:

- C.A. Floudas, Nonlinear and Mixed-Integer Optimization: Fundamentals and Applications, Oxford University Press, 1995
- G.L. Nemhauser, L.A. Wolsey, Integer and Combinatorial Optimization, Wiley, 1988
- M. Tawarmalani, N.V. Sahinidis, Convexification and Global Optimization in Continuous and Mixed-Integer Nonlinear Programming, Kluwer, 2002.

Remarks
The lecture is offered irregularly. The curriculum of the next three years is available online (kop.ior.kit.edu).

Course: Mixed Integer Programming II [25140]

Coordinators: Oliver Stein
Part of the modules: Mathematical Programming (p. 129)[MATHMWOR9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Winter term	de

Learning Control / Examinations
The assessment of the lecture is a written examination (60 minutes) according to §4(2), 1 of the examination regulation.

The examination is held in the semester of the lecture and in the following semester.

Prerequisite for admission to the written examination is attaining at least 30% of the exercise points. Therefore the online-registration for the written examination is subject to fulfilling the prerequisite.

The examination can also be combined with the examination of *Mixed Integer Programming I* [25138]. In this case, the duration of the written examination takes 120 minutes.

In a combined examination of *Mixed Integer Programming I* [25138] and *Mixed Integer Programming II* [25140], upon attaining more then 60% of the exercise points, the grade of the passed examination is improved by a third of a grading step.

In a combined examination of *Mixed Integer Programming I* [25138] and *Mixed Integer Programming II* [25140], upon attaining more then 60% of the computer exercise points, the grade of the passed examination is improved by a third of a grading step.

Conditions
None.

Learning Outcomes
The student

- knows and understands the fundamentals of convex and of nonconvex mixed integer programming,
- is able to choose, design and apply modern techniques of nonlinear mixed integer programming in practice.

Content
Many optimization problems from economics, engineering and natural sciences are modeled with continuous as well as discrete variables. Examples are the energy minimal design of a chemical process in which several reactors may be switched on or off, or the time minimal covering of a distance with a vehicle equipped with a gear shift. While optimal points can be defined straightforwardly, for their numerical identification an interplay of ideas from discrete and continuous optimization is necessary. Part I of the lecture deals with linear mixed integer programs.
Part II treats methods for the numerical solution of optimization problems which depend nonlinearly on continuous as well as discrete variables. It is structured as follows:

- Concepts of convex optimization
- Mixed integer convex programming (branch and bound methods)
- Mixed integer nonconvex programming
- Generalized Benders decomposition
- Outer approximation methods
- Heuristics

The lecture is accompanied by computer exercises in which you can learn the programming language MATLAB and implement and test some of the methods for practically relevant examples.

Literature
Elective literature:

- C.A. Floudas, Nonlinear and Mixed-Integer Optimization: Fundamentals and Applications, Oxford University Press, 1995
- G.L. Nemhauser, L.A. Wolsey, Integer and Combinatorial Optimization, Wiley, 1988
- M. Tawarmalani, N.V. Sahinidis, Convexification and Global Optimization in Continuous and Mixed-Integer Nonlinear Programming, Kluwer, 2002.

Remarks
The lecture is offered irregularly. The curriculum of the next three years is available online (kop.ior.kit.edu).

Course: Generalized Regression Models [MATHST09]

Coordinators: Bernhard Klar, Norbert Henze, Claudia Kirch
Part of the modules: Generalized Regression Models (p. 97)[MATHMWST09]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Geometry of Schemes [MATHAG11]

Coordinators: Frank Herrlich, Stefan Kühnlein
Part of the modules: Geometry of Schemes (p. 34)[MATHMWAG11]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Geometric Group Theory [MATHAG12]

Coordinators: Gabriela Weitze-Schmithüsen
Part of the modules: Geometric Group Theory (p. 35)[MATHMWAG12]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: [GGTIIVorl]

Coordinators: Frank Herrlich, Gabriela Weitze-Schmithüsen
Part of the modules: Advanced Geometric Group Theory (p. 46)[MATHAG24]

ECTS Credits	Hours per week	Term	Instruction language
8	4+2		de

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Geometric Measure Theorie [1040]

Coordinators: Daniel Hug
Part of the modules: Geometric Measure Theory (p. 31)[MATHMWAG08]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Business Strategies of Banks [2530299]

Coordinators: Wolfgang Müller
Part of the modules: Finance 2 (p. 111)[MATHMWBWLFBV2], F2&F3 (Finance) (p. 112)[MATHMWBWLFBV3], Finance 3 (p. 113)[MATH4BWLFBV11]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
Students are told the basics of commercial banking.

Content
The management of a bank is in charge of the determination and implementation of business policy - taking into account all relevant endogenous and exogenous factors - that assures the bank's success in the long run. In this context, there exists a large body of banking models and theories which are helpful in describing the success and risk of a bank. This course is meant to be the bridging of banking theory and practical implementation. In the course of the lectures students will learn to take on the bank management's perspective.
The first chapter deals with the development of the banking sector. Making use of appropriate assumptions, a banking policy is developed in the second chapter. The design of bank services (ch. 3) and the adequate marketing plan (ch. 4) are then built on this framework. The operational business of banks must be guided by appropriate risk and earnings management (ch. 5 and 6), which are part of the overall (global) bank management (ch. 7). Chapter eight, at last, deals with the requirements and demands of bank supervision as they have significant impact on a bank's corporate policy.

Literature
Elective literature:

- A script is disseminated chapterwise within the lecture.
- Hartmann-Wendels, Thomas; Pfingsten, Andreas; Weber, Martin; 2000, Bankbetriebslehre, 2. Auflage, Springer

Course: Global Optimization I [2550134]

Coordinators: Oliver Stein
Part of the modules: Applications of Operations Research (p. 123)[MATHMWOR5], Methodical Foundations of OR (p. 125)[MATHMWOR6], Mathematical Programming (p. 129)[MATHMWOR9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Winter term	de

Learning Control / Examinations
The assessment of the lecture is a written examination (60 minutes) according to §4(2), 1 of the examination regulation.
The examination is held in the semester of the lecture and in the following semester.
Prerequisite for admission to the written examination is attaining at least 30% of the exercise points. Therefore the online-registration for the written examination is subject to fulfilling the prerequisite.
The examination can also be combined with the examination of *Global Optimization II* [2550136]. In this case, the duration of the written examination takes 120 minutes.
In a combined examination of *Global Optimization I* [2550134] and *Global Optimization II* [2550136], upon attaining more then 60% of the exercise points, the grade of the passed examination is improved by a third of a grading step.
In a combined examination of *Global Optimization I* [2550134] and *Global Optimization II* [2550136], upon attaining more then 60% of the computer exercise points, the grade of the passed examination is improved by a third of a grading step.

Conditions
None.

Learning Outcomes
The student

- knows and understands the fundamentals of deterministic global optimization,
- is able to choose, design and apply modern techniques of deterministic global optimization in practice.

Content
In many optimization problems from economics, engineering and natural sciences, numerical solution methods are only able to efficiently identify *local* optimizers, while it is much harder to find *globally* optimal points. This corresponds to the fact that by local search it is easy to find the summit of the closest mountain, but that the search for the summit of Mount Everest is rather elaborate.
Part I of the lecture treats methods for global optimization of convex functions under convex constraints. It is structured as follows:

- Introduction, examples, and terminology
- Existence results
- Optimality in convex optimization
- Duality, bounds, and constraint qualifications
- Numerical methods

Nonconvex optimization problems are treated in part II of the lecture.
The lecture is accompanied by computer exercises in which you can learn the programming language MATLAB and implement and test some of the methods for practically relevant examples.

Literature
Elective literature:

- W. Alt *Numerische Verfahren der konvexen, nichtglatten Optimierung* Teubner 2004
- C.A. Floudas *Deterministic Global Optimization* Kluwer 2000
- R. Horst, H. Tuy *Global Optimization* Springer 1996
- A. Neumaier *Interval Methods for Systems of Equations* Cambridge University Press 1990

Remarks
Part I and II of the lecture are held consecutively in the *same* semester.

Course: Global Optimization II [2550136]

Coordinators: Oliver Stein
Part of the modules: Methodical Foundations of OR (p. 125)[MATHMWOR6], Mathematical Programming (p. 129)[MATHMWOR9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Winter term	de

Learning Control / Examinations
The assessment of the lecture is a written examination (60 minutes) according to §4(2), 1 of the examination regulation.
The examination is held in the semester of the lecture and in the following semester.
Prerequisite for admission to the written examination is attaining at least 30% of the exercise points. Therefore the online-registration to the written examinationen is subject to fulfilling the prerequisite.
The examination can also be combined with the examination of *Global Optimization I* [2550134]. In this case, the duration of the written examination takes 120 minutes.
In a combined examination of *Global Optimization I* [2550134] and *Global Optimization II* [2550136], upon attaining more then 60% of the exercise points, the grade of the passed examination is improved by a third of a grading step.
In a combined examination of *Global Optimization I* [2550134] and *Global Optimization II* [2550136], upon attaining more then 60% of the computer exercise points, the grade of the passed examination is improved by a third of a grading step.

Conditions
None.

Learning Outcomes
The student

- knows and understands the fundamentals of deterministic global optimization,
- is able to choose, design and apply modern techniques of deterministic global optimization in practice.

Content
In many optimization problems from economics, engineering and natural sciences, numerical solution methods are only able to efficiently identify *local* optimizers, while it is much harder to find *globally* optimal points. This corresponds to the fact that by local search it is easy to find the summit of the closest mountain, but that the search for the summit of Mount Everest is rather elaborate.
The global solution of convex optimization problems is subject of part I of the lecture.
Part II of the lecture treats methods for global optimization of nonconvex functions under nonconvex constraints. It is structured as follows:

- Introduction and examples
- Convex relaxation
- Interval arithmetic
- Convex relaxation via αBB method
- Branch and bound methods
- Lipschitz optimization

The lecture is accompanied by computer exercises in which you can learn the programming language MATLAB and implement and test some of the methods for practically relevant examples.

Literature
Elective literature:

- W. Alt *Numerische Verfahren der konvexen, nichtglatten Optimierung* Teubner 2004
- C.A. Floudas *Deterministic Global Optimization* Kluwer 2000
- R. Horst, H. Tuy *Global Optimization* Springer 1996
- A. Neumaier *Interval Methods for Systems of Equations* Cambridge University Press 1990

Remarks
Part I and II of the lecture are held consecutively in the *same* semester.

Course: Graph Theory and Advanced Location Models [2550484]

Coordinators: Stefan Nickel
Part of the modules: Mathematical Programming (p. 129)[MATHMWOR9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Winter term	de

Learning Control / Examinations
The assessment is a 120 minutes written examination (according to §4(2), 1 of the examination regulation).
The examination is held in the term of the lecture and the following lecture.

Conditions
Basic knowledge as conveyed in the module *Introduction to Operations Research* [WI1OR] is assumed.

Learning Outcomes
The lecture is divided into two parts: In the first part "Graph Theory", basic concepts and algorithms of Graph Theory are presented, which are used in engineering, economic and socio-scientific problems. The students become acquainted with models and methods in order to optimize on graphs and networks. The second part "Advanced Location Models" addresses some selected advanced topics of location theory. The students become familiar with praxis-relevant and current research topics and learn about solution concepts of different location problems.

Content
Graph Theory is an important part of Discrete Mathematics. A special attraction is in its clearness and variety of proof techniques. Object of the first part "Graph Theory" is the mediation of basic graph theoretical concepts and algorithms, which are deployed in many areas. In focus is the modeling of different problems with graph theoretical methods und their solutions with efficient algorithms. Significant focal points are Shortest Paths, Flows, Matchings, Colorings and Matroids.
A variety of application areas of location theory has attracted increasing research interest within the last decades, because location decisions are a critical factor in strategic planning. In the second part "Advanced Location Models", some current research questions of modern industrial location theory are discussed after a short introduction. Thereby, practical models and suitable solution methods for location problems in general networks are presented. The lecture goes into details about Pareto Solutions in Networks, Ordered Median Problems, Covering Problems and Allocation Problems.

Literature

- Jungnickel: Graphs, Networks and Algorithms, 2nd edition, Springer, 2005
- Diestel: Graph Theory, 3rd edition, Springer, 2006
- Bondy, Murt: Graph Theory, Springer, 2008
- Nickel, Puerto: Location Theory, Springer, 2005
- Drezner: Facility Location – Applications and Theory, 2nd edition, Springer, 2005

Remarks
The lecture is planned to be held in the summer term 2013.
The planned lectures and courses for the next three years are announced online.

Course: Graphs and Groups [MATHAG17]

Coordinators: Frank Herrlich, Gabriela Weitze-Schmithüsen
Part of the modules: Graphs and Groups (p. 39)[MATHMWAG17]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Foundations of Continuum Mechanics [MATHNM11]

Coordinators: Christian Wieners
Part of the modules: Foundations of Continuum Mechanics (p. 80)[MATHMWNM11]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Insurance Game [2530372]

Coordinators: Christian Hipp, Jasmin Berdel, Alireza Edalati
Part of the modules: Insurance: Calculation and Control (p. 114)[MATHMWBWLFBV2]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	de

Learning Control / Examinations
See module description.

Conditions
None.

Learning Outcomes

Content

Literature

- Insgame: Das Unternehmensplanspiel Versicherungen, Lehrstuhl für Versicherungswirtschaft, FBV, Uni Karlsruhe
- Zweifel, Eisen: Versicherungsökonomie, 2000, Kapitel 1, 2 und 5
- Aktuelle Ausgaben der Zeitschrift „Versicherunsgwirtschaft“

Course: Insurance Models [2530300]

Coordinators: Christian Hipp, Jasmin Berdel, Alireza Edalati
Part of the modules: Insurance: Calculation and Control (p. 114)[MATHMWBWLFBV2]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	de

Learning Control / Examinations
See module description.

Conditions
None.

Learning Outcomes

Content

Literature
Elective literature:

- Versicherungsbetriebslehre: Das Risiko und seine Kalkulation. Studienhefte 21, 22, 23. gabler Studientexte
- Gerber: An Introduction to mathematical Risk Theory. Huebner Foundation Monograph 8, Wharton School.

Course: Insurance Optimisation [2530316]

Coordinators: Christian Hipp
Part of the modules: Applications of Actuarial Sciences I (p. 115)[MATHMWBWLFBV4], Applications of Actuarial Sciences II (p. 116)[WM4BWLFBV5]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	de

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Literature

Elective literature:

- Korn, R. Optimal Portfolios. World Scientific 1997
- Taksar, M. Optimal Risk/Dividend Distribution Control Models: Applications to Insurance. Math.Meth.OR 2000
- Hipp, C. und Plum, M. Optimal investment for an investor with state dependent income, and for insurers. Finance and Stochastics 2003.
- Hipp, Vogt: Optimal Dynamic Reinsurance. ASTIN Bulletin, Vol 33 2003.

Course: Insurance Statistics [2530303]

Coordinators: Christian Hipp, Michael Schrempp
Part of the modules: Applications of Actuarial Sciences I (p. 115)[MATHMWBWLFBV4], Insurance Statistics (p. 117)[MATHMWBWLFBV8], Applications of Actuarial Sciences II (p. 116)[WM4BWLFBV5]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Winter term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Literature
Elective literature:

- Janka, Tinsley: Introduction to Linear Models and Statistical Inference. Wiley 2005.
- McCullagh, Nelder: generalized Linear Models. Chapman & Hull 1989.
- Mack: Schadenversicherungsmathematik. Schriftenreihe angewandte Versicherungsmathematik Band 28. Verlag VW Karlsruhe.
- Fahrmeir, Tutz: Multivariate Statistical Modelling based on Generalized Linear Models. Springer 2001.
- Cox: Regression Models and Life-Tabels. J. Roy.Stat.Soc. B, 34, pp.187-220, 1972.

Remarks
This course belongs to the modules "*Applications of Actuarial Sciences I*" and "*Applications of Actuarial Sciences II*". It doesn't belong to module "*Insurance Statistics*" anymore.
The number of ECTS credits and of hours per week have been reduced.

Course: Integral Geometry [MATHAG20]

Coordinators: Daniel Hug
Part of the modules: Integral Geometry (p. 42)[MATHMWAG20]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Integral Equations [IG]

Coordinators: Tilo Arens, Frank Hettlich, Andreas Kirsch
Part of the modules: Integral Equations (p. 49)[MATHMWAN07]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Intelligent Systems in Finance [2511402]

Coordinators: Detlef Seese
Part of the modules: Emphasis in Informatics (p. 133)[MATHMWINFO2], Informatics (p. 131)[MATHMWINFO1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	de

Learning Control / Examinations
The assessment is a written examination.
See the German part for special requirements to be admitted for the examination.

Conditions
None.

Learning Outcomes

- The students acquire abilities and knowledge of methods and systems from the area of machine learning and learn how to use them in the area of finance, which is the core area of application of this lecture.
- It is taught the ability to choose and change these methods and systems adequate to the situation and to use them for problem solving in the area of finance.
- The students get the ability to find strategic and creative answers in their search for solutions for precisely defined, concrete and abstract problems.
- At the same time the lecture aims to give foundational knowledge and methods in the context of their application in practise. On the basis of the basic understanding of concepts and methods of informatics the students should be able to comprehend quickly the new developments in the area and to use them correctly.

Content
A new generation of computing methods, commonly known as "intelligent systems", has recently been successfully applied to a variety of business and financial modelling tasks. In many application fields these novel methods outperform traditional statistical techniques. The lecture provides a comprehensive coverage of the area, including foundations and applications. In particular it deals with intelligent software agents, genetic algorithms, neural networks, support vector machines, fuzzy-logic, expert systems and intelligent hybrid systems. The presented applications focus on the finance area and are related to risk management (credit risk, operational risk), financial trading, portfolio management and economic modelling. The lecture is given in cooperation with the company msgGILLARDON. The lecture starts with an introduction of the central problems of application in this area, e.g. decision support for investors, Portfolioselection under constraints, information retrieval from business reports, automatic development of trading rules for the capital market, modelling of time series at the capital market, explanation of phenomena at capital markets by simulation, decision support in risk management (credit risk, operational risk). After this the basics of intelligent systems are discussed. Basic ideas and essential results for different stochastic heuristics for local search are discussed next, especially Hill Climbing, Simulated Annealing, Threshold Accepting and Tabu Search. After this different population-based approaches of evolutionary methods are presented, e.g. Genetic Algorithms, Evolutionary Strategies and Programming, Genetic Programming, Memetic Algorithms and Ant-Algorithms. It follows an introduction into Neural Networks, Support Vector Machines and Fuzzylogic. Softwareagents and agentbased stock market models are the next topic. The lecture ends with an overview on the complexity of algorithmic problems in the area of finance, giving in this way one of the key reasons for the necessity to use heuristics and intelligent systems. Essential examples and basic applications are choosen from the area of finance.

Media
Slides.

Literature
There is no text book covering completely the content of the lecture.

- Z. Michalewicz, D. B. Fogel. How to Solve It: Modern Heuristics. Springer 2000.
- J. Hromkovic. Algorithms for Hard Problems. Springer-Verlag, Berlin 2001.
- P. Winker. Optimization Heuristics in Econometrics. John Wiley & Sons, Chichester 2001.
- A. Brabazon, M. O'Neill. Biologically Inspired Algorithms for Financial Modelling. Springer, 2006.
- A. Zell. Simulation Neuronaler Netze. Addison-Wesley 1994.
- R. Rojas. Theorie Neuronaler Netze. Springer 1993.
- N. Cristianini, J. Shawe-Taylor. An Introduction to Support Vector Machines and other kernal-based learning methods. Cambridge University Press 2003.
- G. Klir, B. Yuan. Fuzzy Sets and Fuzzy Logic: Theory and Applications. Prentice-Hall, 1995.

- F. Schlottmann, D. Seese. Modern Heuristics for Fiance Problems: A Survey of Selected Methods and Applications. In S. T. Rachev (Ed.) Handbook of Computational and Numerical Mrthods in Finance, Birkhäuser, Boston 2004, pp. 331 - 359.

Further references will be given in each lecture.
Elective literature:

- S. Goonatilake, Ph. Treleaven (Eds.). Intelligent Systems for Finance and Business. John Wiley & Sons, Chichester 1995.
- F. Schlottmann, D. Seese. Financial applications of multi-objective evolutionary algorithms, recent developments and future directions. Chapter 26 of C. A. Coello Coello, G. B.Lamont (Eds.) Applications of Multi-Objective Evolutionary Algorithms, World Scientific, New Jersey 2004, pp. 627 - 652.
- D. Seese, F. Schlottmann. Large grids and local information flow as reasons for high complexity. In: G. Frizelle, H. Richards (eds.), Tackling industrial complexity: the ideas that make a difference, Proceedings of the 2002 conference of the Manufacturing Complexity Network, University of Cambridge, Institute of Manufacturing, 2002, pp. 193-207. (ISBN 1-902546-24-5).
- R. Almeida Ribeiro, H.-J. Zimmermann, R. R. Yager, J. Kacprzyk (Eds.). Soft Computing in Financial Engineering. Physica-Verlag, 1999.
- S. Russel, P. Norvig. Künstliche Intelligenz Ein moderner Ansatz. 2. Auflage, Pearson Studium, München 2004.
- M. A. Arbib (Ed.). The Handbook of Brain Theory and neural Networks (second edition). The MIT Press 2004.
- J.E. Gentle, W. Härdle, Y. Mori (Eds.). Handbook of Computational Statistics. Springer 2004.
- F. Schweitzer. Brownian Agents and Active Particles. Collective Dynamics in the Natural and Social Sciences, Springer 2003.
- D. Seese, C. Weinhardt, F. Schlottmann (Eds.) Handbook on Information Technology in Finance, Springer 2008.
- Further references will be given in the lecture.

Remarks
The content of the lecture will permanently be adapted to actual developments. This can be the cause to changes of the described contend and schedule.
The course “Intelligent Systems in Finance” will not be offered any more from summer term 2016 on. The examination will be offered latest until summer term 2015 (repeaters only).

Course: International Risk Transfer [2530353]

Coordinators: Wolfgang Schwehr
Part of the modules: Operational Risk Management I (p. 118)[MATHMWBWLFBV9], Operational Risk Management II (p. 119)[MATHMWBWLFBV10]

ECTS Credits	Hours per week	Term	Instruction language
2.5	2/0	Summer term	de

Learning Control / Examinations
The assessment consists of a written exam (according to Section 4 (2), 1 of the examination regulation) .
The exam takes place every semester. Re-examinations are offered at every ordinary examination date.

Conditions
None.

Learning Outcomes
Becoming acquainted with the various possibilities of international risk transfer.

Content
How are the costs of potential major damages financed and covered on a global scale? Traditionally, direct insurers and, especially, reinsurers are conducting a global business, Lloyd's of London is a turntable for international risks, and global industrial enterprises are establishing captives for self insurance. In addition to this, capital markets and insurance markets are developing innovative approaches to cover risks, which were hard to insure in the past (e.g. weather risk). The lecture will elucidate the functioning and the background of these different possibilities of international risk transfer.

Literature

- K. Geratewohl. Rückversicherung: Grundlagen und Praxis Band 1-2.
- Brühwiler/ Stahlmann/ Gottschling. Innovative Risikofinanzierung - Neue Wege im Risk Management.
- Becker/ Bracht. Katastrophen- und Wetterderivate.

Remarks
Block course. To attend the course please register at the secretary of the chair of insurance science.

Course: International Finance [2530570]

Coordinators: Marliese Uhrig-Homburg, Walter
Part of the modules: F2&F3 (Finance) (p. 112)[MATHMWBWLFBV3], Finance 3 (p. 113)[MATH4BWLFBV11], Finance 2 (p. 111)[MATHMWBWLFBV2]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
The objective of this course is to become familiar with the basics of investment decisions on international markets and to manage foreign exchange risks.

Content
The main aspects of this course are the chances and the risks which are associated with international transactions. We carry out our analysis from two distinct perspectives: First the point of view of an international investor second that, of an international corporation. Several alternatives to the management of foreign exchange risks are shown. Due to the importance of foreign exchange risks, the first part of the course deals with currency markets. Furthermore current exchange rate theories are discussed.

Literature
Elective literature:

- D. Eiteman et al. (2004): Multinational Business Finance, 10. Auflage

Course: Management Accounting [2530210]

Coordinators: Torsten Lüdecke
Part of the modules: Finance 2 (p. 111)[MATHMWBWLFBV2], F2&F3 (Finance) (p. 112)[MATHMWBWLFBV3], Finance 3 (p. 113)[MATH4BWLFBV11]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	de

Learning Control / Examinations
The assessment consists of a written exam (60 min) taking place in the recess period (according to §4 (2), 1 of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Conditions
None.

Learning Outcomes
This course aims at providing students with the understanding of the purposes of alternative costing systems as well as the use of relevant information for decision making. The course will also examine techniques for the purpose of cost management and accounting for control.

Content

- Design of Cost Systems
- Cost Classifications, Cost Behavior, and Principles of Cost Allocation
- Activity-based Costing
- Product Costing
- Production Decisions
- Cost-based Pricing
- Cost Management
- Decisions under Risk
- Cost Accounting for Control

Literature
Elective literature:

- Coenenberg, A.G. Kostenrechnung und Kostenanalyse, 6. Aufl. 2007.
- Ewert, R. und Wagenhofer, A. Interne Unternehmensrechnung, 7. Aufl. 2008.
- Götze, U. Kostenrechnung und Kostenmanagement. 3. Aufl. 2007.
- Kilger, W., Pampel, J., Vikas, K. Flexible Plankostenrechnung und Deckungsbeitragsrechnung , 11. Aufl. 2002.

Course: Inverse Problems [IP]

Coordinators: Tilo Arens, Frank Hettlich, Andreas Kirsch, Andreas Rieder
Part of the modules: Inverse Problems (p. 75)[MATHMWNM06]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Inverse Scattering Theory [MATHAN27]

Coordinators: Tilo Arens, Frank Hettlich, Andreas Kirsch
Part of the modules: Inverse Scattering Theory (p. 69)[MATHMWAN27]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Class Field Theory [Klassenkörpertheorie]

Coordinators: Claus-Günther Schmidt
Part of the modules: Class Field Theory (p. 43)[MATHAG21]

ECTS Credits	Hours per week	Term	Instruction language
8	4+2		

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Classical Methods for Partial Differential Equations [KMPD]

Coordinators: Michael Plum, Wolfgang Reichel, Roland Schnaubelt, Lutz Weis
Part of the modules: Classical Methods for Partial Differential Equations (p. 50)[MATHMWAN08]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Knowledge Discovery [2511302]

Coordinators: Rudi Studer
Part of the modules: Emphasis in Informatics (p. 133)[MATHMWINFO2], Informatics (p. 131)[MATHMWINFO1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	de

Learning Control / Examinations
The assessment consists of an 1h written exam following §4, Abs. 2, 1 of the examination regulation.
Students can be awarded a bonus on their final grade if they successfully complete special assignments.

Conditions
None.

Learning Outcomes
Familiarity with fundamentals of Knowledge Discovery, Data Mining and Machine Learning. Standard algorithms, representations, applications and processes needed for knowledge discovery projects are covered.

Content
The lecture provides an overview of machine learning and data mining techniques for knowledge discovery from large data sets. These techniques are examined in respect of algorithms, applicability to different data representations and application in the real world.Topics of the lectures comprise the whole Machine Learning and Data Mining process like CRISP, data warehousing, OLAP-techniques, learning algorithms, visualization and empircial evaluation. Covered learning techniques range from traditional approaches like decision trees, neural networks and support vector machines to selected approaches resulting from current research. Discussed learning problems are amongst others feauturevector-based learning, text mining and social network analysis.

Media
Slides.

Literature

- T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning: Data Mining, Inference, and Prediction (http://www-stat.stanford.edu/ tibs/ElemStatLearn/)
- T. Mitchell. Machine Learning. 1997
- M. Berhold, D. Hand (eds). Intelligent Data Analysis - An Introduction. 2003
- P. Tan, M. Steinbach, V. Kumar: Introduction to Data Mining, 2005, Addison Wesley

Course: Control Theory [MATHAN18]

Coordinators: Roland Schnaubelt, Lutz Weis
Part of the modules: Control Theory (p. 60)[MATHMWAN18]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Convex Geometry [1044]

Coordinators: Daniel Hug
Part of the modules: Convex Geometry (p. 30)[MATHMWAG07]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Car Insurance [2530308]

Coordinators: M. Schrempp, A. Edalati

Part of the modules: Applications of Actuarial Sciences I (p. 115)[MATHMWBWLFBV4], Applications of Actuarial Sciences II (p. 116)[WM4BWLFBV5]

ECTS Credits	Hours per week	Term	Instruction language
6	2/2	Summer term	de

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Remarks

This course *Car Insurance* is newly included in summer term 2011.

Course: Hospital Management [2550493]

Coordinators: Stefan Nickel, Hansis
Part of the modules: Operations Research in Supply Chain Management and Health Care Management (p. 127)[MATHMWOR8]

ECTS Credits	Hours per week	Term	Instruction language
2	2/0	Winter / Summer Term	de

Learning Control / Examinations
The assessment consists of attendance, a seminar thesis and a final exam (according to §4(2), 1 of the examination regulation). The examination is held in the term of the lecture and the following lecture.

Conditions
None.

Learning Outcomes
Students gain insight into fundamental work flows in hospitals. They learn that the application of Operations Research methods can also be useful in so-called non-profit-organisations. In addition, the most important application areas for mathematical models, e.g. personnel planning or quality management, will be discussed.

Content
The lecture "Hospital management" presents internal organization structures, work conditions and work environments at the example of hospitals und relates this to common and expected conditions of other service industries.
Covered topics include normative environment, intra-organizational structure, personnel management, quality, external networking and market appearance. Students have the possibility to participate in a final exam.

Remarks
The lecture is held in every semester.
The planned lectures and courses for the next three years are announced online.
The name of the lecture was changed from "Enterprise Hospital" and updated from 2 to 3 credits.

Course: Credit Risk [2530565]

Coordinators: Marliese Uhrig-Homburg
Part of the modules: Finance 2 (p. 111)[MATHMWBWLFBV2], F2&F3 (Finance) (p. 112)[MATHMWBWLFBV3], Finance 3 (p. 113)[MATH4BWLFBV11]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Winter term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
The objective of this course is to become familiar with the credit markets and the credit risk indicators like ratings, default probabilities and credit spreads. The students learn about the components of credit risk (e.g. default time and default rate) and quantify these in different theoretical models to price credit derivatives.

Content
The lecture deals with the diverse issues arising in the context of measuring and controlling credit risk. At first, the theoretical and empirical relations between ratings, probabilities of default, and credit spreads are analysed. After that, the focus is on the valuation of credit risk. Finally, the management of credit risk, e.g. using credit derivatives and credit portfolio analysis, is examined, and the legal framework and its implications are discussed

Literature

- Lando, D., Credit risk modeling: Theory and Applications, Princeton Univ. Press, (2004).
- Uhrig-Homburg, M., Fremdkapitalkosten, Bonitätsrisiken und optimale Kapitalstruktur, Beiträge zur betriebswirtschaftlichen Forschung 92, Gabler Verlag, (2001).

Elective literature:

- Bluhm, C., Overbeck, L., Wagner, C. , Introduction to Credit Risk Modelling, Chapman & Hall, CRC Financial Mathematics Series, (2002).
- Duffie, D., Singleton, K.J., Credit Risk: Pricing, Measurement and Management, Princeton Series of Finance, Prentice Hall, (2003).

Course: Lie Groups and Lie Algebras [MATHAG13]

Coordinators: Oliver Baues
Part of the modules: Lie Groups and Lie Algebras (p. 36)[MATHMWAG13]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Solution methods for linear and nonlinear equations [LLNGS]

Coordinators: Willy Dörfler, Andreas Rieder, Christian Wieners
Part of the modules: Solution methods for linear and nonlinear equations (p. 79)[MATHMWNM10]

ECTS Credits	Hours per week	Term	Instruction language
6	4/0	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Management of IT-Projects [2511214]

Coordinators: Roland Schätzle
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	de

Learning Control / Examinations
The assessment of this course is a written examination (60 min) in the first week after lecture period according to Section 4(2), 1 of the examination regulation.

Conditions
None.

Learning Outcomes
Students know the terminology of IT project management and typical used methods for planning, handling and controlling. They are able to use methods appropiate to current project phases and project contexts and they know how to consider organisational and social impact factors.

Content
The lecture deals with the general framework, impact factors and methods for planning, handling, and controlling of IT projects. Especially following topics are addressed:

- project environment
- project organisation
- project planning including the following items:
  - plan of the project structure
  - flow chart
  - project schedule
  - plan of resources
- effort estimation
- project infrastructur
- project controlling
- risk management
- feasibility studies
- decision processes, conduct of negotiations, time management.

Media
Slides, access to internet resources.

Literature

- B. Hindel, K. Hörmann, M. Müller, J. Schmied. Basiswissen Software-Projektmanagement. dpunkt.verlag 2004
- Project Management Institute Standards Committee. A Guide to the Project Management Body of Knowledge (PMBoK guide). Project Management Institute. Four Campus Boulevard. Newton Square. PA 190733299. U.S.A.

Further literature is given in each lecture individually.

Course: IT Complexity in Practice [2511404]

Coordinators: Detlef Seese, Kreidler
Part of the modules: Emphasis in Informatics (p. 133)[MATHMWINFO2], Informatics (p. 131)[MATHMWINFO1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	de

Learning Control / Examinations
see German version.

Conditions
see German version.

Learning Outcomes
see German version.

Content
see German version

Literature
Elective literature:
Will be announced in the lecture.

Course: Markov Decision Processes [MATHST11]

Coordinators: Nicole Bäuerle, Dieter Kadelka
Part of the modules: Markov Decision Processes (p. 99)[MATHMWST11]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter / Summer Term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Market Microstructure [2530240]

Coordinators: Torsten Lüdecke
Part of the modules: Finance 2 (p. 111)[MATHMWBWLFBV2], Finance 3 (p. 113)[MATH4BWLFBV11], F2&F3 (Finance) (p. 112)[MATHMWBWLFBV3]

ECTS Credits	Hours per week	Term	Instruction language
3	2/0	Winter term	de

Learning Control / Examinations

Conditions
Knowledge of the content of the course *Asset Pricing* [2530555] is assumed.

Learning Outcomes
This lecture makes students familiar with the fundamental models of trading in financial markets. It starts with generic design features of financial markets which are used to frame price discovery as the key element of the trading process. The link between market design and market quality is pointed out by using alternative measures of market quality. Seminal models of market microstructure are used to show how dealer inventoy and/or asymmetric information affect market prices and the pricing of securities. Theoretical models are shown to provide predictions which are consistent with empiricial evidence.

Content
The focus of this lecture is on the question how the microstructure of financial markets affects price discovery and market quality. First, issues in designing market structure are presented and linked to fundamental dimensions of market quality, i.e liquidity and trading costs. In particular, the services and privileges of market makers are stressed. The main part of the lecture covers inventory-models of dealer markets and models of information-based trading. The final part gives attention to some econometric models to analyze the short-term behavior of security prices.

Media
Slides.

Literature
keine

Elective literature:
See reading list.

Course: Mathematical Methods in Signal and Image Processing [MATHNM16]

Coordinators: Andreas Rieder
Part of the modules: Mathematical Methods in Signal and Image Processing (p. 85)[MATHMWNM16]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Mathematical Statistics [MATHST15]

Coordinators: Bernhard Klar, Norbert Henze, Claudia Kirch
Part of the modules: Mathematical Statistics (p. 103)[MATHMWST15]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Maxwell's Equations [MATHAN28]

Coordinators: Tilo Arens, Frank Hettlich, Andreas Kirsch
Part of the modules: Maxwell's Equations (p. 70)[MATHMWAN28]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Multigrid and Domain Decomposition Methods [MATHNM17]

Coordinators: Christian Wieners
Part of the modules: Multigrid and Domain Decomposition Methods (p. 86)[MATHMWNM17]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Metric Geometry [MATHAG15]

Coordinators: Enrico Leuzinger
Part of the modules: Metric Geometry (p. 37)[MATHMWAG15]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Models of Mathematical Physics [MATHAN17]

Coordinators: Michael Plum, Wolfgang Reichel
Part of the modules: Models of Mathematical Physics (p. 59)[MATHMWAN17]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Modeling Strategic Decision Making [2577908]

Coordinators: Hagen Lindstädt
Part of the modules: Strategic Corporate Management and Organization (p. 122)[MATHMWUO1]

ECTS Credits	Hours per week	Term	Instruction language
6	2/1	Summer term	de

Learning Control / Examinations
Written exam 100% following §4, Abs. 2.

Conditions
None.

Learning Outcomes
Starting from the basic model of economic decision theory, fundamental decision principles and calculi for multi-attribute decisions in certain and uncertain conditions up to subjective expected utility theory and the economic assessment of information are described. To confront numerous infringements by decision-makers against principles and axioms of this calculus, in addition non-expected utility calculi and advanced models for decisions by economic agents are discussed; these are especially important for management decisions.
Within the chapter concerning leadership frameworks the students are given the possibility to individually analyze their management style on the basis of classical concepts of leadership. These concepts will be presented and discussed in detail.

Content

- Principles of strategic management decisions
- Leadership: Classical leadership concepts
- Basic economic decision models
- Limits of the basic models and advanced concepts
- Advanced models: individual decisions with uncertainty and vague information

Media
Slides.

Literature

- Eisenführ, F.; Weber, M.: *Rationales Entscheiden*. Springer, 4. Aufl. Berlin 2003.[1]
- Laux, H.: Entscheidungstheorie. Springer, 6. Aufl. Berlin 2005.[2]
- Lindstädt, H: *Entscheidungskalküle jenseits des subjektiven Erwartungsnutzens*. In: Zeitschrift für betriebswirtschaftliche Forschung 56 (September 2004), S. 495 - 519.
- Scholz, C.: *Personalmanagement*. Vahlen, 5. Aufl. München 2000, Kap. 9.4, S.923 - 948

Course: Business Process Modelling [2511210]

Coordinators: Andreas Oberweis, Marco Mevius
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	de

Learning Control / Examinations
The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation in the first week after lecture period.

Conditions
None.

Learning Outcomes
Students know goals of business process modelling and master different modelling languages. They are able to choose the appropriate modelling language according to a given context and to use the modelling language with suitable modelling tools. They master methods for analysing and assessing process modells and methods for analysing them according to specific quality characteristics.

Content
The proper modeling of relevant aspects of business processes is essential for an efficient and effective design and implementation of processes. This lecture presents different classes of modeling languages and discusses the respective advantages and disadvantages of using actual application scenarios. For that simulative and analytical methods for process analysis are introduced. In the accompanying exercise the use of process modeling tools is practiced.

Media
Slides, access to internet resources.

Literature
Literature will be given in the lecture.

Course: Modular Forms [Modulformen]

Coordinators: Claus-Günther Schmidt
Part of the modules: Modular Forms (p. 45)[MATHAG23]

ECTS Credits	Hours per week	Term	Instruction language
8	4+2		

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Modul Spaces of Curves [MATHAG18]

Coordinators: Frank Herrlich
Part of the modules: Moduli Spaces of Curves (p. 40)[MATHMWAG18]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Multidisciplinary Risk Research [2530328]

Coordinators: Ute Werner
Part of the modules: Operational Risk Management II (p. 119)[MATHMWBWLFBV10], Operational Risk Management I (p. 118)[MATHMWBWLFBV9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	3/0	Winter / Summer Term	de

Learning Control / Examinations
The assessment consists of oral presentations (incl. papers) within the lecture (according to Section 4 (2), 3 of the examination regulation) and a final oral exam (according to Section 4 (2), 2 of the examination regulation).
The overall grade consists of the assessment of the oral presentations incl. papers (50 percent) and the assessment of the oral exam (50 percent).

Conditions
None.

Learning Outcomes
Getting an overview of the various theoretical, empirical and methodological approaches used in risk research. Learning to assess disciplinary perspectives and approaches. Detailed examination of at least one theoretical and one methodological approach by the analysis of case studies.

Content
The course consists of two chapters:
In the theoretical part risk concepts of various disciplines will be discussed as well as categorisations of risk (e.g. technical or natural origin) and of risk carriers. Based on empirical research, processes of risk perception, risk assessment, and risk taking – at the individual, institutional, and global level - are described and explained.
The methodological part of the course deals with hazard research, approaches for identification and mapping of risks and their accumulations, as well as with safety culture research. Using empirical studies, survey methods regarding risk perception and risk assessment will be discussed. Specific problems in the context of intercultural research will be considered too.
Students get an overview on the theroretical, empirical and methodological variety of risk research. As a further result, they learn to differentiate and evaluate the perspectives and methods of the different disciplines for risk research.
All students participate actively in the lecture. Per person, at least one presentation and one elaboration are expected.

Literature

- U. Werner, C. Lechtenbörger. Risikoanalyse & Risikomanagement: Ein aktueller Sachstand der Risikoforschung. Arbeitspapier 2004
- Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (WBGU). Welt im Wandel: Strategien zur Bewältigung globaler Umweltrisiken. Jahresgutachten 1998, http://www.wbgu_jg1998.html.
- R. Löfstedt, L. Frewer. Risk and Modern Society, London 1998.
- http://www.bevoelkerungsschutz.ch

Elective literature:
Additional literature is recommended during the course.

Remarks
This course is offered on demand. For further information, see: http://insurance.fbv.uni-karlsruhe.de
To attend the course please register at the secretary of the chair of insurance science.
This course takes place in spring term 2011.

Course: Multivariate statistics [MATHST17]

Coordinators: Norbert Henze, Claudia Kirch, Bernhard Klar
Part of the modules: Multivariate statistics (p. 105)[MATHMWST17]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Nature-inspired Optimisation Methods [2511106]

Coordinators: Sanaz Mostaghim, Pradyumn Kumar Shukla
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	en

Learning Control / Examinations
The assessment consists of a written exam (60 min) (according to Section 4(2), 1 of the examination regulation) and an additional written examination called "bonus exam", 60 min (according Section 4(2), 3 of the examination regulation) or a selection of exersices . The bonus exam may be split into several shorter written tests.
The grade of this course is the achieved grade in the written examination. If this grade is at least 4.0 and at most 1.3, a passed bonus exam will improve it by one grade level (i.e. by 0.3 or 0.4).

Conditions
None.

Learning Outcomes
To learn:

1. Different nature-inspired methods: local search, simulated annealing, tabu search, evolutionary algorithms, ant colony optimization, particle swarm optimization
2. Different aspects and limitation of the methods
3. Applications of such methods
4. Mlti-objective optimization methods
5. Constraint handling methods
6. Different aspects in parallelization and computing platforms

Content
Many optimization problems are too complex to be solved to optimality. A promising alternative is to use stochastic heuristics, based on some fundamental principles observed in nature. Examples include evolutionary algorithms, ant algorithms, or simulated annealing. These methods are widely applicable and have proven very powerful in practice. During the course, such optimization methods based on natural principles are presented, analyzed and compared. Since the algorithms are usually quite computational intensive, possibilities for parallelization are also investigated.

Media
Powerpoint slides with annotations on graphics screen, access to Internet resources, recorded lectures

Literature
F. Glover and M. Laguna. „Tabu Search" In: Handbook of Applied Optimization, P. M. Pardalos and M. G. C. Resende (Eds.), Oxford University Press, pp. 194-208, 2002. G. Raidl and J. Gottlieb: Empirical Analysis of Locality, Heritability and Heuristic Bias in Evolutionary Algorithms: A Case Study for the Multidimensional Knapsack Problem. Evolutionary Computation, MIT Press, 13(4), pp. 441-475, 2005.
Weiterführende Literatur:
E. L. Aarts and J. K. Lenstra: „Local Search in Combinatorial Optimization". Wiley, 1997. D. Corne and M. Dorigo and F. Glover: „New Ideas in Optimization". McGraw-Hill, 1999. C. Reeves: „Modern Heuristic Techniques for Combinatorial Optimization". McGraw-Hill, 1995. Z. Michalewicz, D. B. Fogel: „How to solve it: Modern Heuristics". Springer, 1999. E. Bonabeau, M. Dorigo, G. Theraulaz: „Swarm Intelligence". Oxford University Press, 1999. A. E. Eiben and J. E. Smith: „Introduction to Evolutionary Computing". Springer, 2003. K. Weicker: „Evolutionäre Algorithmen". Teubner, 2002. M. Dorigo, T. Stützle: „Ant Colony Optimization". MIT Press, 2004. K. Deb: „Multi-objective Optimization using Evolutionary Algorithms", Wiley, 2003.

Course: Nonlinear Evolution Equations [MATHAN19]

Coordinators: Roland Schnaubelt, Lutz Weis
Part of the modules: Nonlinear Evolution Equations (p. 61)[MATHMWAN19]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Nonlinear Functional Analysis [NichtlinFA]

Coordinators: Gerd Herzog
Part of the modules: Nonlinear Functional Analysis (p. 71)[MATHAN29]

ECTS Credits	Hours per week	Term	Instruction language
3	2		

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Nonlinear Optimization I [2550111]

Coordinators: Oliver Stein
Part of the modules: Methodical Foundations of OR (p. 125)[MATHMWOR6], Stochastic Methods and Simulation (p. 126)[MATHMWOR7], Mathematical Programming (p. 129)[MATHMWOR9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	de

Learning Control / Examinations
The assessmentconsits of a written exam (60 minutes) according to Section 4(2), 1 of the examination regulation.
The exam takes place in the semester of the lecture and in the following semester.
Prerequisite for admission to the written examination is attaining at least 30% of the exercise points. Therefore the online-registration for the written examination is subject to fulfilling the prerequisite.
The examination can also be combined with the examination of *Nonlinear Optimization II* [2550113]. In this case, the duration of the written examination takes 120 minutes.
In a combined examination of *Nonlinear Optimization I* [2550111] and *Nonlinear Optimization II* [2550113], upon attaining more then 60% of the exercise points, the grade of the passed examination is improved by a third of a grading step.
In a combined examination of *Nonlinear Optimization I* [2550111] and *Nonlinear Optimization II* [2550113], upon attaining more then 60% of the computer exercise points, the grade of the passed examination is improved by a third of a grading step.

Conditions
None.

Learning Outcomes
The student

- knows and understands fundamentals of nonlinear optimization,
- is able to choose, design and apply modern techniques of nonlinear optimization in practice.

Content
The lecture treats the minimization of smooth nonlinear functions under nonlinear constraints. For such problems, which occur very often in economics, engineering, and natural sciences, we derive optimality conditions that form the basis for numerical solution methods. The lecture is structured as follows:

- Introduction, examples, and terminology
- Existence results for optimal points
- First and second order optimality condtions for unconstrained problems
- Optimality conditions for unconstrained convex problems
- Numerical methods for unconstrained problems (line search, steepest descent method, variable metric methods, Newton method, Quasi Newton methods, CG method, trust region method)

Constrained problems are the contents of part II of the lecture.
The lecture is accompanied by computer exercises in which you can learn the programming language MATLAB and implement and test some of the methods for practically relevant examples.

Literature
Elective literature:

- W. Alt, Nichtlineare Optimierung, Vieweg, 2002
- M.S. Bazaraa, H.D. Sherali, C.M. Shetty, Nonlinear Programming, Wiley, 1993
- H.Th. Jongen, K. Meer, E. Triesch, Optimization Theory, Kluwer, 2004
- J. Nocedal, S. Wright, Numerical Optimization, Springer 2000

Remarks
Part I and II of the lecture are held consecutively in the *same* semester.
The lecture is not held in the summer semester 2011.

Course: Nonlinear Optimization II [2550113]

Coordinators: Oliver Stein
Part of the modules: Methodical Foundations of OR (p. 125)[MATHMWOR6], Mathematical Programming (p. 129)[MATHMWOR9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	de

Learning Control / Examinations
The assessment consists of a written exam (120 minutes) according to §4(2), 1 of the examination regulation.
The exam takes place in the semester of the lecture and in the following semester.
Prerequisite for admission to the written examination is attaining at least 30% of the exercise points. Therefore the online-registrationfor the written examination is subject to fulfilling the prerequisite.
The exam can also be combined with the examination of *Nonlinear Optimization I* [2550111]. In this case, the duration of the written exam takes 120 minutes.
In a combined exam of *Nonlinear Optimization I* [2550111] and *Nonlinear Optimization II* [2550113], upon attaining more then 60% of the exercise points, the grade of the passed exam is improved by a third of a grading step.
In a combined exam of *Nonlinear Optimization I* [2550111] and *Nonlinear Optimization II* [2550113], upon attaining more then 60% of the computer exercise points, the grade of the passed exam is improved by a third of a grading step.

Conditions
None.

Learning Outcomes
The student

- knows and understands fundamentals of nonlinear optimization,
- is able to choose, design and apply modern techniques of nonlinear optimization in practice.

Content
The lecture treats the minimization of smooth nonlinear functions under nonlinear constraints. For such problems, which occur very often in economics, engineering, and natural sciences, we derive optimality conditions that form the basis for numerical solution methods. Part I of the lecture treats unconstrained optimization problems. Part II of the lecture is structured as follows:

- Topology and first order approximations of the feasible set
- Theorems of the alternative, first and second order optimality conditions for constrained problems
- Optimality conditions for constrained convex problems
- Numerical methods for constrained problems (penalty method, multiplier method, barrier method, interior point method, SQP method, quadratic optimization)

The lecture is accompanied by computer exercises in which you can learn the programming language MATLAB and implement and test some of the methods for practically relevant examples.

Literature
Elective literature:

- W. Alt, Nichtlineare Optimierung, Vieweg, 2002
- M.S. Bazaraa, H.D. Sherali, C.M. Shetty, Nonlinear Programming, Wiley, 1993
- H.Th. Jongen, K. Meer, E. Triesch, Optimization Theory, Kluwer, 2004
- J. Nocedal, S. Wright, Numerical Optimization, Springer 2000

Remarks
Part I and II of the lecture are held consecutively in the *same* semester.
The lecture is not held in the summer semester 2011.

Course: Nonparametric statistics [MATHST16]

Coordinators: Norbert Henze, Claudia Kirch, Bernhard Klar
Part of the modules: Nonparametric statistics (p. 104)[MATHMWST16]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Numerics of Ordinary Differential Equations and Differential-Algebraic Systems [NGDG]

Coordinators: Willy Dörfler, Tobias Jahnke, Ingrid Lenhardt, Markus Neher, Andreas Rieder, Christian Wieners
Part of the modules: Numerics of Ordinary Differential Equations and Differential-Algebraic Systems (p. 90)[MATHMWNM21]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Numerical Methods for Differential Equations [NMDG]

Coordinators: Willy Dörfler, Vincent Heuveline, Andreas Rieder, Christian Wieners
Part of the modules: Numerical Methods for Differential Equations (p. 73)[MATHMWNM03]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Numerical Methods for Time-Dependent PDE [MATHNM20]

Coordinators: Willy Dörfler
Part of the modules: Numerical Methods for Time-Dependent PDE (p. 89)[MATHMWNM20]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Numerical Methods in Electrodynamics [MATHNM13]

Coordinators: Willy Dörfler
Part of the modules: Numerical Methods in Electrodynamics (p. 82)[MATHMWNM13]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Numerical Methods in Solid Mechanics [MATHNM12]

Coordinators: Christian Wieners
Part of the modules: Numerical Methods in Solid Mechanics (p. 81)[MATHMWNM12]

ECTS Credits	Hours per week	Term	Instruction language
8	4+2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Numerical Methods in Mathematical Finance [MATHNM18]

Coordinators: Christian Wieners
Part of the modules: Numerical Methods in Mathematical Finance (p. 87)[MATHMWNM18]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Numerical Methods in Fluid Mechanics [MATHNM24]

Coordinators: Vincent Heuveline
Part of the modules: Numerical Methods in Fluid Mechanics (p. 92)[MATHMWNM24]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Numerical Optimization Methods [MATHNM25]

Coordinators: Vincent Heuveline, Christian Wieners
Part of the modules: Numerical Optimization Methods (p. 93)[MATHMWNM25]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Economics of Uncertainty [2520365]

Coordinators: Karl-Martin Ehrhart
Part of the modules: Decision and Game Theory (p. 120)[MATHMWVWL10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/2	Summer term	de

Learning Control / Examinations

Conditions
None.

Recommendations
See corresponding module information.
Knowledge in mathematics and statistics is required.

Learning Outcomes
The student will be made familiar with the basics in modern decision making under uncertainty so that she will be able to analyze concrete decision problems and to develop simple solution procedures. By being confronted with experimental results in decision making the student should also be able to evaluate the behavioral part of decision making.

Content
In the first part of the course we deal with problems of decision making under uncertainty and introduce models like expected utility theory, stochastic dominance, risk aversion, and prospect theory. We also consider the empirical validity of the different approaches.
In the second part the concepts learned in the first part are applied for example to search models and Bayesian games.

Media
overhead slides, possibly additional printed material.

Literature

- Hirshleifer und Riley (1997): The Analytics of Uncertainty and Information. London: Cambridge University Press, 4. Aufl.
- Berninghaus, S.K., K.-M. Ehrhart und W. Güth (2006): Strategische Spiele. Berlin u.a.: Springer, 2., überarbeitete und erweiterte Aufl. (oder erste Auflage, 2002)

Elective literature:

- Lippman/McCall, Economics of Uncertainty, in: Handbook of Mathematical Economics I, 1986
- DeGroot, Optimal Statistical Decisions, Kap. 1 und 2, 1970

Course: Operations Research in Health Care Management [2550495]

Coordinators: Stefan Nickel
Part of the modules: Operations Research in Supply Chain Management and Health Care Management (p. 127)[MATHMWOR8]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	de

Learning Control / Examinations
The assessment is a 120 minutes written examination (according to §4(2), 1 of the examination regulation).
The examination is held in the term of the lecture and the following lecture.

Conditions
Basic knowledge as conveyed in the module *Introduction to Operations Research* [WI1OR] is assumed.

Learning Outcomes
The target of this lecture is to show possible applications of well-known methods of Operations Research applied to health services. The students gain the ability to use quantitative models for the operations planning and logistics in a hospital environment, e.g. appointment, transportation, operating room planning or nurse rostering as well as inventory management and layout planning. Furthermore the advantages and benefits of simulation models and OR methods to plan home health care services are discussed.

Content
In the last years reforms of the German health system, e.g. the introduction of the G-DRG-system, have put an increasing cost pressure on hospitals. Therefore their target is to improve quality, transparency, and efficiency of hospital services, e.g. by reducing the length of stay of patients. To achieve this, processes have to be analyzed in order to optimize them if necessary. When looking at the targets of optimization not only efficiency but also quality of care and patient satisfaction (e.g. waiting times) have to be taken into account.
Besides hospitals also home health care services and their planning are discussed in this lecture. Because of the demographic development this is an emerging field in the health care sector. Here, e.g. nurse rosters have to be built which give details about which nurse visits which patient at what time. While doing so different targets have to be regarded, e.g. the continuity of nurse-patient relationship or the minimization of the distances the nurses have to travel.

Literature
Elective literature:

- Fleßa: Grundzüge der Krankenhausbetriebslehre, Oldenbourg, 2007
- Fleßa: Grundzüge der Krankenhaussteuerung, Oldenbourg, 2008
- Hall: Patient flow: reducing delay in healthcare delivery, Springer, 2006

Remarks
The lecture is planned to be held in the winter term 2011/12.
The planned lectures and courses for the next three years are announced online.

Course: Operations Research in Supply Chain Management [2550480]

Coordinators: Stefan Nickel
Part of the modules: Operations Research in Supply Chain Management and Health Care Management (p. 127)[MATHMWOR8]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	en

Learning Control / Examinations
The assessment is a 120 minutes written examination (according to §4(2), 1 of the examination regulation).
The examination is held in the term of the lecture and the following lecture.

Conditions
Basic knowledge as conveyed in the module *Introduction to Operations Research* [WI1OR] is assumed.

Recommendations
Advanced knowledge of Operations Research (e.g., as conveyed in the lectures *Facility Location and Strategic SCM*, *Tactical and operational SCM*) is recommended.

Learning Outcomes
The lecture conveys basic and advanced modeling techniques playing an important role in today's problem solving occurring in supply networks. The focus is set on mathematical approaches to technical-economical problems, and the derivation of optimal solutions. Students are enabled to classify problems both conceptually and mathematically, and to identify central variables and parameters in a specific problem setting. Additionally, current developments in operations research and supply chain management are reflected and evaluated by students.

Content
Supply Chain Management constitutes a general tool for logistics process planning in supply networks. To an increasing degree quantitative decision support is provided by methods and models from Operations Research. The lecture "OR in Supply Chain Management" conveys concepts and approaches for solving practical problems and presents an insight to current research topics. The lecture's focus is set on modeling and solution methods for applications originating in different domains of a supply chain. The emphasis is put on mathematical methods like mixed integer programming, valid inequalities or column generation, and the derivation of optimal solution strategies.
In form and content, the lecture addresses all levels of Supply Chain Management: After a short introduction, the tactical and operational level will be discussed with regard to inventory models, scheduling as well as cutting and packing. The strategic level will be discussed in terms of layout planning. Another main focus of the lecture is the application of methods from online optimization. This optimization discipline has gained more and more importance in the optimization of supply chains over the several past years due to an increasing amount of dynamic data flows.

Literature

- Simchi-Levi, D.; Chen, X.; Bramel, J.: The Logic of Logistics: Theory, Algorithms, and Applications for Logistics and Supply Chain Management, 2nd edition, Springer, 2005
- Simchi-Levi, D.; Kaminsky, P.; Simchi-Levi, E.: Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies, McGraw-Hill, 2000
- Silver, E. A.; Pyke, D. F.; Peterson, R.: Inventory Management and Production Planning and Scheduling, 3rd edition, Wiley, 1998
- Blazewicz, J.: Handbook on Scheduling - From Theory to Applications, Springer, 2007
- Pinedo, M. L.: Scheduling - Theory, Algorithms, and Systems (3rd edition), Springer, 2008
- Dyckhoff, H.; Finke, U.: Cutting and Packing in Production and Distribution - A Typology and Bibliography, Physica-Verlag, 1992
- Borodin, A.; El-Yaniv, R.: Online Computation and Competitive Analysis, Cambridge University Press, 2005
- Francis, R. L.; McGinnis, L. F.; White, A.: Facility Layout and Location: An Analytical Approach, 2nd edition, Prentice-Hall, 1992

Remarks
The lecture will be held in the summer term 2011.
The planned lectures and courses for the next three years are announced online.

Course: Optimization in a Random Environment [25687]

Coordinators: Karl-Heinz Waldmann
Part of the modules: Stochastic Modelling and Optimization (p. 130)[MATHMWOR10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1/2	Winter / Summer Term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
Students are enabled to apply their knowledge about techniques and methodology on current problems such as the measurement and evaluation of operational risk as required by the Basel II accord.
Subject matter of the course will be announced in due time.

Content
The course is concerned with the quantitative analysis of selected problems arising in economics, engineering, and natural sciences. Subject matter of the course will be announced in due time.

Media
Blackboard, Slides, Flash Animations, Simulation Software

Literature
Lecture Notes.
Elective literature:
problem-oriented

Remarks
The lecture is offered irregularly. The curriculum of the next two years is available online.

Course: Optimization and Optimal Control for Differential Equations [MATHNM09]

Coordinators: Vincent Heuveline
Part of the modules: Optimization and Optimal Control for Differential Equations (p. 78)[MATHMWNM09]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: OR-oriented modeling and analysis of real problems (project) [25688]

Coordinators: Karl-Heinz Waldmann
Part of the modules: Stochastic Modelling and Optimization (p. 130)[MATHMWOR10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	1/0/3	Winter / Summer Term	de

Learning Control / Examinations
Presentation and documentation of the rssults.

Conditions
None.

Learning Outcomes
Students are enabled to apply their knowledge about techniques and methodology on real problems and to develop a practically oriented solution in an OR-lab; e.g. in the public health sector.
Subject matter of the course will be announced in due time.

Content
The course is concerned with the quantitative analysis of selected problems arising in economics, engineering, and natural sciences. Subject matter of the course will be announced in due time.

Media
Blackboard, Slides, OR-Lab

Literature
Problem oriented
Elective literature:
problem-oriented

Remarks
The lecture is offered irregularly. The curriculum of the next two years is available online.

Course: Organic Computing [2511104]

Coordinators: Hartmut Schmeck, Sanaz Mostaghim
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	en

Learning Control / Examinations
The assessment of this course consists of a written examination (60 min) (following §4(2), 1 SPO) and of submitting written exercises that recapitulate the content of the course. The exercises include theoretical questions as well as practical programming. For providing a successful solution to all exercises, a bonus will be granted, improving the grade of a passed exam by one grade-step (0.3 or 0.4, respectively, following §4(2), 3 SPO). The course will be offered every second semester (summer term) and exams may be repeated at every ordinary exam date.

Conditions
None.

Learning Outcomes
The student acquires the ability to master methods and concepts of Organic Computing and to demonstrate innovation skills regarding the used methods.
Therefore the course aims at the teaching of fundamentals and methods of Organic Computing within the context of its applicability in practice. On the basis of a fundamental understanding of the taught concepts and methods the students should be able to choose the adequate methods and concepts, if necessary further develop them according to the situation and use them properly when facing related problems in their later job. The students should be capable of finding arguments for the chosen solutions and express them to others.

Content
The mission of Organic Computing is to tame complexity in technical systems by providing appropriate degrees of freedom for self-organized behaviour adapting to changing requirements of the execution environment, in particular with respect to human needs. According to this vision an organic computer system should be aware of its own capabilities, the requirements of the environment, and it should be equipped with a number of "self-x" properties allowing for the anticipated adaptiveness and for a reduction in the complexity of system management. These self-x properties are self-organisation, self-configuration, self-optimization, self-healing, self-protection and self-explanation. In spite of these self-x properties, an organic system should be open to external control actions which might be necessary to prevent undesired behaviour.

Media
powerpoint slides with annotations using a tablet pc access to applets and Internet ressources lecture recording (camtasia).

Literature

- Autonomic Computing: Concepts, Infrastructure and Applications. M. Parashar and S. Hariri (Ed.), CRC Press. December 2006.
- Self-Organization in Biological Systems. S. Camazine, J. Deneubourg, N. R. Franks, J. Sneyd, G. Theraulaz and E. Bonabeau. Princeton University Press, 2003.
- Complex Adaptive Systems: An Introduction. H. G. Schuster, Scator Verlag, 2001.
- Introduction to Evolutionary Computing. A. E. Eiben and J. E. Smith. Natural Computing Series, Springer Verlag, 2003. Swarm Intelligence: From Natural to Artificial Systems.Eric Bonabeau, Marco Dorigo and Guy Theraulaz. Oxford University Press, 1999.
- Control of Complex Systems. K. Astrom, P. Albertos, M. Blanke, A. Isidori and W. Schaufelberger. Springer Verlag, 2001.

Elective literature:

- **Adaptive and Self-organising Systems,** Christian Müller-Schloer, Moez Mnif, Emre Cakar, Hartmut Schmeck, Urban Richter,
June 2007. Preprint.Submitted to ACM Transactions on Autonomous and Adaptive Systems (TAAS)
- **Organic Computing - Addressing Complexity by Controlled Self-organization,** Jürgen Branke, Moez Mnif, Christian Müller-Schloer, Holger Prothmann, Urban Richter, Fabian Rochner, Hartmut Schmeck, In Tiziana Margaria, Anna Philippou, and Bernhard Steffen, *Proceedings of ISoLA 2006*, pp. 200-206. Paphos, Cyprus, November 2006.
- Evolutionary Optimization in Dynamic Environments. J. Branke. Kluwer Academic Publishers, 2002.
- Self-star Properties in Complex Information Systems: Conceptual and Practical Foundations (Lecture Notes in Computer Science. O. Babaoglu, M. Jelasity, A. Montresor, C. Fetzer, S. Leonardi, A. van Moorsel and M. van Steen. Springer Verlag, 2005.

- Design and Control of Self-organizing Systems. C. Gershenson. PhD thesis, Vrije Universiteit Brussel, Brussels, Belgium, 2007.
- VDE / ITG / GI - Positionspapier: Organic Computing - Computer- und Systemarchitektur im Jahr 2010. Juli 2003. it - Information Technology, Themenheft Organic Computing, Oldenbourg Verlag. Volume: 47, Issue: 4/2005.

further references will be announced in class

Course: Managing Organizations [2577902]

Coordinators: Hagen Lindstädt
Part of the modules: Strategic Corporate Management and Organization (p. 122)[MATHMWUO1]

ECTS Credits	Hours per week	Term	Instruction language
4	2/0	Winter term	de

Learning Control / Examinations
The assessment will consist of a written exam (60 min) taking place at the beginning of the recess period (according to Section 4 (2), 2 of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Conditions
None.

Learning Outcomes
The course should enable the participants to assess the strengths and weaknesses of existing organisational structures and rules using systematic criteria. Here concepts and models for designing organisation structures, regulating organisational processes and managing organisational changes are presented and discussed using case studies. The course is structured to relate to actions and aims to give students a realistic view of the opportunities and limits of rational design approaches.

Content

- Principles of organisational management
- Managing organisational structures and processes: the selection of design parameters
- Ideal-typical organisational structures: choice and effect of parameter combinations
- Managing organisational changes

Media
Slides.

Literature

- Laux, H.; Liermann, F.: *Grundlagen der Organisation*, Springer. 6. Aufl. Berlin 2005.
- Lindstädt, H.: *Organisation*, in Scholz, C. (Hrsg.): Vahlens Großes Personallexikon, Verlag Franz Vahlen. 1. Aufl. München, 2009.
- Schreyögg, G.: *Organisation. Grundlagen moderner Organisationsgestaltung*, Gabler. 4. Aufl. Wiesbaden 2003.

The relevant excerpts and additional sources are made known during the course.

Course: Organization Theory [2577904]

Coordinators: Hagen Lindstädt
Part of the modules: Strategic Corporate Management and Organization (p. 122)[MATHMWUO1]

ECTS Credits	Hours per week	Term	Instruction language
6	2/1	Winter term	de

Learning Control / Examinations
The assessment consists of a written exam following §4, Abs. 2, 1 of the examination regulation.

Conditions
None.

Learning Outcomes
The participants are made familiar with mostly classical principles of economic organisational theory and institutional economics. This includes transaction cost theory and agency-theory approaches, models for the function and design of organisational information and decision-making systems, transfer price models to coordinate the exchange of goals and services within companies, models on incentive systems and relative performance tournaments as well as selected OR optimisation approaches to designing organisational structures. The course therefore lays the basis for a deeper understanding of the advanced literature on this key economic area.

Content

- Basic considerations and institution-economic principles of organisational theory
- Transfer prices and internal market-price relationships
- Design and coordination without conflicting objectives
- Economic evaluation of information
- Organisation under asymmetric information and conflicting objectives: agency theory principles

Media
Folien.

Literature

- Laux, H.; Liermann, F.: Grundlagen der Organisation. Springer, 5. Aufl. Berlin 2003.
- Milgrom, P.; Roberts, J.: Economics, Organization and Management. Prentice Hall, Englewoods Cliffs 1992.

The relevant excerpts and additional sources are made known during the course.

Course: Parallel Computing [MATHNM08]

Coordinators: Vincent Heuveline, Jan-Philipp Weiß
Part of the modules: Parallel Computing (p. 77)[MATHMWNM08]

ECTS Credits	Hours per week	Term	Instruction language
5	2/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Pensions [N.N.]

Coordinators: Christian Hipp, Klaus Besserer
Part of the modules: Applications of Actuarial Sciences I (p. 115)[MATHMWBWLFBV4], Applications of Actuarial Sciences II (p. 116)[WM4BWLFBV5]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Remarks
This course *pensions* replaces part of *Life and Pensions* [2530310].

Course: Percolation [MATHST13]

Coordinators: Günter Last
Part of the modules: Percolation (p. 101)[MATHMWST13]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Life Insurance [N.N.]

Coordinators: Michael Vogt
Part of the modules: Applications of Actuarial Sciences I (p. 115)[MATHMWBWLFBV4], Applications of Actuarial Sciences II (p. 116)[WM4BWLFBV5]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Remarks
This course *life insurance* replaces part of *Life and Pensions* [2530310].

Course: Portfolio and Asset Liability Management [2520357]

Coordinators: Svetlozar Rachev
Part of the modules: Mathematical and Empirical Finance (p. 121)[MATHMWSTAT1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	en

Learning Control / Examinations
The assessment of this course consists of a written examination (following §4(2), 1 SPO) and of possible additional assignments during the course (following §4(2), 3 SPO).

Conditions
None.

Learning Outcomes
Introduction and deepening of various portfolio management techniques in the financial industry.

Content
Portfolio theory: principles of investment, Markowitz- portfolio analysis, Modigliani-Miller theorems and absence of arbitrage, efficient markets, capital asset pricing model (CAPM), multi factorial CAPM, arbitragepricing theory (APT), arbitrage and hedging, multi factorial models, equity-portfolio management, passive strategies, active investment
Asset liability: statistical portfolio analysis in stock allocation, measures of success, dynamic multi seasonal models, models in building scenarios, stochastic programming in bond and liability management, optimal investment strategies, integrated asset liability management

Media
transparencies, exercises.

Literature
To be announced in lecture.
Elective literature:
To be announced in lecture.

Course: Potential Theory [MATHAN20]

Coordinators: Tilo Arens, Frank Hettlich, Andreas Kirsch, Wolfgang Reichel
Part of the modules: Potential Theory (p. 62)[MATHMWAN20]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Computing Lab Information Systems [PraBI]

Coordinators: Andreas Oberweis, Detlef Seese, Rudi Studer
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2	Winter / Summer Term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
Students are able to

- implement a prototype at the computer based on the given topic.
- write the thesis with a minimal learning curve by using format requirements such as those recommended by well-known publishers.
- give presentations in a scientific context in front of an auditorium. These techniques are presented and learn during the course.
- present results of the research in written form generally found in scientific publications.

Content
The lab intensifies and extends specific topis which are discussed within corresponding lectures. Knowledge of these lecture topics is an advantage but not a precondition.

Media
Slides, Access to internet resources

Literature
Literature will be given individually.

Remarks
The title of this course is a generic one. Specific titles and the topics of offered seminars will be announced before the start of a semester in the internet at http://www.aifb.uni-karlsruhe.de/Lehre

Course: Advanced Lab in Efficient Algorithms [25700p]

Coordinators: Hartmut Schmeck
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
4	3	Winter / Summer Term	de

Learning Control / Examinations
The assessment consists of (according Section 4(2), 3 of the examination regulation):

- practical work
- oral presentation of the results
- written report
- discussion and collaboration

Conditions
None.

Learning Outcomes

Content
Topics include the new research issues of the research group “applied Informatics”. The new topics are in the area Organic Computing, Nature-inspired optimization and service oriented architectures.
The methods presented in the lectures are practiced during this laboratory in teamwork including implementation tasks. The results should be presented by an oral presentation and a written report.
The topics of the laboratory are introduced around the end of the former semester on the board A12 of the institute AIFB (building 11.40) and in Internet http://www.aifb.kit.edu/web/SeminarePraktika

Literature
Elective literature:
Will be announced at the beginning of the computer lab.

Remarks
There is a limited number of participants. Therefore students have to register for the lab.

Course: Computing Lab in Intelligent Systems in Finance [25762p]

Coordinators: Detlef Seese
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
4	3	Winter / Summer Term	de

Learning Control / Examinations
see German version

Conditions
see German version

Learning Outcomes
see German version

Content
see German version

Literature
Elective literature:
Literature will be announced in the first meeting.

Remarks
see German version

Course: Computing Lab in Complexity Management [25818]

Coordinators: Detlef Seese
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
4	3	Winter / Summer Term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Literature
Will be announced in the computing lab.

Course: Lab Class Web Services [25820]

Coordinators: Stefan Tai, Christian Zirpins
Part of the modules: Emphasis in Informatics (p. 133)[MATHMWINFO2], Informatics (p. 131)[MATHMWINFO1]

ECTS Credits	Hours per week	Term	Instruction language
4	2	Winter term	de

Learning Control / Examinations
The assessment of this course is according to §4(2), 3 of the examination regulation in form of an examination of the written seminar thesis, a presentation and a project. The final mark is based on the examination of the written seminar thesis and the project but can be upgraded or downgraded according to the quality of the presentation.

Conditions
The lectures *Service Oriented Computing 1* or *Web Service Engineering* are recommeded.

Learning Outcomes
Students will acquire the technical expertise to apply service-oriented platforms and tools. Thereby, they will be enabled to develop practical solutions for concrete problems of constructing service-oriented IT infrastructure for provision of electronic services over the Internet.

Content
The "Praktikum (lab class) Web Services" provides a practical introduction to fundamental Web service technologies and their application to support applications on the Internet. Based on concrete application scenarios, the class focuses on the development of software solutions for specific aspects of service-oriented IT-infrastructure. This includes the complete development lifecycle of a large-scale software project and its implementation in small project teams.

Literature
For introduction, the following books are recommended:

- M. P. Papazoglou. Web Services: Principles and Technology. Pearson, 2007.
- G. Alonso, F. Casati, H. Kuno, and V. Machira ju. Web Services - Concepts, Architec-tures and Applications. Springer, 2004.

Specific literature will be announced in the course.

Course: Ecxercises in Knowlegde Management [25740p]

Coordinators: Rudi Studer
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
4	3	Winter / Summer Term	de

Learning Control / Examinations
Assessment is based on equal parts on (acc. to §4(2), 3 SPO)

- Essay
- Presentation
- Implementation

Conditions
Attending the lecture “Wissensmanagement” [25860] is required.

Learning Outcomes
To autonomously comprehend and work on a topic in the area of knowledge management.

Content
This “Praktikum” covers one of the following topics (the topics rotate annually):

- Ontologie-based Knowledge Management
- Semantic Web and Linked Data Applications
- Social Software and Collaboration Tools
- Data and Web Mining
- Personal Knowledge Management
- Case-based Reasoning

Literature
Elective literature:
Nonaka, H. Takeuchi. The Knowledge Creating Company. Oxford University Press 1995.
G. Probst et al. Wissen managen - Wie Unternehmen ihre wertvollste Ressource optimal nutzen. Gabler Verlag 1999.
S. Staab, R. Studer. Handbook on Ontologies. Springer Verlag 2004.
R. Baeza-Yates, B. Ribeiro-Neto. Modern Information Retrieval. ACM Press 1999.

Course: Practical seminar: Health Care Management (with Case Studies) [2550498]

Coordinators: Stefan Nickel
Part of the modules: Operations Research in Supply Chain Management and Health Care Management (p. 127)[MATHMWOR8]

ECTS Credits	Hours per week	Term	Instruction language
7	2/1/2	Winter / Summer Term	de

Learning Control / Examinations
The assessment consists in a case study, the writing of a corresponding paper, and an oral exam (according to §4(2), 2 of the examination regulation).

Conditions
None.

Recommendations
Basic knowledge as conveyed in the module *Introduction to Operations Research* [WI1OR] is assumed.

Learning Outcomes
The practical seminar will take place in a hospital in Karlsruhe such that the students are confronted with real problems. The target of this seminar is to develop solutions for these problems using well-known methods of Operations Research. Consequently the students' ability to analyze processes and structures, to collect relevant data as well as to develop and solve models will be promoted.

Content
Processes in a hospital are often grown historically ("We have always done it this way"), so that there has not been the need to analyze processes until reforms of the health system have put increasing pressure on hospitals. Consequently, nowadays hospitals look for possibilities to improve their processes. The students are confronted with case studies and are asked to develop a solution. Therefore they have to collect and analyze relevant data , processes and structures. When developing the solution the students have to bear in mind that besides the economic efficiency also the quality of care and patient satisfaction (e.g. measured in waiting time) may not be neglected in the health care sector.

Literature
Elective literature:

- Fleßa: Grundzüge der Krankenhausbetriebslehre, Oldenbourg, 2007
- Fleßa: Grundzüge der Krankenhaussteuerung, Oldenbourg, 2008
- Hall: Patient flow: reducing delay in healthcare delivery, Springer, 2006

Remarks
The lecture is offered every term.
The planned lectures and courses for the next three years are announced online.

Course: Production Planning and Scheduling [2550494]

Coordinators: Jörg Kalcsics
Part of the modules: Operations Research in Supply Chain Management and Health Care Management (p. 127)[MATHMWOR8]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	de

Learning Control / Examinations
The assessment consists of a written exam (120 min) according to Section 4 (2), 1 of the examination regulation. The exam takes place at the beginning of the no lecture phase. Repetition exams are offered after the successive semester.

Conditions
None.

Learning Outcomes
Nach dem Studium dieser Veranstaltung sollten die Studierenden

- die Bedeutung der Produktionsplanung und -steuerung (PPS) für ein Unternehmen einschätzen können,
- die Zielsetzungen und Aufgabenstellungen der PPS im Unternehmen kennen,
- einen Überblick über die grundlegenden PPS-Funktionen haben sowie
- die Methoden zur Analyse der Auftragsabwicklung kennen.

Das Hauptaugenmerk der Veranstaltung liegt auf quantitativen Planungsverfahren zur Losgrößenplanung, sowie der Reihenfolge- und Ablaufplanung.

Content
Aufgrund des enormen Wertschöpfungsprozess der Produktion ist deren Planung und Steuerung von zentraler Bedeutung für jede Industrieunternehmung. Gegenstand der Produktionsplanung und –steuerung (PPS) ist die operative, zeitliche und mengenmäßige Steuerung, Kontrolle und Verwaltung aller Vorgänge, die bei der Produktion von Waren und Gütern notwendig sind. Sie lässt sich die die folgenden Bereiche unterteilen (siehe Gutenberg):

- *Produktionsprogrammplanung*
  Ziel der Produktionsprogrammplanung ist die Festlegung von Art, Menge und zeitlichem Rahmen der in den nächsten Perioden zu produzierenden Erzeugnisse. Je nach Fristigkeit der Planung werden Entscheidungen über grundsätzlich zu fertigende Produktarten und abzudeckende Marktsegmente unter Beachtung der Unternehmensziele und Ressourcenverfügbarkeiten getroffen, oder aber die in einem vorgegebenen Zeitraum tatsächlich herzustellenden Endprodukte und absatzfähigen Zwischenprodukte.
- *Bereitstellungs- und Bedarfsplanung*
  Gegenstand der Bereitstellungs- und Bedarfsplanung ist die Bestimmung von Art, Menge und Bereitstellungstermin der Verbrauchsfaktoren, die für die Erzeugung des zuvor geplanten Produktionsprogramms benötigt werden. Da in der Produktionsprogrammplanung überwiegend Endprodukte betrachtet wurden (Primärbedarfe), muss nun insbesondere eine Planung für die untergeordneten Erzeugnisse, d.h. Zwischen- und Vorprodukte, unter Einbeziehung der Arbeitspläne und Stücklisten folgen (Sekundärbedarfe). Oftmals fällt hierunter auch die Aufgabe der Zusammenfassung von Fertigungsaufträgen zu Losen und die Beschaffungsplanung.
- *Produktionsprozeßplanung*
  Teilgebiete der Produktionsprozeßplanung sind die Durchlauf- und Kapazitätsterminierung, sowie die Reihenfolgeplanung. Mittels der Durchlaufterminierung werden früheste und späteste Termine für die Durchführung einzelner Arbeitsschritte unter Einhaltung der zuvor vereinbarten oder festgelegten Liefertermine ermittelt. Anschließend wird in der Kapazitätsterminierung geklärt, ob die erforderlichen Kapazitäten für das Produktionsprogramm vorhanden sind. Bei Kapazitätsengpässen müssen einzelne Arbeitsschritte in andere Zeiträume verschoben oder Überstunden eingeplant werden. Gegenstand der Reihenfolgeplanung ist schließlich die Bildung von Reihenfolgen für die Bearbeitung von Aufträgen und deren detaillierte zeitliche Verteilung auf einzelne Maschinen.

Literature
Elective literature:

- Domschke, Scholl, Voß: Produktionsplanung, 2. Auflage, Springer, 1997
- Günther, Tempelmeier: Produktion und Logistik, 7. Auflage, Springer, 2007
- Gutenberg: Grundlage der Betriebswirtschaftslehre, Band 1: Die Produktion, 24. Auflage, Springer, 1983
- Nahmias: Production and Operations Analysis, McGraw-Hill, 2008

Remarks
The lecture is held irregularly.
The planned lectures and courses for the next three years are announced online.

Course: Project Work in Risk Research [2530393]

Coordinators: Ute Werner, Madalena Salek
Part of the modules: Operational Risk Management II (p. 119)[MATHMWBWLFBV10], Operational Risk Management I (p. 118)[MATHMWBWLFBV9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	3	Winter / Summer Term	de

Learning Control / Examinations
The assessment consists of oral presentations and papers on the topics presented (50%) as well as of the participation in group work (50%), according to Section 4 (2), 3 of the examination regulation.

Conditions
Willingness to study literature beforehand in order to prepare for the work project at hand.

Learning Outcomes
Learn how to integrate knowledge from individual and collective group work for developing ideas and creating solutions for current problems in risk research.

Content
Project work with topic from current risk research.
Topics covered so far:

- Risk perception of extreme natural events
- Terrorism: Prevention, Provention, Perception
- Damage potential of man-made hazards
- Risk communikation
- Cross-cultural comparison of risk perception
- Scenario-based hazard assessment
- Improving citizens' emergency preparedness
- Innovative insurance products for adapting to climate change
- Developing a questionnaire regarding risk perception of climate change
- Evaluation of the PROSA-project of DRV-BW

Literature
Indicated during the course for the selected topic.
Elective literature:
Indicated during the course for the selected topic.

Remarks
This course is offered in the spring term 2011.
This course is normally offered each semester. For further information, see: http://insurance.fbv.uni-karlsruhe.de
To attend the course please register at the secretary of the chair of insurance science.

Course: Quality Control I [2550674]

Coordinators: Karl-Heinz Waldmann
Part of the modules: Stochastic Modelling and Optimization (p. 130)[MATHMWOR10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1/2	Winter term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
The lecture provides students with knowledge of modern techniques in quality management. Students learn to use the techniques, such as control charts, experimental design, efficiently and targeted.

Content
Topics overview: Introduction to TQM, Statistical Process Control (control charts), Acceptance Sampling (sampling plans), Design and Analysis of Experiments

Media
Blackboard, Slides, Flash Animations.

Literature
Lecture Notes
Elective literature:

- Montgomery, D.C. (2005): Introduction to Statistical Quality Control (5e); Wiley.

Remarks
The lecture is offered irregularly. The curriculum of the next two years is available online.

Course: Quality Control II [25659]

Coordinators: Karl-Heinz Waldmann
Part of the modules: Stochastic Modelling and Optimization (p. 130)[MATHMWOR10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1/2	Summer term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
The lecture provides students with knowledge of modern techniques in reliability engineering.

Content
Topics overview: Reliability Theory (structure function, reliability of complex systems, modeling and estimating lifetime distributions, systems with repair), Maintenance

Media
Blackboard, Slides, Flash Animations.

Literature
Lecture Notes
Elective literature:

- ROSS, S.M.: Introduction to Probability Models (5 ed). Academic Press, 1993.
- KOHLAS, J.: Zuverlässigkeit und Verfügbarkeit. B.G. Teubner, Stuttgart, 1987.
- BIROLINI, A: Qualität und Zuverlässigkeit technischer Systeme, Springer, Berlin, 1991.

Remarks
The lecture is offered irregularly. The curriculum of the next two years is available online.

Course: Spatial Stochastics [MATHST14]

Coordinators: Daniel Hug, Günter Last
Part of the modules: Spatial Stochastics (p. 102)[MATHMWST14]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Boundary Value Problems and Eigenvalue Problems [RUEP]

Coordinators: Michael Plum, Wolfgang Reichel, Roland Schnaubelt, Lutz Weis
Part of the modules: Boundary Value Problems and Eigenvalue Problems (p. 51)[MATHMWAN09]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Summer term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Boundary Value Problems for Nonlinear Differential Equations [MATHAN21]

Coordinators: Michael Plum, Wolfgang Reichel
Part of the modules: Boundary Value Problems for Nonlinear Differential Equations (p. 63)[MATHMWAN21]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Capability maturity models for software and systems engineering [2511216]

Coordinators: Ralf Kneuper
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
4	2	Summer term	de

Learning Control / Examinations
The assessment of this course is a written or (if necessary) oral examination according to §4(2) of the examination regulation.

Conditions
None.

Learning Outcomes
Students master the basics of capability maturity models, oversee the whole process in project management and development processes according to CMMI and SPICE. They know how to use capability maturity models for quality assurance.

Content
Capability maturity models like CMMI and SPICE are an important tool for assessing and improving software development. A significantly increasing number of companies use these models in their own approach to improve their development and to demonstrate a certain minimum quality and effective external presentation. This is the case in Germany, especially in the automotive industry, but also many other industries.

Preliminary Structure of the lecture:

1. Introduction and Overview, motivation
2. Project management according to CMMI
3. Development processes according to CMMI
4. Process management and supporting processes according toCMMI
5. Differences between SPICE and CMMI
6. Introduction of capability maturity models
7. Assessments and Appraisals
8. Costs and benefits of capability maturity models

Media
Slides, access to internet resources.

Literature
Literature is given in each lecture individually.

Course: Reinsurance [2530312]

Coordinators: Christian Hipp, Schwehr
Part of the modules: Applications of Actuarial Sciences I (p. 115)[MATHMWBWLFBV4], Applications of Actuarial Sciences II (p. 116)[WM4BWLFBV5]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Literature
Elective literature:
Pfeiffer, C.: Einführung in die Rückversicherung, Wiesbaden, Gabler, 1986.
Mack: Schadenversicherungsmathematik. Schriftenreihe angewandte Versicherungsmathematik Band 28. Verlag VW Karlsruhe.
Embrechts, Klüppelberg, Mikosch: Modelling Extremal Events. Springer 1998.

Remarks
The credits have been reduced to 3.

Course: Riemannian Geometry [1036]

Coordinators: Enrico Leuzinger
Part of the modules: Riemannian Geometry (p. 27)[MATHMWAG04]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Risk Communication [2530395]

Coordinators: Ute Werner
Part of the modules: Operational Risk Management I (p. 118)[MATHMWBWLFBV9], Operational Risk Management II (p. 119)[MATHMWBWLFBV10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	3/0	Winter / Summer Term	de

Learning Control / Examinations
The assessment consists of oral presentations (incl. papers) within the lecture (according to Section 4 (2), 3 of the examination regulation) and a final oral exam (according to Section 4 (2), 2 of the examination regulation).
The overall grade consists of the assessment of the oral presentations incl. papers (50 percent) and the assessment of the oral exam (50 percent).

Conditions
None.

Learning Outcomes
See German version.

Content
See German version.

Literature
Elective literature:
R. Löfstedt, L. Frewer (Hrsg.). The Earthscan Reader in Risk & Modern Society. London 1998.
B.-M. Drottz-Sjöberg. Current Trends in Risk Communication - Theory and Practice. Hrsg. v. Directorate for Civil Defence and Emergency Planning. Norway 2003.
Munich Re. Risikokommunikation. Was passiert, wenn was passiert? www.munichre.com
O.-P. Obermeier. Die Kunst der Risikokommunikation - Über Risiko, Kommunikation und Themenmanagement. München 1999.
Fallstudien unter www.krisennavigator.de

Remarks
This course is offered on demand, normally during winter term. For further information, see: http://insurance.fbv.uni-karlsruhe.de
To attend the course please register at the secretary of the chair of insurance science.

Course: Risk Management of Microfinance and Private Households [26354]

Coordinators: Ute Werner
Part of the modules: Operational Risk Management II (p. 119)[MATHMWBWLFBV10], Operational Risk Management I (p. 118)[MATHMWBWLFBV9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	3/0	Winter / Summer Term	de

Learning Control / Examinations
The assessment consists of oral presentations (incl. papers) within the lecture (according to Section 4 (2), 3 of the examination regulation) and a final oral exam (according to Section 4 (2), 2 of the examination regulation).
The overall grade consists of the assessment of the oral presentations incl. papers (50 percent) and the assessment of the oral exam (50 percent).

Conditions
None.

Learning Outcomes
Becoming acquainted with starting points for analysing the special risk situation of private households and micro enterprises; learning to synchronize various risk coping instruments, identifying risks of microfinance products and learning to design innovative microfinance products.

Content
The course consists of two interlocking parts:
In the first part the socio-economic framework as well as the goals and strategies of private-sector risk management are discussed, with an emphasis on insurance decisions. In the second part the issue of small enterpreneural entities and their specific risk related problems in covering their financial requirements is addressed. Typically their size and other specific characteristics lead to high risks for financial services institutions. After an introduction to the economic principles of microfinance, the institutions working in this sector are presented as well as innovative credit-, savings-, and insurance products (which are often combined), and we'll discuss approaches for performance measurement from the perspectives of customers, suppliers, and investors.

Media
Scriptum.

Literature

- H.-U. Vollenweider. *Risikobewältigung in Familie und Haushalt - eine sicherheitsökonomische Studie.* 1986.
- P. Zweifel, R. Eisen. Versicherungsökonomie. 2003
- J. Ledgerwood, I. Johnson, J.M. Severino. *Microfinance Handbook: An Institutional and Financial Perspective.* 2001.
- B.M. de Aghion, J. Morduch. The Economics of Microfinance. 2005.

Remarks
This course is offered on demand. For further information, see: http://insurance.fbv.uni-karlsruhe.de
To attend the course please register at the secretary of the chair of insurance science.

Course: Semantic Web Technologies I [2511304]

Coordinators: Rudi Studer, Sebastian Rudolph, Andreas Harth
Part of the modules: Emphasis in Informatics (p. 133)[MATHMWINFO2], Informatics (p. 131)[MATHMWINFO1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	de

Learning Control / Examinations
The assessment consists of an 1h written exam following §4, Abs. 2, 1 of the examination regulation or of an oral exam (20 min) following §4, Abs. 2, 2 of the examination regulation.
The exam takes place every semester and can be repeated at every regular examination date.

Conditions
Lectures on Informatics of the Bachelor on Information Management (Semester 1-4) or equivalent.

Learning Outcomes

- Basic knowledge about the main ideas and the realisation of Semantic Web Technologies

Content
"Semantic Web" denotes an extension of the World Wide Web by meta data and applications in order to make the meaning (semantics) of data on the web usable by intelligent systems, e.g. in e-commerce and internet portals. Central to this is the representation and processing of knowledge in form of ontologies. This lecture provides the foundations for knowledge representation and processing for the corresponding technologies and presents example applications. It covers the following topics:

- Extensible Markup Language (XML)
- Resource Description Framework (RDF) and RDF Schema
- Web Ontology Language (OWL)
- Rule Languages
- Applications

Media
Slides.

Literature

- Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, York Sure: Semantic Web - Grundlagen, Springer, 2008 (ISBN 978-3-540-33993-9)
- S. Staab, R. Studer (Editors). Handbook on Ontologies. International Handbooks in Information Systems. Springer 2003.

Elective literature:

1. Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, Foundations of Semantic Web Technologies. Textbooks in Computing, Chapman and Hall/CRC Press, 2009.
2. G. Antoniou, Grigoris Antoniou, Frank Van Harmelen, A Semantic Web Primer, MIT Press, 2004
3. Uwe Schöning. Logik für Informatiker. Spektrum Akademischer Verlag, 5. Auflage 2000
4. Steffen Hölldobler. Logik und Logikprogrammierung. Synchron Verlag, 3. Auflage 2003
5. Dieter Fensel. Spinning the Semantic Web. 2003 (ISBN 0262062321).
6. Handschuh, Staab. Annotation for the Semantic Web. 2003 (ISBN 158603345X).
7. J. Sowa. Knowledge Representation. Brooks/Cole 1999
8. Tim Berners-Lee. Weaving the Web. Harper 1999 geb. 2000 Taschenbuch.
9. Ian Jacobs, Norman Walsh. Architecture of the World Wide Web, Volume One. W3C Recommendation 15 December 2004. http://www.w3.org/TR/webarch/

Course: Semantic Web Technologies II [2511306]

Coordinators: Elena Simperl, Andreas Harth, Sebastian Rudolph, Daniel Oberle
Part of the modules: Emphasis in Informatics (p. 133)[MATHMWINFO2], Informatics (p. 131)[MATHMWINFO1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	de

Learning Control / Examinations
Written Examination (60 min) according to §4, Abs. 2, 1 of the examination regulations or oral examination of 20 minutes according to §4, Abs. 2, 2 of the examination regulations.
The exam takes place every semester and can be repeated at every regular examination date.

Conditions
Lectures on Informatics of the Bachelor on Information Management (Semester 1-4) or equivalent. *Semantic Web Technologies I* [2511304] is recommended.

Learning Outcomes

- Acquisition of basic competencies in Linked Data and data integration on the web
- Acquisition of advanced knowledge in knowledge representation with ontologies
- Acquisition of detailed knowledge of acquisition and evaluation of ontologies
- Analysis of typical usage scenarios and industry applications

Content
Central components of the Semantic Web are explained in detail. Linked Data foundations, crawling, querying and applications; knowledge representation, ontology modelling; ontology development and evaluation; Further, benefits and challenges of semantic technologies are discussed.

Media
Slides.

Literature

- Pascal Hitzler, Sebastian Rudolph, Markus Krötzsch: Foundations of Semantic Web Technologies. Chapman & Hall/CRC 2009.
- Steffen Staab, Rudi Studer (Editors). Handbook on Ontologies. International Handbooks in Information Systems. Springer 2003.
- John Domingue, Dieter Fensel, James A. Hendler (Editors). Handbook of Semantic Web Technologies. Springer 2011.

Elective literature:

1. Grigoris Antoniou, Frank Van Harmelen. A Semantic Web Primer. MIT Press, 2004
2. Uwe Schöning. Logik für Informatiker. Spektrum Akademischer Verlag, 2000
3. Steffen Hölldobler. Logik und Logikprogrammierung. Synchron Verlag, 2003
4. Dieter Fensel. Spinning the Semantic Web. MIT Press, 2003
5. John Sowa. Knowledge Representation. Brooks/Cole, 1999
6. Tim Berners-Lee. Weaving the Web. HarperOne, 1999
7. 7. Dean Allemang. Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL. Morgan Kaufmann, 2008
8. Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernando Lopez: Ontological Engineering: with examples from the areas of Knowledge Management, e-Commerce and the Semantic Web. Springer, 2004
9. Nicola Guarino and Chris Welty. Identity, Unity, and Individuation: Towards a Formal Toolkit for Ontological Analysis. Proceedings of ECAI-2000: The European Conference on Artificial Intelligence. IOS Press, 2000
10. Nicola Guarino and Chris Welty. Evaluating Ontological Decisions with OntoClean. Communications of the ACM. 45(2):61-65, 2000
11. Tom Heath and Chris Bizer. Linked Data: Evolving the Web into a Global Data Space. Synthesis Lectures on the Semantic Web: Theory and Technology, 2011

Course: Seminar in Enterprise Information Systems [SemAIFB1]

Coordinators: Rudi Studer, Andreas Oberweis, Thomas Wolf, Ralf Kneuper
Part of the modules: Seminar (p. 136)[MATHMWSEM03]

ECTS Credits	Hours per week	Term	Instruction language
4	2	Winter / Summer Term	de

Learning Control / Examinations

Conditions
See corresponding module information.

Learning Outcomes
Students are able to

- do literature search based on a given topic: identify relevant literature, find, assess and evaluate this literature.
- write the seminar thesis (and later the Bachelor-/Masterthesis) with a minimal learning curve by using format requirements such as those recommended by well-known publishers.
- give presentations in a scientific context in front of an auditorium. These techniques are presented and learned during the seminar.
- present results of the research in written form generally found in scientific publications.

Content
The seminar intensifies and extends specific topis which are discussed within corresponding lectures. Knowledge of these lecture topics is an advantage but not a precondition.
Specific titles and the topics of offered seminars will be announced before the start of a semester in the internet at http://www.aifb.uni-karlsruhe.de/Lehre

Literature
Literature will be given individually in the specific seminar.

Course: Seminar Efficient Algorithms [SemAIFB2]

Coordinators: Hartmut Schmeck
Part of the modules: Seminar (p. 136)[MATHMWSEM03]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	de

Learning Control / Examinations
The assessment consists of a talk (presentation of 45-60 minutes) about the research topic of the seminar together with discussion, a written summary about the major issues of the topic (approx. 15 pages) and attending the discussions of the seminar (according Section 4(2), 3 of the examination regulation).
The grade of this course is achieved by the weighted sum of the grades (talk 50%, written summary 30% and discussion 20%).
This seminar is for bachelor as well as master students. The difference between them is calculated according to different evaluation mechanisms for the written summary work and the talk.

Conditions
See corresponding module information.

Learning Outcomes
The students should learn to work on research papers by searching for new topics in computer science and by presenting the major issues of the papers.
The master students should deepen their ability to develop independent insight into new scientific topics and to communicate them through oral presentation and written summary to others.
The students will learn to deal with critical discussions on scientific presentations and written summaries through active participation in the seminar.

Content
Topics include the new research issues of the research group “applied Informatics”. The new topics are in the area Organic Computing, Nature-inspired optimization and service oriented architectures.
The topics of the seminars are introduced around the end of the former semester on the board A12 of the institute AIFB (building 11.40) and in Internet http://www.aifb.kit.edu/web/SeminarePraktika

Literature
Will be announced at the beginning of the semester.

Remarks
There is a limited number of participants. The students have to register for the seminar.

Course: Seminar in Finance [2530293]

Coordinators: Marliese Uhrig-Homburg, Martin E. Ruckes
Part of the modules: Seminar (p. 135)[MATHMWSEM02]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	de

Learning Control / Examinations

Conditions
None.

Recommendations
Knowledge of the content of the modules *Essentials of Finance* [WW3BWLFBV1] or *F1 (Finance)* [MATHMWBWLFBV1] is assumed.

Learning Outcomes
The student gets in touch with scientific work. Through profound working on a specific scientific topic the student is meant to learn the foundations of scientific research and reasoning in particular in finance.
Through the presentations in this seminar the student becomes familiar with the fundamental techniques for presentations and foundations of scientific reasoning. In addition, the student earns rhetorical skills.

Content
Within this seminar different topics of current concern are treated. These topics have their foundations in the contents of certain lectures.
The topics of the seminar are published on the website of the involved finance chairs at the end of the foregoing semester.

Literature
Will be announced at the end of the foregoing semester.

Course: Seminar Complexity Management [SemAIFB3]

Coordinators: Detlef Seese
Part of the modules: Seminar (p. 136)[MATHMWSEM03]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	de

Learning Control / Examinations
see German version

Conditions
None.

Learning Outcomes
see German version

Content
see German version

Literature
Will be announced in the seminar.

Remarks
The number of participants is limited. Please take notice about the inscription procedure at the institutes website. Specific titles and the topics of offered seminars will be announced before the start of a semester on the website of AIFB.

Course: Seminar Public Sector Risk Management [2530355]

Coordinators: Hochrainer
Part of the modules: Operational Risk Management I (p. 118)[MATHMWBWLFBV9], Operational Risk Management II (p. 119)[MATHMWBWLFBV10]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Summer term	de

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Seminar Service Science, Management & Engineering [2590470]

Coordinators: Christof Weinhardt, Gerhard Satzger, Rudi Studer, Stefan Tai
Part of the modules: Seminar (p. 136)[MATHMWSEM03]

ECTS Credits	Hours per week	Term	Instruction language
4	2	Winter / Summer Term	de

Learning Control / Examinations
The assessment of this course is according to §4(2), 3 SPO in form of an examination of the written seminar thesis (15-20 pages), a presentation and active participation in class.
The final mark is based on the examination of the written seminar thesis but can be upgraded or downgraded according to the quality of the presentation.

Conditions
See corresponding module information.

Recommendations
Lecture *eServices* [2540466] is recommended.

Learning Outcomes
Autonomously deal with a special topic in the Service Science, Management and Engineering field adhering to scientific standards.

Content
Each Semester, the seminar will cover topics from a different selected subfield of Service Science, Management & Engineering. Topics include service innovation, service economics, service computing, transformation and coordination of service value networks as well as collaboration for knowledge intensive services.
See the KSRI website for more information about this seminar: http://www.ksri.kit.edu

Literature
The student will receive the necessary literature for his research topic.

Course: Seminar Stochastic Models [SemWIOR1]

Coordinators: Karl-Heinz Waldmann
Part of the modules: Seminar (p. 136)[MATHMWSEM03]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	

Learning Control / Examinations
The assessment of this course is in form of an examination of the written seminar thesis and a presentation. The final mark is the result of both the paper and its presentation.

Conditions
None.

Learning Outcomes
In case studies students comprehend stochastic relationships and gain deep knowledge of modelling, evaluation, and optimization of stochastic systems. In group presentations, students learn basic academic presentation and argument skills.

Content
The actual topic as well as the contemporary issues are available online.

Media
Power Point and related presentation techniques.

Literature
Will be presented with the actual topic.

Course: Seminar Knowledge Management [SemAIFB4]

Coordinators: Rudi Studer
Part of the modules: Seminar (p. 136)[MATHMWSEM03]

ECTS Credits	Hours per week	Term	Instruction language
4	2	Winter term	de

Learning Control / Examinations

Conditions
See module description.

Learning Outcomes
The students will learn to perform literature searches on current topics in computer science and holistic knowledge management as well as preparing and presenting the contents of scientific publications.

During the work on the seminar topics the master students will deepen their skills to autonomously comprehend current scientific knowledge and to convey it to others through oral presentations and written summaries.

Through active participation in the seminar, students acquire skills in critical appraisal of research topics and in oral and written presentation of independently developed research content.

Content
Each year, the seminar will cover topics from a different selected subfield of knowledge management, e.g.:

- Ontology-based knowledge management,
- Information Retrieval and Text Mining,
- Data Mining,
- Personal Knowledge Management,
- Case Based Reasoning (CBR),
- Collaboration and Scoial Computing,
- Business-process Oriented Knowledge Management.

Media
Slides.

Literature

- I. Nonaka, H. Takeuchi: The Knowledge Creating Company. Oxford University Press 1995
- G. Probst et al.: Wissen managen - Wie Unternehmen ihre wertvollste Ressource optimal nutzen. Gabler Verlag, Frankfurt am Main/ Wiesbaden, 1999
- Pascal Hitzler, Markus Krötzsch, Sebastian Rudolf, York Sure: Semantic Web - Grundlagen, Springer, 2008 (ISBN 978-3-540-33993-9)
- S. Staab, R. Studer: Handbook on Ontologies, ISBN 3-540-40834-7, Springer Verlag, 2004
- Modern Information Retrieval, Ricardo Baeza-Yates & Berthier Ribeiro-Neto. New York, NY: ACM Press; 1999; 513 pp. (ISBN: 0-201-39829-X.)

Remarks
The number of students is limited. Students have to observe the designated registration process.

Course: Seminar in Insurance Management [SemFBV1]

Coordinators: Ute Werner
Part of the modules: Seminar (p. 135)[MATHMWSEM02]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	de

Learning Control / Examinations

Conditions
See corresponding module information.
The seminar is held within the courses of *Insurance Management* [WW3BWLFBV4] and [WW4BWLFBV6/7], respectively.
A course taken as a seminar cannot be chosen as a part of a course module (and vice versa).

Recommendations
The seminar fits well with the bachelor modules *Risk and Insurance Management* [WW3BWLFBV3] and *Insurance Markets and Management* [WW3BWLFBV4] as well as with the master modules *Insurance Management I* [WW4BWLFBV6] and *Insurance Management* II [WW4BWLFBV7]. These modules, though, are not required to be taken.

Learning Outcomes
See German version.

Content
The seminar is offered within the following courses:

- Principles of Insurance Management
- Insurance Marketing
- Insurance Production
- Service Management

For their contents refer to the information given at the referring pages.

Literature
Will be announced at the beginning of the lecture period.

Remarks
Some of the respective courses are offered on demand. For further information, see: http://insurance.fbv.uni-karlsruhe.de
To attend the course please register at the secretary of the chair of insurance science.

Course: Seminar in Operational Risk Management [SemFBV2]

Coordinators: Ute Werner
Part of the modules: Seminar (p. 135)[MATHMWSEM02]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	de

Learning Control / Examinations

Conditions

See corresponding module information.
The seminar is held within the courses of *Operational Risk Management I/II* [WW4BWLFBV8/9] but with special forms of working.
A course taken as a seminar cannot be chosen as a part of a course module (and vice versa).

Recommendations

The seminar fits well with the bachelor module *Risk and Insurance Management* [WW3BWLFBV3] as well as with the master modules *Operational Risk Management I* [MATHMWBWLFBV8] and *Operational Risk Management* II [MATHMWBWLFBV9]. These modules, though, are not required to be taken.

Learning Outcomes

See German version.

Content

The seminar is offered within the following courses:

- Enterprise Risk Management
- Multidisciplinary Risk Research
- Risk Communication
- Risk Management of Microfinance and Private Households
- Project Work in Risk Research

For their contents refer to the information given at the referring pages.

Literature

Will be announced at the beginning of the course period.

Remarks

Some of the respective courses are offered on demand. For further information, see: http://insurance.fbv.uni-karlsruhe.de
To attend the course please register at the secretary of the chair of insurance science.

Course: Seminar in Discrete Optimization [2550491]

Coordinators: Stefan Nickel
Part of the modules: Seminar (p. 136)[MATHMWSEM03]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	de

Learning Control / Examinations
The assessment consists of a written seminar thesis of 20-25 pages and a presentation of 40-60 minutes (according to §4(2), 3 of the examination regulation).
The final mark for the seminar is the weighted average of the marks for the assessed assignments (seminar thesis 50 %, presentation 50%).
The seminar can be attended both by Bachelor and Master students. A differentiation will be achieved by different valuation standards for the seminar thesis and presentation.

Conditions
Attendance is compulsory.
If possible, at least one module of the institute should be taken before attending the seminar.

Learning Outcomes
The seminar aims at the presentation, critical evaluation and exemplary discussion of recent questions in discrete optimization. The focus lies on optimization models and algorithms, also with regard to their applicability in practical cases (especially in Supply Chain and Health Care Management).
The students get in touch with scientific working: The in-depth work with a special scientific topic makes the students familiar with scientific literature research and argumentation methods. As a further aspect of scientific work, especially for Master students the emphasis is put on a critical discussion of the seminar topic.
Regarding the seminar presentations, the students will be familiarized with basic presentational and rhetoric skills.

Content
The topics of the seminar will be announced at the beginning of the term in a preliminaty meeting. Dates will be announced on the internet.

Literature
Literature and relevant sources will be announced at the beginning of the seminar.

Remarks
The seminar is offered in each term.

Course: Seminar in Experimental Economics [SemWIOR3]

Coordinators: Siegfried Berninghaus
Part of the modules: Seminar (p. 135)[MATHMWSEM02]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	de

Learning Control / Examinations

Conditions
See corresponding module information.
A course in the field of Game Theory should be attended beforehand.

Learning Outcomes
The seminar wants to deepen the methods of scientific work. Students shall learn to discuss critical the latest research results in Experimental Economics.
Students learn the technical basics of presentation and to argument scientifically. Also rethoric skills shall be amplified.

Content
The seminar's topic will be announced before the beginning of each semester on the internet (http://www.wior.uni-karlsruhe.de/LS_Berninghaus/Studium/).

Media
Slides.

Literature
Will be announced at the end of the recess period.

Course: Seminar in Continous Optimization [2550131]

Coordinators: Oliver Stein
Part of the modules: Seminar (p. 136)[MATHMWSEM03]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	de

Learning Control / Examinations
The assessment is composed of a 15-20 page paper as well as a 40-60 minute oral presentation according to §4(2), 3 of the examination regulation.
The total grade is composed of the equally weighted grades of the written and oral assessments.
The seminar is appropriate for bachelor as well as for master students. Their differentiation results from different assessment criteria for the seminar paper and the seminar presentation.

Conditions
See corresponding module information.
Attendance is compulsory.
Preferably at least one module offered by the institute should have been chosen before attending this seminar.

Learning Outcomes
The seminar aims at describing, evaluating, and discussing recent as well as classical topics in continuous optimization. The focus is on the treatment of optimization models and algorithms, also with respect to their practical application.
The student is introduced to the style of scientific work. By focussed treatment of a scientific topic the student learns the basics of scientific investigation and reasoning.
For further development of a scientific work style, master students are particularly expected to critically question the seminar topics.
With regard to the oral presentations the students become acquainted with presentation techniques and basics of scientifc reasoning. Also rethoric abilities may be improved.

Content
The current seminar topics are announced under http://kop.ior.kit.edu at the end of the preceding semester.

Literature
References and relevant sources are announced at the beginning of the seminar.

Course: Seminar in Risk Theory and Actuarial Science [SemFBV3]

Coordinators: Christian Hipp
Part of the modules: Seminar (p. 135)[MATHMWSEM02]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	

Learning Control / Examinations

Conditions

See corresponding module information.
Knowledge of statistics and actuary science is an advantage.
The seminar is a good addition to the Bachelor module *Calculation and Control* [MATHMWBWLFBV2] and to the Master modules *Applications of Actuarial Sciences I/II* [WW4BWLFBV4/5]. However these modules are not a prerequisite for the participation in the seminar.

Learning Outcomes

Content

Literature

Will be announced at the end of the recess period.

Course: Seminar in Game and Decision Theory [SemWIOR4]

Coordinators: Siegfried Berninghaus
Part of the modules: Seminar (p. 135)[MATHMWSEM02]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	de

Learning Control / Examinations

Conditions
Completion of all 1st an 2nd year modules of the Bachelor Program.
See corresponding module information.

Learning Outcomes
The seminar wants to deepen the methods of scientific work. Students shall learn to discuss critical the latest research results in game theory.
Procurement of SQs: Students learn the technical basics of presentation and to argument scientifically. Also rethoric skills shall be amplified.

Content
The seminar's topic will be announced before the beginning of each semester on the internet (http://www.wior.uni-karlsruhe.de/LS_Berninghaus/Studium/).

Media
Slides.

Literature
Will be announced at the end of the recess period.

Course: Seminar: Management and Organization [2577915]

Coordinators: Hagen Lindstädt
Part of the modules: Seminar (p. 135)[MATHMWSEM02]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	de

Learning Control / Examinations

Conditions
See corresponding module information.

Learning Outcomes
The aim of the seminar is to describe corporate and organisational management approaches, to assess them critically and clarify them using practical examples. The focus is on assessing the models with a view to their applicability and theoretical limits.

Content
The subjects are redefined each semester on the basis of current issues.

Media
Slides.

Literature
The relevant sources are made known during the course.

Course: Practical Seminar Knowledge Discovery [25810]

Coordinators: Rudi Studer
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
4	2	Summer term	de

Learning Control / Examinations

Conditions
None.

Recommendations
Knowledge of algorithms in the area of knowledge discovery is assumed. Therefore it is recommended to attend the course [2511302] Knowledge Discovery beforehand.

Learning Outcomes
Implementation of an own knowledge discovery project. Includes familiarization with, prototypical implementation, experiments and presentation of a topic from the fields of knowledge discovery and data mining adhering to scientific standards.

Content
The practical course will cover topics in the field of knowledge discovery. Each term, a different topic is covered, e.g.: text mining or learning with semantic data. Details will be announced every semester.

Media
Slides.

Course: Service Oriented Computing 1 [2511500]

Coordinators: Stefan Tai
Part of the modules: Emphasis in Informatics (p. 133)[MATHMWINFO2], Informatics (p. 131)[MATHMWINFO1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	de

Learning Control / Examinations
The assessment of this course is a written examination (60min.) in the first week after lecture period (nach §4(2), 1 SPO).

Conditions
Lecture *AI2* [2511032] is recommended.

Learning Outcomes
The course introduces concepts, methods, and techniques of "service-oriented computing", including languages for (Web) service description, methods and tools for the development of services, and platforms (middleware, runtimes) for the Web-based deployment, delivery, and execution of services. The course provides a solid technical foundation that enables the student to address the increasingly relevant challenges of developing "service-oriented architectures (SOA)" in the industry.

Content
Web services represent the next-generation of Web technology, and are an evolution of conventional distributed middleware. They enable new and improved ways for enterprise computing, including application interoperability and integration, and business process management. Modern software systems are being designed as service-oriented architectures (SOA), introduding increased agility and flexibilty at both the software systems and the business level. Web services and SOA thus have a profound impact on software development and the businesses that they support. The course "Service-oriented Computing" introduces the concepts, methods and technology that provide a solid foundation in this area. Topics include:

- Service description
- Service engineering, including development and implementation
- Service composition (aggregation), including process-based service orchestration
- Interoperability formats and protocols
- Service platforms and runtimes (middleware)

Media
Slides, access to internet resources.

Literature
Will be announced in the lecture.

Course: Service Oriented Computing 2 [2511308]

Coordinators: Rudi Studer, Sudhir Agarwal, Barry Norton
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	de

Learning Control / Examinations
The assessment consists of an 1h written exam following §4, Abs. 2, 1 of the examination regulation or of an oral exam (20 min) following §4, Abs. 2, 2 of the examination regulation.

Conditions
It is recommended to attend the course *Service-oriented Computing 1* [2511500] beforehand.

Learning Outcomes
Students will extend their knowledge and proficiency in the area of modern service-oriented technologies. Thereby, they acquire the capability to understand, apply and assess concepts and methods that are of innovative and scientific nature.

Content
Building upon basic Web service technologies the lecture introduces select topics of advanced service computing and service engineering. In particular, focus will be placed on new Web-based architectures and applications leveraging Web 2.0, Cloud Computing, Semantic Web and other emerging technologies.

Literature
Literature will be announced in the lecture.

Course: Simulation I [2550662]

Coordinators: Karl-Heinz Waldmann
Part of the modules: Applications of Operations Research (p. 123)[MATHMWOR5], Stochastic Methods and Simulation (p. 126)[MATHMWOR7], Stochastic Modelling and Optimization (p. 130)[MATHMWOR10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1/2	Winter term	de

Learning Control / Examinations

Conditions
Foundations in the following fields are required:

- Operations Research, as lectured in *Introduction to Operations Research I* [2550040] and *Introduction to Operations Research II* [2530043].
- Statistics, as lectured in *Statistics I* [25008/25009] and *Statistics II* [25020/25021].

Learning Outcomes
The lecture provides insights into the typical process in planning and conducting simulation studies.

Content
As the world is getting more complex it is often not possible to analytically provide key figures of interest without overly simplifying the problem. Thus efficient simulation techniques become more and more important. In the lecture important basic concepts are presented in terms of selected case studies.
Topics overview: Discrete event simulation, generation of random numbers, generating discrete and continous random variables, statistical analysis of simulated data.

Media
Blackboard, Slides, Flash Animations, Simulation Software

Literature

- Lecture Notes
- K.-H. Waldmann / U. M. Stocker: Stochastische Modelle - Eine anwendungsorientierte Einführung; Springer (2004).

Elective literature:

- A. M. Law / W. D. Kelton: Simulation Modeling and Analysis (3rd ed); McGraw Hill (2000)

Remarks
The lecture is offered irregularly. The curriculum of the next two years is available online.

Course: Simulation II [2550665]

Coordinators: Karl-Heinz Waldmann
Part of the modules: Stochastic Methods and Simulation (p. 126)[MATHMWOR7], Stochastic Modelling and Optimization (p. 130)[MATHMWOR10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1/2	Summer term	de

Learning Control / Examinations

Conditions
Foundations in the following fields are required:

- Operations Research, as lectured in *Introduction to Operations Research I* [2550040] and *Introduction to Operations Research II* [2530043].
- Statistics, as lectured in *Statistics I* [25008/25009] and *Statistics II* [25020/25021].
- *Simulation I*[2550662]

not any

Learning Outcomes
The lecture provides insights into the typical process in planning and conducting simulation studies.

Content
As the world is getting more complex it is oftern not possible to analytically provide key figures of interest without overly simplifying the problem. Thus efficient simulation techniques become more and more important. In the lecture important basic concepts are presented in terms of selected case studies.
Topics overview: Variance reduction techniques, simulation of stochastic processes, case studies.

Media
Blackboard, Slides, Flash Animations, Simulation Software

Literature

- Lecture Notes

Elective literature:

- A. M. Law / W. D. Kelton: Simulation Modeling and Analysis (3rd ed); McGraw Hill (2000)
- K.-H. Waldmann / U. M. Stocker: Stochastische Modelle - Eine anwendungsorientierte Einführung; Springer (2004).

Remarks
The lecture is offered irregularly. The curriculum of the next two years is available online.

Course: Software Engineering [2511206]

Coordinators: Andreas Oberweis, Detlef Seese
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	de

Learning Control / Examinations
The assessment consists of an 1h written exam in the first week after lecture period.

Conditions
Modul “Introduction to Informatics” [WW1INFO] is precondition

Learning Outcomes
Students

- are familiar with the concepts and principles of software engineering
- know important and common software development process models
- know methods for requirements analysis and know how to model and evaluate use case models
- know models for systems structuring and controling as well as architecture principles of software systems.
- can model and evaluate component diagrams
- are familiar with basic concepts of software quality management and are able to apply software test and evaluation methods.

Content
The course deals with fundamental aspects of the systematically development of huge software systems. The course covers topics such as:

- software developing process models
- methods and tools for the development phases: requirements analysis, system specification, system design, programming and testing.

Media
Slides, access to internet resources.

Literature
Elective literature:

- H. Balzert. Lehrbuch der Software-Technik. Spektrum Verlag 1996.
- B. Boehm. Software Engineering Economics. Englewood Cliffs, N.J.: Prentice-Hall 1981.
- P. Brössler, Johannes Siedersleben. Softwaretechnik. Hanser Verlag 2000.
- E. Denert. Software-Engineering. Springer-Verlag 1991.
- Frühauf, K., J. Ludewig, H. Sandmayr. Software-Projektmanagement und – Qualitätssiche-rung. Teubner 1991.
- E. Gamma et al.. Design Patterns. Addison Wesley 1995.

Further literature is given in the course.

Course: Software Laboratory: OR Models I [2550490]

Coordinators: Stefan Nickel
Part of the modules: Applications of Operations Research (p. 123)[MATHMWOR5]

ECTS Credits	Hours per week	Term	Instruction language
4.5	1/2	Winter term	de

Learning Control / Examinations
The assessment is a 120 minutes examination, including a written and a practical part (according to §4(2), 1 of the examination regulation).
The examination is held in the term of the software laboratory and the following term.

Conditions
Firm knowledge of the contents from the lecture *Introduction to Operations Research I* [2550040] of the module *Operations Research* [WI1OR].

Learning Outcomes
The software laboratory has the goal to make the students familiar with the usage of computers in practical applications of Operations Research. An important benefit lies in the ability to assess and estimate general possibilities and fields of usage of modeling and implementation software for solving OR models in practice. As software-based planning modules are used in many companies, this course provides a reasonable preparation for students for practical planning activities.

Content
After an introduction to general concepts of modelling tools (implementation, data handling, result interpretation, . . .), the program XPress-MP IVE with its modelling language Mosel will be presented in detail.
Subsequently, a broad range of exercises will be discussed. The main goals of the exercises from literature and practical applications are to learn the process of modeling optimization problems as linear or mixed-integer programs, to efficiently utilize the presented tools for solving these optimization problems and to implement heuristic solution procedures for mixed-integer programs.

Remarks
Due to capacity restrictions, registration before course start is required. For further information see the webpage of the course.
The planned lectures and courses for the next three years are announced online.

Course: Software Laboratory: OR Models II [2550497]

Coordinators: Stefan Nickel
Part of the modules: Operations Research in Supply Chain Management and Health Care Management (p. 127)[MATHMWOR8], Mathematical Programming (p. 129)[MATHMWOR9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	de

Learning Control / Examinations
The assessment is a 120 minutes examination, including a written and a practical part (according to §4(2), 1 of the examination regulation).
The examination is held in the term of the software laboratory and the following term.

Conditions
Successful completion of the course *Software Laboratory: OR-Models I* [2550490].
Basic knowledge as conveyed in the module *Introduction to Operations Research* [WI1OR] is assumed.

Learning Outcomes
The course is based on the first part of the software laboratory. The students advance to detailed modelling knowledge and use the software for the implementation of more complex solution methods. An important aspect lies on the practical application possibilities of OR software in combinatorial and nonlinear optimization problems.

Content
The task of solving combinatorial and nonlinear optimization problems imposes much higher requirements on suggested solution approaches as in linear programming.
During the course of this software laboratory, students get to know important methods from combinatorial optimization, e.g. Branch & Cut- or Column Generation methods and are enabled to solve problems with the software system Xpress-MP IVE with its modeling language Mosel. In addition, issues of nonlinear optimization, e.g. quadratic optimization, are addressed. As an important part of the software laboratory, students get the possibility to model combinatorial and nonlinear problems and implement solution approaches in the software system.
The software laboratory also introduces some of the most frequently used modelling and programming languages that are used in practice to solve optimization problems.

Remarks
The planned lectures and courses for the next three years are announced online.

Course: Software Laboratory: SAP APO [n.n.]

Coordinators: Stefan Nickel
Part of the modules: Operations Research in Supply Chain Management and Health Care Management (p. 127)[MATHMWOR8]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	de

Learning Control / Examinations
The assessment is a 120 minutes examination, including a written and a practical part (according to §4(2), 1 of the examination regulation).
The examination is held in the term of the lecture and the following term.

Conditions
Basic knowledge as conveyed in the module *Introduction to Operations Research* [WI1OR] is assumed.

Learning Outcomes
Students acquire the ability to safely and efficiently use the software systems SAP and SAP APO.
As these software systems are used in many companies, the students get acquainted with an important and frequently used software tool from practice. Besides basic functional elements of the software, the course provides advanced knowledge for specific planning modules. Furthermore, students are enabled to model realistic logistical systems within the software framework.

Content
SAP Advanced Planning & Optimization (SAP APO) is a software solution for dynamic Supply Chain Management consisting of modules for detailed planning and optimization of all processes along a supply chain. These modules allow a concise and global control and planning of the supply chain on the intercompany level. As a part of mySAP Supply Chain Management (mySAP SCM), SAP APO is a logistics solution with integrated surplus. It covers all processes from the planning on a detailed level to the design of the actual network structure.
After an introductory overview of the organization of SAP and the concepts of SAP solutions, the system SAP Supply Chain Management (SCM) will be presented. In detail, the features of the module SAP SCM Advanced Planning and Optimization (APO) will be addressed.
Afterwards, students obtain a small example to get in touch with the standard user environment of the system. A case study taken from practice serves as the basis for a SAP APO-based implementation of a complete Supply Chain, beginning from suppliers, to production plants, warehouses, distribution centers, to the customers. In Demand Planning (DP) anonymous primary demand will be forecasted. In Supply-Network-Planning (SNP) feasible plans for the satisfaction of demands along the entire supply chain will be generated, while in Production Planning & Detailed Scheduling (PP/DS) clock-time-precise orders under consideration of constraints (capacities, setup costs,. . .) will be generated. The choice of appropriate means of transportation allows the planning of transportation and distribution tasks.

Remarks
The course is held irregularly.
The planned lectures and courses for the next three years are announced online.

Course: Software Laboratory: Simulation [n.n.]

Coordinators: Stefan Nickel
Part of the modules: Operations Research in Supply Chain Management and Health Care Management (p. 127)[MATHMWOR8]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	

Learning Control / Examinations
The assessment is a 120 minutes examination, including a written and a practical part (according to §4(2), 1 of the examination regulation).
The examination is held in the term of the lecture and the following term.

Conditions
Basic knowledge as conveyed in the module *Introduction to Operations Research* [WI1OR] is assumed.

Learning Outcomes
The course covers basic concepts of discrete event simulation models and qualifies students for the computer-based usage of simulation systems. Additionally, students deepen their knowledges for logical issues in modeling and discover the importance of statistical methods in simulation.

Content
Discrete event simulation is one of the fundamental modelling techniques and can be used in the analysis of systems where it is not possible to derive analytical results for the system due to complexity issues.
After an introduction to the basics of event-discrete simulation, the basic modeling approach for simulation systems is presented. The implementation of this paradigm is made with the simulation software ProModel. Therewith, students get an insight to system logics of the algorithms. In the practical part of the course, case-studies from industries and health care are discussed. Again, the implementation of identified OR problems is done with ProModel.

Remarks
The course is held irregularly.
The planned lectures and courses for the next three years are announced online.

Course: Software Technology: Quality Management [2511208]

Coordinators: Andreas Oberweis
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	de

Learning Control / Examinations
The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation in the first week after lecture period.

Conditions
Programming knowledge in Java and basic knowledge of computer science are expected.

Learning Outcomes
Students are familiar with basic concepts and principles of software quality and software quality management. They know key measures and models for certification of quality in software development. They are aware of different test methods and evaluation methods. Furthermore, they are able to asses quality management aspects in different standard process models.

Content
This lecture imparts fundamentals of active software quality management (quality planning, quality testing, quality control, quality assurance) and illustrates them with concrete examples, as currently applied in industrial software development. Keywords of the lecture content are: software and software quality, process models, software process quality, ISO 9000-3, CMM(I), BOOTSTRAP, SPICE, software tests.

Media
Slides, access to internet resources.

Literature
- Helmut Balzert: Lehrbuch der Software-Technik. Spektrum-Verlag 1998
- Peter Liggesmeyer: Software-Qualität, Testen, Analysieren und Verifizieren von Software. Spektrum Akademischer Verlag 2002

Elective literature:
Further literature is given in lectures.

Course: Spectral Theory [SpekTheo]

Coordinators: Gerd Herzog, Christoph Schmoeger, Roland Schnaubelt, Lutz Weis
Part of the modules: Spectral Theory (p. 52)[MATHMWAN10]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Summer term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Spectral Theory of Differential Operators [MATHAN22]

Coordinators: Michael Plum
Part of the modules: Spectral Theory of Differential Operators (p. 64)[MATHMWAN22]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Special Topics of Enterprise Information Systems [SBI]

Coordinators: Andreas Oberweis
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter / Summer Term	

Learning Control / Examinations
The assessment of this course is a written or (if necessary) oral examination according to §4(2) of the examination regulation.

Conditions
None.

Learning Outcomes
Students are able to handle methods and instruments in a subarea of "Enterprise Information Systems" and to show the capability to be innovative with regard to applied methods.

The course will impart knowledge of basics and methods in the context of their application in practice. Based on the understanding of the imparted concepts and methods students will be able to choose the appropriate methods and apply them in the right way for problems they will face in their professional life.

Students will be enabled to find arguments for solution approaches and to argue for them.

Content
This course is a placeholder for special courses that are offered in an irregular sequence and cover selected topics in the field of enterprise information systems. These topics include in particular the design and the management of database systems, the computer-support of business processes and strategic planning of information systems and their organization.

Literature
Will be announced at the beginning of the course.

Course: Special Topics of Efficient Algorithms [25700sp]

Coordinators: Hartmut Schmeck
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter / Summer Term	

Learning Control / Examinations
The assessment consists of assignments or of a bonus exam (wrt §4 (2), 3 SPO), and a written exam (60 min.) in the week after the end of the lecturing periodwrt (§4 (2), 1 SPO). The exam will be offered in every semester and can be repeated on regular examination dates.
If the mark obtained in the written exam is in between 1.3 and 4.0, a successful completion of the assignments or the bonus exam will improve the mark by one level (i.e. by 0.3 or 0.4).

Conditions
None.

Learning Outcomes
The student will learn how to use methods and concepts of efficient algorithms and how to demonstrate adequate innovative capabilities with respect to the used methods.
This course emphasizes the teaching of advanced concepts in relation to their applicability in the real world. Based on a fundamental understanding of the covered concepts and methods, students should know how to select appropriate concepts and methods for problem settings in their professional life, and, if necessary, to extend and apply them in an adequate form. The students should be enabled to find adequate arguments for justifying their chosen problem solutions.

Content
This course emphasizes the new topics in the area of algorithms, data structures, and computer infrastructures. The exact topics can vary according to the audiences and the time it is held.

Literature
Elective literature:
Will be announced in the lecture.

Remarks
This course can be particularly used for recognising the external courses with the topics in the area of algorithms, data-structures and computer infrastructures but are not associated in other courses in this subject area.

Course: Special Topics of Complexity Management [KompMansp]

Coordinators: Detlef Seese
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter / Summer Term	de

Learning Control / Examinations
see German version

Conditions
see German version

Learning Outcomes
see German version

Content
see German version

Literature
Elective literature:
Will be announced in the lecture.

Remarks
see German version

Course: Special Topics of Software- and Systemsengineering [SSEsp]

Coordinators: Andreas Oberweis, Detlef Seese
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter / Summer Term	

Learning Control / Examinations
The assessment consists of an 1h written exam in the first week after lecture period.

Conditions
None.

Learning Outcomes
Students are able to handle methods and instruments in a subarea of "Software and Systems Engineering" and to show the capability to be innovative with regard to applied methods.

The course will impart knowledge of basics and methods in the context of their application in practice. Based on the understanding of the imparted concepts and methods students will be able to choose the appropriate methods and apply them in the right way for problems they will face in their professional life.

Students will be enabled to find arguments for solution approaches and to argue for them.

Content
This course is a placeholder for special courses that are offered in an irregular sequence and cover selected topics in the field of software and systems engineering.

Media
Slides, access to internet resources

Literature
Elective literature:
Will be announced at the beginning of the course.

Remarks
This course can be used in particular for the acceptance of external courses whose content is in the broader area of software and systems engineering, but cannot assigned to another course of this topic.

Course: Special Topics of Knowledge Management [25860sem]

Coordinators: Rudi Studer
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter / Summer Term	

Learning Control / Examinations
Assesment is provided by a written exam of 60 minutes or an oral exam during the first few weeks after the lecturing period (acc. to §4(2), 1 or 2 SPO). The exam is offered each semester and may be repeated at the regular examination day.

Conditions
The lecture *Angewandte Informatik I - Modellierung* [2511030] is a prerequisite.

Learning Outcomes
The students acquire the skills, methods and tools in one specialized topic of “knowledge management” to demonstrate their mastery and innovativeness.
The lecture aims at providing principles and methods in the context of the practical application of KM. On the basis of a fundamental understanding of concepts, methods, and tools, students will be able to work on advanced problems. The students will be able to find and argue for solutions of KM problems.

Content
The lecture deals with special topics in the area of knowledge management (incl. Knowledge Discovery and Semantic Web). The lecture deepens one of the following topics:

- Dynamc and Interoperable Systems in Knowledge Management
- Personal and Process-oriented Knowledge Management
- Formal Concept Analysis
- Semantic Search and Text Mining
- Combination of Social Software and Semantic Web

Literature
Elective literature:
Depends on the actual content.

Course: Special Topics in Optimization I [25128]

Coordinators: Oliver Stein
Part of the modules: Mathematical Programming (p. 129)[MATHMWOR9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Winter / Summer Term	de

Learning Control / Examinations
The assessment of the lecture is a written examination (60 minutes) according to §4(2), 1 of the examination regulation.

The examination is held in the semester of the lecture and in the following semester.

Prerequisite for admission to the written examination is attaining at least 30% of the exercise points. Therefore the online-registration for the written examination is subject to fulfilling the prerequisite.

The examination can also be combined with the examination of *Special Topics in Optimization II* [25126]. In this case, the duration of the written examination takes 120 minutes.

In a combined examination of *Special Topics in Optimization I* [25128] and *Special Topics in Optimization II* [25126], upon attaining more then 60% of the exercise points, the grade of the passed examination is improved by a third of a grading step.

Conditions
None.

Learning Outcomes
The student knows and understands fundamentals of a special topic in continuous optimization.

Content

Remarks
The lecture is offered irregularly. The curriculum of the next three years is available online (www.ior.kit.edu).

Course: Special Topics in Optimization II [25126]

Coordinators: Oliver Stein
Part of the modules: Mathematical Programming (p. 129)[MATHMWOR9]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Winter / Summer Term	de

Learning Control / Examinations
The assessment of the lecture is a written examination (60 minutes) according to §4(2), 1 of the examination regulation.

The examination is held in the semester of the lecture and in the following semester.

Prerequisite for admission to the written examination is attaining at least 30% of the exercise points. Therefore the online-registration for the written examination is subject to fulfilling the prerequisite.

The examination can also be combined with the examination of *Special Topics in Optimization I* [25128]. In this case, the duration of the written examination takes 120 minutes.

In a combined examination of *Special Topics in Optimization I* [25128] and *Special Topics in Optimization II* [25126], upon attaining more then 60% of the exercise points, the grade of the passed examination is improved by a third of a grading step.

Conditions
None.

Learning Outcomes
The student knows and understands fundamentals of a special topic in continuous optimization.

Content

Remarks
The lecture is offered irregularly. The curriculum of the next three years is available online (www.ior.kit.edu).

Course: Game Theory [MATHAN13]

Coordinators: Michael Plum, Wolfgang Reichel
Part of the modules: Game Theory (p. 55)[MATHMWAN13]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Game Theory I [2520525]

Coordinators: Siegfried Berninghaus
Part of the modules: Decision and Game Theory (p. 120)[MATHMWVWL10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/2	Summer term	de

Learning Control / Examinations

Conditions
None.

Recommendations
Basic knowledge of mathematics and statistics is assumed.
See corresponding module information.

Learning Outcomes
This course conveys established knowledge in theory of strategic decision making. The students shall be able to analyze strategic problems systematically and to give advice for behavior in concrete economic situations.

Content
Main topic is non-cooperative game theory. Models, solution concepts and applications are discussed for simultaneous as well as sequential games. Different equilibrium concepts are introduced and a short introduction to cooperative game theory is given.

Media
Folien, Übungsblätter.

Literature
Gibbons, A primer in Game Theory, Harvester-Wheatsheaf, 1992
Holler/Illing, Eine Einführung in die Spieltheorie, 5. Auflage, Springer Verlag, 2003
Gardner, Games for Business and Economics, 2. Auflage, Wiley, 2003
Berninghaus/Ehrhart/Güth, Strategische Spiele, 2. Auflage, Springer Verlag 2006
Elective literature:

- Binmore, Fun and Games, DC Heath, Lexington, MA, 1991

Course: Game Theory II [2521369]

Coordinators: Siegfried Berninghaus
Part of the modules: Decision and Game Theory (p. 120)[MATHMWVWL10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/2	Winter term	de

Learning Control / Examinations

Conditions
None.

Recommendations
See corresponding module information.
Basic knowledge of mathematics and statistics is assumed.

Learning Outcomes
This course teaches advanced knowledge in strategic decision theory. Latest developments in game theory are discussed. The student learns to judge complex strategic problems and to offer adequate solutions.

Content
This lecture aims at apmplifying the students' knowledge in game theory. Main topics are further concepts of non-cooperative game theory, cooperative game theory, evolutionary game theory and bargaining theory.

Media
Folien, Übungsblätter.

Literature

- Berninghaus/Ehrhart/Güth, Strategische Spiele, 2. Auflage, Springer Verlag, 2006
- van Damme, Stability and Perfection of Nash Equilibria, 2. Auflage, Springer Verlag, 1991

Elective literature:

- Aumann/Hart (edts.), Handbook of Game Theory I-III, Elsevier Publishers, North Holland, 1992/1994/2002

Course: Stability and Control Theory for Evolution Equations [MATHAN23]

Coordinators: Roland Schnaubelt, Lutz Weis
Part of the modules: Stability and Control Theory for Evolution Equations (p. 65)[MATHMWAN23]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Facility Location and Strategic Supply Chain Management [2550486]

Coordinators: Stefan Nickel
Part of the modules: Operations Research in Supply Chain Management and Health Care Management (p. 127)[MATHMWOR8], Applications of Operations Research (p. 123)[MATHMWOR5], Methodical Foundations of OR (p. 125)[MATHMWOR6]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	de

Learning Control / Examinations
The assessment consists of a written exam (120 min) according to Section 4 (2), 1 of the examination regulation.
The exam takes place in every semester.
Prerequisite for admission to examination is the succesful completion of the online assessments.

Conditions
Prerequisite for admission to examination is the succesful completion of the online assessments.

Learning Outcomes
The lecture covers basic quantitative methods in location planning in the context of strategic Supply Chain Planning. Besides the discussion of several criteria for the evaluation of the locations of facilities, the students are acquainted with classical location planning models (planar models, network models and discrete models) and advanced location planning models designed for Supply Chain Management (single-period and multi-period models).The exercises accompanying the lecture offer the possibility to apply the considered models to practical problems.

Content
Since the classical work “Theory of the Location of Industries” of Weber from 1909, the determination of an optimal location of a new facility with respect to existing customers is strongly connected to strategical logistics planning. Strategic decisions concerning the location of facilities as production plants, distribution centers or warehouses are of high importance for the rentability of supply chains. Thoroughly carried out, location planning allows an efficient flow of materials and leads to lower costs and increased customer service.
Subject of the course is an introduction to the most important terms and definitions in location planning as well as the presentation of basic quantitative location planning models. Furthermore, specialized location planning models for Supply Chain Management will be addressed as they are part in many commercial SCM tools for strategic planning tasks.

Literature
Elective literature:

- Daskin: Network and Discrete Location: Models, Algorithms, and Applications, Wiley, 1995
- Domschke, Drexl: Logistik: Standorte, 4. Auflage, Oldenbourg, 1996
- Francis, McGinnis, White: Facility Layout and Location: An Analytical Approach, 2nd Edition, Prentice Hall, 1992
- Love, Morris, Wesolowsky: Facilities Location: Models and Methods, North Holland, 1988
- Thonemann: Operations Management - Konzepte, Methoden und Anwendungen, Pearson Studium, 2005

Remarks
The planned lectures and courses for the next three years are announced online.

Course: Stochastic Calculus and Finance [2521331]

Coordinators: Svetlozar Rachev
Part of the modules: Mathematical and Empirical Finance (p. 121)[MATHMWSTAT1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	en

Learning Control / Examinations

Conditions
None.

Learning Outcomes
After successful completion of the course students will be familiar with many common methods of pricing and portfolio models in finance. Emphasis we be put on both finance and the theory behind it.

Content
The course will provide rigorous yet focused training in stochastic calculus and finance. The program will cover modern approaches in stochastic calculus and mathematical finance. Topics to be covered:

1. Stochastic Calculus. Stochastic Processes, Brownian Motion and Martingales, Stopping Times, Local martingales, Doob-Meyer Decomposition, Quadratic Variation, Stochastic Integration, Ito Formula, Girsanov Theorem, Jump-diffusion Processes. Stable and tempered stable processes. Levy processes.
2. Mathematical Finance: Pricing Models. The Black-Scholes Model, State prices and Equivalent Martingale Measure, Complete Markets and Redundant Security Prices, Arbitrage Pricing with Dividends, Term-Structure Models (One Factor Models, Cox-Ingersoll-Ross Model, Affine Models), Term-Structure Derivatives and Hedging, Mortgage-Backed Securities, Derivative Assets (Forward Prices, Future Contracts, American Options, Look-back Options), Option pricing with tempered stable and Levy-Processes and volatility clustering, Optimal Portfolio and Consumption Choice (Stochastic Control and Merton continuous time optimization problem), Equilibrium models, Consumption-Based CAPM, Numerical Methods.

Media
transparencies, exercises.

Literature
To be announced in lecture.
Elective literature:

- Dynamic Asset Pricing Theory, Third Edition. by Darrell Duffie, Princeton University Press, 1996
- Stochastic Calculus for Finance II: Continuous-Time Models, by Steven E. Shreve , Springer, 2003
- An Introduction to Stochastic Integration (Probability and its Applications) by Kai L. Chung , Ruth J. Williams , Birkhaueser,
- Methods of Mathematical Finance by Ioannis Karatzas , Steven E. Shreve , Springer 1998
- Kim Y.S. ,Rachev S.T. ,Bianchi M-L, Fabozzi F. Financial market models with Levy processes and time-varying volatility, Journal of Banking and Finance, 32/7,1363-1378, 2008.
- Hull, J., Options, Futures, & Other Derivatives, Prentice Hall, Sixth Edition, (2005).

Course: Stochastic Differential Equations [MATHAN24]

Coordinators: Roland Schnaubelt, Lutz Weis
Part of the modules: Stochastic Differential Equations (p. 66)[MATHMWAN24]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Markov Decision Models I [2550679]

Coordinators: Karl-Heinz Waldmann
Part of the modules: Methodical Foundations of OR (p. 125)[MATHMWOR6], Stochastic Methods and Simulation (p. 126)[MATHMWOR7], Stochastic Modelling and Optimization (p. 130)[MATHMWOR10]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1/2	Winter term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
The lecture provides students with knowledge of modern techniques of stochastic modelling. Students are able to properly describe and analyze basic stochastic systems.

Content
Markov Chains, Poisson Processes, Markov Chains in Continuous Time, Queuing Systems

Media
Blackboard, Slides, Flash Animations, Simulation Software

Literature
Waldmann, K.H. , Stocker, U.M. (2004): Stochastische Modelle - eine anwendungsorientierte Einführung; Springer
Elective literature:
Norris, J.R. (1997): Markov Chains; Cambridge University Press
Bremaud, P. (1999): Markov Chains, Gibbs Fields, Monte Carlo Simulation, and Queues; Springer

Course: Markov Decision Models II [2550682]

Coordinators: Karl-Heinz Waldmann
Part of the modules: Stochastic Modelling and Optimization (p. 130)[MATHMWOR10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1/2	Summer term	de

Learning Control / Examinations

Conditions
None.

Learning Outcomes
The lecture provides students with knowledge on Markov decision processes for analysis to control and optimize stochastic dynamic systems. They are able to apply the theory aquired and to adjust the models to actual problems. They develop the optimality criterion and can solve the resulting optimal value function efficiently to gain optimal policies and the optimal value.

Content
Markov decision models: Foundations, optimality criteria, solution of the optimality equation, optimality of simply structured decision rules, applications.

Media
Blackboard, Slides, Flash Animations, Simulation Software

Literature
Lecture Notes
Elective literature:
Waldmann, K.H. , Stocker, U.M. (2004): Stochastische Modelle - eine anwendungsorientierte Einführung; Springer
Puterman, M.L. (1994): Markov Decision Processes: Discrete Stochastic Dynamic Programming; John Wiley

Remarks
The lecture is offered irregularly. The curriculum of the next two years is available online.

Course: Stochastic Geometry [MATHST06]

Coordinators: Daniel Hug, Günter Last
Part of the modules: Stochastic Geometry (p. 94)[MATHMWST06]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Stochastic control theory [MATHST12]

Coordinators: Nicole Bäuerle
Part of the modules: Control theory of stochastic processes (p. 100)[MATHMWST12]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter / Summer Term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Strategic Management of Information Technology [2511602]

Coordinators: Thomas Wolf
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	de

Learning Control / Examinations
The assessment of this course is a written or (if necessary) oral examination according to §4(2) of the examination regulation.

Conditions
None.

Learning Outcomes
Students know the outer frame of IT in an enterprise and know which functions IT has within an enterprise. They unterstand the organization and the content of these functions.

Content
The following topics will be covered: strategic planing of ICT, architecture of ICT, overall planning of ICT, outsourcing, operation and controlling of ICT.

Media
Slides, internet resources

Literature

- Nolan, R., Croson, D.: Creative Destruction: A Six-Stage Process for Transforming the Organization. Harvard Business School Press, Boston Mass. 1995
- Heinrich, L. J., Burgholzer, P.: Informationsmanagement, Planung, Überwachung, Steuerung d. Inform.-Infrastruktur. Oldenbourg, München 1990
- Nolan, R.: Managing the crises in data processing. Harvard Business Review, Vol. 57, Nr. 2 1979
- Österle, H. et al.: Unternehmensführung und Informationssystem. Teubner, Stuttgart 1992
- Thome, R.: Wirtschaftliche Informationsverarbeitung. Verlag Franz Vahlen, München 1990

Course: Scattering Theory [MATHAN26]

Coordinators: Tilo Arens, Frank Hettlich, Andreas Kirsch
Part of the modules: Scattering Theory (p. 68)[MATHMWAN26]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Symmetric Spaces [MATHAG19]

Coordinators: Enrico Leuzinger
Part of the modules: Symmetric Spaces (p. 41)[MATHMWAG19]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Tactical and Operational Supply Chain Management [2550488]

Coordinators: Stefan Nickel
Part of the modules: Operations Research in Supply Chain Management and Health Care Management (p. 127)[MATHMWOR8], Applications of Operations Research (p. 123)[MATHMWOR5], Stochastic Methods and Simulation (p. 126)[MATHMWOR7]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Winter term	de

Learning Control / Examinations
The assessment consists of a written exam (120 minutes) according to Section 4(2), 1 of the examination regulation.
The exam takes place in every the semester.
Prerequisite for admission to examination is the succesful completion of the online assessments.

Conditions
Prerequisite for admission to examination is the succesful completion of the online assessments.

Learning Outcomes
The main goal of the lecture is the presentation of fundamental techniques from procurement and distribution logistics. A further aspect is set on methods from inventory management and lot sizing. Students acquire the ability to efficiently utilize quantitative models from transportation planning (long-distance and distribution planning), inventory management and lot sizing in production. The introduced methods will be discussed in more detail and illustrated with case-studies in the accompanying exercises

Content
The planning of material transport is an essential element of Supply Chain Management. By linking transport connections across different facilities, the material source (production plant) is connected with the material sink (customer).
The general supply task can be formulated as follows (cf. Gudehus): For given material flows or shipments, choose the optimal (in terms of minimal costs) distribution and transportation chain from the set of possible logistics chains, which asserts the compliance of delivery times and further constraints. The main goal of the inventory management is the optimal determination of order quantities in terms of minimization of fixed and variable costs subject to resource constraints, supply availability and service level requirements. Similarly, the problem of lot sizing in production considers the determination of the optimal amount of products to be produced in a time slot.
The course includes an introduction to basic terms and definitions of Supply Chain Management and a presentation of fundamental quantitative planning models for distribution, vehicle routing, inventory management and lot sizing. Furthermore, case studies from practice will be discussed in detail.

Literature
Elective literature:

- Domschke: Logistik: Transporte, 5. Auflage, Oldenbourg, 2005
- Domschke: Logistik: Rundreisen und Touren, 4. Auflage, Oldenbourg, 1997
- Ghiani, Laporte, Musmanno: Introduction to Logistics Systems Planning and Control, Wiley, 2004
- Gudehus: Logistik, 3. Auflage, Springer, 2005
- Simchi-Levi, Kaminsky, Simchi-Levi: Designing and Managing the Supply Chain, 3rd edition, McGraw-Hill, 2008
- Silver, Pyke, Peterson: Inventory management and production planning and scheduling, 3rd edition, Wiley, 1998

Remarks
The planned lectures and courses for the next three years are announced online.

Course: Management and Strategy [2577900]

Coordinators: Hagen Lindstädt
Part of the modules: Strategic Corporate Management and Organization (p. 122)[MATHMWUO1]

ECTS Credits	Hours per week	Term	Instruction language
4	2/0	Summer term	de

Learning Control / Examinations
The assessment consists of a written exam (60 min) taking place at the beginn of the recess period (according to §4 (2), 1 of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Conditions
None.

Learning Outcomes
The participants learn about central concepts of strategic management along the ideal-typical strategy process: internal and external strategic analysis, concept and sources of competitive advantages, their importance when establishing competitive and corporate strategies as well as strategy assessment and implementation. This aims in particular to provide a summary of the basic concepts and models of strategic management, i.e. to provide in particular an action-oriented integration.

Content

- Corporate management principles
- Strategic management principles
- Strategic analysis
- Competitive strategy: modelling and selection on a divisional level
- Strategies for oligopolies and networks: anticipation of dependencies
- Corporate strategy: modelling and evaluation on a corporate level
- Strategy implementation

Media
Slides.

Literature

- Grant, R.M.: *Contemporary Strategy Analysis.* Blackwell, 5. Aufl. Massachusetts 2005.
- Lindstädt, H.; Hauser, R.: *Strategische Wirkungsbereiche von Unternehmen.* Gabler, Wiesbaden 2004.

The relevant excerpts and additional sources are made known during the course.

Course: Valuation [2530212]

Coordinators: Martin E. Ruckes
Part of the modules: Finance 1 (p. 110)[MATHMWBWLFBV1], Finance 2 (p. 111)[MATHMWBWLFBV2], Finance 3 (p. 113)[MATH4BWLFBV11], F2&F3 (Finance) (p. 112)[MATHMWBWLFBV3]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Winter term	en

Learning Control / Examinations

Conditions
None.

Learning Outcomes
Students learn to assess and compare corporate investment projects from a financial point of view.

Content
Firms prosper when they create value for their shareholders and stakeholders. This is achieved by investing in projects that yield higher returns than their according cost of capital. Students are told the basic tools for firm and project valuation as well as ways to implement these tools in order to enhance a firm's value and improve its investment decisions. Among other things, the course will deal with the valuation of firms and individual projects using discounted cash flow and relative valuation approaches and the valuation of flexibility deploying real options.

Literature
Elective literature:
Titman/Martin (2007): Valuation – The Art and Science of Corporate Investment Decisions, Addison Wesley.

Course: Calculus of Variations [MATHAN25]

Coordinators: Andreas Kirsch, Michael Plum, Wolfgang Reichel
Part of the modules: Calculus of Variations (p. 67)[MATHMWAN25]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Course: Wavelets [Wave]

Coordinators: Andreas Rieder
Part of the modules: Wavelets (p. 83)[MATHMWNM14]

ECTS Credits	Hours per week	Term	Instruction language
8	4/2	Winter / Summer Term	

Learning Control / Examinations

Conditions
None.

Learning Outcomes

Content

Course: Web Service Engineering [2511502]

Coordinators: Christian Zirpins
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	de

Learning Control / Examinations
The assessment consists of an oral exam (20 min) (following §4(2), 2 SPO).

Conditions
The course might be combined with the lecture "Service Oriented Computing 1".

Learning Outcomes
Students will acquire a deep and systematic understanding of service-oriented software systems and their embedding in organizations. Equipped with practical and research-based knowledge, they will be enabled to engineer state-of-art service-oriented applications with Web technologies and gain a broad understanding of tools and methodologies for their own work.

Content
The lecture "Web Service Engineering" covers technical and organizational aspects with respect to the development of modern service-oriented software as socio-technical systems in enterprises and Web environments. It introduces background, state-of-technology and emerging trends of methods, tools and processes for application development with Web services. The topics of the lecture include e.g.:

- Web service foundations and base technologies
- Service-oriented software and enterprise architectures (SOA)
- SOA life cycle and development processes
- Analysis and requirements engineering for SOA
- Service-oriented design and modeling
- Construction and testing of Web service applications
- Web service development tools
- Trends: e.g. development with service mashups / cloud services

Media
Slides in PDF-format will be provided via the course webpages.

Literature
Compulsory literature will be announced in the course.

Course: Seminar Economic Theory [SemWIOR2]

Coordinators: Clemens Puppe
Part of the modules: Seminar (p. 135)[MATHMWSEM02]

ECTS Credits	Hours per week	Term	Instruction language
3	2	Winter / Summer Term	de

Learning Control / Examinations

Conditions
See corresponding module information.
At least one of the courses *Game Theory I* [2520525] and *Welfare Economics* [2520517] should have been attended beforehand.

Learning Outcomes

Content

Literature
Will be announced at the end of the recess period.

Course: Knowledge Management [2511300]

Coordinators: Rudi Studer
Part of the modules: Emphasis in Informatics (p. 133)[MATHMWINFO2], Informatics (p. 131)[MATHMWINFO1]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Winter term	de

Learning Control / Examinations
Written Examination (60 min) according to §4, Abs. 2, 1 of the examination regulations or oral examination of 20 minutes according to §4, Abs. 2, 2 of the examination regulations. The exam takes place every semester and can be repeated at every regular examination date.

Conditions
Basics in logic, e.g. from lecture Foundations of Informatics 1.

Learning Outcomes
Making students sensitive to the problems of corporate knowledge management, knowledge about the central dimensions of influence as well as of relevant technologies for supporting knowledge management.

Content
In modern companies, knowledge is increasingly important for fullfilling central tasks (such as continuous business process improvement, increasing innovation, increasing customer satisfaction, strategic planning etc). Therefore, knowledge management has become a critical success factor.
The lecture covers different types of knowledge that play a role in knowledge management, the corresponding knowledge processes (generation, capture, access and usage of knowledge) as well as methodologies for the introduction of knowledge management solutions.
The lecture will emphasize computer-based support for knowledge management, such as:

- Ontology-based Knowledge Management
- Communities of Practice, Collaboration Tools, Social Software
- Business-process Oriented Knowledge Management
- Personal Knowledge Management
- Case Based Reasoning (CBR)
- Linked Open Data

Media
Slides and scientific publications as reading material.

Literature

- I. Nonaka, H. Takeuchi: The Knowledge Creating Company. Oxford University Press 1995.
- G. Probst, S. Raub, K. Romhardt: Wissen managen: Wie Unternehmen ihre wertvollste Ressource optimal nutzen. Gabler, Wiesbaden, 5. überarb. Auflage, 2006.
- S. Staab, R. Studer (eds.): Handbook on Ontologies, ISBN 3-540-70999-1, Springer Verlag, 2009.
- A. Back, N. Gronau, K. Tochtermann: Web 2.0 in der Unternehmenspraxis - Grundlagen, Fallstudien und Trends zum Einsatz von Social Software. Oldenbourg Verlag München 2008.
- C. Beierle, G. Kern-Isberner: Methoden wissensbasierter Systeme, Vieweg, Braunschweig/Wiesbaden, 2. überarb. Auflage, 2005

Elective literature:

1. P. Hitzler, M Krötzsch, S. Rudolph, Y. Sure: Semantic Web: Grundlagen, ISBN 3-540-33993-0, Springer Verlag, 2008
2. Abecker, A., Hinkelmann, K., Maus, H., Müller, H.J., (Ed.): Geschäftsprozessorientiertes Wissensmanagement, Mai 2002.VII, 472 S. 70 Abb. Geb. ISBN 3-540-42970-0, Springer Verlag
3. Dieter Fensel. Spinning the Semantic Web. 2003 (ISBN 0262062321).
4. Tim Berners-Lee. Weaving the Web. Harper 1999 geb. 2000 Taschenbuch.

Course: Welfare Economics [2520517]

Coordinators: Clemens Puppe
Part of the modules: Decision and Game Theory (p. 120)[MATHMWVWL10]

ECTS Credits	Hours per week	Term	Instruction language
4.5	2/1	Summer term	de

Learning Control / Examinations
The assessment consists of a written exam at the end of the semester (according to Section 4 (2), 1 or 2 of the examination regulation.
The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Conditions
None.

Learning Outcomes

Content

Literature
Elective literature:

- J. Rawls: *A Theory of Justice*. Harvard University Press (1971)
- J. Roemer: *Theories of Distributive Justice*. Harvard University Press (1996)

Course: Workflow-Management [2511204]

Coordinators: Andreas Oberweis
Part of the modules: Informatics (p. 131)[MATHMWINFO1], Emphasis in Informatics (p. 133)[MATHMWINFO2]

ECTS Credits	Hours per week	Term	Instruction language
5	2/1	Summer term	de

Learning Control / Examinations
The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation in the first week after lecture period.

Conditions
Knowledge of course *Applied Informatics I - Modelling* [2511030] is expected.

Learning Outcomes
Students are familiar with the concepts and principles of workflow management concepts and systems and their applications. Based on theoretical foundations they can model business process models. Furthermore they have an overview of further problems of workflow management systems in commercial use.

Content
A workflow is that part of a business process which is automatically executed by a computerized system. Workflow management includes the design, modelling, analysis, execution and management of workflows. Workflow management systems are standard software systems for the efficient control of processes in enterprises and organizations. Knowledge in the field of workflow management systems is especially important during the design of systems for process support.
The course covers the most important concepts of workflow management. Modelling and design techniques are presented and an overview about current workflow management systems is given. Standards, which have been proposed by the workflow management coalition (WfMC), are discussed. Petri nets are proposed as a formal modelling and analysis tool for business processes. Architecture and functionality of workflow management systems are discussed. The course is a combination of theoretical foundations of workflow management concepts and of practical application knowledge.

Media
Slides, Access to internet resources.

Literature

- M. Dumas, W. van der Aalst, A. H. ter Hofstede (Hrsg.): Process Aware Information Systems. Wiley-Interscience, 2005
- J.F. Chang: Business Process Management. Auerbach Publications, 2006

Elective literature:

- W. van der Aalst, H. van Kees: Workflow Management: Models, Methods and Systems, Cambridge 2002: The MIT Press
- G. Vossen, J. Becker (Hrsg.): Geschäftsprozessmodellierung und Workflow-Management. Modelle, Methoden, Werkzeuge; Int. Thomson Pub. Company, 1996.
- A. Oberweis: Modellierung und Ausführung von Workflows mit Petri-Netzen. Teubner-Reihe Wirtschaftsinformatik, B.G. Teubner Verlag, 1996.
- G. Alonso, F. Casati, H. Kuno, V. Machiraju: Web Services, 2004, Springer Verlag, Heidelberg 1997
- S. Jablonski, C. Bussler: Workflow-Management, Modeling Concepts, Architecture and Implementation, Int. Thomson Computing Press, 1996.

Course: Time Series Analysis [MATHST18]

Coordinators: Bernhard Klar, Norbert Henze, Claudia Kirch
Part of the modules: Time Series Analysis (p. 106)[MATHMWST18]

ECTS Credits	Hours per week	Term	Instruction language
4	2/1	Winter / Summer Term	

Learning Control / Examinations

Conditions

None.

Learning Outcomes

Content

Universität Karlsruhe (TH)
Forschungsuniversität · gegründet 1825
Der Rektor

Amtliche Bekanntmachung

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Studien- und Prüfungsordnung der Universität Karlsruhe (TH) für den Masterstudiengang Wirtschaftsmathematik

Aufgrund von § 34 Abs. 1, Satz 1 des Landeshochschulgesetzes (LHG) vom 1. Januar 2005 hat die beschließende Senatskommission für Prüfungsordnungen der Universität Karlsruhe (TH) am 13. Februar 2009 die folgende Studien- und Prüfungsordnung für den Masterstudiengang Wirtschaftsmathematik beschlossen.

Der Rektor hat seine Zustimmung am 28. August 2009 erteilt.

Inhaltsverzeichnis

Die Universität Karlsruhe (TH) hat sich im Rahmen der Umsetzung des Bolognaprozesses zum Aufbau eines Europäischen Hochschulraumes zum Ziel gesetzt, dass am Abschluss der Studierendenausbildung an der Universität Karlsruhe (TH) der Mastergrad stehen soll. Die Universität Karlsruhe (TH) sieht daher die an der Universität Karlsruhe (TH) angebotenen konsekutiven Bachelor- und Masterstudiengänge als Gesamtkonzept mit konsekutivem Curriculum.

In dieser Satzung ist nur die weibliche Sprachform gewählt worden. Alle personenbezogenen Aussagen gelten jedoch stets für Frauen und Männer gleichermaßen.

I. Allgemeine Bestimmungen

§ 1 Geltungsbereich, Zweck der Prüfung

(1) Diese Masterprüfungsordnung regelt Studienablauf, Prüfungen und den Abschluss des Studiums im Masterstudiengang Wirtschaftsmathematik an der Universität Karlsruhe (TH).

(2) Im Masterstudium sollen die im Bachelorstudium erworbenen wissenschaftlichen Qualifikationen weiter vertieft oder ergänzt werden. Die Studentin soll in der Lage sein, die wissenschaftlichen Erkenntnisse und Methoden selbstständig anzuwenden und ihre Bedeutung und Reichweite für die Lösung komplexer wissenschaftlicher und gesellschaftlicher Problemstellungen zu bewerten.

§ 2 Akademischer Grad

Aufgrund der bestandenen Masterprüfung wird der akademische Grad „Master of Science“ (abgekürzt: „M.Sc.“) verliehen.

§ 3 Regelstudienzeit, Studienaufbau, Leistungspunkte

(1) Die Regelstudienzeit beträgt vier Semester. Sie umfasst neben den Lehrveranstaltungen Prüfungen und die Masterarbeit.

(2) Die im Studium zu absolvierenden Lehrinhalte sind in Module gegliedert, die jeweils aus einer Lehrveranstaltung oder mehreren, thematisch und zeitlich aufeinander bezogenen Lehrveranstaltungen bestehen. Art, Umfang und Zuordnung der Module zu einem Fach sowie die Möglichkeiten, Module untereinander zu kombinieren, beschreibt der Studienplan. Die Fächer und deren Umfang werden in § 17 definiert.

(3) Der für das Absolvieren von Lehrveranstaltungen und Modulen vorgesehene Arbeitsaufwand wird in Leistungspunkten (Credits) ausgewiesen. Die Maßstäbe für die Zuordnung von Leistungspunkten entsprechen dem ECTS (European Credit Transfer System). Ein Leistungspunkt entspricht einem Arbeitsaufwand von etwa 30 Stunden.

(4) Der Umfang der für den erfolgreichen Abschluss des Studiums erforderlichen Studienleistungen wird in Leistungspunkten gemessen und beträgt insgesamt 120 Leistungspunkte.

(5) Die Verteilung der Leistungspunkte im Studienplan auf die Semester hat in der Regel gleichmäßig zu erfolgen.

(6) Lehrveranstaltungen können auch in englischer Sprache angeboten werden.

§ 4 Aufbau der Prüfungen

(1) Die Masterprüfung besteht aus einer Masterarbeit und Modulprüfungen, jede Modulprüfung aus einer oder mehreren Modulteilprüfungen. Eine Modulteilprüfung besteht aus mindestens einer Erfolgskontrolle.

(2) Erfolgskontrollen sind:

1. schriftliche Prüfungen,
2. mündliche Prüfungen oder
3. Erfolgskontrollen anderer Art.

Erfolgskontrollen anderer Art sind z.B. Vorträge, Übungsscheine, Projekte, schriftliche Arbeiten, Berichte, Seminararbeiten und Klausuren, sofern sie nicht als schriftliche oder mündliche Prüfung in der Modul- oder Lehrveranstaltungsbeschreibung im Studienplan ausgewiesen sind.

(3) In der Regel sind mindestens 50 % einer Modulprüfung in Form von schriftlichen oder mündlichen Prüfungen (Absatz 2, Nr. 1 und 2) abzulegen, die restlichen Prüfungen erfolgen durch Erfolgskontrollen anderer Art (Absatz 2, Nr. 3). Hiervon ausgenommen sind Seminarmodule.

§ 5 Anmeldung und Zulassung zu den Prüfungen

(1) Um an den Modulprüfungen teilnehmen zu können, muss sich die Studentin schriftlich oder per Online-Anmeldung beim Studienbüro anmelden. Hierbei sind die gemäß dem Studienplan für die jeweilige Modulprüfung notwendigen Studienleistungen nachzuweisen. Darüber hinaus muss sich die Studentin für jede einzelne Modulteilprüfung, die in Form einer schriftlichen oder mündlichen Prüfung (§ 4 Abs. 2, Nr. 1 und 2) durchgeführt wird, beim Studienbüro anmelden. Dies gilt auch für die Anmeldung zur Masterarbeit.

(2) Um zu schriftlichen und/oder mündlichen Prüfungen (§ 4 Abs. 2, Nr. 1 und 2) in einem bestimmten Modul zugelassen zu werden, muss die Studentin vor der ersten schriftlichen oder mündlichen Prüfung in diesem Modul beim Studienbüro eine bindende Erklärung über die Wahl des betreffenden Moduls und dessen Zuordnung zu einem Fach, wenn diese Wahlmöglichkeit besteht, abgeben.

(3) Die Zulassung darf nur abgelehnt werden, wenn die Studentin in einem mit der Wirtschaftsmathematik oder den Wirtschaftswissenschaften vergleichbaren oder einem verwandten Studiengang bereits eine Diplomvorprüfung, Diplomprüfung, Bachelor- oder Masterprüfung endgültig nicht bestanden hat, sich in einem Prüfungsverfahren befindet oder den Prüfungsanspruch in einem solchen Studiengang verloren hat. In Zweifelsfällen entscheidet der Prüfungsausschuss.

§ 6 Durchführung von Prüfungen und Erfolgskontrollen

(1) Erfolgskontrollen werden studienbegleitend, in der Regel im Verlauf der Vermittlung der Lehrinhalte der einzelnen Module oder zeitnah danach, durchgeführt.

(2) Die Art der Erfolgskontrolle (§ 4 Abs. 2, Nr. 1 bis 3) der einzelnen Lehrveranstaltungen wird von der Prüferin der betreffenden Lehrveranstaltung in Bezug auf die Lehrinhalte der Lehrveranstaltung und die Lehrziele des Moduls festgelegt. Die Prüferin, die Art der Erfolgskontrollen, deren Häufigkeit, Reihenfolge und Gewichtung und die Bildung der Lehrveranstaltungsnote müssen mindestens sechs Wochen vor Semesterbeginn bekannt gegeben werden. Im Einvernehmen zwischen Prüferin und Studentin kann die Art der Erfolgskontrolle auch nachträglich geändert werden. Dabei ist jedoch § 4 Abs. 3 zu berücksichtigen.

(3) Eine schriftlich durchzuführende Prüfung kann auch mündlich, eine mündlich durchzuführende Prüfung kann auch schriftlich abgenommen werden. Diese Änderung muss mindestens sechs Wochen vor der Prüfung bekannt gegeben werden.

(4) Weist eine Studentin nach, dass sie wegen länger andauernder oder ständiger körperlicher Behinderung nicht in der Lage ist, die Erfolgskontrollen ganz oder teilweise in der vorgeschriebenen

Form abzulegen, kann der zuständige Prüfungsausschuss – in dringenden Angelegenheiten, deren Erledigung nicht bis zu einer Sitzung des Ausschusses aufgeschoben werden kann, dessen Vorsitzende – gestatten, Erfolgskontrollen in einer anderen Form zu erbringen. Auf begründeten Antrag kann der Prüfungsausschuss auch in anderen Ausnahmefällen gestatten, Erfolgskontrollen in einer anderen Form zu erbringen.

(5) Bei Lehrveranstaltungen in englischer Sprache können mit Zustimmung der Studentin die entsprechenden Erfolgskontrollen in englischer Sprache abgenommen werden.

(6) Schriftliche Prüfungen (§ 4 Abs. 2, Nr. 1) sind in der Regel von einer Prüferin nach § 15 Abs. 2 oder § 15 Abs. 3 zu bewerten. Die Note ergibt sich aus dem arithmetischen Mittel der Einzelbewertungen. Entspricht das arithmetische Mittel keiner der in § 7 Abs. 2, Satz 2 definierten Notenstufen, so ist auf die nächstliegende Notenstufe zu runden. Bei gleichem Abstand ist auf die nächstbessere Notenstufe zu runden. Das Bewertungsverfahren soll sechs Wochen nicht überschreiten. Schriftliche Einzelprüfungen dauern mindestens 60 und höchstens 240 Minuten.

(7) Mündliche Prüfungen (§ 4 Abs. 2, Nr. 2) sind von mehreren Prüferinnen (Kollegialprüfung) oder von einer Prüferin in Gegenwart einer Beisitzenden als Gruppen- oder Einzelprüfungen abzunehmen und zu bewerten. Vor der Festsetzung der Note hört die Prüferin die anderen an der Kollegialprüfung mitwirkenden Prüferinnen an. Mündliche Prüfungen dauern in der Regel mindestens 15 Minuten und maximal 45 Minuten pro Studentin.

(8) Die wesentlichen Gegenstände und Ergebnisse der mündlichen Prüfung in den einzelnen Fächern sind in einem Protokoll festzuhalten. Das Ergebnis der Prüfung ist der Studentin im Anschluss an die mündliche Prüfung bekannt zu geben.

(9) Studentinnen, die sich in einem späteren Prüfungszeitraum der gleichen Prüfung unterziehen wollen, werden entsprechend den räumlichen Verhältnissen als Zuhörerinnen bei mündlichen Prüfungen zugelassen. Die Zulassung erstreckt sich nicht auf die Beratung und Bekanntgabe der Prüfungsergebnisse. Aus wichtigen Gründen oder auf Antrag der zu prüfenden Studentin ist die Zulassung zu versagen.

(10) Für Erfolgskontrollen anderer Art sind angemessene Bearbeitungsfristen einzuräumen und Abgabetermine festzulegen. Dabei ist durch die Art der Aufgabenstellung und durch entsprechende Dokumentation sicherzustellen, dass die erbrachte Studienleistung der Studentin zurechenbar ist. Die wesentlichen Gegenstände und Ergebnisse einer solchen Erfolgskontrolle sind in einem Protokoll festzuhalten.

(11) Schriftliche Arbeiten im Rahmen einer Erfolgskontrolle anderer Art haben dabei die folgende Erklärung zu tragen: „Ich versichere wahrheitsgemäß, die Arbeit selbstständig angefertigt, alle benutzten Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu haben, was aus Arbeiten anderer unverändert oder mit Abänderungen entnommen wurde." Trägt die Arbeit diese Erklärung nicht, wird diese Arbeit nicht angenommen. Die wesentlichen Gegenstände und Ergebnisse einer solchen Erfolgskontrolle sind in einem Protokoll festzuhalten.

(12) Bei mündlich durchgeführten Erfolgskontrollen anderer Art muss in der Regel neben der Prüferin eine Beisitzende anwesend sein, die zusätzlich zur Prüferin die Protokolle zeichnet.

§ 7 Bewertung von Prüfungen und Erfolgskontrollen

(1) Das Ergebnis einer Erfolgskontrolle wird von den jeweiligen Prüferinnen in Form einer Note festgesetzt.

(2) Im Masterzeugnis dürfen nur folgende Noten verwendet werden:

1	=	sehr gut (very good)	=	eine hervorragende Leistung,
2	=	gut (good)	=	eine Leistung, die erheblich über den durchschnittlichen Anforderungen liegt,
3	=	befriedigend (satisfactory)	=	eine Leistung, die durchschnittlichen Anforderungen entspricht,

4	=	ausreichend (sufficient)	=	eine Leistung, die trotz ihrer Mängel noch den Anforderungen genügt,
5	=	nicht ausreichend (failed)	=	eine Leistung, die wegen erheblicher Mängel nicht den Anforderungen genügt.

Für die Masterarbeit und die Modulteilprüfungen sind zur differenzierten Bewertung nur folgende Noten zugelassen:

1	1.0, 1.3	=	sehr gut
2	1.7, 2.0, 2.3	=	gut
3	2.7, 3.0, 3.3	=	befriedigend
4	3.7, 4.0	=	ausreichend
5	4.7, 5.0	=	nicht ausreichend

Diese Noten müssen in den Protokollen und in den Anlagen (Transcript of Records und Diploma Supplement) verwendet werden.

(3) Für Erfolgskontrollen anderer Art kann im Studienplan die Benotung mit „bestanden“ (passed) oder „nicht bestanden“ (failed) vorgesehen werden.

(4) Bei der Bildung der gewichteten Durchschnitte der Modulnoten und der Gesamtnote wird nur die erste Dezimalstelle hinter dem Komma berücksichtigt; alle weiteren Stellen werden ohne Rundung gestrichen.

(5) Jedes Modul, jede Lehrveranstaltung und jede Erfolgskontrolle darf in demselben Studiengang nur einmal angerechnet werden. Die Anrechnung eines Moduls, einer Lehrveranstaltung oder einer Erfolgskontrolle ist darüber hinaus ausgeschlossen, wenn das betreffende Modul, die Lehrveranstaltung oder die Erfolgskontrolle bereits in einem grundständigen Bachelorstudiengang angerechnet wurde, auf dem dieser Masterstudiengang konsekutiv aufbaut.

(6) Erfolgskontrollen anderer Art dürfen in Modulteilprüfungen oder Modulprüfungen nur eingerechnet werden, wenn die Benotung nicht nach Absatz 3 erfolgt ist. Die zu dokumentierenden Erfolgskontrollen und die daran geknüpften Bedingungen werden im Studienplan festgelegt.

(7) Eine Modulteilprüfung ist bestanden, wenn die Note mindestens „ausreichend“ (4.0) ist.

(8) Eine Modulprüfung ist dann bestanden, wenn die Modulnote mindestens „ausreichend“ (4.0) ist. Die Modulprüfung und die Bildung der Modulnote werden im Studienplan geregelt. Die differenzierten Lehrveranstaltungsnoten (Absatz 2) sind bei der Berechnung der Modulnoten als Ausgangsdaten zu verwenden. Enthält der Studienplan keine Regelung darüber, wann eine Modulprüfung bestanden ist, so ist diese Modulprüfung dann endgültig nicht bestanden, wenn eine dem Modul zugeordnete Modulteilprüfung endgültig nicht bestanden wurde.

(9) Die Ergebnisse der Masterarbeit, der Modulprüfungen bzw. der Modulteilprüfungen, der Erfolgskontrollen anderer Art sowie die erworbenen Leistungspunkte werden durch das Studienbüro der Universität erfasst.

(10) Die Noten der Module eines Faches gehen in die Fachnote mit einem Gewicht proportional zu den ausgewiesenen Leistungspunkten der Module ein. Eine Fachprüfung ist bestanden, wenn die für das Fach erforderliche Anzahl von Leistungspunkten nachgewiesen wird.

(11) Die Gesamtnote der Masterprüfung und die Modulnoten lauten:

		bis	1.5	=	sehr gut
von	1.6	bis	2.5	=	gut
von	2.6	bis	3.5	=	befriedigend
von	3.6	bis	4.0	=	ausreichend

(12) Zusätzlich zu den Noten nach Absatz 2 werden ECTS-Noten für Fachprüfungen, Modulprüfungen und für die Masterprüfung nach folgender Skala vergeben:

ECTS-Note	Quote, Definition
A	gehört zu den besten 10 % der Studierenden, die die Erfolgskontrolle bestanden haben,
B	gehört zu den nächsten 25 % der Studierenden, die die Erfolgskontrolle bestanden haben,
C	gehört zu den nächsten 30 % der Studierenden, die die Erfolgskontrolle bestanden haben,
D	gehört zu den nächsten 25 % der Studierenden, die die Erfolgskontrolle bestanden haben,
E	gehört zu den letzten 10 % der Studierenden, die die Erfolgskontrolle bestanden haben,
FX	*nicht bestanden* (failed) - es sind Verbesserungen erforderlich, bevor die Leistungen anerkannt werden,
F	*nicht bestanden* (failed) - es sind erhebliche Verbesserungen erforderlich.

Die Quote ist als der Prozentsatz der erfolgreichen Studierenden definiert, die diese Note in der Regel erhalten. Dabei ist von einer mindestens fünfjährigen Datenbasis über mindestens 30 Studierende auszugehen. Für die Ermittlung der Notenverteilungen, die für die ECTS-Noten erforderlich sind, ist das Studienbüro der Universität zuständig. Bis zum Aufbau einer entsprechenden Datenbasis wird als Übergangsregel die Verteilung der Diplomsnoten des Diplomstudiengangs Wirtschaftsmathematik per 30. September 2009 zur Bildung dieser Skala für alle Module des Masterstudiengangs Wirtschaftsmathematik herangezogen. Diese Verteilung wird jährlich gleitend über mindestens fünf Semester mit mindestens 30 Studierenden jeweils zu Beginn des Semesters für jedes Modul, die Fachnoten und die Gesamtnote angepasst und in diesem Studienjahr für die Festsetzung der ECTS-Note verwendet.

§ 8 Erlöschen des Prüfungsanspruchs, Wiederholung von Prüfungen und Erfolgskontrollen

(1) Studentinnen können eine nicht bestandene schriftliche Prüfung (§ 4 Abs. 2, Nr. 1) einmal wiederholen. Wird eine schriftliche Wiederholungsprüfung mit „nicht ausreichend“ bewertet, so findet eine mündliche Nachprüfung im zeitlichen Zusammenhang mit dem Termin der nicht bestandenen Prüfung statt. In diesem Falle kann die Note dieser Prüfung nicht besser als „ausreichend“ (4.0) sein.

(2) Studentinnen können eine nicht bestandene mündliche Prüfung (§ 4 Abs. 2, Nr. 2) einmal wiederholen.

(3) Wiederholungsprüfungen nach Absatz 1 und 2 müssen in Inhalt, Umfang und Form (mündlich oder schriftlich) der ersten entsprechen. Ausnahmen kann der zuständige Prüfungsausschuss auf Antrag zulassen. Fehlversuche an anderen Hochschulen sind anzurechnen.

(4) Die Wiederholung einer Erfolgskontrolle anderer Art (§ 4 Abs. 2, Nr. 3) wird im Studienplan geregelt.

(5) Eine zweite Wiederholung derselben schriftlichen oder mündlichen Prüfung ist nur in Ausnahmefällen zulässig. Einen Antrag auf Zweitwiederholung hat die Studentin schriftlich beim Prüfungsausschuss zu stellen. Über den ersten Antrag einer Studentin auf Zweitwiederholung entscheidet der Prüfungsausschuss, wenn er den Antrag genehmigt. Wenn der Prüfungsausschuss diesen Antrag ablehnt, entscheidet die Rektorin. Über weitere Anträge auf Zweitwiederholung entscheidet nach Stellungnahme des Prüfungsausschusses die Rektorin. Absatz 1, Satz 2 und 3 gelten entsprechend.

(6) Die Wiederholung einer bestandenen Erfolgskontrolle ist nicht zulässig.

(7) Eine Fachprüfung ist endgültig nicht bestanden, wenn mindestens ein Modul des Faches endgültig nicht bestanden ist.

(8) Die Masterarbeit kann bei einer Bewertung mit „nicht ausreichend“ einmal wiederholt werden. Eine zweite Wiederholung der Masterarbeit ist ausgeschlossen.

(9) Ist gemäß § 34 Abs. 2, Satz 3 LHG die Masterprüfung bis zum Ende des siebten Fachsemesters dieses Studiengangs einschließlich etwaiger Wiederholungen nicht vollständig abgelegt, so erlischt der Prüfungsanspruch im Studiengang, es sei denn, dass die Studentin die Fristüberschreitung nicht zu vertreten hat. Die Entscheidung darüber trifft der Prüfungsausschuss. Die Entscheidung über eine Fristverlängerung und über Ausnahmen von der Fristregelung trifft der Prüfungsausschuss.

§ 9 Versäumnis, Rücktritt, Täuschung, Ordnungsverstoß

(1) Die Studentin kann bei schriftlichen Modulprüfungen ohne Angabe von Gründen bis einen Tag (24 Uhr) vor dem Prüfungstermin zurücktreten (Abmeldung). Bei mündlichen Modulprüfungen muss der Rücktritt spätestens drei Werktage vor dem betreffenden Prüfungstermin erklärt werden (Abmeldung). Ein Rücktritt von einer mündlichen Prüfung weniger als drei Werktage vor dem betreffenden Prüfungstermin ist nur unter den Voraussetzungen des Absatzes 3 möglich. Die Abmeldung kann schriftlich bei der Prüferin oder per Online-Abmeldung beim Studienbüro erfolgen. Eine durch Widerruf abgemeldete Prüfung gilt als nicht angemeldet. Der Rücktritt von mündlichen Nachprüfungen im Sinne von § 8 Abs. 2 ist grundsätzlich nur unter den Voraussetzungen von Absatz 3 möglich.

(2) Eine Modulprüfung gilt als mit „nicht ausreichend“ bewertet, wenn die Studentin einen Prüfungstermin ohne triftigen Grund versäumt oder wenn sie nach Beginn der Prüfung ohne triftigen Grund von der Prüfung zurücktritt. Dasselbe gilt, wenn die Masterarbeit nicht innerhalb der vorgesehenen Bearbeitungszeit erbracht wird, es sei denn, die Studentin hat die Fristüberschreitung nicht zu vertreten.

(3) Der für den Rücktritt nach Beginn der Prüfung oder das Versäumnis geltend gemachte Grund muss dem Prüfungsausschuss unverzüglich schriftlich angezeigt und glaubhaft gemacht werden. Bei Krankheit der Studentin bzw. eines von ihr allein zu versorgenden Kindes oder pflegebedürftigen Angehörigen kann die Vorlage eines ärztlichen Attestes und in Zweifelsfällen ein amtsärztliches Attest verlangt werden. Die Anerkennung des Rücktritts ist ausgeschlossen, wenn bis zum Eintritt des Hinderungsgrundes bereits Prüfungsleistungen erbracht worden sind und nach deren Ergebnis die Prüfung nicht bestanden werden kann. Wird der Grund anerkannt, wird ein neuer Termin anberaumt. Die bereits vorliegenden Prüfungsergebnisse sind in diesem Fall anzurechnen. Bei Modulprüfungen, die aus mehreren Prüfungen bestehen, werden die Prüfungsleistungen dieses Moduls, die bis zu einem anerkannten Rücktritt bzw. einem anerkannten Versäumnis einer Prüfungsleistung dieses Moduls erbracht worden sind, angerechnet.

(4) Versucht die Studentin das Ergebnis seiner Modulprüfung durch Täuschung oder Benutzung nicht zugelassener Hilfsmittel zu beeinflussen, gilt die betreffende Modulprüfung als mit „nicht ausreichend“ (5.0) bewertet.

(5) Eine Studentin, die den ordnungsgemäßen Ablauf der Prüfung stört, kann von der jeweiligen Prüferin oder Aufsicht Führenden von der Fortsetzung der Modulprüfung ausgeschlossen werden. In diesem Fall gilt die betreffende Prüfungsleistung als mit „nicht ausreichend“ (5.0) bewertet. In schwerwiegenden Fällen kann der Prüfungsausschuss die Studentin von der Erbringung weiterer Prüfungsleistungen ausschließen.

(6) Die Studentin kann innerhalb einer Frist von einem Monat verlangen, dass Entscheidungen gemäß Absatz 4 und 5 vom Prüfungsausschuss überprüft werden. Belastende Entscheidungen des Prüfungsausschusses sind der Studentin unverzüglich schriftlich mitzuteilen. Sie sind zu begründen und mit einer Rechtsbehelfsbelehrung zu versehen. Der Studentin ist vor einer Entscheidung Gelegenheit zur Äußerung zu geben.

(7) Näheres regelt die Allgemeine Satzung der Universität Karlsruhe (TH) zur Redlichkeit bei Prüfungen und Praktika (‚Verhaltensordnung').

§ 10 Mutterschutz, Elternzeit, Wahrnehmung von Familienpflichten

(1) Auf Antrag sind die Mutterschutzfristen, wie sie im jeweils gültigen Gesetz zum Schutz der erwerbstätigen Mutter (MuSchG) festgelegt sind, entsprechend zu berücksichtigen. Dem Antrag sind die erforderlichen Nachweise beizufügen. Die Mutterschutzfristen unterbrechen jede Frist nach dieser Prüfungsordnung. Die Dauer des Mutterschutzes wird nicht in die Frist eingerechnet.

(2) Gleichfalls sind die Fristen der Elternzeit nach Maßgabe des jeweiligen gültigen Gesetzes (BErzGG) auf Antrag zu berücksichtigen. Die Studentin muss bis spätestens vier Wochen vor dem Zeitpunkt, von dem an sie die Elternzeit antreten will, dem Prüfungsausschuss unter Beifügung der erforderlichen Nachweise schriftlich mitteilen, in welchem Zeitraum sie Elternzeit in Anspruch nehmen will. Der Prüfungsausschuss hat zu prüfen, ob die gesetzlichen Voraussetzungen vorliegen, die bei einer Arbeitnehmerin den Anspruch auf Elternzeit auslösen würden, und teilt der Studentin das Ergebnis sowie die neu festgesetzten Prüfungszeiten unverzüglich mit. Die Bearbeitungszeit der Masterarbeit kann nicht durch Elternzeit unterbrochen werden. Die gestellte Arbeit gilt als nicht vergeben. Nach Ablauf der Elternzeit erhält die Studentin ein neues Thema.

(3) Der Prüfungsausschuss entscheidet auf Antrag über die flexible Handhabung von Prüfungsfristen entsprechend den Bestimmungen des Landeshochschulgesetzes, wenn Studierende Familienpflichten wahrzunehmen haben. Die Bearbeitungszeit der Masterarbeit kann nicht durch die Wahrnehmung von Familienpflichten unterbrochen oder verlängert werden. Die gestellte Arbeit gilt als nicht vergeben. Die Studentin erhält ein neues Thema, das innerhalb der in § 11 festgelegten Bearbeitungszeit zu bearbeiten ist.

§ 11 Masterarbeit

(1) Die Masterarbeit soll zeigen, dass die Studentin in der Lage ist, ein Problem aus ihrem Fach selbstständig und in begrenzter Zeit nach wissenschaftlichen Methoden, die dem Stand der Forschung entsprechen, zu bearbeiten. Die Masterarbeit kann auf Deutsch oder Englisch geschrieben werden.

(2) Zum Modul Masterarbeit wird zugelassen, wer mindestens 70 Leistungspunkte gesammelt hat.

(3) Die Masterarbeit kann von jeder Prüferin nach § 15 Abs. 2 aus den Fakultäten für Mathematik oder Wirtschaftswissenschaften vergeben werden. Soll die Masterarbeit außerhalb der Fakultäten für Mathematik oder Wirtschaftswissenschaften angefertigt werden, so bedarf dies der Genehmigung des Prüfungsausschusses. Der Studentin ist Gelegenheit zu geben, für das Thema Vorschläge zu machen. Auf Antrag der Studentin sorgt ausnahmsweise die Vorsitzende des Prüfungsausschusses dafür, dass die Studentin innerhalb von vier Wochen nach Antragstellung von einer Betreuerin ein Thema für die Masterarbeit erhält. Die Ausgabe des Themas erfolgt in diesem Fall über die Vorsitzende des Prüfungsausschusses.

(4) Der Masterarbeit werden 30 Leistungspunkte zugeordnet. Die Bearbeitungsdauer beträgt sechs Monate. Thema, Aufgabenstellung und Umfang der Masterarbeit sind von der Betreuerin so zu begrenzen, dass sie mit dem in Satz 1 festgelegten Arbeitsaufwand bearbeitet werden kann. Auf begründeten Antrag der Studentin kann der Prüfungsausschuss diesen Zeitraum um höchstens drei Monate verlängern.

(5) Bei der Abgabe der Masterarbeit hat die Studentin schriftlich zu versichern, dass sie die Arbeit selbstständig verfasst hat und keine anderen als die von ihr angegebenen Quellen und Hilfsmittel benutzt hat, die wörtlich oder inhaltlich übernommenen Stellen als solche kenntlich gemacht und die Satzung der Universität Karlsruhe (TH) zur Sicherung guter wissenschaftlicher Praxis in der jeweils gültigen Fassung beachtet hat. Wenn diese Erklärung nicht enthalten ist, wird die Arbeit nicht angenommen. Bei Abgabe einer unwahren Versicherung wird die Masterarbeit mit „nicht ausreichend" (5.0) bewertet.

(6) Der Zeitpunkt der Ausgabe des Themas der Masterarbeit und der Zeitpunkt der Abgabe der Masterarbeit sind aktenkundig zu machen. Die Studentin kann das Thema der Masterarbeit nur einmal und nur innerhalb der ersten zwei Monate der Bearbeitungszeit zurückgeben. Wird die Masterarbeit nicht fristgerecht abgeliefert, gilt sie als mit „nicht ausreichend" bewertet, es sei denn, dass die Studentin dieses Versäumnis nicht zu vertreten hat. Die Möglichkeit der Wiederholung wird in § 8 geregelt.

(7) Die Masterarbeit wird von einer Betreuerin sowie in der Regel von einer weiteren Prüferin aus den beteiligten Fakultäten begutachtet und bewertet. Eine der beiden muss Hochschullehrerin sein. Bei nicht übereinstimmender Beurteilung der beiden Prüferinnen setzt der Prüfungsausschuss im Rahmen der Bewertung der beiden Prüferinnen die Note der Masterarbeit fest. Der Bewertungszeitraum soll acht Wochen nicht überschreiten.

§ 12 Berufspraktikum

(1) Die Studentin kann während des Masterstudiums ein Berufspraktikum ableisten, welches geeignet ist, der Studentin eine Anschauung von der Verzahnung mathematischer und wirtschaftswissenschaftlicher Sichtweisen zu vermitteln. Dem Berufspraktikum sind 8 Leistungspunkte zugeordnet.

(2) Die Studentin setzt sich in eigener Verantwortung mit geeigneten privaten bzw. öffentlichen Einrichtungen in Verbindung, an denen das Praktikum abgeleistet werden kann. Die Studentin wird dabei von einer Prüferin nach § 15 Abs. 2 und einer Ansprechpartnerin der betroffenen Einrichtung betreut.

(3) Am Ende des Berufspraktikums ist der Prüferin ein kurzer Bericht abzugeben und eine Kurzpräsentation über die Erfahrungen im Berufspraktikum zu halten.

(4) Das Berufspraktikum ist abgeschlossen, wenn eine mindestens sechswöchige Tätigkeit nachgewiesen wird, der Bericht abgegeben und die Kurzpräsentation gehalten wurde. Das Berufspraktikum geht nicht in die Gesamtnote ein. Ein Berufspraktikum kann als Zusatzleistung im Sinne von § 13 Abs. 1 oder im Rahmen des Wahlpflichtfachs gemäß § 17 Abs. 4 erbracht werden.

§ 13 Zusatzleistungen, Zusatzmodule, Schlüsselqualifikationen

(1) Innerhalb der Regelstudienzeit, einschließlich der Urlaubssemester für das Studium an einer ausländischen Hochschule (Regelprüfungszeit), können in einem Modul bzw. Fach auch weitere Leistungspunkte (Zusatzleistungen) im Umfang von höchstens 20 Leistungspunkten pro Studiengang erworben werden. § 3 und § 4 der Prüfungsordnung bleiben davon unberührt. Diese Zusatzleistungen gehen nicht in die Festsetzung der Gesamt-, Fach- und Modulnoten ein. Die bei der Festlegung der Modul- bzw. Fachnote nicht berücksichtigten Leistungspunkte werden als Zusatzleistungen automatisch im Transcript of Records aufgeführt und als Zusatzleistungen gekennzeichnet. Zusatzleistungen werden mit den nach § 7 vorgesehenen Noten gelistet.

(2) Die Studentin hat bereits bei der Anmeldung zu einer Prüfung in einem Modul diese als Zusatzleistung zu deklarieren.

(3) Die Ergebnisse maximal zweier Module, die jeweils mindestens 9 Leistungspunkte umfassen müssen, werden auf Antrag der Studentin in das Bachelorzeugnis als Zusatzmodule aufgenommen und als Zusatzmodule gekennzeichnet. Zusatzmodule werden bei der Festsetzung der Gesamtnote nicht mit einbezogen. Nicht in das Zeugnis aufgenommene Zusatzmodule werden im Transcript of Records automatisch aufgenommen und als Zusatzmodule gekennzeichnet. Zusatzmodule werden mit den nach § 7 vorgesehenen Noten gelistet.

(4) Neben den verpflichtenden fachwissenschaftlichen Modulen sind Module zu den überfachlichen Schlüsselqualifikationen im Umfang von 3 bis 4 Leistungspunkten Bestandteil eines Masterstudiums. Im Studienplan werden Empfehlungen ausgesprochen, welche Module im Rahmen des Angebots zur Vermittlung der additiven Schlüsselqualifikationen belegt werden sollen.

§ 14 Prüfungsausschuss

(1) Für den Masterstudiengang Wirtschaftsmathematik wird ein Prüfungsausschuss gebildet. Er besteht aus sechs stimmberechtigten Mitgliedern, die jeweils zur Hälfte von der Fakultät für Mathematik und der Fakultät für Wirtschaftswissenschaften bestellt werden: vier Hochschullehrerinnen oder Privatdozentinnen, zwei Vertreterinnen der Gruppe der akademischen Mitarbeiterinnen nach § 10 Abs. 1, Satz 2, Nr. 2 LHG und einer Vertreterin der Studentinnen der Fakultät für Mathematik mit beratender Stimme. Weitere Mitglieder mit beratender Stimme können von den jeweiligen Fakultätsräten bestellt werden. Die Amtszeit der nichtstudentischen Mitglieder beträgt zwei Jahre, die des studentischen Mitglieds ein Jahr.

(2) Die Vorsitzende, ihre Stellvertreterin, die weiteren Mitglieder des Prüfungsausschusses sowie deren Stellvertreterinnen werden von den jeweiligen Fakultätsräten bestellt, die Mitglieder der Gruppe der akademischen Mitarbeiterinnen nach § 10 Abs. 1, Satz 2, Nr. 2 LHG und die Vertreterin der Studentinnen auf Vorschlag der Mitglieder der jeweiligen Gruppe; Wiederbestellung ist möglich. Die Vorsitzende und deren Stellvertreterin müssen Hochschullehrerin sein. Die Vorsitzende des Prüfungsausschusses nimmt die laufenden Geschäfte wahr.

(3) Der Prüfungsausschuss ist zuständig für die Organisation der Modulprüfungen und die Durchführung der ihm durch diese Studien- und Prüfungsordnung zugewiesenen Aufgaben. Er achtet auf die Einhaltung der Bestimmungen dieser Studien- und Prüfungsordnung und fällt die Entscheidung in Prüfungsangelegenheiten. Er entscheidet über die Anrechnung von Studienzeiten, Studienleistungen und Modulprüfungen und übernimmt die Gleichwertigkeitsfeststellung. Er berichtet der jeweiligen Fakultät regelmäßig über die Entwicklung der Prüfungs- und Studienzeiten, einschließlich der Bearbeitungszeiten für die Masterarbeiten und die Verteilung der Gesamtnoten. Er gibt Anregungen zur Reform der Studien- und Prüfungsordnung und der Modulbeschreibungen.

(4) Der Prüfungsausschuss kann die Erledigung seiner Aufgaben für alle Regelfälle auf die Vorsitzende des Prüfungsausschusses übertragen.

(5) Die Mitglieder des Prüfungsausschusses haben das Recht, der Abnahme von Prüfungen beizuwohnen. Die Mitglieder des Prüfungsausschusses, die Prüferinnen und die Beisitzenden unterliegen der Amtsverschwiegenheit. Sofern sie nicht im öffentlichen Dienst stehen, sind sie durch die Vorsitzende zur Verschwiegenheit zu verpflichten.

(6) In Angelegenheiten des Prüfungsausschusses, die eine an einer anderen Fakultät zu absolvierende Prüfungsleistung betreffen, ist auf Antrag eines Mitgliedes des Prüfungsausschusses eine fachlich zuständige und von der betroffenen Fakultät zu nennende Hochschullehrerin oder Privatdozentin hinzuzuziehen. Sie hat in diesem Punkt Stimmrecht.

(7) Belastende Entscheidungen des Prüfungsausschusses sind der Studentin schriftlich mitzuteilen. Sie sind zu begründen und mit einer Rechtsbehelfsbelehrung zu versehen. Widersprüche gegen Entscheidungen des Prüfungsausschusses sind innerhalb eines Monats nach Zugang der Entscheidung schriftlich oder zur Niederschrift beim Rektorat der Universität Karlsruhe (TH) einzulegen.

§ 15 Prüferinnen und Beisitzende

(1) Der Prüfungsausschuss bestellt die Prüferinnen und die Beisitzenden. Er kann die Bestellung der Vorsitzenden übertragen.

(2) Prüferinnen sind Hochschullehrerinnen und habilitierte Mitglieder sowie akademischen Mitarbeiterinnen, denen die Prüfungsbefugnis übertragen wurde. Zur Prüferin und Beisitzenden darf nur bestellt werden, wer mindestens die dem jeweiligen Prüfungsgegenstand entsprechende fachwissenschaftliche Qualifikation erworben hat.

(3) Soweit Lehrveranstaltungen von anderen als den unter Absatz 2 genannten Personen durchgeführt werden, sollen diese zu Prüferinnen bestellt werden, wenn die jeweilige Fakultät ihnen eine diesbezügliche Prüfungsbefugnis erteilt hat.

(4) Zur Beisitzenden darf nur bestellt werden, wer einen Masterabschluss in einem Studiengang der Wirtschaftsmathematik oder einen gleichwertigen akademischen Abschluss erworben hat.

§ 16 Anrechnung von Studienzeiten, Anerkennung von Studienleistungen und Modulprüfungen

(1) Studienzeiten und Studienleistungen und Modulprüfungen, die in gleichen oder anderen Studiengängen an der Universität Karlsruhe (TH) oder an anderen Hochschulen erbracht wurden, werden angerechnet, soweit Gleichwertigkeit besteht. Gleichwertigkeit ist festzustellen, wenn Leistungen in Inhalt, Umfang und in den Anforderungen denjenigen des Studiengangs im Wesentlichen entsprechen. Dabei ist kein schematischer Vergleich, sondern eine Gesamtbetrachtung vorzunehmen. Bezüglich des Umfangs einer zur Anerkennung vorgelegten Studienleistung und Modulprüfung werden die Grundsätze des ECTS herangezogen; die inhaltliche Gleichwertigkeitsprüfung orientiert sich an den Qualifikationszielen des Moduls.

(2) Werden Leistungen angerechnet, können die Noten – soweit die Notensysteme vergleichbar sind – übernommen werden und in die Berechnung der Modulnoten und der Gesamtnote einbezogen werden. Liegen keine Noten vor, muss die Leistung nicht anerkannt werden. Die Studentin hat die für die Anrechnung erforderlichen Unterlagen vorzulegen.

(3) Bei der Anrechnung von Studienzeiten und der Anerkennung von Studienleistungen und Modulprüfungen, die außerhalb der Bundesrepublik erbracht wurden, sind die von der Kultusministerkonferenz und der Hochschulrektorenkonferenz gebilligten Äquivalenzvereinbarungen sowie Absprachen im Rahmen der Hochschulpartnerschaften zu beachten.

(4) Absatz 1 gilt auch für Studienzeiten, Studienleistungen und Modulprüfungen, die in staatlich anerkannten Fernstudien- und an anderen Bildungseinrichtungen, insbesondere an staatlichen oder staatlich anerkannten Berufsakademien erworben wurden.

(5) Die Anerkennung von Teilen der Masterprüfung kann versagt werden, wenn in einem Studiengang mehr als die Hälfte aller Erfolgskontrollen und/oder in einem Studiengang mehr als die Hälfte der erforderlichen Leistungspunkte und/oder die Masterarbeit anerkannt werden soll/en. Dies gilt insbesondere bei einem Studiengangwechsel sowie bei einem Studienortwechsel.

(6) Zuständig für die Anrechnungen ist der Prüfungsausschuss. Vor Feststellungen über die Gleichwertigkeit sind die zuständigen Fachvertreterinnen zu hören. Der Prüfungsausschuss entscheidet in Abhängigkeit von Art und Umfang der anzurechnenden Studien- und Prüfungsleistungen über die Einstufung in ein höheres Fachsemester.

II. Masterprüfung

§ 17 Umfang und Art der Masterprüfung

(1) Die Masterprüfung besteht aus den Prüfungen nach Absatz 2, 3 und 4 sowie der Masterarbeit nach Absatz 6.

(2) Es sind Prüfungen aus folgenden Gebieten durch den Nachweis von Leistungspunkten in jeweils einem oder mehreren Modulen abzulegen:

Fach Mathematik:

1. Stochastik: im Umfang von 8 Leistungspunkten,
2. Angewandte und Numerische Mathematik/Optimierung: im Umfang von 8 Leistungspunkten,
3. Analysis: im Umfang von 8 Leistungspunkten.

Des Weiteren sind Prüfungen aus den mathematischen Gebieten Stochastik, Angewandte und Numerische Mathematik/Optimierung, Analysis oder Algebra und Geometrie der Fakultät für Mathematik im Umfang von 12 Leistungspunkten abzulegen.

Fach Wirtschaftswissenschaften:

4. Finance - Risikomanagement - Managerial Economics: im Umfang von 18 Leistungspunkten,

5. Operations Management - Datenanalyse - Informatik: im Umfang von 18 Leistungspunkten.

Die Module, die ihnen zugeordneten Leistungspunkte und die Zuordnung der Module zu den Gebieten und Fächern sind im Studienplan festgelegt. Zur entsprechenden Modulprüfung kann nur zugelassen werden, wer die Anforderungen nach § 5 erfüllt.

(3) Es sind zwei Seminarmodule über je 3 Leistungspunkte nachzuweisen. Dabei muss je ein Seminarmodul aus den beiden beteiligten Fakultäten bestanden werden.

(4) Es sind weiterhin 12 Leistungspunkte zu erbringen, wobei mindestens 8 Leistungspunkte aus den obigen Gebieten 1.-5. oder dem Berufspraktikum kommen müssen und 3 bis 4 Leistungspunkte aus Modulen zu Schlüsselqualifikationen nach § 13 Abs. 4.

(5) Im Studienplan oder Modulhandbuch können darüber hinaus inhaltliche Schwerpunkte definiert werden, denen Module zugeordnet werden können.

(6) Als weitere Prüfungsleistung ist eine Masterarbeit gemäß § 11 anzufertigen.

§ 18 Bestehen der Masterprüfung, Bildung der Gesamtnote

(1) Die Masterprüfung ist bestanden, wenn alle in § 17 genannten Prüfungsleistungen mindestens mit „ausreichend“ bewertet wurden.

(2) Die Gesamtnote der Masterprüfung errechnet sich als ein mit Leistungspunkten gewichteter Notendurchschnitt. Dabei werden alle Prüfungsleistungen nach § 17 mit ihren Leistungspunkten gewichtet.

(3) Hat die Studentin die Masterarbeit mit der Note 1.0 und die Masterprüfung mit einem Durchschnitt von 1.0 abgeschlossen, so wird das Prädikat „mit Auszeichnung“ (with distinction) verliehen. Mit einer Masterarbeit mit der Note 1.0 und bis zu einem Durchschnitt von 1.3 kann auf Antrag an den Prüfungsausschuss das Prädikat „mit Auszeichnung“ (with distinction) verliehen werden.

§ 19 Masterzeugnis, Masterurkunde, Transcript of Records und Diploma Supplement

(1) Über die Masterprüfung werden nach Bewertung der letzten Prüfungsleistung eine Masterurkunde und ein Zeugnis erstellt. Die Ausfertigung von Masterurkunde und Zeugnis soll nicht später als sechs Wochen nach der Bewertung der letzten Prüfungsleistung erfolgen. Masterurkunde und Masterzeugnis werden in deutscher und englischer Sprache ausgestellt. Masterurkunde und Zeugnis tragen das Datum der erfolgreichen Erbringung der letzten Prüfungsleistung. Sie werden der Studentin gleichzeitig ausgehändigt. In der Masterurkunde wird die Verleihung des akademischen Mastergrades beurkundet. Die Masterurkunde wird von der Rektorin und der Dekanin unterzeichnet und mit dem Siegel der Universität versehen.

(2) Das Zeugnis enthält die in den Fachprüfungen, den zugeordneten Modulprüfungen und der Masterarbeit erzielten Noten, deren zugeordnete Leistungspunkte und ECTS-Noten und die Gesamtnote und die ihr entsprechende ECTS-Note. Das Zeugnis ist von den Dekaninnen der beteiligten Fakultäten und von der Vorsitzenden des Prüfungsausschusses zu unterzeichnen.

(3) Weiterhin erhält die Studentin als Anhang ein Diploma Supplement in deutscher und englischer Sprache, das den Vorgaben des jeweils gültigen ECTS User’s Guide entspricht. Das Diploma Supplement enthält eine Abschrift der Studiendaten der Studentin (Transcript of Records).

(4) Die Abschrift der Studiendaten (Transcript of Records) enthält in strukturierter Form alle von der Studentin erbrachten Prüfungsleistungen. Sie beinhaltet alle Fächer, Fachnoten und ihre entsprechende ECTS-Note samt den zugeordneten Leistungspunkten, die dem jeweiligen Fach zugeordneten Module mit den Modulnoten, entsprechender ECTS-Note und zugeordneten Leistungspunkten sowie die den Modulen zugeordneten Lehrveranstaltungen samt Noten und zugeordneten Leistungspunkten. Aus der Abschrift der Studiendaten soll die Zugehörigkeit von Lehrveranstaltungen zu den einzelnen Modulen und die Zugehörigkeit der Module zu den einzelnen Fächern deutlich erkennbar sein. Angerechnete Studienleistungen sind im Transcript of Records aufzunehmen.

(5) Die Masterurkunde, das Masterzeugnis und das Diploma Supplement einschließlich des Transcript of Records werden vom Studienbüro der Universität ausgestellt.

III. Schlussbestimmungen

§ 20 Bescheid über Nicht-Bestehen, Bescheinigung von Prüfungsleistungen

(1) Der Bescheid über die endgültig nicht bestandene Masterprüfung wird der Studentin durch den Prüfungsausschuss in schriftlicher Form erteilt. Der Bescheid ist mit einer Rechtsbehelfsbelehrung zu versehen.

(2) Hat die Studentin die Masterprüfung endgültig nicht bestanden, wird ihr auf Antrag und gegen Vorlage der Exmatrikulationsbescheinigung eine schriftliche Bescheinigung ausgestellt, die die erbrachten Prüfungsleistungen und deren Noten sowie die zur Prüfung noch fehlenden Prüfungsleistungen enthält und erkennen lässt, dass die Prüfung insgesamt nicht bestanden ist. Dasselbe gilt, wenn der Prüfungsanspruch erloschen ist.

§ 21 Ungültigkeit der Masterprüfung, Entziehung des Mastergrades

(1) Hat die Studentin bei einer Prüfungsleistung getäuscht und wird diese Tatsache nach der Aushändigung des Zeugnisses bekannt, so können die Noten der Modulprüfungen, bei deren Erbringung die Studentin getäuscht hat, berichtigt werden. Gegebenenfalls kann die Modulprüfung für „nicht ausreichend“ (5.0) und die Masterprüfung für „nicht bestanden“ erklärt werden.

(2) Waren die Voraussetzungen für die Zulassung zu einer Prüfung nicht erfüllt, ohne dass die Studentin darüber täuschen wollte, und wird diese Tatsache erst nach Aushändigung des Zeugnisses bekannt, wird dieser Mangel durch das Bestehen der Prüfung geheilt. Hat die Studentin die Zulassung vorsätzlich zu Unrecht erwirkt, so kann die Modulprüfung für „nicht ausreichend“ (5.0) und die Masterprüfung für „nicht bestanden“ erklärt werden.

(3) Vor einer Entscheidung des Prüfungsausschusses ist der Studentin Gelegenheit zur Äußerung zu geben.

(4) Das unrichtige Zeugnis ist zu entziehen und gegebenenfalls ein neues zu erteilen. Mit dem unrichtigen Zeugnis ist auch die Masterurkunde einzuziehen, wenn die Masterprüfung aufgrund einer Täuschung für „nicht bestanden“ erklärt wurde.

(5) Eine Entscheidung nach Absatz 1 und Absatz 2 Satz 2 ist nach einer Frist von fünf Jahren ab dem Datum des Zeugnisses ausgeschlossen.

(6) Die Aberkennung des akademischen Grades richtet sich nach den gesetzlichen Vorschriften.

§ 22 Einsicht in die Prüfungsakten

(1) Nach Abschluss der Masterprüfung wird der Studentin auf Antrag innerhalb eines Jahres Einsicht in ihre Masterarbeit, die darauf bezogenen Gutachten und in die Prüfungsprotokolle gewährt.

(2) Für die Einsichtnahme in die schriftlichen Modulprüfungen, schriftlichen Modulteilprüfungen bzw. Prüfungsprotokolle gilt eine Frist von einem Monat nach Bekanntgabe des Prüfungsergebnisses.

(3) Die Prüferin bestimmt Ort und Zeit der Einsichtnahme.

(4) Prüfungsunterlagen sind mindestens fünf Jahre aufzubewahren.

§ 23 In-Kraft-Treten

(1) Diese Studien- und Prüfungsordnung tritt am 1. Oktober 2009 in Kraft.

(2) Studierende, die auf Grundlage der Prüfungsordnung der Universität Karlsruhe (TH) für den Diplomstudiengang Wirtschaftsmathematik vom 15. November 2001 (Amtliche Bekanntmachung der Universität Karlsruhe (TH) Nr. 30 vom 26. November 2001) in der Fassung der Änderungssatzung vom 10. September 2003 (Amtliche Bekanntmachung der Universität Karlsruhe (TH) Nr. 28 vom 20. Oktober 2003) ihr Studium an der Universität Karlsruhe (TH) aufgenommen haben, können einen Antrag auf Zulassung zur Prüfung letztmalig am 30. September 2020 stellen.

Karlsruhe, den 28. August 2009

Professor Dr. sc. tech. Horst Hippler
(Rektor)

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