Appendix B:

Module Catalogue

for the Research Master Data Science (M.Sc.)

Modules

Please note: The German version of this document is the legally binding version. The English translation provided here is for information purposes only.

Agile Research Project Management					**AFPM**
Identification number	Workload	Credits	Study semester	Frequency	Duration
2048	180	6	1st sem.	each semester	1 sem.

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	60	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	2	SCH	30	h	60	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Students are able to plan, organise and control projects (especially software development projects) in an agile research environment.
- The students know methods of agile project management and can select, adapt and apply them to concrete projects and their contexts
- Students will be able to apply procedures and tools for configuration management and testing of software in the context of operational software development
- Students understand the specifics of research projects. In an accompanying group exercise, they applied the methods they have learned and gained experience with non-hierarchical teamwork and conflict resolution.

3 Contents:

- Introduction to project management
  - Resources, time and content
  - Project acquisition
  - Project planning
  - Effort estimate
  - Gantcharts
  - Project organisation
  - Project management
  - Project completion
  - Project review
- Project management
  - Team composition
  - Conflict Management
  - Stakeholder management
- Special features of agile project management
  - Differentiation from traditional project management
  - The Agile Manifesto
  - SCRUM, Extreme Programming, Rapid Prototyping
- Software project management
  - Configuration management
  - Testing and testing procedures
- Special features of innovation, development and research projects
  - Decentralised decision-making structures

	○ Consortia research, specially funded projects of the European Union • Accompanying exercise: ○ Planning and implementation of a mini-software project in Python in group work
4	Forms of teaching: Lecture, exercise
5	Participation requirements:
	Formal:
	Content:
6	Forms of assessment: Term paper or oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Research Master Data Science (M.Sc.)
9	Importance of the grade for the final grade: according to MRPO
10	Module Officer: N. N.
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Big Data Architectures					**BDA**
Identification number	Workload	Credits	Study semester	Frequency of the offer	Duration
2049	180	6	2nd or 3rd sem.	annually in the summer semester	1 sem.

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	60	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	1	SCH	15	h	30	h
	Practical or seminar	15 students	1	SCH	15	h	30	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- The students know the differences between central and distributed systems and can select the right system according to the respective application.
- Students are familiar with the implementation of parallel and distributed information systems and analysis methods for large, complex and volatile datasets.
- They are familiar with the Apache Hadoop/Spark ecosystem for managing, processing and distributing data in data science applications, know its essential components, and can select and apply the components required in a project in a targeted manner.
- They know the principles of NoSQL databases and their characteristics as document-oriented databases, key-value databases, graph databases and column-oriented databases.
- They distinguish between the different types of NoSQL databases based on their scope of application and assess when which type of NoSQL database should be used and apply it in practice.
- Students will be able to describe the information technology requirements that must be taken as a basis for handling large data science projects in the cloud.

3 Contents:

- Introduction to Big Data Computing
- NoSQL databases
  - CAP Theorem
  - ACID vs. BASE
  - Key-value database (e.g. Redis)
  - Document-oriented database (e.g. MongoDB)
  - Wide-column store (e.g. HBase)
  - Graph database (e.g. Neo4J)
- Big Data Architectures
  - Batch vs. online data processing
  - Lambda architecture
- The Apache Big Data Ecosystem
  - Batch data processing using the example of Hadoop (e.g. HDFS, YARN, MapReduce)
  - Online Data Processing using Spark as an example (e.g. Kafka, Spark Streaming)

	• Cloud-based Big Data systems o Serverless computing o Cloud vs. Edge Computing
4	Forms of teaching: Lecture, exercise, practical course
5	Participation requirements: Formal: Content:
6	Forms of assessment: Performance exam or oral exam
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Research Master Data Science (M.Sc.)
9	Importance of the grade for the final grade: according to MRPO
10	Module Officer: Prof. Dr. rer. nat. Stefan Berlik
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Data Mining & Machine Learning	**DMML**

Identification number	Workload	Credits	Study semester	Frequency of the offer	Duration
2050	180	6	2nd or 3rd sem.	annually in the summer semester	1 sem.

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	60	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	1	SCH	15	h	30	h
	Practical or seminar	15 students	1	SCH	15	h	30	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Students gain a sound insight into the techniques, possibilities and applicability of data mining and machine learning. After successful participation, they are able to identify potential fields of application of data mining methods and methods of machine learning in the company, and to select and apply suitable procedures.
- Students know all the steps of the data mining process to generate knowledge from data via algorithms and can apply the individual steps to larger data sets
- Students are familiar with the different types of machine learning and can apply supervised and unsupervised learning methods to practical problems
- They penetrate the theoretical background of the learned procedures and are able to apply them to the respective application context, configuring and adapting them as needed.

3 Contents:

- Introduction to data mining
- Overview of the data mining process
- Pre-processing (data acquisition/generation, data selection, errors in data, standardisation, cleansing/filtering, *characteristic selection, dimension reduction)
- Observation problems (cluster analysis, outlier detection)
- Prognosis problems (classification, association analysis, sequence pattern analysis, regression analysis)
- Introduction to Machine Learning
- Supervised and unsupervised learning with artificial neural networks (feature subset selection, multi-layer perceptron, self-organizing maps, recurrent networks, convolutional neural networks & deep learning)
- Data mining by means of neural networks
- Application and implementation of selected methods using Python, Pandas, Numpy, Scikit-learn and TensorFlow

4 Forms of teaching:

Lecture, exercise, practical course

5 Participation requirements:

Formal:	
Content:	Programming with Python, Basics of Statistics Modules:

		2051 Introduction to Data Science;
6	Forms of assessment: Written examination or oral examination	
7	Prerequisite for the award of credit points: Module examination pass	
8	Application of the module (in the following study programmes) Research Master Data Science (M.Sc.)	
9	Importance of the grade for the final grade: according to MRPO	
10	Module Officer: Prof. Dr.-Ing. Christian Schwede	
11	Other information: Literature will be announced at the beginning of the course.	
12	Language: German	

Introduction to Data Science					**EDS**
Identification number	Workload	Credits	Study semester	Frequency of the offer	Duration
2051	180	6	1st sem.	each semester	1 sem.

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	60	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	1	SCH	15	h	30	h
	Practical or seminar	15 students	1	SCH	15	h	30	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- The students have gained an overview of the scientific field of data science and know a framework for classifying problems, algorithms, processes and procedures.
- They understand the importance of data for today's living and working environment and know the job descriptions and tasks of a data scientist.
- Students understand the basic concepts of functional programming and can implement programmes with Python. They know important standard Python libraries and can operate JupyterNotebook as well as Pycharm.
- The students understand the most important terms and can apply the basic methods of descriptive statistics, probability calculation and inferential statistics, which they need as a basis for the other courses of the Master's programme and for the successful completion of their project. They use Python for statistical data analysis, have mastered the most important functions and are familiar with the most important libraries.

3 Contents:

- Introduction to data science (historical classification, importance and value of data, overview of fields of data science, career paths of data scientist vs. data engineer)
- Introduction to Python (introduction to functional programming, object-oriented programming with Python, JupyterNotebook, PyCharm, introduction and use of standard libraries)
- Basics of statistics (mathematical basics, descriptive statistics, discrete probability spaces, general probability spaces)

4 Forms of teaching:

Lecture, exercise, practical course

5 Participation requirements:

Formal:	None
Content:	Knowledge of the basics of programming, basic mathematical knowledge

6 Forms of assessment:

Written examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass

8 Application of the module (in the following study programmes)

Research Master Data Science (M.Sc.)

9 Importance of the grade for the final grade:

	according to MRPO
10	Module Officer: Prof. Dr.-Ing. Christian Schwede
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Introduction to Applied Research					**EAF**
ID no.	Workload	Credits	Study semester	Frequency of the offer	Duration
2052	180	6	1st sem.	each semester	1 sem.

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	0	h
	Tuition in seminars	30 students	2	SCH	30	h	60	h
	Exercise	20 students	2	SCH	30	h	60	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Students have a deep understanding of the applied scientific way of working. This includes choosing a research method, formulating research questions, researching literature, writing scientific texts and presenting the validated results.
- They have internalised the basic rules of academic writing and can apply them to a concrete question.
- They understand how the scientific community is structured and functions and can classify the purpose and value of organisations, events or activities. They know possible career paths and are able to set milestones for their individual path.
- They know how and where research funds can be obtained to finance their own research projects.
- They know ways to exploit research results
- The students have fundamentally dealt with the search for truth and are able to critically question their own findings.
- They have understood the basics of logic and can apply them to practical problems.

3 Contents:

- Introduction to epistemology and science theory
  - Empiricism and Rationalism
  - Theories of truth
  - What is science?
  - Forms of science (explaining and understanding)
  - Classification of Applied Research and Data Science
- Logic basics
  - Propositional logic
  - Argumentation logic
  - Predicate logic
- Research methods and research design
  - Quantitative, qualitative, (normative), forms of inference (inductive, deductive, abductive) and fallacies (dogma, infinite regress, circular reasoning, naturalistic fallacy)
  - Research methods in applied research and data science
- Deriving research questions
  - Validability and falsifiability

	o Derive problems from practice • Validation o Validation methods o Critical reflection • Scientific writing and presentation o Text quality o Text structure o Argument structure o Scientific formulation o Citation rules o Giving feedback (Writing Fellow concept) • Research • Literature databases and search engines • Procedure for the literature search • Reading scientific texts • Internet: MOOCS and social media o Publishing process o Call for paper o Abstract phase o Submission o Peer review process o Open Access vs. Closed Access • The scientific community o Roles, organisations and forums o Organisation of research in Germany and Europe o Publication and exchange o Research and development in industry o Career paths in applied science • Raise research funds o Funders o Research funds in Germany and Europe o Tenders o Research applications • Applied research: Exploitation of research results o Gap between research and implementation o Copyright o Property rights (patents, utility models, e.g.) o Exploitation within companies (start-ups, product development, internal marketing) o Exploitation outside companies (company formation, licences) • Practical o Research, presentation and discussion of scientific texts o Exercises and tasks on predicate logic (e.g. with ProLog)
4	Forms of teaching: Tuition in seminar, exercise
5	Participation requirements: Formal: Content:
6	Forms of assessment: Written examination or oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Research Master Data Science (M.Sc.)

9	Importance of the grade for the final grade: according to MRPO
10	Module Officer: N. N.
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Social Implications of Data Science					**GIDS**
ID no.	Workload	Credits	Study semester	Frequency of the offer	Duration
2053	180	6	2nd or 3rd sem.	annually in the winter semester	1 sem.

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	60	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	2	SCH	30	h	60	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Students will be able to evaluate and critically reflect on the social impact, especially ethical implications, of their scientific work.
- They are sensitised to consider data protection and personal rights in their own work and to respect applicable law.
- They know the challenges of data exchange in the business environment and can derive possible solutions based on existing technology.
- The students are aware of the responsibility of the data scientist and the necessity of open discourse in democratic constitutional states.
- The students can lead ethical discussions on the topic of data science and classify and justify their own findings against the background.
- Students are aware of the effect of discrimination by machine learning and how it can be prevented.
- The students can independently research findings from the field of science and technology reflection, summarise them in a paper and present them.

3 Contents:

- Ethical foundations
  - What is a good action?
  - Basic ethical theories (deontology, cosequentialism)
  - Ethical dilemmas
- Ethical implications of artificial intelligence
  - Programmers as ethical decision-makers
  - Weak vs. strong AI
  - Anthropology of technology
- Data protection and personal rights
  - Why data protection?
  - Introduction to the law of personality
  - Dilemma: Data value vs. data protection
  - Methods for anonymisation and pseudonymisation of data
  - GDPR
- Data protection in the context of companies

<table>
<tr><td></td><td colspan="2">

o Data exchange between companies
o Data sovereignty

Effects of digitalisation on the world of work and life

o Global networking or digital isolation
o Home office or full accessibility
o Participatory democracy or ‘fake news’
o Empty production or the next economic miracle

Data science and diversity

o Gender and racial profiling
o Diversity in STEM professions

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<tr><td>4</td><td colspan="2">Forms of teaching:
Lecture, seminar</td></tr>
<tr><td rowspan="3">5</td><td colspan="2">Participation requirements:</td></tr>
<tr><td>Formal:</td><td></td></tr>
<tr><td>Content:</td><td>Introduction to epistemology and science theory</td></tr>
<tr><td>6</td><td colspan="2">Forms of assessment:
Term paper or oral examination</td></tr>
<tr><td>7</td><td colspan="2">Prerequisite for the award of credit points:
Module examination pass</td></tr>
<tr><td>8</td><td colspan="2">Application of the module (in the following study programmes)
Research Master Data Science (M.Sc.)</td></tr>
<tr><td>9</td><td colspan="2">Importance of the grade for the final grade:
according to MRPO</td></tr>
<tr><td>10</td><td colspan="2">Module Officer:
N. N.</td></tr>
<tr><td>11</td><td colspan="2">Other information:
Literature will be announced at the beginning of the course</td></tr>
<tr><td>12</td><td colspan="2">Language:
German</td></tr>
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Colloquium					**MKO**
ID no.	Workload	Credits	Study semester	Frequency of the offer	Duration
2033	180	6	3rd or 4th sem.	each semester	

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	180	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences:	
	The colloquium complements the master thesis and is to be assessed independently. It serves to determine whether the candidate is capable of orally presenting and independently justifying the results of the master thesis, its subject-related foundations, its interdisciplinary connections and its extracurricular references, and of assessing its significance for practice.	
3	Contents:	
	• Content of the thesis according to the topic • Defence of the procedure in the preparation of the final thesis and the questions that arose in the context of the thesis	
4	Forms of teaching:	
	Oral examination for the master thesis	
5	Participation requirements:	
	Formal:	None
	Content:	Treatment of the master thesis
6	Forms of assessment:	
	Oral examination	
7	Prerequisite for the award of credit points:	
8	Application of the module (in the following study programmes)	
	Electrical Engineering (M.Eng.), Research Master Data Science (M.Sc.), Mechanical Engineering (M.Sc.) and Optimisation and Simulation (M.Sc.)	
9	Importance of the grade for the final grade:	
	according to MRPO	
10	Module Officer:	
	Prof. Dr.-Ing. Jens Haubrock	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

Artificial Intelligence					**AI**
ID no.	Workload	Credits	Study semester	Frequency of the offer	Duration
2054	180	6	2nd or 3rd sem.	annually in the winter semester	1 sem.

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	60	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	1	SCH	15	h	30	h
	Practical or seminar	15 students	1	SCH	15	h	30	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- The students have acquired the competence to transfer practical problems to the conceptual world of artificial intelligence and to solve them with the help of intelligent agents and the corresponding algorithms.
- The students have understood the mathematical basics of the procedures and algorithms and can adapt them independently.
- They know the advantages and disadvantages of different search and problem solving strategies and are able to independently select and apply suitable algorithms.
- They can develop software agents for complex stochastic, non-permanently observable (multi-agent) environments with Python.
- They are able to apply reinforcement learning to real-world problems and understand its basic concepts such as discounting, temporal-difference learning, policies and value functions.
- They have practised the scientific way of working (recognising, formulating and solving problems), improved their ability to abstract and train their communication skills through free speech in the group.

3 Contents:

- Intelligent agents
  - Types of agents
  - Properties of environments
- Problem solving
  - Uninformed and Informed Search
  - Search procedure (e.g. A* search)
  - Full and partial observability
  - Searches based on real states and belief states
  - Adversarial search
  - Multi-agent environments and game trees
- Knowledge
  - Knowledge representation for agents
  - Ontology and semantic networks
- Reasoning and planning
  - Inferences (Generalised Modus Ponens)
  - Planning graphs
  - Contingency plans

	• Uncertain knowledge and probabilistic reasoning
	  o Markov chains
	  o Bayesian networks
	• Learning (reinforcement learning)
	  o Reward functions
	  o Exploration vs. exploitation
	  o Temporal difference learning
	  o Experience replay
	• Practical exercises with Python (e.g. with Tensor Flow and SPADE)

4	Forms of teaching: Lecture, exercise, practical course
5	Participation requirements:
	Formal:
	Content: Programming with Python, basics of statistics, basics of logic Modules: 2051 Introduction to Data Science; 2052 Introduction to Applied Research;
6	Forms of assessment: Written examination, performance examination or oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Research Master Data Science (M.Sc.)
9	Importance of the grade for the final grade: according to MRPO
10	Module Officer: Prof. Dr.-Ing. Christian Schwede
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Master Thesis					**MA**
ID no.	Workload	Credits	Study semester	Frequency of the offer	Duration
2034	720	24	3rd or 4th sem.	each semester	20 weeks

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	720	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences:	
	With the master thesis, each candidate demonstrates that he/she is able to complete a practice-oriented task from his/her subject area within a specified period of time, both in its subject-specific details and in the interdisciplinary contexts, working independently and according to scientific methods.	
3	Contents:	
	The master thesis is an independent scientific work from the subject area of the respective study programme with a description and explanation of its solution. It can also be determined by an empirical investigation or by conceptual or design tasks or by an evaluation of existing sources. A combination of these forms is possible.	
4	Forms of teaching:	
	Written composition with faculty tutoring	
5	Participation requirements:	
	Formal:	None
	Content:	Coordinated topic from the student's special subject area
6	Forms of assessment:	
7	Prerequisite for the award of credit points:	
8	Application of the module (in the following study programmes)	
	Electrical Engineering (M.Eng.), Research Master Data Science (M.Sc.), Mechanical Engineering (M.Sc.) and Optimisation and Simulation (M.Sc.)	
9	Importance of the grade for the final grade:	
	according to MRPO	
10	Module Officer:	
	Prof. Dr.-Ing. Jens Haubrock	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

Project Phase I					**PP1**
ID no.	Workload	Credits	Study semester	Frequency of the offer	Duration
2055	210	7	1st sem.	each semester	1 sem.

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	0	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	2	SCH	30	h	180	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- The students are able to design and structure an application-oriented scientific work and to transfer it into a research exposé. They can draw up work plans, derive research questions and objectives and select research methods
- Students have gained initial experience of working in interdisciplinary research teams and are able to contribute their work in a goal-oriented manner
- Students can critically question results in the context of a scientific exchange and discuss them with others

3 Contents:

- Project work
  - First practical work in the research project
  - Preparation of a research exposé that defines the framework of the scientific work for the following three semesters and includes the initial situation, problem, objectives, work plan, research questions and research design. When preparing the exposé, the findings from the course "Familiarisation with applied research" are implemented, among other things
- Project colloquium
  - Professional/scientific exchange between all students and the project owners on problems and questions from the projects, discussion of interim results. The focus in the first phase is on learning through participatory observation.
- Research seminar

  In this cross-semester course, various scientific methods and tools are prepared and presented. The students learn from students in other semesters through participatory observation and discussion.

4 Forms of teaching:

Project, seminar and colloquium

5 Participation requirements:

Formal:	
Content:	

6 Forms of assessment:

Project work

7 Prerequisite for the award of credit points:

	Module examination pass
8	Application of the module (in the following study programmes) Research Master Data Science (M.Sc.)
9	Importance of the grade for the final grade: according to MRPO
10	Module Officer: Prof. Dr.-Ing. Christian Schwede
11	Other information: In independently researching sources of knowledge and learning to acquire competences on their own, students are supported by the Project Owner.
12	Language: German

Project Phase II					**PP2**
ID no.	Workload	Credits	Study semester	Frequency of the offer	Duration
2056	360	12	2nd sem.	each semester	1 sem.

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	0	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	2	SCH	30	h	330	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Students can develop and implement structured and team-oriented solutions for problems arising in the project context
- Students are able to independently produce a scientific publication. They will be able to conduct a comprehensive literature search and evaluate, relate and restructure the results. They can assess and select conferences according to the thematic focus and value.
- The students can critically question and discuss results in the context of a scientific exchange. They can prepare their own research results for presentation and present and defend them in front of an academic audience.
- Students can prepare and present scientifically researched knowledge in the form of a presentation.

3 Contents:

- Project work
  - Development of first practical results (e.g. data collection, preparation, clean-up, creation of user stories and mock-ups)
  - Composition of a written contribution on the state of research in the respective field of work. The paper should be written with a view to submission to a scientific conference and, ideally, should also be submitted there
- Project colloquium
  - Professional/scientific exchange between all students and the project owners on problems and questions from the projects, discussion of interim results. The focus in the second phase is on the presentation of the own project based on the research exposé.
- Research seminar

  In this cross-semester course, various scientific methods and tools are prepared and presented. Students independently research a method or tool from their field of research and present it in such a way that other students can understand the content presented.

4 Forms of teaching:

Project, seminar and colloquium

5 Participation requirements:

	Formal:	Modules: 2055 Project Phase I;
	Content:	Modules: 2051 Introduction to Data Science; 2052 Introduction to Applied Research;
6	Forms of assessment: Project work	
7	Prerequisite for the award of credit points: Module examination pass	
8	Application of the module (in the following study programmes) Research Master Data Science (M.Sc.)	
9	Importance of the grade for the final grade: according to MRPO	
10	Module Officer: Prof. Dr.-Ing. Christian Schwede	
11	Other information: In independently researching sources of knowledge and learning to acquire competences on their own, students are supported by the Project Owner.	
12	Language: German	

Project Phase III					**PP3**
ID no.	Workload	Credits	Study semester	Frequency of the offer	Duration
2057	360	12	3rd sem.	each semester	1 sem.

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	0	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	2	SCH	30	h	330	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Students are able to work independently, in a scientifically functional manner in the context of an application-oriented research project. They will be able to develop and acquire technical and methodological knowledge in the field of data science independently, also through exchange with other project staff and the partners. They have the ability to transfer and apply the theoretical knowledge of methods from the other courses of the master programme to new practical problems in order to assess the suitability of the application in a concrete case.
- Students are able to work in a multidisciplinary team, especially in an agile project environment. They receive regular feedback and suggestions for improvement from the project owner and can implement them directly.
- Students can develop and implement structured and team-oriented solutions for problems arising in the project context
- The students are able to independently prepare a scientific publication. They can process and structure their own quantitative results and relate them to the current state of research. They can select conferences according to the thematic focus and the valence
- The students can critically question and discuss results in the context of a scientific exchange. They can prepare their own research results for presentation and present and defend them in front of an academic audience.
- Students can prepare and present scientifically researched knowledge in the form of a presentation.

3 Contents:

- Project work
  - Development of practical, quantitative results through procedures and algorithms of Data Science
  - Write a written report on the results achieved. The paper should be written with a view to submission to a scientific conference and, in the best case, should also be submitted
- Project colloquium
  Professional/scientific exchange of all students and the project owners on problems and questions from the projects, discussions of interim results. The

	focus of the third phase is on the presentation of the intermediate results of the project and the defence in the subsequent discussion. • Research seminar o In this cross-semester course, various scientific methods and tools are prepared and presented. Students independently research a method or tool from their field of research and present it in such a way that other students can understand the content presented.	
4	Forms of teaching:	
	Project, seminar and colloquium	
5	Participation requirements:	
	Formal:	Modules: 2056 Project Phase II;
	Content:	Modules: 2051 Introduction to Data Science; 2052 Introduction to Applied Research;
6	Forms of assessment:	
	Project work	
7	Prerequisite for the award of credit points:	
	Module examination pass	
8	Application of the module (in the following study programmes)	
	Research Master Data Science (M.Sc.)	
9	Importance of the grade for the final grade:	
	according to MRPO	
10	Module Officer:	
	Prof. Dr.-Ing. Christian Schwede	
11	Other information:	
	In independently researching sources of knowledge and learning to acquire competences on their own, students are supported by the Project Owner.	
12	Language:	
	German	

Project-Specific Compulsory Elective Module					**PSWM**
ID no.	Workload	Credits	Study semester	Frequency of the offer	Duration
9029	150	5	1st, 2nd or 3rd sem.	each semester	1 sem.

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students		SCH		h		h
	Tuition in seminars	30 students		SCH		h		h
	Exercise	20 students		SCH		h		h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students		SCH		h		h

2	Learning outcomes/competences: Students have acquired methods and tool knowledge or specific expertise that they can transfer and apply to a practical situation in their project.
3	Contents: • In consultation with the project owner, students select 2–3 elective modules from the range of modules offered in the university's master degree programmes and, if applicable, other courses that fit the content of their project and close any gaps in their knowledge. • Study selected modules and pass exams • The students attend the selected courses, learn the contents and complete the required examinations.
4	Forms of teaching: According to the selected courses, e.g. lecture, seminar, seminar and practical course
5	Participation requirements: Formal: Content:
6	Forms of assessment:
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Research Master Data Science (M.Sc.)
9	Importance of the grade for the final grade: according to MRPO
10	Module Officer: Prof. Dr.-Ing. Christian Schwede
11	Other information: Literature according to the selected courses.
12	Language: German

Scientific Exchange					**WA**
ID no.	Workload	Credits	Study semester	Frequency of the offer	Duration
2059	60	2	2nd sem.	each semester	2 sem.

1	Course	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	0	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	60	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences: • The students can critically question and discuss results in the context of a scientific exchange. • The students can discuss with experts from the economy and know possible future job profiles. • The students are able to summarise acquired knowledge compactly and to communicate it to others through presentation.
3	Contents: Excursions (conferences, research institutions, trade fairs, companies, project meetings) once per semester in coordination with the project owner. The aim of the excursion is to exchange with the scientific community, to get to know the possible future working environment and to build up specific expertise. After the visit, the students summarise what they have learned in a short presentation and present this to the Project Owner.
4	Forms of teaching: Internship
5	Participation requirements: Formal: Content:
6	Forms of assessment:
7	Prerequisite for the award of credit points: Course assessment
8	Application of the module (in the following study programmes) Research Master Data Science (M.Sc.)
9	Importance of the grade for the final grade: according to MRPO
10	Module Officer: Prof. Dr.-Ing. Christian Schwede
11	Other information:
12	Language: German