Universität Münster | Professional School

Course & Module Guide

Data Science
Master of Science &
University Certificate

FB04 School of Business and Economics | UNIVERSITY OF MÜNSTER

Status: April 2025

Universität Münster | Professional School

TABLE OF CONTENTS

Curriculum **Fehler! Textmarke nicht definiert.**

Module 1 – Introduction to Data Science and Programming Systems 3
10 ECTS; 7 Lecture Days
Written exam (90 Minutes), Case Study

Module 2 – Data Management 4
7 ECTS; 5 Lecture Days
Written exam (90 Minutes), Case Study

Module 3 – Data Analytics 5
7 ECTS; 5 Lecture Days
Written exam (90 Minutes), Case Study

Module 4 – IT-Management, IT-Security, Ethics, Legal Aspects 6
7 ECTS; 5 Lecture Days
Group Presentation, Term Paper

Module 5 – Self-Management & Leadership **Fehler! Textmarke nicht definiert.**
7 ECTS; 5 Lecture Days
Report, Group Presentation, Essay

Module 6 – Practical Phase & Project Work 8
8 ECTS
Project Work, Presentation

Module 7 – Social Media & Communication 9
7 ECTS; 5 Lecture Days
Written exam (90 Minutes), Case Study

Module 8 – Applications 10
7 ECTS; 5 Lecture Days
Written exam (90 Minutes), Case Study

Module 9 – Master Thesis 10
30 ECTS
Master Thesis (max. 50 pages, 7 months)

Curriculum

	CP	1.	2.	3.	4.
Modules					
M1 Introduction to Data Science & Programming Systems	10				
M2 Data Management	7				
M3 Data Analytics	7				
M4 IT-Management, IT-Security, Ethics, Legal Aspects	7				
M5 Self-Management & Leadership	7				
M6 Practical Phase & Project Work	8				
M7 Social Media & Communication	7				
M8 Applications	7				
M9 Master Thesis	30				

CP = Credit points according to the European Credit Transfer System

Module 1 – Introduction to Data Science and Programming Systems

ECTS: 10
Lecture Days: 7
Examination: Written exam (90 minutes)
Coursework: Case study (4 weeks, approx. 7 pages)

Objectives

This module introduces students to the foundational concepts and practices of data science with an emphasis on programming skills essential for data analysis, focusing on Python and R. It aims to provide a comprehensive overview of the field's scope and its applications in various sectors. By the end of the module, students are expected to understand the interdisciplinary nature of data science, which combines elements from computer science, mathematics, and statistics, and how these elements are applied to solve real-world problems.

Acquired Competencies

Upon completion of this module, students will have developed essential skills in Python and R programming, enabling them to perform basic and intermediate tasks involved in data analysis. The curriculum is structured to enhance students' analytical abilities to interpret and draw conclusions from data sets effectively. The module also prepares students to work both independently and as part of a team, equipping them with the necessary problem-solving skills required in the professional world of data science. These competencies form the basis for more advanced studies in data science and provide a practical toolkit for future academic and career pursuits.

Module 2 – Data Management

ECTS:	7
Lecture Days:	5
Examination:	Written exam (90 minutes)
Coursework:	Case study (4 weeks, approx. 7 pages)

Objectives

This module introduces fundamental concepts and methods for managing large volumes of data within the context of data science. It focuses on the use of traditional relational database systems (SQL) as well as more recent developments such as NoSQL technologies and distributed file systems like HDFS. The aim is to familiarise students with the strengths, limitations, and areas of application of these systems, and to provide a basis for selecting appropriate technologies for specific data-driven tasks. In addition to system architectures and data management strategies, the module also covers basic algorithms used in data mining and selected tools from the Python ecosystem. A particular emphasis is placed on practical implementation using Python, including the development of data science workflows and the realisation of example applications such as data exploration, web crawling, sentiment analysis, recommender systems, and image classification. The module is part of the foundational phase of the program and builds essential skills that are required in subsequent modules.

Acquired Competencies

Upon successful completion of the module, students are able to assess which category of data management systems is suitable for a given data science task and to justify this choice. They are familiar with the technical principles of both SQL and NoSQL systems and understand how to access and use these systems programmatically. In addition, students have an understanding of core algorithms in data mining and how these are applied in typical data science use cases. They are able to apply relevant tools and methods independently, develop simple data science workflows, and adapt them to different application contexts. Furthermore, the module supports the development of problem-solving skills and promotes the ability to work in teams and present results in a structured and comprehensible manner.

Module 3 – Data Analytics

ECTS:	7
Lecture Days:	5
Examination:	Written exam (90 minutes)
Coursework:	Case study (4 weeks, approx. 7 pages)

Objectives

This module provides an introduction to key analytical methods in the field of data science and serves as one of the core building blocks of the program. It is designed to familiarise students with fundamental concepts and procedures for exploring, preparing, and analysing data in a structured and methodologically sound manner. A central focus is placed on the application of statistical techniques using the software environment R, which is integrated throughout the module as the primary tool for implementation and analysis.

Students learn how to apply both supervised and unsupervised learning methods. Supervised learning includes approaches such as classification and regression, while unsupervised learning covers techniques like cluster analysis and dimensionality reduction. In addition, the module introduces relevant steps in data preprocessing and model validation to ensure that results are both interpretable and robust. These components are essential for conducting reliable analyses and drawing well-founded conclusions from data.

By combining methodological instruction with applied programming exercises, the module helps students develop the analytical thinking and technical skills required for working with data in a professional context. The content covered also lays the foundation for further work in later modules, where advanced modelling and decision-support tasks are addressed.

Acquired Competencies

After completing this module, students are able to carry out structured data analysis using established statistical and machine learning methods. They can clean and transform data, select suitable analytical approaches for a given problem, and interpret results in a targeted and meaningful way. They are familiar with the functionalities of the R programming environment and can independently implement core analytical procedures. This enables them to support and manage data-driven decision processes in professional and interdisciplinary settings. In addition to technical expertise, the module strengthens students' skills in communication, collaboration, and teamwork, particularly through group-based tasks and joint interpretation of analytical findings. These competencies contribute to their ability to work effectively across disciplinary boundaries and to present analytical insights in a clear and practice-oriented manner.

Module 4 – IT-Management, IT-Security, Ethics, Legal Aspects

ECTS:	7
Lecture Days:	5
Partial Examinations:	Group presentation (60 minutes), term paper (approx. 5000 words, completion time: 8 weeks)

Objectives

This module introduces students to the key principles and challenges of managing information technology in environments characterised by growing data volumes and increasingly complex data structures. It focuses on the organisational, technical and regulatory aspects of IT management and addresses the implications of data-driven transformation for corporate governance and operational practice. Students gain insight into the design and management of IT systems with regard to data architecture, security, and the integration of internal and external data sources. Central topics include IT governance models, maturity frameworks, and the role of soft and hard factors in successful implementation.

The module also highlights the value of data as a strategic resource and discusses how data-driven business models can create new opportunities and risks for organisations. In this context, issues related to data security, privacy, and responsible data usage are critically examined. Students are introduced to regulatory frameworks and are encouraged to reflect on ethical principles and practices relevant to the use of sensitive and valuable data. Particular attention is given to authentication, authorisation and identity management, as well as to technical and behavioural aspects of information security. The aim of the module is to enable students to assess and design IT management strategies that align with legal requirements, organisational goals and ethical standards.

Acquired Competencies

Upon successful completion of the module, students are able to describe and evaluate established IT management and governance approaches and apply them to practical organisational contexts. They understand digital transformation processes and can assess both the technical and organisational requirements for managing data effectively. Students are familiar with the concepts of open, linked and closed data, and are able to analyse data exchange processes in inter-organisational value networks.

They can identify relevant regulatory conditions and assess their implications for data governance and data protection. Furthermore, students are able to reflect on ethical principles in the context of data-rich environments and to recognise potential conflicts between economic goals, legal boundaries and ethical responsibility. They develop an understanding of the value of data as an economic asset, the associated security risks, and appropriate strategies to mitigate those risks. In addition to technical and analytical skills, students enhance their ability to communicate, collaborate, and present results effectively—both as part of a team and in individual assignments.

Module 5 – Self-Management & Leadership

ECTS:	7
Lecture Days:	5
Partial Examinations:	Report (completion time: 2 weeks), group presentation (60 minutes), essay (approx. 5000 words, completion time: 8 weeks)

Objectives

This module focuses on the integration of data science into managerial decision-making processes and addresses the organisational and behavioural challenges that arise in this context. While the technical potential of data science is widely recognised, its practical implementation in organisations often encounters obstacles such as limited internal expertise, lack of trust in data-driven insights, or insufficient alignment between data scientists and decision makers. The module therefore explores the organisational environment in which data science is embedded and highlights strategies to support its effective use in management.

Key topics include the influence of data science on decision-making structures, the role of data scientists in interdisciplinary teams, and leadership behaviour in innovation-driven environments. Students examine how data-driven insights can be translated into action and how communication between technical and managerial staff can be shaped to ensure mutual understanding and cooperation. The module also includes elements of negotiation theory and practice, focusing on the interaction between data experts and decision-makers. In addition, students learn how to present complex analytical results in a structured and audience-appropriate manner. The aim is to strengthen participants' ability to act as competent interfaces between data science and organisational leadership.

Acquired Competencies

Upon completion of this module, students are able to analyse and assess the role of data science within organisational decision-making processes. They understand the prerequisites for successfully applying data-based methods in management contexts and are familiar with different types of decision-making and their respective information requirements. Students are able to design suitable project structures for data science initiatives and to evaluate the organisational impact of data-driven innovation.

They also gain insight into leadership dynamics and can reflect on their own leadership behaviour in relation to data science projects. They are able to distinguish between different innovation processes and team structures, and can identify typical success factors and challenges in innovation teams. With regard to negotiation, students are equipped to prepare and conduct structured negotiations related to data science projects, including the identification of negotiation styles and conflict dynamics.

Finally, students develop their ability to communicate complex results clearly and effectively. They learn to structure presentations appropriately, to interact with an audience during a presentation, and to give and receive constructive feedback. These competencies enable them to take on key communicative and coordinating roles in interdisciplinary teams and to actively contribute to the implementation of data-driven strategies in their own organisations.

Module 6 – Practical Phase & Project Work

ECTS:	8
Lecture Days:	-
Partial Examinations:	Project work (approx. 3000 words, completion time: 8 weeks), presentation (15 minutes)

Objectives

This module focuses on the structured analysis of complex and practice-oriented cases in the context of data science. It aims to enable students to work systematically with unstructured, real-life problems by identifying the essential elements of a case, distinguishing them from secondary aspects, and arriving at a well-founded and clearly formulated problem definition. The development of this skill is a crucial step in applying data science methods effectively in real-world decision-making processes.

Building on the problem definition, students learn to generate creative solution approaches and evaluate them using clearly defined criteria, such as the SMART framework. The focus is on assessing the feasibility, relevance and clarity of the proposed solutions and on selecting the most promising option based on analytical reasoning. In addition, students prepare an outline for an implementation strategy that shows how the selected solution can be translated into practical steps within an organisational or project-related context.

The results of the analysis, solution design and implementation plan are documented in a structured written report. This report is an integral part of the module and demonstrates the student's ability to communicate complex reasoning in a clear, concise and logically coherent manner. The module combines elements of case-based learning, analytical thinking, and practical application, and supports the development of problem-solving and communication skills that are essential in interdisciplinary, data-driven professional environments.

Acquired Competencies

After completing this module, students are able to critically analyse complex case situations in the context of data science and to identify the core of the problem. They can derive and compare creative solution approaches based on clearly defined evaluation criteria and select the most appropriate option. Students are able to design an implementation plan that translates analytical insight into practical action and to document all steps of their reasoning in a structured and coherent written report.

In addition, students improve their communication skills by presenting interim results and engaging with peer feedback in a constructive manner. They are capable of reflecting on their own and others' contributions and integrating this feedback into a revised final product. Overall, students gain competencies in independent problem-solving, structured planning, clear communication, and critical documentation—skills that are central to data-driven project work in interdisciplinary and practice-oriented environments.

Module 7 – Social Media & Communication

ECTS:	7
Lecture Days:	5
Examination:	Written exam (90 minutes)
Coursework:	Case study (4 weeks, approx. 7 pages)

Objectives

This module introduces students to the empirical study of online communication from a social science perspective and provides foundational knowledge in the disciplines of communication studies and media psychology. The aim is to enable students to understand how digital communication can be systematically examined using established empirical research methods, and how relevant theoretical approaches inform the design and interpretation of such studies. Particular emphasis is placed on understanding the specific characteristics of communication in social media environments and the methodological implications that arise from these conditions.

The module begins with an introduction to basic principles of empirical research, including research logic, study design, and typical data collection strategies in the social sciences. Building on this, students are introduced to current research areas and findings related to online communication, with examples from both classic and recent studies. The second part of the module focuses on computational methods in communication research. Here, students learn to apply network analysis and (semi-)automated content analysis, using specialised software tools for practical exercises. These methods are presented in terms of their conceptual foundations, application contexts, and analytical potential.

The module is designed to bridge theoretical and methodological knowledge with practical application. By working with real-world data and case examples, students develop a deeper understanding of how digital communication phenomena can be analysed and interpreted in a structured and scientifically sound manner. This foundation also supports their ability to critically engage with research findings and to design their own small-scale projects in later stages of the program.

Acquired Competencies

Upon successful completion of the module, students are able to plan, conduct and evaluate research projects in the area of social media and online communication based on empirical principles. They understand the theoretical foundations and typical methodological approaches of communication research and media psychology, and are able to apply these perspectives in evaluating digital media phenomena. They are familiar with the basics of network analysis and (semi-)automated content analysis and are able to assess the strengths and limitations of these methods.

Students are also capable of applying relevant software tools to implement these methods in concrete analytical contexts. In addition to methodological knowledge, the module strengthens the students'

ability to work independently as well as collaboratively in small teams. They are able to present their results using appropriate presentation techniques and to reflect critically on both their own findings and the analytical approaches used.

Module 8 – Applications

ECTS:	7
Lecture Days:	5
Examination:	Case study (4 weeks, approx. 7 pages)

Objectives

This module builds on the foundational modules of the program and introduces students to practical application areas of data science. It focuses on how analytical methods can be transferred into diverse decision-making contexts, with an emphasis on deriving business and customer value from data-driven strategies. Students are familiarised with selected domains—such as artificial intelligence, marketing, customer relationship management, supply chain management, logistics, business development, and budget allocation—and discuss typical data-related challenges and goals in these fields.

The module aims to promote the ability to match appropriate analytical approaches to domain-specific problems, to work with relevant tools and software environments, and to critically reflect on the implications of data-based decision-making. This includes questioning underlying assumptions, assessing the potential for automation, and considering the broader organisational and societal consequences of implementing such strategies. Additionally, students are encouraged to approach problem-solving in an interdisciplinary and collaborative manner and to engage with practical examples that illustrate the relevance and complexity of applied data science.

Acquired Competencies

Upon successful completion of this module, students are able to design and manage data science applications in real-world business and organisational contexts. They can identify relevant objectives, define suitable analytical strategies, and implement them using established software tools. In doing so, they are able to tailor their approach to the specific requirements of a given application domain.

Students are also equipped to evaluate the effectiveness and limitations of data-driven solutions, including their feasibility, added value, and potential risks. They demonstrate the ability to communicate findings clearly to both technical and non-technical audiences, and to collaborate effectively in interdisciplinary teams. Furthermore, they have strengthened their capacity to apply data science methods in a goal-oriented, context-sensitive, and responsible manner—linking technical expertise with strategic thinking and practical decision-making.

Module 9 – Master's Thesis

ECTS:	30
Lecture Days:	-
Examination:	Master's Thesis (max. 50 text pages, 7 months processing time)

Objectives

The Master's thesis represents the final component of the program and builds on the knowledge and skills acquired throughout the preceding modules. It is designed to enable students to independently address a complex, application-oriented or research-based problem in the field of data science using scientific methods. The focus lies on the structured and in-depth development of a written thesis that reflects both academic rigour and practical relevance.

The topic of the thesis should relate to current data-driven challenges and may arise either from the subject areas covered during the program or from the student's professional environment. The thesis aims to deepen subject-specific knowledge in a selected area of data science and to apply theoretical and methodological insights to a clearly defined problem. By integrating practical experience with academic learning, the thesis is expected to contribute to solving real-world challenges and to generate value in an academic or professional context.

Acquired Competencies

Upon successful completion of the Master's thesis, students are able to identify and define a relevant scientific question related to a concrete and complex problem in the field of data science. They can formulate hypotheses and apply appropriate scientific methods and subject-specific knowledge to analyse, evaluate, or develop a solution to the problem at hand. Based on their findings, they are able to derive meaningful implications for theory and practice.

Students are also capable of critically analysing relevant academic and professional literature and of assessing its significance for their own research. They can present and evaluate their results in a clear, structured, and academically sound manner, while adhering to established scientific standards. In addition, students are able to recognise and reflect on key developments in the field of data science and to position their work within the broader disciplinary context.