

**Master of Science (M.Sc.)**  
**“Mannheim Master in Data Science”**

University of Mannheim

**– Module catalog –**

for students starting before spring 2020

Academic Year  
HWS 2021/ FSS 2022

# Content

Foreword .....	3
A. Overview and Study plan.....	4
B. Fundamentals .....	6
1. Overview.....	6
2. Detailed descriptions.....	7
C. Data Management.....	11
1. Overview.....	11
D. Data Analytics Methods .....	13
1. Overview.....	13
E. Projects.....	16
1. Overview.....	16
2. Detailed descriptions.....	17
F. Seminar.....	19
1. Overview.....	19
G. Master Thesis .....	21
Abbreviations .....	23

## Foreword

This document describes the courses that will be offered in the academic year 2021/2022 for students studying M. Sc. Mannheim Master in Data Science before spring 2020. You can find the Examination Regulations on the website of the Student Services (Studienbüros):

<https://www.uni-mannheim.de/studium/im-studium/pruefungen/pruefungsordnungen/>

It is possible that additional courses will be made available during the course of the academic year. These will be published in an appendix available on the following web page:

<https://www.wim.uni-mannheim.de/studium/studienorganisation/mannheim-master-in-data-science/#c112237>

## A. Overview and Study plan

		ECTS
<b>Fundamentals</b>	"Fundamentals" courses with at most 14 ECTS	0 – 14
<b>Data Management</b>	Minimum of four "Data Management" courses	24 – 36
<b>Data Analytics Methods</b>	Minimum of four "Data Analytics Methods" courses with at least 30 ECTS	30 – 54
<b>Project</b>	Either a "Team Project" course or an "Individual Project" course	8 – 12
<b>Seminar</b>	One Seminar course	4
<b>Master Thesis</b>	Six-months-long written academic assignment	30
<b>Total</b>		120

### General constraints:

1. Courses with 0-14 ECTS can be taken (0 to 14 ECTS)
2. 4 to 6 Data Management courses must be taken (24 to 36 ECTS)
3. Data Analytics Methods courses worth a combined 30 to 54 ECTS must be taken
4. You must either take a Team Project course or an Individual Project course
5. You must take a Seminar
6. A total of 78 ECTS must be taken within the Fundamentals, Data Management and Data Analytics Methods courses combined when you take an Individual Project. If you take a Team Project, that total is 74 ECTS. In any case, your combined total of all courses (including the Seminar and the Master Thesis) must be at least 120 ECTS.

### Abbreviations:

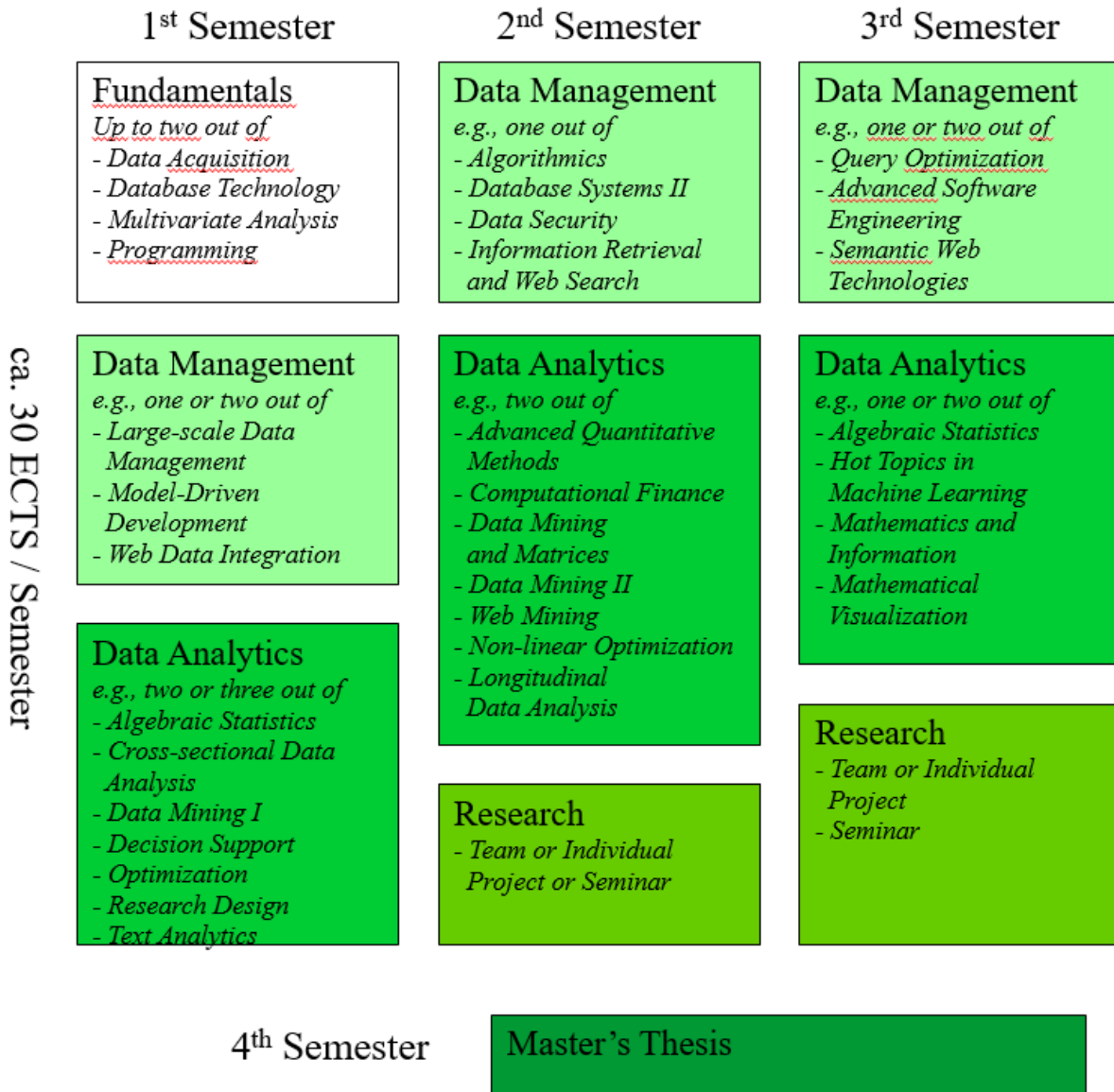
HWS (Herbst-/Wintersemester): Course is offered in the respective Fall semester

FSS (Frühjahrs-/Sommersemester): Course is offered in the respective Spring semester

FSS/HWS: course is offered both in Spring semester and Fall semester

## Example study plan

Please note: this is just an example - your actual study plan may vary depending on the semester in which you start, your preferences, etc.



## B. Fundamentals

### 1. Overview

Module no.	Name of Module	Offered	Language	ECTS	Page
CS 450	Programming Course	HWS	E	6	7
CS 460	Database Technology	FSS	E	6	9
	Multivariate Analyses	HWS	E	6	PS*
	Tutorial Multivariate Analyses	HWS	E	2	PS*
	Empirische Methoden der Politikwissenschaft	HWS	G	6	PW*

\* For a detailed description, please see the module catalogs of the respective following degree programs:

- PW: B.A. Politikwissenschaft, <https://www.sowi.uni-mannheim.de/en/academics/students/political-science/ba-in-political-science/> (only available in German)
- PS: M.A. Political Science, <https://www.sowi.uni-mannheim.de/en/academics/students/political-science/ma-in-political-science/>

## 2. Detailed descriptions

CS 450	Programming Course
Form of module	Lecture and accompanying practical sessions
Type of module	Computer Science Fundamental
Level	Master
ECTS	6
Workload	Hours per semester present: 84h (6 SWS)
	Self-study: 84h per semester <ul style="list-style-type: none"> <li>• 28h: pre and post lecture studying and revision</li> <li>• 56h: preparation and presentation of small software projects</li> </ul>
Prerequisites	-
Aim of module	<p>The course deals with the basic concepts of (object-oriented) programming using Java. In addition, some advanced topics are covered such as writing GUI applications and dealing with external data (XML, databases):</p> <ul style="list-style-type: none"> <li>• primitive data types, variables, operators, expressions</li> <li>• control flow statements</li> <li>• complex data types (arrays), references</li> <li>• classes</li> <li>• OO concepts (information hiding, inheritance, polymorphism, abstract classes, interfaces)</li> <li>• Java API</li> <li>• Exceptions</li> <li>• IO using streams</li> <li>• Java Collections</li> <li>• GUI programming</li> <li>• processing of XML documents</li> <li>• database access (SQL, JDOM)</li> </ul>
Learning outcomes and qualification goals	Expertise: After taking the course, students will be familiar with the basic concepts of (object-oriented) programming in Java.
	Methodological competence: Students will acquire the skills to develop high-quality

	console and GUI Java applications of moderate size.
	Personal competence: <ul style="list-style-type: none"> <li>• ability to work independently</li> <li>• ability to work in a team</li> </ul>
Media	Beamer, PC (Linux), printed lecture slides
Literature	<ul style="list-style-type: none"> <li>• Learning Java (P. Niemeyer, P. Leuck), O'Reilly UK Ltd.</li> <li>• Core Java Volume I—Fundamentals (C.S. Horstmann), Prentice Hall</li> </ul>
Methods	lectures, tutorials, independent study
Form of assessment	written examination (Programmiertestat)
Admission requirements for assessment	successful completion and presentation of at least 75% of the weekly assessments
Duration of assessment	180 minutes
Language	English
Offering	Fall semester
Lecturer	Dr. Ursula Rost
Person in charge	Dr. Ursula Rost
Duration of module	1 semester
Further modules	-
Range of application	MMDS
Semester	1 <sup>st</sup> /2 <sup>nd</sup> semester



<b>CS 460</b>	<b>Database Technology</b>
Form of module	Lecture with Exercise
Type of module	MMDS Fundamental
Level	Master
ECTS	6
Workload	Hours per semester present: 56 h (4 SWS)
	Self-study per semester: 98 h <ul style="list-style-type: none"> <li>• 70 h: pre and post lecture studying and revision</li> <li>• 28 h: examination preparation</li> </ul>
Prerequisites	-
Aim of module	The course provides an introduction to relational database systems. The course will cover the following topics: <ul style="list-style-type: none"> <li>• Principles of data storage</li> <li>• Database query languages (SQL)</li> <li>• Relational modeling</li> <li>• Keys and normal forms</li> <li>• Hash and index structures</li> <li>• Transactions and concurrency</li> </ul>
Learning outcomes and qualification goals	Expertise: Basic understanding of relational data modeling and database design, as well as the functionality of relational database management systems, query handling, and transaction management. (BK4, BK5, BK6, BK7)
	Methodological competence: Abstraction, modeling, complexity consideration. (BF1, BF2)
	Personal competence: Understanding the role of data management in enterprises. (BK01, BK02)
Media	Electronic slides and exercise sheets
Literature	Avi Silberschatz, Henry F. Korth, S. Sudarshan: Database System Concepts
Methods	The course consists of a lecture together and exercises. The

	exercises encompass both theoretical exercises as well as practical assignments, which are conducted with a free modern database management system and allow the students to deepen their theoretical understanding of the course contents, as well as to gather hands-on experience with database management systems.
Form of assessment	Written examination
Admission requirements for assessment	-
Duration of assessment	60 minutes
Language	English
Offering	Spring semester
Lecturer	Prof. Dr. Heiko Paulheim
Person in charge	Prof. Dr. Heiko Paulheim
Duration of module	1 semester
Further modules	Database Systems II, Transaktionssysteme, Anfrageoptimierung, Large Scale Data Management
Range of application	MMDS
Semester	1 <sup>st</sup> /2 <sup>nd</sup> semester

## C. Data Management

### 1. Overview

Module no.	Name of Module	Offered	Language	ECTS	Page
AC 651	Additional Course – Data Management	HWS/FSS	E	AC 651*	12
CS 500	Advanced Software Engineering	HWS	E	6	BI*
CS 530	Database Systems II	FSS	E	6	BI*
CS 550	Algorithmics	FSS/HWS	E	6	BI*
CS 560	Large Scale Data Management	HWS	E	6	BI*
CS 600	Model-driven Development	HWS	E	6	BI*
CS 652	Data Security and Privacy	FSS	E	6	BI*
IE 630	Query Optimization	FSS	E	6	BI*
IE 650	Semantic Web Technologies	HWS	E	6	BI*
IE 663	Information Retrieval and Web Search	FSS	E	3	BI*
IE 670	Web Data Integration	HWS	E	3	BI*
IE 691	Information Retrieval Project	FSS	E	3	BI*
IE 683	Web Data Integration Project	HWS	E	3	BI*

\* For a detailed description, please see the module catalog of the respective following degree programs:

- BI: M.Sc. Business Informatics, <https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-business-informatics/>
- MMDS: Mannheim Master in Data Science (PO 2020) <https://www.wim.uni-mannheim.de/studium/studienorganisation/mannheim-master-in-data-science>

<b>AC 651</b>	<b>Additional Course – Data Management</b>
Form of module	Depends on course
Level	Master
ECTS	Max. 18
Workload	Depends on course
Prerequisites	Depends on course
Aim of module	The course falls into the data management area of the MMDS and covers topics related to data management, but is not directly equivalent to any course in the MMDS module catalogue. The course level equals a regular course in MMDS study program. The module can be taken either at the University of Mannheim or at any other university in Germany or abroad.
Learning outcomes and qualification goals	Depends on course
Media / Literature / Methods / Form and duration of assessment	Depends on course
Language	English preferred, but any other language possible if Mannheim faculty member is able to identify content and level
Offering	Spring semester / Fall semester
Lecturer	Lecturer at the host university
Person in charge	Lecturer at the host university
Duration of module	1 Semester
Further modules	-
Range of application	MMDS
Semester	2 <sup>nd</sup> /3 <sup>rd</sup> /4 <sup>th</sup> semester

## D. Data Analytics Methods

### 1. Overview

Module no.	Name of Module	Offered	Language	ECTS	Page
AC 652	Additional Course – Data Analytics Methods	HWS/FSS	E	AC 652*	15
IE 500	Data Mining I	FSS/HWS	E	6	BI*
IE 560	Decision Support	HWS	E	6	BI*
IE 661	Text Analytics	HWS	E	6	BI*
IE 671	Web Mining	FSS	E	3	BI*
IE 672	Data Mining II	FSS	E	6	BI*
IE 675	Machine Learning	HWS	E	6	BI*
IE 684	Web Mining Project	FSS	E	3	BI*
IE 689	Relational Learning	HWS	E	6	BI*
MAB 504	Mathematics and Information	irregular	G	8	MBE*
MAB 508	Algebraische Statistik	irregular	G/E	8	MBE*
MAC 404	Optimierung	HWS	G	8	WM*
MAC 502	Computational Finance	FSS	G/E	6	MBE*
MAC 505	Mathematische Visualisierung	irregular	G/E	8	MBE*
MAC 507	Nichtlineare Optimierung	FSS	G/E	6	MBE*
	Lecture Cross Sectional Data Analysis	HWS	E	6	Soc*
	Tutorial Cross Sectional Data Analysis	HWS	E	3	Soc*
	Lecture Advanced Quantitative Methods	FSS	E	6	PS*
	Tutorial Advanced Quantitative Methods	FSS	E	2	PS*
	Lecture Longitudinal Data Analysis	FSS	E	6	Soc*
	Tutorial Longitudinal Data Analysis	FSS	E	3	Soc*
	Lecture Research Design	HWS	E	6	Soc*
	Tutorial Research Design	HWS	E	3	Soc*

\* For a detailed description, please see the module catalogs of the respective following degree programs:

- BI: M.Sc. Business Informatics, <https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-business-informatics/>
- WM: B.Sc. Wirtschaftsmathematik, <https://www.wim.uni-mannheim.de/studium/studienorganisation/b-sc-wirtschaftsmathematik/> (only available in German)
- MBE: M.Sc. Mathematics in Business and Economics, <https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-wirtschaftsmathematik/> (only available in German)
- PS: M.A. Political Science, <https://www.sowi.uni-mannheim.de/en/academics/students/political-science/ma-in-political-science/>
- Soc: M.A. Sociology, <https://www.sowi.uni-mannheim.de/en/academics/students/sociology/ma-in-sociology/>
- MMM: Mannheim Master in Management, <https://www.bwl.uni-mannheim.de/studium/master/mmm/#c176637>

<b>AC 652</b>	<b>Additional Course – Data Analytics Methods</b>
Form of module	Depends on course
Level	Master
ECTS	Max. 18
Workload	Depends on course
Prerequisites	Depends on course
Aim of module	The course falls into the data analytics methods area of the MMDS and covers topics related to data analytics methods, but is not directly equivalent to any course in the MMDS module catalogue. The course level equals a regular course in MMDS study program. The module can be taken either at the University of Mannheim or at any other university in Germany or abroad.
Learning outcomes and qualification goals	Depends on course
Media / Literature / Methods / Form and duration of assessment	Depends on course
Language	English preferred, but any other language possible if Mannheim faculty member is able to identify content and level
Offering	Spring semester / Fall semester
Lecturer	Lecturer at the host university
Person in charge	Lecturer at the host university
Duration of module	1 Semester
Further modules	-
Range of application	MMDS
Semester	2 <sup>nd</sup> /3 <sup>rd</sup> /4 <sup>th</sup> semester

## E. Projects

### 1. Overview

Module no.	Name of Module	Offered	Language	ECTS	Page
TP 500	Team Project	FSS/HWS	G/E	12	BI*
IP 500	Individual Project	irregular	G/E	8	17

\* For a detailed description, please see the module catalogs of the respective following degree programs:

- BI: M.Sc. Business Informatics, <https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-business-informatics/>



## 2. Detailed descriptions

IP 500	Individual Project
Form of module	Project
Type of module	Individual Project
Level	Master
ECTS	8
Workload	Self study: 240 h per semester
Prerequisites	Depends on topic
Aim of Modules	The student solves a practical problem individually. The student has to analyse and refine the problem and come up with a project plan for developing a concrete solution. Concrete topics for projects are defined by the supervisors and offered to the students who can apply for different topics. Problem area and techniques involved depend on the expertise of the offering chair.
Learning outcomes and qualifications goals	<p>Depending on the actual topic of the project, participants will acquire ☐</p> <ul style="list-style-type: none"> <li>• in-depth knowledge in a certain application of data science</li> <li>• knowledge about methods and technologies typically applied in the application area ☐</li> <li>• knowledge about practical problems and challenges when applying a certain technique in a given application area</li> </ul> <p>Participants will learn to ☐</p> <ul style="list-style-type: none"> <li>• refine a given problem statement by analysing requirements and the state of the art using techniques like literature research and expert interviews. ☐</li> <li>• define a workplan including tasks, milestones, deliverables and resources and continually assess and modify the plan according to the actual progress of the work.</li> </ul>
Media	Depends on project
Literature	Depends on topic
Methods	Self study, presentations

Form of Assessment	Final report and presentation
Admission requirements for assessment	-
Duration of Assessment	15 minutes (presentation)
Language	English/German
Offering	Spring semester/Fall semester
Lecturer	Professors of the Institute of School of Business Informatics and Mathematics or of the School of Social Sciences
Person in Charge	A professor of the Institute of School of Business Informatics and Mathematics of the School of Social Sciences
Duration of module	1 semester
Further modules	-
Range of Applications	MMDS
Semester	1 <sup>st</sup> /2 <sup>nd</sup> /3 <sup>rd</sup> semester

## F. Seminar

### 1. Overview

Module no.	Name of Module	Offered	Language	ECTS	Page
AC 653	Additional Course – Projects and Seminars	HWS/FSS	E	AC 653*	20
CS 701	Selected Topics in Algorithmics and Cryptography	FSS	E	4	BI*
CS 704	Master Seminar Artificial Intelligence	HWS/FSS	E	4	BI*
CS 705	Datenbankseminar	HWS/FSS	G/E	4	BI*
CS 707	Seminar Data and Web Science	HWS/FSS	E	4	BI*
CS 708	Seminar Software Engineering	HWS/FSS	E	4	BI*
CS 709	Seminar Text Analytics	HWS/FSS	G/E	4	BI*
CS 710	Selected Topics in Data Science	FSS	G/E	4	BI*
CS 715	Large-Scale Data Integration Seminar (Prof. Bizer)	FSS	E	4	BI*
CS 716	IT-Security	HWS	E	4	BI*
CS 718	AI and Data Science in Fiction and Society	HWS	E	4	BI*
CS 719	Seminar on Process Analysis	HWS/FSS	E	4	BI*
IE 704	Seminar AI Systems Engineering	HWS/FSS	E	4	BI*

\* For a detailed description, please see the module catalogs of the respective following degree programs:

- BI: M.Sc. Business Informatics, <https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-business-informatics/>

<b>AC 653</b>	<b>Additional Course – Projects and Seminars</b>
Form of module	Depends
Level	Master
ECTS	Max. 18
Workload	Depends
Prerequisites	Depends
Aim of module	The course equals a seminar in the MMDS study program. The module can be taken either at the University of Mannheim or at any other university in Germany or abroad.
Learning outcomes and qualification goals	Depends on course
Media / Literature / Methods / Form and duration of assessment	Depends
Language	English preferred, but any other language possible if Mannheim faculty member is able to identify content and level
Offering	Spring semester / Fall semester
Lecturer	Lecturer at the host university
Person in charge	Lecturer at the host university
Duration of module	1 Semester
Further modules	-
Range of application	MMDS
Semester	2 <sup>nd</sup> /3 <sup>rd</sup> /4 <sup>th</sup> semester

## G. Master Thesis

	Master Thesis
Form of module	Master Thesis
Type of module	Thesis
Level	Master
ECTS	30
Workload	Self study: 840 h per semester
Prerequisites	-
Aim of Modules	Develop a deep understanding of an advanced topic of data science
Learning outcomes and qualifications goals	Expertise: The student has a deep understanding of an advanced topic. (MK1)
	Methodological competence: The student is familiar with methods for analysing and independently solving advanced, complex problems. (MK1, MK2, MK3)
	Personal competence: The student has the capability to understand, analyse and independently find solutions to advanced, complex problems. The student has the capability to assess and understand the state-of-the-art in business informatics and adapt the latest technologies and methods to solve real world problems. The student is able to present a complex topic in written and oral form in a clear and understandable way. (MF1, MF2, MF3, MF4, MKO2, MKO3)
Media	Various
Literature	Topic dependent
Methods	Independent research work
Form of Assessment	Written thesis
Admission requirements for assessment	To be permitted to write the master thesis, the student is to obtain at least 60 ECTS
Duration of Assessment	-

Languages	English only
Offering	Every semester
Person in Charge	Examiners: University teachers, auxiliary professors, honorary professors and senior academic staff members of the School of Business informatics and mathematics or of the School of Social Sciences
Duration of module	1 semester
Further modules	-
Range of Applications	MMDS
Semester	4 <sup>th</sup> semester

## **Abbreviations**

### **Explanation of abbreviations**

#### **Knowledge**

This degree program provides students with a solid theoretical foundation as well as practical skills for data management and data analytics. The courses are divided into two groups – fundamental courses and advanced courses. After studying optional fundamental courses in computer science and empirical social sciences, in their advanced courses students can focus on the concepts and methods of computers science and advanced empirical methods and the application of these methods. In addition to the regular lecture courses, students participate in a one or two semester team project or individual project.

During their studies -

(MK1) all students develop a deep understanding of the relevant concepts, methods and problem solving strategies used in different application domains.

(MK2) technology-oriented students learn the concepts, algorithms and strategies used to solve concrete, practical application-oriented problems in informatics.

(MK3) social sciences-oriented students develop a deep understanding of how to set up, analyse and interpret advanced empirical research questions.

As part of this education, students become familiar with a wide range of models, modelling languages, methods and tools. Regardless of their specialization, students also learn how to collect, structure, manipulate, prepare, interpret, communicate and use data, information and knowledge.

#### **Capabilities**

After completing their studies, students have the ability to –

(MF1) apply a wide range of abstraction and analysis techniques.

(MF2) understand, interpret, describe and present relevant scientific publications.

(MF3) exploit the latest scientific results.

(MF4) independently tackle problems in data management and analytics and describe their results in a structured, written form.

(MF5) continue their studies at the PhD level, if their results are of sufficient quality.

### **Competencies**

After completing their studies, students have the competences needed to –

(MKO1) apply their knowledge and capabilities to solve specific problems in a team context.

(MKO2) use their interdisciplinary education to mediate between technical and non-technical individuals.

(MKO3) evaluate the latest changes in programming languages, systems, models and, wherever possible, exploit them to develop better solutions to data-science related problems.