

Master of Science (M.Sc.)

**“Mannheim Master in Social
Data Science”**

University of Mannheim

– Module catalog –

for students starting in or after fall 2024

Academic Year
HWS 2025/ FSS 2026

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Foreword

This document describes the courses that will be offered in HWS 2025/ FSS 2026 for students studying M. Sc. Mannheim Master in Social Data Science (Examination Regulations for the Master's program from 26th April 2023). You can find the Examination Regulations on the website of the Student Services (Studienbüros):

<https://www.uni-mannheim.de/en/academics/during-your-studies/examinations/examination-regulations/>

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/en/academics/organizing-your-studies/mannheim-master-in-social-data-science/#c368706>

A. Overview

| | | ECTS |
|--|--|-------|
| Foundations of Data Science | Five courses | 27 |
| Data Science Methods: Fundamentals | Three courses | 27 |
| Data Science Methods: Specializations | Minimum of three courses from the Areas “Data Management” or “Data Analytics Methods” of the MMDS Curriculum | 18-23 |
| Data Science Applications | At least two Master elective courses from the School of Social Sciences | 18-23 |
| Master’s Thesis | Six-months-long written academic assignment | 30 |
| Total | | 120 |

General constraints:

1. Courses with 3-10 ECTS can be taken
2. All Foundations of Data Science courses worth a combined 27 ECTS must be taken
3. All Data Science Methods: Fundamentals courses worth a combined 27 ECTS must be taken
4. Three Data Science: Specializations courses must be taken (18-23 ECTS)
5. At least two Master elective courses from the School of Social Sciences (18-23 ECTS) must be taken in Data Sciences Applications.
6. You must write a Master Thesis

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

| 1st Semester | 2nd Semester | 3rd Semester | 4th Semester |
|---|--|---|----------------------------|
| Sampling and Data 9 ECTS | ML and Causal Inference 9 ECTS | Seminar + Lab "Current Topics" 9 ECTS | Master's Thesis 30 ECTS |
| Programming for Data Scientists 6 ECTS | Database Technology 6 ECTS | Methods 3 3-9 ECTS | |
| Open Science and Reproducibility 3 ECTS | Methods 1 3-9 ECTS | Applications 2 6-10 ECTS | |
| Ethical and Legal Aspects 3 ECTS | | | |
| Statistics for Data Scientists 9 ECTS | Methods 2 3-9 ECTS | Applications 3 6-10 ECTS (if applicable) | |
| | Applications 1 6-10 ECTS | | |
| | | | Total: 120 ECTS |

- Foundations of Data Science
- Data Science Methods: Fundamentals
- Data Science Methods: Specialization
- Data Science Applications

B. Foundations of Data Science

1. Overview

| Module no. | Name of Module | Offered | ECTS | Page |
|------------|--------------------------------------|---------|------|------|
| DS 100 | Statistics for Data Scientists | HWS | 6+3 | 7 |
| CS 460 | Databases for Data Scientists | FFS | 6 | 9 |
| DS 450 | Programming for Data Scientists | HWS | 6 | 11 |
| DS 500 | Open Science & Reproducible Research | HWS | 3 | 13 |
| | Legal and Ethical Aspects of Privacy | HWS | 3 | 15 |

2. Detailed descriptions

| DS 100 | Statistics for Data Scientists |
|---|--|
| Form of module | Lecture and Tutorial |
| Type of module | Foundations of Data Science |
| Level | Master |
| ECTS | 9 (270 hours) |
| Workload | Hours per semester present: 56 h (4 SWS) |
| | Self-study: 214 h per semester <ul style="list-style-type: none"> • 91 h: pre and post lecture/tutorial studying and revision • 42 h: studying for and taking weekly online tests • 40 h: examination preparation • 41 h: preparation and presentation of weekly exercises |
| Prerequisites | A sound introduction of the linear regression model (OLS) is required. Knowledge in linear algebra and calculus is useful. This is the first in a two-course sequence covering statistical models and causal inference, continuing into Data Science 201 next semester. The topics in both courses will be integrated through the year. It is expected that students will take both semesters. |
| Aim of module | The course provides an introduction to the basics of regression models, including <ul style="list-style-type: none"> • The theoretical development of linear regression • Extensions to generalized linear models • Extensions to machine learning and model selection • Regular practice on applied data analysis |
| Learning outcomes and qualification goals | <u>Expertise:</u> Understand how to appropriately translate research question into statistical models, be able to apply statistical models appropriate for non-linear problems and learn how to present and interpret estimation results in a substantive meaningful way. (MK1, MK3) |
| | <u>Methodological competence:</u> Estimate regression parameters using the maximum likelihood principle; Perform hypothesis tests for regression models using the maximum likelihood principle; Be able to identify violations of the respective regression assumptions of the discussed GLMs; Be able to identify limitations of non-linear regression models. (MK1, MK3) |
| | <u>Personal competence:</u> |

| | |
|---------------------------------------|--|
| | The course supports students to develop competences with regard to choosing the appropriate statistical method(s) to answer respective research questions and how to present and communicate statistical results. (MF1, MF2, MF3, MKO1, MKO2) |
| Media | Lecture slides available online, exercises available online |
| Literature | <ul style="list-style-type: none"> • Verbeek, M. 2017. <i>A Guide to Modern Econometrics</i>. 5th ed. Chichester: Wiley. • Hansen, Bruce E. 2022. <i>Econometrics</i>. Princeton: Princeton University Press. • Angrist, Joshua D., and Jörn-Steffen Pischke. 2009. <i>Mostly Harmless Econometrics: An Empiricist's Companion</i>. Princeton: Princeton University Press. • Wooldridge, J.M. 2002. <i>Econometric Analysis of Cross Section and Panel Data</i>. Cambridge, MA: MIT Press. |
| Methods | Lecture elements, weekly tests, literature studies |
| Form of assessment | Written examination |
| Admission requirements for assessment | Oral participation, homework, presentations, compulsory attendance |
| Duration of assessment | 90 Minutes |
| Language | English |
| Offering | Fall semester |
| Lecturer | Prof. Dr. Marc Ratkovic |
| Person in charge | Prof. Dr. Marc Ratkovic |
| Duration of module | 1 semester |
| Further modules | |
| Range of application | MMSDS |
| Semester | 1 st semester |

| CS 460 | Databases for Data Scientists |
|---|--|
| Form of module | Lecture with Exercise |
| Type of module | Foundations of Data Science (MMSDS) Fundamental (MMDS for students who started before 2024) |
| 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"> • 70 h: pre and post lecture studying and revision • 28 h: examination preparation |
| Prerequisites | - |
| Aim of module | The course provides an introduction to data storage and database systems. The course will cover the following topics: <ul style="list-style-type: none"> • Principles of data storage • Relational modelling • Query languages for relational databases (SQL) • Keys and normal forms • Hash and index structures • Concurrency • Databases for non-relational data • Principles of data integration |
| Learning outcomes and qualification goals | <u>Expertise:</u> Basic understanding of data storage, relational data modelling and database design, as well as the functionality of relational database management systems, query handling, and transaction management. Handling non-relational data. (MK1, MK 2, MK3) |
| | <u>Methodological competence:</u> Abstraction, modelling, complexity consideration. (MF1, MF2) |
| | <u>Personal competence:</u> Understanding the role of data management in enterprises. (MK01, MK02) |
| Media | Electronic slides and exercise sheets |
| Literature | Avi Silberschatz, Henry F. Korth, S. Sudarshan: Database System Concepts |

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| 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 or oral examination |
| Admission requirements for assessment | - |
| Duration of assessment | 60 minutes (written exam)/30 minutes (oral exam) |
| Language | English |
| Offering | Spring semester |
| Lecturer | Dr. Sven Hertling |
| Person in charge | Prof. Dr. Heiko Paulheim; Dr. Sven Hertling |
| Duration of module | 1 semester |
| Further modules | Database Systems II, Large Scale Data Management, Web Data Integration |
| Range of application | MMSDS, MMDS (for students who started before HWS 2024) |
| Semester | 1 st /2 nd semester |

| | |
|---|--|
| DS 450 | Programming for Data Scientists |
| Form of module | Lecture with Exercise |
| Type of module | Foundations of Data Science |
| Level | Master |
| ECTS | 6 |
| Workload | Hours per semester present: 56h (4 SWS) |
| | Self-study: 84h per semester |
| | <ul style="list-style-type: none"> • 28h: pre and post lecture studying and revision • 56h: preparation and presentation of tutorial exercises |
| Prerequisites | None (programming skills recommended) |
| Aim of module | <p>The course will provide data scientists with the knowledge they need to be able to apply Python3 in data science projects. It assumes that students have basic knowledge of a programming language, but does not assume any prior Python knowledge. Topics covered include –</p> <ul style="list-style-type: none"> • The Python interpreter & programming paradigms • Basic expressions & control flow statements • Functions & scoping • Data structures • Modules • Classes & object-oriented concepts • Errors and exceptions • Testing and debugging • Exploring & visualizing data with Python |
| Learning outcomes and qualification goals | <u>Expertise:</u> After taking the course, students will be familiar with Python3 and will be able to use it in data science projects |
| | <u>Methodological competence:</u> Students will acquire the skills to develop high-quality Python software for data science and other applications |
| | <u>Personal competence:</u> <ul style="list-style-type: none"> • ability to work independently • ability to work in a team |
| Media | Projector, PC (Linux), printed lecture slides |
| Literature | <ul style="list-style-type: none"> • Introduction to Computation and Programming Using Python, Third Edition (John. V. Guttag), MIT Press • Think Python: How to Think Like a Computer Scientist, 2nd Edition, Allen B. Downey, O`Reilly • The (Official) Python Tutorial |
| Methods | lectures, tutorials/practical sessions, independent study |

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| Form of assessment | Programming test |
| Admission requirements for assessment | Successful completion of several small programming exercises and of a programming project in a small team |
| Duration of assessment | 120 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 | MMSDS |
| Semester | 1st/2nd semester |

| DS 500 | Open Science & Reproducible Research |
|---|--|
| Form of module | Lecture + Exercise |
| Type of module | Foundations of Data Science |
| Level | Master |
| ECTS | 3 (90 hours) |
| Workload | Hours per semester present: 28 h (2 SWS) |
| | Self-study: 62 h per semester <ul style="list-style-type: none"> • 28 h: pre and post lecture studying and revision • 34 h: exercises + report writing |
| Prerequisites | - |
| Aim of module | This course deals with Open Science which focuses in openness, transparency and reproducibility in research. Students learn about Open Science practices like Open Data, Open Materials, and Open Access to published research. Reproducible research and questions around replications are covered as well. In addition, students will gain practical skills in Open Science and reproducible research (e.g., pre-registration, code documentation, research data management and planning). |
| Learning outcomes and qualification goals | <u>Expertise:</u> The students will know Open Science principles and understand how reproducible research can be done. (MK1, MK3) |
| | <u>Methodological competence:</u> Students will be able to implement a diverse range of Open Science practices tailored for their research purposes. (MF1, MF4) |
| | <u>Personal competence:</u> Students will be able to assess where and which Open Science practices can be implemented within their own and others' research. (MKO1) |
| Media | Lecture slides and exercises will be available online |
| Literature | <ul style="list-style-type: none"> • Christensen, G., Freese, J., & Miguel, E. (2019). <i>Transparent and reproducible social science research: How to do open science</i>. University of California Press. • Miedema, F. (2022). <i>Open science: The very idea</i>. Springer Nature. |

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|---------------------------------------|---|
| Methods | This course consists of weekly lectures and practical exercises. The concepts and skills acquired during lectures and workshops will then be applied to an independent final written report (e.g. reporting the attempt of reproducing results from previous research). |
| Form of assessment | Written report, 5-10 pages |
| Admission requirements for assessment | Oral participation, Practical work, presentations (10 - 90 minutes) |
| Duration of assessment | 4-8 weeks (writing of the report). |
| Language | English |
| Offering | Fall semester |
| Lecturer | Dr. David Philip Morgan, Open Science Office Dr. Philipp Zumstein |
| Person in charge | Dr. David Philip Morgan, Open Science Office Dr. Philipp Zumstein |
| Duration of module | 1 semester |
| Further modules | |
| Range of application | MMSDS |
| Semester | 3 rd semester |

| | Legal and Ethical Aspects of Privacy |
|---|--|
| Form of module | Lecture |
| Type of module | Responsible Data Science |
| Level | Master |
| ECTS | 3 |
| Workload | Hours per semester present: 28 h (2 SWS) |
| | Self-study per semester: 60 h <ul style="list-style-type: none"> • Pre-and post-lecture studying and preparation (30h) • Examination preparation (30h) |
| Prerequisites | None |
| Aim of module | <p>In a first section the course will acquaint the students with the origins and basic principles of privacy law mainly in Europe. Furthermore, it will contrast the European privacy foundations with the U.S. approach. At the core of this course stands the new European General Data Protection Regulation (GDPR) and its applicability to specific cases and basic principles. Moreover, the course will cover current challenges to the existing privacy paradigms by big data and big data analytics.</p> <p>In a second section the course will cover ethical aspects of the use of personal and non-personal data. Data potentially allows to identify and target individuals and offer individualized products to them. However, sometimes this kind of individualization might be legal, but the question arises whether it is also desirable from an ethical and societal point of view? The course will use selected examples (e.g., first-degree price discrimination) in order to illustrate the ambivalence of legality, legitimacy, and ethics. In this context, the use of artificial intelligence and its impact on privacy will be addressed.</p> |
| Learning outcomes and qualification goals | <p>Students will...</p> <ul style="list-style-type: none"> • have a basic knowledge on the applicability of the General Data Protection Regulation (GDPR) and its basic principles; • be aware of privacy issues and potential legal limitations when processing data; • be aware of current challenges to the existing privacy • have an understanding why privacy issues are treated differently in Europe and the U.S.; • paradigms by big data and big data analytics; • be aware of currently discussed new approaches to privacy (e.g., privacy by design); • be aware of ethical issues of using personal as well as non-personal data |

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|---------------------------------------|---|
| | <ul style="list-style-type: none"> • be aware of the chances and challenges the use of artificial intelligence will bring |
| Media | Video tutorials, lectures, online quizzes |
| Literature | Students will receive reading assignments for each unit together with the syllabus at the beginning of the semester. |
| Methods | The class will generally be conducted as a lecture. However, some of the sessions will be conducted on an inverted class-room principle. Students will be able to access the video lectures at the beginning of the semester. The content of these videos will be discussed along with additional reading in the individual class sessions. |
| Form of assessment | written examination |
| Admission requirements for assessment | Successful participation in 5 out of at least 7 online quizzes |
| Duration of assessment | 90 minutes |
| Language | English |
| Offering | HWS |
| Lecturer | Prof. Dr. Egidy |
| Person in charge | Prof. Dr. Egidy |
| Duration of module | 1 semester |
| Further modules | - |
| Range of application | MMDS |
| Semester | 1 st /2 nd /3 rd semester |

C. Data Science Methods: Fundamentals

1. Overview

| Module no. | Name of Module | Offered | ECTS | Page |
|------------|--|---------|------|------|
| DS 200 | Sampling and Data | HWS | 6+3 | 18 |
| DS 201 | Machine Learning and Causal Inference | FSS | 6+3 | 20 |
| DS 202 | Seminar and Lab on Machine Learning and Causal Inference | HWS | 9 | 22 |

2. Detailed descriptions

| DS 200 | Sampling and Data |
|---|---|
| Form of module | Lecture and Tutorial |
| Type of module | Data Science Methods: Fundamentals |
| Level | Master |
| ECTS | 9 (270 hours) |
| Workload | Hours per semester present: 56 h (4 SWS) |
| | Self-study: 214 h per semester <ul style="list-style-type: none"> • 91 h: pre and post lecture studying and revision • 42 h: studying for and taking weekly online tests • 41 h: preparation and presentation of weekly exercises • 40 h: examination preparation |
| Prerequisites | - |
| Aim of module | The course introduces the relevant methods for research design and data analysis in the social science. The course will center on causal inference, identification, and estimation. Reading and critiquing papers will be emphasized along with the data and statistical analyses. |
| Learning outcomes and qualification goals | <u>Expertise:</u> Students can independently formulate research questions and empirically verifiable hypotheses. (MK1) |
| | <u>Methodological competence:</u> Students know different data collection methods and their advantages and disadvantages; they are able to assess the appropriateness of the methods used to answer various questions; they understand and critically evaluate the design of empirical studies. (MK1) |
| | <u>Personal competence:</u> The course supports students to develop competences with regard to choosing the appropriate research design and sampling frame. (MF2, MKO1, MKO2) |
| Media | Lecture slides available online |
| Literature | <ul style="list-style-type: none"> • Angrist, Joshua D., and Jörn-Steffen Pischke. 2009. Mostly Harmless Econometrics: An Empiricist's Companion. Princeton: Princeton University Press. • Imbens, Guido W., and Donald B. Rubin. 2015. Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction. Cambridge: Cambridge University Press. |

| | |
|---------------------------------------|--|
| | <ul style="list-style-type: none"> • Cunningham, Scott. 2021. Causal Inference: The Mixtape. New Haven and London: Yale University Press. |
| Methods | Lecture elements, weekly tests, literature studies |
| Form of assessment | Written examination |
| Admission requirements for assessment | Oral participation, homework, presentations, compulsory attendance |
| Duration of assessment | 90 Minutes |
| Language | English |
| Offering | Fall semester |
| Lecturer | Prof. Dr. Marc Ratkovic |
| Person in charge | Prof. Dr. Marc Ratkovic |
| Duration of module | 1 semester |
| Further modules | |
| Range of application | M.Sc. Mannheim Master in Data Science, M.Sc. Mannheim Master in Social Data Science |

| DS 201 | Machine Learning and Causal Inference |
|---|---|
| Form of module | Lecture and Tutorial |
| Type of module | Data Science Methods: Fundamentals |
| Level | Master |
| ECTS | 9 (270 hours) |
| Workload | Hours per semester present: 56 h (2 SWS) |
| | Self-study: 214 h per semester <ul style="list-style-type: none"> • 91 h: pre and post lecture studying and revision • 42 h: studying for and taking weekly online tests • 41 h: preparation and presentation of weekly exercises • 40 h: examination preparation |
| Prerequisites | A sound understanding of basic statistical methods incl. regression analysis, estimation methods (OLS, MLE), and statistical inference is required. Knowledge in linear algebra and calculus is also required. This is the third in a three-course sequence covering statistical models and causal inference for MMSDS. The topics in all three courses (DS 100, DS 200) will be integrated. It is expected that students will take both semesters. |
| Aim of module | The course aims to introduce students to likelihood-based and Bayesian methods, machine learning methods, then deep learning methods. Extensions and connections to causal methods will be made at each stage. Advanced and popular techniques of machine learning are introduced. |
| Learning outcomes and qualification goals | <u>Expertise:</u> Students are aware of how machine learning can help answer causal questions; they can analyze (large) data sets using popular techniques of machine learning. (MK1) |
| | <u>Methodological competence:</u> Students are able to translate their research question(s) into a causal framework; they can apply different techniques of machine learning. (MK1, MK3) |
| | <u>Personal competence:</u> The course supports students to develop competences with regard to choosing the appropriate statistical method(s) to answer respective research questions. (MF1, MF2, MF4, MKO1, MKO2) |
| Media | Lecture slides available online |

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|---------------------------------------|---|
| Literature | <ul style="list-style-type: none"> • McElreath, Richard. 2020. Statistical Rethinking: A Bayesian Course with Examples in R and STAN. Routledge. • Murphy, Kevin P. 2012. Machine Learning: A Probabilistic Perspective. Cambridge: MIT Press. • Hastie, Trevor, Robert Tibshirani, and Jerome Friedman. 2008. The Elements of Statistical Learning. 2nd ed. New York: Springer. • Jurafsky, Daniel, and James H. Martin. 2009. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition. 2nd ed. Upper Saddle River, NJ: Prentice Hall. • Imbens, Guido W., and Donald B. Rubin. 2015. Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction. Cambridge: Cambridge University Press. |
| Methods | Lecture elements, weekly tests, literature studies |
| Form of assessment | Written examination |
| Admission requirements for assessment | Oral participation, homework, presentations, compulsory attendance |
| Duration of assessment | 90 Minutes |
| Language | English |
| Offering | Spring semester |
| Lecturer | Prof. Dr. Marc Ratkovic |
| Person in charge | Prof. Dr. Marc Ratkovic |
| Duration of module | 1 semester |
| Further modules | |
| Range of application | MMSDS, MMDS |
| Semester | 2 nd semester |

| DS 202 | Seminar and Lab on Machine Learning and Causal Inference |
|---|--|
| Form of module | Seminar |
| Type of module | Data Science Methods: Fundamentals |
| Level | Master |
| ECTS | 9 (270 hours) |
| Workload | Hours per semester present: 56 h (4 SWS) |
| | Self-study: h per semester <ul style="list-style-type: none"> • 70 h: pre and post seminar studying and revision • 70 h: analyzing data, programming Python scripts • 74 h: preparation and presentation of research project |
| Prerequisites | Students should be familiar with Python or R or at least with any other object-programming language. |
| Aim of module | The module introduces, discusses, and offers hands-on experience in state-of-the-art topics in data science. It consists of a “theoretical” part (seminar) which offers room for discussion on hot topics of data science and an “empirical” part where students formalize research questions and analyze data (of their own) using advanced techniques of machine learning. |
| Learning outcomes and qualification goals | <u>Expertise:</u> Students are able to find appropriate techniques of machine learning to answer complex research questions; they can analyze (large) data sets using state-of-the-art techniques of machine learning. (MK1) |
| | <u>Methodological competence:</u> Students are able to program in Python; they can apply advanced techniques of machine learning to individual research questions; they have in-depth knowledge in application of data science. (MK1, MK2, MK3) |
| | <u>Personal competence:</u> Students are able to independently implement their research question in a research project; they can deal with and solve theoretical and empirical problems. (MF1, MF2, MF3, MF4, MKO1, MKO2) |
| Media | Slides available online |
| Literature | <ul style="list-style-type: none"> • Downey, Allen B. 2016. Think Python. How to Think Like a Computer Scientist. 2nd ed. Needham: Green Tea Press. (available online: http://greenteapress.com/thinkpython2/thinkpython2.pdf) |

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|---------------------------------------|--|
| | <ul style="list-style-type: none"> • McElreath, Richard. 2020. Statistical Rethinking: A Bayesian Course with Examples in R and STAN. Routledge. • Martin and Jurafsky. 2024. Speech and Language Processing. Available at https://web.stanford.edu/~jurafsky/slp3/. • Guttag, John V. 2021. Introduction to Computation and Programming Using Python. 3rd. ed. Cambridge: MIT Press. • The Python Tutorial (online: https://docs.python.org/3/tutorial/) |
| Methods | Lecture elements, classroom discussion, weekly lab-sessions, literature studies, external speakers |
| Form of assessment | Written examination |
| Admission requirements for assessment | Oral participation, homework, presentations, compulsory attendance |
| Duration of assessment | 90 Minutes |
| Language | English |
| Offering | Fall semester |
| Lecturer | Prof. Dr. Marc Ratkovic |
| Person in charge | Prof. Dr. Marc Ratkovic |
| Duration of module | 1 semester |
| Further modules | |
| Range of application | MMSDS |
| Semester | 3 rd semester |

D. Data Science Methods: Specialization

1. Overview

| Module no. | Name of Module | Offered | ECTS | Page |
|------------|---|---------|------|-------|
| CS 500 | Advanced Software Engineering | HWS | 6 | MMDS* |
| CS 550 | Algorithmics | FSS/HWS | 6 | MMDS* |
| CS 560 | Large Scala Data Management | HWS | 6 | MMDS* |
| CS 600 | Model-driven Development | HWS | 6 | MMDS* |
| CS 646 | Higher Level Computer Vision | HWS | 6 | MMDS* |
| CS 647 | Image Processing | FSS | 6 | MMDS* |
| CS 651 | Cryptography II | HWS | 6 | MMDS* |
| CS 655 | Cryptography not offered in FSS 26 | FSS | 6 | MMDS* |
| CS 664 | Blockchain Security | HWS | 6 | MMDS* |
| CS 668 | Generative Computer Vision Models | FSS | 6 | MMDS* |
| IE 500 | Data Mining | HWS/FSS | 6 | MMDS* |
| IE 560 | Decision Support | HWS | 6 | MMDS* |
| IE 650 | Knowledge Graphs | HWS | 6 | MMDS* |
| IE 663 | Information Retrieval and Web Search | HWS | 3 | MMDS* |
| IE 686 | Large Language Models and Agents | HWS | 3 | MMDS* |
| IE 670 | Web Data Integration | HWS | 3 | MMDS* |
| IE 671 | Web Mining not offered in FSS 26 | FSS | 3 | MMDS* |
| IE 675b | Machine Learning | HWS | 9 | MMDS* |
| IE 678 | Deep Learning | FSS | 6 | MMDS* |
| IE 683 | Web Data Integration Project | HWS | 3 | MMDS* |
| IE 684 | Web Mining Project not offered in FSS 26 | FSS | 3 | MMDS* |
| IE 691 | Information Retrieval Project | HWS | 3 | MMDS* |
| IE 696 | Advanced Methods in Text Analytics | FSS | 6 | MMDS* |
| IS 556 | Public Blockchains | FSS | 6 | MMM* |
| IS 616 | Large Scale Data Analysis and Visualization not offered in FSS 26 | HWS | 6 | MMM* |
| IS 661 | Text Analytics | HWS | 6 | MMM* |

| | | | | |
|--------|------------------------------|---------|-----|-------|
| IS 622 | Network Science | FSS | 6 | MMM* |
| | Any other elective from MMDS | FSS/HWS | 3-6 | MMDS* |

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

- MMDS: Mannheim Master in Data Science
<https://www.wim.uni-mannheim.de/studium/studienorganisation/mannheim-master-in-data-science>
(only courses from the modules "Data Management" and "Data Analytics Methods" are allowed)
- MMM: Mannheim Master in Management
<https://www.bwl.uni-mannheim.de/studium/master/mmm/#c176637>
- Choose courses to match 18-23 ECTS

E. Data Science Applications

1. Overview

| Module no. | Name of Module | Offered | ECTS | Page |
|------------|--|---------|------|------------|
| | Elective MA Pol, School of Social Sciences | FSS/HWS | 8-10 | MA Pol* |
| | Elective MA Soc, School of Social Sciences | FSS/HWS | 6 | MA Soc* |
| | Elective MA Psy, School of Social Sciences | FSS/HWS | 4 | M.Sc. Psy* |
| CS 630 | Generative Software Engineering | FSS | 6 | MMDS* |
| IE 694 | Industrial Applications of Artificial Intelligence | FSS | 6 | MMDS* |
| DA 110 | Computational Analysis of Communication | HWS/FSS | 6 | MMDS* |
| | Themenseminar Digitale Medien | FSS | 6 | MKW* |
| | Course from "Methodenmodul Grundlagen" | HWS | 6-10 | MKW* |
| | Course from "Methodenmodul Vertiefung" | FSS/HWS | 6-7 | MKW* |

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

- MA Pol: Master of Arts in Political Science
<https://www.sowi.uni-mannheim.de/studium/studierende/politikwissenschaft/ma-political-science/>
- MA Soc: Master of Arts in Sociology
<https://www.sowi.uni-mannheim.de/studium/studierende/soziologie/ma-sociology/>
- M.Sc. Psy: Master of Science Psychologie - Arbeit, Wirtschaft, Gesellschaft (only in German)
<https://www.sowi.uni-mannheim.de/en/academics/students/psychology/msc-in-psychology-work-economy-and-society/>
- MMDS: Mannheim Master in Data Science
<https://www.wim.uni-mannheim.de/studium/studienorganisation/mannheim-master-in-data-science>
- Master Medien und Kommunikationswissenschaft
<https://www.phil.uni-mannheim.de/studium/modulkataloge/#c111078>
- For detailed information about offered modules by the School of Social Sciences (MA Pol, MA Soc and M.Sc. Psy) and in Master Medien und Kommunikationswissenschaften (MKW), please refer to Portal².
- Choose at least two electives from the School of Social Sciences
- Choose courses to match 18-23 ECTS

F. Master's Thesis

| | Master's Thesis |
|--|---|
| Form of module | Master's Thesis |
| Type of module | Thesis |
| Level | Master |
| ECTS | 30 (900 hours) |
| Workload | Self-study: 900 h per semester |
| Prerequisites | - |
| Aim of Modules | Develop a deep understanding of an advanced topic of social data science |
| Learning outcomes and qualifications goals | <u>Expertise:</u> The student has a deep understanding of an advanced topic. (MK1) |
| | <u>Methodological competence:</u> The student is familiar with methods for analysing and independently solving advanced, complex problems. (MK1, MK2, MK3) |
| | <u>Personal competence:</u> 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 social sciences and data science 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, 10-120 pages |
| Admission requirements for assessment | To be permitted to write the master thesis, the student is to obtain at least 60 ECTS |
| Duration of Assessment | 6 months (execution of the thesis work and writing of the thesis manuscript). |
| Langauges | English only |
| Offering | Every semester |
| Person in Charge | Examiners: University teachers, auxiliary professors, honorary professors and senior academic staff members of the School of Social Sciences, the Business School, the School of Humanities, or the School of Business Informatics and Mathematics. |

| | |
|-----------------------|--------------------------|
| Duration of module | 1 semester |
| Further modules | - |
| Range of Applications | MMSDS |
| Semester | 4 th 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 methods. 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.

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.