Data Science for Society and Business

(online)

Master of Science

Subject-specific Examination Regulations for the MSc Program Data Science for Society and Business (online)

The subject-specific examination regulations for Data Science for Society and Business (online) are defined in this program handbook and are valid only in combination with the General Examination Regulations for master's degree programs ("General Master Policies").

This handbook also contains the program-specific Study and Examination Plan (in 2.2).

Upon graduation, students in this program will receive a Master of Science degree with a scope of 120 European Credit Transfer System (ECTS) credit points (see chapter 3 of this handbook for specifics).

Version	**Valid as of**	**Decision**	**Details**
Fall 2024 – V1	Sep 01, 2024	Pending	Originally approved by Academic Senate

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1 Program Overview

1.1 Concept

Digital innovations are rapidly conquering all areas of social and economic life. Today, modern societies can hardly function without social media, search engines, communication and e-commerce platforms, and individualized online offers. In less than a decade, these multi-purpose technologies have become the core components of an economy and other social sectors. External shocks such as the COVID-19 pandemic have pushed digitalization toward another leap. Home office solutions, digital learning, online conferencing, telemedicine, cybersecurity and other digital services have become an essential part of our private, professional, and public life in no time. Meanwhile, we are permanently adding to the surging data stockpile gathered and harvested by the IT services. Research institutions, private firms, public administration, political parties, NGOs and other—including criminal—actors are already using and will continue to use "big" data to better understand, predict, and effectively intervene in issues of crucial interest to contemporary and future societies. Data may become the "new oil of the 21st century," as predicted by British mathematician Clive Humby in 2006. The second part of his famous quote is already true: Data "is valuable, but if unrefined, it cannot really be used."

The aim of this consecutive, application-oriented 2-year Data Science for Society and Business (DSSB) (online) MSc program is two-fold. On the one hand, it aims to use rapidly growing digital data resources and new computational tools and methods to describe, model, predict, and potentially solve pressing business, ecological, economic, organizational, political, or other social problems and important trends like innovation diffusion, migration flows, susceptibility to infections, sustainable growth, political mobilization, and the likes. On the other hand, the program addresses the rising demand for social data science expertise and critical skills in new industries (i.e., social media, start-ups), in established sectors (i.e., production, civil and private services), common job specifications (i.e., consulting, market research, marketing), public administration (i.e., health, security), and academia (all sciences).

Hence, this study program equips students with core competencies, up-to-date skills, and tools. They will learn to identify, manage, analyze, understand, critically evaluate, and thoughtfully use digital traces to answer challenging questions on today's most progressive labor and business markets and in other social spheres. This also reflects on the dark sides of digitization and the development of sustainable countermeasures. Emerging threats can appear at all levels of the society: at an individual level, that is, in pathological computer gaming or ill-consumption of social media content, as well as at a level of organizations or entire public or economic spheres, that is, in digital espionage or manipulated social media communication. To address media bias, to identify unauthorized users, and to understand emerging problems of our digital future, we foster critical thinking in classroom discussions, enable students to develop and mature intellectual behavior, and teach how to outsmart digital crimes and build creative and corrective solutions.

The graduate program provides room for individual specialization to prepare students for an ambitious international academic or professional career. An international, virtual campus, asynchronous learning, and an intensive online communication with instructors, and peers provide an intellectual and up to date environment that offers numerous opportunities to further grow as a person.

The DSSB program also makes use of innovative online learning environments (virtual reality labs, virtual classrooms, gaming ecologies) and the expertise of digital natives. By offering an online program, students with diverse cultural and knowledge backgrounds, individual needs, and personal wants can be rapidly integrated into a virtual classroom community. Tailor-made online learning will also enable individual students to close their mathematical or technical knowledge gaps according to their personal schedules. Within the virtual classroom, students can share learning experiences, and discuss, motivate, and challenge themselves during lectures, seminars, tutorials, laboratory sessions, and virtual excursions. They will also learn how to cooperate in social teams online and how to become a valuable collaborator, and even a responsible leader in larger projects. Online learning enables each student to train, drill, and develop unique, personalized self-learning skills. The learning material and tutorial sessions advises, encourages, and supports students to think and study independently, conduct autonomous background reading, solve problems alone or in teams, and bring new ideas and solutions to the virtual classroom for discussion.

The program enables students to improve and complement their prior knowledge not only from social sciences (e.g., business, economics, demography, human geography, management science, media studies, political science, psychology, sociology, and social history) but also from humanities, cognitive or natural sciences, or computer science—preferably with a minor in one social science field—to advance their academic, technical, and social expertise, and to realign their career plans outside and inside academia.

The MSc in DSSB is an interdisciplinary online program that benefits particularly from the online teaching mode as data science programs thrive on data-driven learning environments. Online platforms enable the direct use of large datasets and real-time data analysis within the learning modules, which is ideal for teaching data science. Students can work on datasets that reflect current societal and business trends, giving them practical and relevant experience.

Online formats allow students to access a wide variety of data sources from different sectors such as business, economics, politics, and social media, reflecting the program's multidisciplinary approach. This diversity enriches the learning experience by exposing students to a broad range of scenarios and data challenges.

Data science is a field that is continually evolving with new tools and technologies. An online program can quickly integrate the latest software and computational tools into the curriculum, ensuring that students learn the most up-to-date practices and are prepared for the current job market.

The online format facilitates collaboration on projects that can involve real-world data from governmental, non-profit, or business entities. Such projects are critical for understanding how to apply data science to societal and business problems, as mentioned in the program's aims.

With the online delivery, the DSSB program can regularly update its curriculum to reflect the rapidly changing skill sets required by employers in data science fields. This ensures that students gain the most relevant and current skills that are in high demand.

Online programs can create simulated environments where students can practice problem-solving with real-time data and scenarios, directly relating to the program’s focus on societal and business challenges.

The DSSB MSc online connects students with peers, faculty, and industry leaders from across the globe. This is particularly advantageous for a field that is global in nature, as data science solutions are often applied across international boundaries.

Beyond the dynamically evolving study content the DSSB MSc graduate online program offers a personalized learning environment with peer interaction, tutorial gatherings and borderless exchange in a virtual classroom of a growing global learning community.

The program aims at shaping a common knowledge base in data science and its applications in business and society to builds on the individual diversity of students resulting from their heterogeneous undergraduate studies and work experiences.

1.2 Qualification Aims

The program is an online program with optional blended elements. Lectures incorporate asynchronous material and primarily follow a flipped classroom model, i.e., including application components in the spirit of problem-based as well as project-based learning. Practical components, particularly labs, projects, and thesis are based on remote access, and distributed development. Tutoring includes virtual study groups, peer evaluation and mentoring by faculty. Performance evaluations are conducted as online e-exams.

The remote work aspects include collaborative software development and remote access to physical devices for, e.g., control, monitoring and maintenance. Due to the aspects of independent, self-governed knowledge acquisition, the students are prepared for life-long learning, where additional knowledge and skills need to be acquired or updated in a regular fashion, especially in Data Science.

1.2.1 Educational Aims

The DSSB (online) program aims at

- instructing students to self-organize their individual study and learning behavior
- deepening a collaborative, remote learning style
- teaching students to identify problems in business and other social spheres (e.g., crime, education, media, politics, or public health) that can be best analyzed with digital data
- educating students about the social (e.g. business, economic, legal, political), and ethical prerequisites, and implications of digital technologies
- providing critical knowledge about cybersecurity, , and data ethics
- imparting knowledge about up-to-date data science concepts
- training and motivating students to learn fundamental programming skills in R and Python and to understand state-of-the-art computational and software tools
- achieving expertise in data analytics and modeling approaches
- conveying technical skills on how to connect and cross-validate data science studies with conventional research approaches
- guiding students to develop a critical understanding of data-driven solutions
- demonstrating why and how to apply scientific research to societal and business problems
- motivating and training how to effectively communicate and visualize scientific research results
- conveying a deep understanding of how to responsibly act as a data scientist.

1.2.2 Intended Learning Outcomes

At the end of the 2-year online program, students will have acquired a strong body of expertise, both in content and in computational skills, to solve challenging problems in digital societies thoughtfully and responsibly. More specifically, graduates of the DSSB (online) program will be able to:

1. identify, analyze, interpret, and critically assess the social (e.g., business, economic, and political) causes and consequences of the digital transformation of societies.
2. academically reflect and evaluate the legal and ethical implications surrounding privacy, data sharing, algorithmic decision making, and new business models in various digitalized sectors.
3. combine data science concepts and put them into practice by developing and designing state-of-the-art applications.
4. develop scientific and professional solutions for social, ecological, economic, health, scientific, and political problems.
5. creatively and convincingly solve research implementation problems.
6. learn programming and implementation in at least one computer language (R or Python) and acquire at least basic skills in the other.
7. use state-of-the-art digital data mining methods from the Internet and other sources.
8. efficiently and securely manage social media and business data.
9. deliberately choose between, adapt, and potentially develop statistical models for “big data”.
10. elaborately command analytical, critical, and synthesizing quantitative skills to correctly model and interpret scientific results, make valid predictions, and derive thoughtful conclusions and interventions for pressing social and business problems.
11. apply innovative writing, communication, presentation techniques, and state-of-the-art visualization tools to reach out effectively and convincingly to scientific and non-scientific audiences.
12. efficiently and effectively use online materials to boost self-learning and time-management skills to sharpen one’s professional expertise and stay updated in a rapidly developing scientific domain.
13. function very well in an international and diverse working environment.
14. adhere to and defend ethical, scientific, and professional standards.
15. make valuable contributions to society and businesses.
16. grow personally to become a responsible, smart, and resilient researcher, leader, and collaborator.
17. take up an ambitious academic, business, or professional career in thriving digital domains.

1.4 Online teaching and learning

1.4.1 General Framework

Constructor University online study programs focus on the holistic learning success of students and offer a variety of synchronous and asynchronous formats that align with problem- and project-based learning.

The online master program in DSSB applies proven and effective teaching and learning modalities that engage distance learners and support a vibrant learning community. This means that students participate in online courses with predominantly asynchronous lectures and learning activities that are complemented by synchronous tutorials and hands-on sessions.

Students are guided and supported by faculty as well as experienced tutors and lecturers to transfer acquired knowledge into practice. The hands-on elements include dedicated collaboration with other students using tools and concepts that enable distributed work from different places and different time-zones.

Students enrolled in online study programs will find their course materials such as videos, case studies, scholarly articles, websites, podcasts, online games etc. on a Learning Management Software (LMS) platform provided by Constructor University.

1.4.2 Student Workload

Module sizes range from 2.5 to 7.5 CP. Studying in an online program at Constructor University involves students actively participating in reading, preparing assignments, meeting with peers on task/group projects, synchronous tutor sessions, and watching the required videos.

The terms used in the module data sheets that refer to student workload are defined as follows:

- Asynchronous Self-study = time that that student uses in predefined study contents on digital platforms. Main goal is to acquire content and methods.

- Interactive Learning = time that students spend in a synchronous manner with tutors and in study groups and working on group projects.

- Independent Study = time that students use with recommended further study content and first application of acquired knowledge.

- Assessment preparation = Application of acquired knowledge to specific problems that serve as examples of typical exam questions or writing term papers, designing presentations etc.

1.4.3 Academic Tutors

Academic tutors specifically support the instructor of records and students within the graduate program in their asynchronous teaching and learning. They hold tutorial sessions for online students (individually or in groups) and serve as a first point of contact for student concerns and questions regarding asynchronous learning material and their learning process. In this way, we guarantee that

all students, regardless of the global time zone in which they live, can be fully supported by Constructor University.

1.4.4 Assessment and Grading

In Constructor University's online study programs, we particularly emphasize formative forms of assessment. Formative assessment is used to monitor and evaluate how students are learning as they work through a module or study program. It is designed to help students learn more effectively by giving them feedback on their performance and on how it can be improved and/or maintained. It may be marked pass-fail, complete-incomplete, or other rating scale as part of the requirement to qualify for or participate in the final assessment. There are also similar assessment formats, so-called summative assessment with a final grade at the end of the course as in the on-campus teaching, e.g., written exams, presentations, and lab reports.
Any type of assessment may be conducted electronically or complemented by electronic and online assessment and submission elements. This includes computerized testing in a test center, video interviews, online/electronic submission and other formats which use electronic systems and/or devices. For computerized assessments, students will be offered an introduction to the system used to familiarize themselves with it.

1.4.5 Learning Management Software

Constructor University's online classes are supported by technology that includes a learning management system (LMS) and additional education technology tools that may be integrated into the LMS or offered as an alternative environment for students to engage in or to apply their knowledge and skills and to participate in simulations. The LMS includes discussion forums, assignments and quizzes, a gradebook, calendars, instructor and student dashboards. Additional tools offered may include video or document annotations, virtual labs for a variety of technical skills, gamified experiences, and more. The LMS and some associated tools enable timely communication to the students that can support time management and motivation to engage in their course work. The students will have access to applications that enable group work and peer-to-peer communication.

1.5 Target Audience

The DSSB (online) graduate program is a highly selective program for students of all age groups with a strong background in the social sciences, such as anthropology, business, economics, demography, management science, media science, political science, psychology, social history, or sociology, who want to become a data scientist and are interested in business and social science research questions. However, we are also open to ambitious learners from humanities such as history or linguistics, natural science such as cognitive or health sciences, or other areas with a quantitative orientation. Students must be interested in working in interdisciplinary, international, and innovative research fields. The program prepares for a professional and an academic career.

1.6 Career Options

Data scientists with a focus on business and social sciences face manifold career options. The demand for their expertise is significant and growing. They can work not only in tech and for social or consulting firms but also for NGOs and international organizations; in retail, e-commerce, and telecommunication; in the finance sector; in the automotive and health industries; for public administration; and in academia. Companies and institutions in almost every domain need:

- data scientists, "big data" scientists, artificial intelligence (AI) research scientists, business intelligence analysts, computational social scientists, consultants, data analysts, data management experts, data protection specialists, financial analysts, managers, market researchers, marketing managers, medical data analysts, public affairs consultants, scientific advisors, social media analysts, web analysts, etc. Graduates of the DSSB program can work in these roles.

- experts in data analysis who (critically) evaluate, analyze, and interpret the collected digital data accurately and can visualize the findings clearly are also needed in public relations, journalism, political think tanks, government, police departments, and international organizations such as the World Bank, WHO, EU, UN, etc.

- experts in digital data acquisition, who can instantaneously collect the relevant data, working in all sectors of an industry

- experts in data management who know how to store, enhance, protect, and process large amounts of data efficiently work as an information security analyst, database manager, project manager, or in similar roles

- an MSc degree in DSSB also allows students to move on to a PhD and a career in academia and research institutions

The employability of DSSB graduates is promoted by sharing contacts with industry, public institutions, non-governmental organizations, and research institutes throughout the curriculum. In the fourth semester, participation in additional public big data challenges is organized as an elective in the curriculum.

The Career Service Center (CSC) helps students in their career development. It provides students with high-quality training and coaching in CV creation, cover letter formulation, interview preparation, effective presenting, business etiquette, and employer research as well as in many other aspects, thus helping students identify and follow up on rewarding careers after graduating from Constructor University. Furthermore, the Alumni Office helps students establish a long-lasting and global network which is useful when exploring job options in academia, industry, and elsewhere.

1.7 Admission Requirements

Admission to Constructor University is selective and based on a candidate's university achievements, recommendations, and self-presentation. Students admitted to Constructor University demonstrate exceptional academic achievements, intellectual creativity, and the desire and motivation to make a difference in the world.

The following documents need to be submitted with the application:

- Letter of motivation
- Curriculum vitae (CV)
- Official or certified copies of university transcripts
- Bachelor's degree certificate or equivalent
- Language proficiency test results (minimum score of 90 (TOEFL), 6.5 (IELTS) or 110 (Duolingo)).
- Copy of Passport
- Letter of recommendation (optional).

Formal admission requirements are subject to higher education law and are outlined in the Admission and Enrollment Policy of Constructor University.

For more detailed information about the admission visit:
https://constructor.university/admission-aid/application-information-graduate

1.8 More Information and Contact

For more information on the study program please contact the Study Program Chair:

Prof. Dr. Hilke Brockmann

Professor of Sociology

Email: hbrockmann@constructor.university

Prof. Dr. Adalbert Wilhelm

Professor of Statistics

Email: awilhelm@constructor.university

or visit our program website:

For more information on Student Services please visit:

https://constructor.university/student-life/student-services

2 The Curriculum

2.1 The Curriculum at a Glance

The DSSB (online) MSc program is composed of foundational lectures, specialized modules, tutorials, and asynchronous activities. These lead to a master thesis that can be conducted in close collaboration with research, institutional, or industry partners. The program takes four semesters (two years). The following table provides an overview of the program's modular structure. The program is partitioned into three areas (core, methods and foundation) and the master thesis. All credit points (CP) are based on ECTS. Students need to obtain a total of 120 CP to graduate. The default module size is 7.5 CP, with smaller 2.5 CP modules being possible as justified exceptions, e.g., if the learning goals are more suitable for 2.5 CP and the overall student workload is balanced.

2.2 Schematic Study Scheme

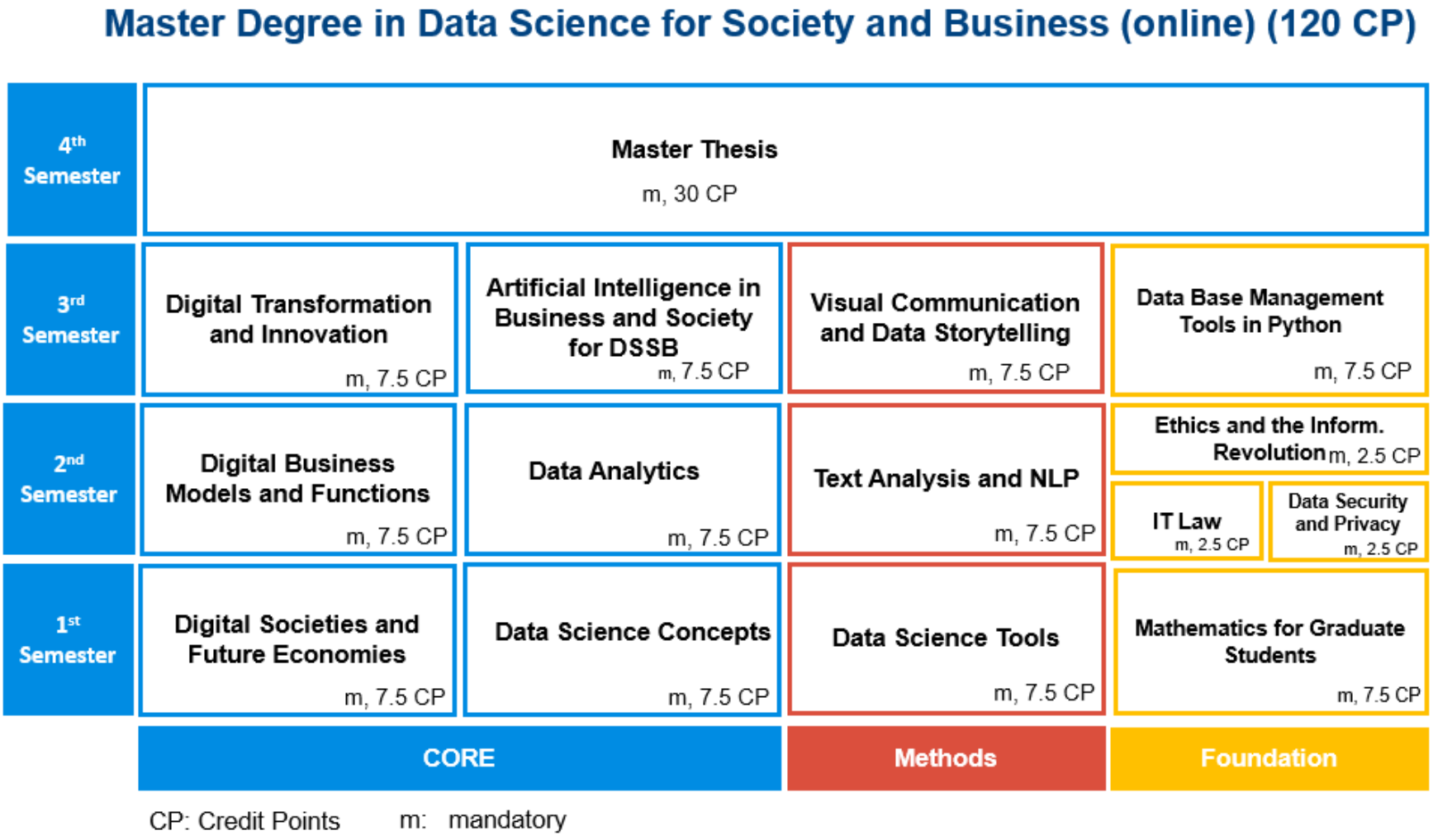

Figure 1: Schematic Study Scheme

2.3 Study and Examination Plan

MSc Degree in Data Science for Society and Business (online) Matriculation Fall 2024							
Module Code	**Program-Specific Modules**	**Type**	**Assessment**	**Period**	**Status[1]**	**Semester**	**CP**
Semester 1							**30**
	Core Area						**15**
	Unit: Digital Societies						
	Module: Digital Societies and Future Economies				**m**	**1**	**7.5**
	Digital Societies and Future Economies	Lecture (online)	Written examination	Examination period			5
	Digital Societies and Future Economies Tutorial	Tutorial (online)					2.5
	Module: Data Science Concepts				**m**	**1**	**7.5**
	Data Science Concepts	Lecture (online)	Written examination	Examination period			5
	Data Science Concepts	Tutorial (online)					2.5
	Methods Area						**7.5**
	Module: Data Science Tools				**m**	**1**	**7.5**
	Data Science Tools in R	Lecture (online)	Project report	During Semester			2.5
	Data Science Tools in Python	Lecture (online)					2.5
	Data Science Tools Tutorial	Tutorial (online)					2.5
	Foundation Area						**7.5**
	Module: Mathematics for Graduate Students				**m**	**1**	**7.5**
	Mathematics for Graduate Students	Lecture (online)	Written examination	Examination period			7.5
Semester 2							**30**
	Core Area						**15**
	Unit: Digital Transformation in Business						
	Module: Digital Business Models and Functions				**m**	**2**	**7.5**
	Digital Business Models and Functions	Lecture (online)	Term paper	During Semester			5
	Digital Business Models and Functions Tutorial	Tutorial (online)					2.5
	Module: Data Analytics				**m**	**1 or 2**	**7.5**
	Data Analytics	Lecture (online)	Project report	During Semester			5
	Data Analytics Tutorial	Tutorial (online)					2.5
	Methods Area						**7.5**
	Module: Text Analysis and Natural Language Processing				**m**	**2**	**7.5**
	Text Analysis and Natural Language Processing	Seminar (online)	Project report	During Semester			5
	Text Analysis and Natural Language Processing Tutorial	Tutorial (online)					2.5
	Foundation Area						**7.5**
	Module: IT Law				**m**	**2**	**2.5**
	IT Law	Lecture (online)	Term Paper	During Semester			
	Module: Data Security and Privacy				**m**	**2**	**2.5**
	Data Security and Privacy	Lecture (online)	Written examination	Examination period			
	Module: Ethics and the Information Revolution				**m**	**2**	**2.5**
	Ethics and the Information Revolution	Seminar (online)	Term paper (report)	During Semester			

Semester 3							**30**
	Core Area						**15**
	Unit: Data Science and Artificial Intelligence Concepts						
	Module: Digital Transformation and Innovation				**m**	**3**	**7.5**
	Digital transformation of organizations	Seminar (online)	Term paper	During Semester			2.5
	Digital services and innovation	Seminar (online)					2.5
	Digital services and innovation Tutorial	Tutorial (online)					2.5
	Module: Artificial Intelligence in Business and Society for DSSB				**m**	**3**	**7.5**
	Artificial Intelligence in Business and Society	Lecture (online)	Project report	During Semester			2.5
	Artificial Intelligence in Business and Society Tutorial	Tutorial (online)					2.5
	Artificial Intelligence in Business and Society	Seminar (online)	Presentation	During Semester			2.5
	Methods Area						**7.5**
	Module: Visual Communication and Data Story Telling				**m**	**3**	**7.5**
	Visual Communication and Data Story Telling	Lecture (online)	Project report	During Semester			5
	Visual Communication and Data Story Telling Tutorial	Tutorial (online)					2.5
	Foundation Area						**7.5**
	Module: Data Base Mangement in Python				**m**	**3**	**7.5**
	Data Base Mangement in Python	Lecture (online)	Written examination	Examination period			2.5
	Data Base Mangement in Python - Programming Tutorial	Tutorial (online)	Program Code				2.5
	Data Base Mangement in Python Tutorial	Tutorial (online)					2.5
Semester 4							**30**
	Module: Master Thesis DSSB (online)				**m**	4	**30**
	Master Thesis MSc DSSB (online)	Thesis	Thesis				
	Master Thesis Defense		Oral examination				
Total CP							**120**

Figure 2: Study and Examination Plan

2.4 Core Area

Core modules describe and analyze the machine-social context, along with the changes and challenges imposed by new information technologies on today's and future firms, entire economies, and societies. They also teach students data science approaches, new models, and analytical techniques. Hence, we aim at three units consisting of two 7.5 CP modules for research on digitization and societies (15 CP), digital transformation in business (15 CP), and data science and AI concepts (15 CP).

To pursue an DSSB (online) master, the following CORE modules (45 CP) need to be taken as mandatory modules (m):

- CORE Module: Digital Societies and Future Economics (m, 7.5 CP)
- CORE Module: Data Science Concepts (m, 7.5 CP)
- CORE Module: Digital Business Models and Functions (m, 7.5 CP)
- CORE Module: Data Analytics (m, 7.5 CP)
- CORE Module: Artificial Intelligence in Business and Society for DSSB (m, 7.5 CP)
- CORE Module: Digital Transformation and Innovation (m, 7.5 CP)

2.5 Methods Area

Methods modules are important in data science. Programming skills, innovative and dynamic models, experimental methods, and up-to-date software are essential for understanding, replicating, and contributing to research.

To pursue a DSSB (online) master, the following Methods modules (22.5 CP) need to be taken as mandatory modules (m):

- Methods Module: Data Science Tools (m, 7.5 CP)
- Methods Module: Text Analysis and Natural Language Processing (m, 7.5 CP)
- Methods Module: Visual Communication and Data Storytelling (m, 7.5 CP)

2.6 Foundation Area

The foundation modules aim to enhance students' mathematical and data science skills, and to convey ethical and legal understanding in order to improve their employability. Basic knowledge of matrix algebra and probability theory is recapitulated and refreshed to secure foundational knowledge for data science techniques and for a critical understanding and evaluation of machine learning algorithms. Introduction to data management with Python is an inevitable skill for academic as well as professional data scientists. Seminars on ethical and legal issues provide deep insights and analytical expertise to test, justify, and to design norm compliant IT applications.

To pursue a DSSB master (online), the following Foundations modules (22.5 CP) need to be taken as mandatory modules (m):

- Foundations Module: Mathematics for Graduate Students (m, 7.5 CP)
- Foundations Module: IT Law (m, 2.5 CP)
- Foundations Module: Ethics and the Information Revolution (m, 2.5 CP)
- Foundations Module: Data Security and Privacy (m, 2.5 CP)
- Foundations Module: Data Base Management Tools in Python (m, 7.5 CP)

2.7 Master Thesis

In the fourth semester, students deepen their knowledge and expertise by choosing a specific study or research topic in the field of Data Science for Society and Business. They demonstrate their scientific understanding and independent research abilities by developing and constructing a body of knowledge in a mandatory master thesis guided by the thesis supervisor.

- Thesis Module: Master Thesis (m, 30 CP)

The Master thesis provides an opportunity for students to develop their interests in a specific subject area or specialization, and to demonstrate their ability to undertake independent research. Before being eligible to submit the final thesis, students must present and submit a research proposal in advance.

3 DSSB Program Regulations

3.1 Scope of These Regulations

The regulations in this handbook are valid for all students who entered the DSSB graduate online program at Constructor University in Fall 2024. In case of conflict between the regulations in this handbook and the general policies for master online studies, the latter shall apply (see https://constructor.university/student-life/student-services/university-policies/academic-policies).
).

In exceptional cases, certain necessary deviations from the regulations of this study handbook might occur during the course of study (e.g., change of the semester sequence, assessment type, or the teaching mode of courses).

In general, Constructor University Bremen reserves therefore the right to change or modify the regulations of the program handbook also after its publication at any time and in its sole discretion.

3.2 Degree

Upon successful completion of the program, students are awarded a Master of Science (MSc) degree in Data Science for Society and Business.

3.3 Graduation Requirements

In order to graduate, students need to obtain 120 CP. In addition, the following graduation requirements apply:

- In each module, students need to obtain a minimum CP, as indicated in Chapter 2 of this handbook.
- Students need to complete all mandatory components of the program, as indicated in Chapter 2 of this handbook.

4 Module Descriptions

4.1 Core Area

4.1.1 Digital Societies and Future Economies

Module Name	**Module Code**	**Level (type)**	**CP**
Digital Societies and Future Economies		Year 1 (CORE)	7.5

Module Components

Number	Name	Type	CP
	Digital Societies and Future Economies	Lecture (online)	5
XXXXX	Digital Societies and Future Economies Tutorial	Tutorial (online)	2.5

Module Coordinator	**Program Affiliation**	**Mandatory Status**
Prof. Dr. Hilke Brockmann	• MSc Data Science for Society and Business online (DSSB) (online)	Mandatory for DSSB (online)

Entry Requirements			**Frequency**	**Duration**
Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills	Annually (Fall)	1 semester
☒ None	☒ None			

Student Workload

Asynchronous Self Study	Interactive Learning	Assessment Preparation	Independent Study	Hours Total
45 h	25 h	47.5h	70 h	187.5 h

Recommendations for Preparation

- Martin Kenney (Ed) (2000) Understanding Silicon Valley. The Anatomy of an Entrepreneurial Region. Stanford University Press. Stanford.
- OECD (2019) Measuring the Digital Transformation. A Roadmap to the Future. OECD Publishing. Paris.

Content and Educational Aims

What institutional, scientific, economic, political, and social constellations procured the development and success of digital technologies? Who are the major agents in the IT revolution? And what consequences will future people, economies, political regimes, and societies face from ongoing digital innovations? During this introductory lecture, students learn in depth about digital technologies, their economy, as well as their legal, political, and social context and future impact. Starting with the rise of Silicon Valley, the module shows how the clustering of political will, research money, university trained resources, venture capital, and expanding intellectual property rights enabled people to innovate, start new businesses, and eventually become rich. We will then take stock of the contemporary digital technologies, and analyze how they shape today's economy, power structures, and social processes around the globe. The last part of the lecture will focus on the predicted and simulated outcomes of the next wave of digital innovations, particularly on the effect of AI, quantum computing, and other digital innovations on future societies and our planet.

Topics

- the history of digital innovation
- the specifics of digital and communication technologies
- the digital networked economy and its legal framework
- digital politics - chances and threats
- networked elites
- from the digital divide to digital social mobility
- prediction, simulation, and discussions on the effects of digital innovations on future capitalism, democracy, consumption, and the planet

Intended Learning Outcomes

By the end of this module, students should be able to

1. know, understand, and assess the major concepts and social determinants of technological progress, digital progress in particular, and the concept of digital technologies as "general purpose technologies"
2. explain and evaluate the social, military, economic, and political context of technological innovation
3. comprehend and critically assess the political economy and business models of the IT industry
4. know and discuss the most important IT regulations in the EU, US, and developing countries
5. analyze and judge digital politics from an international perspective
6. identify, comprehend, and develop solutions for the social "digital divide"
7. explain, compare, and predict the disruptive consequences of digital innovations, particularly the impact of AI on people's life and social institutions

Indicative Literature

None.

Usability and Relationship to other Modules

This module lays the groundwork for the study and a deeper understanding of the causes and consequences of digital transformation of contemporary societies. It connects to the studies on digital business functions and models, artificial intelligence, digital innovation and ethics and IT law.

Examination Type: Module Examination

Assessment Type: Written Examination Duration: 120 min
Weight: 100%

Scope: All intended learning outcomes of the module.
Completion: To pass this module, the examination has to be passed with at least 45%.

4.1.2 Data Science Concepts

Module Name	**Module Code**	**Level (type)**	**CP**
Data Science Concepts		Year 1 (CORE)	7,5

Module Components

Number	Name	Type	CP
	Data Science Concepts	Lecture (online)	5
XXXXX	Data Science Concepts Tutorial	Tutorial (online)	2.5

Module Coordinator	**Program Affiliation**	**Mandatory Status**
Prof. Dr. Jan Lorenz	• MSc Data Science for Society and Business online (DSSB) (online)	Mandatory for DSSB (online)

Entry Requirements			**Frequency**	**Duration**
Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills	Annually (Fall)	1 semester
☒ None	☒ Data Science Tools			

Student Workload

Asynchronous Self Study	Interactive Learning	Assessment Preparation	Independent Study	Hours Total
35 h	52.5 h	30 h	70 h	187.5 h

Recommendations for Preparation

Partake in the free online introduction “Data Science 101” from simplilearnhttps://youtu.be/swqjxawCh_Y?si=dS83AvckDBp2nP9d

Content and Educational Aims

Data science is currently one of the hottest fields in the job market, and combines concepts and techniques from various fields, in particular computer science and statistics. This module combines the mathematical and statistical foundations with the major algorithmic concepts of data science. The module introduces the fundamental principles of linear algebra for data analysis and gives special attention to dimension reduction techniques and other data projection algorithms. It covers the fundamental probability concepts needed for assessing and evaluating modeling results and predictions, and proceeds to discuss complexity issues for data science projects. The second part of the module overviews supervised and unsupervised learning techniques.
This module aims at providing the fundamental knowledge in mathematics and statistics necessary for understanding the practical application of data science algorithms and evaluating their performance. It also provides an overview of the fundamental concepts along with the main questions and approaches in data science.
Students will learn how to address societal and business-related issues based on practically relevant questions, digital data, and their learned programming and analytical skills from synchronized methods modules.

Intended Learning Outcomes

Upon the completion of this module, students will be able to:

1. understand and use the mathematical foundations of statistical learning algorithms
2. explain and classify data science problems
3. explain and classify data-driven approaches
4. understand the application of data science techniques to typical situations and tasks in business and societal research, including the search, retrieval, preparation, and statistical analysis of data
5. interpret complexity analysis and performance evaluation of data science problems and algorithms

Indicative Literature

Kotu, Deshpande (2019) Data Science: Concepts and Practice. Cambridge, MA: Morgan Kaufman, Elsevier.

Bruce, Bruce, Gedeck (2020) Practical Statistics for Data Scientists. 50+ Essential Concepts Using R and Python. Sebastopol, CA: O-Reilley.

Usability and Relationship to other Modules

This module creates the foundation for all data science related modules in the program. Practical applications of approaches studied in this module will be performed in the Data Science Tools module.

Examination Type: Module Examination

Assessment Type: Written Examination Duration: 120 min
Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the examination has to be passed with at least 45%.

4.1.3 Digital Business Models and Functions

Module Name			**Module Code**	**Level (type)**	**CP**
Digital Business Models and Functions				Year 1 (CORE)	7.5
Module Components					
Number	Name			Type	CP
	Digital Business Models and Functions			Lecture (online)	5
XXXXX	Digital Business Models and Functions Tutorial			Tutorial (online)	2.5
Module Coordinator	**Program Affiliation** • MSc Data Science for Society and Business online (DSSB) (online)			**Mandatory Status** Mandatory for DSSB (online)	
Entry Requirements			**Frequency**	**Duration**	
Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills	Annually (Spring)	1 semester	
☒ none	☒ None	• Academic writing skills • Good understanding of the principles of business functions			

Student Workload				
Asynchronous Self Study	Interactive Learning	Assessment Preparation	Independent Study	Hours Total
35 h	52.5 h	30 h	70 h	187.5 h

Recommendations for Preparation
None.

Content and Educational Aims

Businesses today have just begun to understand the potential of data abundance. Companies such as Amazon and Google were among the pioneers of data-driven business models. Many technology-based start-ups are eager to follow their lead. The data-driven revolution in the business world is nothing less than what Schumpeter termed a process of creative destruction. In this case, the destruction is of the long-established ways of doing business. The representatives of this new-age alternative business models range from shared economies and platform businesses to subscription models, even in the most traditional industries.

In this module, we will uncover the antecedents, drivers, and potentials of a data-driven economy by focusing on entrepreneurs and how their experiments creatively disrupt the way we used to do business. We will explain why e-commerce is the fastest growing segment in retail today. We will examine e-commerce business models, technology infrastructure, e-commerce marketing and advertising concepts, social networks, auctions, and portals, as well as ethical, social, and political issues with the help of prominent case studies. At the end of the module, students will be able to build their own e-commerce (small-scale) companies.

Intended Learning Outcomes

By the end of this module, students should be able to

1. know about the development of business models on the Internet
2. conceptually understand how to build an e-commerce presence
3. comprehensively understand e-commerce security and payment systems
4. critically understand e-commerce marketing and advertising
5. discuss and reflect on major obstacles and possible solutions in e-commerce ethics
6. critically evaluate and design business case studies

Indicative Literature

Zott, Amit (2017) Business Model Innovation: How to Create Value in a Digital World. Marketing Intelligence Review 9 (1) DOI: https://doi.org/10.1515/gfkmir-2017-0003

Wirtz (2019) Digital Business Models: Concepts, Models, and the Alphabet Case Study. Cham: Springer Nature.

Usability and Relationship to other Modules

This module focuses on digital business concepts and digital business models. It connects to the core "Digital Transformation and Innovation" and "Artificial Intelligence in Business and Society" modules. However, it also forms the base for students who want to develop their own business ideas in the discovery section of the program and outside academia.

Examination Type: Module Examination

Assessment Type: Term Paper Length: 5000 words
Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the examination has to be passed with at least 45%.

4.1.4 Data Analytics

Module Name			**Module Code**	**Level (type)**	**CP**
Data Analytics			XXX	Year 1 (CORE)	7.5
Module Components					
Number	Name			Type	CP
XXXX	Data Analytics			Lecture (online)	5
XXXX	Data Analytics Tutorial			Tutorial (online)	2.5
Module Coordinator Prof. Dr. Adalbert F.X. Wilhelm	**Program Affiliation** MSc Data Engineering Technologies online (DET) (online)			**Mandatory Status** Mandatory for DET (online), and for DSSB (online)	
Entry Requirements Pre-requisites ☒ None	Co-requisites ☒ None	Knowledge, Abilities, or Skills ☒ None	**Frequency** Biannually (Fall and Spring)	**Duration** 1 semester	

Student Workload				
Asynchronous Self Study	Interactive Learning	Assessment Preparation	Independent Study	Hours Total
35 h	35h	60 h	57.5 h	187.5 h

Recommendations for Preparation

Read the Syllabus.
Take the free online course “Introduction to Data Science” at https://cognitiveclass.ai/courses/data-science-101/

Content and Educational Aims

This module introduces the concepts and methods of data analytics. The objective of the module is to present methods for gaining insights from data and drawing conclusions for analytical reasoning and decision making. The module comprises a broad spectrum of methods for modeling and understanding complex datasets. Comprising both descriptive and predictive analytics, the standard portfolio of supervised and unsupervised learning techniques is introduced. Automatic analysis components, such as data transformation, aggregation, classification, clustering, and outlier detection, will be treated as an integral part of the analytics process.
As a central part of this module, students are introduced to the major concepts of statistical learning, such as cross-validation, feature selection, and model evaluation. The module combines and applies the theoretical foundation of data analytics with a practical exposure to the data analysis process.

Intended Learning Outcomes

By the end of this module, students will be able to

1. explain advanced data analytics techniques in theory and application
2. apply data analytics methods to real-life problems using appropriate tools
3. evaluate and compare different data analytics algorithms and approaches
4. apply statistical concepts to evaluate data analytics results

Indicative Literature

G. James, D. Witten, T. Hastie, Rob Tibshirani: Introduction to Statistical Learning with R by Springer, 2013. (ISLR)
A. Telea, Data Visualization: Principles and Practice, Wellesley, Mass.: AK Peters, 1st edition, 2008. (DV)

M. Ward, G. Grinstein, D. Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. AK Peters, 1st edition, 2010. (IDV)

Usability and Relationship to other Modules

- In this module, students will learn the concepts and various techniques of data analysis. They will be applied in other Data Engineering Technologies modules, and typically also in the master thesis.

Examination Type: Module Examination

Assessment Type: Project Report Length: 4000 words

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the examination has to be passed with at least 45%.

4.1.5 Digital Transformation and Innovation

Module Name	**Module Code**	**Level (type)**	**CP**
Digital Transformation and Innovation		Year 2 (CORE)	7.5

Module Components

Number	Name	Type	CP
	Digital Transformation of Organizations	Seminar (online)	2.5
	Digital Services and Innovation	Seminar (online)	2.5
	Digital Services and Innovation Tutorial	Tutorial (online)	2.5

Module Coordinator	**Program Affiliation**	**Mandatory Status**
NN	• MSc Data Science for Society and Business online (DSSB) (online)	Mandatory for DSSB (online)

Entry Requirements			**Frequency**	**Duration**
Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills	Annually (Fall)	1 semester
☒ None	☒ None	☒ None		

Student Workload

Asynchronous Self Study	Interactive Learning	Assessment Preparation	Independent Study	Hours Total
47.5 h	20 h	30 h	90 h	187.5 h

Recommendations for Preparation

Vargo, S. L., Lusch, R. F. (2004). Evolving to a new dominant logic for marketing. Journal of Marketing, 68(1): 1-17.

Content and Educational Aims

The goal of this module is to help students learn, understand, and practice data-driven innovation for customers and change processes at an individual and organizational level. This module helps students understand real-life challenges in a complex and digitized world with multiple stakeholder interests. Further, students learn to develop and present innovative user-centered and theory-oriented solutions for real-world challenges in an IT-driven world. This module is home to two seminars. The first seminar investigates the digital transformations of organizations. It prepares students to understand and manage organizational change and transformation processes against a digitalization background. In particular, the following topics are discussed: organizational and algorithmic decision making, change and inertia, automation and reliability, and data-driven blindspots. The second seminar looks into digital innovation and their users. This seminar is strongly based on the paradigm of user-centeredness, user-centered design, and the ideas of the service dominant logic—a meta-theoretical framework for explaining value co-creation through exchange among various configurations of actors. Case studies will deepen the understanding howa service dominant logic, customer integration, gamification, P2P translates into innovative business services and products

Intended Learning Outcomes

Upon completion of this module, students will be able to:

1. summarize and classify the new data- and customer-driven technologies in a business context
2. explain the economic and business rules in the information age
3. explain the pros and cons of reliance on data and automation in organizations
4. conduct independent analyses of organizations,' markets,' and users' needs using scientific methods
5. explain the service dominant logic (SDL) for business/entrepreneurial activities and the power of new technologies for customer relationship management
6. improve their oral communication, along with individual and group presentation skills

Indicative Literature

Vargo, S. L., Lusch, R. F. (2004). Evolving to a new dominant logic for marketing. Journal of Marketing, 68(1): 1-17.

Usability and Relationship to other Modules

This module teaches the impact of digital technologies on product innovation and organizational change. Insights can be used in all business and society related modules and the master thesis module.,

Examination Type: Module Examination

Assessment Type: Term Paper Length: 4000 words
Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the examination of each module component has to be passed with at least 45%.

4.1.6 Artificial Intelligence in Business and Society for DSSB

Module Name	**Module Code**	**Level (type)**	**CP**
Artificial Intelligence in Business and Society for DSSB		Year 2 (CORE)	7.5

Module Components

Number	Name	Type	CP
XX-A	Artificial Intelligence in Business and Society	Lecture (online)	2.5
XX-B	Artificial Intelligence in Business and Society Tutorial	Tutorial (online)	2.5
XX-C	Artificial Intelligence in Business and Society	Seminar (online)	2.5

Module Coordinator	**Program Affiliation**	**Mandatory Status**
Prof. Dr. Adalbert F.X. Wilhelm	• MSc Data Science for Society and Business online (DSSB) (online)	Mandatory for DSSB (online)

Entry Requirements			**Frequency**	**Duration**
Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills	Annually (Fall)	1 semester
• None	☒ None	• Profound knowledge in R or Python • Profound knowledge of the data science life cycle		

Student Workload

Asynchronous Self Study	Interactive Learning	Assessment Preparation	Independent Study	Hours Total
35 h	35 h	90 h	27.5 h	187.5 h

Recommendations for Preparation

Harvard Business Review (2019) Artificial Intelligence. HBSP: Boston, MA.

Content and Educational Aims

AI is one of the current key words that instills hopes for reshaping economies by promising to generate productivity gains, improve efficiency, and contribute to better lives. At the same time, AI is also fueling anxieties and ethical concerns about codifying and reinforcing existing biases and infringing human rights, along with exacerbating inequality, climate change, market concentration, and the digital divide. This module will give a historical overview of AI's evolution, from the development of symbolic AI in the 1950s to the recent achievements in machine learning. It will introduce the basic AI principles and algorithms applied to common problems, including search, optimization, planning, and pattern recognition. The module will discuss the economic landscape of AI and its role as a new general-purpose technology that can lower the cost of prediction and enable better decisions, hence resulting in cost savings and enabling better resource allocation for a variety of applications, such as transport, agriculture, finance, marketing and advertising, science, health, criminal justice, security, the public sector, and augmented/virtual reality. The module will also review salient policy issues that accompany the diffusion of AI.

The objective of this module is to enhance students with the fundamental technical skills and knowledge to plan, design, develop, and evaluate AI applications from a business and a societal viewpoint. Upon successful completion of the module, students will not only have a profound knowledge on common techniques and areas of AI, including problem

solving, knowledge representation, reasoning, decision making, planning, perception and action, and learning, but will also be able to understand the implementation of the key components of intelligent agents with a moderate complexity.

The tutorial offers students the opportunity to ask questions, discuss content with their peers and to deepen their understanding of the material presented in the lectures.
The seminar provides additional opportunities to dive deeper in individual aspects and applications of AI systems in business and society. Moreover, it strengthens the critical review potential of students by debating about ethical, legal, and cultural issues relating to the usage of AI systems.

Intended Learning Outcomes

Upon the completion of this module, students will be able to:

1. understand key terms and components in AI approaches
2. explain key methods and techniques for automated decision making
3. understand implementations of key components of AI systems
4. evaluate the potentials and threats induced by AI systems
5. appraise AI application areas
6. discuss salient policy issues stirred by AI systems
7. Debate about ethical, legal and cultural controversies around AI systems

Indicative Literature

Agrawal, Gans, Goldfarb (2018) Prediction Machines. The Simple Economics of Artificial Intelligence. HBSP: Boston, MA

Cath, Wachter et al. (2017) Artificial Intelligence and the "Good Society": The US, EU, and UK approach. Science and Engineering Ethics 24, 505-528.

Usability and Relationship to other Modules

This module uses insights from core and methods modules and can be applied to the master thesis.

Examination Type: Module Component Examination

Module Component 1: Lecture & Tutorial

Assessment Type: Project Report Length: 3000 words
Weight: 67%

Scope: All intended learning outcomes, but with a predominant focus on 1-6

Module Component 2: Seminar

Assessment Type: Presentation Duration: 20 minutes
Weight: 33%

Scope: All intended learning outcomes, but with a predominant focus on ILO 7.

Completion: To pass this module, the examination of each module component has to be passed with at least 45%.

4.2 Methods Area

4.2.1 Data Science Tools

<table>
<tr><td colspan="3">Module Name
Data Science Tools</td><td>Module Code</td><td>Level (type)
Year 1 (METHODS)</td><td>CP
7.5</td></tr>
<tr><td colspan="6">Module Components

Number | Name | Type | CP
| Data Science Tools in R | Lecture (online) | 2.5
| Data Science Tools in Python | Lecture (online) | 2.5
XXXXXX | Data Science Tools Tutorial | Tutorial (online) | 2.5</td></tr>
<tr><td>Module Coordinator

Dr.
Jan Lorenz</td><td colspan="3">Program Affiliation

• MSc Data Science for Society and Business online (DSSB) (online)</td><td colspan="2">Mandatory Status

Mandatory for DSSB (online)</td></tr>
<tr><td colspan="3">Entry Requirements

Pre-requisites: ☒ None
Co-requisites: ☒ Data Science Concepts
Knowledge, Abilities, or Skills: ☒ None</td><td>Frequency

Annually (Fall)</td><td colspan="2">Duration

1 semester</td></tr>
<tr><td colspan="6">Student Workload
Asynchronous Self Study | Interactive Learning | Assessment Preparation | Independent Study | Hours Total
35 h | 67.5 h | 0 h | 85 h | 187,5 h</td></tr>
<tr><td colspan="6">Recommendations for Preparation

Partake in the free online introduction “Data Science 101”. from Simplilearn at https://youtu.be/swqjxawCh_Y?si=dS83AvckDBp2nP9d</td></tr>
<tr><td colspan="6">Content and Educational Aims

Python and R are the most common programming languages in data science. Both Python and R build on vast software ecosystems and communities, and hence, can be used for tackling any data science task. While Python typically comes more intuitively to persons with a computer science or software development background, R allows them to be more productive in a shorter time without a programming background. This module has two lectures and an accompanying tutorial session. The first lecture will focus on R and the second one on Python. Students will acquire fundamental programming skills in R and Python. They will explore various features of both programming languages and learn essential steps and commands for reading, converting, cleaning, storing, and transforming data to prepare it for statistical analyses. The tutorial allows students to discuss practical implementation issues, to ask questions, and to collaborate in teams on programming assignments. The module aims at providing an overview of the entire knowledge discovery process and will illustrate the predominant challenges and strategies through examples.</td></tr>
</table>

Intended Learning Outcomes

By the end of this module, students will be able to:

1. explain basic concepts of imperative and object-oriented programming
2. write, test, and debug programs
3. perform data handling and data manipulation tasks in R and Python
4. apply their knowledge to implement their own functions in R and Python
5. effectively use core packages and libraries of R and Python for data analysis
6. know about the typical applications of R and Python in data science
7. implement and apply advanced data mining methods with appropriate tools
8. perform a full cycle of data analysis

Indicative Literature

Wickham, Grolemund (2017) R for Data Science: Import, Tidy, Transform, Visualize, and Model Data. Sebastopol, CA: O-Reilly.

VanderPlas (2016) Python Data Science Handbook: Essential Tools for Working with Data. Sebastopol, Ca: O'Reilly.

Usability and Relationship to other Modules

This module will put the theoretical and conceptual knowledge in "Data Science Concepts" into practice. It is the fundamental basis for all advanced modules comprising practical programming tools for Data Science.

Examination Type: Module Examination

Assessment Type: Project Report Length: 4000 - 5000 words
Weight: 100%

Scope: All intended learning outcomes of the module.

Module achievement: 50% of the assignments correctly solved.
This module introduces the R and Python programming languages. Students develop their imperative programming skills by solving data handling and data analysis problems. The module achievement ensures that a sufficient level of practical programming and problem-solving skills has been obtained.

In addition, students can use these assignments to improve their grade by 0.33 points (German grading system). although this is not necessary to reach the best grade in the module (1.0).

Completion: To pass this module, the examination has to be passed with at least 45%.

4.2.2 Text Analysis and Natural Language Processing

Module Name	**Module Code**	**Level (type)**	**CP**
Text Analysis and Natural Language Processing		Year 1 (METHODS)	7.5

Module Components

Number	Name	Type	CP
	Text Analysis and Natural Language Processing	Seminar (online)	5
XXXXX	Text Analysis and Natural Language Processing Tutorial	Tutorial (online)	2.5

Module Coordinator	**Program Affiliation**	**Mandatory Status**
NN	• MSc Data Science for Society and Business online (DSSB) (online)	Mandatory for DET (online) and DSSB (online)

Entry Requirements			**Frequency**	**Duration**
Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills	Annually (Spring)	1 semester
☒ None	☒ None	☒ Programming skills in R or Python at an intermediate level		

Student Workload

Asynchronous Self Study	Interactive Learning	Assessment Preparation	Independent Study	Hours Total
35 h	67.5 h	0 h	85 h	187.5 h

Recommendations for Preparation
None.

Content and Educational Aims

This module will teach the fundamentals of text mining, natural language processing, and automated content analysis using RapidMiner and Python. Students will learn the entire text analysis pipeline, from basic web scraping techniques for collecting text data from social media, over text representations and ontologies, to text mining algorithms and efficient representation of analysis results. Students will be exposed to theoretical and methodological foundations of text mining, such as word frequencies, ontologies, bag-of-word, as well as the application of machine learning algorithms for text and sentiment analysis. The module will introduce exemplary studies on text and sentiment analysis and provide an opportunity for hands-on programming to realize different analyses. The module covers a spectrum of text mining methods, from basic lexicographic measures to more complex statistical learning algorithms such as sentiment analysis and topic modeling.

Intended Learning Outcomes

By the end of this module, students should be able to

1. explain the concept of “text as data”
2. use basic methods for information extraction and text data retrieval
3. process and prepare text data for statistical modeling and automated content analysis
4. perform different text analyses using text mining packages in R
5. interpret diverse text analytical measures
6. undertake a knowledgeable automated content analysis with text data

Indicative Literature

Lane, Howard, Hapke (2019) Natural Language Processing in Action. Shelter Ilant: NYy

Usability and Relationship to other Modules

This module translates the insights from “Data Science Concepts” into text analysis. It presents the fundamentals of text analysis to be applied and expanded in the module AI in Business and Society as well as for potential master thesis topics in this area.

Examination Type: Module Examination

Assessment Type: Project Report Length: 4000 words
Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the examination has to be passed with at least 45%.

4.2.3 Visual Communication and Data Storytelling

Module Name Visual Communication and Data Storytelling	**Module Code**	**Level (type)** Year 2 (METHODS)	**CP** 7.5

Module Components

Number	Name	Type	CP
	Visual Communication and Data Storytelling	Lecture (online)	5
XXXXX	Visual Communication and Data Storytelling Tutorial	Tutorial (online)	2.5

Module Coordinator Dr. Jan Lorenz	**Program Affiliation** • MSc Data Science for Society and Business online (DSSB) (online)	**Mandatory Status** Mandatory for DET (online) and DSSB (online)

Entry Requirements Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills	**Frequency** Annually (Fall)	**Duration** 1 semester
☒ Data Science Concepts ☒ Data Science Tools	☒ None	☒		

Asynchronous Self Study	Interactive Learning	Assessment Preparation	Independent Study	Hours Total
35 h	62.5 h	60 h	30 h	187.5 h

Recommendations for Preparation
Read the syllabus and search for appropriate online example cases.

Content and Educational Aims

Data is often intuitively communicated using statistical graphs and visualization dashboards. Effective communication using visuals and dashboards has become a key qualification for modern business intelligence professionals. This module introduces the basic ideas and concepts of data visualization and data storytelling. Computer-based visualization systems provide visual representations of datasets to process data more effectively. These datasets may come from different sources, such as scientific experiments, simulations, medical scans, commercial databases, financial transactions, health records, and social networks. They also cater to different audiences. Students will learn about the theory of graphical design and the science of visual perception to make compelling visual representations with static and interactive maps for a scientific and non-scientific audience. Students learn to design elegant data visualizations that support the exchange of information and corroborate the data findings. Students also learn to evaluate visualization systems from both the designer's and audience's perspective. Visualization skills are further elaborated with the support of selected online programming snippets.

Topics:
- Theory of graphical design
- Grammar of graphics
- Science of visual perception
- Exploratory data analysis and static graphics in R
- Scientific storytelling for various formats and audiences
- Visualization programming

Intended Learning Outcomes

By the end of this module, students should be able to

1. visually represent various data sources
2. choose suitable visual representations for different data sets
3. evaluate visual depictions of data
4. assist users in visual data analysis
5. target visual representations to different audiences

Indicative Literature

Dykes (2019) Effective Data Storytelling: How to Drive Change with Data, Narrative, and Visuals. Hoboken, NJ: Wiley.

Nussbaumer, Knaflic (2015) Storytelling with Data: A Data Visualization Guide for Business Professionals. Hoboken, NJ: Wiley.

Usability and Relationship to other Modules

Can be used in all modules, particularly in master thesis modules.

Examination Type: Module Examination

Assessment Type: Project Report Length: 5000 words
Weight: 100%

Scope: All intended learning outcomes of the module.
Completion: To pass this module, the examination has to be passed with at least 45%.

4.3 Foundation Area

4.3.1 Mathematics for Graduate Students

<table>
<tr><td colspan="3">Module Name
Mathematics for Graduate Students</td><td>Module Code
XX-01</td><td>Level (type)
Year 1
(Foundation)</td><td>CP
7.5</td></tr>
<tr><td colspan="6">Module Components

Number | Name | Type | CP
XX-01 | Mathematics for Graduate Students | Lecture (online) | 7.5</td></tr>
<tr><td>Module Coordinator

NN</td><td colspan="3">Program Affiliation

• MSc Data Engineering Technologies online (DET) (online)</td><td colspan="2">Mandatory Status

Mandatory for DET (online) and DSSB (online)</td></tr>
<tr><td colspan="3">Entry Requirements

Pre-requisites: ☒ None
Co-requisites: ☒ None
Knowledge, Abilities, or Skills: • Mathematics at High School level</td><td>Frequency

Annually (Fall)</td><td colspan="2">Duration

1 semester</td></tr>
<tr><td colspan="6">Student Workload
Asynchronous Self Study | Interactive Learning | Assessment Preparation | Independent Study | Hours Total
35 h | 35 h | 30 h | 87.5 h | 187.5 h</td></tr>
<tr><td colspan="6">Recommendations for Preparation
Read the Syllabus.</td></tr>
<tr><td colspan="6">Content and Educational Aims
• This module offers a highly structured introduction to the fundamentals of three major pillars of mathematical modelling and analysis: Single and multivariable calculus, linear algebra, as well as the fundamentals of combinatorics and probabilities as they are used for statistical modeling and estimation.
• It is a gateway for graduate students who have not been exposed to the topics so far, or who were exposed to them long ago and need a refresher.
• The module starts with an introduction to linear algebra, including matrices, determinants, eigenvalues, eigenvectors, scalar products, and norms. It continues with single and multivariable calculus, including sequences, series, limits, derivatives, Taylor series, and integrals. The module focuses on practical experience rather than on mathematical rigor.
• The module continues then with the concept of probabilities, including joint, conditional and total probabilities with a focus on independence, which leads us to a discussion of Bayes's theorem. We shall then proceed to factorials, and binomial coefficients, with many applications to be followed by the binomial law, and its Poisson and Normal approximations. A second block covers random variables with their distributions and density functions. Here we are going to discuss continuous random variables in detail. It concludes with the essential ideas of expected values, moments, and estimation.</td></tr>
</table>

Intended Learning Outcomes

Upon completion of this module, students will be able to:

1. calculate derivatives and simple integrals;
2. apply the fundamental concepts of calculus and linear algebra in structured situations;
3. understand and use vectors and matrices, calculate determinants, eigenvalues and eigenvectors in simple cases;
4. explain the importance of the methods of calculus and linear algebra in problems arising from applications;
5. understand the methods of calculus and linear algebra used in more advanced modules as well as in scientific literature.
6. understand the fundamental concepts of probabilities and combinatorics and to apply them in structured situations,
7. apply important probability laws (Binomial, Poisson, Normal),
8. understand and apply probability distributions and densities,
9. understand and apply means, variances, and covariances – also in the context of simple estimation contexts.

Indicative Literature

G. Strang, Introduction to Linear Algebra, 5th edtion, Wellesley-Cambridge Press, 2016, ISBN: 978-09802327-7-6.

H. Stark, J. W. Woods, Probability and Random Processes with Applications to Signal Processing, Third Edition, 2002.

Usability and Relationship to other Modules

This module introduces and refreshes the essential Calculus and Linear Algebra required in most of the modules of the data science and data engineering programs. Familiarity with probability-related concepts is the basis to understand the foundations of stochastic modelling and the data analytics and machine learning techniques which form a central part of data science.

Examination Type: Module Examination

Assessment Type: Written Examination Duration: 120 min
Weight: 100%

Scope: All intended learning outcomes of the module

Completion: To pass this module, the examination has to be passed with at least 45%.

4.3.2 IT Law

Module Name			**Module Code**	**Level (type)**	**CP**
IT Law				Year 1 (Foundation)	2.5
Module Components					
Number	Name			Type	CP
	IT Law			Lecture (online)	2.5
Module Coordinator Prof. Dr Hilke Brockmann/ Prof. Dr. Stefan Kettemann	**Program Affiliation** • MSc Data Science for Society and Business (DSSB) (online)			**Mandatory Status** Mandatory for DET (online) and DSSB (online)	
Entry Requirements Pre-requisites ☒ None	Co-requisites ☒ None	Knowledge, Abilities, or Skills ☒ None	**Frequency** Annually (Spring)	**Duration** 1 semester	

Student Workload

Asynchronous Self Study	Interactive Learning	Assessment Preparation	Independent Study	Hours Total
17.5 h	10 h	10h	25 h	62.5 h

Recommendations for Preparation
None.

Content and Educational Aims

Digital information, the Internet, and applications like YouTube or social networking tools like Instagram, Facebook, or Twitter have disrupted legal systems (Murray 2016). IT law is not limited to one legal area but encompasses civil, public, and criminal laws. It spans from human rights law to intellectual property law, contract and consumer protection law, privacy law, data protection law, and other legal domains. Moreover, the global exchange of data is in conflict with the territorial principle of jurisdiction. In addition, IT regulations are in constant flux to keep up with the accelerated pace of technological progress. This module investigates the most important areas of IT law. It provides the participants with a sound understanding of legal principles and regulations, and sheds light on international as well as European ICT policies and governance. A special focus will be given to the European General Data Protection Regulation (GDPR).

Intended Learning Outcomes

By the end of this module, students should be able to

1. identify legal questions and implications in relation to digital transformation technologies/IT law/ AI and algorithms
2. understand fundamental national and international legal frameworks related to the use of data
3. know the relevant IP rights regarding data and algorithms
4. understand and critically assess legal regulations about data privacy and data protection
5. recognize and explain the types of bias inherent in data processing
6. explain the legal concerns related to data-based automatic decision making
7. understand how to comply to the GDPR and assess its impact on individuals, firms, and organizations
8. understand and critically evaluate the liabilities and available remedies regarding data
9. explain and develop potential future IT regulation mechanisms

Indicative literature

Lloyd (2020). Information Technology Law. Oxford: Oxford University Press (9th ed).

Usability and Relationship to other Modules

IT Law provides the fundamental knowledge on the legal framework when dealing with data. This knowledge will be expanded and applied in courses such as "Ethics and the Information revolution" and needs to be taken into account in the master thesis module.

Examination Type: Module Examination

Assessment Type: Term Paper Length: 3000 words
Weight: 100%

Scope: All intended learning outcomes of the module.
Completion: To pass this module, the examination has to be passed with at least 45%.

4.3.3 Data Security and Privacy

Module Name Data Security and Privacy			**Module Code** XX	**Level (type)** Year 1 (Foundation)	**CP** 2.5
Module Components					
Number	Name			Type	CP
XX	Data Security and Privacy			Lecture (online)	2.5
Module Coordinator NN	**Program Affiliation** • MSc Data Engineering Technologies online (DET) (online)			**Mandatory Status** Mandatory for DET (online) and DSSB (online)	
Entry Requirements Pre-requisites ☒ None	Co-requisites ☒ None	Knowledge, Abilities, or Skills ☒ None	**Frequency** Annually (Spring)	**Duration** 1 semester	

Student Workload				
Asynchronous Self Study	Interactive Learning	Assessment Preparation	Independent Study	Hours Total
17.5 h	10 h	10 h	25 h	62.5 h

Recommendations for Preparation
Read the syllabus.

Content and Educational Aims

- Data Security and Privacy introduces concepts of data security. Basic cryptographic mechanisms are introduced, and it will be explained how these mechanisms can be used to protect data during transmission over the Internet or while data is stored on computing systems. The module component will also introduce the technical aspects of data privacy and concepts such as anonymity, linkability, observability and pseudonymity.

Intended Learning Outcomes

Upon completion of this module, students will be able to:

1. analyze and develop principles of symmetric and asymmetric encryption
2. understand the use of cryptographic hash functions to ensure data integrity
3. summarize and communicate the principles of key management approaches
4. assess and choose appropriate techniques for authentication
5. critically assess how data security and privacy issues are solved and how this will impact the data security of applications

Indicative Literature

D. R. Stinson, Cryptography: Theory and Practice, ISBN, 1-58488-206-9, Chapman & Hall. 4th edition, 2018.

https://ebookcentral.proquest.com/lib/jacob/detail.action?docID=5493336

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment Type: Written examination Duration: 90 minutes
Weight: 100%

Scope: All intended learning outcomes of the module

Completion: To pass this module, the examination has to be passed with at least 45%.

4.3.4 Data Base Management Tools in Python

Module Name Data Base Management Tools in Python			**Module Code** XX	**Level (type)** Year 2 (Foundation)	**CP** 7.5
Module Components					
Number	Name			Type	CP
XX-A	Data Base Management Tools in Python			Lecture (online)	2.5
XX-B	Data Base Management Tools in Python – Programming Tutorial			Tutorial (online)	2.5
XX-C	Data Base Management Tools in Python Tutorial			Tutorial (online)	2.5
Module Coordinator NN	**Program Affiliation** • MSc Data Engineering Technologies (DET) (online)			**Mandatory Status** Mandatory for DET (online) and DSSB (online)	
Entry Requirements Pre-requisites ☒ None	Co-requisites ☒ None	Knowledge, Abilities, or Skills ☒ None	**Frequency** Annually (Fall)	**Duration** 1 semester	

Student Workload				
Asynchronous Self Study	Interactive Learning	Exam Preparation	Independent Study	Hours Total
35 h	35 h	30 h	87.5 h	187.5 h

Recommendations for Preparation
Read the Syllabus.

Content and Educational Aims

- This module introduces students to the field of data management with Python. Data management describes the vast field of methodologies to collect, store, process and provision data. The aim of this module is to focus on a very applied view of these tasks.
- Since Python has become the de-facto standard in the field, the initial part of the module is concerned with a basic introduction into core concepts of imperative programming in Python.
- Data structures and fundamental algorithms are discovered in a hands-on fashion. These will also include basic numerical and data analysis tasks based on NumPy/SciPy. One source from which we can collect and in which we can store data are relational databases.
- The course introduces the Structured Query Language (SQL) to get access to this data source. More recently, data is frequently stored in Data Frames, a data structure provided by Pandas, a Python library. Pandas also

provides functionality to carry out data analysis tasks. Provisioning of data analysis outputs will be done by basic2D visualization techniques.

Intended Learning Outcomes

Upon completion of this module, students will be able to:

1. explain and apply fundamental concepts of imperative programming using Python
2. understand and use basic data structures
3. summarize and apply fundamental algorithms (e.g. sorting)
4. execute basic data analysis tasks (average, min, max, ...)
5. understand and implement linear algebra operations using NumPy/SciPy
6. explain fundamentals of relational databases
   describe and use SQL to create, modify and query data from relational
7. databases
8. understand and apply DataFrames and data analysis using Pandas
9. visualize simple data by different types of 2D plots using Matplotlib

Indicative Literature

Jake VanderPlas, Python Data Science Handbook, O'Reilly.

Cay S. Horstmann, Rance D. Necaise, Python For Everyone, 3rd Edition, Wiley.

Usability and Relationship to other Modules

The course provides the necessary background knowledge for

- DET: all subsequent Data Engineering Technologies courses, in particular to “Advanced Databases” and “Statistical and Machine Learning”
- DSSB (online): efficient data handling and processing typically required in the master thesis module.

Examination Type: Module Component Examinations

Module Component 1: Lecture
Assessment Type: Written Examination Duration: 120 minutes
Weight: 50%

Scope: All intended learning outcomes of this module excluding practical aspects.

Module Component 2: Programming Tutorial

Assessment Type: Program Code Weight: 50%

Scope: All intended learning outcomes of the module
Completion: To pass this module, the examination of each module component must be passed with at least 45%.

4.3.5 Ethics and the Information Revolution

Module Name	**Module Code**	**Level (type)**	**CP**
Ethics and the Information Revolution		Year 1 (Foundation)	2.5

Module Components

Number	Name	Type	CP
	Ethics and the Information Revolution	Seminar (online)	2.5

Module Coordinator	**Program Affiliation**	**Mandatory Status**
Prof. Dr. Hilke Brockmann	• MSc Data Science for Society & Business online (DSSB) (online)	Mandatory for DET (online) and DSSB (online)

Entry Requirements			**Frequency**	**Duration**
Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills	Annually (Spring)	1 semester
☒ None	☒ None	☒ None		

Student Workload

Asynchronous Self Study	Interactive Learning	Assessment Preparation	Independent Study	Hours Total
17.5 h	10 h	10 h	25 h	62.5 h

Recommendations for Preparation

Read the Syllabus.
Binns (2018) Fairness in Machine Learning: Lessons from Political Philosophy. Proceedings of Machine Learning Research 81:1-11.

Content and Educational Aims

Many data specialists claim that we are at the cusp of an information revolution. Based on inventions dating back to WWII, IT innovations have re-organized our society around one "big metadata computer" that is permanently computing data and associating metadata about everything we do. Digital technologies also have the potential to disrupt the ethical standards and rules of our society. In this module, we discuss whether we have to forfeit privacy in times of big data, if machines compromise our identity, and if shared data enables institutions to abuse their power and undermine the civil society?

The module pursues three goals. 1. Participants will immerse themselves and learn about core ethical theories. 2. They will integrate this theoretical knowledge and develop a "Big Data Ethics," which they 3. will put into practice. For the second and third purposes, discussions and interactions are indispensable for identifying possible dilemmas and conflict of interests and for balancing contradictions to derive practical solutions and policy advice.

Intended Learning Outcomes

By the end of the module, students will be able to

1. report on major ethical theories relevant to digital technologies
2. integrate different ethical standpoints and arguments to address concrete societal problems
3. assess the societal and ethical implications of digitization
4. deal with legal aspects of ethics by applying means to prevent and deal with violations of privacy and transparency

5. apply actions to contribute to the transition to a more just and trustworthy digital transformation as a part of one's job
6. implement justice and social equality as dimensions of ethics and sustainability

Indicative Literature

Binns (2018) Fairness in Machine Learning: Lessons from Political Philosophy. Proceedings of Machine Learning Research 81:1-11.

Examination Type: Module Examination

Assessment Type: Term Paper Length: 3000 words
Weight: 100%

Scope: All intended learning outcomes of the module.
Completion: To pass this module, the examination has to be passed with at least 45%.

4.4 Master Thesis (30 CP)

Module Name	**Module Code**	**Level (type)**	**CP**
Master Thesis DSSB		Year 2	30

Module Components

Number	Name	Type	CP
	Thesis	Thesis	30

Module Coordinator	**Program Affiliation**	**Mandatory Status**
NN	• MSc Data Science for Society & Business online (DSSB (online))	Mandatory for DSSB (online) students

Entry Requirements			**Frequency**	**Duration**
Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills	Annually (Spring)	1 semester
☒ Successful completion of at least 75 CP	☒ None	• Proficiency in the chosen thesis topic		

Student Workload

Asynchronous Self Study	Interactive Learning	Assessment Preparation	Independent Study	Hours Total
10h	15h	25h	700h	750 h

Recommendations for Preparation

- Identify an area or a topic of interest and contact potential supervisors
- Create a research proposal including a research plan to ensure timely submission.
- Ensure you possess all required technical research skills or are able to acquire them on time.
- Review again the University's Code of Academic Integrity and Guidelines to Ensure Good Academic Practice

Content and Educational Aims

The Master thesis provides an opportunity for students to develop their own interests and to gain scientific expertise in a specific subject area. Students will also demonstrate that they are able to undertake independent and high-quality research.

The selected topic and methodology of the thesis must be related to a data science problem of current interest. The Study Program Chair has to approve the topic to ensure it is embedded in the program's overall topic, its aims and goals.

The thesis has to comprise the full cycle of a scientific research endeavor: (i) identifying a relevant open research question, (ii) carrying out a literature survey to put the planned work in its context and relate it to the state of the art (SoA), (iii) formulate a concrete research objective, (iv) design a research plan including a statement of criteria to evaluate the success of the project, (v) carry out the plan (with the possibility to change the original plan when motivated), (vi) document the results, (vii) analyze the results with respect to the SoA, the original objective, and the success criteria, and (viii) document all of this in a thesis report. All of this work should be done with as much self-guidance as can be reasonably expected. The instructor will likely give substantial guidance for (i) and (iii), whereas the other aspects will be addressed with larger degrees of self-guidance.

In the first weeks of the course, an intense taught tutorial on scientific working and writing is held. The subsequent weeks follow a seminar style where students present and discuss literature as well as their own results to date. The project consists of the proposal, a thesis report (target size: 30–60 pages, and an oral presentation at the end of the course.

Intended Learning Outcomes

Upon completion of this module, students will be able to

1. independently develop research questions guided by gaps in existing knowledge and determine appropriate research strategies and plans;
2. independently choose and justify appropriate research methods to new unsolved problems or issues;
3. critically assess scientific results and literature;
4. summarize the current state of knowledge in their chosen specialization area;
5. independently apply appropriate knowledge, methods and competencies acquired during their studies;
6. develop conclusions based on their own analysis;
7. use individual feedback to develop and mature within the field of their specialization;
8. effectively communicate and discuss their research results to various audiences;
9. take into consideration the social and ethical consequences of their activities;
10. formulate a research project proposal;
11. presentation of project results for specialists and non-specialists.

Indicative Literature

Jane Bottomley: Academic Writing for International Students of Science, Routledge, 2ed. 2021.
Stephen B. Heard. The Scientist's Guide to Writing. Princeton University Press, 2nd edition, 2022.

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment Component 1: Thesis

Length: 30-50 pages
Weight: (75%)

Assessment Component 2: Oral Examination (Master Thesis Defense)

Duration: approx. 15–30 minutes
Weight:(25%)

Module Achievement: Completion of proposal and proposal presentation are pre-requisites prior to the submission of the thesis.

Scope: All intended learning outcomes of the module

Completion: This module is passed with an assessment-component weighted average grade of 45% or higher.

5 Appendices

5.1 Intended Learning Outcomes Assessment-Matrix

Data Science for Society and Business (MSc.)					CORE:Digital Societies and Future Economies	CORE: Data Science Concepts	CORE: Digital Business Models and Functions	CORE: Data Analytics	CORE: Digital Transf and Innovation	CORE: AI in Business and Society for DSSB	Methods: Data Science Tools	Methods: Text Analysis and NLP	Methods: Vis Comm and Data Story T	Foundations: Math for Grad Stud	Foundations: IT Law	Foundations: Data Security and Privacy	Foundations: Ethics and Inform Rev	Foundations: Data Base Management Tools in Python	Masster Thesis
Semester					1	1	2	2	3	3	1	2	3	1	2	2	3	2	4
Mandatory/ mandatory elective					m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
Credits					7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	2.5	2.5	2.5	7.5	30
	Competencies*																		
Program Learning Outcomes	**A**	**E**	**P**	**S**															
Identify, analyze, interpret, and critically assess the social (e.g. business, economic, political) causes and consequences of the digital transformation of societies;	x		x	x	x		x		x	x					x	x	x		x
Academically reflect and evaluate the legal and ethical implications surrounding privacy, data sharing, algorithmic decision making, and new business models in various digitized sectors;	x	x	x	x	x		x		x	x					x	x	x		x
Combine data science concepts and put them into practice by developing and designing state-of-the-art applications;	x	x		x		x	x	x	x	x	x	x	x	x					x
Develop scientific and professional solutions for social, ecological, economic, health, scientific, and political problems;	x	x	x	x	x		x		x	x		x	x		x		x		x
Creatively and convincingly solve research implementations problems;	x	x		x			x	x		x		x	x		x				x
Program well in at least one computer language;	x	x		x				x			x	x	x					x	x
Use state-of-the-art methods of digital data mining from the internet and other sources;	x	x						x		x	x	x	x					x	x
Efficiently and securely manage social media and business data;	x	x		x			x	x		x	x	x	x					x	x
Deliberately choose between, adapt, and potentially develop statistical models for 'big data' further;	x	x		x		x		x				x	x					x	x
Elaborately command analytical, critical, and synthesizing quantitative skills to correctly model and interpret scientific results, to make valid predictions, and to derive thoughtful conclusions and interventions for pressing social and business problems;	x	x	x	x		x		x		x	x	x	x	x		x			x
Apply innovative writing, communication, presentation techniques, and state-of-the-art visualization tools to effectively and convincingly reach out to a scientific and non-scientific audience;		x	x	x	x		x			x		x			x		x		x
Use efficiently and effectively online and material to boost self-learning and time-management skills to sharpen one's professional expertise, and to stay updated in a fast-developing scientific area;		x	x	x	x	x	x	x	x	x	x	x			x		x	x	x
Function very well in an international and diverse working environment;		x	x	x	x	x	x		x	x	x				x		x	x	
Adhere to and defend ethical, scientific, and professional standards;	x		x	x	x		x	x	x	x	x	x			x		x	x	x
Make valuable contributions to society and business;		x	x	x	x		x		x	x					x	x	x		x
Grow personally to a responsible, smart, and resilient researcher, leader and collaborator;		x	x	x	x	x	x	x	x	x					x		x		x
take on an ambitious academic, business, or professional career in thriving digital areas.		x	x	x	x	x	x	x	x	x	x	x			x		x	x	x
Assessment Type																			
Oral examination																			x
Written examination					x	x								x		x		x	
Practical assessment																			
Program Code																		x	
Project report								x		x	x	x	x						
Term paper							x		x						x		x		
Report																			
Poster presentation																			
Presentation										x									
Thesis																			x
Module achievements											x								x

*Competencies: A-scientific/academic proficiency; E-competence for qualified employment; P-development of personality; S-competence for engagement in society

Figure 3: Intended Learning Outcomes Assessment Matrix