Curriculum for the Master's Degree Programme

Data Science

Curriculum 2024

This curriculum was approved by the Senate of the University of Graz at the meeting of 22 May 2024, and by the Senate of Graz University of Technology at the meeting of 27 May 2024.

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I. General

§ 1 Subject matter of degree programme and qualification profile

The Master's Degree Programme Data Science is an interdisciplinary engineering degree. Graduates of this study programme are awarded the academic degree 'Diplom-Ingenieurin' or 'Diplom-Ingenieur', abbreviated as 'Dipl.-Ing.' or 'DI'. The international equivalent of this university degree is 'Master of Science', abbreviated as 'MSc'. The Master's Degree Programme Data Science is held in English.

(1) Subject matter of the degree programme:

The Master's Degree Programme Data Science provides broad, fundamental and interdisciplinary training in various topics of data science, with a focus on mathematics, statistics and computer science. The degree programme focuses on subject areas such as machine learning and statistics in the field of data analysis and forecasting, information integration for processing complex data structures, and optimisation as the basis of important algorithms in machine learning and artificial intelligence. Furthermore, ethical and legal aspects related to the discipline are also covered as general subject areas in the degree programme. Students can further specialise in a broad, interdisciplinary selection of both application-oriented and fundamental topics. It is possible to complete part of the degree programme abroad. Specific options within the Unite! and ARQUS networks are published on the related websites for the degree programme.

The Master's Degree Programme Data Science fits seamlessly into the existing range of degree programmes in mathematics and computer science. Using predefined entry paths, it is designed to be accessible not just to graduates of the Bachelor's Degree Programmes Mathematics or Computer Science, but also to graduates of the Bachelor's Degree Programmes Physics, Software Engineering and Management, and Information and Computer Engineering. Individual entry paths are also possible for graduates of other natural sciences or engineering degree programmes.

(2) Qualification profile and competencies:

In recent decades, large-scale data collection has increased significantly in all areas of life. This data can be a source of great potential for society, business and science. To maximise the benefits that come with this potential, competent and careful exploration and processing of the available information is required. The main goal of this degree programme is thus to provide students with the skills and methods needed to do this based on the relevant mathematical and statistical principles.

Graduates of the Master's Degree Programme Data Science have the following knowledge, skills and competencies:

Knowledge and understanding

Graduates

- have advanced knowledge in fundamental mathematics in the areas of analysis, linear algebra, statistics and optimisation,
- have advanced fundamental knowledge in databases, data integration, programming and software development,

- are familiar with the most important models and algorithms of logic- and learning-based artificial intelligence,
- are familiar with fundamental ethical and legal aspects related to the use and further processing of data,
- acquire fundamental knowledge in developing new methods for statistics, machine learning and artificial intelligence and their respective areas of application,
- can define and interpret the special features, limits, terminology and schools of thought of their field, and
- have specialist knowledge in the areas of *Advanced Mathematics for Data Science, Modelling in Data Science, Advanced Machine Learning, Visual Computing, Applied Data Analysis Methods and Computing,* and *Applications of Data Science* depending on their chosen specialisation.

Application of knowledge

Graduates

- can implement and expand on statistical and artificial intelligence algorithms using the latest programming languages,
- are able to manage, analyse and interpret large quantities of data gathered with real-world systems,
- can independently acquire new knowledge and conduct scientific research independently,
- can apply complex scientific methods,
- are able to work on scientific tasks independently, and
- can apply their knowledge and problem-solving abilities in new and unfamiliar situations.

Evaluation and assessment

Graduates

- deal with complex situations,
- formulate reasoned opinions in the terms of the relevant disciplines, including taking account of incomplete or limited information, and
- take societal, social, legal and ethical effects into account in their specialist or scientific activities.

Communication, social and organisational skills

Graduates

- have mastered communication and presentation techniques and can use them appropriately,
- are able to write scientific texts,
- can communicate information, ideas, problems and their solutions clearly and unambiguously to an audience of both specialists and non-specialists,
- are able to clarify questions together with users from industry and business or with scientists from other disciplines,

- can use learning strategies that enable them to further develop their knowledge independently, and
- are able to work independently or in teams, motivating themselves and others.

(3) Need and relevance of the degree programme for science and for the labour market:

Over the last decade, data science has become increasingly established as an independent scientific field worldwide. In particular, fundamental research in this area has grown exponentially. At the same time, data science approaches to statistics, machine learning or artificial intelligence have found their way into almost all scientific and academic disciplines, from the natural sciences to the humanities. Graduates of this degree programme are able to conduct both fundamental and applied research in science. The master's degree programme also provides students with the skills required for independent scientific work within the framework of a doctoral programme.

Rapid developments in digitalisation, as we are currently seeing them especially in industry, are largely driven by a wider availability of data and advances in data-based technologies such as machine learning and artificial intelligence. Data science approaches are expected to hold enormous potential for future innovation, and thus there is a high demand from industry for the skills of data scientists. Graduates meet this demand thanks to their in-depth training and are a versatile asset in research, development and industrial production, driving innovation and strengthening and expanding industrial leadership positions in the future.

§ 2 Admission requirements

(1) a. The Master's Degree Programme Data Science builds on the Bachelor's Degree Programme Mathematics offered at NAWI Graz and the Bachelor's Degree Programme Computer Science offered at TU Graz. Graduates of these bachelor's degree programmes thus meet the admission requirements for the Master's Degree Programme Data Science.

b. Furthermore, the following degree programmes meet the admission requirements:

- NAWI Graz Bachelor's Degree Programme Physics
- TU Graz Bachelor's Degree Programme Information and Computer Engineering
- TU Graz Bachelor's Degree Programme Software Engineering and Management

Additionally, graduates of a bachelor's, diploma, or master's degree programme in the following subject areas also meet the admission requirements:

- Mathematics
- Technical Mathematics
- Statistics
- Computer Science
- Physics
- Technical Physics

if the degree programme was completed at an Austrian university or at a university in one of the following countries:

Belgium, Bulgaria, Denmark, Germany, Estonia, Finland, France, Greece, Ireland, Iceland, Italy, Croatia, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Austria, Poland, Portugal, Romania, Sweden, Switzerland, Slovakia, Slovenia, Spain, Czech Republic, Hungary, United Kingdom and Cyprus.

(2) Any degree programmes that are not mentioned in (1) are considered eligible for admission if at least 120 ECTS credit points have been positively completed in the following subject areas:

- Mathematics
- Computer Science
- Statistics
- Physics

Of these 120 ECTS credit points, at least

- 30 ECTS credit points must be from courses on fundamental mathematics, and
- 5 ECTS credit points must be from courses on programming.

(3) Any degree programmes that are not mentioned in (1) and that do not meet the requirements of (2) are not considered equivalent to a subject-related degree programme. If at least 90 ECTS credit points have been completed in the subject areas mentioned in (2), full equivalence may be established by requiring supplementary examinations. Additional completion of supplementary examinations may be required to the extent of a maximum of 30 ECTS credit points.

(4) Any degree programmes that are not mentioned in (1) and do not meet the requirements of (2) and (3) are not close enough in subject matter to establish full equivalency. In such cases, admission to the Master's Degree Programme Data Science is not possible.

(5) Proof of sufficient English language skills is a prerequisite for admission to the degree programme. The type of proof required is specified in a regulation issued by the Rectorate.

§ 3 Structure of the degree programme

(1) The Master's Degree Programme Data Science with a workload of 120 ECTS credit points covers four semesters and is structured in modules as follows:

	ECTS
Module A (A.1–A.4): Bridge Courses[1]	12.5–18[2]
Compulsory Module B.1: Stochastic Methods	10.5
Compulsory Module B.2: Ethics and Law	4.5
Compulsory Module B.3: Data and Software Engineering	8
Compulsory Module B.4: Machine Learning	9
Compulsory Module B.5: Optimisation	6
Compulsory Module B.6: Project and Seminar	10
Module C (C.1–C.6): Elective Subjects	17–22.5
Master's thesis	30
Master's examination	1
Free-choice subjects	6
Total	120

[1]: One of the modules A.1–A.4 must be completed in full.
[2]: The exact number of ECTS credit points is dependent on the Bridge Module to be completed. ECTS credit points from Modules A and C must total 35.

(2) Examinations taken as part of a bachelor's or diploma degree programme that served as a prerequisite for admission to a subsequent master's degree programme can only be recognised for this subsequent master's degree programme to the extent that the scope of the bachelor's or diploma degree programme exceeds 180 ECTS credit points.

§ 4 Group sizes

The following maximum numbers of participants (group sizes) have been established:

Lecture (VO) Lecture part of lecture with integrated exercises (VU)	no restriction
Exercise (UE) Exercise part of lecture with integrated exercises (VU) Supplementary tutorial (KO/KV)	*25*
Project (PT)	*10*
Seminar (SE)	*10*
Design exercise (KU)	*25*

§ 5 Guidelines for the allocation of places in courses

(1) If the number of students exceeds the number of available places, students are allocated places on a course according to the following priority criteria, whereby the individual criteria are to be applied in the order given:

a. Position of the course in the curriculum (acc. to § 6 and § 7): Priority is given to students for whom the course is compulsory according to their curriculum over those who are taking the course as part of an elective module.

b. Total of completed/recognised ECTS credit points for the degree programme: All study achievements completed in the degree programme for which the student wants to take the course are taken into account for the ranking. Students with the highest total of ECTS credit points already completed in their current degree programme are ranked preferentially.

c. Number of semesters spent studying in the degree programme so far: Students are ranked according to the number of semesters they have already studied in the degree programme. Priority is given to those who have studied for longer.

d. Decision by lot: If it is not possible to rank students according to the above criteria, admission to the course is decided by lot.

(2) Up to 10% of the places on the course are reserved for students completing part of their studies at a NAWI Graz university as part of a mobility programme.

II. Degree Programme Content and Structure

§ 6 Modules, courses and semester assignment

(1) The individual courses of this master's degree programme and their designation as compulsory and elective modules are set out below. The knowledge, methods or skills to be taught in each course are described in detail in Appendix I. The assignment of courses to specific semesters is a recommendation for students and ensures that the sequence of courses is best able to build on prior knowledge and that the workload of an academic year does not exceed 60 ECTS credit points. The allocation of the courses to the participating universities is defined in Appendix II and § 7.

Modules A are designed to serve as an introduction to the degree programme. One of the modules A.1–A.4 must be completed in full. The entry path and corresponding Bridge Module is predetermined by the degree programme that a student has previously completed in accordance with § 2 (1) of this curriculum. If a student is admitted to this master's degree programme in accordance with § 2 (2) or (3), the officer responsible for study matters decides which of the Bridge Modules A.1–A.4 the student must complete as their entry path to the degree programme.

If a student can prove that they have previously completed study achievements that match the content of one or more courses in a Bridge Module, the scope of the Bridge Module may be reduced by the respective course(s) and, to offset this, the scope of Modules C must be increased by at least the same amount of ECTS credit points. Upon application for recognition by the student, the officer responsible for study matters at the university of admission determines whether a course can be recognised.

Master's Degree Programme Data Science					ECTS credit points per semester			
Mod.	Course	SSt.	Type	ECTS	I	II	III	IV
Module A: Bridge Courses								
Compulsory Module A.1: Bridge Courses for Students with a Degree in Mathematics or Statistics								
A.1.1	Data Management	2	VO	3		3		
A.1.2	Data Management	1	KU	1		1		
A.1.3	Machine Learning 1[1]	2	VO	3		3		
A.1.4	Machine Learning 1[1]	1	UE	1.5		1.5		
A.1.5	Object-Oriented Programming 2[2]	1	VO	1.5	1.5			
A.1.6	Object-Oriented Programming 2[2]	2	KU	2.5	2.5			
Subtotal Compulsory Module A.1		**9**		**12.5**	**4**	**8.5**		
Compulsory Module A.2: Bridge Courses for Students with a Degree in Computer Science								
A.2.1	Analysis for Data Science	3	VU[3]	4.5	4.5			
A.2.2	Numerical Linear Algebra for Data Science	3	VU[3]	4.5	4.5			
A.2.3	Probability and Statistics for Data Science	3	VU[3]	4.5	4.5			
Subtotal Compulsory Module A.2		**9**		**13.5**	**13.5**			
Compulsory Module A.3: Bridge Courses for Students with a Degree in Physics								
A.3.1	Data Management	2	VO	3		3		
A.3.2	Data Management	1	KU	1		1		
A.3.3	Machine Learning 1	2	VO	3		3		
A.3.4	Machine Learning 1	1	UE	1.5		1.5		
A.3.5	Numerical Linear Algebra for Data Science	3	VU[3]	4.5	4.5			
A.3.6	Probability and Statistics for Data Science	3	VU[3]	4.5	4.5			
Subtotal Compulsory Module A.3		**12**		**17.5**	**9**	**8.5**		
Compulsory Module A.4: Bridge Courses for Students with a Degree in Software Engineering and Management or Information and Computer Engineering								
A.4.1	Analysis for Data Science	3	VU[3]	4.5	4.5			
A.4.2	Numerical Linear Algebra for Data Science	3	VU[3]	4.5	4.5			
A.4.3	Probability and Statistics for Data Science	3	VU[3]	4.5	4.5			
A.4.5	Machine Learning 1[4]	2	VO	3		3		
A.4.6	Machine Learning 1[4]	1	UE	1.5		1.5		
Subtotal Compulsory Module A.4		**12**		**18**	**13.5**	**4.5**		
Module B: Core Areas								
Compulsory Module B.1: Stochastic Methods								
B.1.1	Applied Statistics	3	VO	4.5	4.5			
B.1.2	Applied Statistics	1	UE	1.5	1.5			
B.1.3	Bayesian Modelling[5]	3	VU[3]	4.5			4.5	
Subtotal Compulsory Module B.1		**7**		**10.5**	**6**		**4.5**	
Compulsory Module B.2: Ethics and Law								
B.2.1	Digital Ethics: An Introduction	1	VO	1.5	1.5			
B.2.2	Introduction to IT-Law	2	VO	3		3		
Subtotal Compulsory Module B.2		**3**		**4.5**	**1.5**	**3**		
Compulsory Module B.3: Data and Software Engineering								
B.3.1	Software Development	2	VU[6]	3	3			
B.3.2	Data Integration and Large-Scale Analysis[7]	3	VU[3]	5	5			
Subtotal Compulsory Module B.3		**5**		**8**	**8**			
Compulsory Module B.4: Machine Learning								
B.4.1	Statistical Learning	2	VO	3			3	
B.4.2	Statistical Learning	1	UE	1.5			1.5	
B.4.3	Machine Learning 2	2	VO	3		3		
B.4.4	Machine Learning 2	1	KU	1.5		1.5		

Master's Degree Programme Data Science					ECTS credit points per semester			
Mod.	Course	SSt.	Type	ECTS	I	II	III	IV
Subtotal Compulsory Module B.4		**6**		**9**		**4.5**	**4.5**	
Compulsory Module B.5: Optimisation								
B.5.1	Optimisation for Data Science	2	VO	3		3		
B.5.2	Optimisation for Data Science	2	UE	3		3		
Subtotal Compulsory Module B.5		**4**		**6**		**6**		
Compulsory Module B.6: Project and Seminar								
B.6.1	Project in Data Science[8]	4	PT	6		6		
B.6.2	Seminar in Data Science[8]	2	SE	4			4	
Subtotal Compulsory Module B.6		**6**		**10**		**6**	**4**	
Total Compulsory Modules		**40–43**		**60.5–66**	**19.5–29**	**19.5–28**	**13**	
Elective Modules C (C.1–C.6): Elective Subjects				**17–22.5**				
Total Elective Modules				**17–22.5**				
Master's thesis				**30**				**30**
Master's examination				**1**				**1**
Free-choice courses acc. to § 8				**6**				
Overall total				**120**	**30**	**30**	**29**	**31**

[1]: If a student has completed the course Mathematics of Machine Learning (VO+UE) as part of the Bachelor's Degree Programme Mathematics, the scope of Module A.1 may be reduced by Machine Learning 1 (VO+UE) and, to offset this, the scope of Modules C must be increased by at least the same amount of ECTS credit points.

[2]: Course is conducted in English.

[3]: 2 semester course hours lecture part, 1 semester course hour exercise part

[4]: If a student has completed the course Computational Intelligence (VO+UE) as part of the Bachelor's Degree Programme Information and Computer Engineering or the Bachelor's Degree Programme Software Engineering and Management, the scope of Module A.4 may be reduced by Machine Learning 1 (VO+UE) and, to offset this, the scope of Modules C must be increased by at least the same amount of ECTS credit points.

[5]: For Bridge Modules A.1 and A.3 in semester I.

[6]: 1 semester course hour lecture part, 1 semester course hour exercise part.

[7]: For Bridge Modules A.1 and A.3 in semester III.

[8]: Course is offered in summer and winter semesters.

§ 7 Elective modules

As outlined in § 3 (1), 17 to 22.5 ECTS credit points must be completed from the six elective modules of Modules C: Elective Subjects. Of these, either a) at least 4.5 ECTS credit points must be completed from the elective modules C.1–C.2 and at least 4.5 ECTS credit points from the elective modules C.3–C.6, OR b) at least 8 ECTS credit points must be completed abroad in courses that are attributable to Modules C: Elective Subjects.

The elective modules of Modules C: Elective Subjects may be completed in their entirety at a partner university as part of the ARQUS or Unite! cooperations. The officers responsible for study matters determine the suitability for recognition of any course in agreement with the partner universities and publish their findings on the website for the degree programme. The student must apply for the necessary stay abroad, e.g. via Erasmus+, in good time.

(1) For Elective Module C.1: Advanced Mathematics for Data Science, courses from the following elective module catalogue must be completed.

Elective Module C.1: Advanced Mathematics for Data Science					
Course	**SSt.**	**Type**	**ECTS**	**Uni Graz[1]**	**TU Graz[1]**
C.1.1 Nonlinear Optimisation	4	VO	6	x	
C.1.2 Nonlinear Optimisation	2	UE	3	x	
C.1.3 Topological Data Analysis	3	VU[2]	5		x
C.1.4 Stochastische Prozesse[3]	3	VO	4.5	x	x
C.1.5 Stochastische Prozesse[3]	1	UE	1.5	x	x
C.1.6 Mathematical Statistics	3	VO	4.5		x
C.1.7 Mathematical Statistics	1	UE	1.5		x
C.1.8 Advanced Probability	3	VO	4.5	x	x
C.1.9 Advanced Probability	1	UE	1.5	x	x
C.1.10 Combinatorial Optimisation 2	3	VO	4.5		x
C.1.11 Combinatorial Optimisation 2	1	UE	1.5		x
C.1.12 Advanced and Algorithmic Graph Theory	3	VO	4.5		x
C.1.13 Advanced and Algorithmic Graph Theory	1	UE	1.5		x
C.1.14 Integer and Discrete Optimisation	3	VO	4.5		x
C.1.15 Integer and Discrete Optimisation	1	UE	1.5		x
C.1.16 Random Matrices	3	VO	4.5		x
C.1.17 Random Matrices	1	UE	1.5		x
C.1.18 Elective Subject Advanced Mathematics for Data Science: "Subheading"[4]	1–4	VO/UE/VU	1.5-6	x	x

[1]: Assignment of the course to the participating universities. Both universities are named if the course is offered at both universities in combination, in parallel or alternately.
[2]: 2 semester course hours lecture part, 1 semester course hour exercise part.
[3]: Course is held in English as "Stochastic Processes".
[4]: The de facto ECTS credit points are published in the online system of the respective university (TUGonline/UNIGRAZonline).

(2) For Elective Module C.2: Modelling in Data Science, courses from the following elective module catalogue must be completed.

Elective Module C.2: Modelling in Data Science					
Course	**SSt.**	**Type**	**ECTS**	**Uni Graz[1]**	**TU Graz[1]**
C.2.1 Time Series Analysis	3	VO	4.5		x
C.2.2 Time Series Analysis	1	UE	1.5		x
C.2.3 Mathematische Modellierung in Data Science[2]	4	VU[3]	6	x	
C.2.4 Mathematical Modelling in the Natural Sciences	3	VO	4	x	
C.2.5 Mathematical Modelling in the Natural Sciences	1	UE	1	x	
C.2.6 Statistical Modelling	3	VO	4		x
C.2.7 Statistical Modelling	1	UE	1.5		x
C.2.8 Inverse Problems	3	VO	4.5	x	
C.2.9 Inverse Problems	1	UE	1.5	x	
C.2.10 Advanced Topics in Bayesian Statistics	3	VO	4.5		x
C.2.11 Advanced Topics in Bayesian Statistics	1	UE	1.5		x
C.2.12 Elective Subject Modelling in Data Science: "Subheading"[4]	1–4	VO/UE/VU	1.5-6	x	x

[1]: Assignment of the course to the participating universities. Both universities are named if the course is offered at both universities in combination, in parallel or alternately.
[2]: This course is offered in English as "Mathematical Modelling in Data Science".
[3]: 2 semester course hours lecture part, 2 semester course hours exercise part.
[4]: The de facto ECTS credit points are published in the online system of the respective university (TUGonline/UNIGRAZonline).

(3) For Elective Module C.3: Advanced Machine Learning, courses from the following elective module catalogue must be completed.

Elective Module C.3: Advanced Machine Learning					
Course	**SSt.**	**Type**	**ECTS**	**Uni Graz[1]**	**TU Graz[1]**
C.3.1 Deep Learning	2	VO	3		x
C.3.2 Deep Learning	1	KU	2		x
C.3.3 Mathematics of Deep Learning	2	VO	3	x	
C.3.4 Mathematics of Deep Learning	2	UE	3	x	
C.3.5 Generative Modelling	4	VU[2]	6	x	
C.3.6 Reinforcement Learning	2	VO	3		x
C.3.7 Reinforcement Learning	1	KU	2		x
C.3.8 Physics Informed Learning	4	VU[2]	6	x	
C.3.9 Natural Language Processing	3	VU[3]	5		x
C.3.10 Recommender Systems	2	VU[4]	3		x
C.3.11 Elective Subject Advanced Machine Learning: "Subheading"[5]	1–4	VO/UE/VU	1.5-6	x	x

[1]: Assignment of the course to the participating universities. Both universities are named if the course is offered at both universities in combination, in parallel or alternately.
[2]: 2 semester course hours lecture part, 2 semester course hours exercise part.
[3]: 1.5 semester course hours lecture part, 1.5 semester course hours exercise part.
[4]: 1 semester course hour lecture part, 1 semester course hour exercise part.
[5]: The de facto ECTS credit points are published in the online system of the respective university (TUGonline/UNIGRAZonline).

(4) For Elective Module C.4: Visual Computing, courses from the following elective module catalogue must be completed.

Elective Module C.4: Visual Computing					
Course	**SSt.**	**Type**	**ECTS**	**Uni Graz[1]**	**TU Graz[1]**
C.4.1 Mathematische Signal- und Bildverarbeitung[2]	3	VO	4.5	x	
C.4.2 Mathematische Signal- und Bildverarbeitung[2]	1	UE	1.5	x	
C.4.3 Mathematical Principles in Visual Computing	3	VU[3]	5		x
C.4.4 Medical Image Analysis	2	VO	3		x
C.4.5 Medical Image Analysis	1	KU	2		x
C.4.6 Information Visualisation	3	VU[3]	5		x
C.4.7 Image Processing and Pattern Recognition	2	VO	3		x
C.4.8 Image Processing and Pattern Recognition	1	KU	2		x
C.4.9 Visual Analytics	3	VU[3]	5		x
C.4.10 Elective Subject Visual Computing: "Subheading"[4]	1–4	VO/UE/VU	1.5-6	x	x

[1]: Assignment of the course to the participating universities. Both universities are named if the course is offered at both universities in combination, in parallel or alternately.
[2]: This course is offered in English as "Mathematical Signal and Image Processing".
[3]: 2 semester course hours lecture part, 1 semester course hour exercise part.
[4]: The de facto ECTS credit points are published in the online system of the respective university (TUGonline/UNIGRAZonline).

(5) For Elective Module C.5: Applied Data Analysis Methods and Computing, courses from the following elective module catalogue must be completed.

Elective Module C.5: Applied Data Analysis Methods and Computing Course	SSt.	Type	ECTS	Uni Graz[1]	TU Graz[1]
C.5.1 Industrial Statistics	3	VO	4		x
C.5.2 Industrial Statistics	1	UE	2		x
C.5.3 Knowledge Discovery and Data Mining 2	3	VU[2]	5		x
C.5.4 Network Science	3	VU[3]	5		x
C.5.5 Information Search and Retrieval	3	VU[3]	5		x
C.5.6 High Performance Computing	2	VU[4]	2.5	x	
C.5.7 Computer Simulations	3	VU[5]	4		x
C.5.8 Cryptography	2	VO	3		x
C.5.9 Cryptography	1	KU	2		x
C.5.10 Elective Subject Applied Data Analysis Methods and Computing: "Subheading"[6]	1–4	VO/UE/VU	1.5-6	x	x

[1]: Assignment of the course to the participating universities. Both universities are named if the course is offered at both universities in combination, in parallel or alternately.
[2]: 1.5 semester course hours lecture part, 1.5 semester course hours exercise part.
[3]: 2 semester course hours lecture part, 1 semester course hour exercise part.
[4]: 1 semester course hour lecture part, 1 semester course hour exercise part.
[5]: 1 semester course hour lecture part, 2 semester course hours exercise part.
[6]: The de facto ECTS credit points are published in the online system of the respective university (TUGonline/UNIGRAZonline).

(6) For Elective Module C.6: Applications of Data Science, courses from the following elective module catalogue must be completed.

Elective Module C.6: Applications of Data Science Course	SSt.	Type	ECTS	Uni Graz[1]	TU Graz[1]
C.6.1 Selected Topics of Business Informatics	2	VO	2		x
C.6.2 Selected Topics of Business Informatics	1	UE	1		x
C.6.3 Business Modelling and Simulation	2	VO	2		x
C.6.4 Business Modelling and Simulation	2	UE	2		x
C.6.5 Selected Topics of Business Simulation	2	SE	2		x
C.6.6 Elective Subjects Applications of Data Science: "Subheading"[2]	1–4	VO/UE/VU	1.5-6	x	x

[1]: Assignment of the course to the participating universities. Both universities are named if the course is offered at both universities in combination, in parallel or alternately.
[2]: The de facto ECTS credit points are published in the online system of the respective university (TUGonline/UNIGRAZonline).

§ 8 Free-choice subjects

(1) The courses to be completed as part of the free-choice subjects in the Master's Degree Programme Data Science are designed to provide individual strategic focus and further development of the students. They may be freely selected from the courses offered by any recognised national or international universities as well as recognised national post-secondary educational institutions.

Appendix III contains recommendations for specific free-choice courses.

(2) If no specific number of ECTS credit points is assigned to a free-choice course, ECTS credit points are allocated by the officer responsible for study matters according to the estimated time spent on the course.

§ 9 Master's thesis

(1) The purpose of the master's thesis is to demonstrate a student's ability to work on scientific topics on their own, both with regard to content and methodology.

(2) The topic of the master's thesis must be meaningfully related to the contents of Modules B or C.

(3) The master's thesis must be registered with the respective officer responsible for study matters via the Dean's office/Registrar's Office before beginning work on it.

§ 10 Registration requirements for courses/examinations

(1) The registration condition for the final master's examination before a committee is proof of positive assessment of all study achievements/examinations as described in § 6 to § 8 and a positive grade for the master's thesis.

§ 11 Stays abroad and internships

(1) Recommended stays abroad

It is recommended for students to spend time abroad in the course of their studies. In this master's degree programme, the 3rd semester is especially suitable for this purpose.

It is also possible to obtain recognition of work done in shorter study periods abroad, for example participation in summer or winter schools, as part of the free-choice subjects, by application to the officer responsible for study matters.

(2) Internships

It is possible to include professionally-oriented internships in the free-choice subject.

Each week of full employment corresponds to 1.5 ECTS credit points. Active participation in an academic event may also count as an internship. This internship must be approved by the officers responsible for study matters and considered a useful addition to the degree programme.

III. Examination Regulations and Conclusion of Studies

§ 12 Assessment of modules

The overall grade for a module is the average grade of all examinations completed as part of the module, weighted according to ECTS credit points. The grade is rounded up if the decimal place exceeds 0.5. Otherwise, the grade is rounded down. Examinations whose assessment consists only of "successfully completed/not completed" are not included in the calculation of the overall module assessment. Positive assessment of a module requires the positive assessment of all individual examinations to be completed within the module.

§ 13 Master's examination

(1) The master's examination is an oral examination before a committee and consists of

- the presentation of the master's thesis (max. 20 minutes),
- the defence of the master's thesis (examination interview on the subject matter of the master's thesis and other subject-related areas), as well as
- an examination interview on another subject area covered in the master's degree programme.

(2) The subject areas acc. to (1) are determined by the officer responsible for study matters of the university of admission based on the candidate's suggestion. The total duration of the master's examination before a committee is usually 60 minutes and must not exceed 75 minutes.

(3) The examination committee for the mater's examination includes the supervisor of the master's thesis and two other members who are nominated by the officer responsible for study matters, after hearing any recommendations from the candidate. The examination committee must be chaired by one of the members who is not the supervisor of the master's thesis.

(4) The master's examination must be graded based on the performance achieved during the examination.

§ 14 Completion of studies

(1) The master's degree programme is completed once all academic achievements pursuant to § 3 have been assessed positively.

(2) Successful completion of the degree programme is documented by issuing a certificate. The master's degree certificate for the Master's Degree Programme Data Science is composed of:

a. a list of all the completed modules as set out in § 3 (along with their ECTS credit points) and their assessment results,
b. the title and assessment of the master's thesis,
c. the assessment of the master's examination,
d. the total of the ECTS credit points of the free-choice subjects as defined in § 8, and
e. the overall assessment.

IV. Entry into Force

§ 15 Entry into force

This Curriculum 2024 [in the version of 1 October 2024] enters into force on 1 October 2024.

Appendix I: Module Descriptions

Module A.1	**Bridge Courses for Students with a Degree in Mathematics or Statistics**
ECTS credit points	12.5
Contents	Fundamentals of machine learning and data management. In-depth knowledge of object-oriented programming.
Expected learning outcomes	Students can • explain the key concepts of machine learning and use them correctly in context. • design databases and alternative data representations and use them for query processing, transaction processing and complex analyses. • independently design and implement solutions for system-related problems. • design Java systems with a certain level of complexity.
Recommended prerequisites for participation	Basic programming knowledge.
Frequency in which the module is provided	Every academic year.

Module A.2	**Bridge Courses for Students with a Degree in Computer Science**
ECTS credit points	13.5
Contents	Brushing-up and deepening of fundamental mathematical knowledge in the areas of linear algebra, analysis, statistics and probability theory.
Expected learning outcomes	Students can • explain fundamental concepts of linear algebra and use them correctly in context. • explain the basic concepts of multivariate calculus. • examine functions and mappings in Euclidean space qualitatively and quantitatively. • describe data from different experiments or processes using stochastic models. • understand how to draw conclusions from data sets using statistical inference methods. • use subject-specific language correctly to formulate questions precisely and present them in a structured manner. • explain the relationship between different mathematical concepts and applications in data science. • apply such concepts to solve data science problems.
Recommended prerequisites for participation	Fundamental knowledge of linear algebra, statistics and probability theory, as well as prior knowledge of differential and integral calculus in one dimension.
Frequency in which the module is provided	Every academic year.

Module A.3	Bridge Courses for Students with a Degree in Physics
ECTS credit points	17.5
Contents	Fundamentals of machine learning and data management. Brushing-up and deepening of fundamental mathematical knowledge in the areas of linear algebra, statistics and probability theory.
Expected learning outcomes	Students can • understand the fundamental concepts of linear algebra in depth. • describe data from different experiments or processes using stochastic models. • draw conclusions from data sets using statistical inference methods. • use subject-specific language correctly to formulate questions precisely and present them in a structured manner. • explain the relationship between different mathematical concepts and applications in data science. • apply such concepts to solve data science problems. • explain and use the most important concepts of machine learning. • design databases and alternative data representations and use them for query processing, transaction processing and complex analyses.
Recommended prerequisites for participation	Fundamental knowledge of linear algebra, statistics and probability theory. Basic programming knowledge.
Frequency in which the module is provided	Every academic year.

Module A.4	Bridge Courses for Students with a Degree in Software Engineering and Management or Information and Computer Engineering
ECTS credit points	18
Contents	Brushing-up and deepening of fundamental mathematical knowledge in the areas of linear algebra, analysis, statistics and probability theory. Introduction to machine learning.
Expected learning outcomes	Students can • understand the fundamental concepts of linear algebra in depth. • explain the basic concepts of multivariate calculus. • examine functions and mappings in Euclidean space qualitatively and quantitatively. • describe data from different experiments or processes using stochastic models. • draw conclusions from data sets using statistical inference methods. • use subject-specific language correctly to formulate questions precisely and present them in a structured manner. • explain the relationship between different mathematical concepts and applications in data science. • apply such concepts to solve data science problems.

	• explain the key concepts of machine learning and use them correctly in context.
Recommended prerequisites for participation	Fundamental knowledge of linear algebra, statistics and probability theory, as well as prior knowledge of differential and integral calculus in one dimension. Basic programming knowledge.
Frequency in which the module is provided	Every academic year.

Module B.1	**Stochastic Methods**
ECTS credit points	10.5
Contents	Statistical inference in multivariate models, principal component or factor analysis, classification and clustering, linear models and their applications in the field of ANOVA and multifactorial designs. Introduction to the Bayesian interpretation of probability, manipulation of probability distributions. Calculation of conditional probabilities and the application of Bayes' theorem as a consistent, rigorous and optimal method of conclusion (inference).
Expected learning outcomes	Students can • explain the most important methods of multivariate statistics. • explain and apply linear models in the context of regression, analysis of variance and experimental design. • define statistical problems and carry out exploratory and confirmatory analyses with statistical software. • explain and apply basic Bayesian models and their analytical inference methods. • create advanced and complex Bayesian models. • explain the most common inference methods for such models, in particular a variety of Monte Carlo methods and methods based on variational inference. • explain the most common Bayesian approaches in the field of machine learning (deep learning).
Recommended prerequisites for participation	Basic knowledge of analysis, numerical linear algebra, probability theory and statistics.
Frequency in which the module is provided	Every academic year.

Module B.2	**Ethics and Law**
ECTS credit points	4.5
Contents	• Legal fundamentals for the use of information and communication technology. • Selected data protection law, e-commerce law, copyright law, media law and computer criminal law case studies as well as Internet governance. • Basics on the subject of fundamental rights and the Internet. • Introduction to key ethical concepts and overview of important challenges of the ethics of digitalisation. • Selected aspects of digitalisation and digital transformation with a

Module B.2	Ethics and Law
	focus on artificial intelligence, in particular questions related to the priority of human autonomy, fairness, gender and bias aspects, transparency, responsibility and “ethics by design”.
Expected learning outcomes	Students can • apply basic legal knowledge to the lawful handling or legal use of information and communication technology. • apply the acquired legal knowledge to comparable practical cases. • independently reflect on various ethical challenges and questions in the context of digitalisation, in particular in connection with AI and its social implications and consequences. • act mindfully of the particular relevance of ethics as well as gender and bias aspects in the context of digital transformation, especially in connection with AI. • independently take a well-founded and problem-solving-oriented position and participate in the current discourse.
Recommended prerequisites for participation	None.
Frequency in which the module is provided	Every academic year.

Module B.3	Data and Software Engineering
ECTS credit points	8
Contents	• Version control with GIT (especially in Python and/or C++ projects). • Practical implementation of development processes in (larger) open-source software projects. • Software development models from literature. • Virtualisation solutions for making software available in packages, regardless of platform, as well as via web services. • Tool for automatically creating documentation, hosting services and software for generating static websites. • Databases and information systems. • Essential concepts and methods of data, information and application integration. • Methods of distributed data storage and analysis.
Expected learning outcomes	Students can • explain and implement common workflows, best practices and processes for setting up and maintaining larger software projects in the area of data science, especially with regard to open-source software. • set up and maintain larger software projects in the area of data science independently. • provide an overview of distributed data and information systems. • understand the theoretical and practical design and implementation of modern, data-driven analysis pipelines.
Recommended prerequisites	Programming skills and fundamental knowledge of databases.

Module B.3	Data and Software Engineering
for participation	
Frequency in which the module is provided	Every academic year.

Module B.4	Machine Learning
ECTS credit points	9
Contents	Theoretical knowledge and practical implementation of modern machine learning methods and their application to specific problems. Statistical learning theory, in particular optimal predictors, no-free-lunch theorems, error decomposition, estimation of approximation and estimation errors.
Expected learning outcomes	Students can • explain and implement the basics of modern machine learning methods and apply them in practical examples. • explain the most important principles of statistical learning theory. • analyse and estimate generalisation errors for important machine learning methods and derive a practical course of action for their application.
Recommended prerequisites for participation	Basic knowledge of data management, programming, machine learning, analysis, numerical linear algebra, probability theory and statistics.
Frequency in which the module is provided	Every academic year.

Module B.5	Optimisation
ECTS credit points	6
Contents	• Convex analysis, duality, proximal operator calculus. • Methods of non-smooth optimisation, convergence rates and acceleration strategies. • Stochastic gradient methods.
Expected learning outcomes	Students can • explain the most important basic and modern optimisation methods. • correctly apply optimisation methods to specific problem classes, especially for non-smooth and convex optimisation problems. • estimate the computational effort and convergence properties of relevant optimisation methods and make a suitable selection for data science applications. • understand enough of the necessary analytical background, especially duality and concepts of generalised derivatives, to implement a structured approach to specific optimisation problems.
Recommended prerequisites for participation	Basic knowledge of analysis, numerical linear algebra, probability theory and statistics.
Frequency in which the module is provided	Every academic year.

Module B.6	Project and Seminar
ECTS credit points	10
Contents	Work on a practical problem, preferably with external companies or institutions, e.g. in the form of an internship. Presentation of student's own scientific results as part of the project, or preparation and presentation of a scientific paper.
Expected learning outcomes	Depending on the type of project, students learn to • tackle scientific or practical topics and questions. • work in a non-university environment. • collaborate with colleagues from other disciplines. • independently handle a project and the associated organisational processes (estimating effort, literature research, reviewing available methodology, etc.). • present scientific results as part of a lecture and/or a written report.
Recommended prerequisites for participation	Basic knowledge of data management, programming, machine learning, analysis, numerical linear algebra, probability theory and statistics.
Frequency in which the module is provided	Every semester.

Module C.1	Advanced Mathematics for Data Science
ECTS credit points	-
Contents	Advanced mathematical theories and methods relevant to data science.
Expected learning outcomes	Depending on the courses selected, students learn to understand in-depth mathematical subject areas and methods relevant to data science and can use and apply this knowledge and the corresponding methods to specific data science problems.
Recommended prerequisites for participation	Basic knowledge of analysis, numerical linear algebra, probability theory and statistics.
Frequency in which the module is provided	Every academic year, some courses of the module every two academic years.

Module C.2	Modelling in Data Science
ECTS credit points	-
Contents	Advanced methods of mathematical modelling for problems in the context of data science. Mathematical theory and analysis of the corresponding modelling methods.
Expected learning outcomes	Depending on the courses selected, students learn to model data science questions and problems using mathematical methods. They can explain the capabilities and limitations of mathematical modelling, analyse mathematical models, implement them in practice and derive conclusions from models.
Recommended prerequisites for participation	Basic knowledge of analysis, numerical linear algebra, probability theory and statistics.
Frequency in which the module is provided	Every academic year, some courses of the module every two academic years.

Module C.3	Advanced Machine Learning
ECTS credit points	-
Contents	Advanced and specialised machine learning methods and techniques such as deep learning, reinforcement learning, generative models, recommender systems and natural language processing methods. Theoretical knowledge and practical implementation of these methods.
Expected learning outcomes	Depending on the courses selected, students learn to explain specific, advanced methods of machine learning, can explain their theoretical fundamentals and limitations, and use them for relevant problems in a targeted manner.
Recommended prerequisites for participation	Basic knowledge of machine learning, optimisation and programming.
Frequency in which the module is provided	Every academic year, some courses of the module every two academic years.

Module C.4	Visual Computing
ECTS credit points	-
Contents	Basic and advanced methods of visual computing and the theoretical background, specific applications in the field of image processing and visualisation.
Expected learning outcomes	Depending on the courses selected, students learn to explain specific advanced methods and applications in the context of image data processing and visualisation, can elaborate on their possibilities and limitations, and select and implement suitable methods for specific problems.
Recommended prerequisites for participation	Basic knowledge of data management, programming, machine learning, analysis, numerical linear algebra, probability theory and statistics.
Frequency in which the module is provided	Every academic year, some courses of the module every two academic years.

Module C.5	Applied Data Analysis Methods and Computing
ECTS credit points	-
Contents	Advanced methods from the fields of statistics, computer science and simulation, and related security-relevant aspects for the analysis and processing of large amounts of data.
Expected learning outcomes	Depending on the courses selected, students learn to analyse and process large amounts of data using suitable methods and explain basic security-relevant aspects.
Recommended prerequisites for participation	Basic knowledge of data management, programming, machine learning, analysis, numerical linear algebra, probability theory and statistics.
Frequency in which the module is provided	Every academic year, some courses of the module every two academic years.

Module C.6	Applications of Data Science
ECTS credit points	-
Contents	Specific applications of data science methods. Presentation, analysis and

Module C.6	Applications of Data Science
	modelling of realistic problems and case studies, along with the fundamentals of system dynamics, agent-based modelling and discrete simulation.
Expected learning outcomes	Students can implement data science methods for various application areas in a practical way. They develop an understanding of complex systems and are able to analyse, model and simulate them.
Recommended prerequisites for participation	Basic knowledge of data management, programming, machine learning, analysis, numerical linear algebra, probability theory and statistics.
Frequency in which the module is provided	Every academic year, some courses of the module every two academic years.

Appendix II: Recommended Curriculum Timeline

Appendix II a: Recommended Curriculum Timeline for Students with a Degree in Mathematics or Statistics

1st semester	SSt.	Type	ECTS	Uni Graz[1]	TU Graz[1]
A.1.5 Object-Oriented Programming 2	1	VO	1.5		x
A.1.6 Object-Oriented Programming 2	2	KU	2.5		x
B.1.1 Applied Statistics	3	VO	4.5		x
B.1.2 Applied Statistics	1	UE	1.5		x
B.1.3 Bayesian Modelling	3	VU	4.5		x
B.2.1 Digital Ethics: An Introduction	1	VO	1.5	x	
B.3.1 Software Development	2	VU	3	x	
Courses from Modules C: Elective Subjects or free-choice subjects			11	x	x
1st semester total			30		

2nd semester					
A.1.1 Data Management	2	VO	3		x
A.1.2 Data Management	1	KU	1		x
A.1.3 Machine Learning 1	2	VO	3		x
A.1.4 Machine Learning 1	1	UE	1.5		x
B.2.2 Introduction to IT-Law	2	VO	3	x	
B.4.3 Machine Learning 2	2	VO	3		x
B.4.4 Machine Learning 2	1	KU	1.5		x
B.5.1 Optimisation for Data Science	2	VO	3	x	
B.5.2 Optimisation for Data Science	2	UE	3	x	
B.6.1 Project in Data Science	4	PT	6	x	x
Courses from Modules C: Elective Subjects or free-choice subjects			2	x	x
2nd semester total			30		

3rd semester					
B.3.2 Data Integration and Large Scale Analysis	3	VU	5		x
B.4.1 Statistical Learning	2	VO	3	x	
B.4.2 Statistical Learning	1	UE	1.5	x	
B.7.2 Seminar in Data Science	2	SE	4	x	x
Courses from Modules C: Elective Subjects or free-choice subjects			15.5	x	x
3rd semester total			29		

4th semester					
Master's examination			1	x	x
Master's thesis			30	x	x
4th semester total			31		

Total overall ECTS	120

[1]: Assignment of the course to the participating universities. Both universities are named if the course is offered at both universities in combination, in parallel or alternately.

Appendix II b: Recommended Curriculum Timeline for Students with a Degree in Computer Science

1st semester	SSt.	Type	ECTS	Uni Graz[1]	TU Graz[1]
A.2.1 Analysis for Data Science	3	VU	4.5	x	x
A.2.2 Numerical Linear Algebra for Data Science	3	VU	4.5	x	x
A.2.3 Probability and Statistics for Data Science	3	VU	4.5	x	x
B.1.1 Applied Statistics	3	VO	4.5		x
B.1.2 Applied Statistics	1	UE	1.5		x
B.3.2 Data Integration and Large Scale Analysis	3	VU	5		x
B.2.1 Digital Ethics: An Introduction	1	VO	1.5	x	
B.3.1 Software Development	2	VU	3	x	
Courses from Modules C: Elective Subjects or free-choice subjects			1	x	x
1st semester total			30		
2nd semester					
B.2.2 Introduction to IT-Law	2	VO	3	x	
B.4.3 Machine Learning 2	2	VO	3		x
B.4.4 Machine Learning 2	1	KU	1.5		x
B.5.1 Optimisation for Data Science	2	VO	3	x	
B.5.2 Optimisation for Data Science	2	UE	3	x	
B.6.1 Project in Data Science	4	PT	6	x	x
Courses from Modules C: Elective Subjects or free-choice subjects			10.5	x	x
2nd semester total			30		
3rd semester					
B.1.3 Bayesian Modelling	3	VU	4.5		x
B.4.1 Statistical Learning	2	VO	3	x	
B.4.2 Statistical Learning	1	UE	1.5	x	
B.7.2 Seminar in Data Science	2	SE	4	x	x
Courses from Modules C: Elective Subjects or free-choice subjects			16	x	x
3rd semester total			29		
4th semester					
Master's examination			1	x	x
Master's thesis			30	x	x
4th semester total			31		
Total overall ECTS			120		

[1]: Assignment of the course to the participating universities. Both universities are named if the course is offered at both universities in combination, in parallel or alternately.

Appendix II c: Recommended Curriculum Timeline for Students with a Degree in Physics

1st semester	SSt.	Type	ECTS	Uni Graz[1]	TU Graz[1]
A.3.5 Numerical Linear Algebra for Data Science	3	VU	4.5	x	x
A.3.6 Probability and Statistics for Data Science	3	VU	4.5	x	x
B.1.1 Applied Statistics	3	VO	4.5		x
B.1.2 Applied Statistics	1	UE	1.5		x
B.1.3 Bayesian Modelling	3	VU	4.5		x
B.2.1 Digital Ethics: An Introduction	1	VO	1.5	x	
B.3.1 Software Development	2	VU	3	x	
Courses from Modules C: Elective Subjects or free-choice subjects			6	x	x
1st semester total			30		
2nd semester					
A.3.1 Data Management	2	VO	3		x
A.3.2 Data Management	1	KU	1		x
A.3.3 Machine Learning 1	2	VO	3		x
A.3.4 Machine Learning 1	1	UE	1.5		x
B.2.2 Introduction to IT-Law	2	VO	3	x	
B.4.3 Machine Learning 2	2	VO	3		x
B.4.4 Machine Learning 2	1	KU	1.5		x
B.5.1 Optimisation for Data Science	2	VO	3	x	
B.5.2 Optimisation for Data Science	2	UE	3	x	
B.6.1 Project in Data Science	4	PT	6	x	x
Courses from Modules C: Elective Subjects or free-choice subjects			2	x	x
2nd semester total			30		
3rd semester					
B.3.2 Data Integration and Large Scale Analysis	3	VU	5		x
B.4.1 Statistical Learning	2	VO	3	x	
B.4.2 Statistical Learning	1	UE	1.5	x	
B.7.2 Seminar in Data Science	2	SE	4	x	x
Courses from Modules C: Elective Subjects or free-choice subjects			15.5	x	x
3rd semester total			29		
4th semester					
Master's examination			1	x	x
Master's thesis			30	x	x
4th semester total			31		
Total overall ECTS			120		

[1]: Assignment of the course to the participating universities. Both universities are named if the course is offered at both universities in combination, in parallel or alternately.

Appendix II d: Recommended Curriculum Timeline for Students with a Degree in Software Engineering and Management or Information and Computer Engineering

1st semester	SSt.	Type	ECTS	Uni Graz[1]	TU Graz[1]
A.4.1 Analysis for Data Science	3	VU	4.5	x	x
A.4.2 Numerical Linear Algebra for Data Science	3	VU	4.5	x	x
A.4.3 Probability and Statistics for Data Science	3	VU	4.5	x	x
B.1.1 Applied Statistics	3	VO	4.5		x
B.1.2 Applied Statistics	1	UE	1.5		x
B.3.2 Data Integration and Large Scale Analysis	3	VU	5		x
B.2.1 Digital Ethics: An Introduction	1	VO	1.5	x	
B.3.1 Software Development	2	VU	3	x	
Courses from Modules C: Elective Subjects or free-choice subjects			1	x	x
1st semester total			30		
2nd semester					
A.4.5 Machine Learning 1	2	VO	3		x
A.4.6 Machine Learning 1	1	UE	1.5		x
B.2.2 Introduction to IT-Law	2	VO	3	x	
B.4.3 Machine Learning 2	2	VO	3		x
B.4.4 Machine Learning 2	1	KU	1.5		x
B.5.1 Optimisation for Data Science	2	VO	3	x	
B.5.2 Optimisation for Data Science	2	UE	3	x	
B.6.1 Project in Data Science	4	PT	6	x	x
Courses from Modules C: Elective Subjects or free-choice subjects			6	x	x
2nd semester total			30		
3rd semester					
B.1.3 Bayesian Modelling	3	VU	4.5		x
B.4.1 Statistical Learning	2	VO	3	x	
B.4.2 Statistical Learning	1	UE	1.5	x	
B.7.2 Seminar in Data Science	2	SE	4	x	x
Courses from Modules C: Elective Subjects or free-choice subjects			16	x	x
3rd semester total			29		
4th semester					
Master's examination			1	x	x
Master's thesis			30	x	x
4th semester total			31		
Total overall ECTS			120		

[1]: Assignment of the course to the participating universities. Both universities are named if the course is offered at both universities in combination, in parallel or alternately.

Appendix III: Recommended Free-Choice Subjects

As free-choice subjects, students can choose courses as desired in accordance with 0 8 of this curriculum.

For students to broaden their knowledge, courses in the fields of foreign languages, social competence, technological impacts assessment and women's and gender studies are recommended. In particular, the following institutions and service departments are offered:

- Languages, Key Competencies and In-House Training of TU Graz,
- Science, Technology and Society Unit (STS Unit) of TU Graz,
- treffpunkt sprachen – Centre for Language, Plurilingualism and Didactics,
- The transfer initiative for management and entrepreneurship fundamentals, awareness, training and employability ("TIMEGATE"), and
- Centre for Social Competence of Uni Graz.

Furthermore, it is recommended to complete an interfaculty master's module offered by the University of Graz that supplements the content of the degree programme (students must apply in advance to participate). Additionally, the following courses are recommended:

Course	**SSt.**	**Type**	**ECTS**
Basic Module of the University: Gender Studies	1	VO	2
Social Aspects of Digital Technologies: Gender, Diversity and Research Ethics	2	VU	3