These degree program and examination regulations have been worded carefully to be up to date; however, errors cannot be completely excluded. The official German text available from L1 – Legal Affairs and Academic Quality Management is the version that is legally binding.

Note: Students who started their studies before the latest amendment came into effect are requested to also comply with previous amendments and the respective transitory provisions.

Degree Program and Examination Regulations for the Bachelor's and Master's degree program in Data Science at the Faculty of Sciences, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) – FPODataScience –
Dated August 20, 2020

amended by statutes of
March 11, 2021
August 05, 2021
March 28, 2022

Based on Section 13 (1)(2), Section 43 (5)(2), Section 58 (1) and Section 61 (2)(1) of the Bavarian Higher Education Act (Bayerisches Hochschulgesetz, **BayHSchG**), FAU enacts the following General Degree Program and Examination Regulations:

Contents:

Part I: General Provisions

Section 37 Scope

The degree program and examination regulations for the Bachelor's degree program and consecutive Master's degree program in Data Science supplement the current version of the general degree program and examination regulations for the Bachelor's degree programs in Data Science, Mathematics, Industrial Mathematics and Economics and Mathematics as well as the Master's degree programs in Data Science, Mathematics, Computational and Applied Mathematics and Economics and Mathematics at the Faculty of Sciences at FAU (**ABMPOMathe/NatFak**).

Section 38 Bachelor's Degree Program, Standard Duration of Studies, Related Degree Programs

(1)[1]The Bachelor's degree program in Data Science consists of modules worth 180 ECTS credits distributed over six semesters. [2]This includes the period for working on the Bachelor's thesis.

(2) Bachelor's degree programs count as related degree programs pursuant to Section 26 (1)(2)(2) **ABMPOMathe/NatFak** if at least 65 ECTS credits are allocated to mathematics in the curriculum of the degree program, and the degree program also includes at least 55 ECTS credits from computer sciences.

Section 39 Master's Degree Program, Standard Duration of Studies, Teaching Language, Related Degree Programs

(1) [1]The Master's degree program in Data Science builds on the content covered in the Bachelor's degree program in Data Science. [2]It consists of modules worth 120 ECTS credits including the Master's thesis, distributed over four semesters for the full-time degree program (**Appendix 2b** or **2c**) or eight semesters for the part-time degree program (**Appendix 2d** or **2e**).

(2) Master's degree programs count as related degree programs pursuant to Section 32 (2)(2) **ABMPOMathe/NatFak** if at least 80 ECTS credits are allocated to mathematics in the curriculum of the degree program, and 30 ECTS credits are included from computer science.

(3) [1]The teaching and examination language for the Master's degree program in Data Science is German for the specializations Mathematical theory/foundations of data science (MTG) and Mathematical statistical data analysis (MSD). [2]The teaching and examination language in the specializations Data-based optimization (DO), Data bases and knowledge representation (DW), Machine learning/artificial Intelligence (AI), and Simulation and numerics (SN) is English. [3]Individual modules in the specializations mentioned in sentences 1 and 2 can also be held in the other language; Section 4 (5) **ABMPOMathe/NatFak** shall remain unaffected.

Part II: Special Provisions

First Bachelor's Examination

Section 40 Structure of the Bachelor's Degree Program

[1]The Bachelor's degree program consists of:
  a) compulsory modules for data science (nos. 1 and 2 and nos. 5 to 15)
  b) compulsory elective modules for
    – the core modules in data science (nos. 3 and 4 pursuant to Section 42)
    – compulsory electives in mathematics (no. 16 pursuant to Section 43)
    – compulsory electives in computer science (no. 17 pursuant to Section 44)
    – specializations (no. 18 and 19 pursuant to Section 45)
    – the application field (no. 20 pursuant to Section 46)
  c) elective modules for technical and non-technical key qualifications (no. 21 pursuant to Section 47)
  d) Bachelor's seminar and Bachelor's thesis (nos. 22 and 23 pursuant to Section 48).
[2]Details are set forth hereinafter and in **Appendix 1**.

Section 41 Grundlagen- und Orientierungsprüfung (GOP)

In order to pass the Grundlagen- und Orientierungsprüfung (**GOP**), students must acquire a minimum of 30 ECTS credits from the foundation modules in mathematics and computer science.

Section 42 Compulsory Elective Modules for Core Modules in Data Science

(1) [1]The core modules in data science consist of the compulsory modules no. 1 and no. 2 and the compulsory elective modules no. 3 and no. 4 pursuant to **Appendix 1b**. [2]Students must acquire a total of 20 ECTS credits in the core modules in data science.

(2) [1]Students choose compulsory elective modules no. 3 and no. 4 by registering for the first examination in a module from the group of compulsory elective modules. [2]The modules are listed in module catalogs that are announced in accordance with local practice at the latest one week before the semester begins. [3]Changes to the module catalogs can be made by the Examinations Committee, to take effect from the following semester.

(3) [1]The type and scope of the examinations and the way in which the grade is determined for the compulsory elective modules for the core modules in data science depend on the specific manner in which the respective modules are taught; see module handbook for details. [2]Possible examination achievements for modules offered by the Department of Mathematics or the Department of Data Science as compulsory elective modules for the core modules in data science are as follows:

1. Written examination (60–120 min)
2. Written assignment (approx. 5–10 pages)
3. Report (approx. 5–10 pages)
4. Oral examination (15–30 min)
5. Electronic examination (e-examination 30–60 min)
6. Tutorial achievement (approx. 30–45 pages)
7. Practical achievement (report approx. 5–10 pages or series of reports approx. 40 pages)
8. Seminar achievement (presentation 30–80 min), possibly with written assignment (approx. 5–10 pages)
9. Excursion achievement (report approx. 5–10 pages or series of reports approx. 30–45 pages)

and combinations of the above. [3]In particular in the cases covered by Section 6 (2)(3) **ABMPOMathe/NatFak**, it is possible to combine a written or oral examination with achievements as set forth in Section 6 (4) **ABMPOMathe/NatFak**. [4]Further details are stipulated in the module handbook. [5]The type and scope of examinations and the way in which the grade is determined for the compulsory elective modules for the core modules in data science depend on the specific manner in which the modules are taught; see the relevant **degree program and examination regulations** and/or the module handbook for details.

(4) [1]Modules from the Department of Mathematics or the Department of Data Science amounting to 5 ECTS credits usually consist of lectures (2 SWS) and tutorials (up to 2 SWS) or seminars (2 SWS). [2]Modules from the Department of Mathematics or the Department of Data Science amounting to 10 ECTS credits usually consist of lectures (4 SWS) and tutorials (up to 3 SWS). [3]Any exceptions are detailed in the module handbook. [4]Modules from other departments and faculties may deviate from the provisions stipulated in sentences 1 and 2. [5]Further details are stipulated in the respective **degree program and examination regulations** and/or the module handbook.

Section 43 Compulsory Elective Modules in Mathematics

(1) [1]The compulsory elective modules in mathematics (no. 16 pursuant to **Appendix 1b**) account for between 5 and 15 ECTS credits. [2]Together with the compulsory elective modules in computer science, students must take modules coming to a total of 20 ECTS credits.

(2) [1]The learning outcome of the compulsory elective modules in mathematics is to allow students to gain a more in-depth knowledge of selected mathematical skills. [2]The second learning outcome has a research focus, with students learning subject-related methods of research and exploring their subject in more depth. [3]Thirdly, the element of choice allows students to tailor their profile in view of the area of data science they intend to specialize in.

(3) Section 42 (2) shall apply accordingly with respect to registering for the examination and announcing the modules students can choose from.

(4) The type and scope of teaching units and the examination are stipulated in Section 42 (3) and (4).

Section 44 Compulsory Elective Modules in Computer Science

(1) [1]The compulsory elective modules in computer science (no. 17 pursuant to **Appendix 1b**) account for between 5 and 15 ECTS credits. [2]Together with the compulsory elective modules in mathematics, students must take modules amounting to a total of 20 ECTS credits.

(2) [1]The learning outcome of the elective modules in computer science is firstly to allow students to acquire skills in a specific area of computer science. [2]The second learning outcome has a research and practical focus, with students learning subject-related methods of research and practical application, and exploring their subject in more depth. [3]Thirdly, the element of choice allows students to tailor their profile in view of the area of data science they intend to specialize in.

(3) Section 42 (2) shall apply accordingly with respect to registering for the examination and announcing the modules students can choose from.

(4) The type and scope of teaching units and the examination are stipulated in Section 42 (3)(5) and (4)(4).

Section 45 Compulsory Elective Modules in Specializations

(1)[1]The compulsory elective modules in the specializations (nos. 18 and 19 in **Appendix 1b**) are specifically aimed at allowing students to acquire more extensive skills in specific areas of mathematics and computer science. [2]The learning outcome has a research and practical focus, with students learning subject-related methods of research and exploring their subject in more depth. [3]The element of choice gives students the opportunity to tailor their profile in view of a subsequent Master's degree or their future career.

(2) [1]At least 30 ECTS credits must be obtained in the specializations. [2]Students choose to specialize in mathematics, computer science or an interdisciplinary specialization. [3]Students shall acquire a minimum of 15 ECTS credits and a maximum of 20 ECTS credits from the chosen specialization. [4]The remaining 10 to 15 ECTS credits shall be submitted from the specializations that were not chosen. [5]Students shall take at least 10 ECTS credits in specialization modules offered by the Department of Mathematics or the Department of Data Science and the Department of Computer Science respectively.

(3)[1]The specializations (modules nos. 18 and 19 pursuant to **Appendix 1b)** are offered by different departments and consist of module packages. [2]The following specializations are available for mathematics and data science:
 a) Mathematical statistical data analysis (MSD)
 b) Data-oriented optimization (DO)
 c) Mathematical theory / foundations of data science (MTG).
[3]The following specializations are available for computer science:
 a) Databases and knowledge representation (DW)
 b) Machine learning and artificial intelligence (AI).
[4]Students may also choose the interdisciplinary specialization Simulation and numerics (SN).

(4) Section 42 (2) shall apply accordingly with respect to registering for the examination and announcing the modules students can choose from.

(5) The type and scope of teaching units and the examination are stipulated in Section 42 (3) and (4).

Section 46 Compulsory Elective Modules for Application Fields

(1) [1]The application fields (no. 20 pursuant to **Appendix 1b**) account for a total of 10 ECTS credits. [2]The following application fields may be chosen:
1. Chemistry
2. Digital Humanities
3. Geography
4. Geosciences
5. Medical data science
6. Physics
7. Materials science
8. Information systems
9. Artificial intelligence in biomedical engineering (AIBE).

[3]The Examinations Committee can approve additional application fields upon request.

(2) Section 42 (2) shall apply accordingly with respect to registering for the examination and announcing the modules students can choose from.

(3) The type and scope of teaching units and the examination are stipulated in Section 42 (3)(5) and (4)(4).

Section 47 Elective Modules for Technical and Non-Technical Key Qualifications

(1) [1]Module no. 20 pursuant to **Appendix 1b** comprises elective modules for technical and non-technical key qualifications. [2]The available technical and non-technical key qualification modules are listed in a module catalog that is announced in accordance with local practice at the latest one week before the semester begins. [3]Changes to the module catalog can be made by the Examinations Committee, to take effect from the following semester.

(2) Section 42 (2) shall apply accordingly with respect to registering for the examination and announcing the modules students can choose from.

(3) The type and scope of teaching units and the examination are stipulated in Section 42 (3) and (4).

Section 48 Bachelor's Seminar and Bachelor's Thesis

(1) [1]Specialist knowledge and skills relating to one specialist area of data science are acquired during a Bachelor's seminar worth 5 ECTS credits. [2]The subject of this Bachelor's seminar can be taken as the basis for the Bachelor's thesis, worth 10 ECTS credits, which is generally supervised by the person responsible for teaching the Bachelor's seminar. [3]Students must have acquired at least 100 ECTS credits before they may be allocated a subject for their Bachelor's thesis.

(2) [1]Notwithstanding Section 29 (2) **ABMPOMathe/NatFak**, university lecturers employed full time at the Department of Computer Science are entitled to assign Bachelor's theses (supervisors). [2]Any exceptions are decided by the Examinations Committee.

2. Master's Examination

Section 49 Qualification for a Master's Degree, Certificates and Admission Requirements

(1) A subject-specific degree as defined in Section 31 (1)(1)(1) **ABMPOMathe/NatFak** is a Bachelor's or Diplom degree program in mathematics, technomathematics, economics and mathematics, computer science, data science or physics at FAU or a degree from a university in Germany or another country with equivalent content.

(2) [1]Additional proof that must be submitted as stipulated in Section 2 (2)(3) of the **Appendix to ABMPOMathe/NatFak** shall be proof of language proficiency of at least English Level B 2 (Common European Framework of Reference for Languages – CEFR) Vantage or Upper Intermediate. Evidence of this can be provided, in particular, by having participated in English lessons for 6 years at a German grammar school (Gymnasium). [2]Applicants who have completed their university entrance qualifications or their first degree in English are not required to provide proof of proficiency in English.

(3) [1]Notwithstanding (5)(3) **Appendix to ABMPOMathe/NatFak**, the admissions committee shall deem the applicant qualified based on submitted documents if the final grade of the subject-specific or subject-related/equivalent degree fulfills the provisions under Section 31 (1)(1)(1), sentence 2 or in the case of Section 31 (3) if the student has achieved an average of 2.5 (good) or better in their previous achievements; otherwise, (5)(3) of the **Appendix to ABMPOMathe/NatFak** shall remain unaffected. [2]The average grade shall be calculated by weighting the grades of the achievements according to the weighting of the ECTS credits in the individual modules; achievements in modules with more credits shall therefore have more weighting than modules with fewer credits. [3]Notwithstanding (5)(4) of the **Appendix to ABMPOMathe/NatFak**, only those applicants shall be invited to the oral admission examination whose average grade in modules related to mathematics and computer science in their undergraduate degree that is subject-specific, subject-related or relevant to the specific Master's degree program or another equivalent German or non-German qualification with equivalent content pursuant to Section 31 (1)(1)(1), Section 31 sentence 2 or Section 31 (3) is worse than 2.5 (good), but at least 2.8 (satisfactory).

(4) In the oral admission examination according to Section 5 (4) et seq. of the Appendix to **ABMPOMathe/NatFak**, applicants shall be evaluated according to the following criteria:
1. Quality of knowledge in the foundations of the subject (analysis, linear algebra, algorithms and data structures) (35%)
2. Quality of basic knowledge in two specialist areas within the specializations suggested by the applicant pursuant to Section 45 (3) (35%)
3. Ability to hold an academic discussion in English on topics relating to mathematics and computer science (30%).

(5) [1]Notwithstanding (5) sentences 9 and 12 in the **Appendix** to **ABMPOMathe/NatFak**, the admissions interview is conducted by two individuals with doctoral degrees whose main employment is at the Department of Mathematics, Data Science or Computer Science appointed by the admissions committee. [2]After the interview, they shall submit a recommendation to the admissions committee stating whether the applicant should be offered a place on the degree program or not. [3]The

admissions committee decides on the basis of this recommendation whether to accept or reject the applicant.

Section 50 Content, Scope and Structure of the Master's Degree Program

(1) [1]The Master's degree program shall consist of the modules set forth in **Appendix 2**. [2]A total of 120 ECTS credits must be obtained during the Master's degree program as follows:
1. 20 ECTS credits from compulsory modules (nos. 1 to 3 and 8)
2. 30 ECTS credits from compulsory elective modules from major subject (no. 4 pursuant to (2) in conjunction with Section 51)
3. 20 ECTS credits from compulsory elective modules in minor subjects (no. 5 pursuant to Section (2) in conjunction with Section 51)
4. 15 ECTS credits from compulsory elective modules from the application fields (no. 6 pursuant to Section 52)
5. 5 ECTS credits from elective modules from technical key qualifications (no. 7 pursuant to Section 53)
6. A Master's seminar amounting to 5 ECTS credits from the modules offered by the Department of Mathematics, the Department of Data Science or the Department of Computer Science
7. 30 ECTS credits from the Master's thesis in the main field of study.

(2) [1]The Master's degree program in Data Science is taken in one of the following specializations:
1. Data-oriented optimization (DO)
2. Mathematical theory/foundations of data science (MTG)
3. Databases and knowledge representation (DW)
4. Machine learning/artificial intelligence (AI)
5. Simulation and numerics (SN)
6. Mathematical statistical data analysis (MSD).

[2]Applicants state their chosen specialization in their application for admission to the Master's degree program, but this can be changed over the course of the degree program. [3]The chosen specialization shall be referred to as the major field of study, the specializations that are not chosen shall be referred to as minor fields of study. [4]Students shall take at least 20 ECTS credits in specialization modules offered by the Department of Mathematics or the Department of Data Science and the Department of Computer Science respectively.

Section 51 Compulsory Elective Modules in Specializations

(1) [1]In the compulsory elective modules in the specializations, students acquire skills in scientific methods for classifying mathematical structures, for modeling and for problem-solving strategies, and the ability to carry out academic work independently. [2]The learning outcome has a research focus, with students learning subject-related methods of research and exploring their subject in more depth. [3]The element of choice allows students to tailor their profile in view of their career plans.

(2) The specializations have the following subject-specific learning outcomes:
1. In the specialization Data-oriented optimization (DO), students acquire methodological skills covering various aspects of this field of study such as linear and non-linear systems, and combinatorial, non-linear or robust optimization.

2. In the specialization Mathematical theory/foundations of data science, students acquire methodological skills covering various aspects of this field of study such as differential equations and algebra.
3. In the specialization Databases and knowledge representation, students acquire methodological skills covering various aspects of this field of study such as data management in distributed systems, data warehouse systems, big data technology, and semantic web technologies.
4. In the specialization Machine learning/artificial intelligence, students acquire methodological skills covering various aspects of this field of study such as symbolic and non-symbolic AI, supervised and non-supervised learning, deep learning.
5. In the specialization Simulation and numerics in data science, students acquire methodological skills covering various aspects of this field of study such as simulation, modeling, scientific computing or numerical methods for partial differential equations.
6. In the specialization Mathematical statistical data analysis in data science, students acquire methodological skills covering various aspects of this field of study such as statistics, stochastics, image and data analysis or risk data analytics.

(3) Section 42 (2) shall apply accordingly with respect to registering for the examination and announcing the modules students can choose from.

(4) The type and scope of teaching units and the examination are stipulated in Section 42 (3) and (4).

Section 52 Compulsory Elective Modules for Application Fields
(1) [1]The application fields (no. 6 pursuant to **Appendix 2b** to **2e**) account for a total of 15 ECTS credits. [2]The following application fields may be chosen:
1. Chemistry
2. Digital Humanities
3. Geography
4. Geoscience
5. International information systems
6. Medical data science
7. Physics
8. Materials science
9. Artificial intelligence in biomedical engineering (AIBE).

[3]The Examinations Committee can approve additional application fields upon request.

(2) Section 42 (2) shall apply accordingly with respect to registering for the examination and announcing the modules students can choose from.

(3) The type and scope of teaching units and the examination are stipulated in Section 42 (3)(5) and (4)(4).

Section 53 Elective Modules for Technical Key Qualifications
(1) [1]Module no. 7 pursuant to **Appendix 2b** comprises elective modules for technical key qualifications. [2]Technical key qualifications may be selected from the following modules:
1. Selected modules from computer science
2. Selected modules from mathematics

3. Working as a tutor in mathematics or computer science for two semesters after participating in the relevant tutor training course
4. Completing an internship approved by the Examinations Committee lasting (a minimum of) four weeks.

(2) Section 42 (2) shall apply accordingly with respect to registering for the examination and announcing the modules students can choose from.

(3) The type and scope of teaching units and the examination are stipulated in Section 42 (3) and (4).

Section 54 Mentoring and Individual Study Agreement

(1) [1]Each student is assigned a mentor upon commencing the Master's degree program. [2]The mentor is responsible for assisting the student in drawing up an individual study agreement and answering any questions students may have concerning their degree program. [3]This mentoring relationship shall be maintained throughout the Master's degree program.

(2) [1]At the beginning of the Master's degree program, the mentor and the student shall work together to draw up an individual study agreement which should take the specific subject areas the student is interested in into account. [2]This study agreement shall remain valid for the duration of the Master's degree program and shall list all the modules which are to be taken. [3]It shall be submitted to the Examination Committee for approval by the date of the first examination in the Master's degree program.

(3) [1]The study agreement may be updated in consultation with the mentor if necessary in order to ensure that the subject area suits the individual focus chosen by the student and can be studied accordingly. [2]The updated version shall be submitted to the Examination Office for approval without delay.

Section 55 Master's Thesis

(1) [1]The Master's thesis is intended to demonstrate students' ability to solve scientific problems in the field of data science independently. [2]Requirements for the thesis shall be such that it can completed within a period of six months.

(2) [1]Notwithstanding Section 34 (3) **ABMPOMathe/NatFak**, university lecturers employed full time at the Department of Computer Science are entitled to assign Bachelor's theses (supervisors). [2]Any exceptions are decided by the Examinations Committee.

(3) The Master's thesis shall usually deal with a scientific subject from the chosen branch of study.

(4) 30 ECTS credits shall be awarded for the Master's thesis.

Part III: Final Provisions

Section 56 Legal Validity

(1) [1]These examination regulations shall come into effect on the day after their publication. [2]They shall apply to all students who start the Bachelor's or Master's degree program in Data Science in the winter semester 2020/2021 or later.

(2) [1]The first amendment statute shall come into effect on the day after its publication. [2]It shall apply to all students starting a degree program from winter semester 2021/2022 onwards. [3]Notwithstanding sentence 2, the changes in Appendix 1 also apply to all students who are already enrolled in the Bachelor's degree program in Data Sciene at the time the first amendment statue comes into effect.

(3) The second amendment statute shall come into effect on the day after its publication.

(4) [1]The third amendment statute shall come into effect on the day after its publication. [2]It shall apply to all students starting the Bachelor's degree program as of summer semester 2022 and to those who have already started to study the Master's degree program in Data Science in accordance with an already valid version of the **FPO Data Science**. [3]Notwithstanding sentence 2, the amendments in Section 48 (1)(3) and **Appendices 2b** and **2c** shall apply to all students who have not yet started examinations (first attempt) for the Bachelor's thesis module or the amended core modules "Mathematics of learning" and "Selected topics in mathematics of learning". [4]Notwithstanding sentences 2 and 3, the amendments in section 39 (1)(2), Section 49 and Section 54 (1) and **Appendices 2d** and **2e** shall apply to all students starting the Master's degree program from winter semester 2022/2023 onwards. [5]Examinations in the modules mentioned in sentence 3 from **Appendices 2b** and **2c** shall be offered in accordance with the currently valid versions of these degree program and examination regulations for the last time in winter semester 2022/2023. [6]From the date stated in sentence 5, those students who are affected by the modules no longer being offered shall take their (re-sit) examinations in accordance with the version of the degree program and examination regulations valid at that time.

Appendix 1: Bachelor's degree program in Data Science

Appendix 1a: Overview of Curriculum

Core modules: Data science 20 ECTS credits	Bachelor's thesis (6th semester) 15 ECTS credits		Technical and non-technical key qualifications 12.5 ECTS
	Application field (5th and 6th semesters) 10 ECTS credits		
	Specializations (5th and 6th semesters) 30 ECTS credits		
	Compulsory elective modules mathematics (4th semester) 5–15 ECTS	Compulsory elective modules computer science (4th semester) 5– 5 ECTS	
	Intermediate modules in mathematics and computer science (3rd and 4th semesters) 30 ECTS credits		
	Intermediate modules in mathematics and computer science (1st and 2nd semesters) 42.5 ECTS credits		

The regulations for the colored blocks are explained in detail in the example degree program structure below (see **Appendix 1b**)

Appendix 1b: Study Plan for the Bachelor's Degree Program in Data Science

	No.	Module name	Teaching unit	L	T	P	S	T	Total ECTS credits	1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.	Type and scope of the examination	Grade factor
Core modules: Data science	1	Seminar: Data science in research and industry	Seminar: Data science in research and industry				4		**5**	5						Written examination with multiple choice 90 min	0
	2	Introduction to mathematical data analysis	Lecture: Introduction to mathematical data analysis	2					**5**		5					Written examination, 60 min	1
			Tutorial: Introduction to mathematical data analysis		1												
	3	Compulsory elective modules from the catalog for machine learning pursuant to Section 42	see module catalog pursuant to Section 42 (4)						**5**		5					see module catalog pursuant to Section 42 (3)	1
	4	Compulsory elective modules from the catalog for data science project pursuant to Section 42	see module catalog pursuant to Section 42 (4)						**5**					5		see module catalog pursuant to Section 42 (3)	1
		Total for core modules: Data science		**4**	**3**	**2**	**4**	**0**	**20**	**5**	**10**	**0**	**0**	**5**	**0**		

	No.	Module name	Teaching unit	SWS (semester hours)					Total ECTS credits	Distribution of workload per semester in ECTS credits						Type and scope of the examination	Grade factor
				L	T	P	S	T		1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.		
Foundational modules in mathematics and computer science	5	Mathematics for data science 1 GOP [1]	Lecture: Data science 1	4					10	10						Written examination 120 min and tutorial achievement (ungraded)	0
			Tutorial: Data science 1		2												
			Blackboard exercise: Data science 1		2												
	6	Mathematics for data science 2 GOP[1]	Lecture: Data science 2	4					10		10					Written examination 120 min and tutorial achievement (ungraded)	1
			Tutorial: Data science 2		2												
			Blackboard exercise: Data science 2		2												
	7a	Lecture: Algorithms and data structures for medical engineers (GOP[1], only applicable in conjunction with 7b)	see **FPOMT**						5	5						see **FPOMT**	0
	7b	Tutorial on algorithms and data structures for medical engineers (GOP[1], only applicable in conjunction with 7a)	see **FPOMT**						5	5						see **FPOMT**	0
	8	Conceptual modeling	see **FPOINF**						7.5		7.5					see **FPOINF**	1
	9	Information visualization[3] GOP[1]	see **FPOINF**						5		5					see **FPOINF**	1
		Total foundation modules in mathematics and computer science		**16**	**16**	**0**	**0**	**0**	**42.5**	**20**	**22.5**	**0**	**0**	**0**	**0**		

[1]In order to pass the Grundlagen- und Orientierungsprüfung (**GOP**), students must acquire a minimum of 30 ECTS credits from the foundation modules in mathematics and computer science.

	No.	Module name	Teaching unit	SWS (semester hours)					Total ECTS credits	Distribution of workload per semester in ECTS credits						Type and scope of the examination	Grade factor
				L	T	P	S	T		1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.		
Intermediate modules in mathematics and computer science	10	Linear and combinatorial optimization [2]	see **FPOWiMathe**						10			10				see **FPOWiMathe**	1
	11	Introduction to numerics [2]	see **FPOTechnoMathe**						10			10				see **FPOTechnoMathe**	1
	12	Stochastic modeling [2]	see **FPOWiMathe**						10			10				see **FPOWiMathe**	1
	13	Parallel and functional programming [3]	see **FPOINF**						5			5				see **FPOINF**	1
	14	Knowledge discovery in databases with tutorial [3]	see Section 39a (3) **FPOINF**						5				5			see Section 39a (3) **FPOINF**	1
	15	Foundations of logic in computer science [3]	see **FPOINF**						5			5				see **FPOINF**	1
		Total intermediate modules in mathematics and computer science		**20**	**14**	**0**	**0**	**0**	**30**	**0**	**0**	**25–30**	**0–5**	**0**	**0**		

[2] Two out of three modules must be chosen. The third module can be taken from the compulsory elective modules in mathematics.
[3] Two out of three modules must be chosen. The third module can be taken from the compulsory elective modules in computer science.

	No.	Module name	Teaching unit	SWS (semester hours)					Total ECTS credits	Distribution of workload per semester in ECTS credits						Type and scope of the examination	Grade factor
				L	T	P	S	T		1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.		
Compulsory elective modules mathematics	16	Compulsory elective modules from the catalog of compulsory electives in mathematics pursuant to Section 43	see module catalog pursuant to Section 43 (4)						**5–15**				5–15			see Section 43 (4)	1
		Total compulsory elective modules in mathematics[4]		**6**	**5**	**0**	**0**	**1**	**5–15**	**0**	**0**	**0**	**5–15**	**0**	**0**		
Compulsory elective modules in computer science	17	Compulsory elective modules from the catalog of compulsory electives for computer science pursuant to Section 44	see module catalog pursuant to Section 44 (4)						**5–15**				5–15			see Section 44 (4)	1
		Total compulsory elective modules in computer science[4]		**4**	**3**	**0**	**0**	**0**	**5–15**	**0**	**0**	**0**	**5–15**	**0**	**0**		
Specializations	18	Compulsory elective modules from the catalog for chosen specialization pursuant to Section 45	see module catalog pursuant to Section 45 (5)						**15–20**					10–20	0–10	see Section 45 (5)	1
	19	Compulsory elective modules from the catalogs for specializations not chosen pursuant to Section 45	see module catalog pursuant to Section 45 (5)						**10–15**					0–10	0–10	see Section 45 (5)	1
		Total for computer science specialization [5]		**12**	**8**	**0**	**2**	**0**	**30**	**0**	**0**	**0**	**0**	**20**	**10**		

[4] Students must take at least one module worth 5 ECTS credits and may only take modules worth a maximum of 15 ECTS credits from the compulsory elective modules in mathematics and computer science. Students must take compulsory elective modules in mathematics and computer science amounting to a total of 20 ECTS credits.

[5] Students shall take at least 10 ECTS credits in specialization modules offered by the Department of Mathematics or the Department of Data Science and the Department of Computer Science respectively.

	No.	Module name	Teaching unit	SWS (semester hours)					Total ECTS credits	Distribution of workload per semester in ECTS credits						Type and scope of the examination	Grade factor
				L	T	P	S	T		1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.		
Application fields	20	Compulsory elective modules from the catalog for the application fields pursuant to Section 46	see module catalogs pursuant to Section 46 (3)						**10**					5	5	see Section 46 (3)	1
		Total: Application field		**2**	**4**	**8**	**0**	**0**	**10**	**0**	**0**	**0**	**0**	**5**	**5**		
Technical and non-technical key qualifications	21	Compulsory elective modules from the catalog of technical and non-technical key qualifications pursuant to Section 47	see module catalog pursuant to Section 47 (3)						**12.5**	2.5		0–5	5–10			see Section 47 (3)	1
		Total technical and non-technical key qualifications		**6**	**6**	**0**	**0**	**0**	**12.5**	**2.5**	**0**	**0–5**	**5–10**	**0**	**0**		
Bachelor's thesis	22	Bachelor's seminar	Bachelor's seminar (see section 48)				2		**5**						5	Seminar achievement pursuant to Section 6 **ABMPOMathe/NatFak**	1
	23	Bachelor's thesis							**10**						10	Bachelor's thesis (approx. 20–25 pages)	1
		Total Bachelor's thesis		**0**	**0**	**0**	**2**	**0**	**15**	**0**	**0**	**0**	**0**	**0**	**15**		
		Total SWS (at least) ² and ECTS credits		**70**	**59**	**10**	**8**	**1**	**180**	**27.5**	**32.5**	**30**	**30**	**30**	**30**		

Key:
Tutorial achievement: see Section 6 (4) **ABMPOMathe/NatFak**.

Appendix 2: Master's degree program in Data Science

Appendix 2a: Overview of Curriculum
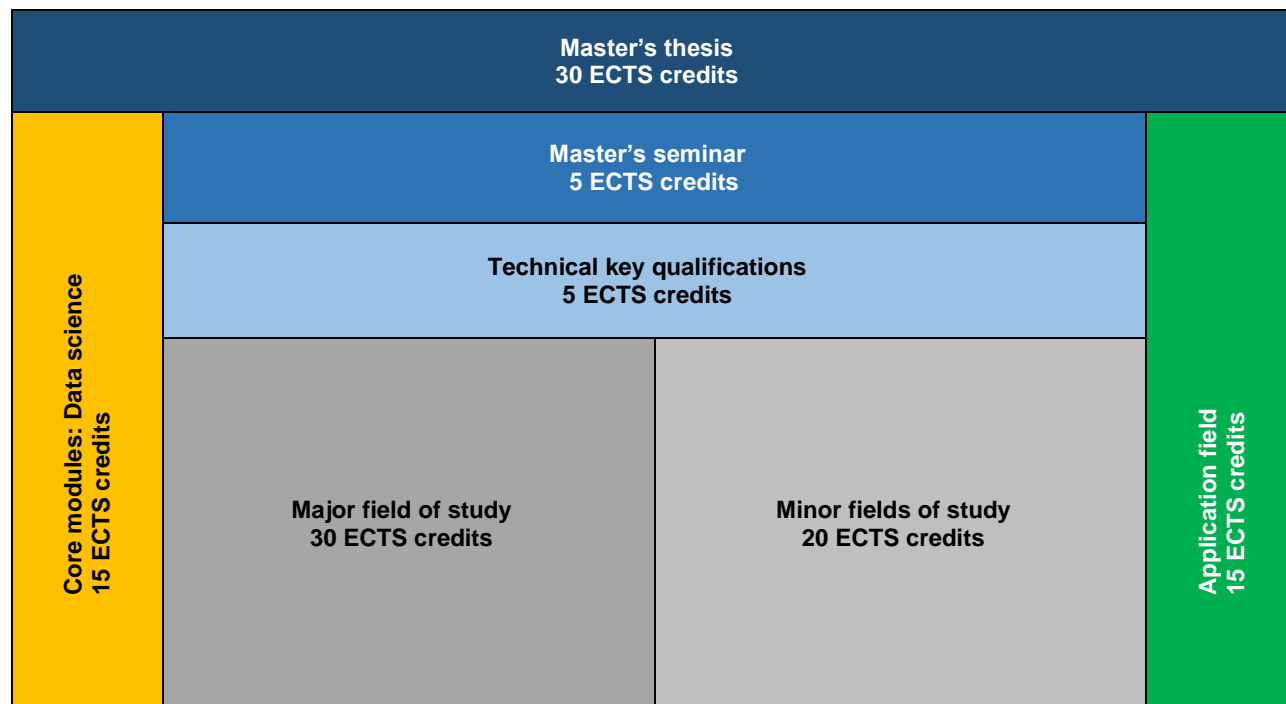
Master's thesis 30 ECTS credits			
Core modules: Data science 15 ECTS credits	Master's seminar 5 ECTS credits		**Application field 15 ECTS credits**
	Technical key qualifications 5 ECTS credits		
	Major field of study 30 ECTS credits	Minor fields of study 20 ECTS credits	

The regulations for the colored blocks are explained in detail in the example degree program structure below (see **Appendix 2b**).

Appendix 2b: Study Plan for the Master's Degree Program in Data Science, starting in the winter semester

	No.	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Workload per semester in ECTS credits				Type and scope of the examination	Grade factor
				L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Core modules: Data science	1	Mathematics of learning	Mathematical data science	2				**5**	3				Written examination (60 min)	1
			Practical: Mathematical data science		1				2					
	2	Deep learning	see Section 43a (3) **FPOINF**					**5**		5			see Section 43a (3) **FPOINF**	1
	3	Selected topics in mathematics of learning	Mathematics of learning	2				**5**			3		Written examination (60 min)	1
			Tutorial: Mathematics of learning		1						2			
		Total for core modules: Data science						**15**	**5**	**5**	**5**	**0**		
Major field of study	4	Compulsory elective modules from the catalog for chosen major field of study pursuant to Section 51	see module catalog pursuant to Section 51 (4)						10	10	10	0	see Section 51 para. 4	1
		Total compulsory electives in major field of study						**30**	**5–15**	**5–15**	**10**	**0**		
Minor fields of study	5	Compulsory elective modules from the catalogs for the minor fields of study not chosen by the student pursuant to Section 51	see module catalog pursuant to Section 51 (4)						10	10	0	0	see Section 51 para. 4	1
		Total: Compulsory electives for minor field of study						**20**	**5–15**	**5–15**	**0**	**0**		
Application fields	6	Compulsory elective modules from the catalog for modules in application fields pursuant to Section 52	see module catalog pursuant to Section 52 (3)						5	0–5	5–10	0	see Section 52 para. 3	1
		Total: Application field						**15**	**5**	**0–5**	**5–10**	**0**		

	No.	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Workload per semester in ECTS credits				Type and scope of the examination	Grade factor
				L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Technical key qualifications	7	Elective modules in technical key qualifications pursuant to Section 53	see module catalog pursuant to Section 53 (3)						0	0–5	0–5	0	see Section 53 para. 3	1
		Total: Technical key qualifications						**5**	**0**	**0–5**	**0–5**	**0**		
Master's seminar	8	Master's seminar pursuant to Section 6 **ABMPO-Mathe/NatFak**	Master's seminar				2		0	0	5	0	Seminar achievement pursuant to Section 6 **ABMPOMathe/NatFak**	1
		Total: Master's seminar		**0**	**0**	**0**	**2**	**5**	**0**	**0**	**5**	**0**		
Master's thesis	9	Master's thesis pursuant to Section 55	Master's thesis					**30**				30	Master's thesis (approx. 60 pages)	1
		Total: Master's thesis						**30**	**0**	**0**	**0**	**30**		
		Total SWS (minimum) and ECTS credits		**0**	**0**	**0**	**2**	**120**	**30**	**30**	**30**	**30**		

Key:
Seminar achievement: see Section 6 (4) and (5) **ABMPOMathe/NatFak**

Appendix 2c: Study Plan for the Master's Degree Program in Data Science, starting in the summer semester

	No.	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Workload per semester in ECTS credits				Type and scope of the examination	Grade factor
				L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Core modules: Data science	1	Mathematics of learning	Mathematical data science	2				5		3			Written examination (60 min)	1
			Practical: Mathematical data science		21					2				
	2	Deep learning	see Section 43a (3) **FPOINF**					5	5				see Section 43a (3) **FPOINF**	1
	3	Selected topics in mathematics of learning	Mathematics of learning	2				5		3			Written examination (60 min)	1
			Practical: Mathematics of learning		1					2				
		Total for core modules: Data science						**15**	**5**	**10**	**0**	**0**		
Major field of study	4	Compulsory elective modules from the catalog for the chosen major field of study pursuant to Section 51	see module catalog pursuant to Section 51 (4)						5–15	5–15	5–15	0	see Section 51 (4)	1
		Total compulsory electives in major field of study						**30**	**5–15**	**5–15**	**5–15**	**0**		

	No.	Module name	Teaching unit	SWS (semester hours)				Total ECTS credits	Workload per semester in ECTS credits				Type and scope of the examination	Grade factor
				L	T	P	S		1st sem.	2nd sem.	3rd sem.	4th sem.		
Minor fields of study	5	Compulsory elective modules from the catalogs for the minor fields of study not chosen pursuant to Section 51	see module catalog pursuant to Section 51 (4)						5–15	5–15	0–10	0	see Section 51 (4)	1
		Total: Compulsory electives in minor field of study						**20**	**5–15**	**5–15**	**0–10**	**0**		
Application fields	6	Compulsory elective modules from the catalog of modules for application fields pursuant to Section 52	see module catalog pursuant to Section 52 (3)						0–5	5–10	0–5	0	see Section 52 (3)	1
		Total: Application field						**15**	**0–5**	**5–10**	**0–5**	**0**		
Technical key qualification	7	Elective modules from technical key qualifications pursuant to Section 53	see module catalog pursuant to Section 53 (3)						0–5	0–5	0–5	0	see Section 53 (3)	1
		Total: Technical key qualifications						**5**	**0–5**	**0–5**	**0–5**	**0**		
Master's seminar	8	Master's seminar pursuant to Section 6 **ABMPOMathe/NatFak**	Master's seminar				2		0	0	5	0	Seminar achievement pursuant to Section 6 **ABMPOMathe/NatFak**	1
		Total: Master's seminar		**0**	**0**	**0**	**2**	**5**	**0**	**0**	**5**	**0**		
Master's thesis	9	Master's thesis pursuant to Section 55	Master's thesis					**30**				30	Master's thesis (approx. 60 pages)	1
		Total: Master's thesis						**30**	**0**	**0**	**0**	**30**		
		Total SWS (minimum) and ECTS credits		**0**	**0**	**0**	**2**	**120**	**30**	**30**	**30**	**30**		

Key: Seminar achievement: see Section 6 (4) and (5) **ABMPOMathe/NatFak**

Appendix 2d: Study Plan for the Master's Degree Program in Data Science, part-time, starting in the winter semester

	No.	Module name	Teaching unit	SWS (semester hours)					ECTS credits	Distribution of workload per semester								Type and scope of the examination	Grade factor
				L	T	P	S	T		1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.		
Core modules: Data science	1	Mathematics of learning	Mathematical data science	2					5	5								Written examination (60 min)	1
			Practical: Mathematical data science		1														
	2	Deep learning	see Section 43a (3) **FPOINF**						5		5							see Section 43a (3) **FPOINF**	1
	3	Selected topics in mathematics of learning	Mathematics of learning	2					5			5						Written examination (60 min)	1
			Tutorial: Mathematics of learning		1														
		Total for core modules: Data science							15	5	5	5	0						
Major field of study	4	Compulsory elective modules from the catalog for chosen major field of study pursuant to Section 51	see module catalog pursuant to Section 51 (4)							0–10	0–10	0–10	0–10	0–10				see Section 51 (4)	1
		Total compulsory electives in major field of study							30	0–10	0–10	0–10	0–10	0–10					
Minor field of study	5	Compulsory elective modules from the catalogs for the minor fields of study not chosen pursuant to Section 51	see module catalog pursuant to Section 51 (4)							0–10	0–10	0–10	0–10	0–10				see Section 51 (4)	1
		Total: Compulsory electives for minor field of study							20	0–10	0–10	0–10	0–10	0–10					

	No.	Module name	Teaching unit	L	T	P	S	T	ECTS credits	1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	Type and scope of the examination	Grade factor
Application fields	6	Compulsory elective modules from the catalog of modules for the application fields pursuant to Section 52	see module catalog pursuant to Section 52 (3)										0–5	0–5	5–10			see Section 52 (3)	1
		Total: Application field							15				0–5	0–5	5–10				
Technical key qualifications	7	Elective modules from technical key qualifications pursuant to Section 53	see module catalog pursuant to Section 53 (3)										0–5	0–5	0–5			see Section 53 (3)	1
		Total: Technical key qualifications							5				0–5	0–5	0–5				
Master's seminar	8	Master's seminar pursuant to Section 6 **ABMPO Mathe/NatFak**	Master's seminar				2								5			Seminar achievement pursuant to Section 6 **ABMPOMathe/NatFak**	1
		Total: Master's seminar					2		5						5				
Master's thesis	9	Master's thesis pursuant to Section 55	Master's thesis						30							30		Master's thesis (approx. 60 pages)	1
		Total: Master's thesis							30							30			
		Total SWS (minimum) and ECTS credits							120	15	15	15	15	15	15	30			

Key:
Seminar achievement: see Section 6 (4) and (5) **ABMPOMathe/NatFak**

Appendix 2e: Study Plan for the Master's Degree Program in Data Science, part-time, starting in the summer semester

	No.	Module name	Teaching unit	SWS (semester hours)					ECTS credits	Distribution of workload per semester								Type and scope of the examination	Grade factor
				L	T	P	S	T		1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.		
Core modules: Data science	1	Mathematics of learning	Mathematical data science	2					5		5							Written examination (60 min)	1
			Practical: Mathematical data science		1														
	2	Deep learning	see Section 43a (3) **FPOINF**						5	5								see Section 43a (3) **FPOINF**	1
	3	Selected topics in mathematics of learning	Mathematics of learning	2					5		5							Written examination (60 min)	1
			Tutorial: Mathematics of learning		1														
		Total for core modules: Data science							**15**	**5**	**10**	**0**	**0**						
Major field of study	4	Compulsory elective modules from the catalog for chosen major field of study pursuant to Section 51	see module catalog pursuant to Section 51 (4)							0–10	0–5	0–15	0–10	0–10				see Section 51 (4)	1
		Total compulsory electives in major field of study							**30**	**0–10**	**0–5**	**0–15**	**0–10**	**0–10**					
Minor field of study	5	Compulsory elective modules from the catalogs for the minor fields of study not chosen pursuant to Section 51	see module catalog pursuant to Section 51 (4)							0–10	0–5	0–15	0–10	0–10				see Section 51 (4)	1
		Total: Compulsory electives in minor field of study							**20**	**0–10**	**0–5**	**0–15**	**0–10**	**0–10**					

Category	No.	Module name	Teaching unit	L	T	P	S	T	ECTS credits	1st sem.	2nd sem.	3rd sem.	4th sem.	5th sem.	6th sem.	7th sem.	8th sem.	Type and scope of the examination	Grade factor
Application fields	6	Compulsory elective modules from the catalog of modules for the application fields pursuant to Section 52	see module catalog pursuant to Section 52 (3)										0–5	0–5	5–10			see Section 52 (3)	1
		Total: Application field							15				0–5	0–5	5–10				
Technical key qualifications	7	Elective modules from technical key qualifications pursuant to Section 53	see module catalog pursuant to Section 53 (3)										0–5	0–5	0–5			see Section 53 (3)	1
		Total: Technical key qualifications							5				0–5	0–5	0–5				
Master's seminar	8	Master's seminar pursuant to Section 6 **ABMPO Mathe/NatFak**	Master's seminar				2								5			Seminar achievement pursuant to Section 6 **ABMPOMathe/NatFak**	1
		Total: Master's seminar					2		5						5				
Master's thesis	9	Master's thesis pursuant to Section 55	Master's thesis						**30**							30		Master's thesis (approx. 60 pages)	1
		Total: Master's thesis							30							30			
		Total SWS (minimum) and ECTS credits							30	15	15	15	15	15	15	30			

Key:
Seminar achievement: see Section 6 (4) and (5) **ABMPOMathe/NatFak**