Module Catalog Master of Science in Data Science

BM3 Advanced Problem Solving	Techniques	Number of credit points (CPs): 9		
Module type (mandatory or elective module):	Elective module			
	Objectives Students are ab terminologies, an Students' knowled and/or application solving from a res and critical compr the field of decla knowledge and un new and unfamili connection to the	le to define and d doctrines in the f dge and comprehension of their own ideas search-oriented viewp rehension of the latest arative problem solvi iderstanding, as well a ar situations that star field of declarative pr	interpret the part field of declarative on form the basis for in the field of do point. Students have findings in selected ng. Students are a as their facility in so and in a broader and oblem solving.	icularities, limits, problem solving. or the development eclarative problem e a broad, detailed, l specialist areas in ble to apply their olving problems, in d multidisciplinary
Content and objectives of module:	<i>Contents</i> This course is dedicated to the fundamentals, algorithms, systems, and application of declarative problem-solving methods. Declarative problem- solving methods employ general problem-solving techniques to automate the solution of (typically combinatorial) problems. These include design, diagnosis, action planning and scheduling, and configuration, to name just a few. In contrast to traditional programming, no programs are created to solve the problem; instead, we merely model the original problem (formally). Problem-solving systems today are in a position to solve problems with as many as several million variables. The resulting systems are being used in industry as well as the natural sciences and linguistics.			
Module (partial) exam(s) (number, form, scope):	Examination, 90 n	ninutes		
Independent study time (in hours):	180			
	Contact	Supplementary exam (number, form, scop	n work e)	Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Lecture (lecture)	2	-	-	-
Tutorial (tutorial)	2	-	-	-
Lab (lab)	1	Oral discussion of certificates (15	-	-
Project (project)	2	Documentation (5 pages)	-	-
Ottered:		Each year (in the wi	nter semester)	
Prerequisite for taking the module:		None		
Teaching unit:		Computer science		

FM2: Foundations of Computer Science			Number of (CPs): 6	credit points
Module type (mandatory or elective module):	Elective module			
	<i>Objectives</i> Students have the required background knowledge in computer science to successfully complete the basic modules of this degree program. They have the self-organizational skills to acquire this knowledge self sufficiently and be able to describe subject matter and thematic connections out loud.			
Content and objectives of module:	<i>Contents</i> Algorithms and data structures: Growth of functions and O-notation; divide and conquer; sorting and searching; elementary data structures; dynamic programming; greedy algorithms; elementary graph algorithms. Formal languages: Chomsky hierarchy; regular languages and finite automata; context-free languages and push-down automata; finite state transducers; Turing machines. Theoretical foundations: Calculability; halting problem; non-determinism; recursion; inductive definitions (lists, trees). Content is presented via online video lectures, for example from Coursera or MIT OpenCourseWare.			
Module (partial) exam(s) (number, form, scope):	Oral exam, 20 min	nutes		
Independent study time (in hours):	150			
		Supplementary exam work (number, form, scope)		Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Video lecture (lecture)	-	-	-	-
Tutorial (tutorial)	2	-	Successful completion of the exercises	-
Offered:		Each year (in the wi	nter semester)	
Prerequisite for taking the module:		Examining Board decision under Section 5 subsection 1.		
Teaching unit:		Computer science		

INF-DSAM10: Research Data Management, Law,		and Ethics	Number of (CPs): 6	credit points
Module type (mandatory or elective module):	Elective module			
	Contents The module covers a selection of the following topics: research data management, data protection law, rules for good scientific practice, and the fundamentals of law and ethics in regard to Data Science.			
Content and objectives of module:	Objectives Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected subfields of data protection law, rules for good scientific practice, and fundamentals of law and ethics in regard to Data Science. They have the ability to analyze data assimilation and inference problems, to develop and implement solutions, and to ascertain the quality of solutions. They are familiar with and can apply the rules of good scientific practice. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.			
Module (partial) exam(s) (number, form, scope):	Oral exam, 20 min			
Independent study time (in hours):	180			
		Supplementary exam (number, form, scop	n work be)	Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Lecture or seminar (lecture or seminar)	2	-	-	-
Project (project)	2	Report (for example, a research data management plan),	-	-
Offered:		Every other year		
Prerequisite for taking the module:		None		
Teaching unit:		Computer science		

INF-DSAM11: Applied Data Scie	ence Internship		Number of (CPs): 12	credit points
Module type (mandatory or elective module):	Elective module			
	Contents Students complete research institution project. The topics	e an internship lasting on, during which the s are cleared with a ur	at least eight week y work on a prac niversity advisor.	cs at a company or tical data analysis
Content and objectives of module:	Objectives Students have the ability to analyze applied problems in Data Science, to map them to paradigms from the field, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics. They are able to present and defend the results of their work in public using appropriate presentation media and have advanced communication and organizational skills.			
Module (partial) exam(s) (number, form, scope):	Portfolio exam consisting of an internship report (10-20 report) and associated presentation (20 min)			
Independent study time (in hours):	360			
	Contract	Supplementary exam (number, form, scop	n work be)	Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Internship (8 weeks minimum) (internship)	-	-	-	-
Offered:		Every semester		
Prerequisite for taking the module:		None		
Teaching units:		Computer science (2	20%) Deseivers	
		informatics (20%)	Dusiness	
		sciences (20%)	/u1 (11	
		Biology/Biochemist	ry (20%)	

INF-DSAM1A: Advanced Machi	ne Learning A		Number of (CPs): 9	credit points
Module type (mandatory or elective module):	Elective module			
Content and objectives of module:	Contents Building on the module INF-DS-C1, this module covers a selection of additional topics in machine learning such as graphical models, deep neural networks, neural networks for processing images and time sequences, recommendation algorithms, reinforcement learning, and cluster algorithms. Objectives Students possess comprehensive, detailed, and specialized knowledge at the state of the art of the main specialized subfields of machine learning. Students have the ability to analyze model-building problems, to map paradigms of machine learning and Bayesian statistics, to develop and			
	paradigms of ma implement solution evaluation protoc consider the option on various metrics	achine learning and ons, and to ascertain ols. They are able to ons given incomplete s.	Bayesian statistics the quality of solu develop new idea information, and to	s, to develop and tions with suitable is and methods, to assess them based
Module (partial) exam(s) (number, form, scope):	Oral exam, 30 min	1		
Independent study time (in hours):	210			
	Contract	Supplementary exar (number, form, scop	n work be)	Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Lecture and lab (lecture and lab)	2L + 2T	Successful completion of the exercises (70%) and a project task	-	-
		1		
Offered:		Winter semester		
Prerequisite for taking the module:		Recommended: INF-DS-C1		
Teaching unit:		Computer science		

INF-DSAM1B: Advanced Machin	ne Learning B		Number of (CPs): 6	credit points
Module type (mandatory or elective module):	Elective module			
Content and objectives of module:	Contents Building on the n additional speciali Objectives Students possess of state of the art Students have th paradigms of ma implement solution evaluation protocol consider the option on various metric work in public us communication art	nodule INF-DS-C1, zed topics in machine comprehensive, detail of the main special e ability to analyze ichine learning and ons, and to ascertain ols. They are able to ns given incomplete s. They are able to p sing appropriate prese id organizational skill	students familiariz e learning and work led, and specialized ized subfields of e model-building p Bayesian statistics the quality of solur develop new idea information, and to resent and defend entation media and s.	e themselves with on a project task. I knowledge at the machine learning. problems, to map s, to develop and tions with suitable s and methods, to assess them based the results of their possess advanced
Module (partial) exam(s) (number, form, scope):	Project report, 10-	20 pages		
Independent study time (in hours):	120			
Courses (type of teaching)	Contact time	Supplementary exar (number, form, scop	n work be) For admission to	Course-related supplementary module (partial) exam(s) (number
	(in semester hours)	module	the module exam	form, scope)
Project (project)	2	-	-	-
Seminar (seminar)	2	-	Presentation (20 min)	-
Offered:		Winter semester		
Prerequisite for taking the module:		Recommended: INF-DS-C1		
Teaching unit:		Computer science		

INF-DSAM4A: Advanced Infrast A	tructures and Soft	ware Engineering	Number of (CPs): 6	credit points
Module type (mandatory or elective module):	Elective module			
	Contents Building on the module INF-DS-C2, the follow-up module covers additional content from the fields of software engineering, information systems, databases, and parallel programming paradigms that underlie the field of Data Science.			
Content and objectives of module:	Objectives Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties of software engineering, information systems, databases, and parallel programming paradigms that underlie the field of Data Science. Students have the ability to analyze problems, to map them to paradigms from the field, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.			
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min			
Independent study time (in hours):	120			
	Contact	Supplementary exar (number, form, scop	n work be)	Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Lecture and tutorial (lecture and tutorial)	2L + 2T	Successful completion of the exercises (70%)	-	-
Offered:		Every semester		
Prerequisite for taking the module:		Recommended: INF-DS-C2		
Teaching unit:		Computer science		

INF-DSAM4B: Advanced Infrast B	ructures and Soft	ware Engineering	Number of (CPs): 6	credit points
Module type (mandatory or elective module):	Elective module			
	Contents Building on the n content from th databases, and p Data Science.	nodule INF-DS-C2, the e fields of software arallel programming	e follow-up modul e engineering, info paradigms that un	e covers additional ormation systems, derlie the field of
Content and objectives of module:	Objectives Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties of software engineering, information systems, databases, and parallel programming paradigms that underlie the field of Data Science. Students possess the ability to analyze problems, to map them to paradigms from the field, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.			
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min Portfolio exam consisting of seminar presentation (20 min) and accompanying written elaboration (10-20 pages)			
Independent study time (in hours):	120			
	Contract	Supplementary exar (number, form, scop	n work be)	Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Lecture or seminar (lecture or seminar)	2	-	-	-
Exercise or project (exercise)	2	Successful completion of the exercise assignments	-	-
Offered:		Every semester		
Prerequisite for taking the module:		Recommended: INF-DS-C2		
Teaching unit:		Computer science		

INF-DSAM5A: Advanced Business Analytics A			Number of (CPs): 9	credit points	
Module type (mandatory or elective module):	Elective module				
	Contents Students familiarize themselves with advanced topics in business analytics.				
Content and objectives of module:	Objectives The students are familiar with the basic concepts, methods, approaches, and tools used in business analytics and be able to explain, assess, and apply them self-sufficiently. They are able to recognize appropriate issues self-sufficiently, especially in business, analyze them methodically, present results, and if applicable extrapolate the practical implications. They are able to present and defend the results of their work in public using appropriate presentation media and possess advanced communication and organizational skills.				
Module (partial) exam(s) (number, form, scope):	Term paper, 15-20 pages				
Independent study time (in hours):	180				
	1	1			
	Contact	Supplementary exam (number, form, scop	n work e)	Course-related supplementary	
Courses (type of teaching) (in semu- hours)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)	
Individual research project (project)	2	-	-	-	
Seminar 2 (seminar)	2	Presentation (15-20 min)	-	-	
Seminar 1 (seminar)	2	Presentation (15-20 min)	-	-	
Offered:		Summer semester			
Prerequisite for taking the module:		Recommended: INF	-DS-C3		
Teaching unit:		Business informatics	S		

INF-DSAM5B: Advanced Busine	ess Analytics B		Number of (CPs): 6	credit points	
Module type (mandatory or elective module):	Elective module				
	Contents Students familiarize themselves with advanced topics in business analytics.				
Content and objectives of module:	Objectives The students are familiar with the basic concepts, methods, approaches, and tools used in business analytics and be able to explain, assess, and apply them self-sufficiently. They are able to recognize appropriate issues self-sufficiently, especially in business, analyze them methodically, present results, and if applicable extrapolate the practical implications. They are able to present and defend the results of their work in public using appropriate presentation media and possess advanced communication and organizational skills.				
Module (partial) exam(s) (number, form, scope):	Portfolio exam co associated present	nsisting of a term pap tation (20 min) [25%]	er (approx. 25 page	s) [75%] and	
Independent study time (in hours):	120				
	Contact	Supplementary exam work (number, form, scope)		Course-related supplementary	
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)	
Seminar (seminar)	2	-	-	-	
Individual research project (project)	2	-	-	-	
Offered:		Winter semester			
Prerequisite for taking the module:		Recommended: INF-DS-C3			
Teaching units:		Computer science (60%) Business informatics (40%)			

INF-DSAM6A: Advanced Applied Data Science A			Number of (CPs): 9	credit points
Module type (mandatory or elective module):	Elective module			
	Contents The module broa module goes into this field, explain challenges of app related to this app	dens at least one ap the specific data analy s the models used in lying Data Science i lication and present th	pplication area of 1 ysis issues and perform this application ar methods. Students heir results.	Data Science. The ormance metrics in ea, and covers the work on a project
Content and objectives of module:	Participants have acquired a deepened understanding of an application area for Data Science methods. Students have the ability to analyze problems in this application area of Data Science, to map them to paradigms of Data Science, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, consider the options given incomplete information and assess them based on various metrics. They are able to present and defend the results of their work in public using appropriate presentation media and possess advanced communication and organizational skills.			
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min Portfolio exam consisting of seminar presentation (20 min.) and accompanying text, elaboration (10-20 pages)			
Independent study time (in hours):	180			
	Contract	Supplementary exam (number, form, scop	n work ve)	Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Lecture / seminar / tutorial / Project (lecture or seminar or tutorial)	4	-	-	-
Lecture / seminar / tutorial / Project (lecture or seminar or tutorial)	2	-	-	-
Offered		Winter constant		
Direction of the second state of the second st		winter semester		
Tapphing units:		Computer acience (-DS-C-4	
reaching units.		Mathematics (20%) sciences (20%) Biology/biochemistr	Earth ry (20%)	
		Business informatic	s (20%)	

INF-DSAM6B: Advanced Applie	d Data Science B		Number of (CPs): 6	credit points
Module type (mandatory or elective module):	Elective module			
	Contents The module broadens at least one application area of Data Science. The module goes into the specific data analysis issues and performance metrics in this field, explains the models used in this application area, and covers the challenges of applying Data Science methods. Students investigate a research question from this area of application and present their results.			
Content and objectives of module:	Objectives Participants have acquired a deepened understanding of an application area for Data Science methods. Students have the ability to analyze problems in this application area of Data Science, to map them to paradigms of Data Science, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, consider the options given incomplete information and assess them based on various metrics. They are able to present and defend the results of their work in public using appropriate presentation media and possess advanced communication and organizational skills.			
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min Portfolio exam consisting of seminar presentation (20 min) and accompanying written elaboration (10-20 pages)			
Independent study time (in hours):	120			
	-	Supplementary exam work (number, form, scope)		Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Lecture / seminar / tutorial / Project (lecture or seminar or tutorial)	4	-	-	-
Offered:		Once per year		
Prerequisite for taking the module:		Recommended: INF	-DS-C-4	
Teaching units:		Computer science (2	20%)	
		Mathematics (20%)	Earth	
		sciences (20%) Busi	iness	
		informatics (20%)		
		Biology/biochemistr	ry (20%)	

INF-DSAM7: Computer Engineering for Big Data			Number of (CPs): 6	credit points
Module type (mandatory or elective module):	Elective module			
	Contents The module introduces students to the topics of process architecture for Big Data applications, high performance computing architectures, data analysis, and applications of predictive models (such as neural networks) to embedded systems and hardware design in Data Science.			
Content and objectives of module:	Objectives Students possess comprehensive, detailed, and specialized knowledge at the state of the art of hardware architecture for Big Data applications. Students are able to assess the suitability of various processor architectures to specific data analysis problems and to select appropriate architectures. They are familiar with challenges in implementing analytical and predictive procedures in embedded systems. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.			
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min			
Independent study time (in hours):	120			
	Contract	Supplementary exam (number, form, scop	n work be)	Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Lecture or seminar (lecture or seminar)	2	-	-	-
Exercise or project (exercise)	2	Successful completion of the exercise assignments	-	-
Offered:		Summer semester		
Prerequisite for taking the module:		None		
Teaching unit:		Computer science		

INF-DSAM9: Computational Foundations of Data		Science	Number of (CPs): 6	credit points
Module type (mandatory or elective module):	Elective module			
	Contents The module imparts some of the computational foundations of Data Science. It covers a selection of topics in algorithm engineering and complexity, the science of computing, and methods of artificial intelligence.			
Content and objectives of module:	Objectives Students possess comprehensive, detailed, and specialized knowledge at the state of the art of some of the computational foundations of Data Science. Students possess in-depth knowledge of selected Data Science methods. They have the ability to analyze novel problems in machine learning, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.			
Module examinations (number, form, scope):	One exam of the following format: Written exam, 120 min, oral exam, 30 min			
Independent study time (in hours):	180			
	Contact	Supplementary exar (number, form, scop	n work be)	Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Lecture and tutorial (lecture and tutorial)	4	Successful completion of the exercises (70%)	-	-
Offered:		Every semester		
Prerequisite for taking the module:		None		
Teaching unit:		Computer science		

INF-DS-C1: Machine Learning			Number of (CPs): 9	credit points
Module type (mandatory or elective module):	Mandatory modul	e		
	Contents			
	The module covers a selection of topics in machine learning, such as generalized linear classification and regression models, neural networks, graphical models, reinforcement learning, recommendation algorithms.			
	Objectives			
Content and objectives of module:	Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties in machine learning. Students have the ability to analyze model-building problems, to map paradigms of machine learning and Bayesian statistics, to develop and implement solutions, and to ascertain the quality of solutions with suitable evaluation protocols. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.			
Module (partial) exam(s) (number, form, scope):	Oral exam, 30 min			
Independent study time (in hours):	120			
	Gented	Supplementary exar (number, form, scop	n work be)	Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Inverted classroom (seminar)	2	-	-	-
Online lecture (lecture)	-	-	-	-
Lab exercise (tutorial)	2	Successful completion of the exercise assignments	-	-
Offered:		Summer semester		
Prerequisite for taking the module:		None		
Teaching unit:		Computer science		

INF-DS-C2: Data Infrastructures	s and Software En	gineering	Number of (CPs): 6	credit points
Module type (mandatory or elective module):	Mandatory modul	e		
	Contents			
	The module cove databases, and par	ers content in softwa callel programming pa	re engineering, inf radigms.	ormation systems,
	Objectives			
Content and objectives of module:	Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties of software engineering, information systems, databases, and parallel programming paradigms. Students possess the ability to analyze problems, to map them to paradigms from the field, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.			
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min			
Independent study time (in hours):	120			
		Supplementary exam work		Course-related
	Contact	(number, form, scop		supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Lecture and tutorial (lecture and tutorial)	2L + 2T	Successful completion of the exercises (70%)	-	-
Offered:		Every semester		
Prerequisite for taking the module:		None		
Teaching unit:		Computer science		

INF-DS-C3: Data Science and Bu	siness Analytics		Number of (CPs): 9	credit points
Module type (mandatory or elective module):	Mandatory modul	e		
	Contents			
	The module cove employing analyt visualizing data, parallelization fra	ers a selection of the ical frameworks (in gathering data by cra meworks (such as Spa	e following topics: Python, for examp wing and using w urk), data warehousi	programming and le), preparing and veb services, using ing.
	Objectives			
Content and objectives of module:	The students are familiar with the basic concepts, methods, approaches, and tools used in business analytics and be able to explain, assess, and apply them self-sufficiently. They are able to recognize appropriate issues, especially business, analyze them methodically, present results, and if applicable extrapolate the practical implications. They are able to present and defend the results of their work in public using appropriate presentation media and possess advanced communication and organizational skills.			
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min			
Independent study time (in hours):	150			
		Supplementary exar	n work	Course-related
Courses (type of teaching)	Contact time (in semester hours)	For completing the module	For admission to the module exam	supplementary module (partial) exam(s) (number, form, scope)
Lecture and lab (lecture and lab)	2L + 2T	Successful completion of the exercises (70%)	-	-
Offered:		Winter semester		
Prerequisite for taking the module:		None		
Teaching units:		Computer science (Business informatic	50%) s (50%)	

INF-DS-C4: Applied Data Science		Number of credit points (CPs): 6		
Module type (mandatory or elective module):	Mandatory modul	e		
Content and objectives of module:	 Contents The module covers the basics of at least one application area of Data Science. The module goes into the specific data analysis issues and performance metrics in this field, explains the models used in this application area, and covers the challenges of applying Data Science methods. Objectives Participants have acquired an understanding of fundamental concepts and the ability to use various approaches in an area of application of Data Science methods. Students have the ability to analyze problems in this application area of Data Science, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, consider the options given incomplete information and assess them based on various metrics. One exam of the following format:			
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min Portfolio exam consisting of a project report (10-20 report) and associated seminar presentation (20 min)			
Independent study time (in hours):	120			
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam (number, form, scop) For completing the module	n work be) For admission to the module exam	Course-related supplementary module (partial) exam(s) (number, form, scope)
Lecture or seminar (lecture or seminar)	4	-	-	-
Exercise or project (exercise)	2	Successful completion of the exercise assignments	-	-
Offered:		Winter semester		
Prerequisite for taking the module:		None		
Teaching units:		Computer science (2 Mathematics (20%) informatics (20%) E sciences (20%) Biology/Biochemist	20%) Business Carth ry (20%)	

INF-DS-RMA: Research Module	A		Number of (CPs): 12	credit points
Module type (mandatory or elective module):	Elective module			
	Contents			
	Students familiarize themselves with a research topic in the field of Data Science and work on an individual research question developed under the advisor's supervision as a part of a research team. The complexity of the research question is adapted to the scope of the module.			
	Objectives			
Content and objectives of module:	Students have the ability to analyze problems in this application area of Data Science, to map them to paradigms of Data Science, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics. They are able to present and defend the results of their work in public using appropriate presentation media and have advanced communication and organizational skills. They are able to take on extra responsibility within a team.			
Module (partial) exam(s) (number, form, scope):	Portfolio exam co 20	onsisting of a presentat	tion (20 min.) and a	project report (10-
Independent study time (in hours):	300			
	Contact	Supplementary exam work (number, form, scope)		Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Exercise or project (exercise)	2	-	-	-
Lecture or seminar (lecture or seminar)	2	-	-	-
Offered:		Every semester		
Terequisite for taking the module:		None	200/)	
Teaching units.		Mathematics (20%)	20%) Business	
		informatics (20%) F	Earth	
		sciences (20%)		
		Biology/Biochemist	rry (20%)	

INF-DS-RMB: Research Module	В		Number of (CPs): 15	credit points
Module type (mandatory or elective module):	Elective module			
	Contents			
	Students familiar Science and wor advisor's supervi research question	ize themselves with k on an individual re sion as a part of a ro is adapted to the scop	a research topic in search question de esearch team. The e of the module.	the field of Data veloped under the complexity of the
	Objectives			
Content and objectives of module:	Students have the ability to analyze research questions in this application area of Data Science, to map them to paradigms of Data Science, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics. They are able to present and defend the results of their work in public using appropriate presentation media and have advanced communication and organizational skills. They are able to take on extra responsibility within a team.			
Module (partial) exam(s) (number, form, scope):	Portfolio exam consisting of seminar presentation (30 min.) and accompanying project			
Independent study time (in hours):	390			
		1		
		Supplementary exar (number, form, scop	n work ve)	Course-related supplementary
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Lecture or seminar (lecture or seminar)	2	-	-	-
Exercise or project (exercise)	2	-	-	-
Ottered:		Every semester		
Teaching units:		INORE	20%)	
reaching units.		Mathematics (20%) informatics (20%) E	Business Carth	
		Biology/Biochemist	ry (20%)	

MAT-DSAM2A Advanced Statistical Data Analysi		is A	Number of (CPs): 9	credit points	
Module type (mandatory or elective module):	Elective module				
	Contents				
	Building on the content of the module MATVMD837, this module covers additional topics in statistical data analysis, such as statistical learning theory, high-dimensional statistics, or computation-intensive statistical models.				
	Objectives				
Content and objectives of module:	Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties of statistical analysis. Students have the ability to analyze data analysis problems, to map them to statistic paradigms, to develop and implement solutions, and to ascertain the qualit of those solutions. They are able to develop new ideas and methods, consider the options given incomplete information, and to assess them base on various metrics.				
Module examinations (number, form, scope):	One exam of the following format: Written exam, 120 min, oral exam 30 min				
Independent study time (in hours):	180				
	Contact	Supplementary exam (number, form, scop	Supplementary exam work (number, form, scope)		
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)	
Lecture and seminar (lecture and seminar)	4	-	-	-	
Tutorial (tutorial)	2	Successful completion of the exercises (70%)	-	-	
		1-			
Offered:		Summer semester			
Prerequisite for taking the module:		Recommended: MA	TVMD837		
Teaching unit:		Mathematics			

MAT-DSAM2B: Advanced Statis	stical Data Analys	is B	Number of (CPs): 6	credit points	
Module type (mandatory or elective module):	Elective module				
	Contents				
	Building on the additional topics high-dimensional	content of the modul in statistical data analy statistics, or computa	e MATVMD837, t ysis, such as statistic tion-intensive statis	his module covers cal learning theory, tical models.	
	Objectives				
Content and objectives of module:	Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties of statistical analysis. Students have the ability to analyze data analysis problems, to map them to statistical paradigms, to develop and implement solutions, and to ascertain the quality of those solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.				
Module examinations (number, form, scope):	One exam of the Written exam, 12 oral exam, 30 min	following format: 0 min, 1			
Independent study time (in hours):	120				
		Supplementary examplementary	m work	Course-related	
	Contact	(number, form, scor	pe)	supplementary	
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)	
Lecture and tutorial (lecture and tutorial)	4	Successful completion of the exercises	-	-	
		(7070)			
Offered:		Summer semester			
Prerequisite for taking the module:		Recommended: MATVMD837			
Teaching unit:		Mathematics			

MAT-DSAM3A: Advanced Data	Assimilation and	Modeling A	Number of (CPs): 9	credit points
Module type (mandatory or elective module):	Elective module			
	Contents			
	The module covers a selection of additional content relating to data assimilation or to how mathematical models can be linked to data from recorded measurements. The topics deal with statistical data analysis and modeling temporal processes.			
Content and objectives of	Objectives			
module:	Students possess comprehensive, detailed, and specialized knowledg state of the art of selected specialties of data assimilation. Students h ability to analyze data assimilation and inference problems, to map paradigms in the field, to develop and implement solutions, and to a the quality of solutions. They are able to develop new ideas and meth consider the options given incomplete information, and to assess ther on various metrics.			
Module examinations (number, form, scope):	One exam of the following format: Written exam, 120 min, oral exam, 30 min			
Independent study time (in hours):	180			
		Supplementary exar (number, form, scop	n work ve)	Course-related supplementary
Courses (type of teaching)	Contact time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)
Lecture or seminar (lecture or seminar)	4	-	-	-
Tutorial (tutorial)	2	Successful completion of the exercises (70%)	-	-
		XXX		
Ottered:		Winter semester		
Teaching unit:		Inone Mathematics		
reaching unit.		mainematics		

MAT-DSAM3B: Advanced Data	Assimilation and 1	Modeling B	Number of (CPs): 6	credit points
Module type (mandatory or elective module):	Elective module			
Content and objectives of	Contents The module covers a selection of additional content relating to data assimilation or to how mathematical models can be linked to data from recorded measurements. The topics deal with statistical data analysis and modeling temporal processes. Objectives			
module:	Students possess comprehensive, detailed, and specialized knowled state of the art of data assimilation. Students have the ability to an assimilation and inference problems, to map them to paradigms in to develop and implement solutions, and to ascertain the quality of They are able to develop new ideas and methods, to consider the given incomplete information, and to assess them based on various re-			
Module examinations (number, form, scope):	One exam of the following format: Written exam, 120 min, oral exam 30 min			
Independent study time (in hours):	120			
	Contact	Supplementary exar (number, form, scop	n work be)	Course-related supplementary module (partial) exam(s) (number, form, scope)
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	
Lecture and tutorial (lecture and tutorial)	2L + 2T	Successful completion of the exercises (70%)	-	-
Offered:		Winter semester		
Prerequisite for taking the module:		None		
Teaching unit:		Mathematics		

MAT-DSAM8A: Mathematical F	oundations of Da	ta Science A	Number of (CPs): 9	credit points	
Module type (mandatory or elective module):	Elective module				
	Contents The module imparts some of the mathematical foundations of Data Science. A selection of topics are covered including analyzing graphs, stochastic models, and signal analysis with wavelets.				
Content and objectives of module:	Objectives Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected foundational areas of Data Science. Studen possess in-depth knowledge of selected Data Science methods. They have the ability to analyze data assimilation and inference problems, to develop and implement solutions, and to ascertain the quality of solutions. They are ability develop new ideas and methods, consider the options given incomplet information, and to assess them based on various metrics.				
Module examinations (number, form, scope):	One exam of the following format: Written exam, 120 min, oral exam, 30 min				
Independent study time (in hours):	180				
	Gardand	Supplementary exam work (number, form, scope)		Course-related supplementary	
Courses (type of teaching)	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)	
Lecture or seminar (lecture or seminar)	4	-	-	-	
Tutorial (tutorial)	2	Successful completion of the exercises (70%)	-	-	
		1			
Offered:		Every semester			
Prerequisite for taking the module:		None			
Teaching unit:		Mathematics			

MAT-DSAM8B: Mathematical F	oundations of Dat	a Science B	Number of (CPs): 6	credit points	
Module type (mandatory or elective module):	Elective module				
	Contents The module imparts some of the mathematical foundations of Data Science. A selection of topics are covered including analyzing graphs, stochastic models, and signal analysis with wavelets.				
Content and objectives of module:	Objectives Students possess comprehensive, detailed, and specialized knowledge at state of the art of selected foundational areas of Data Science. Stude possess in-depth knowledge of selected Data Science methods. They have ability to analyze data assimilation and inference problems, to develop a implement solutions, and to ascertain the quality of solutions. They are a to develop new ideas and methods, consider the options given incompl information, and to assess them based on various metrics.				
Module examinations (number, form, scope):	One exam of the following format: Written exam, 120 min Oral exam, 30 min				
Independent study time (in hours):	120				
Courses (type of teaching)	Contract	Supplementary exam work (number, form, scope)		Course-related supplementary	
	time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)	
Lecture and tutorial (lecture and tutorial)	4	Successful completion of the exercises (70%)	exercises (50%)	-	
Offered:		Winter semester			
Prerequisite for taking the module:		None			
Teaching unit:		Mathematics			

MAT-DSBM1: Foundations of Stochastics			Number of (CPs): 6	credit points
Module type (mandatory or elective module):	Elective module			
Content and objectives of module:	Contents			
	This course lays the foundations for stochastics. After contextualizing and introducing the basic concepts at length, it covers the concepts of the independence of random variables, conditional probabilities and factors (expected value and variance). Then it presents the Law of Large Numbers and the Central Limit Theorem (approximation via the Gauss distribution). The lecture concludes with basic statistical applications.			
	Objectives			
	Students have the required background knowledge in linear algebra and stochastics to successfully complete the basic modules of this degree program. They have the self-organizational skills to acquire this knowledge self-sufficiently and be able to describe subject matter and thematic connections aloud.			
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 20 min			
Independent study time (in hours):	150			
Courses (type of teaching)		Supplementary exam work		Course-related
	Contact time (in semester hours)	For completing the module	For admission to the module exam	supplementary module (partial) exam(s) (number, form, scope)
Online lecture (lecture)	-	-	-	-
Exercise or inverted classroom (seminar or tutorial)	2	Successful completion of the exercises (70%)	-	-
		· · · · ·		
Offered:		Winter semester		
Prerequisite for taking the module:		Examining Board decision under Section 5 subsection 1.		
Teaching unit:		Mathematics		

MATVMD837: Statistical Data Analysis			Number of (CPs): 9	credit points
Module type (mandatory or elective module):	Mandatory modul	e		
Content and objectives of module:	Contents This module centers on the statistical study and quantitative analysis of the dependency between observed random variables (such as production yield/setting variables; longevity/treatment type and injury type). The linear regression model, which the course examines in detail, provides important foundations for statistically representing such relationships. This is the framework for considering research questions involving estimation, testing, and quantifying uncertainty (variance analysis). The second part of the module provides an introduction to advanced methods and approaches for investigating relationships. These include non-linear and nonparametric regression models. In addition, it covers issues of classification and dimension reduction. <u>Objectives</u> Students possess comprehensive, detailed, and specialized knowledge at the state of the art of the linear regression model. They have also acquired basic concepts and methods of nonparametric statistics. They can also solve complex statistical data analysis problems, consider the advantages and drawbacks of alternative modeling approaches, and evaluate them based on different metrics. They are able to use features of statistical software packages for this purpose. <u>Academic Competences</u> Organizing work: Self-organization, planning skills: identifying steps. Analytical techniques: Scientific thinking and working methods (devising solutions to complex research questions), discussing methods, verifying hypotheses, applying mathematical methods, working with statistical methods, working with software packages.			
Module examinations (number, form, scope):	One exam of the following format: Examination, 120-180 minutes Oral exam, 30 minutes			
Independent study time (in hours):	180			
Courses (type of teaching)	Contact time (in semester hours) 6	Supplementary exam (number, form, scop) For completing the module	n work e) For admission to the module exam Successful	Course-related supplementary module (partial) exam(s) (number, form, scope) -
In-depth lecture in the field of Statistical data analysis and tutorial (lecture and tutorial)			completion of the Exercises and presentation of individual solutions	
Offered [.]		Winter semester		
Prerequisite for taking the module:		None		
Teaching unit:		Mathematics		

MATVMD838: Bayesian Inferen	ilation	Number of (CPs): 9	credit points		
Module type (mandatory or elective module):	Mandatory module				
Content and objectives of module:	ContentsThis course covers random variables and conditional distributions, MonteCarlo processes, the Bayes Theorem, point estimates, importance sampling,Markov processes, sequential Monte Carlo processes, and data assimilationfor stochastic processes.ObjectivesThe students are familiar with the basic concepts and foundational methodsand techniques of Bayes inference and assimilating data into mathematicalmodels. There are able to apply the techniques of Bayes inference self-sufficiently and deploy their skills for solving concrete tasks.				
Module examinations (number, form, scope):	One exam of the following format: Examination, 90 minutes Oral exam, 30 minutes				
Independent study time (in hours):	180				
Courses (type of teaching)	Contract	Supplementary exam work (number, form, scope)		Course-related supplementary	
	Contact time (in semester hours)	For completing the module	For admission to the module exam	module (partial) exam(s) (number, form, scope)	
Intermediate lecture on Bayes inference and data assimilation and tutorial (lecture and tutorial)	6	-	Successful completion of the Exercises and presentation of individual solutions	-	
Offered:		Summer semester			
Prerequisite for taking the module:		None			
Teaching unit:		Mathematics			