

## Subdivided Module Catalogue for the Subject

# Mathematical Data Science

as a Bachelor's with 1 major with the degree "Bachelor of Science" (180 ECTS credits)

Examination regulations version: 2022 Responsible: Faculty of Mathematics and Computer Science Responsible: Institute of Mathematics

JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record 82|l22|-|-|H|2022



## **Learning Outcomes**

German contents and learning outcome available but not translated yet.

#### Wissenschaftliche Befähigung

- Die Absolventinnen und Absolventen sind vertraut mit den Arbeitsweisen und der zugehörigen Fachsprache der Mathematik und beherrschen die Methoden mathematischen Denkens und Beweisens.
- Die Absolventinnen und Absolventen besitzen grundlegende Kenntnisse der Numerischen Mathematik, der mathematischen Modellierung und des Wissenschaftlichen Rechnens und können sicher mit den Methoden umgehen.
- Die Absolventinnen und Absolventen besitzen grundlegende Kenntnisse weiterer Gebiete der Mathematik und sind vertraut mit den grundlegenden Beweismethoden dieser Gebiete.
- Die Absolventinnen und Absolventen kennen die grundlegenden Denkweisen und Arbeitstechniken eines weiteren Fachs aus dem Bereich der Naturwissenschaften und der Informatik.
- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein hohes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen sind in der Lage, sich selbständig mithilfe von Fachliteratur in weitere Gebiete der Mathematik einzuarbeiten.
- Die Absolventinnen und Absolventen sind in der Lage, ihre Kenntnisse, Ideen und Problemlösungen verständlich zu präsentieren.
- Die Absolventinnen und Absolventen besitzen die für ein weiterführendes, insbesondere Master-Studium, erforderlichen Grundkenntnisse, Denk- und Arbeitsweisen und Methodenkenntnisse.
- Die Absolventinnen und Absolventen kennen die Regeln guter wissenschaftlicher Praxis und sind in der Lage, sie in ihrer eigenen Arbeit zu beachten.

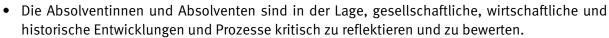
#### Befähigung zur Aufnahme einer Erwerbstätigkeit

- Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein hohes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.
- Die Absolventinnen und Absolventen sind in der Lage, ihre Kenntnisse, Ideen und Problemlösungen zielgruppenorientiert verständlich zu formulieren und zu präsentieren.
- Die Absolventinnen und Absolventen sind in der Lage, konkrete Probleme aus anderen Gebieten zu erkennen, zu strukturieren, zu modellieren und mit mathematischen Methoden Lösungswege zu entwickeln.
- Die Absolventinnen und Absolventen besitzen ein ausgeprägtes Durchhaltevermögen bei der Lösung komplexer Probleme.
- Die Absolventinnen und Absolventen sind in der Lage, konstruktiv und zielorientiert in Teams zu arbeiten.
- Die Absolventinnen und Absolventen sind in der Lage, sich weitere Wissensgebiete selbständig, effizient und systematisch zu erschließen.
- Die Absolventinnen und Absolventen sind vertraut mit mindestens einer modernen Programmiersprache und können sicher mit mathematischer Software umgehen.
- Die Absolventinnen und Absolventen besitzen die Fähigkeit, in interdisziplinär zusammengesetzten Teams im Bereich der Informatik und Naturwissenschaften gestaltend mitzuwirken.

#### Persönlichkeitsentwicklung

• Die Absolventinnen und Absolventen sind geschult in analytischem Denken, besitzen ein hohes Abstraktionsvermögen, universell einsetzbare Problemlösungskompetenz und die Fähigkeit, komplexe Zusammenhänge zu strukturieren.

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- Die Absolventinnen und Absolventen sind in der Lage, in partizipativen Prozessen gestaltend mitzuwirken.
- Die Absolventinnen und Absolventen besitzen ein ausgeprägtes Durchhaltevermögen bei der Lösung komplexer Probleme.
- Die Absolventinnen und Absolventen sind in der Lage, Ideen und Lösungsvorschläge allgemeinverständlich zu formulieren und präsentieren.

Julius-Maxi

UNIVERSITÄT

WÜRZBURG

## Abbreviations used

Course types:  $\mathbf{E}$  = field trip,  $\mathbf{K}$  = colloquium,  $\mathbf{O}$  = conversatorium,  $\mathbf{P}$  = placement/lab course,  $\mathbf{R}$  = project,  $\mathbf{S}$  = seminar,  $\mathbf{T}$  = tutorial,  $\ddot{\mathbf{U}}$  = exercise,  $\mathbf{V}$  = lecture

Term: **SS** = summer semester, **WS** = winter semester

Methods of grading: **NUM** = numerical grade, **B**/**NB** = (not) successfully completed

Regulations: **(L)ASPO** = general academic and examination regulations (for teaching-degree programmes), **FSB** = subject-specific provisions, **SFB** = list of modules

Other: **A** = thesis, **LV** = course(s), **PL** = assessment(s), **TN** = participants, **VL** = prerequisite(s)

## Conventions

Unless otherwise stated, courses and assessments will be held in German, assessments will be offered every semester and modules are not creditable for bonus.

## Notes

Should there be the option to choose between several methods of assessment, the lecturer will agree with the module coordinator on the method of assessment to be used in the current semester by two weeks after the start of the course at the latest and will communicate this in the customary manner.

Should the module comprise more than one graded assessment, all assessments will be equally weighted, unless otherwise stated below.

Should the assessment comprise several individual assessments, successful completion of the module will require successful completion of all individual assessments.

### In accordance with

the general regulations governing the degree subject described in this module catalogue:

#### ASPO2015

associated official publications (FSB (subject-specific provisions)/SFB (list of modules)):

#### 29-Mar-2022 (2022-4)

#### 22-Nov-2023 (2023-103)

This module handbook seeks to render, as accurately as possible, the data that is of statutory relevance according to the examination regulations of the degree subject. However, only the FSB (subject-specific provisions) and SFB (list of modules) in their officially published versions shall be legally binding. In the case of doubt, the provisions on, in particular, module assessments specified in the FSB/SFB shall prevail.

## The subject is divided into

Abbreviation	Module title	ECTS credits	Method of grading	pag
Compulsory Courses (98	ECTS credits)	•		
Subfield Mathematics (	73 ECTS credits)			
10-M-ANA-Ü-222-m01	Overview Analysis	13	NUM	36
10-M-LNA-Ü-222-m01	Overview Linear Algebra	13	NUM	57
10-M-ST01-222-m01	Stochastics 1	10	NUM	76
10-M-NUM1-222-m01	Numerical Mathematics 1	10	NUM	65
10-M-MFD-222-m01	Mathematical Foundations of Data Science	10	NUM	59
10-M-SEM-152-m01	Seminar Mathematics	5	NUM	74
10-M-APSL-222-m01	Applied Stochastics Lab	6	NUM	37
10-M-MLNL-222-m01	Machine Learning and Numerics Lab	6	NUM	60
Subfield Computer Scie	nce (25 ECTS credits)	•		
10-I-AKIDS1-222-m01	Algorithms, Al and Data Science 1	10	NUM	9
10-I-AKIDS2-222-m01	Algorithms, Al and Data Science 2	10	NUM	11
10-I-DSML-222-m01	Data Science & Machine Learning	5	NUM	17
Compulsory Electives Lin	ear Algebra (5 ECTS credits)		I	
10-M-LNA1-222-m01	Linear Algebra 1	5	B/NB	55
10-M-LNA2-222-m01	Linear Algebra 2	5	B/NB	56
Compulsory Electives An			,	
10-M-ANA1-222-m01	Analysis 1	5	B/NB	34
10-M-ANA2-222-m01	Analysis 2	5	, B/NB	3
-	thematical Data Science (40 ECTS credits)		27.12	<u> </u>
Subfield Mathematics (				_
10-M-NUM2-222-m01	Numerical Mathematics 2	10	NUM	66
10-M-STO2-222-m01	Stochastics 2	10	NUM	77
10-M-OML-222-m01	Optimization for Machine Learning	10	NUM	67
10-M-MML-222-m01	Mathematics of Machine Learning	10	NUM	6:
10-M-MWR-222-m01	Modelling and Computational Science	10	NUM	64
10-M-VAN-222-m01	Advanced Analysis	10	NUM	8:
10-M-ALG-222-m01	Introduction to Algebra	10	NUM	
10-M-DGE-222-m01	Introduction to Differential Geometry	10	NUM	33
10-M-DGL-222-m01	Ordinary Differential Equations	10	NUM	43
10-M-DGL-222-m01	Introduction to Complex Analysis	10	NUM	44
10-M-PGE-222-m01	Introduction to Projective Geometry			49
		10	NUM	69
10-M-GAN-222-m01	Geometric Analysis Introduction to Discrete Mathematics	10	NUM	50
		10	NUM	4
10-M-FAN-222-m01	Introduction to Functional Analysis	10	NUM	48
10-M-PAR-222-m01	Introduction to Partial Differential Equations	10	NUM	68
10-M-ZTH-222-m01	Introduction to Number Theory	10	NUM	84
10-M-AAL-222-m01	Applied Algebra	10	NUM	30
10-M-TOP-222-m01	Introduction to Topology	5	NUM	78
10-M-EFM-222-m01	Introduction to Stochastic Financial Mathematics	10	NUM	46
10-M-LOGP-232-m01	Introduction to Mathematical Logic	1	NUM	58

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10-I-ST-KIDS-222-m01	Software Technology for Artificial Intelligence and Data Science	5	NUM	28
10-I-PPM-222-m01	Practical Course in Programming for Mathematical Data Science	5	B/NB	25
10-I-DB-152-m01	Databases	5	NUM	1/
10-I-GdP-172-m01	Fundamentals of Programming	5	NUM	18
10-I-DL-222-m01	Deep Learning	5	NUM	16
10-I-MCS-191-m01	Introduction into Human-Computer Interaction	5	NUM	2
10-I-CV-222-m01	Computer Vision	5	NUM	1
10-I-NLP-222-m01	Natural Language Processing	5	NUM	2
10-I-SNA-222-m01	Statistical Network Analysis	5	NUM	2
10-l-KogSys-222-m01	Cognitive Systems	5	NUM	2
10-I-TML-222-m01	Theory of Machine Learning	5	NUM	2
10-I-AGKIDS1-222-m01	Selected Fundamentals of Artificial Intelligence and Data Science 1	5	NUM	7
10-I-AGKIDS2-222-m01	Selected Fundamentals of Artificial Intelligence and Data Science 2	5	NUM	8
Subfield Applications				
10-M-ADS1-222-m01	Applications of Data Science in other disciplines 1	5	NUM	3
10-M-ADS2-222-m01	Applications of Data Science in other disciplines 2	5	NUM	3
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	e title				Abbreviation
Select	ed Fund	lamentals of Artificial	Intelligence and Data S	Science 1	10-I-AGKIDS1-222-m01
Modul	e coord	inator		Module offered	d by
Dean o	of Studi	es Informatik (Comput	er Science)	Institute of Cor	nputer Science
ECTS	Meth	od of grading	Only after succ. co	mpl. of module(s	
5	nume	rical grade			
Duratio	on	Module level	Other prerequisites	5	
1 seme	ester	undergraduate			
Conter	nts				
Selecte	ed topi	cs in artificial intellige	nce and data science		
Intend	ed lear	ning outcomes			
		be able to understand ransfer them to related		ntal problems in	artificial intelligence and data
Course	es (type	, number of weekly co	ntact hours, language -	– if other than G	erman)
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If anno examir prox. 1 Langua credita Allocat  Additio  150 h Teachi  Referre  Modulo	ed to in e appea	by the lecturer at the b of one candidate each tes per candidate). Issessment: German a bonus places formation e LPOI (examination re ars in	eginning of the course (approx. 20 minutes) o nd/or English 	r an oral examin	ation in groups of 2 candidates (ap-
If anno examir prox. 1 Langua credita Allocat  Additio  150 h Teachi  Referre  Bachel	e appea ourse de pation of print age of a ble for tion of ponal inf pad	by the lecturer at the bof one candidate each tes per candidate). Issessment: German a bonus places formation e LPOI (examination real ars in gree (1 major) Mathem	egginning of the course (approx. 20 minutes) o nd/or English 	r an oral examin degree program	ation in groups of 2 candidates (ap-
If anno examir prox. 1 Langua credita Allocat  Worklo 150 h Teachi  Referre Bachel Bachel Bachel	ation of 5 minu age of a ble for tion of onal inf onal inf oad ad ed to in e appea or's de or's de	by the lecturer at the bof one candidate each tes per candidate). Issessment: German abonus places formation e LPOI (examination real ars in gree (1 major) Mathem gree (1 major) Artificia	eginning of the course (approx. 20 minutes) o nd/or English 	r an oral examin degree program	ation in groups of 2 candidates (ap-

Module	e title				Abbreviation
Selecte	ed Func	lamentals of Artificial Inf	elligence and Data S	cience 2	10-I-AGKIDS2-222-m01
Modul	e coord	inator		Module offered by	•
Dean o	of Studi	es Informatik (Computer	Science)	Institute of Compu	ter Science
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
5	nume	rical grade			
Duratio	on	Module level	Other prerequisites	i	
1 seme	ster	undergraduate			
Conten	Its				
Selecte	ed topio	cs in artificial intelligence	and data science		
Intend	ed lear	ning outcomes			
		be able to understand ho ransfer them to related p		ntal problems in artif	icial intelligence and data
Course	s (type	, number of weekly conta	act hours, language –	- if other than Germa	an)
V (2) +		,			·
If anno examir prox. 1 Langua credita	unced nation o 5 minut age of a ble for	of one candidate each (ap tes per candidate). Issessment: German and bonus	inning of the course, oprox. 20 minutes) or		ation may be replaced by an oral n in groups of 2 candidates (ap-
Allocat	lon of	places			
Additio	onal Inf	ormation			
Worklo	ad				
150 h			-		
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	lations for teaching-	degree programmes)	)
Module	e appea	ars in			
		gree (1 major) Mathemat			
		gree (1 major) Artificial In	-		
		gree (1 major) Artificial In			
васпеі	or's de	gree (1 major) Artificial In	teiligence and Data S	Science (2024)	

Modul					Abbreviation
Algorit	thms, A	l and Data Science 1			10-I-AKIDS1-222-m01
Modul	e coord	inator		Module offered by	<u>,</u>
Dean o	of Studio	es Informatik (Computer S	Science)	Institute of Comput	er Science
ECTS	1	od of grading	Only after succ. con	npl. of module(s)	
10		rical grade			
Durati		Module level	Other prerequisites		
1 seme		undergraduate			
Conter					
sics of sets, s memo and qu bles (a test pa Uninfo metah optimi on algo ductio <b>Intend</b> Studer scienc state s ve to in rithmic proble	algorith tack, qu ry comp uick sort and has ath, min ormed (c euristic zation, orithms n to ma e, with space se mpleme c perspe	nms (building blocks, det ueue, heap), together with elexity, growth of function the and algorithms of order h functions), trees (binary imum spanning tree); alg lepth/width first search), search (genetic algorithm numerical optimization, n (linear and quadratic pro- chine learning (parametric <b>hing outcomes</b> acquire fundamental kno a particular focus on the earch or optimization). The ent most of the algorithms ective, identify the nature	erminism, functional h basics of programm is, asymptotic notation r statistics; Advanced y search trees, red-bl gorithm design and re heuristic (A* algorith n, ant colony optimiz numerical optimization ogramming, branch-a ic and non-parametri wledge of algorithms fundamentals of artif ey will acquire both t s covered). They will l	vs. imperative para- ning (in Python); Algo on and "Big-O"; Sorti d data structures with ack trees) and graph ecursion; dynamic pr nm), adversarial (Mir ation); Function opti on with gradient des nd-bound algorithm) c classification mod s and data structures ficial intelligence algo theoretical and pract pe able to analyze pr choose an optimal a	elligence and data science; ba- digm); Core data structures (lists, prithmic complexity: time and ing (bubble, insert, heap, merge h associated algorithms: Hash ta- is (connected components, shor- ogramming; state space search: niMax, alpha-beta pruning) and imization (convex vs. non-convex cent) and constrained optimizati- ); learning from data: light intro- els, clustering).
		, number of weekly conta	ct hours language -	- if other than Germa	n)
V (4) +		, hamber of weekly conta	יישנאסייטיאין איז		
Metho	d of ass	<b>Sessment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-
lf anno examii prox. 1	ounced nation c	of one candidate each (ap es per candidate).	inning of the course,		tion may be replaced by an oral in groups of 2 candidates (ap-
Alloca	tion of p	olaces			
Additi	onal inf	ormation			
Workle	oad				
300 h					
Teachi	ing cycl	е			
Referr	ed to in	LPOI (examination regu	lations for teaching-o	degree programmes)	

#### Module appears in

Bachelor's degree (1 major) Mathematical Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)

Module					Abbreviation
		I and Data Science 2			10-I-AKIDS2-222-m01
Module	e coord	inator		Module offered by	
Dean o	fStudi	es Informatik (Computer S	Science)	Institute of Comput	er Science
ECTS		od of grading	Only after succ. com	pl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
algorith mic str duced.	nmic fo ategies A treat n of sim	undations of computer so for solving fundamental ment of elementary prob pple statistical methods w	cience and artificial in problems, approach abilistic methods for	ntelligence. In additi es to logical reasonii modeling uncertaint	dule introduces the logical and on to dealing with basic algorith- ng in computer science are intro- ies forms the basis for the intro- problems of machine learning
Intend	ed lear	ning outcomes			
develo in com tificial	p soluti mon pr intellige	ions for specific compute oblem-solving strategies ence. They know basic ap	r science problems u and have initial expe proaches for deriving	sing an analytical ap rience of how these g logical conclusions	They are able to independently pproach. Students are proficient can be used in the context of ar- s, have an understanding of for- context of machine learning.
Course	<b>s</b> (type	, number of weekly conta	ct hours, language —	· if other than Germa	n)
V (4) +	Ü (2)				
		sessment (type, scope, la ion on whether module ca			tion offered — if not every seme-
lf anno examir	unced nation c 5 minut	of one candidate each (ap tes per candidate).	inning of the course,		tion may be replaced by an oral in groups of 2 candidates (ap-
Allocat	ion of p	olaces			
Additio	onal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	lations for teaching-o	legree programmes)	
		<u></u>		0 1 0 /	
Module	e appea	ars in			
		gree (1 major) Mathemati	cal Data Science (20:	22)	
		gree (1 major) Artificial In			
		gree (1 major) Artificial In	-		
Bachel	or's de	gree (1 major) Artificial In	telligence and Data S	ocience (2024)	

Module	title			Abbreviation
	er Vision			10-l-CV-222-m01
Module	coordinator		Module offered by	
l l	of the Chair of Computer Science		Institute of Comput	er Science
	Method of grading	Only after succ. con	npl. of module(s)	
-	numerical grade			
Duratio		Other prerequisites		
1 semes				
the rece It shows is consid- turns to near filte procedu the reco zed. A la <b>Intende</b> • Un tu tra • Un • Un • Un • Un	irse aims at offering a self-cont nt use of deep learning. It start how image processing is ente dered and the image acquisitio image representation and disc ers) used to enhance image qua ires to extract information from	s with an overview of ring multiple fields fr n cameras and illum retization, and descr ality and/or detect sp multiple images, wit l/or class level) will b s deep learning and A puter vision concep hancement, feature (MLP, ConvNets, arch ag algorithms from st	f existing and emerging om our daily life. First ination sources are a ibes pre-processing pecific features. The ch motion and 3D shape discussed and diff Al-based approaches ts: light, matter, acq extraction, segments itectures) and the ap andard libraries.	also discussed. The course then steps (such as linear and non-li- course will continue by analyzing ape as major examples. Finally, ferent approaches will be analy- s to vision tasks. Juisition of images, color, tex- ation, 3D acquisition, motion, oplication to visual data.
	(type, number of weekly conta	ct hours, language –	- if other than Germa	in)
V (2) + Ü Module	J (2) taught in: German and/or Engli	ish		
	<b>of assessment</b> (type, scope, la ormation on whether module ca			tion offered — if not every seme-
lf annou examina prox. 15 Languag	,	inning of the course, pprox. 20 minutes) or		tion may be replaced by an oral in groups of 2 candidates (ap-
Allocati	on of places			
Addition	nal information			
Workloa	ıd			
150 h				
Teachin	g cycle			
Referred	to in LPO I (examination regu	lations for teaching-	degree programmes)	
§ 22    N			<u> </u>	
_	appears in			

Bachelor's degree (1 major) Mathematical Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024) Bachelor's degree (1 major) Games Engineering (2025)

Modul	e title			Abbreviation	
Databa	ases			10-l-DB-152-m01	
Modul	e coordinator		Module offered by		
Dean o	of Studies Informatik (Compute	er Science)	Institute of Comput	er Science	
ECTS	Method of grading	Only after succ. cor			
5	numerical grade				
Durati	·	Other prerequisites			
1 seme					
Conte					
Relatio ment.	onal algebra and complex SQL	statements; database	planning and norma	l forms; transaction	manage-
Intend	ed learning outcomes				
	udents possess knowledge ab	 out database modellin	σ and queries in SOL	as well as transaction	ons
					5113.
	es (type, number of weekly con	lact nours, language -	– II other than Germa	IN)	
V (2) +					
	<b>d of assessment</b> (type, scope, nformation on whether module			tion offered — if not	every seme-
If anno examin prox. 1 Langua	n examination (approx. 60 to 1: ounced by the lecturer at the be nation of one candidate each ( 15 minutes per candidate). age of assessment: German ar able for bonus	eginning of the course, approx. 20 minutes) of			
	tion of places				
Alloca					
Additio	onal information				
Workle	oad				
150 h					
Teachi	ing cycle				
Referr	ed to in LPO I (examination re	gulations for teaching-	degree programmes)		
	Nr. 1 b) Nr. 1 b)				
Modul	e appears in				
	lor's degree (1 major) Compute	er Science (2015)			
	lor's degree (1 major) Mathema				
	lor's degree (1 major) Business		(2015)		
Bache	lor's degree (1 major) Computa	tional Mathematics (2	015)		
Bache	lor's degree (1 major) Aerospa	ce Computer Science (2	2015)		
Bache	lor's degree (1 major) Function	al Materials (2015)			
	tate examination for the teachi		•		
	ate examination for the teachi	,	Computer Science (2	2015)	
	r's degree (1 major) Physics (20				
	lor's degree (1 major) Business	•			
	lor's degree (1 major) Aerospa	•	2017)		
Bache	lor's degree (1 major) Compute	er Science (2017)			
Bachelor's (2022)	s with 1 major Mathematical Data Science		enerated 19-Apr-2025 • exam to ECTS) Mathematical Data S	-	page 14 / 84

#### UNIVERSITÄT WÜRZBURG

Bachelor's degree (1 major) Computer Science (2019) Bachelor's degree (1 major) Business Information Systems (2019) Bachelor's degree (1 major) Business Information Systems (2020) Bachelor's degree (1 major) Aerospace Computer Science (2020) Bachelor's degree (1 major) Functional Materials (2021) Bachelor's degree (1 major) Computer Science und Sustainability (2021) Bachelor's degree (1 major) Business Information Systems (2021) Bachelor's degree (1 major) Mathematical Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023) Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Business Information Systems (2023) Bachelor's degree (1 major) Business Information Systems (2024) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024) Bachelor's degree (1 major) Functional Materials (2025) Bachelor's degree (1 major) Games Engineering (2025)

Modul	e title				Abbreviation
Deep L	.earning	5			10-I-DL-222-m01
Modul	e coord	inator		Module offered by	
Dean c	of Studie	es Informatik (Computer S	Science)	Institute of Comput	er Science
ECTS		od of grading	Only after succ. com	pl. of module(s)	
5	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ester	undergraduate			
Conter	nts				
applica methor field of retical all the and te	ation ex ds of m f deep la founda models xt gener	amples for NN architectu achine learning and their earning, such as CNNs, R tions of these models, su s covered, it is shown hov ration.	rres, e.g. in the field of technical backgroun NNs and sequence-to ich as training throug	of image and speech d are presented. Bu p-sequence architect h backpropagation,	FCN, CNN and LSTMs, practical processing. Current models and ilding on this, models from the tures, are discussed. The theo- are also discussed in detail. For oblems such as image processing
Intend	ed learı	ning outcomes			
res and	d how th		ools such as Tensorfl	ow/Keras, of the abi	earning, of important architectu- lity to reprogram network structu-
Course	<b>es</b> (type	, number of weekly conta	ct hours, language —	if other than Germa	n)
V (2) +	Ü (2)				
		<b>sessment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-
lf anno examir prox. 1	ounced l nation o	of one candidate each (ap es per candidate).	inning of the course,		tion may be replaced by an oral in groups of 2 candidates (ap-
Allocat	tion of p	olaces			
Additio	onal inf	ormation			
Worklo	oad				
150 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	lations for teaching-o	legree programmes)	
-	Nr. 3 b)			<u> </u>	
	e appea				
		gree (1 major) Mathemati	cal Data Science (20:	22)	
		gree (1 major) Artificial In			
		gree (1 major) Artificial In	•		
		gree (1 major) Artificial In	•	Science (2024)	
Bache	lor's de	gree (1 major) Games Eng	gineering (2025)		

Module title				Abbreviation
Data Science	& Machine Learning			10-I-DSML-222-m01
Module coord	inator		Module offered by	
Dean of Studi	es Informatik (Computer	Science)	Institute of Comput	er Science
	od of grading	Only after succ. com	pl. of module(s)	
5 nume	rical grade			
Duration	Module level	Other prerequisites		
1 semester	undergraduate			
Contents				
Intended lear	ning outcomes			
Courses (type	, number of weekly conta	ct hours, language —	if other than Germa	n)
V (2) + Ü (2)	· · · · · · · · · · · · · · · · · · ·			
	sessment (type, scope, la ion on whether module ca			tion offered — if not every seme-
examination o	of one candidate each (ap tes per candidate).			tion may be replaced by an oral in groups of 2 candidates (ap-
Allocation of	olaces			
Additional inf	ormation			
Workload				
150 h				
Teaching cycl	е			
Referred to in	LPOI (examination regu	lations for teaching-c	legree programmes)	
Module appea	ars in			
Bachelor's de	gree (1 major) Mathemati	cal Data Science (20:	22)	
	gree (1 major) Artificial In			
Bachelor's de	gree (1 major) Artificial In	tolligonco and Data S	• ( )	
	gree (1 major) Artificial In			

Fundamentals of Programming       10-I-GdP-172-m01         Module coordinator       Module offered by         holder of the Chair of Computer Science II       Institute of Computer Science         ECTS       Method of grading       Only after succ. compl. of module(s)         5       numerical grade          Duration       Module level       Other prerequisites         1 semester       undergraduate          Contents          Data types, control structures, foundations of procedural programming, selected topics of C, introduction to object orientation in Java, selected topics of C++, further Java concepts, digression: scripting languages.         Intended learning outcomes          The students possess a fundamental knowledge about programming languages (in particular Java, C and C++) and are able to independently develop average to high level Java programs.         Courses (type, number of weekly contact hours, language — if other than German)         V (2) + Ü (2)         Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)         written examination (approx. 6o to 120 minutes).
Module coordinator       Module offered by         holder of the Chair of Computer Science II       Institute of Computer Science         ECTS       Method of grading       Only after succ. compl. of module(s)         5       numerical grade          Duration       Module level       Other prerequisites         1 semester       undergraduate          Contents       Data types, control structures, foundations of procedural programming, selected topics of C, introduction to object orientation in Java, selected topics of C++, further Java concepts, digression: scripting languages.         Intended learning outcomes       The students possess a fundamental knowledge about programming languages (in particular Java, C and C++) and are able to independently develop average to high level Java programs.         Courses (type, number of weekly contact hours, language — if other than German)       V (2) + Ü (2)         Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)         written examination (approx. 6o to 120 minutes).
holder of the Chair of Computer Science II       Institute of Computer Science         ECTS       Method of grading       Only after succ. compl. of module(s)         5       numerical grade          Duration       Module level       Other prerequisites         1 semester       undergraduate          Contents       Data types, control structures, foundations of procedural programming, selected topics of C, introduction to object orientation in Java, selected topics of C++, further Java concepts, digression: scripting languages.         Intended learning outcomes       Institute of the chair of weekly contact hours, language – if other than German)         V (2) + Ü (2)       Method of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module can be chosen to earn a bonus)         written examination (approx. 60 to 120 minutes).       0
ECTS       Method of grading       Only after succ. compl. of module(s)         5       numerical grade          Duration       Module level       Other prerequisites         1 semester       undergraduate          Contents
5       numerical grade          Duration       Module level       Other prerequisites         1 semester       undergraduate          Contents       Data types, control structures, foundations of procedural programming, selected topics of C, introduction to object orientation in Java, selected topics of C++, further Java concepts, digression: scripting languages.         Intended learning outcomes       Intended learning outcomes         The students possess a fundamental knowledge about programming languages (in particular Java, C and C++) and are able to independently develop average to high level Java programs.         Courses (type, number of weekly contact hours, language — if other than German)         V (2) + Ü (2)         Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)         written examination (approx. 60 to 120 minutes).
Duration       Module level       Other prerequisites         1 semester       undergraduate          Contents
1 semester       undergraduate          Contents
Contents         Data types, control structures, foundations of procedural programming, selected topics of C, introduction to object orientation in Java, selected topics of C++, further Java concepts, digression: scripting languages.         Intended learning outcomes         The students possess a fundamental knowledge about programming languages (in particular Java, C and C++) and are able to independently develop average to high level Java programs.         Courses (type, number of weekly contact hours, language — if other than German)         V (2) + Ü (2)         Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)         written examination (approx. 60 to 120 minutes).
Data types, control structures, foundations of procedural programming, selected topics of C, introduction to object orientation in Java, selected topics of C++, further Java concepts, digression: scripting languages.         Intended learning outcomes         The students possess a fundamental knowledge about programming languages (in particular Java, C and C++) and are able to independently develop average to high level Java programs.         Courses (type, number of weekly contact hours, language — if other than German)         V (2) + Ü (2)         Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)         written examination (approx. 60 to 120 minutes).
ject orientation in Java, selected topics of C++, further Java concepts, digression: scripting languages. Intended learning outcomes The students possess a fundamental knowledge about programming languages (in particular Java, C and C++) and are able to independently develop average to high level Java programs. Courses (type, number of weekly contact hours, language — if other than German) V (2) + Ü (2) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes).
The students possess a fundamental knowledge about programming languages (in particular Java, C and C++) and are able to independently develop average to high level Java programs. <b>Courses</b> (type, number of weekly contact hours, language — if other than German) V (2) + Ü (2) <b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes).
and are able to independently develop average to high level Java programs. Courses (type, number of weekly contact hours, language — if other than German) V (2) + Ü (2) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes).
and are able to independently develop average to high level Java programs. Courses (type, number of weekly contact hours, language — if other than German) V (2) + Ü (2) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes).
V (2) + Ü (2) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes).
V (2) + Ü (2) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes).
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes).
ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap-
prox. 15 minutes per candidate).
creditable for bonus
Allocation of places
Additional information
Workload
150 h
Teaching cycle
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)
§ 49   Nr. 1 b) § 69   Nr. 1 b)
Module appears in
Bachelor's degree (1 major) Physics (2015)
Bachelor's degree (1 major) Aerospace Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2017)
Bachelor's degree (1 major) Computer Science (2019)
Bachelor's degree (1 major) Business Information Systems (2020)
Bachelor's degree (1 major) Physics (2020)
Bachelor's degree (1 major) Aerospace Computer Science (2020)
Bachelor's degree (1 major) Computer Science und Sustainability (2021)
Bachelor's degree (1 major) Business Information Systems (2021)
Bachelor's degree (1 major) Mathematical Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)
Bachelor's with 1 major Mathematical Data Science       JMU Würzburg • generated 19-Apr-2025 • exam. reg. data re-       page 18 / 84         (2022)       cord Bachelor (180 ECTS) Mathematical Data Science - 2022       page 18 / 84

#### Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Business Information Systems (2023) Bachelor's degree (1 major) Business Information Systems (2024) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024) Bachelor's degree (1 major) Economathematics (2025)

Module	title				Abbreviation
Cognitive Systems					10-l-KogSys-222-m01
Module	e coord	inator		Module offered by	
Dean o	f Studie	es Informatik (Computer S	Science)	Institute of Comput	er Science
ECTS		od of grading	Only after succ. com	pl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
Intende	ed learr	ning outcomes			
Course	<b>s</b> (type,	, number of weekly conta	ct hours, language —	if other than Germa	n)
V (2) +	Ü (2)				
		e <b>ssment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-
lf anno examin prox. 15	unced l ation o 5 minut ge of a	f one candidate each (ap es per candidate). ssessment: German and,	inning of the course, pprox. 20 minutes) or		tion may be replaced by an oral in groups of 2 candidates (ap-
Allocat	ion of p	olaces			
Additio	nal info	ormation			
Worklo	ad				
150 h					
Teachir	ng cycl	e			
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)					
Module	e appea	irs in			
Bachel	or's deg	gree (1 major) Mathemati	cal Data Science (202	22)	
		gree (1 major) Artificial In	-		
Bachel	Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)				

Module title	Abbreviation						
Introduction into Human-Computer Int	eraction		10-I-MCS-191-m01				
Module coordinator		Module offered by					
holder of the Chair of Computer Scienc	e IX	Institute of Comput	er Science				
ECTS Method of grading	Only after succ. con	npl. of module(s)					
5 numerical grade							
Duration Module level	Other prerequisites						
1 semester undergraduate							
Contents							
Human-Computer Interaction studies the design, evaluation, and implementation of interactive computer sy- stems. Special focus lies on fundamental psychological and physiological properties of the human users, the technical principals and models of modern computer systems, as well as on the derived boundary conditions of designing usable and human-oriented interactions with technical systems. The topics of this course cover the human perception and cognition, the human memory and attention, the design of interactive systems, popuplar evaluation methods, principles of computer systems, input processing techniques, human interfaces and typical means of interaction, from text-based input methods over graphical user interfaces to multi-modal interfaces. Accompanying practical tasks convey to the students typical methods of requirement analysis, prototyping and evaluation.							
Intended learning outcomes							
After successfully completing this course, students have a fundamental understanding of human-computer inter- face design principles. They understand the possibilities and limitations of technology and user and the applica- tions of modern user interfaces. They know the necessary steps of user-centric design and typical design princip- les.							
Courses (type, number of weekly conta	ct hours, language –	- if other than Germa	n)				
V (3) + Ü (1)							
<b>Method of assessment</b> (type, scope, la ster, information on whether module ca			tion offered — if not	every seme-			
written examination (approx. 120 minutes) If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus							
Allocation of places							
Additional information							
Workload							
150 h							
Teaching cycle							
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)							
Module appears in							
Bachelor's degree (1 major) Computer S	Science (2019)						
Bachelor's degree (1 major) Business Ir	•						
Bachelor's degree (1 major) Computer S							
Bachelor's degree (1 major) Business Ir	-						
Bachelor's with 1 major Mathematical Data Science (2022)	JMU Würzburg • g cord Bachelor (18	enerated 19-Apr-2025 • exam	. reg. data re-	page 21 / 84			

#### Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Bachelor's degree (1 major) Mathematical Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023) Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Business Information Systems (2023)

Module title Abbreviation							
Natural Language Processing 10-I-NLP-222-m01							
Module coordinator			Module offered by				
	of the Cl	hair of Computer Scier		Institute of Comput	er Science		
ECTS	1	d of grading	Only after succ. con	npl. of module(s)			
5	<u> </u>	cal grade					
Duratio	1	Module level	Other prerequisites				
	1 semester undergraduate Contents						
Introduction to Text Mining and Natural Language Processing; Traditional computational representations of text data (bag-of-words) and text preprocessing (sentence splitting, tokenization, morphological normalization, stemming); Corpus linguistics and lexical association measures (ngram frequencies, co-occurrences, collocations and terminology extraction); Syntactic analysis: Part-of-Speech tagging and chunking (with Hidden Markov Models and Conditional Random Fields), parsing (Probabilistic Context Free Grammars and parsers); Distributional semantics and latent text representations: distributional hypothesis, Latent Semantic Analysis (LSA), word embeddings; Light introduction to (modern) deep learning-based NLP: embeddings, convolutional and recurrent networks, Transformers. NLP Applications: text classification tasks (e.g., document classification, sentiment analysis) vs. token classification tasks (e.g., information extraction - named entity recognition) vs. text generation tasks (e.g. machine translation and text summarization).							
		-	ll and practical knowle	dae of the typical ma	thods and algorithm	ac in the field	
of text knowle well as experie	mining a edge: and the app ence imp	and natural language p alyze the text data for ropriate (machine lea plementing solutions f	processing. They will be the task at hand, choo rning for NLP) model to or a wide range of com tact hours, language –	e able to solve practi se the appropriate re solve the task. They mon NLP tasks and a	cal problems with the presentation for the vill have gained ric applications.	ie obtain eir texts as	
V (2) +		number of weekly con			(11)		
Module	e taught	in: German and/or En					
			language — if other th can be chosen to earn		tion offered — if not	every seme-	
ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus							
Allocat	tion of pl	aces					
Additio	onal info	rmation					
Workload							
150 h							
Teaching cycle							
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)							
§ 22	Nr. 3 b)						
Module	e appear	rs in					
Bachel	or's deg	ree (1 major) Mathema	atical Data Science (20	22)			
Bachelor's (2022)	with 1 majo	r Mathematical Data Science		enerated 19-Apr-2025 • exam o ECTS) Mathematical Data S	-	page 23 / 84	

#### Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024) Bachelor's degree (1 major) Games Engineering (2025)

Module	e title				Abbreviation
Practic	al Cou	rse in Programming for N	Nathematical Data Sci	ence	10-I-PPM-222-m01
Module coordinator N				Module offered by	
Dean o	of Studi	es Informatik (Computer	Science)	Institute of Compu	ter Science
ECTS		od of grading	Only after succ. com		
5	(not)	successfully completed			
Duratio	on	Module level	Other prerequisites		
1 seme	ster		-		wing module are required: 10-l- ed to complete this before.
Conten	Its				
Intend	ed lear	ning outcomes			
Course	e <b>s</b> (type	, number of weekly conta	act hours, language —	if other than Germa	an)
P (6)					
ster, in practic minute If anno examir	format al exan es) unced nation o	ion on whether module c nination (programming e by the lecturer at the beg	an be chosen to earn xercises, approx. 120 ;inning of the course,	a bonus) hours) and written the written examina	ation offered — if not every seme- examination (approx. 60 to 120 ation may be replaced by an oral n in groups of 2 candidates (ap-
Allocat	ion of	places			
Additio	onal inf	ormation			
Worklo	ad				
150 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	llations for teaching-d	egree programmes	
Module	e appea	ars in			

Module title					Abbreviation		
Statist	ical Net	work Analysis			10-I-SNA-222-m01		
Modul	e coord	inator		Module offered by			
holder	of the (	Chair of Computer Scienc	e XV	Institute of Comput	er Science		
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)			
5	nume	rical grade					
Durati	on	Module level	Other prerequisites				
1 seme	ester	undergraduate					
Conter	nts						
Networks matter! This holds for technical infrastructures like communication or transportation networks, for in- formation systems and social media in the World Wide Web, but also for various social, economic and biologi- cal systems. What can we learn from data that capture the interaction topology of such complex systems? What is the role of individual nodes and how can we discover significant patterns in the structure of networks? How do these structures influence dynamical process like diffusion or the spreading of epidemics? Which are the most influential actors in a social network? And how can we analyse time series data on systems with dynamic net- work topologies? Addressing those questions, the course combines a series of lectures - which introduce fundamental concepts for the statistical modelling of complex networks - with weekly exercises that show how we can apply them to practical network analysis tasks. Topics covered include foundations of graph theory, centrality and modulari- ty measures, aggregate statistical characteristics of large networks, random graphs and statistical ensembles of complex networks, generating function analysis of expected graph properties, scale-free networks, stochastic dynamics in networks, spectral analysis, as well as the modelling of time-varying networks. The course material consists of annotated slides for lectures as well as a accompanying git-Repository of jupyter notebooks, which							
		d validate the theoretical ning outcomes					
ven mo titative terns. very la dersta	Intended learning outcomes The course will equip participants with statistical network analysis techniques that are needed for the data-driven modelling of complex technical, social, and biological systems. Students will understand how we can quantitatively model the topology of networked systems and how we can detect and characterize topological patterns. Participants will learn how to use analytical methods to make statements about the expected properties of very large networks that are generated based on different stochastic models. They further gain an analytical understanding of how the structure of networks shapes dynamical processes, how statistical fluctuations in degree distributions influence the robustness of systems, and how emergent network features emerge from simple ran-						
Course	es (type	, number of weekly conta	ict hours, language –	- if other than Germa	n)		
V (2) + Modul	• •	t in: German and/or Engl	ish				
		e <b>ssment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-		
lf anno examin prox. 1 Langua	written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus						
Alloca	tion of p	olaces					
Additi	onal info	ormation					

#### Workload

150 h

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#### Teaching cycle

Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 3 b)

#### Module appears in

Bachelor's degree (1 major) Mathematical Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)

Module	e title				Abbreviation
Software Technology for Artificial Intelligence and Data Science				ence	10-I-ST-KIDS-222-m01
Module coordinator Modu				Module offered	by
Dean o	of Studi	es Informatik (Computer	r Science)	Institute of Com	iputer Science
ECTS	Meth	od of grading	Only after succ. com	npl. of module(s)	
5	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	Its				
Intend	ed lear	ning outcomes			
Course	<b>s</b> (type	, number of weekly cont	act hours, language –	- if other than Ge	rman)
V (2) +					
		sessment (type_scope_l	anguage — if other the	an Corman, oyan	nination offered — if not every seme-
written If anno examir	format exami unced nation o	ion on whether module on nation (approx. 60 to 12 by the lecturer at the be of one candidate each (a	can be chosen to earn o minutes). ginning of the course,	a bonus) the written exam	nination may be replaced by an oral tion in groups of 2 candidates (ap-
written lf anno examir prox. 1 credita	format exami unced nation o 5 minu ble for	ion on whether module on nation (approx. 60 to 12 by the lecturer at the be of one candidate each (a tes per candidate). bonus	can be chosen to earn o minutes). ginning of the course,	a bonus) the written exam	nination may be replaced by an oral
written If anno examir prox. 1	format exami unced nation o 5 minu ble for	ion on whether module on nation (approx. 60 to 12 by the lecturer at the be of one candidate each (a tes per candidate). bonus	can be chosen to earn o minutes). ginning of the course,	a bonus) the written exam	nination may be replaced by an oral
written If anno examir prox. 1 credita Allocat	format exami ounced nation o 5 minu ble for tion of	ion on whether module of nation (approx. 60 to 12 by the lecturer at the be of one candidate each (a tes per candidate). bonus <b>places</b>	can be chosen to earn o minutes). ginning of the course,	a bonus) the written exam	nination may be replaced by an oral
written If anno examir prox. 1 credita Allocat	format exami ounced nation o 5 minu ble for tion of	ion on whether module on nation (approx. 60 to 12 by the lecturer at the be of one candidate each (a tes per candidate). bonus	can be chosen to earn o minutes). ginning of the course,	a bonus) the written exam	nination may be replaced by an oral
written If anno examir prox. 1 credita Allocat	format exami unced nation of 5 minu ble for <b>ion of</b> p	ion on whether module of nation (approx. 60 to 12 by the lecturer at the be of one candidate each (a tes per candidate). bonus <b>places</b>	can be chosen to earn o minutes). ginning of the course,	a bonus) the written exam	nination may be replaced by an oral
written If anno examir prox. 1 credita Allocat  Additic	format exami unced nation of 5 minu ble for <b>ion of</b> p	ion on whether module of nation (approx. 60 to 12 by the lecturer at the be of one candidate each (a tes per candidate). bonus <b>places</b>	can be chosen to earn o minutes). ginning of the course,	a bonus) the written exam	nination may be replaced by an oral
written If anno examir prox. 11 credita Allocat  Additic  Worklo 150 h	format exami unced nation of 5 minu ble for ion of p onal inf	ion on whether module of nation (approx. 60 to 12 by the lecturer at the be of one candidate each (a tes per candidate). bonus places	can be chosen to earn o minutes). ginning of the course,	a bonus) the written exam	nination may be replaced by an oral
written If anno examir prox. 1 credita Allocat  Additic	format exami unced nation of 5 minu ble for ion of p onal inf	ion on whether module of nation (approx. 60 to 12 by the lecturer at the be of one candidate each (a tes per candidate). bonus places	can be chosen to earn o minutes). ginning of the course,	a bonus) the written exam	nination may be replaced by an oral
written If anno examir prox. 11 credita Allocat  Additic  150 h Teachin 	format exami unced nation of 5 minu ble for ion of onal inf	ion on whether module of nation (approx. 60 to 12 by the lecturer at the be of one candidate each (a tes per candidate). bonus places	can be chosen to earn o minutes). ginning of the course, pprox. 20 minutes) or	a bonus) the written exam an oral examina	nination may be replaced by an oral tion in groups of 2 candidates (ap-
written If anno examir prox. 11 credita Allocat  Additic  150 h Teachin 	format exami unced nation of 5 minu ble for ion of onal inf	ion on whether module of nation (approx. 60 to 12 by the lecturer at the be of one candidate each (a tes per candidate). bonus places	can be chosen to earn o minutes). ginning of the course, pprox. 20 minutes) or	a bonus) the written exam an oral examina	nination may be replaced by an oral tion in groups of 2 candidates (ap-
written If anno examir prox. 11 credita Allocat  Additic  Teachin  Referre	format exami unced aation of 5 minut ble for tion of mal inf	ion on whether module of nation (approx. 60 to 12- by the lecturer at the be- of one candidate each (a tes per candidate). bonus places formation	can be chosen to earn o minutes). ginning of the course, pprox. 20 minutes) or	a bonus) the written exam an oral examina	nination may be replaced by an oral tion in groups of 2 candidates (ap-
written If anno examir prox. 1 credita Allocat  Modulo  Referre  Modulo	format exami unced nation of 5 minut ble for ion of p onal inf pad	ion on whether module of nation (approx. 60 to 12- by the lecturer at the be- of one candidate each (a tes per candidate). bonus places formation e LPO I (examination reg	can be chosen to earn o minutes). ginning of the course, ipprox. 20 minutes) or ulations for teaching-c	a bonus) the written exam an oral examina	nination may be replaced by an oral tion in groups of 2 candidates (ap-
written If anno examir prox. 11 credita Allocat  Additic 150 h Teachin  Referre  Bachel	format exami unced nation of 5 minut ble for ion of p onal inf onal inf oad ed to in e appea or's de	ion on whether module of nation (approx. 60 to 12- by the lecturer at the be- of one candidate each (a tes per candidate). bonus places formation	can be chosen to earn o minutes). ginning of the course, approx. 20 minutes) or ulations for teaching-o tical Data Science (20)	a bonus) the written exam an oral examina	nination may be replaced by an oral tion in groups of 2 candidates (ap-
written If anno examir prox. 11 credita Allocat  Additic  Teachin  Referre Bachel Bachel Bachel	format exami unced bation of 5 minut ble for ion of onal inf onal inf onal inf ead ed to in e appea or's de or's de	ion on whether module of nation (approx. 60 to 12- by the lecturer at the be- of one candidate each (a tes per candidate). bonus places formation e LPO I (examination reg ars in gree (1 major) Mathemation	can be chosen to earn o minutes). ginning of the course, approx. 20 minutes) or ulations for teaching-or tical Data Science (20) ntelligence and Data S	a bonus) the written exam an oral examina degree programm 22) Science (2022)	nination may be replaced by an oral tion in groups of 2 candidates (ap-

Module title					Abbreviation	
Theory of Machine Learning					10-I-TML-222-m01	
Module	coord	inator		Module offered by		
Dean of	fStudie	es Informatik (Computer S	Science)	Institute of Comput	er Science	
ECTS		od of grading	Only after succ. com	pl. of module(s)		
5	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	undergraduate				
Conten	ts					
Intende	ed learr	ning outcomes				
Courses	<b>s</b> (type	, number of weekly conta	ct hours, language —	if other than Germa	n)	
V (2) + I Module		t in: German and/or Engli	ish			
		<b>essment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-	
lf annou examin prox. 15	unced l ation o 5 minut ge of a	f one candidate each (ap es per candidate). ssessment: German and/	inning of the course, pprox. 20 minutes) or		tion may be replaced by an oral in groups of 2 candidates (ap-	
Allocati	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
150 h						
Teachir	ng cycl	e				
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
§ 22    N	§ 22    Nr. 3 b)					
		irs in				
Module appears inBachelor's degree (1 major) Mathematical Data Science (2022)Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)Bachelor's degree (1 major) Games Engineering (2025)						

Module	e title				Abbreviation
Applied Algebra					10-M-AAL-222-m01
Module	e coord	inator		Module offered by	·
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS		od of grading	Only after succ. com	pl. of module(s)	
10	nume	rical grade			
Duratio		Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
theory,	solvab	theory (particularly algeb ility of equations, cycloto of algebra and number the	omic fields, finite field	ds).	constructions, basics in Galois omputer algebra).
Intende	ed lear	ning outcomes			
	ainted				ebra and its applications. He/She damental proof methods inde-
Course	<b>s</b> (type	, number of weekly conta	ct hours, language —	if other than Germa	in)
V (4) +	Ü (2)				
		<b>sessment</b> (type, scope, la ion on whether module ca			tion offered — if not every seme-
b) oral c) oral	examir examin Ige of a	mination (approx. 90 to 1 nation of one candidate e nation in groups (groups c ssessment: German and/ bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or	
Allocat					
Additio	nal inf	ormation			
Worklo	ad				
300 h					
Teachi		e			
	.5 . , . (	-			
Referre	d to in	LPOI (examination regu	lations for teaching-c	legree programmes)	
			0		
Module	appea	ars in			
Bachel exchan	or's de ge pro	gree (1 major) Mathemati gram Mathematics (2023) gree (1 major) Mathemati	)	22)	

Intended learning outcomes	Mathematics) Only after succ Other prerequisi data science in other disci importance of mathematica sciplinary context. kly contact hours, languag	ciplines, e.g., in science, humanities or economics. cal data science for other fields, and can apply the the ge — if other than German)
Dean of Studies MathematikECTSMethod of grading5numerical gradeDurationModule level1 semesterundergraduateContentsApplications of mathematicalIntended learning outcomesThe student understands the studied methods in an interdidCourses (type, number of weedV (2) + Ü (2)Method of assessment (type, ster, information on whether in a) written examination (60 to b) term paper (15 to 30 pages) c) oral examination of one car	Only after succ.	Institute of Mathematics . compl. of module(s) sites ciplines, e.g., in science, humanities or economics. cal data science for other fields, and can apply the the ge — if other than German)
ECTSMethod of grading5numerical grade5numerical gradeModule level1 semesterundergraduateContentsApplications of mathematicalIntended learning outcomesThe student understands the studied methods in an interdiCourses (type, number of weeV (2) + Ü (2)Method of assessment (type, ster, information on whether i a) written examination (60 to b) term paper (15 to 30 pages) c) oral examination of one call	Only after succ.	. compl. of module(s) sites ciplines, e.g., in science, humanities or economics. cal data science for other fields, and can apply the the ge — if other than German)
5       numerical grade         Duration       Module level         1 semester       undergraduate         Contents       undergraduate         Applications of mathematical       Intended learning outcomes         The student understands the studied methods in an interdi       Courses (type, number of weet         V (2) + Ü (2)       Method of assessment (type, ster, information on whether in a) written examination (60 to b) term paper (15 to 30 pages) c) oral examination of one can	 Other prerequisi  data science in other disci importance of mathematica sciplinary context. kly contact hours, languag	sites ciplines, e.g., in science, humanities or economics. cal data science for other fields, and can apply the the ge — if other than German)
DurationModule level1 semesterundergraduate1 semesterundergraduateContentsApplications of mathematicalIntended learning outcomesThe student understands the studied methods in an interdiCourses (type, number of weeV (2) + Ü (2)Method of assessment (type, ster, information on whether i a) written examination (60 to b) term paper (15 to 30 pages) c) oral examination of one can	 data science in other disci importance of mathematica sciplinary context. kly contact hours, languag	ciplines, e.g., in science, humanities or economics. cal data science for other fields, and can apply the the ge — if other than German)
1 semesterundergraduateContentsApplications of mathematicalIntended learning outcomesThe student understands the studied methods in an interdiCourses (type, number of weeV (2) + Ü (2)Method of assessment (type, ster, information on whether i a) written examination (60 to b) term paper (15 to 30 pages) c) oral examination of one can	 data science in other disci importance of mathematica sciplinary context. kly contact hours, languag	ciplines, e.g., in science, humanities or economics. cal data science for other fields, and can apply the the ge — if other than German)
Contents Applications of mathematical Intended learning outcomes The student understands the studied methods in an interdi Courses (type, number of wee V (2) + $\ddot{U}$ (2) Method of assessment (type, ster, information on whether i a) written examination (60 to b) term paper (15 to 30 pages) c) oral examination of one can	data science in other disci importance of mathematica sciplinary context. kly contact hours, languag	cal data science for other fields, and can apply the the ge — if other than German)
Applications of mathematical <b>Intended learning outcomes</b> The student understands the studied methods in an interdi <b>Courses</b> (type, number of wee V (2) + $\ddot{U}$ (2) <b>Method of assessment</b> (type, ster, information on whether in a) written examination (60 to b) term paper (15 to 30 pages) c) oral examination of one can	importance of mathematica sciplinary context. kly contact hours, languag	cal data science for other fields, and can apply the the ge — if other than German)
Intended learning outcomes The student understands the studied methods in an interdi Courses (type, number of wee $V(2) + \ddot{U}(2)$ Method of assessment (type, ster, information on whether in a) written examination (60 to b) term paper (15 to 30 pages) c) oral examination of one can	importance of mathematica sciplinary context. kly contact hours, languag	cal data science for other fields, and can apply the the ge — if other than German)
The student understands the studied methods in an interdi <b>Courses</b> (type, number of weet $V(2) + \ddot{U}(2)$ <b>Method of assessment</b> (type, ster, information on whether rail a) written examination (60 to b) term paper (15 to 30 pages) c) oral examination of one car	sciplinary context. kly contact hours, languag	ge — if other than German)
studied methods in an interdi <b>Courses</b> (type, number of wee V (2) + Ü (2) <b>Method of assessment</b> (type, ster, information on whether i a) written examination (60 to b) term paper (15 to 30 pages) c) oral examination of one can	sciplinary context. kly contact hours, languag	ge — if other than German)
V (2) + Ü (2) <b>Method of assessment</b> (type, ster, information on whether a) written examination (60 to b) term paper (15 to 30 pages) c) oral examination of one can		-
Method of assessment (type, ster, information on whether r a) written examination (60 to b) term paper (15 to 30 pages c) oral examination of one car	scone language — if other	
ster, information on whether i a) written examination (60 to b) term paper (15 to 30 pages) c) oral examination of one car	scope language — if other	
Language of assessment. Cer	) or Ididate each (15 to 30 minu	nutes)
Allocation of places		
Additional information		
Workload		
150 h		
Teaching cycle		
Referred to in LPO I (examina	tion regulations for teaching	ing-degree programmes)
Module appears in		
Bachelor's degree (1 major) M exchange program Mathemat		2 (2022)

Module					Abbreviation
Applications of Data Science in other disciplines 2					10-M-ADS2-222-m01
Module	coord	inator		Module offered by	<u> </u>
Dean of	Studie	es Mathematik (Mathem	atics)	Institute of Mathem	natics
		od of grading	Only after succ. con	npl. of module(s)	
5	nume	rical grade			
Duratio	n	Module level	Other prerequisites		
1 semes	ster	undergraduate			
Content	S				
Applicat	tions c	of mathematical data scie	ence in other disciplin	nes, e.g., in science,	humanities or economics.
Intende	d learı	ning outcomes			
		nderstands the importan ods in an interdisciplinar		ata science for othe	r fields, and can apply the the
Courses	(type	, number of weekly conta	act hours, language –	- if other than Germa	ın)
V (2) + Ü	j (2)				
b) term c) oral e	paper xamin	nination (60 to 120 minu (15 to 30 pages) or ation of one candidate e ssessment: German and	ach (15 to 30 minutes	5)	
Allocati					
Additior	nal inf	ormation			
Workloa	ad				
150 h					
Teachin	g cycl	9			
Referred	d to in	LPOI (examination regu	llations for teaching-	degree programmes)	
Module	appea	irs in			
Bachelo	or's de	gree (1 major) Mathemat gram Mathematics (2023		22)	
excitality	se hioŝ		)		

Module	e title				Abbreviation	
Introduction to Algebra 10-M-ALG-222-mo1					10-M-ALG-222-m01	
Module	e coord	inator		Module offered by		
Dean o	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
ECTS	i	od of grading	Only after succ. com	pl. of module(s)		
10	nume	rical grade				
Duratio		Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Fundan	nental	algebraic structures (grou	ups, rings, fields), Gal	lois theory.		
Intende	ed learı	ning outcomes				
		nows and masters the es ncepts in this field, and is			ebra. He/She is acquainted with thods independently.	
Course	<b>s</b> (type	, number of weekly conta	ct hours, language —	if other than Germa	n)	
V (4) +	 Ü (2)					
		<b>essment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-	
b) oral c) oral e	examin examin ge of a	mination (approx. 90 to 1 nation of one candidate e ation in groups (groups c ssessment: German and/ bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or		
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teaching cycle						
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
				_ , 0 /		
Module	e appea	urs in				
		gree (1 major) Mathemati	cal Data Science (202	22)		
	exchange program Mathematics (2023)					

Module	title				Abbreviation	
Analysis 1					10-M-ANA1-222-m01	
Module	coord	inator		Module offered by		
Dean of	fStudie	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
ECTS		od of grading	Only after succ. com	pl. of module(s)		
5		uccessfully completed				
Duratio		Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
ries; po	wer se		sics in differential ca		ivergence of sequences and se- e; basics of integral calculus in	
Intende	ed learr	ning outcomes				
central	proof n	nethods in analysis and o	can employ them to s	olve easy problems.	He/She is acquainted with the He/she is able to perform easy s precisely and clearly in written	
Course	<b>s</b> (type,	, number of weekly conta	ct hours, language —	· if other than Germa	n)	
Ü (2)						
		essment (type, scope, la on on whether module ca			tion offered — if not every seme-	
exercis	es eacł			n exercises (approx.	12 exercise sheets with approx. 4	
Allocat			U			
Additio	nal info	ormation				
Worklo	ad					
150 h						
Teaching cycle						
Referre	d to in	LPOI (examination regu	lations for teaching-c	legree programmes)		
			5			
Module	appea	rs in				
Bachelo	or's deg	gree (1 major) Mathemati	cal Data Science (202	22)		

Module	e title		Abbreviation						
Analysi	is 2		10-M-ANA2-222-m01						
Module	e coord	inator		Module offered by					
Dean of Studies Mathematik (Mathema			atics)	Institute of Mathematics					
ECTS Method of grading			Only after succ. compl. of module(s)						
5	(not) s	successfully completed							
Duration		Module level	Other prerequisites						
1 semester		undergraduate							
Contents									
Further topological considerations, basics in differential calculus in several variables, inverse function theorem, implicit function theorem.									
Intended learning outcomes									
The student knows and masters the essential methods and notions of analysis. He/She is acquainted with the central proof methods in analysis and can employ them to solve easy problems. He/she is able to perform easy mathematical arguments independently and to express mathematical arguments precisely and clearly in written form.									
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)									
Ü (2)									
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus)									
written examination (approx. 90 to 180 minutes) and written exercises (approx. 12 exercise sheets with approx. 4 exercises each) Language of assessment: German and/or English									
Allocation of places									
Additional information									
Workload									
150 h									
Teaching cycle									
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)									
Module appears in									
Bachelor's degree (1 major) Mathematical Data Science (2022)									

Module	title		Abbreviation						
Overvie		•			10-M-ANA-Ü-222-m01				
Module	coord	inator		Module offered by					
Dean of	fStudie	es Mathematik (Mathema	atics)	Institute of Mathematics					
ECTS	<b>v</b>		Only after succ. compl. of module(s)						
13 nume		rical grade							
Duration		Module level	Other prerequisites						
2 semester		undergraduate							
Contents									
Real numbers and completeness, basic topological notions, convergence and divergence of sequences and se- ries, differential and integral calculus in one variable, further topological considerations, differential calculus with a focus on functions in several variables.									
Intende	ed learn	ning outcomes							
The student knows and masters the essential methods and proof techniques of analysis and is able to apply them independently, He/She has an overview over the fundamental notions and concepts of analysis, their analytic background and geometric interpretation, and can interconnect them and express them adequately in written and oral form.									
<b>Courses</b> (type, number of weekly contact hours, language — if other than German)									
V (4) + V (4) + Ü (2)									
<b>Method of assessment</b> (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus)									
oral examination of one candidate each (20 to 40 minutes) Assessment will have reference to the contents of modules 10-M-ANA1 and 10-M-ANA2. Language of assessment: German and/or English									
Allocation of places									
Additio	nal info	ormation							
Workload									
390 h									
Teaching cycle									
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)									
Module appears in									
Bachelo	Bachelor's degree (1 major) Mathematical Data Science (2022)								

Module	title				Abbreviation
Applied	l Stoch	astics Lab			10-M-APSL-222-m01
Module	coord	inator		Module offered by	<u> </u>
		es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS		od of grading	Only after succ. con		
6		rical grade		<u> </u>	
Duratio	n	Module level	Other prerequisites		
1 semes	ster	undergraduate			
Conten	ts				
		per generators, Monte Ca ce intervals, linear and lo			lementation of tests, estimators e. data applications
		ning outcomes			
The stu	dent is				e statistical methods to given da-
Courses	<b>s</b> (type	, number of weekly conta	ct hours, language –	- if other than Germa	ın)
V (2) + I	P (2)				
		sessment (type, scope, la ion on whether module ca			tion offered — if not every seme-
	ge of a	30 to 60 hours) ssessment: German and, bonus	/or English		
Allocati	ion of <sub>l</sub>	olaces			
Additio	nal inf	ormation			
Worklo	ad				
180 h					
Teachir	ng cycl	e			
Referre	d to in	LPOI (examination regu	lations for teaching-o	degree programmes)	
Module	appea	ars in			
		gree (1 major) Mathemati gram Mathematics (2023)		22)	

Module	title			Abbreviation	
Reason	ing and Writing in Mathemati	cs		10-M-ASM-152-mo	L
Module	coordinator		Module offered by		
	f Studies Mathematik (Mathen	atics)	Institute of Mathem	atics	
ECTS	Method of grading	Only after succ. con		latics	
2	(not) successfully completed	Only after Succ. con			
Duratio		Other prerequisites			
1 semes					
Conten					
	ction to fundamental methods ical writing;insight into examp 1.				
Intende	ed learning outcomes				
	dent is acquainted with the ba asy mathematical arguments ir m.				
Course	<b>s</b> (type, number of weekly cont	act hours, language –	· if other than Germa	n)	
V (1) + Ü					
	<b>d of assessment</b> (type, scope,	language — if other tha	an German, examina	tion offered — if not	every seme-
	formation on whether module	0 0			
	(10 to 20 pages)				
Langua	ge of assessment: German and	d/or English			
Allocat	ion of places				
Additio	nal information				
Worklo	ad				
60 h					
	ng cycle				
Teachir	ng cycle	_			
Referre	d to in LPO I (examination reg	ulations for teaching-o	legree programmes)		
Module	e appears in				
Bachelo	or's degree (1 major) Mathema	tics (2015)			
Bachelo	or's degree (1 major) Economa	thematics (2015)			
	or's degree (1 major) Mathema				
	or's degree (1 major) Computa		015)		
	or's degree (1 major) Mathema				
	or's degree (1 major) Economa				
	or's degree (1 major) Mathema	•			
	or's degree (1 major) Economa				
	or's degree (1 major) Economa				
	or's degree (1 major) Mathema		22)		
	ge program Mathematics (202 or's degree (1 major) Mathema	-			
	or's degree (1 major) Mathema or's degree (1 major) Economa				
	or's degree (1 major) Economa				
	or's degree (1 major) Mathema	tical Physics (2024)			
Bachelo	or's degree (1 major) Mathema with 1 major Mathematical Data Science		enerated 19-Apr-2025 • exam		page 38 / 84



Bachelor's degree (1 major) Economathematics (2024) Bachelor's degree (1 major) Economathematics (2025)

Modul	e title				Abbreviation
Thesis	Mathe	matical Data Science			10-M-BAD-222-m01
Modul	e coord	inator		Module offered by	
Dean c	of Studi	es Mathematik (Mathe	ematics)	Institute of Mathem	natics
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
12	nume	rical grade			
Durati	on	Module level	Other prerequisites	6	
1 seme	ester	graduate			l completion of certain modu- opic a prerequisite for the assign-
Conter	nts				
Indepe	endently	<pre>/ researching and writ</pre>	ing on a topic in mather	matics selected in co	nsultation with the supervisor.
Intend	ed lear	ning outcomes			
tained			, .	•	oply the skills and methods ob- vn the result of his/her work in a
Course	es (type	, number of weekly co	ntact hours, language –	– if other than Germa	ın)
No cou	urses as	signed to module			
			e, language — if other th e can be chosen to earn		tion offered — if not every seme-
Bachel	lor's the	esis (approx. 300 to 30	60 hours)		
Allocat	tion of <sub>l</sub>	olaces			
Additio	onal inf	ormation			
Time to	o compl	ete: 12 weeks			
Worklo	oad				
360 h					
Teachi	ing cycl	e			
Referre	ed to in	LPOI (examination re	egulations for teaching-	degree programmes)	
-	e appea	urs in			

Modul	e title				Abbreviation		
Compu	tationa	l Mathematics			10-M-COM-152-m01		
Modul	e coord	inator		Module offered by			
Dean o	of Studie	es Mathematik (Mathema	atics)	Institute of Mathem	atics		
ECTS		od of grading	Only after succ. con				
4		successfully completed		······································			
Duratio	<u> </u>	Module level	Other prerequisites				
	1 semester undergraduate						
Conter	its						
merica and 10	l compi -M-LNA	o modern mathematical s utation (e.g. Matlab) to s -G). Computer-based solu egral calculus; visualisat	upplement the basic ution of problems in	modules in analysis	and linear algebra (	(10-M-ANA-G	
Intend	ed learı	ning outcomes					
		arns the use of advanced cation to solve mathematic		cal software package	es, and is able to ass	sess their	
Course	<b>s</b> (type	, number of weekly conta	ct hours, language –	- if other than Germa	n)		
V (1) +	Ü (2)						
		e <b>ssment</b> (type, scope, la on on whether module ca			tion offered — if not	every seme-	
Langua	age of a	form of programming exe ssessment: German and, ffered: Once a year, winte	or English	25 hours)			
Allocat	ion of p	olaces					
Additio	onal inf	ormation					
Worklo	ad						
120 h							
Teachi	ng cycl	e					
Referre	ed to in	LPOI (examination regu	lations for teaching-	degree programmes)			
§ 22	-		0				
	e appea	urs in					
		gree (1 major) Mathemati	<u>(2015)</u>				
		gree (1 major) Physics (20					
		gree (1 major) Nanostruct	-	c)			
		gree (1 major) Economath	•, •				
		gree (1 major) Mathemati					
		gree (1 major) Computatio	• -	015)			
		gree (1 major) Functional					
		mination for the teaching	_	Mathematics (2015)			
		gree (1 major) Mathemati					
		gree (1 major) Economath					
		mination for the teaching		Mathematics (2019)			
		gree (1 major) Physics (20					
		gree (1 major) Nanostruct		o)			
Bachelor's (2022)	with 1 maj	or Mathematical Data Science		enerated 19-Apr-2025 • exam o ECTS) Mathematical Data S		page 41 / 84	

## Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major) Functional Materials (2021) Bachelor's degree (1 major) Quantum Technology (2021) Bachelor's degree (1 major) Economathematics (2021) Bachelor's degree (1 major) Economathematics (2022) Bachelor's degree (1 major) Mathematical Data Science (2022) exchange program Mathematics (2023) First state examination for the teaching degree Gymnasium Mathematics (2023) Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Economathematics (2023) Bachelor's degree (1 major) Economathematics (2024) Bachelor's degree (1 major) Functional Materials (2025) Bachelor's degree (1 major) Economathematics (2025)

Module					Abbreviation
Introdu	uction t	o Differential Geometry			10-M-DGE-222-m01
Module	e coord	inator		Module offered by	·
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ster	undergraduate			
Conten	ts				
surface of surfa	es in R^ aces; ci	3; parametrisation of su	rfaces, examples; fun	damental forms (me	rsion of curves; 2-dimensional etrics, normal vector fields); area mple covariant derivatives, mini-
Intend	ed lear	ning outcomes			
	ed with				erential geometry. He/She is ac- ental proof methods indepen-
Course	<b>s</b> (type	, number of weekly conta	ict hours, language —	- if other than Germa	an)
V (4) +	Ü (2)				
		<b>sessment</b> (type, scope, la ion on whether module ca			tion offered — if not every seme-
b) oral c) oral Langua	examir examin age of a ment o	mination (approx. 90 to 1 nation of one candidate e nation in groups (groups o ssessment: German and, ffered: In the semester ir bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes /or English	s) or per candidate)	ubsequent semester
Allocat	ion of <sub>l</sub>	places			
Additio	onal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	lations for teaching-o	degree programmes)	
				p.eg.annied)	
Module	e appea	ars in			
Module Bachel		<b>ars in</b> gree (1 major) Mathemati	ical Data Science (20)	22)	

Module title Abbreviation					Abbreviation
Ordinaı	ry Diffe	rential Equations			10-M-DGL-222-m01
Module	coord	inator		Module offered by	
Dean of	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	atics
ECTS		od of grading	Only after succ. com	pl. of module(s)	
10	<u> </u>	rical grade			
Duratio		Module level	Other prerequisites		
1 seme		undergraduate			
Conten	ts				
on of co and unit dence of method rised as <b>Intende</b> The stu equation <b>Courses</b> V(4) + 1 <b>Method</b> ster, inf a) writte b) oral of c) oral of	onstant iquene of solut is, mat sympto ed learn dent is ons. He s (type U (2) I of ass formati en exar examin examin ge of a	is, exact equations) and p ss of solutions; Gronwall ions on initial values, lin rix exponential function; tic stability; Lypunov met <b>ning outcomes</b> acquainted with the fund /she is able to apply thes , number of weekly conta essment (type, scope, la on on whether module ca nination (approx. 90 to 1 lation of one candidate e ation in groups (groups c ssessment: German and	particular examples li lemma; extendability ear differential equat autonomous systems thods, first integrals. damental concepts a se methods to practic ct hours, language — nguage — if other tha an be chosen to earn 80 minutes, usually of ach (15 to 30 minutes) of 2, 10 to 15 minutes	ke Bernoulli, Riccati y of solutions, maxin ions, algebraic struc s; notion of stability; nd methods of the the al problems. if other than Germa an German, examina a bonus) chosen) or s) or	separation of variables, variati- ; initial value problem; existence nal solution; continuous depen- ture of solution spaces, solution ; stability of linear systems; linea- neory of ordinary differential n) tion offered — if not every seme-
Allocat	ion of p	olaces			
Additio	nal inf	ormation			
Worklo	ad				
300 h					
Teachir	ng cycl	e			
Referre	d to in	LPOI (examination regu	lations for teaching-c	legree programmes)	
Module	appea	irs in			
		gree (1 major) Mathemati		22)	
exchan	ge prog	gram Mathematics (2023)			

Module title         Abbreviation					Abbreviation	
Introdu	ction t	o Discrete Mathematics			10-M-DIM-222-m01	
Module	coord	inator		Module offered by	Module offered by	
Dean of	fStudie	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
ECTS		od of grading	Only after succ. com	pl. of module(s)		
10	nume	rical grade				
Duratio		Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
		om combinatorics, introd g codes.	uction to graph theor	y (including applicat	ions), cryptographic methods,	
Intende	ed learr	ning outcomes				
levant p	proof te		ly methods from num		e mathematics, masters the re- ora to discrete mathematics and	
Course	<b>s</b> (type	, number of weekly conta	ct hours, language —	if other than Germa	n)	
V (4) +	Ü (2)					
ster, inf	formati	on on whether module ca	an be chosen to earn	a bonus)	tion offered — if not every seme-	
b) oral ( c) oral (	examin examin ge of a	nination (approx. 90 to 1 ation of one candidate e ation in groups (groups c ssessment: German and/ bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or		
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teachir	ng cycl	9				
Referre	d to in	LPOI (examination regu	lations for teaching-c	legree programmes)		
Module	appea	irs in				
Bachelo	or's deg	gree (1 major) Mathemati	cal Data Science (202	22)		
exchan	ge prog	gram Mathematics (2023)	)			

Introdu	e title				Abbreviation
	iction t	o Stochastic Financial M	lathematics		10-M-EFM-222-m01
Module	e coord	inator		Module offered by	1
Dean o	f Studi	es Mathematik (Mathem	atics)	Institute of Mather	natics
ECTS	Methe	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites	;	
1 seme	ster	undergraduate			
Conten	ts				
of asse stochas	t pricin stic mu	g in the stochastic one-p lti-period models, valua	period model, risk ner	utral price measures	derivates, fundamental theorem , replication and completeness, model, Black-Scholes formula.
Intende	ed lear	ning outcomes			
		acquainted with the fur practical problems and			hastic financial mathematics, can
Course	<b>s</b> (type	, number of weekly conta	act hours, language –	– if other than Germa	an)
V (4) +	Ü (2)				
Method	d of ass	sessment (type scope )	· · · · · · · · · · · · · · · · · · ·		
		ion on whether module c			ation offered — if not every seme-
ster, int a) writt b) oral c) oral o	formati en exa examir examir ige of a	ion on whether module of mination (approx. 90 to nation of one candidate of nation in groups (groups ssessment: German and	an be chosen to earn 180 minutes, usually each (15 to 30 minute of 2, 10 to 15 minutes	a bonus) chosen) or s) or	ation offered — if not every seme-
a) writt b) oral c) oral Langua	format en exa examir examin ige of a ble for	ion on whether module of mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German and bonus	an be chosen to earn 180 minutes, usually each (15 to 30 minute of 2, 10 to 15 minutes	a bonus) chosen) or s) or	ation offered — if not every seme-
ster, ini a) writt b) oral c) oral o Langua credita	format en exa examir examin ige of a ble for	ion on whether module of mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German and bonus	an be chosen to earn 180 minutes, usually each (15 to 30 minute of 2, 10 to 15 minutes	a bonus) chosen) or s) or	ation offered — if not every seme-
ster, int a) writte b) oral c) oral c Langua credita Allocat	formati en exa examir examin ige of a ble for <b>ion of j</b>	ion on whether module of mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German and bonus	an be chosen to earn 180 minutes, usually each (15 to 30 minute of 2, 10 to 15 minutes	a bonus) chosen) or s) or	ation offered — if not every seme-
ster, int a) writte b) oral c) oral c Langua credita Allocat	formati en exa examir examin ige of a ble for <b>ion of j</b>	ion on whether module of mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German and bonus places	an be chosen to earn 180 minutes, usually each (15 to 30 minute of 2, 10 to 15 minutes	a bonus) chosen) or s) or	ation offered — if not every seme-
ster, int a) writte b) oral c) oral c Langua credita Allocat	format en exa examir examin ge of a ble for ion of p nal inf	ion on whether module of mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German and bonus places	an be chosen to earn 180 minutes, usually each (15 to 30 minute of 2, 10 to 15 minutes	a bonus) chosen) or s) or	ation offered — if not every seme-
ster, ini a) writt b) oral c) oral o Langua credita Allocat  Additio	format en exa examir examin ge of a ble for ion of p nal inf	ion on whether module of mination (approx. 90 to nation of one candidate of ation in groups (groups ssessment: German and bonus places	an be chosen to earn 180 minutes, usually each (15 to 30 minute of 2, 10 to 15 minutes	a bonus) chosen) or s) or	ation offered — if not every seme-
ster, ini a) writt b) oral c) oral d Langua credita Allocat  Additio  Worklo	format en exa examin examin ge of a ble for ion of p onal inf	ion on whether module of mination (approx. 90 to nation of one candidate e nation in groups (groups ssessment: German and bonus places ormation	an be chosen to earn 180 minutes, usually each (15 to 30 minute of 2, 10 to 15 minutes	a bonus) chosen) or s) or	ation offered — if not every seme-
ster, ini a) writt b) oral c) oral o Langua credita Allocat  Additio  Soo h	format en exa examin examin ge of a ble for ion of p onal inf	ion on whether module of mination (approx. 90 to nation of one candidate e nation in groups (groups ssessment: German and bonus places ormation	an be chosen to earn 180 minutes, usually each (15 to 30 minute of 2, 10 to 15 minutes	a bonus) chosen) or s) or	ation offered — if not every seme-
ster, ini a) writt b) oral c) oral o Langua credita Allocat  Additio  300 h Teachin 	format en exa examin examin ge of a ble for ion of p onal inf pad	ion on whether module of mination (approx. 90 to nation of one candidate e nation in groups (groups ssessment: German and bonus places ormation	an be chosen to earn 180 minutes, usually each (15 to 30 minute of 2, 10 to 15 minutes l/or English	a bonus) chosen) or s) or per candidate)	
ster, ini a) writt b) oral c) oral o Langua credita Allocat  Additio  300 h Teachin 	format en exa examin examin ge of a ble for ion of p onal inf pad	ion on whether module of mination (approx. 90 to nation of one candidate e nation in groups (groups ssessment: German and bonus places ormation	an be chosen to earn 180 minutes, usually each (15 to 30 minute of 2, 10 to 15 minutes l/or English	a bonus) chosen) or s) or per candidate)	
ster, ini a) writt b) oral c) oral o Langua credita Allocat  Additio  300 h Teachin 	format en exa examin examin ige of a ble for ion of p onal inf pad	ion on whether module of mination (approx. 90 to a nation of one candidate of ation in groups (groups issessment: German and bonus places ormation e LPO I (examination regu	an be chosen to earn 180 minutes, usually each (15 to 30 minute of 2, 10 to 15 minutes l/or English	a bonus) chosen) or s) or per candidate)	

Modul	e title				Abbreviation
Extern	al Inter	nship Mathematical Data	a Science		10-M-EPMDS-222-m01
Modul	e coord	inator		Module offered by	<u> </u>
Dean c	of Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
7	(not)	successfully completed			
Durati	on	Module level	Other prerequisites		
1 seme	ester	undergraduate			
Conter	nts				
		onsists of a placement of data science and the sul			r another organisation related to report.
Intend	ed lear	ning outcomes			
The stu dies.	udent h	as practical experience in	n the relevant fields a	ind is able to apply t	he skills obtained in his/her stu-
Course	es (type	, number of weekly conta	ict hours, language –	- if other than Germa	in)
P (o)		,	, 0 0		
ster, in	format	ion on whether module c			tion offered — if not every seme-
		oort (10 to 20 pages) ssessment: German and	/or English		
Alloca	tion of	places			
Additio	onal inf	ormation			
Worklo	oad				
210 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	lations for teaching-	degree programmes)	
	0 2000	arc in			
Modul	e appea				

Module	title				Abbreviation	
Introdu	ction t	o Functional Analysis			10-M-FAN-222-m01	
Module	coord	inator		Module offered by		
Dean of Studies Mathematik (Mathemati			atics)	Institute of Mathem	atics	
ECTS		od of grading	Only after succ. com	pl. of module(s)		
10	nume	rical grade				
	Duration Module level Other prerequisites					
1 seme	ster	undergraduate				
Conten	ts					
ty; linea ple, ope (extens glu theo thonorr theory o	ar oper en map ion the orem, a nal sys of com	ators, fundamental theor ping theorem, closed gra orem, separation theore djoint operator, closed r	ems for linear operat aph theorem; linear fu m), double dual spac ange theorem; Hilber operators, Arzela-Asc	ors; Baire's theorem unctionals and dual e and reflexivity; we t spaces: Fréchet-Rie coli theorem; spectra	spaces), denseness, separabili- , uniform boundedness princi- spaces; Hahn-Banach theorem ak convergence, Banach-Alao- esz representation theorem, or- al theory: basic notions, spectral	
			ncents and methods	of functional analys	is as well as the pertinent proof	
					Il analysis, and realises the	
broad a	pplica	bility of the theory to oth	er branches of mathe	matics.	·	
Course	<b>s</b> (type	, number of weekly conta	ct hours, language —	if other than Germa	n)	
V (4) +	Ü (2)					
		e <b>ssment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-	
b) oral ( c) oral (	examin examin ge of a	nination (approx. 90 to 1 ation of one candidate e ation in groups (groups c ssessment: German and, bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or		
Allocat	ion of <b>r</b>	olaces				
Additio	nal info	ormation				
Worklo	ad					
300 h						
Teachir	ng cycl	e				
Referre	d to in	LPOI (examination regu	lations for teaching-c	legree programmes)		
Module	appea	irs in				
		gree (1 major) Mathemati gram Mathematics (2023)		22)		

Module title					Abbreviation
Introdu	ction t	o Complex Analysis			10-M-FTH-222-m01
Module	coord	inator		Module offered by	
Dean of	fStudie	es Mathematik (Mathema	atics)	Institute of Mathem	atics
ECTS		od of grading	Only after succ. com	pl. of module(s)	
10		rical grade			
Duratio		Module level	Other prerequisites		
1 seme		undergraduate			
Conten					
formati comple Cauchy tation c and Vita <b>Intende</b> The stu apply th <b>Course</b> V (4) + 1 <b>Methoo</b>	ons), c x analy integra of real i ali's the dent is nese m s (type, Ü (2) I of ass	omplex integration, Cauc vsis (in particular identity al theorem, isolated sing ntegrals, argument princi eorem), Riemann's mapp ning outcomes acquainted with the func ethods to practical probl , number of weekly conta	hy's integral theorem theorem, maximum ularities and Laurent ple, Rouche's theore ing theorem. damental concepts a ems. ct hours, language — nguage — if other tha	and Cauchy's integ principle, openness series, residue theo m), normal families nd methods in comp if other than Germa an German, examina	ps (in particular Möbius trans- ral formula, basic principles of priciple, Schwarz lemma), gneral rem and its applications (compu- (in particular Montel's theorem elex analysis. He/she is able to n) tion offered — if not every seme-
a) writte b) oral e c) oral e	en exar examin examin ge of a	on on whether module can nination (approx. 90 to 1 ation of one candidate e ation in groups (groups c ssessment: German and/ bonus	80 minutes, usually o ach (15 to 30 minutes of 2, 10 to 15 minutes	chosen) or 5) or	
Allocat	ion of p	olaces			
Additio	nal info	ormation			
Worklo	ad				
300 h					
Teachir	ng cycl	9			
Referre	d to in	LPO I (examination regu	lations for teaching-c	legree programmes)	
Module	appea	irs in			
		gree (1 major) Mathemati		22)	
exchan	ge prog	gram Mathematics (2023)			

~	e title				Abbreviation
Geome	tric An	alysis			10-M-GAN-222-m01
Module	e coord	inator		Module offered by	
Dean o	f Studi	es Mathematik (Mathen	natics)	Institute of Mathen	natics
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites	;	
1 seme	ster	undergraduate			
Conten	ts				
tial form	ms and specia	exterior derivative; Sto l cases Gauss' theorem	kes' theorem for differ	ential forms; Hodge	It boundary; orientation; differen- star operator; Stokes' theorem opics like density or submani-
Intend	ed lear	ning outcomes			
		acquainted with the fu ethods to practical pro		and methods in geon	netric analysis. He/she is able to
Course	<b>s</b> (type	, number of weekly con	tact hours, language –	- if other than Germa	in)
V (4) +	Ü (2)				
		<b>sessment</b> (type, scope, ion on whether module			tion offered — if not every seme-
b) oral c) oral	examir examin age of a	mination (approx. 90 to nation of one candidate nation in groups (groups ssessment: German an bonus	each (15 to 30 minute of 2, 10 to 15 minutes	s) or	
	ion of I				
Allocat		olaces			
Allocat		places			
		ormation			
	onal inf				
 Additio	onal inf				
 Additio  Worklo	onal inf oad	ormation			
 Additio  Worklo 300 h	onal inf oad	ormation			
 Additio  Worklo 300 h Teachin	onal inf oad ng cycl	ormation	gulations for teaching-	degree programmes)	
 Additio  Worklo 300 h Teachin	onal inf oad ng cycl	ormation e	gulations for teaching-	degree programmes)	
 Additio  Worklo 300 h Teachin	onal inf bad ng cycl ed to in	ormation e LPOI (examination reg	gulations for teaching-	degree programmes)	

Modul	e title				Abbreviation	
Basic Notions and Methods of Mathematical Reasoning					10-M-GBM-152-mo1	
Modul	e coord	inator		Module offered by	l	
		es Mathematik (Mathem	atics)	Institute of Mathem	natics	
ECTS	1	od of grading	Only after succ. con	pl. of module(s)		
2	(not)	successfully completed		•		
Durati	on	Module level	Other prerequisites			
1 seme	ester	undergraduate				
Conter	nts					
Introdu	uction t	o the basic notions and	proof techniques in m	athematics: approa	ch to sets, formal log	gic and maps
Intend	ed lear	ning outcomes				
		ets acquainted with the s degree study programn		ues which are prere	quisites for the furth	er courses in
Course	<b>es</b> (type	, number of weekly cont	act hours, language –	if other than Germa	ın)	
V (1) +	Ü (1)					
		sessment (type, scope, la ion on whether module o			ition offered — if not	every seme-
		15 pages) ssessment: German and	l/or English			
	tion of		<u>·</u> · · · ·			
			_			
Additi	onal inf	ormation				
Additio	onal inf	ormation on module dur	ation: block taught pr	ior to the beginning	of the lecture period	
Worklo					·	
60 h						
Teachi	ing cycl	e	-			
			_			
Referre	ed to in	LPOI (examination regi	ulations for teaching-o	legree programmes)	I	
§ 22	Nr. 1 h) Nr. 2 f)			<u> </u>		
	e appea	ars in				
		gree (1 major) Mathemat	ics (2015)			
		gree (1 major) Economat	-			
		gree (1 major) Mathemat				
		gree (1 major) Computat		-	、	
		mination for the teachin			)	
		mination for the teachin		-		
		mination for the teachin		Mathematics (2015,	)	
		gree (1 major) Mathemat gree (1 major) Economat	•			
		mination for the teachin		Mathematics (2020	(Prüfungsordnungs	version
2015))	מוב באמ		S degree milleischule	mathematics (2020	n nanangsoranangs	
	lor's de	gree (1 major) Mathemat	ical Physics (2020)			
		gree (1 major) Economat				
		gree (1 major) Economat				
Bache	lor's de	gree (1 major) Mathemat	ical Data Science (20	22)		
exchar	nge pro	gram Mathematics (2023	3)			
	s with 1 ma	jor Mathematical Data Science		enerated 19-Apr-2025 • exam	-	page 51 / 84
2022)			cord Bachelor (18)	o ECTS) Mathematical Data S	cience - 2022	

## Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Economathematics (2023) Bachelor's degree (1 major) Mathematical Physics (2024) Bachelor's degree (1 major) Economathematics (2024) Bachelor's degree (1 major) Economathematics (2025)

Module	e title			Abbreviation		
Selecte	ed Topics in History of Mathema	atics		10-M-GES-152-m01		
Module coordinator			Module offered by			
	f Studies Mathematik (Mathem	atics)	Institute of Mathem			
ECTS	Method of grading	Only after succ. con		latics		
5	(not) successfully completed					
Duratio		Other prerequisites				
1 seme						
Conten		<u> </u>				
Historio the fun	cal and cultural development as damentals of mathematics, in p of mathematics in modern socie	particular in its relatio				
Intend	ed learning outcomes					
	on selected examples, the stud eories and their social relevanc ce.					
Course	<b>s</b> (type, number of weekly conta	act hours, language –	if other than Germa	n)		
V (2) +	Ü (2)					
	<b>d of assessment</b> (type, scope, la formation on whether module c			tion offered — if not	every seme-	
Langua Assess	ect work (15 to 25 hours) ge of assessment: German and ment offered: In the semester in		offered and in the su	ıbsequent semester		
Allocat	ion of places					
		_				
Additio	nal information					
		_				
Worklo	ad					
150 h						
Teachi	ng cycle					
Roforro	ed to in LPO I (examination regu	lations for teaching.	legree programmes)			
§ 22						
	e appears in	· ( )				
	or's degree (1 major) Mathemat	-				
	or's degree (1 major) Mathemat or's degree (1 major) Computati		245)			
	Bachelor's degree (1 major) Computational Mathematics (2015) First state examination for the teaching degree Gymnasium Mathematics (2015)					
	Bachelor's degree (1 major) Mathematical Physics (2016)					
	ate examination for the teaching	•	Mathematics (2019)			
	or's degree (1 major) Mathemat					
	or's degree (1 major) Mathemat	•	22)			
	ge program Mathematics (2023					
	ate examination for the teachin or's degree (1 major) Mathemat		Mathematics (2023)			
Dackel - 1	with a major Mathematical Data Calana	18411 18/25	anaratad to American	rog data ra	nore == / 0	
DACHEIOPS	with 1 major Mathematical Data Science	JNIU WURZburg • g	enerated 19-Apr-2025 • exam	. reg. uata re-	page 53 / 84	



Bachelor's degree (1 major) Mathematical Physics (2024)

				Abbreviation		
Linear Algebra 1					10-M-LNA1-222-m01	
Module	coord	inator		Module offered by		
Dean of	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
ECTS		od of grading	Only after succ. com	pl. of module(s)		
5	(not) s	successfully completed				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
Basic n termina		and structures; vector sp	aces, linear maps, sy	stems of linear equa	ations; theory of matrices and de-	
Intende	ed learı	ning outcomes				
ted with	h the ce	entral proof methods in li	near algebra and can	apply them to solve	ear algebra. He/She is acquain- e easy problems. He/She is able m adequately in written form.	
Course	<b>s</b> (type	, number of weekly conta	ct hours, language —	if other than Germa	n)	
Ü (2)						
		<b>sessment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-	
exercis	es eacl			n exercises (approx.	12 exercise sheets with approx. 4	
Allocat						
Additio	nal inf	ormation				
Worklo	ad					
150 h						
Teachir	Teaching cycle					
Referre	d to in	LPOI (examination regu	lations for teaching-c	legree programmes)		
Module	e appea	urs in				
Bachelo	or's de	gree (1 major) Mathemati	cal Data Science (20:	22)		

Module title Abbreviation					Abbreviation		
Linear Algebra 2					10-M-LNA2-222-m01		
Module	e coord	inator		Module offered by			
Dean of	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	atics		
ECTS		od of grading	Only after succ. com	pl. of module(s)			
5	Lì - Í	successfully completed					
Duratio		Module level	Other prerequisites				
1 seme	ster	undergraduate					
Conten	ts						
Eigenva	alue the	eory, bilinear forms, Eucli	dean and unitary vec	tor spaces, diagona	lisation and Jordan normal form.		
Intende	ed learr	ning outcomes					
ted with	h the ce	entral proof methods in li	near algebra and can	apply them to solve	ear algebra. He/She is acquain- e easy problems. He/She is able m adequately in written form.		
Course	<b>s</b> (type,	, number of weekly conta	ct hours, language —	if other than Germa	n)		
Ü (2)							
		s <b>essment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-		
exercis	es eacł			n exercises (approx.	12 exercise sheets with approx. 4		
Allocati							
Additio	nal inf	ormation					
Worklo	ad						
150 h							
Teachir	ng cycl	e					
Referre	d to in	LPOI (examination regu	lations for teaching-c	legree programmes)			
Module	e appea	irs in					
Bachelo	or's de	gree (1 major) Mathemati	cal Data Science (202	22)			

Module title					Abbreviation	
Overview Linear Algebra 10-M-LNA-Ü-222-m01					10-M-LNA-Ü-222-m01	
Module	e coord	inator		Module offered by	<u> </u>	
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS	Methe	od of grading	Only after succ. com	pl. of module(s)		
13	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
2 seme	ester	undergraduate				
Conten	ts					
	inants	; eigenvalue theory; bilin			equations; theory of matrices and baces; diagonalisability and Jor-	
Intend	ed lear	ning outcomes				
ply the knows	m inde about t	pendently. He/She has a	in overview over the fi etric background, is a	undamental notions	linear algebra and is able to ap- and methods of linear algebra, b each other and can present	
Course	<b>s</b> (type	, number of weekly conta	act hours, language —	· if other than Germa	in)	
V (4) +	V (4) +	Ü (2)				
		sessment (type, scope, la ion on whether module c			tion offered — if not every seme-	
oral ex Assess	aminat ment w	ion of one candidate eac vill have reference to the ssessment: German and	h (20 to 40 minutes) contents of modules		I-LNA2.	
Allocat		~ · · · · · · · · · · · · · · · · · · ·	,			
	-					
Additio	onal inf	ormation				
Worklo	ad					
390 h						
Teachi	ng cvcl	e				
	0 29 30					
Referre	ed to in	LPOI (examination regu	lations for teaching of	legree programmes)		
		•				
Module	e appea	ars in				

					Abbreviation	
Introduction to Mathematical Logic					10-M-LOGP-232-m01	
Module	coord	inator		Module offered by		
				Institute of Mathem	atics	
ECTS		od of grading	Only after succ. com	pl. of module(s)		
10	nume	rical grade				
Duratio		Module level	Other prerequisites			
1 seme	ster					
Conten	ts					
Intende	ed learn	ning outcomes				
Course	<b>s</b> (type,	number of weekly conta	ct hours, language —	if other than Germa	n)	
V (4) +	Ü (2)					
Module	taugh	t in: German and/or Engli	ish			
		<b>essment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-	
a) writt	en exar	nination (approx. 90 to 1	80 minutes, usually o	chosen) or		
		ation of one candidate e		-		
		ation in groups (groups c ssessment: German and/		per candidate)		
		ffered: In the semester in		offered and in the su	ibsequent semester	
credita					•	
Allocat	ion of p	olaces				
Additio	nal info	ormation				
Worklo	ad					
300 h						
Teachi	ng cycl	e				
Referre	<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)					
Module	appea	rs in				
Bachel	or's de	gree (1 major) Mathemati	cal Data Science (202	22)		
		gree (1 major) Mathemati				
Bachel	Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)					

Modul	e title				Abbreviation
Mathe	matica	l Foundations of Data	Science		10-M-MFD-222-m01
Modul	e coord	linator		Module offered by	
Dean o	of Studi	es Mathematik (Math	ematics)	Institute of Mathen	natics
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites	5	
2 seme	ester	undergraduate			
Conter	nts				
for dat compo	a scien sition,	ce: orthogonality, ma classification, approx	trix calculus, matrix facto	orisation, tensors, le reduction; Applied a	etric tests; Applied linear algebra ast squares, singular value de- nalysis for data science: convexi- ze tuning
Intend	ed lear	ning outcomes			
The stu practic		•	fundamental methods a	nd concepts of data	science and can apply them to
Course	<b>es</b> (type	, number of weekly c	ontact hours, language –	- if other than Germa	in)
V (2) +	Ü (1) +	V (2) + Ü (1)			
			e, language — if other th le can be chosen to earn		tion offered — if not every seme-
b) oral c) oral	examii examir age of a	nation of one candida nation in groups (grou assessment: German	to 180 minutes, usually te each (15 to 30 minute ps of 2, 10 to 15 minutes and/or English	s) or	
Allocat	tion of	places			
Additio	onal inf	ormation			
Worklo	bad				
300 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination	regulations for teaching-	degree programmes)	
Modul	e appe	ars in			
	lor's de				

Module title Abbreviation					Abbreviation
Machi	ne Lear	ning and Numerics Lab			10-M-MLNL-222-m01
Modul	e coord	inator		Module offered by	
Dean c	of Studi	es Mathematik (Mathema	atics)	Institute of Mathem	atics
ECTS	Meth	od of grading	Only after succ. con	npl. of module(s)	
6	nume	rical grade			
Durati	on	Module level	Other prerequisites		
1 seme	ester	undergraduate			
Conter	nts				
		ution of linear and nonlir nerical optimization, opti		-	ods, Newton methods, step size 1)
Intend	ed lear	ning outcomes			
					Julia, able to apply suitable nu- present developed solutions.
Course	<b>es</b> (type	, number of weekly conta	ict hours, language –	- if other than Germa	n)
V (2) +	P (2)		-		
		sessment (type, scope, la ion on whether module ca			tion offered — if not every seme-
Langua		30 to 60 hours) ssessment: German and, bonus	/or English		
Allocat	tion of <sub>l</sub>	places			
Additio	onal inf	ormation			
Worklo	bad				
180 h					
Teachi	ng cycl	e			
Referre	<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)				
Modul	e appea	ars in			
		gree (1 major) Mathemati gram Mathematics (2023		22)	

Modul	e title				Abbreviation
Mathe	matics	of Machine Learning			10-M-MML-222-m01
Modul	e coord	linator		Module offered by	
Dean c	of Studi	es Mathematik (Mathema	atics)	Institute of Mather	natics
ECTS		od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Durati	on	Module level	Other prerequisites		
1 seme	ester	undergraduate			
Conter	nts				
Basic a	and adv	vanced concepts and met	hods of machine lea	rning, in particular t	heir mathematical foundations.
Intend	ed lear	ning outcomes			
The stu	udent k	nows the basic mathema	tical concepts and m	ethods that are app	olied in the field of machine lear-
ning.					
Course	<b>es</b> (type	, number of weekly conta	ct hours, language –	- if other than Germ	an)
V (4) +	• •				
		it in: German and/or Engl			
					ation offered — if not every seme-
		ion on whether module ca		-	
		mination (approx. 90 to 1 nation of one candidate e			
		nation in groups (groups of		-	
		assessment: German and		p - · · · · · · · · · · · · · · · · · ·	
		offered: In the semester in	which the course is	offered and in the s	ubsequent semester
	ble for				
Alloca	tion of	places			
Additio	onal inf	ormation			
Worklo	bad				
300 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	lations for teaching-	degree programmes	)
	-	<u> </u>			
Modul	e appe	ars in			
		gree (1 major) Mathemati	cal Data Science (20	22)	
		gram Mathematics (2023)		,	

Module title Abbreviation						
Mathe	Mathematical Writing 10-M-MSC-152-mo1					
Module coordinator Module offered by						
Dean c	of Studies Mat	hematik (Mather	natics)	Institute of Mathem	atics	
ECTS	Method of g	rading	Only after succ. com	pl. of module(s)		
5		sfully completed		•		
Duratio	on Modu	le level	Other prerequisites			
1 seme	ester under	graduate				
Conter	nts					
vers th compre	ie whole range ehensive work	of mathematica	atical writing using pra l texts from short proof lor's or Master's theses c questions.	s and the formulation	on of theorems and d	lefinitions to
Intend	ed learning ou	itcomes				
			nematical subject matters of mathematical liters			
Course	<b>es</b> (type, numb	er of weekly con	tact hours, language —	· if other than Germa	n)	
V (2) +	Ü (2)					
			language — if other tha can be chosen to earn		tion offered — if not	every seme-
c) proje Langua Assess		25 hours) nent: German an	d/or English in which the course is	offered and in the su	ıbsequent semester	
Additio	onal information	on				
Worklo	bad					
150 h	_					
Teachi	ng cycle					
Referre	ed to in LPO I	(examination reg	gulations for teaching-o	legree programmes)		
§ 22	Nr. 3 f)					
Modul	e appears in					
Bachel Bachel First st Bachel First st Bachel Bachel exchar First st	Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) First state examination for the teaching degree Gymnasium Mathematics (2015) Bachelor's degree (1 major) Mathematical Physics (2016) First state examination for the teaching degree Gymnasium Mathematics (2019) Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major) Mathematical Data Science (2022) exchange program Mathematics (2023) First state examination for the teaching degree Gymnasium Mathematics (2023) Bachelor's degree (1 major) Mathematical Data Science (2022)					
Bachelor's (2022)	with 1 major Mathe	matical Data Science		enerated 19-Apr-2025 • exam D ECTS) Mathematical Data S	-	page 62 / 84



Bachelor's degree (1 major) Mathematical Physics (2024)

Module title			Abbreviation	
Modelling and Computational Science				10-M-MWR-222-m01
Module coordinator			Module offered by	
Dean of St	udies Mathematik (Mathema	atics)	Institute of Mathem	natics
	ethod of grading	Only after succ. com		
	Imerical grade			
Duration	Module level	Other prerequisites		
1 semester	r undergraduate			
Contents	· · · · · ·			
scaling the	e modelling, asymptotic serie amental methods for numeric	es, classical methods	for solving ordinary	rinciples of modelling, aspects of and partial differential equati- ns and the resulting systems of li
Intended l	earning outcomes			
	nt masters the fundamental r eering sciences on a comput		ls and techniques to	o simulate processes from natura
Courses (ty	ype, number of weekly conta	ct hours, language –	· if other than Germa	in)
V (4) + Ü (2 Module tai	2) ught in: German and/or Engli	ish		
a) written ( b) oral exa c) oral exa Language	nation on whether module ca examination (approx. 90 to 1 mination of one candidate e mination in groups (groups c of assessment: German and/ nt offered: In the semester in for bonus	80 minutes, usually ( ach (15 to 30 minutes of 2, 10 to 15 minutes /or English	chosen) or 5) or per candidate)	ubsequent semester
Allocation	of places			
	•			
Additional	information			
Workload				
300 h				
Teaching of	rvcle			
	.,			
Referred to	o in LPO I (examination regu	lations for teaching of	legree programmes)	
	()			
Module ap	opears in			
Master's d Bachelor's exchange Bachelor's	legree (1 major) Functional M 6 degree (1 major) Mathemati program Mathematics (2023) 6 degree (1 major) Mathemati	cal Data Science (20) ) cal Physics (2024)	22)	
Master's d	legree (1 major) Functional M	aterials (2025)		

Module	e title				Abbreviation
Numeri	ical Ma	thematics 1			10-M-NUM1-222-m01
Module	e coord	inator		Module offered by	<u> </u>
Dean o	of Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS	Meth	od of grading	Only after succ. con	pl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ester	undergraduate			
Conten	nts				
		stems of linear equations tion with polynomials, sp			quations and systems of equati- rical integration.
Intend	ed lear	ning outcomes			
		acquainted with the fun oblems and knows about			erical mathematics, applies them
Course	e <b>s</b> (type	, number of weekly conta	ct hours, language –	· if other than Germa	an)
V (4) +	Ü (2)				
a) writt b) oral c) oral	en exa examir examir age of a	ion on whether module ca mination (approx. 90 to 1 nation of one candidate e ation in groups (groups o ssessment: German and, bonus	80 minutes, usually ach (15 to 30 minutes of 2, 10 to 15 minutes	chosen) or 5) or	
Allocat	tion of p	olaces			
Additio	onal inf	ormation			
Worklo	ad				
300 h	_				
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	lations for teaching-o	legree programmes)	
Module	e appea	ars in			
Pachal	or's do	gree (1 major) Mathemati			

Module title					Abbreviation		
Numerical Mathematics 2					10-M-NUM2-222-m01		
Module coordinator				Module offered by			
Dean of Studies Mathematik (Mathematics)			atics)	Institute of Mathem	atics		
ECTS		od of grading	Only after succ. com	pl. of module(s)			
10	nume	rical grade					
Duratio		Module level	Other prerequisites				
1 seme	ster	undergraduate					
Conten	ts						
		oblems, linear programm e problems.	ing, methods for initi	al value problems fo	r ordinary differential equations,		
Intende	ed learr	ning outcomes					
about t	The student is able to draw a distinction between the different concepts of numerical mathematics and knows about their advantages and limitations concerning the possibilities of application in different fields of natural and engineering sciences and economics.						
Course	<b>s</b> (type,	, number of weekly conta	ct hours, language —	if other than Germa	n)		
V (4) +	Ü (2)						
		e <b>ssment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-		
a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate) Language of assessment: German and/or English creditable for bonus							
Allocation of places							
Additional information							
Workload							
300 h							
Teaching cycle							
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)							
Module	appea	irs in					
Bachelo	or's deg	gree (1 major) Mathemati	cal Data Science (202	22)			
exchange program Mathematics (2023)							

Module	e title				Abbreviation	
Optimization for Machine Learning 10-M-OML-222-m						
Module coordinator				Module offered by		
	r	es Mathematik (Mathem	<u> </u>	Institute of Mathem	natics	
ECTS		d of grading	Only after succ. con	npl. of module(s)		
10	·	rical grade				
Duratio	on	Module level	Other prerequisites	i		
1 seme	ster	undergraduate				
Conten	ts					
		nming, quadratic progra ems such as support ve		ization, first order m	ethods, application	to machine
Intende	ed learr	ing outcomes				
		acquainted with the re	evant methods in ont	imization and is able	to apply these meth	ods to prac-
		learning problems, both				
		number of weekly cont		•	n)	
V (4) +					,	
		t in: German and/or Enន្	lish			
		essment (type, scope, l		an German, examina	tion offered — if not	everv seme-
		on on whether module				every serife
-		nination (approx. 90 to		-		
		ation of one candidate				
		ation in groups (groups		-		
		ssessment: German and				
		ffered: In the semester	n which the course is	offered and in the su	ubsequent semester	
credita	ble for	bonus				
Allocat	ion of p	laces				
Additio	onal info	ormation				
			_			
Worklo						
300 h						
Teachi	ng cycl	5				
Referre	ed to in	LPOI (examination reg	ulations for teaching-	degree programmes)		
Module	e appea	rs in				
		gree (1 major) Economa	thematics (2022)			
	-			22)		
Bachelor's degree (1 major) Mathematical Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022)						
exchange program Mathematics (2023)						
Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023)						
		gree (1 major) Economa	-	-		
Bachel	or's deg	gree (1 major) Mathema	tical Physics (2024)			
Master	's degre	ee (1 major) Physics Inte	ernational (2024)			
Bachel	or's deg	gree (1 major) Economa	thematics (2024)			
		gree (1 major) Artificial I	-	Science (2024)		
Bachel	or's deg	gree (1 major) Economa	thematics (2025)			
Bachelor's	with 1 mai	or Mathematical Data Science	IMU Würzhurg ● g	enerated 19-Apr-2025 • exam	. reg. data re-	page 67 / 84
(2022)				o ECTS) Mathematical Data S	-	F-0- 5/ / 64

Modul					Abbreviation
Introduction to Partial Differential Equations					10-M-PAR-222-m01
Module coordinator				Module offered by	
Dean o	of Studio	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS	Metho	od of grading	Only after succ. com	pl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 seme	ester	undergraduate			
Conten	nts				
transpo Dirichlo near pa mula fo variabl	ort equa et probl artial di or scala les, Fou	ation, the Poisson equati lems; energy methods, G fferential equations of fir r conservation laws; furth rier and Laplace transform	on, the heat equatior reen's functions, max st order; Hopf-Lax for ner methods for solvi	n and the wave equa kimum principle; exp rmula for Hamilton-J	; exact solutions for the linear ation; boundary value problems, blicit solutions for general nonli- acobi equations; Lax-Oleinik for- al equations (e.g., separation of
		ning outcomes		1 11 1 1 11 11	
		acquainted with the fun- is able to apply these me			heory of partial differential equa
Course	es (type	, number of weekly conta	ct hours, language —	· if other than Germa	in)
V (4) +					
		<b>sessment</b> (type, scope, la on on whether module ca			tion offered — if not every seme
b) oral c) oral Langua Assess	examir examin age of a	mination (approx. 90 to 1 nation of one candidate e ation in groups (groups c ssessment: German and, ffered: In the semester in bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes /or English	5) or per candidate)	ubsequent semester
Allocat	tion of p	olaces			
Additic	onal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	e			
Referre	ed to in	LPOI (examination regu	lations for teaching-c	legree programmes)	
Modul	e appea	urs in			
		gree (1 major) Mathemati		22)	
	nan nrod	gram Mathematics (2023)			

Module	e title				Abbreviation
Introduction to Projective Geometry 10-M-PGE-222-mo1					
Module coordinator				Module offered by	<u> </u>
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics
ECTS	Metho	od of grading	Only after succ. con	npl. of module(s)	
10	nume	rical grade			
Duratio	on	Module level	Other prerequisites		
1 semester undergraduate					
Conten	ts				
		l affine planes, projective , dualities and polarities			s, fundamental theorems for pro-
Intende	ed lear	ning outcomes			
		acquainted with the fun ethods to practical probl		nd methods of proje	ective geometry. He/she is able to
Course	<b>s</b> (type	, number of weekly conta	ct hours, language –	- if other than Germa	ın)
V (4) +	Ü (2)				
		<b>essment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-
b) oral c) oral o Langua	examir examin Ige of a ment o	mination (approx. 90 to 1 nation of one candidate e ation in groups (groups o ssessment: German and, ffered: In the semester in bonus	ach (15 to 30 minute: of 2, 10 to 15 minutes /or English	s) or per candidate)	ubsequent semester
Allocat	ion of p	olaces			
	2				
Additio	nal inf	ormation			
Worklo	ad				
300 h					
Teachi	ng cycl	е			
Referre	d to in	LPOI (examination regu	lations for teaching-	degree programmes)	
Module	e appea	urs in			
		gree (1 major) Mathemati gram Mathematics (2023)		22)	

Module	title			Abbreviation		
Program	mming course for students of M	10-M-PRG-152-m01				
	e coordinator		Module offered by			
Dean of	f Studies Mathematik (Mathema		Institute of Mathem	natics		
ECTS	Method of grading	Only after succ. com	pl. of module(s)			
3	(not) successfully completed					
Duratio		Other prerequisites				
1 seme	ster undergraduate					
Conten	ts					
Basics	of a modern programming langu	uage (e. g. C).				
Intende	ed learning outcomes					
	dent is able to work independe	ntly on small program	ming exercises and	standard programm	ing problems	
	nematics.	nity on shatt program		standard programm	ing prostering	
Course	<b>s</b> (type, number of weekly conta	act hours language —	if other than Germa	n)		
P (2)						
	<b>1</b> - <b>f</b>			tion offered if wet		
	<b>d of assessment</b> (type, scope, la formation on whether module c			ition offered — if not	every seme-	
	in the form of programming exe ge of assessment: German and		25 nours)			
0	ment offered: Once a year, sum					
	ion of places					
Allocat						
Additio	nal information					
		-				
Worklo	ad					
90 h						
Teachir	ng cycle					
Poforro	ed to in LPO I (examination regu	lations for teaching	legree programmes			
§ 22						
	e appears in					
	or's degree (1 major) Mathemati					
	or's degree (1 major) Physics (20	-	-)			
Bachelor's degree (1 major) Nanostructure Technology (2015)						
Bachelor's degree (1 major) Economathematics (2015)						
Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Computational Mathematics (2015)						
Bachelor's degree (1 major) Computational Mathematics (2015) Bachelor's degree (1 major) Functional Materials (2015)						
First state examination for the teaching degree Gymnasium Mathematics (2015)						
Bachelor's degree (1 major) Mathematical Physics (2016)						
Bachelor's degree (1 major) Economathematics (2017)						
First state examination for the teaching degree Gymnasium Mathematics (2019)						
Bachelor's degree (1 major) Physics (2020)						
	or's degree (1 major) Nanostruc		o)			
	or's degree (1 major) Mathemati	•				
	or's degree (1 major) Functional					
Bachel	or's degree (1 major) Quantum 1	Fechnology (2021)				
	with 1 major Mathematical Data Science		enerated 19-Apr-2025 • exam	-	page 70 / 84	
2022)		cord Bachelor (180	o ECTS) Mathematical Data S	cience - 2022		

Bachelor's degree (1 major) Economathematics (2021) Bachelor's degree (1 major) Economathematics (2022) Bachelor's degree (1 major) Mathematical Data Science (2022) exchange program Mathematics (2023) First state examination for the teaching degree Gymnasium Mathematics (2023) Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Economathematics (2023) Bachelor's degree (1 major) Mathematical Physics (2024) Bachelor's degree (1 major) Economathematics (2024) Bachelor's degree (1 major) Functional Materials (2025) Bachelor's degree (1 major) Economathematics (2025)

Module title					Abbreviation	
School Mathematics from a Higher Perspective			rspective		10-M-SCH-152-m01	
Module coordinator				Module offered by	<u> </u>	
		es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS		od of grading	Only after succ. cor			
5		successfully completed		1		
Duratio	on	Module level	Other prerequisites	5		
1 seme	ster	undergraduate				
Conten	Its		·			
		selected topics in schoo implementation at both s			ration into wider theories and	
Intende	ed lear	ning outcomes				
	vancec	mathematical theories.			between school mathematics athematical, didactical and me-	
		, number of weekly conta	act hours, language -	– if other than Germa	an)	
V (2) +	Ü (2)					
		<b>sessment</b> (type, scope, la on on whether module c			ation offered — if not every seme	
Assess Allocat		ffered: In the semester ir <b>blaces</b>	i which the course is	onered and in the s	ubsequent semester	
Additio	onal inf	ormation				
	-					
Worklo	ad					
150 h			-			
Teachi	ng cycl	e				
Referre	ed to in	LPOI (examination regu	lations for teaching-	degree programmes	)	
§ 22      § 22      § 22	Nr. 2 f)					
§ 22      Module		ors in				
		gree (1 major) Mathemat	ics (2015)			
Bachelor's degree (1 major) Mathematical Physics (2015) Bachelor's degree (1 major) Computational Mathematics (2015)						
		mination for the teaching			;)	
		mination for the teaching		-		
		mination for the teachinន្	g degree Gymnasium	Mathomatics (2015)		
	ате еха	in the state for the state of t				
		mination for the teaching	g degree Mittelschule			
Bachel	or's de	mination for the teaching gree (1 major) Mathemat mination for the teaching	g degree Mittelschule ical Physics (2016)	e Mathematics (2015	)	



First state examination for the teaching degree Mittelschule Mathematics (2020 (Prüfungsordnungsversion 2015))

Bachelor's degree (1 major) Mathematical Physics (2020) Bachelor's degree (1 major) Mathematical Data Science (2022) exchange program Mathematics (2023) First state examination for the teaching degree Gymnasium Mathematics (2023) Bachelor's degree (1 major) Mathematics (2023)

Bachelor's degree (1 major) Mathematical Physics (2024)

Module title					Abbreviation
Seminar Mathematics					10-M-SEM-152-m01
Module coordinator				Module offered by	
Dean of	fStudie	es Mathematik (Mathema	atics)	Institute of Mathem	atics
ECTS		od of grading	Only after succ. com	pl. of module(s)	
-		rical grade			
Duratio		Module level	Other prerequisites		
1 semes		undergraduate			
Conten	ts				
A select	ted top	ic in mathematics.			
Intende	ed learr	ning outcomes			
of a give	en topi				sters elaboration and structuring /She is able to participate active-
Courses	<b>s</b> (type,	, number of weekly conta	ct hours, language —	if other than Germa	n)
S (2)					
ster, inf	ormati	essment (type, scope, la on on whether module ca minutes)			tion offered — if not every seme-
		ssessment: German and/	or English		
Allocati	ion of p	olaces			
Additio	nal info	ormation			
Worklo	ad				
150 h					
Teachin	ng cycl	9			
Referre	d to in	LPOI (examination regu	lations for teaching-c	legree programmes)	
§ 22 II Nr. 3 f)					
Module appears in					
Bachelor's degree (1 major) Mathematics (2015) Bachelor's degree (1 major) Computational Mathematics (2015) First state examination for the teaching degree Gymnasium Mathematics (2015) First state examination for the teaching degree Gymnasium Mathematics (2019) Bachelor's degree (1 major) Mathematical Data Science (2022) exchange program Mathematics (2023) First state examination for the teaching degree Gymnasium Mathematics (2023) Bachelor's degree (1 major) Mathematics (2023)					

Module title Abbreviation						
Supple	menta	ry Seminar Mathematics			10-M-SEM2-152-m01	
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS		od of grading	Only after succ. con			
4	(not) s	successfully completed				
Duratio	n	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Contents						
A selec	ted top	ic in mathematics.				
Intende	ed lear	ning outcomes				
of a giv	en topi				sters elaboration and structuring /She is able to participate active-	
Course	<b>s</b> (type	, number of weekly conta	ct hours, language –	- if other than Germa	n)	
S (2)						
talk (60	o to 120 ge of a	on on whether module ca o minutes) ssessment: German and, <b>places</b>				
Additio	nal inf	ormation				
Worklo	ad					
120 h						
Teachi	ng cycl	e				
Referre	d to in	LPOI (examination regu	lations for teaching-	degree programmes)		
Module	e appea	urs in				
Bachelor's degree (1 major) Mathematics (2015)						
	Bachelor's degree (1 major) Mathematical Physics (2015)					
	Bachelor's degree (1 major) Computational Mathematics (2015)					
	Bachelor's degree (1 major) Mathematical Physics (2016)					
		gree (1 major) Mathemati	•			
		gree (1 major) Mathemati		22)		
		gree (1 major) Mathemati	-			
Bachel	or's de	gree (1 major) Mathemati	cal Physics (2024)			

Module	Module title Abbreviation					
Stocha	stics 1				10-M-ST01-222-m01	
Module	e coord	inator		Module offered by	<u> </u>	
		es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS Method of grading Only after succ. compl. of module(s)						
10 numerical grade						
Duration Module level Other prerequisites						
1 seme	ster	undergraduate				
Contents						
chastic varianc	indepe e, limit		ditional probability,	characteristics of dis	ction, product measures and sto- stributions: expected value and	
		acquainted with fundan lems and knows about th			ics, applies these methods to	
Course	<b>s</b> (type	, number of weekly conta	act hours, language –	· if other than Germa	ın)	
V (4) +	Ü (2)		_			
		s <b>essment</b> (type, scope, la on on whether module c			tion offered — if not every seme-	
b) oral c) oral Langua	examir examin	nination (approx. 90 to 1 ation of one candidate e ation in groups (groups o ssessment: German and bonus	each (15 to 30 minutes of 2, 10 to 15 minutes	s) or		
Allocat	ion of p	olaces				
Additio	onal inf	ormation				
Worklo	ad					
300 h	300 h					
Teaching cycle						
Referre	<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)					
Module	e appea	irs in				
	Module appears in Bachelor's degree (1 major) Mathematical Data Science (2022)					

Module title					Abbreviation	
					10-M-STO2-222-m01	
Module coordinator				Module offered by		
Dean o	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
ECTS		od of grading	Only after succ. com	pl. of module(s)		
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 seme		undergraduate				
Conten	ts					
Elemen	ts of da	ata analysis, statistics of	data in normal and o	ther distributions, e	lements of multivariate statistics.	
Intende	ed learr	ning outcomes				
		acquainted with fundam and knows about the typ			, applies these methods to prac-	
Course	<b>s</b> (type,	, number of weekly conta	ct hours, language —	· if other than Germa	n)	
V (4) +	Ü (2)					
		e <b>ssment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-	
b) oral c) oral (	examin examin ge of a	nination (approx. 90 to 1 ation of one candidate e ation in groups (groups c ssessment: German and/ bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or		
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teaching cycle						
-						
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
Module	appea	rs in				
		gree (1 major) Mathemati	cal Data Science (20:	22)		
	exchange program Mathematics (2023)					

Module title					Abbreviation		
Introduction to Topology					10-M-TOP-222-m01		
Module coordinator				Module offered by			
Dean of	f Studie	es Mathematik (Mathema	atics)	Institute of Mathem	atics		
ECTS		od of grading	Only after succ. com	pl. of module(s)			
5 numerical grade							
Duratio		Module level	Other prerequisites				
1 seme		undergraduate					
Conten							
les and compa	constr ctness,	uctions of topological sp	aces, quotients, conv	vergence of sequence	properties, connectivity, examp- es and nets, different notions of aß, Arzela-Ascoli and Baire, and		
Intende	ed learr	ning outcomes					
is able	to appl		gebra and analysis to		as the pertinent proof methods, ses the broad applicability of the		
Course	<b>s</b> (type,	number of weekly conta	ct hours, language —	if other than Germa	n)		
V (2) +	Ü (2)						
		<b>essment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-		
b) oral c) oral e Langua	examin examin ge of a ment o	nination (approx. 90 to 1 ation of one candidate e ation in groups (groups c ssessment: German and/ ffered: In the semester in bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes ⁄or English	5) or per candidate)	ıbsequent semester		
Allocat	ion of p	olaces					
Additio	nal info	ormation					
Worklo	ad						
150 h							
Teaching cycle							
Referre	<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
Module	e appea	rs in					
	-	gree (1 major) Mathemati gram Mathematics (2023)		22)			

Module	title			Abbreviation		
Exercis	e tutor or proof-reading in Ma	10-M-TuKo-152-mo	L			
	coordinator		Module offered by			
Dean of Studies Mathematik (Mathematics)			Institute of Mathem	natics		
ECTS	Method of grading	Only after succ. con	npl. of module(s)			
5	(not) successfully completed					
Duratio		Other prerequisites				
1 seme	1 semester undergraduate					
Conten	Contents					
	g or grading homework for one pervision of the respective lect			eaching degree prog	rammes un-	
Intende	ed learning outcomes					
The stu	dent is able to support the ac es in mathematical proof exer			edge. He/She helps	to identify	
	<b>s</b> (type, number of weekly con	•		un)		
	(type, number of weekly con	anguage –		<i>)</i>		
T (o)		1 10 11 1				
ster, in	<b>d of assessment</b> (type, scope, formation on whether module	can be chosen to earn	a bonus)			
	ment of tutoring activities or c nits or approx. 5 pieces of cor		rvising lecturers or e	exercise supervisors	(1 to 2 tea-	
Allocat	ion of places					
Additio	nal information					
	direct application to teaching		icc. ho/showill colo	ct participants		
			ics, ite/site witt sete	et participants.		
Worklo	a0					
150 h						
Teachir	ng cycle					
Referre	d to in LPO I (examination reg	gulations for teaching-o	degree programmes)			
§ 22	Nr. 3 f)					
Module	appears in					
	or's degree (1 major) Mathema	atics (2015)				
	or's degree (1 major) Economa					
	or's degree (1 major) Mathema					
	or's degree (1 major) Computa	,	015)			
	ate examination for the teachi					
Bachel	or's degree (1 major) Mathema	atical Physics (2016)				
Bachelor's degree (1 major) Economathematics (2017)						
First state examination for the teaching degree Gymnasium Mathematics (2019)						
Bachelor's degree (1 major) Mathematical Physics (2020)						
Bachelor's degree (1 major) Economathematics (2021)						
	Bachelor's degree (1 major) Economathematics (2022)					
	Bachelor's degree (1 major) Mathematical Data Science (2022)					
	ge program Mathematics (202	-	Mathematics			
	ate examination for the teachi		iniatnematics (2023)			
	or's degree (1 major) Mathema or's degree (1 major) Economa					
	with 1 major Mathematical Data Science		anaratad to Arrana	rog data ro	nogo == / 0 :	
Bachelor's ( (2022)	with Emajor Mathematical Data Science		enerated 19-Apr-2025 • exam o ECTS) Mathematical Data S	-	page 79 / 84	



Bachelor's degree (1 major) Mathematical Physics (2024) Bachelor's degree (1 major) Economathematics (2024) Bachelor's degree (1 major) Economathematics (2025)

Module title					Abbreviation	
Advanced Analysis					10-M-VAN-222-m01	
Module coordinator				Module offered by		
Dean of	fStudie	es Mathematik (Mathema	atics)	Institute of Mathem	atics	
ECTS		od of grading	Only after succ. com	pl. of module(s)		
10	nume	rical grade				
Duratio	n	Module level	Other prerequisites			
1 semes	ster	undergraduate				
Conten	Contents					
Continu rems.	ation o	of analysis in several vari	ables; Lebesgue mea	isure and Lebesgue i	integral in R^n, integral theo-	
Intende	ed learn	ning outcomes				
		acquainted with advanc understand the construct			of the Lesbegue integral, he or	
Courses	<b>s</b> (type,	number of weekly conta	ct hours, language —	if other than Germa	n)	
V (4) + l	Ü (2)					
		essment (type, scope, la on on whether module ca			tion offered — if not every seme-	
b) oral e c) oral e	examin examin ge of a	nination (approx. 90 to 1 ation of one candidate e ation in groups (groups c ssessment: German and/ bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or		
Allocati	ion of p	olaces				
Additio	nal info	ormation				
Worklo	ad					
300 h						
Teaching cycle						
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
Module appears in						
exchan; Master'	Module appears in Bachelor's degree (1 major) Mathematical Data Science (2022) exchange program Mathematics (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)					

	e title				Abbreviation		
E-Learning and Blended Learning Mathematics 1					10-M-VHB1-152-m01		
Modul	<u></u>	instor		Module offered by			
Module coordinator				Module offered by			
Dean of Studies Mathematik (Mathematics)			1	Institute of Mathen	natics		
			Only after succ. con	npl. of module(s)			
2		r i					
			Other prerequisites				
1 seme		undergraduate					
Contents							
Becom	ing fan	niliar with and reflecting t	techniques in e-learn	ing and blended lea	rning in mathematics.		
Intend	ed lear	ning outcomes					
The stu	udent is	able to employ basic me	ethods of e-learning a	and blended learning	g in mathematics-		
		, number of weekly conta			-		
Ü (2)		, namber of weekly conte			<i>,</i>		
• •	e type: e	eLearning, mostly Virtuell	le Hochschule Baver	ı (vhb)			
			-		ation offered — if not every seme-		
		ion on whether module c					
project	t (web-l	based, 15 to 20 hours)					
		offered: Once a year, wint	er semester				
Allocat	tion of	places					
Additic	onal inf	ormation					
Auuiin		ormation					
Worklo							
			-				
		60 h					
Teaching cycle							
reduill	ng cycl	e					
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		e LPOI (examination regu	lations for teaching-	degree programmes)	)		
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 Referre  Module	ed to in e appea	LPOI (examination regu		degree programmes)	)		
 Referre  Module Bachel	<b>ed to in</b> <b>e appea</b> lor's de	LPOI (examination regu ars in gree (1 major) Mathemat	ics (2015)	degree programmes)	).		
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Modul	e title				Abbreviation	
E-Lear	ning an	d Blended Learning Math	nematics 2		10-M-VHB2-152-m01	
Modul	e coord	inator		Module offered by		
			atian)			
	1	es Mathematik (Mathema		Institute of Mathem	Tatics	
ECTS     Method of grading     Only after su       2     (not) successfully completed			Only after succ. com	ipt. of module(s)		
	<u> </u>	, ,				
Durati		Module level	Other prerequisites			
1 seme		undergraduate				
Conter	nts					
Becoming familiar with and reflecting techniques in e-learning and blended learning in mathematics.						
Intend	ed lear	ning outcomes				
The stu	udent is	able to employ advance	d methods of e-learni	ing and blended lea	rning in mathematics-	
		, number of weekly conta		-		
Ü (2)					,	
• •	e type: e	Learning, mostly Virtuell	e Hochschule Bavern	(vhb)		
		- •	· · · ·		tion offered — if not every seme-	
		ion on whether module c			alion offered — if not every selle	
project	t (web-ł	based, 15 to 20 hours)				
Assess	sment o	ffered: Once a year, sum	mer semester			
Allocat	tion of	olaces				
Additi	onal inf	ormation				
Auuitio		Unination				
 Worklo	ad					
60 h	Jau					
	ing cycl	e				
Deferr	ad to in	LPOI (examination regu	lations for tooshing s			
		LFUT (examination regu		legree programmes)		
	e appea					
		gree (1 major) Mathemati	-			
		gree (1 major) Economath				
		gree (1 major) Mathemati		,		
		gree (1 major) Computati		015)		
		gree (1 major) Mathemati	•			
		gree (1 major) Economath				
	Bachelor's degree (1 major) Mathematical Physics (2020)					
Bachelor's degree (1 major) Economathematics (2021) Bachelor's degree (1 major) Economathematics (2022)						
		gree (1 major) Mathemati gram Mathematics (2023		< <i>Z</i> )		
		gree (1 major) Mathemati				
		gree (1 major) Mathemati gree (1 major) Economati	-			
		gree (1 major) Economati gree (1 major) Mathemati				
		gree (1 major) Mathemati gree (1 major) Economati	•			
		gree (1 major) Economati gree (1 major) Economati				
Ducito			10110012023			

Module title					Abbreviation	
Introduction to Number Theory					10-M-ZTH-222-m01	
Module	e coord	inator		Module offered by		
Dean o	f Studi	es Mathematik (Mathema	atics)	Institute of Mathem	natics	
ECTS		od of grading	Only after succ. com	pl. of module(s)		
10	nume	rical grade				
Duratio	on	Module level	Other prerequisites			
1 seme	ster	undergraduate				
Conten	ts					
tests ai	nd met		ucture of the residue	class rings, theory o	ation, modular arithmetics, prime of quadratic remainder, quadratic	
Intende	ed lear	ning outcomes				
		acquainted with the fun methods and proof tech			per theory. He/she is able to em-	
Course	<b>s</b> (type	, number of weekly conta	ct hours, language —	if other than Germa	n)	
V (4) +	Ü (2)					
		<b>sessment</b> (type, scope, la on on whether module ca			tion offered — if not every seme-	
b) oral c) oral	examir examin Ige of a	mination (approx. 90 to 1 nation of one candidate e ation in groups (groups c ssessment: German and, bonus	ach (15 to 30 minutes of 2, 10 to 15 minutes	s) or		
Allocat	ion of p	olaces				
Additio	nal inf	ormation				
Worklo	ad					
300 h						
Teaching cycle						
<b>Referred to in LPO I</b> (examination regulations for teaching-degree programmes)						
Module appears in						
	Bachelor's degree (1 major) Mathematical Data Science (2022)					
	exchange program Mathematics (2023)					
5.1011011						