

Additional Certificates for Specialisation

To obtain a certificate of specialisation either in Geomathematics/Resource Sciences or in Mathematical Data Science the student is required to obtain at least 47 CPs from the elective modules of either of the following lists.

Specialization “Mathematical Data Science”

Module	CP
Algorithmic and Structural Graph Theory	9
Algorithmic Geometry	6
Algorithmic Topology	6
Algorithms	6
Applied Machine Learning for Geoscience	5
Applied Statistics	6
Current Topics in Stochastics	6
Data Analysis Project	4
Data-driven Forecasting under Uncertainty	6
Geometry and Topology	6
Introduction to Bayesian Data Analysis	4
Introduction to High Performance Computing and Optimization	4
Introduction to Machine Learning and Big Data	6
Mathematical Image Processing	6
Mathematics of Crystallographic Texture Analysis	5
Mathematics of Ethics	5
Methods in Machine Learning	6
Methods of Applied Algebra	6
Numerical Methods for Nonlinear Optimization and Nonlinear Systems	9
Parallel Computing	6
Random Graphs	5
Statistical Analysis of Systems	6
Stochastic Processes	6
Stochastic Programming	6
Topological Data Analysis	6
Vector Optimization	6
Wavelets	6
Total (27 modules)	158

Specialization “Geomathematics”

Module	CP
Advanced Theory of Potential Fields	4
Applied Geomodelling	4
Applied Machine Learning for Geoscience	5
Basics in Partial Differential Equations	4
Climate Change	5
Continuum Multiphysics in the Geosciences	4
Current Topics in Numerical Analysis I	6
Current Topics in Numerical Analysis II	6
Differential Geometry	5
Finite Element Methods (FEM) for Mathematicians	9
Fourier Analysis	5
Global Analysis	5
Introduction to Scientific Programming	4
Inverse Problems	5
Inverse Problems in Geophysics	6
Mathematics of Crystallographic Texture Analysis	5
Modelling and Simulation	9
Numerical Methods for Initial Value Problems	9
Numerical Simulation Methods in Geophysics	6
Parallel Computing	6
Scientific Computing Project	6
Selected Topics in Applied Operator Theory	5
Selected Topics in Partial Differential Equations	5
Theory of Electromagnetic Methods	4
Theory of Potential Methods	4
Vector Optimization	6
Total (26 modules)	142

These lists can be updated by the study commission if required.

Sample study plans for specialisations (starting in winter term)

NOTE: These sample plans are not mandatory (except for the compulsory courses)!

“Geomathematics”

Module	1st sem. L/E/S/P	2nd sem. L/E/S/P	3rd sem. L/E/S/P	4th sem. L/E/S/P	CP
Compulsory modules					
Seminar Mathematical Fundamentals for Data and Resource Science	0/0/3/0				5
German A1/ 1st Semester ¹	0/4/0/0				4
Statistical Foundations of Data Science	2/1/0/0				5
Geomodelling – Geostatistics for Natural Resource Modelling		2/2/0/0			5
German A1/ 2nd Semester ¹		0/4/0/0			4
Mathematics of Machine Learning		3/1/0/0			6
Seminar Mathematics for Data and Resource Sciences			0/0/2/0		6
Master Thesis (Mathematics for Data and Resource Sciences)			x	x	30
Compulsory elective modules					
Modules totalling 55 credit points are to be chosen from the elective catalogues Mathematical Elective Modules, Minor Subjects and Free Elective Module. Of these, modules totalling at least 37 credit points must be chosen from the catalogue Mathematical Elective Modules and modules totalling at least 4 credit points from the catalogue Minor Subjects. In addition, at most 6 credit points may be covered by free elective modules.					
Compulsory elective modules: Mathematical Elective Modules					
Basics in Partial Differential Equations	2/1/0/0				4
Introduction to Scientific Programming	2/2/0/0				4
Modeling and Simulation (even years only)	4/2/0/0				9
Numerical Methods for Initial Value Problems (odd years only)					
Selected Topics in Partial Differential Equations		2/1/0/0			5
Introduction to Bayesian Data Analysis		1/1/0/0			4
Inverse Problems			2/1/0/0		5
Scientific Computing Project			0/0/3/0		6
Compulsory elective modules: Minor Subjects					
Inverse Problems in Geophysics		2/2/0/0			6
Climate Change			2/2/0/0		5
Applied Machine Learning for Geoscience				2/1/0/0	5
Theory of Electromagnetic Methods				2/1/0/0	4
Credit points per semester	31	31	31	29	122

L/E/S/P = lectures/exercises/seminars/practical courses in contact hours per week (SWS).

¹ Students with advanced knowledge of German take one of the continuing two-semester German courses “German A2”, “German B1” or “German B2” offered by the International University Centre of TU Bergakademie Freiberg instead of the modules “German A1/ 1st Semester” and “German A1/ 2nd Semester”. Students whose native language is German or who have a German language level of at least B2 take other language modules of the International University Centre or modules from the elective catalogue “A. Mathematical Elective Modules” totalling at least 8 CP instead of the modules “German A1/ 1st Semester” and “German A1/ 2nd Semester”.

NOTE: These sample plans are not mandatory (except for the compulsory courses)!

“Mathematical Data Science”

Module	1st sem. L/E/S/P	2nd sem. L/E/S/P	3rd sem. L/E/S/P	4th sem. L/E/S/P	CP
Compulsory modules					
Seminar Mathematical Fundamentals for Data and Resource Science	0/0/3/0				5
German A1/ 1st Semester ¹	0/4/0/0				4
Statistical Foundations of Data Science	2/1/0/0				5
Geomodelling – Geostatistics for Natural Resource Modelling		2/2/0/0			5
German A1/ 2nd Semester ¹		0/4/0/0			4
Mathematics of Machine Learning		3/1/0/0			6
Seminar Mathematics for Data and Resource Sciences			0/0/2/0		6
Master Thesis (Mathematics for Data and Resource Sciences)			x	x	30
Compulsory elective modules					
Modules totalling 55 credit points are to be chosen from the elective catalogues Mathematical Elective Modules, Minor Subjects and Free Elective Module. Of these, modules totalling at least 37 credit points must be chosen from the catalogue Mathematical Elective Modules and modules totalling at least 4 credit points from the catalogue Minor Subjects. In addition, at most 6 credit points may be covered by free elective modules.					
Compulsory elective modules: Mathematical Elective Modules					
Mathematics of Crystallographic Texture Analysis	2/1/0/0				5
Introduction to High Performance Computing and Optimization	2/1/0/0				4
Methods in Machine Learning	3/1/0/0				6
Algorithms		2/2/0/0			6
Introduction to Bayesian Data Analysis		1/1/0/0			4
Applied Statistics			2/2/0/0		6
Data Analysis Project			0/0/1/0 + 1 SWS project Work		4
Mathematical Image Processing (in odd years)				3/1/0/0	6
Data-driven Forecasting under Uncertainty (in even years)				2/2/0/0	
Compulsory elective modules: Minor Subjects					
Introduction to Machine Learning and Big Data		2/2/0/0			6
Applied Geomodelleing			1/2/0/0		4
Applied Machine Learning for Geoscience				2/1/0/0	5
Credit points per semester	29	31	30	31	121

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