### Numerical Methods and Stochastics

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<th>Module-No./Abbreviation</th>
<th>Credits</th>
<th>Workload</th>
<th>Term</th>
<th>Frequency</th>
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<tr>
<td>CE-WP08/NMS</td>
<td>6 CP</td>
<td>180 h</td>
<td>2(^{nd}) Sem.</td>
<td>Summer term</td>
<td>1 Semester</td>
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#### Courses
- Numerical Methods and Stochastics

#### Contact hours
- Contact hours: 4 SWS (60 h)
- Self-Study: 120 h
- Group Size: No Restrictions

#### Prerequisites
Basic knowledge of: partial differential equations, numerical methods and stochastics

#### Learning goals / Competences
Students should become familiar with modern numerical and stochastic methods

After successfully completing the module, the students
- should be able to formulate and analyze data from a probabilistic perspective,
- should understand the theoretical aspects of FEM and FVM methods,
- should be familiar with modern iterative solvers for large systems of linear equations and their necessity for numerical PDE solving,
- should be familiar with standard methods for solving optimization problems.

#### Content
**Numerical Methods:**
- Boundary value problems for ordinary differential equations (shooting, difference and finite element methods)
- Finite element methods (brief retrospection as a basis for further material)
- Efficient solvers (preconditioned conjugate gradient and multigrid algorithms)
- Finite volume methods (systems in divergence form, discretization, relation to finite element methods)
- Nonlinear optimization (gradient-type methods, derivative-free methods, simulated annealing)

**Stochastics:**
- Fundamental concepts of probability and statistics, such as random variables, univariate distributions & densities, descriptive statistics, parameter estimation, & law of large numbers
- Regression, such as univariate and multivariate linear regression, least-squares estimation, data transformations, qualitative predictors, and regularization
- Exploratory data analysis, such as qq-plots and summary statistics

#### Teaching Methods / Language
- Lectures (3h / week), Exercises (1h / week) / English

#### Mode of assessment
- Written examination (180 min, 100%)

#### Requirement for the award of credit points
- Passed final module examination

#### Module applicability
- MSc. Computational Engineering, MSc. Bauingenieurwesen

#### Weight of the mark for the final score
- 6 %

#### Module coordinator and lecturer(s)
- Prof. Dr. M. Weimar, Prof. Dr. J. Lederer, Assistants

#### Further information