Course content

The course introduces the fundamental tools and processes of mathematical modeling, focusing on translating real-world problems into mathematical frameworks and interpreting the results back into practical contexts.

The following topics are covered in the course:

1. Introduction to Mathematical Modeling: Understanding the principles of constructing mathematical models and the transition between reality and mathematics.
2. Differential Equations: Applying differential equations to describe dynamic systems in various fields.
3. Stochastic Simulations: Exploring randomness and probability in simulations for real-world problems.
4. Agent-Based Modeling: Developing computational models to simulate interactions within complex systems.
5. Applications of Modeling: Using case studies from epidemiology, economics, biology, and sociology to illustrate the impact of mathematical models on decision-making.
6. Programming and Tools: Implementing mathematical models using tools such as Maple or Python, and documenting results in project reports.

Course objectives

Knowledge

1. Understand the three-phase process of mathematical modeling: problem formulation, mathematical solution, and real-world interpretation.
2. Gain familiarity with mathematical tools, including differential equations, simulations, and data analysis techniques.
3. Learn to document and communicate findings through project reports and programming implementations.

Skills

1. Translate real-world problems into mathematical frameworks and solve them effectively.
2. Apply modeling techniques to analyze and interpret data from real-world scenarios.
3. Identify assumptions and limitations within mathematical models.
4. Utilize computational tools for model implementation and validation.

Competencies

1. Construct and analyze mathematical models tailored to specific real-world contexts.
2. Evaluate the applicability and limitations of models in decision-making processes.
3. Collaborate effectively in teams to address complex modeling challenges.
4. Present results and insights through written reports and discussions with diverse professional audiences.