Universiteit Leiden
Leiden University College The Hague

LUC Mathematics courses

Liberal Arts and Sciences: Global Challenges

Admission 2024

Description of Mathematics courses offered at LUC

At LUC there are two mathematics courses offered: Mathematical Reasoning and Mathematical Modeling.

The Mathematical Reasoning course at LUC focuses more on computations than the theory behind the mathematics. Those who do not intend to take additional mathematics courses at LUC are encouraged to take Mathematical Reasoning.

The Mathematical Modeling course at LUC requires more mathematical proficiency and focuses on both the theory behind the mathematics as well as computations, as well as in general moving at a faster pace. Those who intend to take additional mathematics courses at LUC are encouraged to take Mathematical Modelling, as well as those who will use mathematics in other courses as part of their major.

Mathematical Reasoning

Students are assumed to have a basic familiarity with polynomials, as well as in manipulating equations to isolate a variable. Those who do not feel comfortable with these topics are advised to review these subjects before the first lecture.

This course begins with a review and introduction of the mathematical foundations needed later in the course, including functions such as the exponential and logarithmic function, and trigonometric functions. The latter half of the course is devoted to studying rates of change and optimisation problems, and serves as an introduction to differential calculus. At all points throughout the course, examples will be drawn from areas such as physics, economics, biology, chemistry, population dynamics, and the environmental sciences.

After successful completion of this course, students will be able to:

- Compute the derivatives of advanced functions and interpret the derivative as a rate of change.
- Solve optimization problems where a maximal / minimal answer is desired subject to constraints.
- Work with derivatives in the context of real-world scenarios, drawn from economics, the physical sciences, and population dynamics.

After successful completion of this course, students will know and understand:

- How to work with basic functions, including polynomials, trigonometric functions, exponential functions, and compositions of these functions with one another.
- The meaning of the derivative of a function both as the slope of a tangent line, and as rate of change of some phenomenon.
- The relevance and ubiquity of differential calculus in numerous fields, such as in marginal cost in economics, the relationship between distance, velocity, and acceleration in physics, and in regression models used everywhere in machine learning.

Mathematical Modeling

Students are assumed to be familiar with polynomials, trigonometric functions, exponential functions, and logarithms. No prior knowledge of calculus is assumed. A review document will be available on before the beginning of the first lecture.

This course begins with a look at the notion of continuity of functions and limits of functions, which is used as a jumping-off point for the study of differential calculus. We will examine what it means to be differentiable, the rules of differentiation, and how differential calculus is used in optimisation problems.

The latter half of the course covers integral calculus, where a variety of techniques will be introduced so as to solve integrals. Finally, there will be some lectures devoted to both multivariate calculus, and linear differential equations. Problems will be focused on connecting calculus with real modelling problems that arise in areas such as economics and the physical sciences.

After successful completion of this course, students will be able to:

- Compute the derivatives and definite/indefinite integrals of numerous functions, as well as provide interpretations for these in various real-world contexts.
- Find a mathematical model for optimization problems and problems involving the calculation of areas/volumes of objects, and then find the optimal solution.
- Solve elementary linear differential equations.

After successful completion of this course, students will know and understand:

- The notions of continuity, limits of functions, differentiability, and the Riemann integral.
- The intimate connection between differential and integral calculus through the Fundamental Theorems of calculus.
- The relevance of calculus in advanced topics in areas as economics and business, environmental sciences, physics, and machine learning.