Laurea / B.A.
in Global Governance

Academic Year 2022-2023
Syllabus
Calculus
CFU 12
Proff. Alessio Porretta and Alfonso Sorrentino

Course Description

One of the things we learned from the 20th century is that complex phenomena arising from social and life sciences cannot be deeply analyzed and understood unless we make use of the universal language of mathematics. This goes back to Galileo's intuition that universe be written in mathematical symbols, a principle nowadays applied to human sciences as well as to natural ones. The purpose of this course is to introduce students to those basic notions in mathematics which are essential to describe, understand and analyze possibly different models of quantitative phenomena. Main concepts and tools of differential and integral calculus are taught in order that students become familiar with functions of real variables, notions of growth, limits, rate of change, optimization, time evolution, all of them being necessary to approach mathematical models in applied sciences as well as to pursue further studies in probability and statistics. Students are expected to learn the main concepts, to practice with basic tools of calculus and to understand the use of mathematical language in applied models of real life.

Teaching Method

The course is essentially taught in the traditional way through classroom lectures, where theory and practice become intrinsically linked. Additional tutorials will be devoted to extra practice, based on exercises from the used textbook as well as from previous exams.

Schedule of Topics

Topic 1	Real numbers, elementary functions and graphs
Topic 2	Sequences and limits
Topic 3	Recurrence, discrete time models: exponentials and logarithms, log scales
Topic 4	Derivatives: rules and applications, rate of change in applied models
Topic 5	Optimization: maxima and minima, convexity, curve sketching
Topic 6	Integration: areas, antiderivatives, Fundamental Theorem of Calculus
Topic 7	Differential equations and growth models: equilibrium points, stability
Topic 8	Multivariable calculus: partial derivatives, optimization.

Textbook and Materials

Laurence D. Hoffmann, Gerald L. Bradley, Dave Sobecki, Michael Price: *Applied Calculus for Business, Economics, and the Social and Life Sciences, Expanded Edition,* ed. Mc Graw-Hill, 2012-2013.

Further readings:
1. Notes given by the teacher on differential equations
(available at http://axp.mat.uniroma2.it/~porretta/notes-porretta2.pdf)
2. Not mandatory - Claudia Neheauser: Calculus for biology and medicine, 3rd ed. Pearson International, 2011.
(especially devoted to models in biology and life sciences, it may complement the main textbook on topics like discrete and continuous time growth models, differential equations)

Pre-requisites: Students are required to have adequate knowledge and practice of the mathematics which is taught in standard high school programs in Italy. This includes, in particular: elementary rules of computation involving numbers, fractions and polynomials, representation of points in the plane through

Cartesian coordinates, basic notions concerning lines and parabolas and their representation in the plane, methods of resolution of first and second order equations and inequations, definition and basic properties of logarithms, exponentials and trigonometric functions. All the arguments in the above list are included among the topics of the math Pre-courses so that all students can go through a quick review of those notions while attending the Pre-courses. However, a quick review may be not enough for all students who have a weak - or even very weak - background in mathematics. In this case, students are strongly encouraged to work hard even before the beginning of Pre-courses in order to catch up with the ordinary Italian school level. Any school textbook can be used for reviewing the above mentioned topics.

Assessment
The exam consists of written examinations. All written examinations require students to solve exercises through a detailed written explanation containing all the necessary steps and computations.
Two mid-term examinations are given, roughly corresponding to Topics 1-5 and 6-7 respectively, although variations could happen according to the up-to-date program of lessons. Each mid-term examination may count up to 30% of the final grade, provided the exam is passed in the winter session.
At the end of the lecture period, a final written examination on topics 1 to 8 is given and is worth at least 40% if the exam is passed in the winter session. Attendance to the final examination is compulsory in order to pass the exam.
Students who fail or do not attend mid-term examinations or non-attending students have the opportunity to give the final examination where they may be required to solve additional exercises. Students who fail or reject the grade of the final examination will need to give a new complete examination in different exam dates of the year and forego their previous mid-term results. Students who do not attend the first final examination can redo it without forgoing the mid-results in the second exam of the winter session. Students who retake the exam in the September session have to forego any result of the Winter session and do a new complete examination.

Office hours
By appointment.

E-mail
porretta@mat.uniroma2.it

NOTE: If you are an Erasmus or a non Global Governance student who would like to attend one or more courses in the Global Governance programme, please be aware that, **before enrolling in the course**, you should have read the code of conduct and the procedural rules characterizing our programme. We assume that, if you enroll in the course, **you have read and accepted all Global Governance values and rules**. Notice that attendance is required from the very first lesson and you need to attend at least 80% of the course to be considered an attending student.