



## DEPARTMENT OF MATHEMATICAL SCIENCES

### **MMA712 Financial Derivatives and Partial Differential Equations, 7.5 credits**

Finansiella derivat och partiella differentialekvationer, 7,5 högskolepoäng  
*Second Cycle*

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#### **Confirmation**

This course syllabus was confirmed by Department of Mathematical Sciences on 2022-11-29 and was last revised on 2023-01-16 to be valid from 2023-01-16, spring semester of 2023.

*Field of education:* Science 100%

*Department:* Department of Mathematical Sciences

#### **Position in the educational system**

The course can be part of the following programme: 1) Mathematical Sciences, Master's Programme (N2MAT)

*Main field of studies*

Mathematics

*Specialization*

A1F, Second cycle, has second-cycle course/s as entry requirements

#### **Entry requirements**

General entry requirements and the equivalent of the course *MMG810 Options and Mathematics* or in all 90 higher education credits in Mathematics and Mathematical statistics.

#### **Learning outcomes**

On successful completion of the course the student will be able to:

- master applications of martingale methods to option pricing,
- explain risk-neutral pricing and market completeness,
- derive the differential equation for the price of European derivatives when the underlying stock has stochastic volatility,

- calibrate simple interest rate models,
- compute numerically the price of European and American options.

### **Course content**

Concepts from stochastic calculus reviewed in the course: Brownian motion, Ito's calculus, stochastic differential equations. Change of measure, Girsanov theorem.

Topics in financial derivatives pricing theory include: Self-financing portfolio strategies and arbitrage. Black-Scholes' model. Stochastic volatility models and interest rate models. Asian options. Forwards and futures contracts. Financial derivatives depending on multiple stocks.

Connection with partial differential equations: Parabolic and hypoelliptic PDEs for option prices. Initial and boundary value problems. Numerical computation of option prices by finite difference and finite element methods.

### **Form of teaching**

*Language of instruction:* English

### **Assessment**

The examination consists of assignments (of which some require the use of Matlab or Python) and a written exam. During the course, there may be optional assignments that give bonus points on the exam. Examples of such assignments are small written tests, labs, and oral or written presentations. Information about this is found on the course home page.

If a student, who has failed the same examined component twice, wishes to change examiner before the next examination, a written application shall be sent to the department responsible for the course and shall be granted unless there are special reasons to the contrary (Chapter 6, Section 22 of Higher Education Ordinance).

### **Grades**

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).

### **Course evaluation**

The course is evaluated with an anonymous questionnaire and/or a discussion with the student representatives. The results of and possible changes to the course will be shared with students who participated in the evaluation and students who are starting the course.

### **Additional information**

The course *MMA712 Financial Derivatives and Partial Differential Equations* largely overlaps the content of the courses *MMA711 Financial Derivatives and Partial Differential Equations* and *MMA710 Financial Derivatives and Stochastic Analysis*. It is not allowed to be registered and/or examined in more than one of these courses.

For a list of course literature, see:

<https://www.chalmers.se/sv/institutioner/math/utbildning/grundutbildning-goteborgs-universitet/kurslitteratur/Sidor/Kurslitteratur-i-matematik.aspx>