Università degli Studi di L'Aquila - Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica

Course catalogue

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Programme of Course "Stochastic models and applications"

- Code: DT0133
- Type of course unit: Elective (Master Degree in Mathematics curriculum Generale)
- Level of course unit: Postgraduate Degrees
- Semester: 1

Number of ects credits: (Master Degree in Mathematics) 6 (workload 150 hours)

Teachers: Fabio Antonelli (fabio.antonelli@univaq.it)

1	**Course objectives**	Students should acquire a good knowledge of advanced probabilistic tools employed in the modeling of financial markets. In particular they should become able to - learn and understand the first mathematical models involving stochastic calculus techniques; - solve derivatives evaluation problems of medium difficulty; - extend the studied notions to more complex models; - read an advanced text in financial modeling; - implement computations for the studied models.
2	**Course content and learning outcomes (dublin descriptors)**	Topics of the module include: • Complements of stochastic calculus. The martingale representation theorem, Girsanov theorem, existence and uniqueness of the solutions of stochastic differential equations, quadratic variation. • Discrete market models. First and second fundamental theorem of asset pricing. Evaluation of European and American derivatives. • Black and Scholes world. European options evaluation, Barrier options, American options, (perpetual puts and critical price). Option evaluation for a general diffusion model: the infinitesimal generator of a diffusion, computation of expectations and partial differential equations The multidimensional model: viability and completeness. Asian options and exchange options. • Bonds and interst rate models. Zero coupon bonds. Merton model, Vasicek model, Cox Ingersoll Ross model. • If there is enough time. Weak solutions of stochastic differential equations. weak solutions via Girsanov. Yamada and Watanabe's results. The unidimensional case. • If there is enough time. Stochastic volatility models. Stein and Stein, Hull and White, Heston models On successful completion of this module, the student should : • Students shuould acquire a good knowledge of advanced probabilistic tools employed in the modeling of financial markets. • students should become able to • learn and understand the first mathematical models involving stochastic calculus techniques; • solve derivatives evaluation problems of medium difficulty; • students should become able to • solve derivatives evaluation problems of medium difficulty; • extend the studied notions to more complex models; • Students should become able to expose the main points of financial modeling to an audience of experts and non experts. • students should become able to • read an advanced text in financial modeling; • implement computations for the studied models.
3	**Course prerequisites**	An advanced course in probability and the first part of the integrated course
4	**Teaching methodsand language**	lectures **Language**: English **Reference textbooks** • I. Karatzas, S. Shreve, ***Brownian motion and stochastic calculus***. Springer. • A. Pascucci, ***Calcolo Stocastico per la Finanza***. Springer.

		• D. Lamberton, D. Lapeyre, ***Introduction to stochastic calculus applied to Finance***. Chapman and Ha. • J. Zhu, ***Modular pricing of options (Lecture notes in Economics and Mathematical Systems)***. Springer. (vol. 493) • P.E. Kloeden, E. Platen, ***Numerical Solution of Stochastic Differential Equations***. Springer. • P. Billingsley, ***Probability and measure***. Wiley . 1984.
5	**Assessment methods**	oral exam with possible integrations either written or oral