



Programme of Module "Financial Data Analytics and Investment Data Driven Decisions II"

- Code: DT0322
- Type of course unit: Elective (Bachelor Degree in Computer Science curriculum General), Elective (Master Degree in Computer Science curriculum NEDAS), Elective (Master Degree in Computer Science curriculum SEAS)
- Level of course unit: Undergraduate Degrees, Postgraduate Degrees
- Semester: 2

Number of ects credits: (Bachelor Degree in Computer Science) 3 (workload 75 hours), (Master Degree in Computer Science) 3 (workload 75 hours)

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1	Course objectives	The students quantitative and programming capabilities are applied to normative asset pricing and positive portfolio selection modelling.
2	Course content and learning outcomes (dublin descriptors)	<p>Topics of the module include:</p> <ul style="list-style-type: none"> • Asset pricing, portfolio selection and data analytics: from positive economics modelling to normative approaches. asset management issues and algorithmic solutions. • portfolio selection in practice. case studies to recast optimized portfolios dealt with in the first part of the course: a) constraints used in practice: a.1) no short selling positions; a.2) holding positions; a.2) turnover; a.3) factor sensitivity; a.4) cardinality; a.5) minimum holding and transaction size; a.5) round lot; a.6) tracking error; a.7) other soft constraints; b) tail risk measure constraints: b.1) VaR optimized portfolios; b.2) CVaR optimized portfolios. c) incorporating transaction costs in portfolio optimization: c.1) linear; c.2) piecewise linear; c.4) quadratic; c.5) fixed; d) incorporating taxes in portfolio optimization. • robust equity portfolio construction: a) box uncertainty b) ellipsoidal uncertainty • shrinkage methods and the Black Litterman model for equity portfolio construction • VaR and CVaR constrained equity portfolio construction. • Performance testing. main performance ratios: 1) Sharpe Ratio; 2) Jensen's alpha; 3) Tracking Error; 4) Information Ratio; 5) Sortino Ratio; 6) Maximum Draw-down; 7) VaR; 8) CVaR; Stress testing of portfolio strategies. <p>On successful completion of this module, the student should :</p> <p>-- have a thorough and deep knowledge of some asset pricing and some normative portfolio selection models. In particular, he/she must be able to estimate using also Bayesian statistical methods the main inputs for portfolio modelling. He/she must be able to construct optimized portfolios using Monte Carlo and bootstrapping methods and numerical optimization approaches as well, having laid out the mathematical setting to be simulated and/or optimized. Finally, the student should be able to perform data scraping, getting data needed for the models, and to organize them in a database.</p> <p>-- be able to use her/his programming skills in simple Excel spreadsheets and/or in high programming languages such as Gauss or MatLab, not only for financial models and algorithms dealt with at lesson but also for other similar problems.</p> <p>-- have acquired general skills in the field of algorithms and applied programming for asset pricing and portfolio selection which enable him/her to make educated choices in a problem solving practice framework. To be specific, the student should be able set up Excel spreadsheets and/or high level language, GAUSS or MatLab, codes implementing numerical optimization and Monte Carlo or bootstrapping simulation in view of achieving portfolio selection solutions in both original and new kind of problems.</p> <p>-- be capable to give a presentation both in front of a general practitioners' audience and a more academic one about the models dealt within the course.</p>

		-- have acquired a method of study both thanks to a wide knowledge of the main streams in which financial modelling is evolving, theoretical continued learning, and a confident practice with respect to the main high level programming languages, GAUSS and MatLab, which are continually evolving, best practice continued learning.
3	Course prerequisites	Programming skills in Excel and in a matrix oriented language such as MatLab, Gauss, Ox, Scilab, Octave. The student should be confident in calculus in both univariate and multivariate functions studies, in the basics of probability calculus, namely main continuous and discrete density functions. In order to attend the course it is highly advisable to have passed the following exams or equivalent: Probability And Mathematical Statistics, Foundations Of Programming And Laboratory, Operation Research And Optimization in addition to Financial Data Analytics and Investment Data Driven Decisions I
4	Teaching methods and language	lectures and practice drills in the computer lab. Language: Italian Reference textbooks <ul style="list-style-type: none"> • Benninga, Simon et al, <i>Financial modeling</i>. The MIT Press. 2008. • Fabozzi, Frank J.; Pachamanova, Dessislava A., <i>Portfolio construction and analytics</i>. John Wiley & Sons. 2016. • Kim, Woo Chang; Kim, Jang Ho; Fabozzi, Frank J, <i>Robust Equity Portfolio Management,+ Website: Formulations, Implementations, and Properties Using MA</i>. John Wiley & Sons. 2015. • Fabozzi, Frank J; Kolm, Petter N.; Pachamanova, Dessislava A.; Focardi, Sergio M., <i>Robust portfolio optimization and management</i>. John Wiley & Sons. (vol. 1) 2007. • Pachamanova, Dessislava A.; Fabozzi, Frank J., <i>Simulation and Optimization in Finance: Modeling with MATLAB,@ RISK, or VBA</i>. John Wiley & Sons. (vol. 1) 2010.
5	Assessment methods	**Pre Assessment** A preliminary assessment of prerequisite skills is not performed in this course. **Formative Assessment** The formative assessment of this course teaching and learning process is performed through class participation during lessons: A) students may be asked to answer questions about topics dealt with at lesson; students may ask instructor questions during lessons both about the very topic dealt with at lesson and about correlated topics they are particularly interested in. B) summary of previous week lessons: a student is randomly selected to sum up topics dealt with in the previous sessions, actually introducing extant session; C) short seminars: students are required to apply their skills in Calculus, Stochastic Calculus, Numerical Analysis and Mathematical Statistics to specific problems in finance, proposing their own solutions previously prepared as homeworks. **Summative Assessment** The summative assessment of this course is performed through A) Written tests: i) during the semester module a mid term and a final test at the end of the semester are given for students attending lessons; ii) a comprehensive test is given in ordinary exam sessions for students not attending lessons and for attending students that do not pass mid term and final semester tests; B) Homeworks and take home projects: some compulsory homeworks are given on specific topics to let students delve into the subject at her/his own pace; some optional take home projects are suggested to students particularly interested in applying quantitative methods of their choice to finance problems. C) Oral exams: after achieving at least an average pass grade in written tests during the semester or, as an alternative, an equivalent valuation on a comprehensive written test in an ordinary exam session, students are required to take an oral exam made up of: 1) questions about mistakes in written tests; 2) one's choice topic question. **aims and formative purposes** students are evaluated with respect to three different dimensions of learning: A) Baseline theoretical knowledge provided through lessons and suggested reading list: tested through open questions to be answered through short essays; B) Problem solving involving symbolic calculus and stochastic calculus capabilities: tested through questions about model building and algorithms tuning for specific formal problems; C) Programming capabilities: tested through small (large) problems in class (at home) assignments to be programmed in a high level language, e.g. MatLab, Gauss, Ox, Scilab. **Evaluation criteria** 1) final numerical results achievement; 2) style: 2.1) in modelling – possibly new – solutions in a symbolic layout; 2.2) in writing codes for extant models; 2.3) in prose for short essays questions.

	<p>**Assessment breakdown** Formative and Summative Assessment towards the definition of a final grade weights on the final grade: In class participation 5%; Summary of previous week lessons 10%; Short seminars (if given, else the weight is given to class participation) 5%; In Class written tests 50%; Home assignments (homeworks and take home projects) 25%; Oral Exam 5%.</p>
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