



## Course and Examination Fact Sheet: Spring Semester 2022

### 6,252: Stochastic Methods in Finance

ECTS credits: 3

#### Overview examination/s

(binding regulations see below)

Decentral - Oral examination (individual) (100%, 20 mins.)

Examination time: term time

#### Attached courses

Timetable -- Language -- Lecturer

[6,252,1.00 Stochastic Methods in Finance](#) -- Englisch -- [Mahmoud Ola](#)

#### Course information

##### Course prerequisites

Some previous exposure to probability and statistics will help in the learning process. The Bachelor level course Mathematics for Economists is useful, and in general a good level of mathematical interest and sophistication is required. The course is nevertheless fully self contained.

##### Learning objectives

The material of this course represents a first step that needs to be taken by any student interested in quantitative finance. This course is a good educational block for future practitioners in the financial industry as well as for those students that want to continue their studies in the applications of stochastic methods in finance and in financial econometrics. Upon completion of the course, the students will be familiar with the fundamentals of probability theory and stochastic calculus, no-arbitrage pricing techniques, and elementary portfolio optimization techniques.

##### Course content

The course introduces the fundamental stochastic tools for derivative asset pricing and portfolio theory. The ability to price and hedge derivative products and to properly manage asset portfolios is of paramount importance in the financial industry. The existing techniques to carry this out require a good command of the concepts in stochastic calculus that will be presented in this course. The two main mathematical methods used in this course are probability theory and stochastic calculus. These tools allow for a mathematically rigorous formulation of the hypotheses underlying the no-arbitrage approach to asset pricing and that yield explicit quantitative results that can be easily used in practice.

##### Course structure and indications of the learning and teaching design

###### 1. Probability Theory:

- Introduction
- Distribution functions
- Normal distribution
- Multivariate normal distribution
- Lognormal distribution
- Binomial distribution

###### 2. Pricing and No-arbitrage:

- Binomial model
- Fundamental asset pricing theorem

###### 3. Ito's lemma and Stochastic Integrals:



- Random walk and Brownian motion
- Ito processes and Ito's lemma
- Derivative pricing
- Partial differential equations
- Stochastic differential equations

#### 4. Risk Neutral Valuation:

- Discrete model
- Lognormal model
- Extensions

#### 5. Markowitz Portfolio Theory:

- Markowitz approach
- Asset liability approach
- Shortfall constraint

#### 6. Arbitrage Pricing Theory Model

- Discussion of the model
- Mathematical properties of the model

#### 7. Portfolio Theory in Continuous Time

- Definition
- Extensions

## Course literature

Course slides posted online.

Lamberton, D. and Lapeyre, B. "Introduction to stochastic calculus applied to finance". Chapman and Hall/CRC, 2008.

Neftci, S. N. "An Introduction to the Mathematics of Financial Derivatives". Academic Press, 2000.

Watsham, T. J. and Parramore, K. "Quantitative Methods in Finance". International. Thomson Business Press, 1997.

## Additional course information

In the case of the President's Board having to implement new directives due to the SARS-CoV-2 pandemic in SpS2022, the course information listed above will be changed as follows:

- The course is conducted online via the platform Zoom;
- The recordings of the course are available for 30 days;
- The lecturer informs via StudyNet/e-mail on the changed implementation modalities of the course;

The examination information listed below would be changed depending on the situation. If no presence is allowed for the oral examination, the oral examination will take place online via Zoom.

## Examination information

### Examination sub part/s

#### 1. Examination sub part (1/1)

##### Examination time and form



Decentral - Oral examination (individual) (100%, 20 mins.)

Examination time: term time

## Remark

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## Examination-aid rule

Extended Closed Book

The use of aids is limited; any additional aids permitted are exhaustively listed under "Supplementary aids". Basically, the following is applicable:

- At such examinations, all the pocket calculators of the Texas Instruments TI-30 series and mono- or bilingual dictionaries (no subject-specific dictionaries) without hand-written notes are admissible. Any other pocket calculator models and any electronic dictionaries are inadmissible.
- In addition, any type of communication, as well as any electronic devices that can be programmed and are capable of communication such as notebooks, tablets, mobile telephones and others, are inadmissible.
- Students are themselves responsible for the procurement of examination aids.

## Supplementary aids

none

## Examination languages

Question language: English

Answer language: English

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## Examination content

Contents presented in the lectures and reading assignments.

These include:

1. Probability Theory: - Introduction - Distribution functions - Normal distribution - Multivariate normal distribution - Lognormal distribution - Binomial distribution 2. Pricing and No-arbitrage: - Binomial model - Fundamental asset pricing theorem 3. Ito's lemma and Stochastic Integrals: - Random walk and Brownian motion - Ito processes and Ito's lemma - Derivative pricing - Partial differential equations - Stochastic differential equations 4. Risk Neutral Valuation: - Discrete model - Lognormal model - Extensions 5. Markowitz Portfolio Theory: - Markowitz approach - Asset liability approach - Shortfall constraint 6. Arbitrage Pricing Theory Model - Discussion of the model - Mathematical properties of the model 7. Portfolio Theory in Continuous Time - Definition - Extensions

## Examination relevant literature

Lecture slides and reading assignments. All material will be uploaded on Canvas before the end of the term.



## Please note

Please note that only this fact sheet and the examination schedule published at the time of bidding are binding and takes precedence over other information, such as information on StudyNet (Canvas), on lecturers' websites and information in lectures etc.

Any references and links to third-party content within the fact sheet are only of a supplementary, informative nature and lie outside the area of responsibility of the University of St.Gallen.

Documents and materials are only relevant for central examinations if they are available by the end of the lecture period (CW21) at the latest. In the case of centrally organised mid-term examinations, the documents and materials up to CW 12 are relevant for testing.

Binding nature of the fact sheets:

- Course information as well as examination date (organised centrally/decentrally) and form of examination: from bidding start in CW 04 (Thursday, 27 January 2022);
- Examination information (regulations on aids, examination contents, examination literature) for decentralised examinations: in CW 12 (Monday, 21 March 2022);
- Examination information (regulations on aids, examination contents, examination literature) for centrally organised mid-term examinations: in CW 12 (Monday, 21 March 2022);
- Examination information (regulations on aids, examination contents, examination literature) for centrally organised examinations: two weeks before the end of the registration period in CW 15 (Monday, 11 April 2022).