



## Course and Examination Fact Sheet: Spring Semester 2019

### 6,270: Introduction to Time Series Modelling

ECTS credits: 6

#### Overview examination/s

(binding regulations see below)

Decentral - Oral examination (individual) (50%, 15 mins.)

Central - Written examination (50%, 90 mins.)

#### Attached courses

Timetable -- Language -- Lecturer

[6,270,1.00 Introduction to Time Series Modelling](#) -- Englisch -- [Audrino Francesco](#), [Fengler Matthias](#)

#### Course information

#### Course prerequisites

Statistics knowledge at the level of the HSG Bachelor in Economics course "Statistics".

#### Course content

This course is aimed at students who wish to gain a working knowledge of time series and forecasting methods as applied in economics, finance, engineering, and the natural and social sciences. The emphasis is on methods and the analysis of data sets. The core of the course covers the identification and estimation of trend and seasonal components, as well as the theory underlying ARMA, and ARIMA processes. Turning to specific topics in financial econometrics, the class covers the basic facts of asset returns, market efficiency and the predictability of asset returns, ARCH and GARCH models, and market microstructure and high-frequency data. Theoretical exercises as well as practical implementations in R for the analysis of real and simulated datasets are discussed during the exercise sessions.

The class provides the basic, fundamental knowledge needed to understand the main concepts in time series econometrics. It will teach students how to deal with possible practical applications related to the analysis of a time series basic characteristics, going from data acquisition, the identification and filtering of eventual non-stationary components, to the estimation of a suitable time series process. Moreover, students will learn how to choose and use the different packages and commands available in the free R software.

#### Course structure

##### 1. Introduction

##### 2. Basic Concepts

Estimation and elimination of trend and seasonality components; Tests for the estimated residual sequence.

##### 3. Stationary Processes

Basic properties; Linear Processes; Wold Decomposition.

##### 4. ARMA models

Definition and basic properties of ARMA models; autocorrelation function (ACF) and partial autocorrelation function (PACF).

##### 5. Modeling and prediction with ARMA processes

Preliminary estimation; Yule-Walker equations; Maximum-likelihood estimation (MLE); Order selection; Diagnostic checking.

##### 6. Non-stationary time series models

ARIMA models; Unit roots tests in time series models

##### 7. Prices, returns, and volatility

Computing prices, returns, and volatility



## 8. Stylized facts of asset returns

normality tests; tail index regression; dependence structure of returns

## 9. Conditional heteroscedasticity

ARCH models, GARCH models

## 10. Forecasting

prediction of volatility

## 11. Market Microstructure

elements of high-frequency data; Roll's model; realized variance

## Course literature

- F. Audrino, Lecture Notes on Studynet (mandatory).
- M. Fengler, Slides on Studynet (mandatory).
- Brockwell, P.J. and Davis, R.A. (2002), *Introduction to Time Series and Forecasting*, 2<sup>nd</sup> edition, Springer Texts in Statistics (available online at Researchgate). This is the main reference book used to prepare the slides.
- Tsay, R.S. (2010), *Analysis of Financial Time Series*, 3<sup>rd</sup> edition, Wiley Series in Probability and Statistics (<http://faculty.chicagobooth.edu/ruey.tsay/teaching/fts3/>).
- Hamilton, J.D. (1994), *Time Series Analysis*, Princeton University Press.
- Enders, W. (2010), *Applied Econometric time series*, Wiley & Sons.
- Franke, Härdle, Hafner (2015), *Statistics of Financial Markets*, Springer-Verlag

## Additional course information

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## Examination information

### Examination sub part/s

#### 1. Examination sub part (1/2)

##### Examination time and form

Decentral - Oral examination (individual) (50%, 15 mins.)

##### 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, PDAs, mobile telephones and others, are inadmissible.
- Students are themselves responsible for the procurement of examination aids.

##### Supplementary aids

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##### Examination languages



Question language: English

Answer language: English

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## 2. Examination sub part (2/2)

### Examination time and form

Central - Written examination (50%, 90 mins.)

### 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, PDAs, mobile telephones and others, are inadmissible.
- Students are themselves responsible for the procurement of examination aids.

### Supplementary aids

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### Examination languages

Question language: English

Answer language: English

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## Examination content

### Part I: (oral exam)

#### 1. Introduction

#### 2. Basic Concepts

Estimation and elimination of trend and seasonality components; Tests for the estimated residual sequence.

#### 3. Stationary Processes

Basic properties; Linear Processes; Wold Decomposition.

#### 4. ARMA models

Definition and basic properties of ARMA models; autocorrelation function (ACF) and partial autocorrelation function (PACF).

#### 5. Modeling and prediction with ARMA processes

Preliminary estimation; Yule-Walker equations; Maximum-likelihood estimation (MLE); Order selection; Diagnostic checking.

#### 6. Non-stationary time series models

ARIMA models; Unit roots tests in time series models

### PART II (written exam)

#### 7. Prices, returns, and volatility

Computing prices, returns, and volatility

#### 8. Stylized facts of asset returns

normality tests; tail index regression; dependence structure of returns

#### 9. Conditional heteroscedasticity

ARCH models, GARCH models

#### 10. Forecasting

prediction of volatility

#### 11. Market Microstructure

elements of high-frequency data; Roll's model; realized variance



## Examination relevant literature

### Part I:

F. Audrino, Lecture Notes available on Studynet at the beginning of the term.

### Part II:

Slides of Matthias Fengler

### Please note

We would like to point out to you that this fact sheet has absolute priority over other information such as StudyNet, faculty members' personal databases, information provided in lectures, etc. When will the fact sheets become binding?

- Information about courses and examination time (central/decentral and grading form): from the start of the bidding process on 24 January 2019
- Information about decentral examinations (examination-aid rule, examination content, examination relevant literature): after the 4th semester week on 18 March 2019
- Information about central examinations (examination-aid rule, examination content, examination relevant literature): from the start of the enrolment period for the examinations on 08 April 2019

Please look at the fact sheet once more after these deadlines have expired.