



## Course and Examination Fact Sheet: Spring Semester 2022

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

ECTS credits: 6

#### Overview examination/s

(binding regulations see below)

Decentral - Oral examination (individual) (50%)

Examination time: term time

Decentral - Oral examination (individual) (50%)

Examination time: term time

#### Attached courses

Timetable -- Language -- Lecturer

[6.270.1.00 Introduction to Time Series Modelling](#) -- Englisch -- [Audrino Francesco](#) , [Fengler Matthias Reginald](#)

#### Course information

#### Course prerequisites

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

#### Learning objectives

Students will gain the basic, fundamental knowledge needed to understand the main concepts in time series and financial econometrics. We will teach students how to deal with possible practical applications related to the analysis of a (financial) 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 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 time series 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.

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

The course takes place in form of a weekly lecture (and exercises) on the following topics:

##### 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

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 and e-mail on the changed implementation modalities of the course.

The examination information listed below would be changed as follows:

- The oral examinations are conducted online via Zoom.

## Examination information

### Examination sub part/s

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

##### Examination time and form

Decentral - Oral examination (individual) (50%)

Examination time: term time

##### Remark

--



## 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

-

## Examination languages

Question language: English

Answer language: English

---

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

### Examination time and form

Decentral - Oral examination (individual) (50%)

Examination time: term time

### Remark

--

## 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

--

## Examination languages

Question language: English

Answer language: English

---

## Examination content

### Part I: (oral exam)

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

### Stationary Processes

Basic properties; Linear Processes; Wold Decomposition.

### ARMA models

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

### Modeling and prediction with ARMA processes

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

### Non-stationary time series models



ARIMA models; Unit roots tests in time series models

## **PART II (oral exam)**

### **Prices, returns, and volatility**

Computing prices, returns, and volatility

### **Stylized facts of asset returns**

normality tests; tail index regression; dependence structure of returns

### **Conditional heteroscedasticity**

ARCH models, GARCH models

### **Forecasting**

prediction of volatility

### **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**

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).