University of St.Gallen

Course and Examination Fact Sheet: Spring Semester 2019

8,318: Financial Volatility

ECTS credits: 4

Overview examination/s

(binding regulations see below)
Decentral - Group examination paper (all given the same grades) (50%)
Decentral - Oral examination (individual in groups - individual grades) (50%, 15 mins.)

Attached courses

Timetable -- Language -- Lecturer
8,318,1.00 Financial Volatility -- Englisch -- Audrino Francesco

Course information

Course prerequisites

Basic knowledge in Statistics, Econometrics, and Time Series Econometrics (or Time Series Analysis).

Course content

Topic of this course is the estimation, modelling, and forecasting of the second-order time-varying dynamics of financial asset returns.

Prices of commodities or assets produce what is called time-series. Different kinds of financial time-series have been recorded and studied for decades. Nowadays, all transactions on a financial market are recorded, leading to a huge amount of data available, either for free in the Internet or commercially. Financial time-series analysis is of great interest to practitioners as well as to theoreticians, for making inferences and predictions. Furthermore, the stochastic uncertainties inherent in financial time series and the theory needed to deal with them make the subject especially interesting not only to economists, but also to statisticians and physicists.

One of the most important common features exhibited by financial time series is time-varying volatility. Time-varying volatility refers to the tendency of small values to be followed by small values and large values to be followed by large values. It is now 20 years since the publication of Engle's (1982) seminal paper, which introduced ARCH to the world. The ARCH model was the first published paper that considered a parametric model for volatility. It had an enormous influence on both theoretical and applied econometrics, and was influential in the establishment of the discipline of Financial Econometrics.

In this lecture I provide an introduction to the subject of modeling and forecasting financial volatility, starting from the univariate and multivariate ARCH/GARCH classes of models (and their extensions) to models for stochastic volatility and realized volatility. Recent tests proposed to evaluate differences in the forecasting ability of two or more competitive approaches are also reviewed.

This course provides the basic, fundamental knowledge needed to understand the main concepts in financial econometrics. It will teach students how to deal with possible practical applications related to that subject, going from data acquisition and filtering to the choice and use of the different packages in the freely online available R software. The course will prepare students to work for institutions belonging to the financial sector or to continue the academic studies by doing a Ph.D. in quantitative finance.

Students will learn how to estimate and predict volatility and how to solve concrete problems that need to understand the behavior of financial volatility as a key ingredient, such as risk management or portfolio selection applications. In particular, students will properly apply the gained theoretical knowledge on a concrete dataset of their choice using the statistical R software and prepare a research paper summarizing their results.

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Course structure

A. Financial time series and their characteristics Asset returns; Distributional properties of returns; Stationary Processes; ARMA and ARIMA models; Random Variance Models. *B. Univariate conditional heteroskedastic models* ARCH/GARCH: properties; estimation; testing for ARCH effects; prediction. *C. Extensions of univariate ARCH/GARCH models* Exponential GARCH; Threshold GARCH; Asymmetric Power GARCH; Semi- and non-parametric ARCH; Long-memory GARCH; Markov-Switching ARCH/GARCH; Varying coefficient GARCH. *D. Multivariate GARCH models* Overview of existing models; BEKK; CCC; DCC; estimation; diagnostic checking. *E. Alternative approaches* Stochastic volatility: Introduction and overview. Realized volatility: Introduction; definition; measures; microstructrure noise; HAR-type models. *F. Evaluating volatility and correlation forecasts* Direct/Indirect comparisons of volatility forecasts; pairwise vs. multi-models comparisons; robust comparisons; Reality Check test; MCS. *G. Financial applications* Extreme values, quantiles, and risk measures.

Course literature

Main references:

- F. Audrino, *Lecture Notes.*
- Tsay, R.S. (2010), *Analysis of Financial Time Series*, (third edition), Wiley Series in Probability and Statistics.
- Francq, C. and Zakoian, J.-M. (2010), *GARCH Models:Structure, Statistical Inference and Financial Applications*, John Wiley & Sons, Incorporated.
- Andersen, T.G., Davis, R.A., Kreiss, J.-P., and Mikosch, T. (2009), *Handbook of Financial Time Series*, Springer, Berlin. (selected chapters)
- Bauwens, L., Hafner, C., and Laurent S. (2012), *Handbook of Volatility Models and their Applications*, Wiley Handbooks in Financial Engineering and Econometrics Series, John Wiley & Sons, Incorporated. (selected chapters)

Additional course information

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Examination information

Examination sub part/s

1. Examination sub part (1/2)

Examination time and form

Decentral - Group examination paper (all given the same grades) (50%)

Remark

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Examination-aid rule

Term papers

- Term papers must be written without anyone else's help and in accordance with the known quotation standards, and they must contain a declaration of authorship.
- The documentation of sources (quotations, bibliography) has to be done throughout and consistently in accordance with the APA or MLA standards. The indications of the sources of information taken over verbatim or in paraphrase (quotations) must be integrated into the text in accordance with the precepts of the applicable quotation standard, while informative and bibliographical notes must be added as footnotes (recommendations and standards can be found, for example, in METZGER, C. (2017), Lern- und Arbeitsstrategien (12th ed., Cornelsen Schweiz).
- For any work written at the HSG, the indication of the page numbers both according to the MLA and the APA standard is never optional.
- Where there are no page numbers in sources, precise references must be provided in a different way: titles of chapters or sections, section numbers, acts, scenes, verses, etc.

- For papers in law, the legal standard is recommended (by way of example, cf. FORSTMOSER, P., OGOREK R. et SCHINDLER B. (2018, Juristisches Arbeiten: Eine Anleitung für Studierende (6. Auflage), Zürich: Schulthess, or the recommendations of the Law School).

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
Decentral - Oral examination (individual in groups - individual grades) (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
Students must bring an hardcopy of the group examination paper to the oral exam.

Examination languages
Question language: English
Answer language: English

Examination content

A. Financial time series and their characteristics.

Asset returns; Distributional properties of returns; Stationary Processes; ARMA and ARIMA models; Random Variance Models.

B. Univariate conditional heteroskedastic models

ARCH/GARCH: properties; estimation; testing for ARCH effects; prediction.

C. Extensions of univariate ARCH/GARCH models

Exponential GARCH; Threshold GARCH; Asymmetric Power GARCH; Semi- and non-parametric ARCH; Long-memory GARCH; Markov-Switching ARCH/GARCH; Varying coefficient GARCH.

D. Multivariate GARCH models

Overview of existing models; BEKK; CCC; DCC; estimation; diagnostic checking.

E. Alternative approaches

Stochastic volatility: Introduction and overview.

Realized volatility: Introduction; definition; measures; microstructrure noise; HAR-type models.

F. Evaluating volatility and correlation forecasts

Direct/Indirect comparisons of volatility forecasts; pairwise vs. multi-models comparisons; robust comparisons; Reality Check test; MCS.

G. Financial applications.

Extreme values, quantiles, and risk measures.

Examination relevant literature

F. Audrino, *Lecture Notes,* available on StudyNet.

Group examination paper.

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.