University of St.Gallen

Course and Examination Fact Sheet: Autumn Semester 2021

10,386: Time Series Methods in Financial Econometrics

ECTS credits: 4

Overview examination/s
(binding regulations see below)
Decentral - Oral examination (individual) (70%)
Examination time: term time
Decentral - examination paper written at home (in groups - all given the same grades) (30%)
Examination time: term time

Attached courses
Timetable -- Language -- Lecturer
10,386,1.00 Time Series Methods in Financial Econometrics -- Englisch -- Gagliardini Patrick

Course information

Course prerequisites
Students who plan to take this course as an *optional* course and *without an examination* should not register via the bidding system. They should register directly with the lecturer.

Students who plan to take this course as a r*egular* course or as an *optional* course *with an examination* should register via the bidding system. Enrolment in a course is binding: students have to attend the course and take the exam. The grade will be shown on the scorecard.

Learning objectives
The goal of this course is to introduce students to advanced econometric methods for time series data in financial applications.

Course content
The course focuses on the Generalized Method of Moment (GMM) and nonparametric methods, and considers estimation and inference for asset pricing and derivative pricing models.

The first part of the course is concerned with the GMM. The GMM has been introduced in Hansen (1982) and Hansen, Singleton (1982) to estimate a structural parameter defined by moment restrictions. In economic applications, moment restrictions are typically deduced from the Euler conditions implied by expected utility maximization or, more generally, the no-arbitrage principle. In this course we investigate the implementation and the large sample properties of GMM with serially dependent data. We address the key issues of consistent estimation of the variance-covariance matrix of the GMM estimator and optimal choice of the weighting matrix.

Nonparametric methods are the subject of the second part of the course. Nonparametric methods are appealing for empirical economic analysis since they dispense the researcher from introducing restrictive parametric assumptions, that have no justification in economic or financial theory. The course focuses on the most commonly used nonparametric method in economics, that is the kernel based approach. We consider kernel estimators of density functions, regression functions and their derivatives, with time series data. We investigate the large sample properties of kernel estimators, and we address the issue of the choice of the bandwidth parameter.

There exists an important literature in finance on applications of GMM and nonparametric methods for asset pricing purposes. In the last part of the course we consider GMM estimation of asset pricing models in either preference-based, or no-arbitrage, modeling frameworks. We also review recent applications of nonparametric methods for estimation of risk-neutral densities and derivative pricing. The literatures on GMM estimation and nonparametric analysis find a point of contact in the so-called

information-based approach to GMM. In this area, the course introduces the Extended Method of Moments (XMM), which is a new information-based estimator of option prices using time series data on spot prices and cross-sectional data on derivatives, and the conditional Hansen-Jagannathan distance for comparing possibly misspecified conditional asset pricing models.

Course structure and indications of the learning and teaching design

The outline of the course is the following:

1. GMM with time series data

i) Mixing processes and mixingales. Law of Large Numbers (LLN) and Central Limit Theorem (CLT) for mixing processes.

ii) Consistency and asymptotic normality of the GMM estimator with serially dependent data.

iii) Consistent estimation of the asymptotic variance-covariance matrix.

2. Nonparametric methods

i) Kernel estimators of density functions and regression functions. Integrals and derivatives of kernel estimators.

ii) Bias-variance tradeoff. Bandwidth selection rules.

iii) Large sample properties of kernel estimators.

3. Applications to asset pricing and derivative pricing

i) GMM estimation of asset pricing models.

ii) Nonparametric estimation of risk-neutral densities and derivative pricing.

iii) Information theoretic GMM for estimating and comparing conditional asset pricing models.

Course literature

[1] Bosq, D. (1998): *Nonparametric Statistics for Stochastic Processes. Estimation and Prediction,* Springer, New-York.
[2] Davidson, J. (1994): *Stochastic Limit Theory*, Oxford University Press.
[3] Gagliardini, P., Gouriéroux, C., and E., Renault (2011): Efficient Derivative Pricing by the Extended Method of Moments, Econometrica, 79, 1181-1232.
[4] Gagliardini, P., and D., Ronchetti (2019): Comparing Asset Pricing Models by the Conditional Hansen Jagannathan Distance, forthcoming Journal of Financial Econometrics.
[5] Gagliardini, P., and D., Ronchetti (2013): Semi-parametric Estimation of American Option Prices, Journal of Econometrics, 173, 57-82.
[6] Gouriéroux, C., and J., Jasiak (2001): *Financial Econometrics. Problems, Models and Methods,* Princeton University Press.
[7] Hall, A. (2005): *The Generalized Method of Moments*, Oxford University Press.
[8] Hansen, L. (1982): "Large Sample Properties of Generalized Method of Moments Estimators", Econometrica, 50, 1029-1054.
[9] Hansen, L., and K., Singleton (1982): "Generalized Instrumental Variable Estimation of Nonlinear Rational Expectations Models", Econometrica, 50, 1269-1286.
[10] Pagan, A., and A., Ullah (1999): *Nonparametric Econometrics,* Cambridge University Press.
[11] Singleton, K. (2006): *Empirical Dynamic Asset Pricing*, Princeton University Press.
[12] White, H. (2001): *Asymptotic Theory for Econometricians*, Revised Edition, Academic Press.
Selected research articles will be discussed in the lectures.

Additional course information

In the case of the President's Board having to implement new directives due to the SARS-CoV-2 pandemic in autumn semester 2021, the course information listed above will be changed as follows:

- The course is conducted online via Zoom;
- The recordings of the course are available for 30 days;
- The lecturer informs via e-mail on the changed implementation modalities of the course;
- There are no changes necessary to the course information.

The examination information listed below would be changed as follows:

- The oral examinations are conducted online and are being recorded;
- There are no changes necessary to the examination information.

Examination information

Examination sub part/s

1. Examination sub part (1/2)

Examination time and form
Decentral - Oral examination (individual) (70%)
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
No aid during the exam.

Examination languages
Question language: English
Answer language: English

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2. Examination sub part (2/2)

Examination time and form
Decentral - examination paper written at home (in groups - all given the same grades) (30%)
Examination time: term time

Remark
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Examination-aid rule
Term papers

Written work must be written without outside help according to the known citation standards, and a declaration of authorship must be attached, which is available as a template on the StudentWeb.

Documentation (quotations, bibliography, etc.) must be carried out universally and consistently according to the requirements of the chosen/specified citation standard such as e.g. APA or MLA.

The legal standard is recommended for legal work (cf. by way of example: FORSTMOSER, P., OGOREK R., SCHINDLER B., Juristisches Arbeiten: Eine Anleitung für Studierende (the latest edition in each case), or according to the recommendations of the Law School).

The reference sources of information (paraphrases, quotations, etc.) that has been taken over literally or in the sense of the

original text must be integrated into the text in accordance with the requirements of the citation standard used. Informative and bibliographical notes must be included as footnotes (recommendations and standards e.g. in METZGER, C., Lern- und Arbeitsstrategien (latest edition)).

For all written work at the University of St.Gallen, the indication of page numbers is mandatory, regardless of the standard chosen. Where page numbers are missing in sources, the precise designation must be made differently: chapter or section title, section number, article, etc.

Supplementary aids
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Examination languages
Question language: English
Answer language: English

Examination content
Whole material discussed in class and related literature.

Examination relevant literature
Whole material discussed in class and related literature.

Please note

Please note that only this fact sheet and the examination schedule published at the time of bidding are is 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 (CW51) at the latest. In the case of centrally organised mid-term examinations, the documents and materials up to CW 42 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 34 (Thursday, 26 August 2021);
- Examination information (regulations on aids, examination contents, examination literature) for decentralised examinations: in CW 42 (Monday, 18 October 2021);
- Examination information (regulations on aids, examination contents, examination literature) for centrally organised mid-term examinations: in CW 42 (Monday, 18 October 2021);

Examination information (regulations on aids, examination contents, examination literature) for centrally organised examinations: two weeks before the end of the registration period in CW 45 (Monday, 8 November 2021).