Institut für STATISTIK

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Seminar: Econometrics

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Topics

Please notice: For every topic a short description, a broad goal you should work towards as well as some introductory literature are given. The bullet points listed under *Goal of thesis* do not represent an outline, but should be regarded merely as a suggestion.

Overview

1. **Prediction Evaluation**

   Description: The generation of forecasts is an important part of time series analysis. In order to be able to assess the forecast quality of different models, statistical tests are carried out. Either the quality of forecasts is checked on the basis of theoretical quality criteria (such as unbiasedness) (this is done, for example, with the help of Mincer-Zarnowitz regressions) or forecasts are compared with benchmarks with which it is tested whether the forecast is significantly better than the benchmark. This is the aim of the Diebold-Mariano test and other more modern tests.

   Goal of thesis: Discussion of the properties of optimal forecasts, introduction of tests for rationality and optimality, discussion of tests for the comparison of forecasts and their advantages as well as disadvantages.

   Literature: West (2006), Clements and Hendry (1998), Diebold and Mariano (1995)

2. **Bootstrapping for Time Series**

   Description: Boostrap methods approximate the exact distribution of an estimator or test statistic without additional structural assumptions on the underlying process, given the data. The original Boostrap method is based on independent random variables. In the case of dependent observations in time series analysis, however, this assumption leads to an incorrect approximation of the distribution. Therefore, there are extensions such as the block bootstrap, among others, in which individual observations are not drawn from the data with reclining, but blocks of consecutive observations in order to preserve the dependency structure.

   Goal of thesis: Introduction to the bootstrap method, problems with time series data, presentation of extensions to time series, especially block bootstrap.

   Literature: Kunsch (1989), Kreiss and Lahiri (2012), Beran (2013)

3. **HAC Estimator**

   Description: In regression analysis with time series, the variance-covariance matrix of the innovations usually does not correspond to the classical assumption of independently and identically distributed innovations. Instead, the innovations usually exhibit autocorrelation and heteroscedasticity, so that inference based on the classical assumptions is no longer valid. This is remedied by H(eteroscedasticity) and A(utocorrelation) C(onsistent) estimators for the variance-covariance matrix, which can be understood as weighted sums of the autocovariances of the process.

   Goal of thesis: Discussion of the regression analysis with autocorrelated innovations and explanation of the common (HAC) estimation methods, as well as their properties.

   Literature: Zeileis (2004), Andrews (1991)

4. **Fixed-b Asymptotics**

   Description: HAC estimators are based on the assumption that the number of autocovariances needed to estimate the variance-covariance matrix converges to zero in proportion to the length of the time series. It is well known that tests based on HAC estimators are too liberal when the underlying process is relatively persistent, as a larger number of autocovariances is then needed to represent the persistence of the process. Fixed-b asymptotics, on the other hand, is based on the assumption that the proportion of autocovariances needed converges to a constant $0 < b \leq 1$. It thus provides a better approximation to the situation at hand, where only a finite sample is available.

   Goal of thesis: Brief discussion of HAC estimators and explanation of fixed-b asymptotics, optimal bandwidth selection, possibility to include long memory processes as an extension

   Literature: Kiefer et al. (2005), McElroy and Politis (2012), Sun et al. (2008)

5. **MIDAS Regression**

   Description: Many macroeconomic variables and financial market data are observed at different time intervals. For example, gross domestic product is calculated quarterly, while unemployment figures are published monthly and stock prices are available daily. The MIDAS (Mi(xed) Da(ta) S(ampling)) model allows regressions for such time series data observed at different frequencies. The basic idea is to use an aggregate of the more frequently observed variables to explain the less frequently observed variables.

   Goal of thesis: Explanation of the MIDAS model, its variants and their statistical properties.

   Literature: Ghysels et al. (2007), Foroni and Marcellino (2013)

6. **Vector-Autoregressive-Moving-Average Processes**

   Description: VARMA processes generalize univariate ARMA models to vectorial series. This allows to model correlations between several ARMA processes. Therefore, they are often used for macroeconomic predictions.

   Goal of thesis: Introduction, forms of representation, stationarity conditions, estimation, possibly SVAR, relation to cointegration or FIVAR/VARFI models

   Literature: Hamilton (1994), Lütkepohl (2005), Martin et al. (2012)

7. **Analysis of Cointegrated Time Series**

   Description: A cointegration relationship exists when two non-stationary time series share a common stochastic trend, such that a linear combination of the time series is stationary. This concept is of fundamental importance to economics, because it allows to model equilibrium relationships. Methods to determine whether a cointegration relationship exists between two (or more) series include the Engle-Granger procedure, the Phillips-Ouliaris test, or the Johansen test. The estimation of the correct linear combination can be done using linear regression, among other methods. Error correction models model the deviation from the equilibrium.

   Goal of thesis: Definition and explanation of cointegration, presentation of selected test methods, e.g. Engle-Granger test and Phillips-Ouliaris test or the Johansen test, estimation of the cointegration vector, explanation and discussion of error correction models

   Literature: Engle and Granger (1987), Phillips and Ouliaris (1990), Hamilton (1994), Martin et al. (2012)

8. **Threshold Cointegration**

   Description: The framework of cointegration implicitly sets the requirement that any kind of deviation from the long-run equilibrium needs to be corrected instantaneously and symmetrically. This assumption is relaxed by allowing only an adjustment after the deviation surpasses a critical threshold. In the same way asymmetric behaviour can be taken into account by allowing the adjustment to respond differently to negative and to positive deviations from the long-run equilibrium. Threshold cointegration can be used to model, for example, transaction costs, stickiness of prices, or asymmetry in agents' reactions.

   Goal of thesis: Brief explanation of cointegration, explanation of threshold cointegration, estimation and testing, impulse response functions, relation to univariate and/or multivariate threshold models

   Literature: Engle and Granger (1987),Balke and Fomby (1997), Tong (1978)

9. **Stochastic Volatility and GARCH-Models**

   Description: Volatility has a great impact on risk, for which reason volatility modelling plays an important role in risk management. There are two different types of models. Historical volatility focuses on the past price variations, implicit volatility also takes option prices into account. Option prices contain additional information on expectations of the future movement of the market. Generalized-Autoregressive-Conditional-Heteroscedasticity-Models are often applied to model volatility, as the variance of the innovations is depended on the size of the shocks. Stochastic volatility models extend GARCH models. Here, the conditional variance not only depends on the previous shocks, but is also driven by a second innovation process. This allows a better model fit for a given sample, but makes the estimation more difficult.

   Goal of thesis: Definition and properties of stationarity, conditions for stationarity, existence of moments, forecasting, estimation methods, tests for GARCH effects

   Literature: Taylor (1994), Poon and Granger (2003), Tsay (2005)

10. **Extensions of GARCH-Models**

   Description: A number of empirically observable phenomena of financial market time series can only be inadequately represented by classic GARCH processes. This especially holds for long memory and asymmetries. Therefore, a variety of extensions to the GARCH model exist. For example, EGARCH, APARCH and GJR-GARCH model asymmetries, the IGARCH model generates non-stationary variance processes, FIGARCH, FEXP and LARCH generate long memory and GARCH-M generates feedback effects of the variance on the behaviour of the conditional expectation.

   Goal of thesis: Brief introduction to GARCH, presentation and explanation of a selection of extensions, discussion of their properties, estimation and prediction

   Literature: Tsay (2005), Baillie et al. (1996)

11. **Multivariate Volatility Models**

   Description: Multivariate volatility models have a variety of applications, e.g. in portfolio selection or the calculation of risk measures such as the value-at-risk. The difficulty in transferring GARCH models to multivariate processes is that the number of parameters grows rapidly with increasing dimension. For this reason, simplifying assumptions must be made about the structure of the process. Multivariate GARCH models such as the BEKK or the DCC model differ in these assumptions and in the way their adherence is enforced during estimation.

   Goal of thesis: Explanation of a selection of the most important multivariate volatility models, discussion of their characteristics, advantages and disadvantages

   Literature: Tsay (2005)

12. **Duration Models for High Frequency Data**

Description: Today's availability of high-frequency data such as tick-by-tick data on individual transactions offers new possibilities for the analysis of time series, e.g. when used in so-called duration models. In financial market analysis, the duration is defined as the time between two trading activities and describes the market activity. It indicates, whether new information is available to the market participants. Thereby, the expected duration is parameterized analogously to the conditional variance in the GARCH model, so that estimation and forecasting with both models are similar. In addition, duration models can be used as an alternative to modelling volatilities.

Goal of thesis: Discussion of different duration models with high frequency data, relation to GARCH models and volatility modeling, estimation and prediction with duration models

Literature: Engle and Russell (1998), Tsay (2005)

13. **Time Series and Quantile Regression**

Description: Quantile regression provides a more comprehensive model than simple mean regression by gathering information that is not captured by mean regression. It provides a collections of conditional quantiles to characterize the entire conditional distribution. In quantile regression most often the observations of response variables are assumed to be conditionally independent. Given the conditional quantiles one is able to construct prediction intervals for the next value, when a small section of recent past values in a stationary time series is at hand. Besides applications in econometrics, finance and related fields, quantile information is important for time series applications. If a statistical application requires more than a few moments, quantile regression provides a method for the estimation of conditional quantiles of conventional time series models. Additionally it extends the modeling options for time series analysis, because it allows for local, quantile-specific time series dynamics.

Goal of thesis: Explanation of quantile regression, in particular for time series, estimation of conditional quantiles, time series specific extensions

Literature: Xiao (2012), Yu et al. (2003), Cai (2002)

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