Financial Time Series

Questions for lecture preparation

Annika Lang

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CHALMERS
UNIVERSITY OF TECHNOLOGY

UNIVERSITY OF
GOTHENBURG

Mathematical Sciences, Chalmers University of Technology & University of Gothenburg, Sweden

Lecture 1

Content

- General introduction and motivation
- Abbreviation (s. X–Y): Slide X to Y in the slides corresponding to the lecture
- Section 2.1 in the lecture notes

While reading/watching, try to answer these questions:

- Why are you taking this course?
- What do you expect from the course?
- What is your background?
- What are the challenges when starting with the first recorded lecture?
- What are examples of a time series?
- What is IID noise?

Lecture 2

Content

- stationary time series (s. 2–8), autocovariance (s. 9–10), estimators (s. 11)
- Section 2.2 in the lecture notes

While reading/watching, try to answer these questions:

- What is stationarity? What is the difference between strong and weak stationarity?
- What do you have to prove that a given time series is stationary?
- When are you able to define the autocovariance function?
- What is the difference between IID noise and white noise? Do you know an example which is one but not the other one?
- Are the concepts of sample mean and sample (auto)covariance known to

Lecture 3

Content

- Rep. of Lecture 2, sample mean and autocovariance (s. 3–6), testing for IID (s. 7–9)
- Section 2.3 in the lecture notes

While reading/watching, try to answer these questions:

- How are sample mean and sample autocovariance related to the mean and the autocovariance?
- In which sense do the sample mean and sample autocovariance converge? What does convergence mean?
- When do you apply IID tests? When do they give the desired result?
- What are you testing for in IID tests?

Lecture 4

Content

- Best predictor (4a s. 2–4), best linear predictor: existence and linear equations (4a s. 5–9), example (4a s. 10–12), recursive algorithms: Durbin–Levinson algorithm (4b s. 3), innovations algorithm (4b s. 4–7)
- Section 2.4 in the lecture notes

While reading/watching, try to answer these questions:

- In which sense are best predictors "best"?
- What is the difference between a best predictor and a best linear predictor? When do they coincide?
- Which options are presented to compute best linear predictors?
- Do all presented methods lead to the same results?

Lecture 5a

Content

- Trend and seasonality (5a): general (s. 2–4), trend estimation by moving average (s. 5/6) and by exponential smoothing (s. 7/8), trend and seasonality estimation by linear least squares (s. 9/10) and by moving average (s. 11/12), elimination (s. 13/14), forecasting (s. 15)
- Section 2.5 in the lecture notes

While reading/watching, try to answer these questions:

- How are trend and seasonality described in models?
- What is the difference between estimation and elimination?
- How do the results differ when using the different methods?

Lecture 5b

Content

- Linear processes (5b): definition (s. 2), proof of stationarity and the ACVF (s. 3–5)
- Section 3.1 in the lecture notes

While reading/watching, try to answer these questions:

- Try to find an example that fits in the framework of Proposition 3.1.2.
- What are the main steps in the proof?
- Are all details included for you? If not, work out the missing details.

Lecture 6a

Content

- Definitions AR, MA, ARMA (s. 2–4), exist. & uniqueness of a stationary solution (s. 4–5), construction of stationary TS and ARMA as linear TS (s. 6–7), causal (s. 8–9) and invertible ARMA (s. 10–11), examples (s. 12–14)
- Section 3.2 (before 3.2.1) in the lecture notes

While reading/watching, try to answer these questions:

- What is the difference between AR and MA processes?
- What is an intuitive understanding of causality?
- What is the importance of the lemma on causality and invertibility?

Lecture 6b

Content

- ACVF of an ARMA process (s. 2–4), PACF (s. 5/6), example (s. 7/8)
- Section 3.2.1 in the lecture notes

While reading/watching, try to answer these questions:

- What is the ACVF of an ARMA process?
- What is a possible interpretation of the PACF?
- How can the PACF be used?

Lecture 7a

Content

- Parameter estimation for ARMA processes: Yule–Walker estimation (s. 3–5), Hannan–Rissanen estimation (s. 6/7), MLE (s. 8–11)
- Section 3.2.2 in the lecture notes

While reading/watching, try to answer these questions:

- What is given, what is estimated?
- Which method fits for which model? Why?

Lecture 7b

Content

- Order selection for ARMA processes: visual with ACF and PACF (s. 3), AICC (s. 4), BIC (s. 5), complete ARMA model fitting procedure (s./ 6/7)
- Section 3.2.3/4 in the lecture notes

While reading/watching, try to answer these questions:

- What is the "best" or "correct" order of the model?
- Given data, how do you use the knowledge of the lectures so far to find a suitable model?

Lecture 8a

Content

- Forecasting ARMA processes
- Section 3.2.5 in the lecture notes

While reading/watching, try to answer these questions:

- What is this long computation good for?
- What is the difference to forecasting of stationary time series in Lecture 4?

Lecture 8b

Content

- SARIMA processes (s. 2), ARIMA processes (s. 3), unit root tests for ARIMA (s. 4–7)
- Section 3.3 in the lecture notes

While reading/watching, try to answer these questions:

- What is a SARIMA process?
- What is an ARIMA process?
- How do you estimate the parameters of an ARIMA process?

Lecture 9

Content

- Modeling stock prices/returns (s. 2–4), random variance model (s. 5), ARCH model (s. 6/7), GARCH model (s. 8–14): GARCH(1,1) (s. 9–12), GARCH(p,q) (s. 13), GARCH and ARMA (s. 14)
- Section 4–4.1 in the lecture notes

While reading/watching, try to answer these questions:

- Why do we consider yet another model?
- What do we know about parameter choices in (G)ARCH models?
- How are GARCH and ARMA processes related? Which opportunities do we have using this relation?

Lecture 10

Content

- Parameter estimation for GARCH with conditional MLE (s. 3/4) and via ARMA (s. 5/6), order selection (s. 7), ARMA–GARCH (s. 8–10)
- Section 4.2/3 in the lecture notes

While reading/watching, try to answer these questions:

- How can you fit parameters of a GARCH model?
- How can we combine ARMA and GARCH?
- Which links do you see between Chapter 3 and Chapter 4?

Lecture 11a

Content

- Recall random variance and GARCH models (s. 2/3), EGARCH (s. 4–7), IGARCH (s. 8/9)
- Section 4.4 in the lecture notes

While reading/watching, try to answer these questions:

- Why is it interesting to consider EGARCH and IGARCH?
- What is the key property of EGARCH compared to GARCH?
- How is IGARCH related to the models considered in earlier lectures?

Lecture 11b

Content

- Nonlinear models: general (s. 3), bilinear (s. 3), SETAR (s. 4), Markov switching (s. 5/6)
- Section 5.1 in the lecture notes

While reading/watching, try to answer these questions:

- What are possible types of nonlinearities?
- Which connections do you see between the considered examples and models seen in earlier lectures?

Lecture 12a

Content

- nonlinearity tests in general (s. 2/3), nonparametric tests (s. 4–6), parameteric tests (s. 7/8)
- Section 5.2 in the lecture notes

While reading/watching, try to answer these questions:

- What is the difference between nonparametric and parametric tests?
- What is tested? What is not tested?

Lecture 12b

Content

- nonparametric methods and general time series models (s. 2/3), kernel regression (s. 4/5), bandwidth selection (s. 6/7), local linear regression (s. 8–10)
- Section 5.3 in the lecture notes

While reading/watching, try to answer these questions:

- What is the idea when doing nonparametric fitting?
- Try to visualize the process in a graph.

Lecture 13

Content

- Parametric bootstrap/Monte Carlo simulation (s. 2/3), evaluation of the quality of forecasts (s. 4–8)
- Section 5.4 in the lecture notes

While reading/watching, try to answer these questions:

- How do you generate forecasts in the more general setting?
- What is an easy example that you can use to test the algorithm "by hand"?
- What is a "good" forecast? What is "best"?