

UNIVERSITY OF BOLOGNA

Department of Statistics

Academic year 2023–2024

Advanced time series

Instructions

- You can work in groups of at most 4. Your results should be presented in a written report of at most 20 pages.
- Coursework delivery will be via Vrituale.
- Please nominate one person to upload the report and supplementary materials in Vrituale. Make sure that the names of all group members are clearly stated on the first page.
- You may use any publicly available free or commercial software and packages. Indicate in your report which software and packages you have used. Also cite any other sources used in the report. Common rules for academic integrity apply.
- Include your code and data as supplementary files for reproducibility.
- This coursework is assessed and weights 50% of the exam.
- **Deadline: Monday 13th May 2024, 1:00pm (Italian time).**

Theory

Study Chapter 2 of the book by Durbin and Koopman (2012) *Time series analysis by state space methods*, with particular attention to the following sections: 2.1, 2.2, 2.5.1, 2.10, 2.11.

Assignment

1. Download the Nile data, available in the R dataset:
`library(TSA)`
`data()`
and fit a LLM to the data. Compare your results with Table 2.1.
2. Reproduce the Simulation example on Section 2.6.

3. Choose a time series over a period of your choice. You can for instance download time series from the FRED database <https://fred.stlouisfed.org/>, from the time series data library <https://pkg.yangzhuoranyang.com/tsdl/>, from the R website. In any case, document the data that you have chosen and provide the source.
4. Analyse the series fitting an appropriate linear Gaussian state space model.

Please note that there is not a single correct answer and the overall mark will depend on many factors such as (for example): overall quality of the report including, besides correct and rigorous procedures, quality of the writing (clarity, conciseness, formal style) and of the presentation (detailed and well explained figures, well organised paragraph structure), quality of the code (ease of implementation, detailed comments), originality (interesting, well described and well contextualised time series, critical comments and comparisons).