

TMA4285 Time series models

Excercise 8, Autumn 2020

The task is to investigate the Norwegian covid-19 data using R and methods from time series analysis.

Hint: Try an analysis similar to the analysis by Brockwell and Davis of the Wolfer's sunspot numbers. They were analyzed by George Udny Yule in 1927. These data were also used in the Examination paper for TMA4285 Time Series Models given on November 27, 2019. Different transformations of the data can be considered, but an analysis without a transformation should be considered initially. The analysis must include tentative additional GARCH analysis for the noise term.

Minimum demands of a standard analysis include in this case:

1. Exploring the data with plotting of relevant statistics including transformed data.
2. Model parameter estimation including uncertainty¹
3. Diagnostics, and model choice discussion.
4. Two week forecast and simulation and plotting of five corresponding two week realizations.
5. Two week forecast and simulation and plotting of five corresponding two week realizations **using the model estimated in Exercise 3**. Discuss differences.
6. Fitting of GARCH process to estimated noise. Discuss purpose.

The analysis should be limited to concepts and methods found in Chapters 1-7.2 (minus Ch 4) in the textbook by Brockwell and Davis, *Introduction to Time Series and Forecasting*, Springer 2016. Important concepts and quantities used in the analysis should be defined and identified. Proofs given in the textbook need not be replicated, but precise formulations of results used should be included as appropriate. It is, however, an advantage if you give indications of the ideas involved in the statement and proof of the results you use. The explanations should be such that the reader is only assumed to have background knowledge corresponding to the introductory course TMA4240 - Statistics, and university level calculus and linear algebra.

It is required to use the language R in the analysis. Complete copies of the computer code you write for the analysis must be included in an Appendix. Standard R libraries can be used, but the theory and concepts involved in the algorithm used should be indicated. Help regarding using R can be found in the book by Shumway and Stoffer: *Time Series Analysis and Its Applications (With R Examples)*, Springer 2017. The data used in the analysis must be included together with the R code in separate electronic attachments.

The result of your analysis **MUST** be reported according to the outline: **Title, Abstract, Introduction, Theory, Data analysis, Discussion, Conclusion, Appendix, References**. The report length is limited to at most 10 pages excluding the title page, the Appendix and the list of References. The title page must contain the title, the list of authors, and the abstract. It may also contain a table of contents. Figures may be included in the Appendix, but it is recommended to have some figures in the main text.

If parts of the report is judged to be essentially copy-pasted versions of other reports, then this will be taken into account in the grading.

¹Repeated estimation on simulated data for parameters equal to your estimate gives an alternative to using asymptotic formulas for uncertainty found in the textbook.