Financial time-series data

Jan Kloppenborg Møller

November 2018

Background

In this project, the weekly returns for an ETF is analyzed and modelled. An ETF (Exchange Traded Fund) can be described as a structured publicly traded pool of shares. ETFs are bought and sold in the same way as ordinary shares on a stock exchange.

An ETF is a pooled investment fund similar to a unit trust or mutual fund. For investors, ETFs blend the benefits of pooled funds and shares.

The available data is found in the file `finance_data.csv` and consists of 2 columns. The first column is a date column and the second column indicates the weekly returns (i.e. the ratio between the final and initial price for that week minus 1) of 1 ETF.

An important aspect of financial date is the volatility, i.e. standard error of the return. In this assignment you will explore properties of volatility and return in the given data, and a model for the time evolution of these.

Assigment

1: Descriptive statistics and initial analysis

a) Present the data, estimate the parameters in a normal model, and asses if the normal model is appropriate.

b) Hypothesize a model that could fit the data better (Hint: consider tail probabilities), and compare with the normal model estimated above

c) Present the final model (i.e. relevant keynumbers for the estimates)

2: Mixture model

a) Fit normal mixture models with 2 and 3 components, argue which one is better.

b) For the chosen model, report confidence interval for the parameters, and give an interpretation of these intervals.

c) For the two component model make a profile likelihood plot of one of the variance parameters.

d) In the previous question you should see multiple maxima, reprametrize the model such that you only see one maximum.

e) Present the final model and discuss the interpretaion.

3: Hidden Markov Models

a) Fit two and three states normal Hidden Markov Models to the data and conclude on the best choice

b) For the chosen model report 95% confidence intervals for the working parameters.

c) Report the natural parameters and interpret the result.

d) Compare the following distributions (by plots)

   - The long term distribution of the return.
   - The 1-step ahead distribution given that you known the current state.

e) Report 95% confidence intervals for some (or all) natural parameters (note that the natural paramters include the stationary distribution). Some options for finding these CI's are

   - Formula (3.2) in the textbook.
   - The bootstrap method in Section 3.6.2.
   - Profile likelihood.

f) Discuss what would be needed in order to make short term (say 1-2 weeks) predictions.