02418 Project 3: Analyzing soap sales

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Formalities

The data can be found in the file soap.txt together with the assignment on CampusNet.

In this assignment you will analyze the soap sale series given in Table 1.5 of the HMM-textbook.

1 Descriptive statistic and initial analysis

a) Present the data by relevant key numbers and plots

b) Are there clear indications that a poisson distribution is not appriate

c) Can you provide quantitative tests (i.e. p-value)?

2 Poisson mixture model

a) Fit poisson mixture models with $m = 1, 2, 3$ and 4 components, and report the best choice.

b) For the chosen model report the Wald confidence interval of the working parameters.

   - What is the interpretation of these confidence intervals?

c) For the two state model plot the profile likelihood of one of the mean value parameters

   - You should see a profile likelihood with multiple maxima, give an explanation of these
   - Reparametrize the model such that the profile likelihood only one maximum.

d) Evaluate the unceartainty of some (or all) of the natural parameters in the 3-state model.

3 Hidden Markov Models

a) Fit two, three and four state Hidden Markov Models to the soap data, conclude on the best choice

b) Find 95% confidence intervals for the working parameter

c) Find 95% confidence intervals for some (or all) of the natural parameters (including the stationary distribution), some options are

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

d) Give an interpretation of the parameters in your final model.

e) What is the long term distribution of future soap sales?

f) Discuss what would be needed to make short term (say 1-2 month ahead) forecasts of future soap sales.