A few remarks regarding written exercise 1

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02433 Hidden Markov Models

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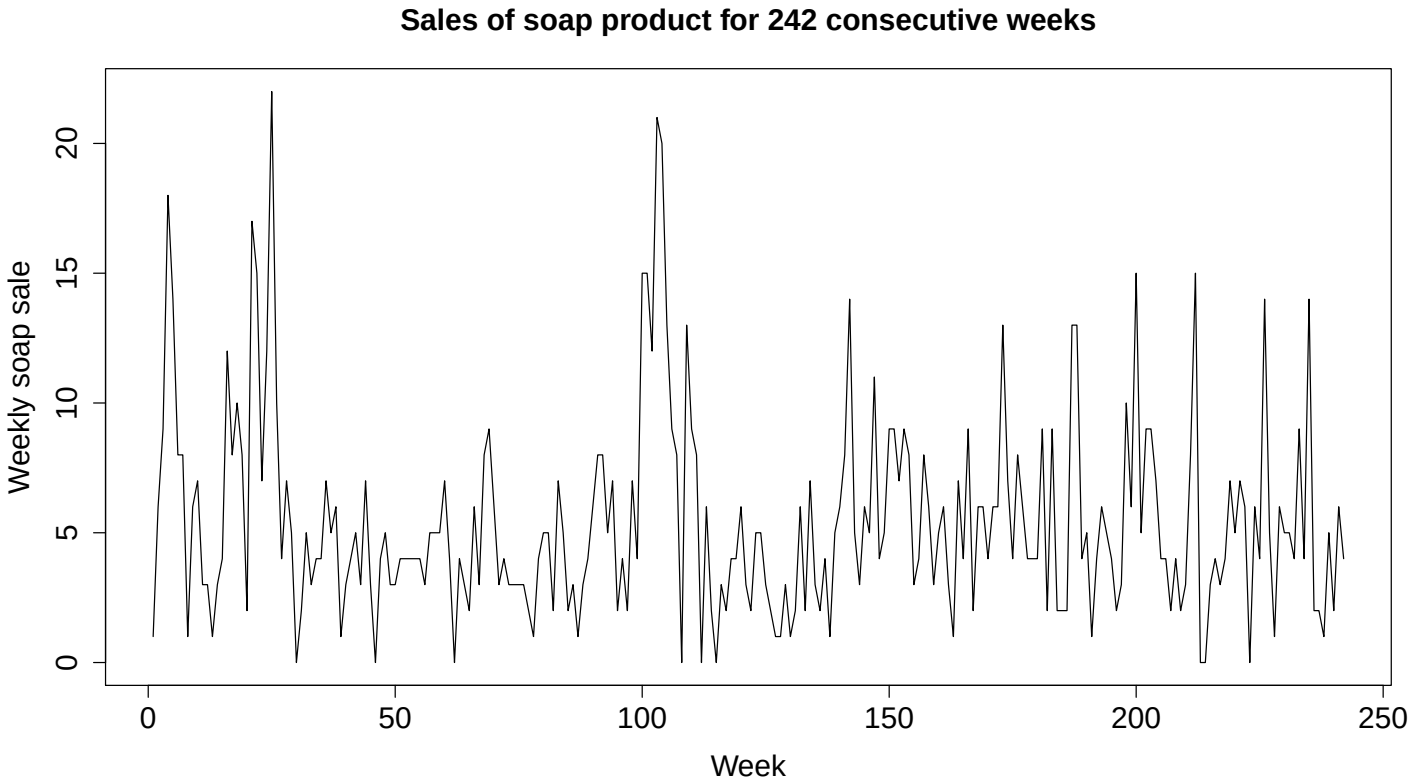
Quick remarks

- I forgot to put a hat on the parameter estimates. The estimate of $\boldsymbol{\Gamma}$ should have been denoted $\widehat{\boldsymbol{\Gamma}}$ etc.

Dataset for the exercise



Count data so Poisson seems natural. But $\bar{x} = 5.44$ and $s^2 = 15.40$, so the data is overdispersed. Also the data is serially correlated so a simple Poisson mixture will not work. HMM to the rescue.

Direct maximmization vs EM

Comparing direct maximization (DM) vs EM was the main focus of the exercise

- Similar parameter estimates was obtained
- The likelihood for the EM algorithm was a bit higher as expected
- Relates to the fact that stationarity was assumed for DM but not for EM
- In principle EM solves a harder problem, but $\boldsymbol{\delta}_0$ can be shown to be a unit vector, and m different simpler maximizations can be performed.
- For some initial parameter values the `nlm` function gave `NA` values when using the DM method.

Direct maximmization vs EM performance

- In report it is concluded that no significant difference in performance is noticed. This was a qualitative remark.
- In section 4.4 in the course text book the DM method is mentioned to converge faster than EM.
- Let's try to time the performance of the two methods using the `system.time` function in R.

Comparing performance of Direct Maximization vs EM

Direct maximization

```
   user  system elapsed
  3.732   0.000   3.740
```

```
   user  system elapsed
 28.602   0.136  28.763
```

```
   user  system elapsed
 60.595   0.092  60.747
```

EM algorithm

```
   user  system elapsed
  3.784   0.008   3.795
```

```
   user  system elapsed
 20.326   0.020  20.363
```

```
   user  system elapsed
 26.138   0.076  26.234
```

Conclusion?

- Large difference in performance for 3-state and especially 4-state models.
- EM is seen to perform much better than DM for 4-states.
- Opposite of the remarks in section 4.4 in Zucchini 09

More time left?

If time permits...