

# Lab 3

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## Assignment 1 - Normal model, mixture of normal model with semi-conjugate prior.

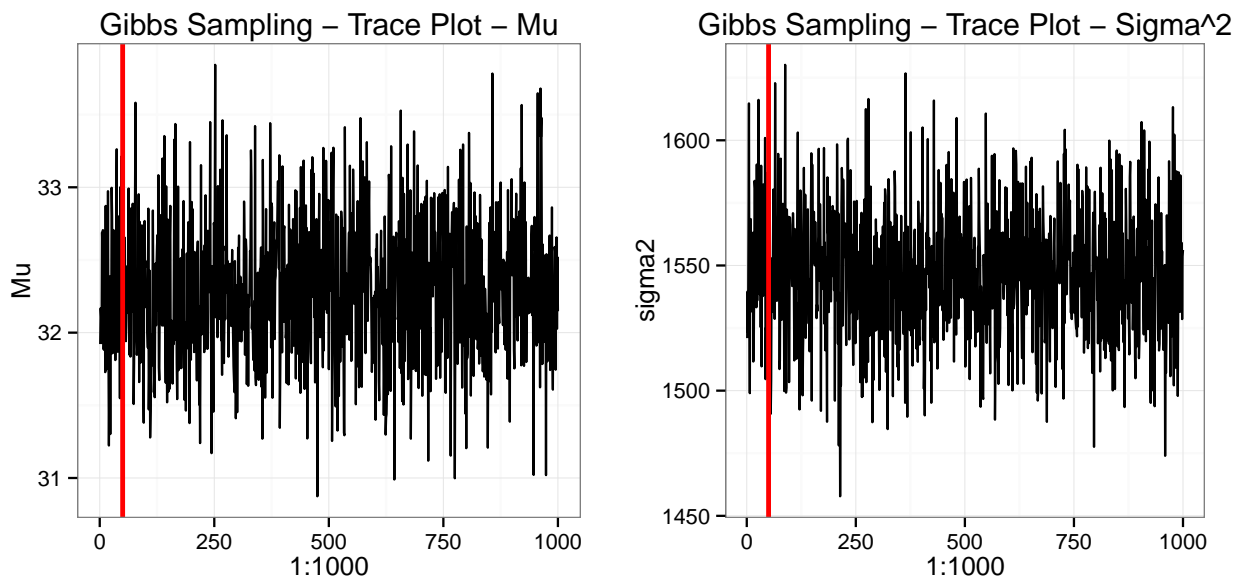
### a) Normal model.

i)

The code used to implement the Gibbs sampler that simulates from the joint posterior can be seen in the appendix *R-code*.

ii)

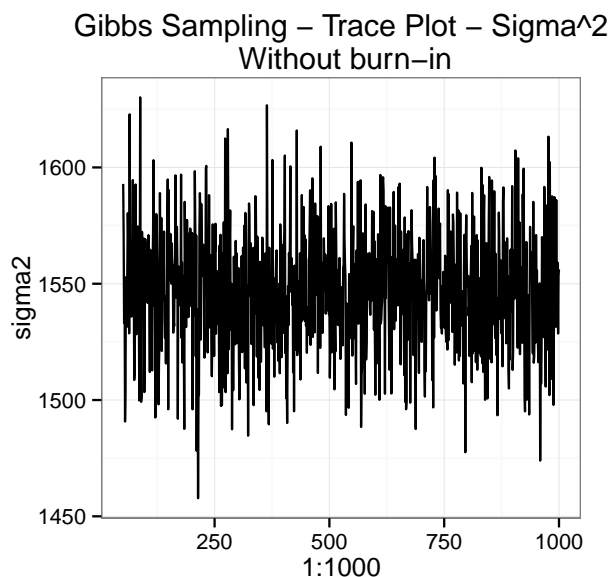
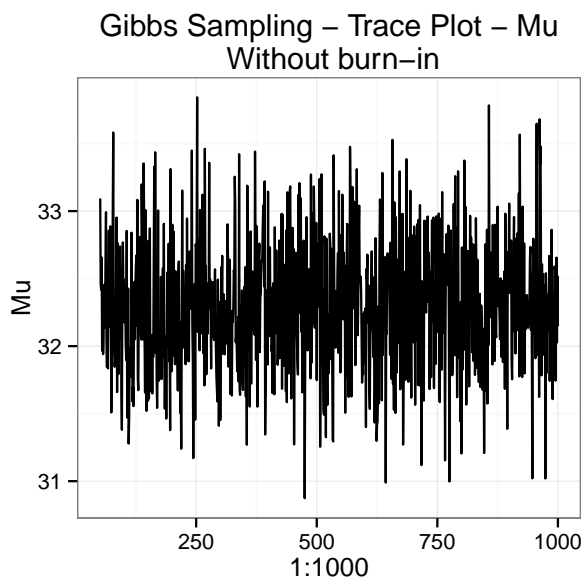
The Gibbs sampler from *i)* is tested and it is of interest to investigate the convergence of the chains. One way to check this is by trace plots.



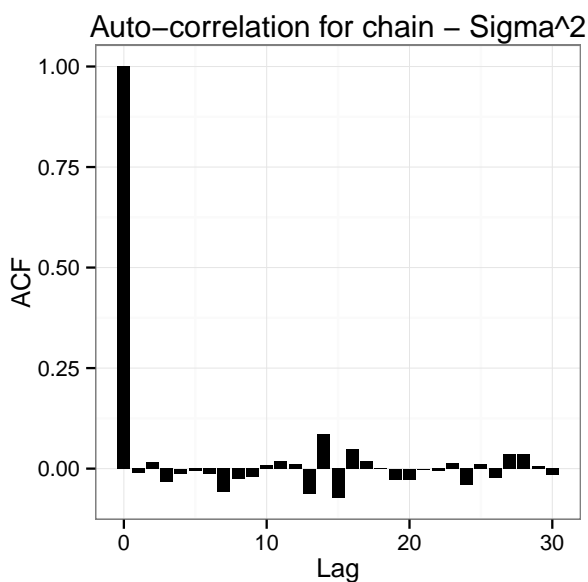
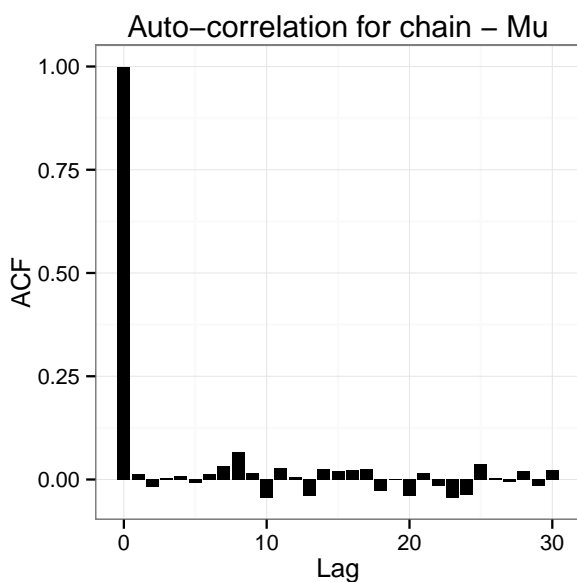
By the look of the plots above it seems like the chain has converged for both  $\mu$  and  $\sigma^2$ . The chains converges quickly and if there is a burn-in period, it is thought to be short. Out of the 1000 iterations, perhaps 50 iterations in both cases can be classified as belonging to the burn-in period. Even though it is hard to see a specific burn-in period it is reasonable to make the assumption that some proportion of the first iterations not have converged and should be discarded.

The chains are thought to have converged since they have a pattern that is...

Next, trace plots for the respective chains shown without the burn-in period.



The convergence can also be checked by looking at the autocorrelation of the chains with the burn-in removed.



Seem to move quite freely, there is no strong correlation between one iteration and the coming iterations. Does also speaks for the conclusion that convergence has been reached for both chains.

## b) Mixture normal model.

i)

Mattias's code are used for this assignment and added to the appendix at the end of the report. The prior hyperparameters are set to

Uses standard deviation of observations for assigning prior standard deviation for  $\mu$ . The variance of the observations is used for  $\sigma_0^2$  The prior mean is set to 30, close to the mean for the observations (32.27). For

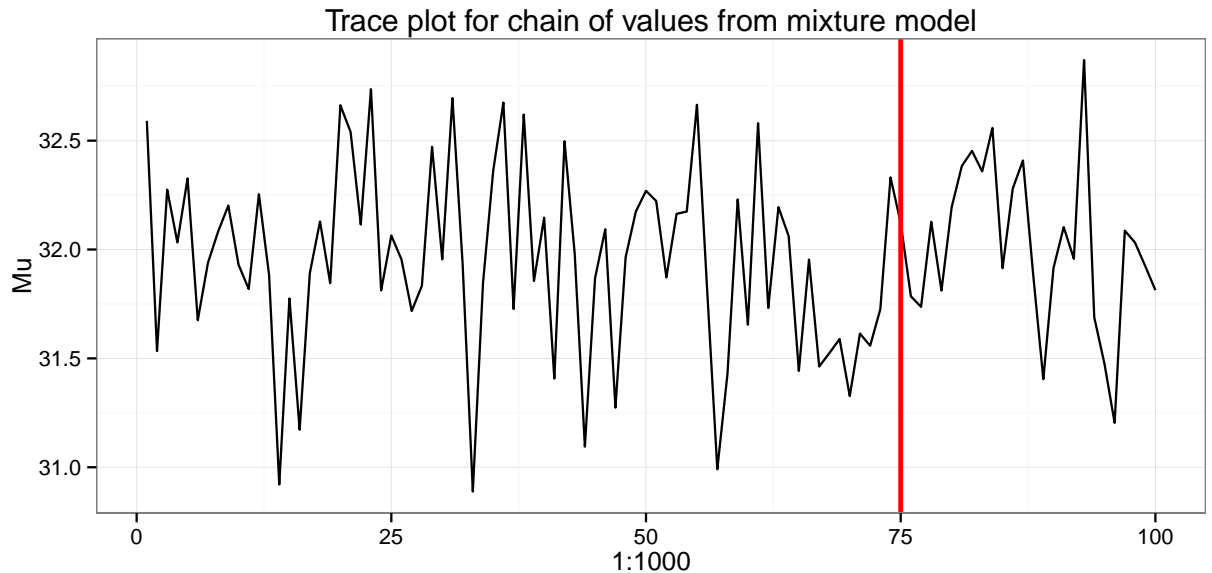
the prior on  $\sigma^2$  is the degrees of freedom set to 4.  $\alpha_0$ , the prior for the beta distribution, is set (10,10). This is a prior that is used for assigning the probability that a value belongs to the distribution.

ii)

The resulting distribution given after 1000 iterations is shown by the plot below.

Picture! It can be seen the the mixture of the two normals quite well fits the observed data.

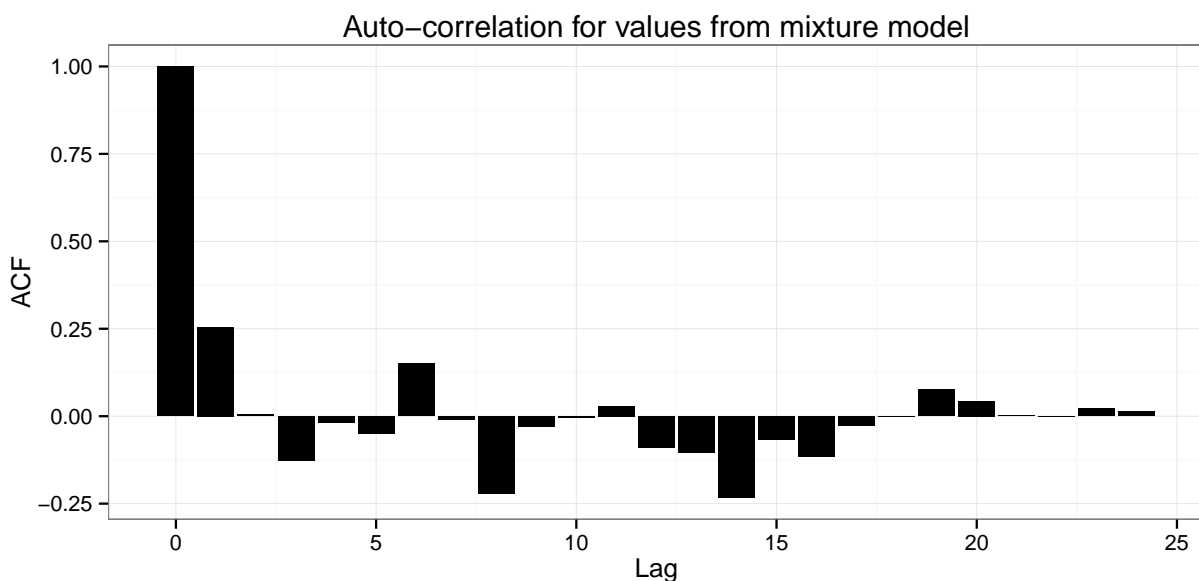
The convergence of the Gibbs sampler is analyzed by looking at a trace plot for the chain given by the mixture of



the normals.

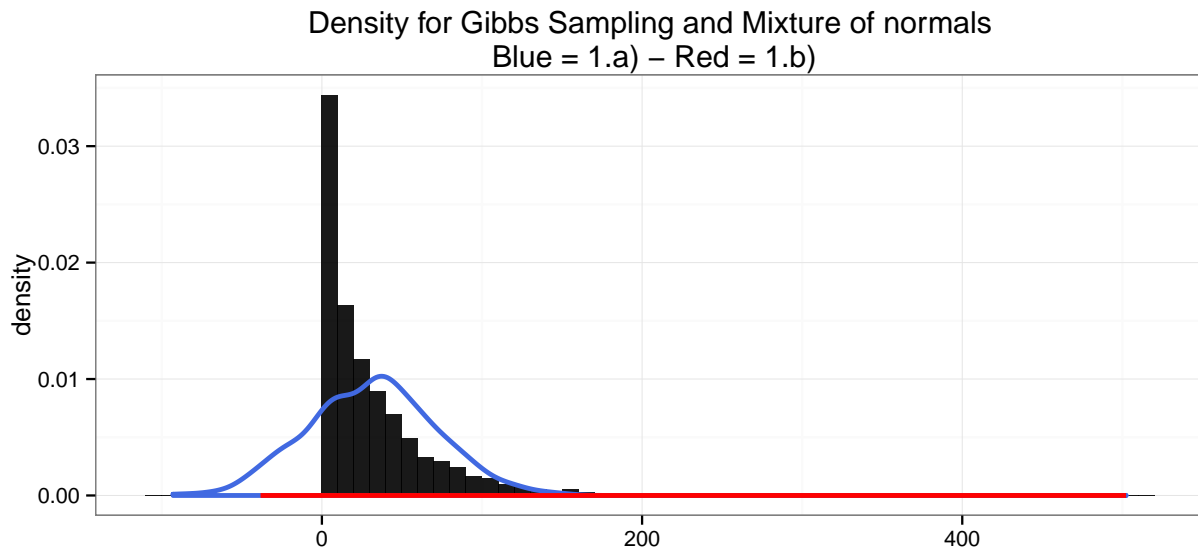
Again, it seems like the chain have converged rather rapidly. Just the first 75 observations are discarded because of the burn-in period. Convergence is thought to have been reached since...

The autocorrelation is also visualised in order to investigate the convergence of the chain.



The correlation between values from iterations close to each other is low.

c) Graphical comparison.



## Assignment 2 - Binary regression models

- a)
- b)
- c)
- d)