# Lab 10: Change Point Model

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# Contents

# Change point regression models

In this lab we will investigate another class of models which are extremely flexible in their application.

This topic can be seen as piecewise regression.

You can answer the questions and carry out the lab by filling in this RMD document.

# Stagnant Water: Change point model

$y_i$ is the log flow rate down an inclined channel, and $x_i$ is the log height of stagnant surface layers of different surfactants. The rate of decline in flow rate seems to suddenly increase around $x = 0$.

# The change point model

$$y_i \sim N(\mu_i, \sigma^2)$$

$$\mu_i = \beta_0 + \beta_1 x_i + \beta_2 (x_i - \theta) I_{(1, x_i \geq \theta,\, 0\ else)}$$

## The data

```
dataList = list(y = c(1.12, 1.12, 0.99, 1.03, 0.92, 0.90, 0.81, 0.83, 0.65, 0.67, 0.60,  0.59, 0.51, 0.
        x = c(-1.39, -1.39, -1.08, -1.08, -0.94, -0.80, -0.63, -0.63, -0.25, -0.25, -0.12, -0.12, 0.01, 0.
        N = 29)
```

## Task 1

Plot the data using ggplot

```
df = data.frame(x = dataList$x, y=dataList$y)

head(df)
```

```
##       x    y
## 1 -1.39 1.12
## 2 -1.39 1.12
## 3 -1.08 0.99
## 4 -1.08 1.03
## 5 -0.94 0.92
## 6 -0.80 0.90
```

```
library(ggplot2)
# place code here
```

Comment on the plot

## Task 2

Inspect the jags model below and answer the questions

```
model {
  for (i in 1:N) {
    y[i]      ~ dnorm(mu[i], tau)
    mu[i]   <- alpha + beta[1]*x[i] + beta[2]*(x[i] - theta)
             * step(x[i] - theta)
  }
  tau        ~ dgamma(0.001, 0.001)
  alpha      ~ dnorm(0.0, 1.0E-6)
  for (j in 1:2) {
    beta[j] ~ dnorm(0.0, 1.0E-6)
  }
  sigma     <- 1/sqrt(tau)
  theta      ~ dunif(-1.3, 1.1)
}
```

**In the expression of the analytical model we used** $I_{(1, x_i \geq \theta,\, 0\ else)}$

What jags function is used for $I$?

**A prior is placed on** $\tau$

What is the mean and variance of the prior distribution for $\tau$?

# Task 3

## Make a Jags script

Make a complete Jags script to run the model. You can use the script below and alter it to fit.

```r
library(rjags)
#Define the model:
modelString = "
model{
for(i in 1:N)
{




}



}
" # close quote for modelString
writeLines( modelString , con="TEMPmodel.txt" )

#  initsList = list( theta=thetaInit )

initsList = list(...)
# Run the chains:
jagsModel = jags.model( file="TEMPmodel.txt" , data=dataList , inits=initsList ,
                        n.chains=3 , n.adapt=500 )
list.samplers(jagsModel)

update( jagsModel , n.iter=500 )
codaSamples = coda.samples( jagsModel , variable.names=c("beta0", "beta1"),
                            n.iter=33340 )
save( codaSamples , file=paste0("lab10","Mcmc.Rdata") )

summary(codaSamples)

library(ggmcmc)
s = ggs(codaSamples)
ggs_density(s)
```

```
ggs_crosscorrelation(s)
```

## Task 4

Run the model and make point and interval estimates.

Interpret these estimates.

## Task 5

Plot the estimating lines onto the data