TDDE07 - Lab 2

Arvid Edenheim - arved490
Sophie Lindberg - sopli268

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1. Linear and polynomial regression

1a)

Before looking at the data, we came to the conclusion that the intercept should be about -10 degrees, with a cyclic temperature throughout the year and a maximum at 7 months.

μ_0 = [-10, 100, -90]

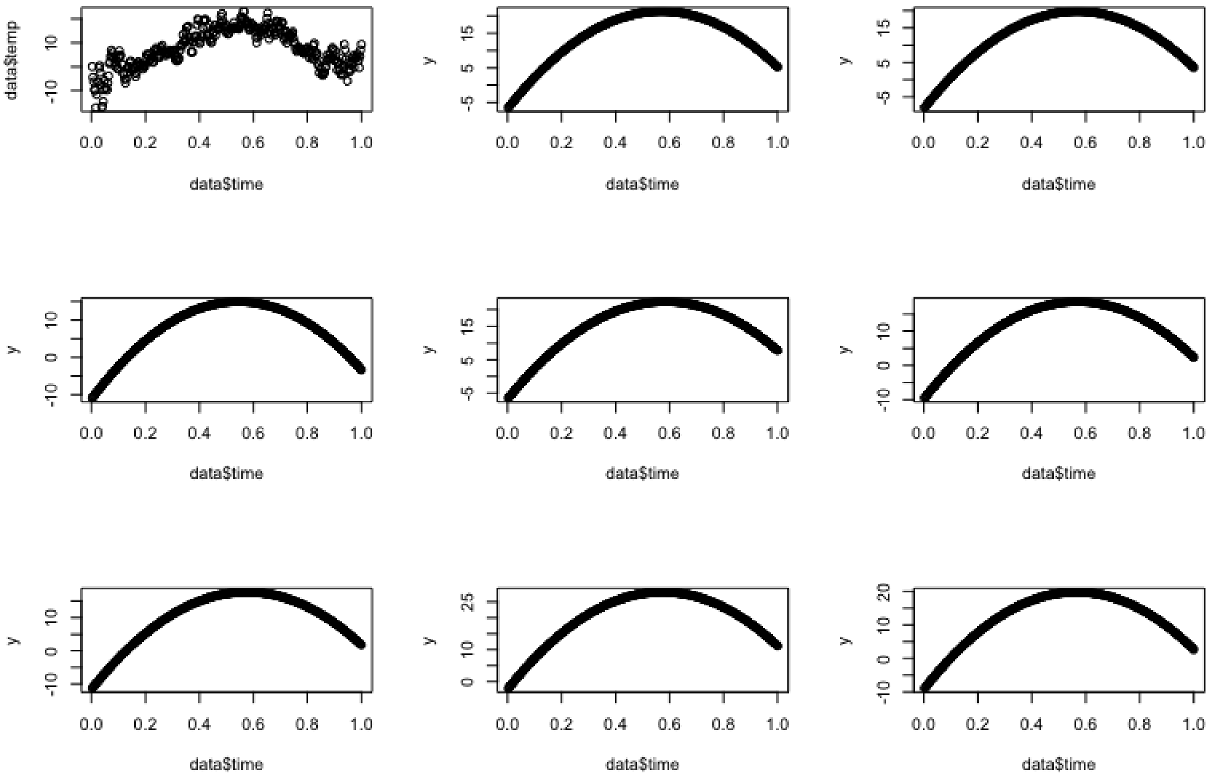

Figure 1: Plotting th chosen hyperparameters

1 - Code

```r
library(mvtnorm)
library(invgamma)
data = read.table("TempLinkoping.txt", header=TRUE)

######## A ########
I <- diag(3)
mu <- c(-10, 100, -90)
omega <- 10 * I
v <- 4
s2 <- 8
x <- seq(0, 10, by=0.01)


# Inverse chisquare from lab1
draw_sigma <- function(v, s2) {
  X_draw <- rchisq(1, v)
  return (v * s2 / X_draw)
}

# Given temperature regression function
temp <- function(beta, time) {
  return (beta[1] + beta[2] * time + beta[3] * (time ^ 2)) + rnorm(0,1)
}

par(mfrow=c(3,3))

plot(data$time, data$temp)

for (i in 1:8) {
  sigma_sq = draw_sigma(v, s2)
  beta = rmvnorm(1, mu, sigma_sq*solve(omega))
  y = temp(beta[1,], data$time)
  plot(data$time, y)
}

dev.off()


######## B ########
n_draws <- 1000
ones <- c(rep(1, length(data$time)))
x2 <- data$time^2
X <- cbind(ones, data$time, x2)
beta_hat <- solve(t(X)%*%X)%*%t(X)%*%data$temp
omega_n <- t(X) %*% X + omega
mu_n <- solve(omega_n) %*% (t(X) %*% X %*% beta_hat + omega %*% mu)

v_n <- v + length(data$time)
s2_n <- (v*s2 + (t(data$temp)%*%data$temp + t(mu)%*%omega%*%mu - t(mu_n)%*%omega_n%*%mu_n))/v_n

sigma_post = draw_sigma(v_n, s2_n)
```

```r
beta_post = rmvnorm(n_draws, mu_n, solve(omega_n)*sigma_post[1])

Y = matrix(nrow=n_draws, ncol=366)
for (i in 1:n_draws) {
  Y[i,] = temp(beta_post[i,], data$time)
}

y_med = c()
y_up = c()
y_low = c()

for (i in 1:366) {
  y_med = c(y_med, median(Y[,i]))
  y_low = c(y_low, quantile(Y[,i], 0.025))
  y_up = c(y_up, quantile(Y[,i], 0.975))
}

par(mfrow=c(1,3))
hist(beta_post[,1], freq = FALSE, xlab = "Beta 0")
hist(beta_post[,2], freq = FALSE, xlab = "Beta 1")
hist(beta_post[,3], freq = FALSE, xlab = "Beta 2")
dev.off()

plot(data$temp, type='p', col='lightgray')
lines(y_med, type='l')
lines(y_low, type='l')
lines(y_up, type='l')

######## C ########

x_max = - 366 * beta_post[,2]/(2 * beta_post[,3])
hist(x_max)

######## D ########

# Prior
# Mu_0 = [...mu, 0, 0, 0, 0] due to suspicion that the introduced variables might not be needed
# Omega_0, want low variance (high bias to avoid overfitting) => High diagonal values in omega_0for the

new_mu = c(mu_n, rep(0, 5))
new_omega <- 100 * diag(8)
new_omega[1:3,1:3] = omega_n
```

2 - Code