

Variable Selection in Functional Linear Concurrent Regression

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Introduction

This document presents an illustration of the variable selection method proposed in Ghosal and Maity (2019). The whole process is based on using the following steps.

- Using the `preprocess` function to smooth noisy covariates.
- Finally using the `FLCM.select` function, which performs variable selection from the given input data.

All the functions mentioned above are included in the source file `varselect.R`.

Required libraries

Loading the required libraries

```
library(MASS)
library(mgcv)
library(refund)
library(fda)
library(parallel)
library(grpreg)
```

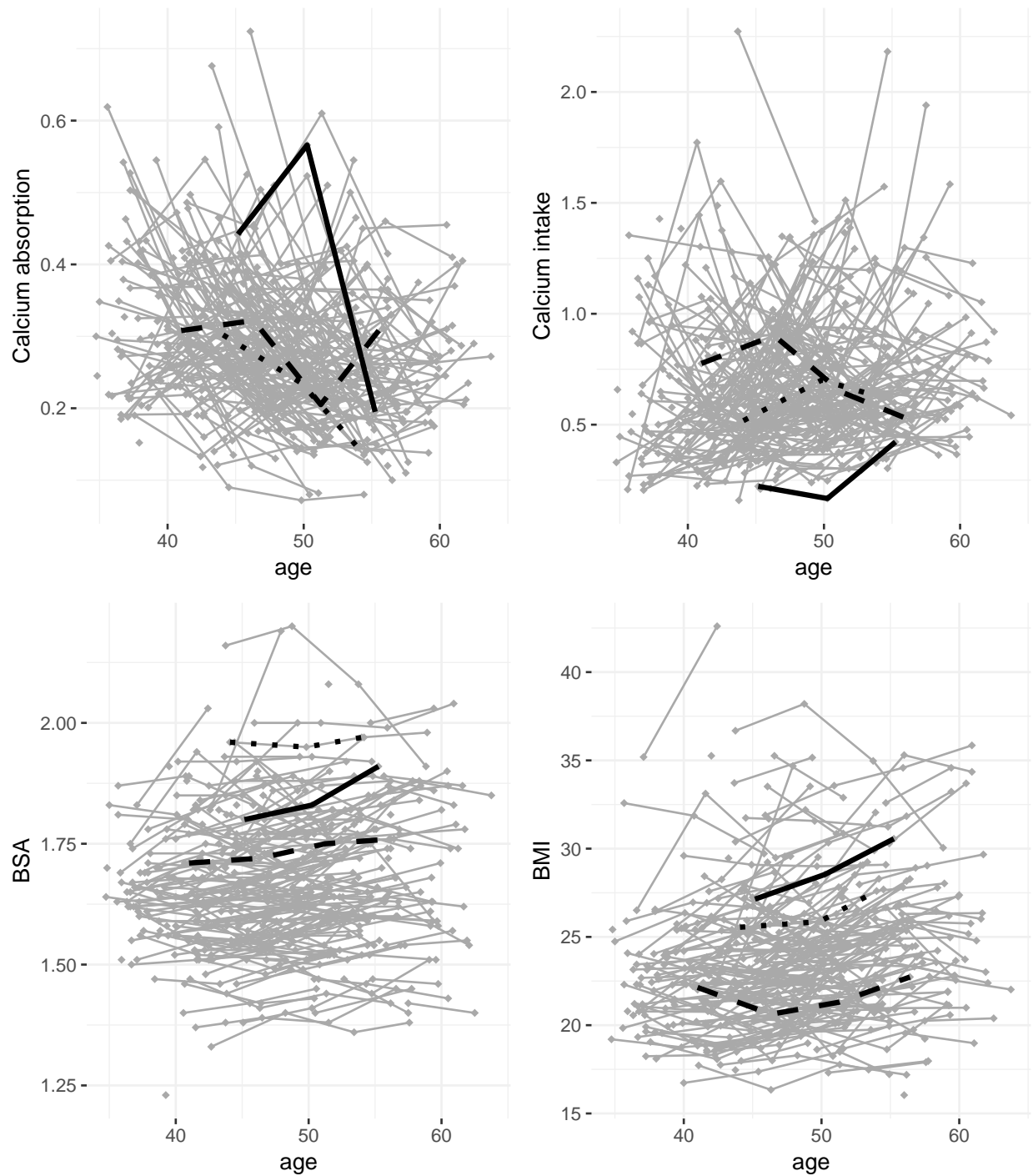
Loading and plotting the dietary calcium absorption data

```
##load calcium data
calcium<-read.csv("calcium.csv")
#####
# @ n=188, p=3                                #
# @ calabs = response
# @ caldiet = covariate
# @ bsa = covariate
# @ bmi = covariate
#####
attach(calcium)
library(ggplot2)
library(gridExtra)
temp <- data.frame(x = age[1:10], y = calabs[1:10], group=id[1:10] )
temp2 <- data.frame(x = age[1:10], y = caldiet[1:10], group=id[1:10] )
temp3 <- data.frame(x = age[1:10], y = bsa[1:10], group=id[1:10] )
temp4 <- data.frame(x = age[1:10], y = bmi[1:10], group=id[1:10] )
linet<-c()
linet[1:3]<-c("solid")
linet[4:7]<-c("dashed")
linet[8:10]<-c("dotted")
```

```

par(mfrow=c(2,2))
par(mar=c(5.1,4.1,4.1,2.1))
#setEPS()
#postscript("calciумsel.eps", width=7, height=10)
pp <- ggplot(calciум, aes(x=age, y=calabs, group=id)) +
  theme(panel.background = element_rect(fill = "white"),
        panel.grid.major = element_line(colour = "gray94"),
        panel.grid.minor = element_line(colour = "gray94")) +
  xlab("age") + ylab("Calcium absorption") + geom_line(color='dark gray') + geom_point(shape=18, color='dark gray')
pp2 <- ggplot(calciум, aes(x=age, y=caldiet, group=id)) +
  theme(panel.background = element_rect(fill = "white"),
        panel.grid.major = element_line(colour = "gray94"),
        panel.grid.minor = element_line(colour = "gray94")) +
  xlab("age") + ylab("Calcium intake") + geom_line(color='dark gray') + geom_point(shape=18, color='dark gray')
pp3 <- ggplot(calciум, aes(x=age, y=bsa, group=id)) +
  theme(panel.background = element_rect(fill = "white"),
        panel.grid.major = element_line(colour = "gray94"),
        panel.grid.minor = element_line(colour = "gray94")) +
  xlab("age") + ylab("BSA") + geom_line(color='dark gray') + geom_point(shape=18, color='dark gray') + geom_point(shape=18, color='dark gray')
pp4 <- ggplot(calciум, aes(x=age, y=bmi, group=id)) +
  theme(panel.background = element_rect(fill = "white"),
        panel.grid.major = element_line(colour = "gray94"),
        panel.grid.minor = element_line(colour = "gray94")) +
  xlab("age") + ylab("BMI") + geom_line(color='dark gray') + geom_point(shape=18, color='dark gray') + geom_point(shape=18, color='dark gray')
grid.arrange(pp, pp2, pp3, pp4, ncol=2)

```



Preprocessing the data and removing noise

```
y<-calabs      ##Response
mydata<-calcium[,c(1,2,4,5,6)] ##data in long format
names(mydata)[2]<-c("time")    ##1st column id, 2nd time, rest covariates
source('varselect.R')
#Preprocessing Covariates
```

```
mydata<- preprocess(mydata)
```

Adding simulated covariates

```
set.seed(1)                # Set seed for reproducibility
p=15                       # adding 15 simulated covariates
n=length(unique(mydata$id)) # 188
A<-matrix(0,n,p)
B<-matrix(0,n,p)
for(i in 1:n)
{for(j in 1:p)
{
  A[i,j]<-rnorm(1,0,2)
}
}
for(i in 1:n)
{for(j in 1:p)
{
  B[i,j]<-rnorm(1,0,2)
}
}
X<-function(i,j,t){A[i,j]*sqrt(2)*sin(pi*j*t/200)+B[i,j]*sqrt(2)*cos(pi*j*t/200)}

for(i in 1:527)
  for(j in 6:20)
  {
    {mydata[i,j]<- X(mydata$id[i],(j-5),mydata$time[i])}}
##Final list of Covariates
names(mydata)[-c(1:2)]

## [1] "caldiet" "bsa"      "bmi"      "V6"       "V7"       "V8"       "V9"
## [8] "V10"     "V11"     "V12"     "V13"     "V14"     "V15"     "V16"
## [15] "V17"     "V18"     "V19"     "V20"
```

Performing Variable Selection

```
#####Inputs#####
# @ y= response
# @ mydata = a dataframe in long format column 1=id, column 2 = time,
# rest of the column covariates
# @ nbasis1 = Number of basis functions for intercept
# @ nbasis  = Number of basis functions for regression functions
# @ cvl     = Length of crossvalidation grid for parameter \psi
#####
# cvl set to 10 for illustration purpose,use cvl>=100
FLCM.select(y,mydata,nbasis1=7,nbasis2=15, cvl=10)

## $scad
## [1] "caldiet"
##
```

```
## $mcp  
## [1] "caldiet"
```

Both SCAD and MCP method selects only caldiet.