```r
########
#Accompanying material to the paper:
#Garcia-Donato, Castellanos and Quirón (2021), Bayesian Variable Selection with
Applications in Health Sciences
#published in Mathematics
########

#This code contains algorithm that illustrates the use of the Gibbs sampling
#algorithm to explore the model space. For illustrative purposes, the Bayes factor
#is taken as defined by the unit information prior but you are supposed to
#make use of your own Bayes factor
#(The standard way of using BayesVarSel is much more
#efficient than this code)

library(MASS)
library(BayesVarSel)
data(UScrime)
#47 16
y<- UScrime$y
X<- UScrime[,1:15]

p<- dim(X)[2]
#Factor Bayes x Prior
B.PM<- function(model){
    data<- data.frame(y=y, X=X[,model==1])
    tt<- Btest(models=list(M1=y~., M0=y~1), prior.betas="g", priorprob="c",
data=data)
    return(tt$BFi0[1]/choose(length(model), sum(model)))
}

###
#B.PM(sample(c(1,0), rep=T, size=16))

#null model
modelsB.PM<- rep(0, p+1) #the last column contains BF*Pr(M)
modelsB.PM[p+1]<- 1 #B.PM(rep(0,p)) Null vs Null
modelsB.PM[p+2]<- 0 #Laber for each model

d.ini=8  #This is the dimension of the initial model, we have choose an
intermediate dimension, it can be modified or random generated.
current.model<- sample(c(rep(1, d.ini), rep(0, p-d.ini)))
B.PMcurrent<- B.PM(current.model)
proposal.model<- current.model

pow2=2^((p-1):0)
#matrix of unique models and BFxP(M)
modelsB.PM<- rbind(modelsB.PM, c(current.model,
B.PMcurrent,ind=c(pow2%*%current.model)))

visitedmodels.PM<- modelsB.PM[,-(p+2)]

set.seed(12)
N<- 300
```

```
for (i in 1:N){
    #cat("It:",i,"\n")
    for (j in 1:p){
        proposal.model<- current.model; proposal.model[j]<- 1-current.model[j]
        #check if it is in your list
        ind.prop=c(pow2%*%proposal.model)
        coincident<- which(modelsB.PM[,p+2]==ind.prop)
        #cat("coincident", coincident, "\n")
        if (length(coincident)==0) {B.PMproposal<- B.PM(proposal.model);
modelsB.PM<- rbind(modelsB.PM, c(proposal.model, B.PMproposal,ind.prop))}
        else B.PMproposal<- modelsB.PM[coincident, p+1]

        #B.PMproposal<- B.PM(proposal.model)
        ratio<- B.PMproposal/(B.PMproposal+B.PMcurrent)
        #cat("ratio", ratio, "\n")

        if (runif(1)<ratio) {current.model[j]<- proposal.model[j]; B.PMcurrent<-
B.PMproposal}

    }

        visitedmodels.PM<- rbind(visitedmodels.PM, c(current.model, B.PMcurrent))

}

round(colMeans(visitedmodels.PM[,-(p+1)]), 2)

#0.59 0.13 0.82 0.87 0.24 0.12 0.29 0.15 0.09 0.15 0.33 0.18 0.98 0.55 0.11


#the real
crimeBvs<- Bvs(formula=y~., n.keep=10, prior.models="S", prior.betas="g",
data=UScrime)
round(crimeBvs$inclprob, 2)
   M   So   Ed  Po1  Po2   LF  M.F  Pop   NW   U1   U2  GDP Ineq Prob Time
0.59 0.13 0.80 0.84 0.27 0.13 0.29 0.16 0.12 0.17 0.34 0.22 0.97 0.54 0.14
```