Lecture 7: R script, MAST90125 Bayesian Statistical Learning

Example one: Regression.

```
set.seed(123456)
n=100; p =2
x<-runif(100,1,5) #Generate predictor variable.
y<- -0.2+ 4*x +rnorm(100,0,1.5) #Simulate response variable
mod<-lm(y~x) #Fit model
SSE<-sum(mod$resid^2) #Estimate SSE
sigma2hat<-SSE/(100-2)#Estimate sigma^2
sigma2hat
```

```
## [1] 2.124201
```

```
#Estimating WAIC.
iter=1000 #Number of iterations
lppd<-matrix(0,100,iter) #storing log posterior predictive densities.
library(mvtnorm) #R package for drawing from multivariate normal.
```

```
## Warning: package 'mvtnorm' was built under R version 4.3.1
```

```
for(i in 1:iter){
  tau = rgamma(1,0.5*(100-2), 0.5*SSE) #Estimate inverse variance from marginal posterior.
  #Note this is just an extension of marginal posterior in lab 2, q1,
  #but 2 rather than 1 parameters are estimated.
  sigma2 = 1/tau #Convert inverse variance to variance
  #Estimate beta from conditional posterior.
  #Note by extracting vcov from lm fit, we need to remove s^2 to obtain XTXinv.
  #beta.s = rmvnorm(1,mean=mod$coef,sigma=vcov(mod)/sigma2hat*sigma2)

  beta.s<-rmvt(1, sigma=vcov(mod)/sigma2hat*sigma2, df=n-p,delta=coef(mod))
  #Estimate beta from posterior
  lppd[,i]= dnorm(y,mean=beta.s[1]+x*beta.s[2],sd=sqrt(sigma2))
  #Saving lppd for simulation s.
}
lppdest = sum(log(rowMeans(lppd))) #Estimating lppd for whole dataset.
pwaic2 = sum(apply(log(lppd),1,FUN=var)) #Estimating effective number of parameters.
#Comparing AIC and WAIC
AIC(mod)
```

```
## [1] 363.107
```

```r
WAIC= -2*lppdest + 2*pwaic2; WAIC
```

```
## [1] 362.8789
```

Example two: Bayes factor for sample proportion. $H_0 : p = 0.2$ **vs.** $H_A : p \sim U(0, 1)$**.**

```r
p0<-0.2;p1<-0.215
#Plotting the Bayes Factor for range of n.
#For illustrative purposes, y is chosen as the nearest as the nearest integer to n*p.
n=1:(200*50)
plot(n,dbinom(round(n*p1),n,p0)*(n+1),type='l',ylab='Bayes Factor',xlab='n')
abline(h=1)
```