2019122064 오다건

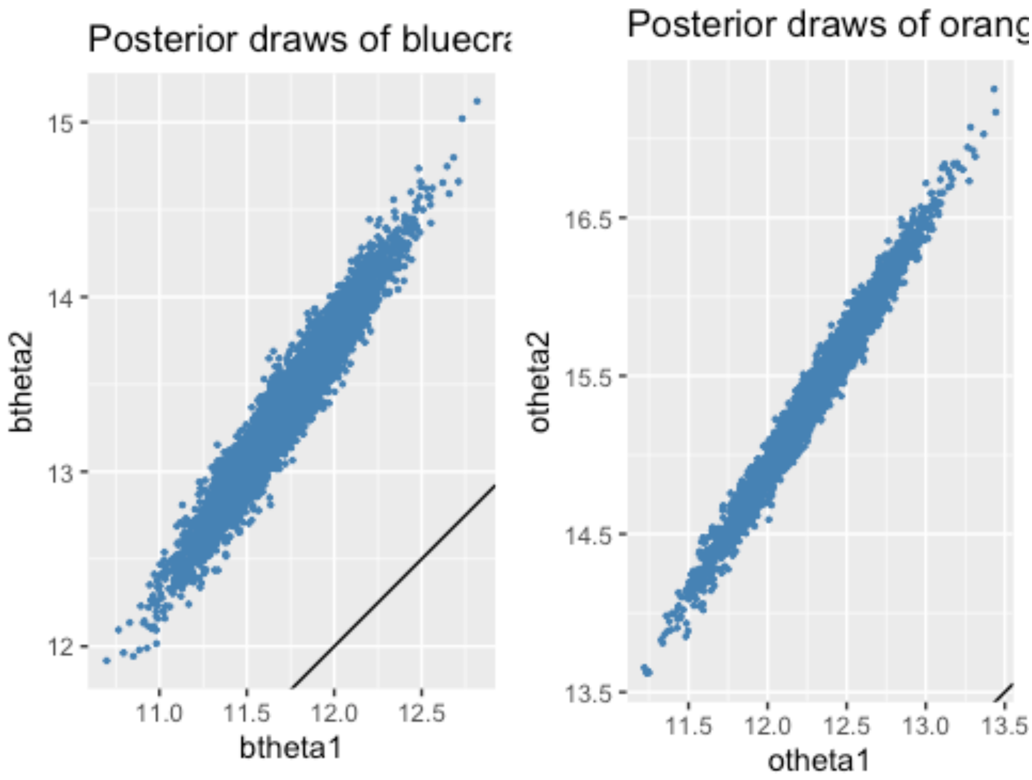
Exercise 7.3

Gibbs Sampler for each crab

```
#### Exercise 7.3
# data
bluecrab
=as.matrix(read.table(url("http://www2.stat.duke.edu/~pdh10/FCBS/Exercises/blue
crab.dat")))
orangecrab
=as.matrix(read.table(url("http://www2.stat.duke.edu/~pdh10/FCBS/Exercises/oran
gecrab.dat")))

# blue crab
n = nrow(bluecrab)
ybar = colMeans(bluecrab)
#c:array
Mu0 = c(ybar)
Sigma = cov(bluecrab)
S0 = Lambda0 = Sigma
nu0=4

# Gibbs Sampler
inv=solve #inverse matrix
S = 10000
MU = matrix(NA, nrow=S, ncol=2)
SIGMA = matrix(NA, nrow = S, ncol = 4)

for(s in 1:S){
  # update MU
  Lambdan = inv(inv(Lambda0) + n*inv(Sigma))
  Mun = Lambdan %*% (inv(Lambda0) %*% Mu0 + n*inv(Sigma) %*% ybar)
  Mu = MASS::mvrnorm(n=1, Mun, Lambdan) #pdf MASS
  #python 부분에서는

  # update Sigma
  Sn = S0 + (t(bluecrab) - c(Mu)) %*% t(t(bluecrab) - c(Mu))
  # notation -> Sn = S0 = Smu
  # Smu = sum(yi-mu)(y-mu)T
  Sigma = inv(rWishart(1, nu0+n, inv(Sn))[,,1])
  MU[s,] = Mu
  SIGMA[s,] = c(Sigma)
}
```

```r
#orange crab

n = nrow(orangecrab)
ybar = colMeans(orangecrab)
Mu0 = c(ybar)
Sigma = cov(orangecrab)
S0 = Lambda0 = Sigma
nu0=4

# Gibbs Sampler
inv=solve
S = 10000
MU1 = matrix(NA, nrow=S, ncol=2)
SIGMA1 = matrix(NA, nrow = S, ncol = 4)
for(s in 1:S){
  # update MU
  Lambdan = inv(inv(Lambda0) + n*inv(Sigma))
  Mun = Lambdan %*% (inv(Lambda0) %*% Mu0 + n*inv(Sigma) %*% ybar)
  Mu = MASS::mvrnorm(n=1, Mun, Lambdan)
  # update Sigma
  Sn = S0 + (t(orangecrab) - c(Mu)) %*% t(t(orangecrab) - c(Mu))
  # notation -> Sn = S0 = Smu
  # Smu = sum(yi-mu)(y-mu)T
  Sigma = inv(rWishart(1, nu0+n, inv(Sn))[,,1])
  MU1[s,] = Mu
  SIGMA1[s,] = c(Sigma)
}
```

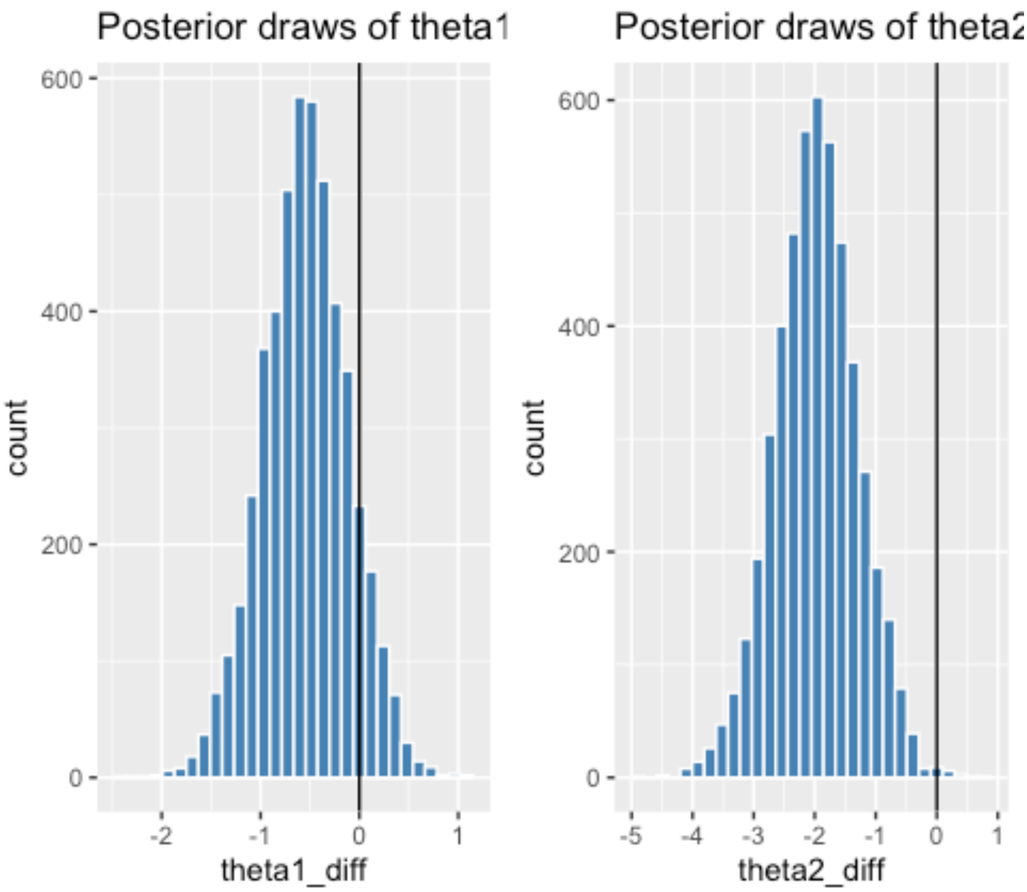
```r
library(ggplot2)
library(dplyr)
library(ggpubr)

disp=tail(1:S,S/2)
title1="Posterior draws of bluecrab size"
p1=data.frame(btheta1=MU[disp,1],btheta2=MU[disp,2]) %>%
  ggplot(aes(x=btheta1,y=btheta2))+geom_point(size=0.5,color="steelblue")+
  geom_abline(slope=1,intercept = 0)+coord_fixed(ratio=1)+labs(title = title1)

title2 = "Posterior draws of orangecrab size"
p2 = data.frame(otheta1 = MU1[disp,1], otheta2 = MU1[disp, 2]) %>%
  ggplot(aes(x=otheta1, y=otheta2))+ geom_point(size = 0.5, color
="steelblue")+
  geom_abline(slope =1, intercept = 0)+coord_fixed(ratio=1)+labs(title =
title2)

ggarrange(p1, p2)
```



(b)

```
#difference plot

title3 = "Posterior draws of theta1 difference"
theta1_diff = MU[disp, 1] - MU1[disp, 1]
p3 = data.frame(theta1_diff = theta1_diff) %>%
  ggplot(aes(x=theta1_diff))+
  geom_histogram(color = "white", fill = "steelblue", bins = 30)+
  geom_vline(xintercept = 0)+
  labs(title=title3)


title4 = "Posterior draws of theta2 differece"
theta2_diff = MU[disp, 2] - MU1[disp, 2]
p4 = data.frame(theta2_diff = theta2_diff) %>%
  ggplot(aes(x=theta2_diff))+
  geom_histogram(color = "white", fill = "steelblue", bins = 30)+
  geom_vline(xintercept = 0)+
  labs(title=title4)

ggarrange(p3, p4)


#
```

```
mean(MU[disp, 1] > MU1[disp, 1])
mean(MU[disp, 2] > MU1[disp, 2])
```




```
> mean(MU[disp, 1] > MU1[disp, 1])
[1] 0.1062
> mean(MU[disp, 2] > MU1[disp, 2])
[1] 0.0024
```

(c)

```
bcorr = apply(SIGMA, MARGIN = 1, FUN = function(SIGMA){
  SIGMA[2] / sqrt(SIGMA[1]*SIGMA[4])
})
# apply(X, MARGIN = , FUN) MARGIN 1이면 row별 적용, 2이면 col별 적용
ocorr =apply(SIGMA1, MARGIN = 1, FUN = function(SIGMA){
  SIGMA[2] / sqrt(SIGMA[1]*SIGMA[4])
})
p5 = data.frame(crab = c(rep('blue', length(bcorr)/2), rep('orange', 
length(ocorr)/2)),
                corr = c(bcorr[disp], ocorr[disp])) %>%
  ggplot(aes(x = corr, fill = crab))+
```

```
  geom_density(alpha = 0.5)+
  scale_fill_manual(values = c('blue', 'orange'))
ggarrange(p5)
mean(bcorr<ocorr)
```