STAT_205_HW3

HONGLEI REN

02/03/2020

Problem 1

Use BetaBuster to find the Beta(a,b) priors for mode 0.75 and 5th percentile 0.60, and for mode 0.01 and 99th percentile 0.02. What is the Beta prior when the mode is 1 and the first percentile is 0.80?

```
S = 100000 #Sample size
dist1 <- epi.betabuster(mode = 0.75, conf = 0.05, greaterthan = F, x = 0.6)
dist1$shape1;dist1$shape2
```

```
## [1] 23.567
```

```
## [1] 8.522333
```

```
s1 <- rbeta(S, dist1$shape1, dist1$shape2)
dist2 <- epi.betabuster(mode = 0.01, conf = 0.99, greaterthan = F, x = 0.02)
dist2$shape1;dist2$shape2
```

```
## [1] 11.035
```

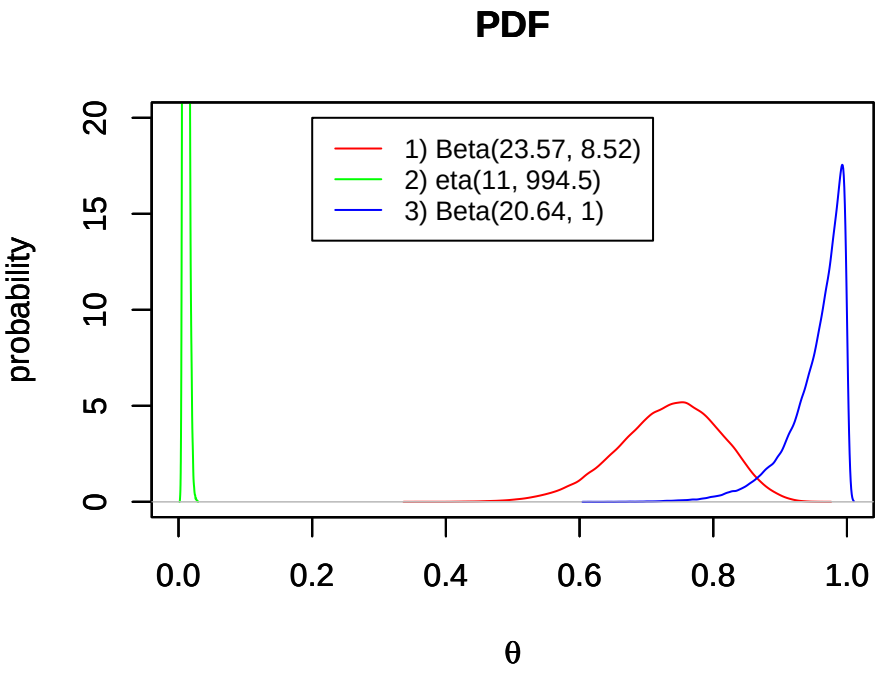
```
## [1] 994.465
```

```
s2 <- rbeta(S, dist2$shape1, dist2$shape2)
dist3 <- epi.betabuster(mode = 1, conf = 0.01, greaterthan = F, x = 0.8)
dist3$shape1;dist3$shape2
```

```
## [1] 20.638
```

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

```
s3 <- rbeta(S, dist3$shape1, dist3$shape2)

# Plotting
plot(density(s1),col="red", type="l", xlab = expression(theta), xlim=range(c(0, 1)), ylab = "probabilit
par(new=TRUE)
plot(density(s2),col="green", type="l", xlab = expression(theta), xlim=range(c(0, 1)), ylab = "probabil
par(new=TRUE)
plot(density(s3),col="blue", type="l", xlab = expression(theta), xlim=range(c(0, 1)), ylab = "probabili
legend(0.2, 20, legend=c("1) Beta(23.57, 8.52)", "2) eta(11, 994.5)", "3) Beta(20.64, 1)"),
       col=c("red", "green", "blue"), lty=1:1, cex=0.8)
```



Problem 2

2.1 Propose a model to conduct a meta-analysis

The model I considered for this study is as follows:

$$Y_i \overset{\text{ind}}{\sim} Binomial(n_i, \theta_i)$$

$$\theta_i \overset{\text{iid}}{\sim} Beta(\alpha, \beta)$$

$$\alpha, \beta \sim p(\alpha, \beta)$$

, which describes the probability of "hit" is from a prior distribution $Beta(\alpha, \beta)$, and it describes the variablity across trails.

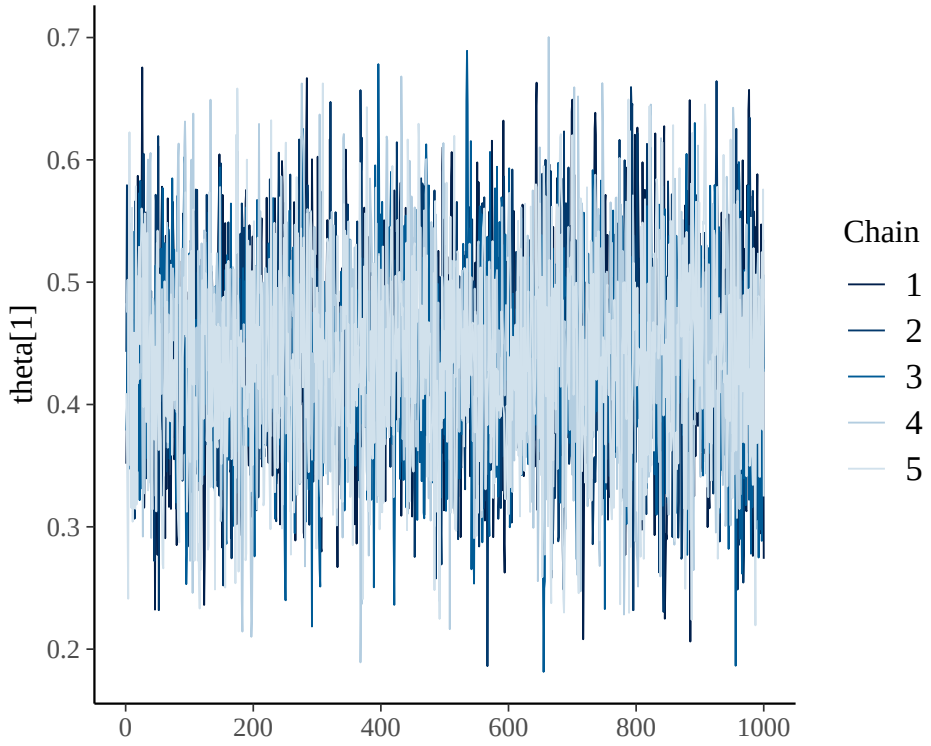
2.2 Write model in Jags

```
ESP.data=read.csv("./GanzStudiesUsed-56.csv", header=T)
head(ESP.data)
```

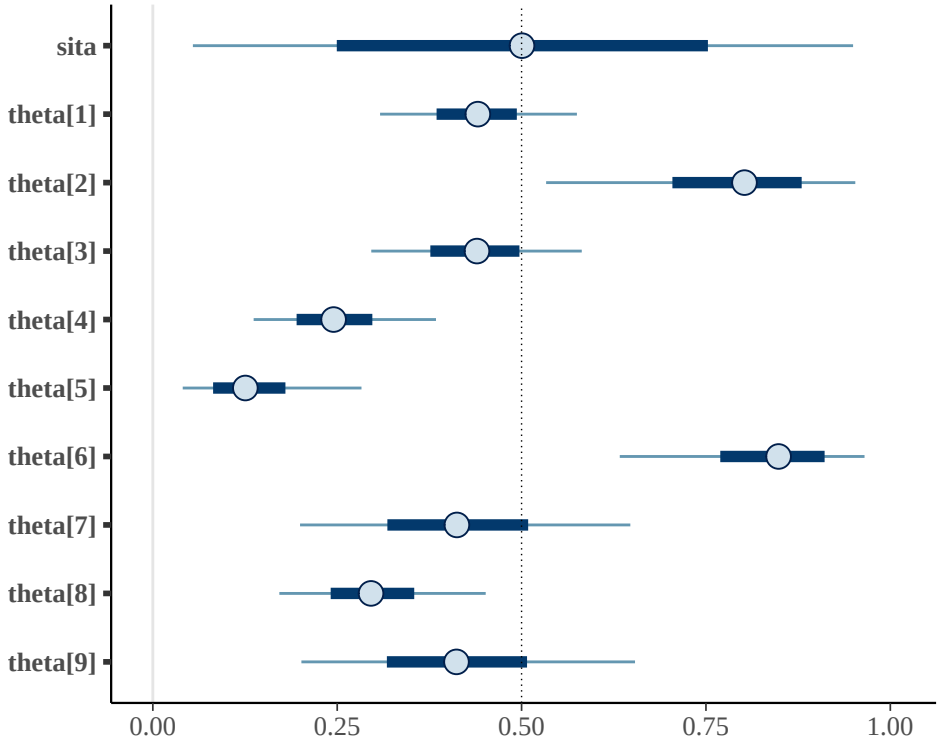
```
##    n hits
## 1 32   14
## 2  7    6
## 3 30   13
## 4 30    7
## 5 20    2
## 6 10    9
```

```
jags_model = "model{
  for (i in 1 : N){
  Y[i] ~ dbin(theta[i], n[i])
  theta[i] ~ dbeta(alpha, beta)
  }
```

```
  sita ~ dbeta(alpha, beta)
}"

jags.data = list(Y = ESP.data$hits, n = ESP.data$n, N = dim(ESP.data)[1], alpha = 1, beta = 1)
jags.param <- c("theta", "alpha", "beta", "sita")
jagsfit <- jags(data = jags.data, n.chains = 5, inits = NULL, parameters.to.save = jags.param, n.iter =

## module glm loaded

## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 56
##    Unobserved stochastic nodes: 57
##    Total graph size: 172
##
## Initializing model
jags.mcmc = as.mcmc(jagsfit)
mcmc_trace(jags.mcmc, pars = c("theta[1]"))
```




```
color_scheme_set("blue")
p1 <- mcmc_intervals(jags.mcmc, pars = c("sita", "theta[1]", "theta[2]", "theta[3]", "theta[4]",
                     "theta[5]", "theta[6]", "theta[7]", "theta[8]", "theta[9]"))
p1 + vline_at(0.5, linetype = 3, size = 0.25)
```



2.3 Choice of Priors

```
open_mind_prior <- epi.betabuster(mode = 0.25, conf = 0.95, greaterthan = F, x = 0.3)
psi_believer_prior <- epi.betabuster(mode = 0.33, conf = 0.95, greaterthan = F, x = 0.36)
psi_skeptic_prior <- epi.betabuster(mode = 0.25, conf = 0.95, greaterthan = F, x = 0.255)
```

The open-minded prior estimated is: Beta(58.825, 174.475)

The psi believer prior estimated is: Beta(100, 202)

The psi skepticr prior estimated is: Beta(100, 298)

2.4 Posterior Mean and 95% Posterior Credible Interval