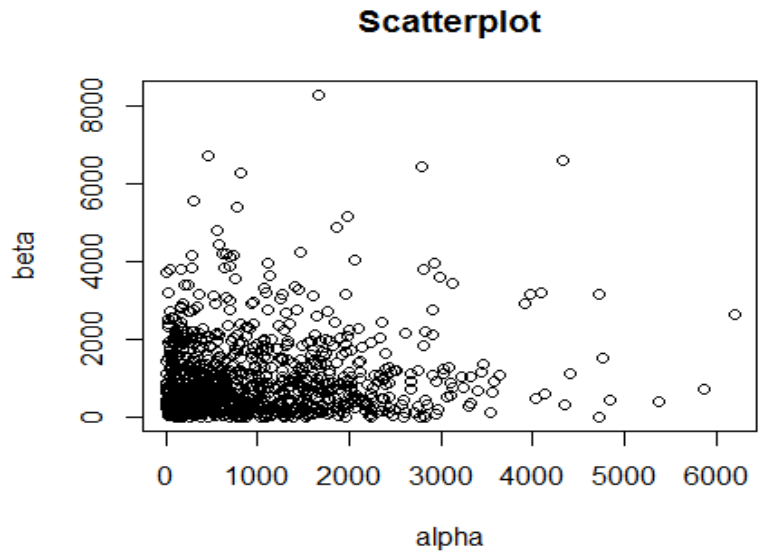
Assignment 2

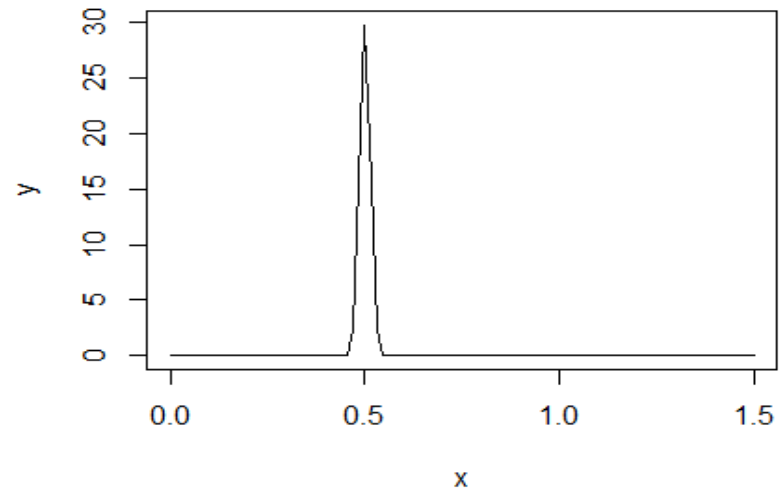
1.(a)(i)

```
> a <- rexp(1000, 0.001)
> b <- rexp(1000, 0.001)
> plot(a, b, main="Scatterplot", xlab="alpha", ylab="beta
")
```



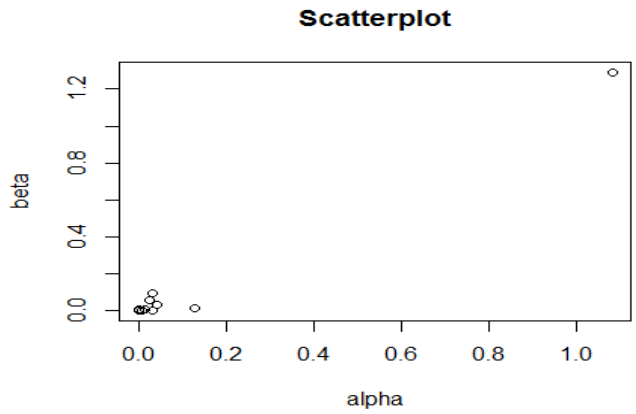
(ii)

```
> x=seq(0,1.5,length=100)
> y=dbeta(x,700,700)
> plot(x,y,type="l")
```

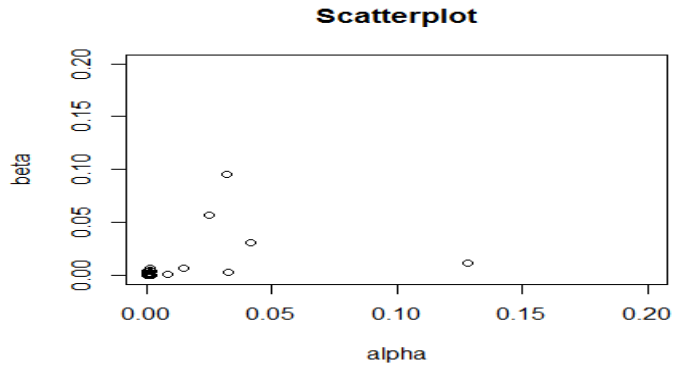


(b)(i)

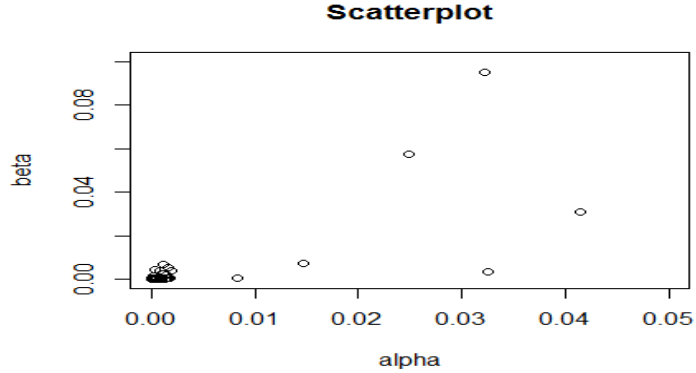
```
> phi1<-runif(1000, 0, 1)
> phi2<-runif(1000,0,1000)
> alpha<-phi1/phi2^2
> beta<-(1-phi1)/phi2^2
> plot(alpha, beta, main="Scatterplot", xlab="alpha", ylab
="beta")
```




```
> plot(alpha, beta, main="Scatterplot", xlab="alpha", ylab
="beta", xlim = c(0, 0.2), ylim=c(0, 0.2))
```

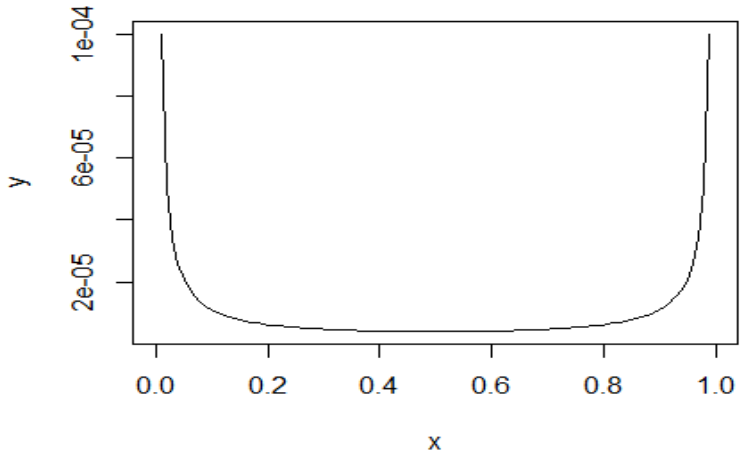



```
> plot(alpha, beta, main="Scatterplot", xlab="alpha", ylab
="beta", xlim = c(0, 0.05), ylim=c(0, 0.10))
```



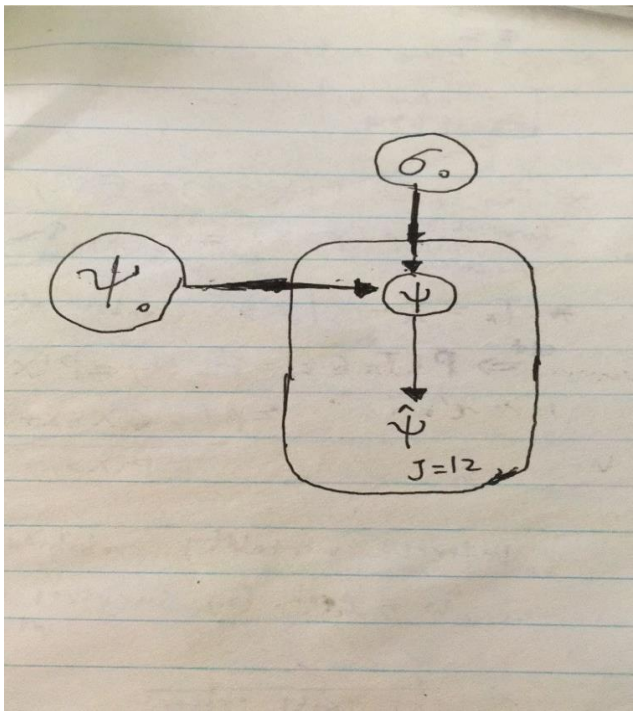
(ii)

```
> x<-seq(0,1,length=100)
> y<-dbeta(x,0.000002,0.000002)
> plot(x,y,type="l")
```



2.(a) ψ_0 and σ_0 are the hyperparameters.

(b)



(c)

model {

```
    for (j in 1:12) {
        psihat[j] ~ dnorm(psi[j],1/sigma[j]^2)
        psi[j] ~ dnorm(psi0, 1/sigmasq0)
    }

    psi0 ~ dnorm(0,1/1000^2)
    sigma0 ~ dunif(0, 1000)

    sigmasq0 <- pow(sigma0, 2)
}
```

(d)data.txt:

j	psi	sigma
1	1.055	0.373
2	-0.097	0.116
3	0.626	0.229
4	0.017	0.117
5	1.068	0.471
6	-0.025	0.120
7	-0.117	0.220
8	-0.381	0.239
9	0.507	0.186

10 0.000 0.328

11 0.385 0.206

12 0.405 0.254

```
> d <- read.table("data.txt", header = TRUE)
> m <- jags.model("a2.bug", d)
Compiling model graph
   Resolving undeclared variables
   Allocating nodes
Graph information:
   Observed stochastic nodes: 12
   Unobserved stochastic nodes: 14
   Total graph size: 70

Initializing model

  |++++++++++++++++++++++++++++++++++++++++++++++++++| 10
0%
> update(m, 12000)
  |**************************************************| 10
0%
> x <- coda.samples(m,c("psi0","sigmasq0"),n.iter = 10000
0)
  |**************************************************| 10
0%


> summary(x)

Iterations = 13001:113000
Thinning interval = 1
Number of chains = 1
Sample size per chain = 1e+05

1. Empirical mean and standard deviation for each variabl
e,
   plus standard error of the mean:

          Mean     SD  Naive SE Time-series SE
psi0     0.2878 0.1584 0.0005008      0.0005049
```

```
sigmasq0 0.3001 0.1744 0.0005516      0.0009059

2. Quantiles for each variable:

            2.5%    25%    50%    75%  97.5%
psi0     -0.02938 0.1884 0.2881 0.3872 0.6018
sigmasq0  0.11770 0.1914 0.2571 0.3555 0.7405
```

posterior expected values: psi0 0.2878

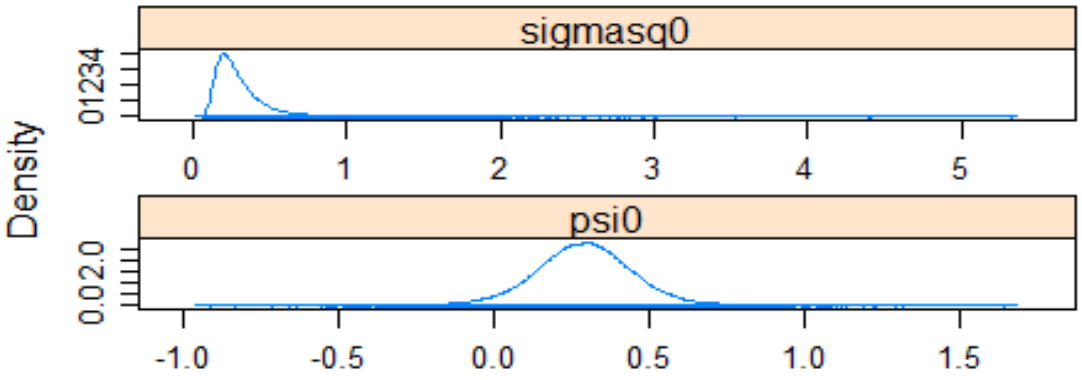
sigmasq0 0.3001

posterior standard deviations: psi0 0.1584

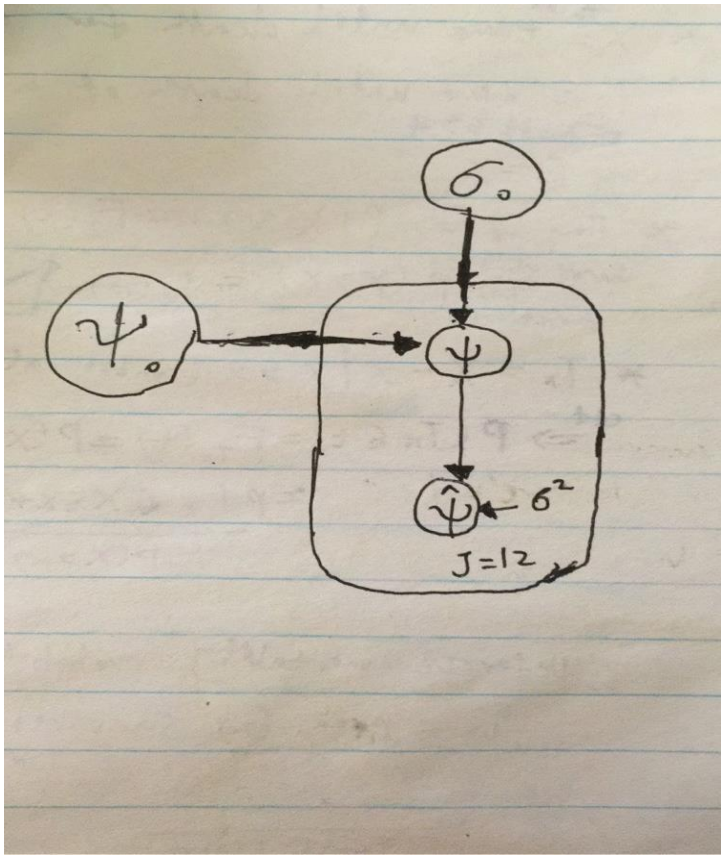
sigmasq0 0.1744

95% central posterior intervals: psi0: (-0.02938, 0.6018)

sigmasq0: (0.11770, 0.7405)



(e)(i)



(ii)

```
model {
    for (j in 1:12) {
        psihat[j] ~ dnorm(psi[j],1/sigma[j]^2+1/0.2^2)
        psi[j] ~ dnorm(psi0, 1/sigmasq0)
    }

    psi0 ~ dnorm(0,1/1000^2)
    sigma0 ~ dunif(0, 1000)

    sigmasq0 <- pow(sigma0, 2)
```

```
}


> m <- jags.model("a2.bug", d)
Compiling model graph
   Resolving undeclared variables
   Allocating nodes
Graph information:
   Observed stochastic nodes: 12
   Unobserved stochastic nodes: 14
   Total graph size: 85

Initializing model

  |++++++++++++++++++++++++++++++++++++++++++++++++++| 10
0%
> update(m, 12000)
  |**************************************************| 10
0%
> x <- coda.samples(m,c("psihat"),n.iter = 100000)
  |**************************************************| 10
0%
> summary(x)

Iterations = 13001:113000
Thinning interval = 1
Number of chains = 1
Sample size per chain = 1e+05

1. Empirical mean and standard deviation for each variabl
e,
   plus standard error of the mean:

              Mean     SD  Naive SE Time-series SE
psihat[1]   1.0551807 0.1755 0.0005549      0.0005549
psihat[2]  -0.0966936 0.1002 0.0003168      0.0003168
psihat[3]   0.6258504 0.1507 0.0004765      0.0004765
psihat[4]   0.0167642 0.1008 0.0003187      0.0003187
psihat[5]   1.0689535 0.1832 0.0005795      0.0005795
psihat[6]  -0.0251337 0.1031 0.0003261      0.0003227
psihat[7]  -0.1171585 0.1477 0.0004670      0.0004670
psihat[8]  -0.3810007 0.1534 0.0004851      0.0004851
psihat[9]   0.5060688 0.1360 0.0004301      0.0004301
```

```
psihat[10] -0.0002103 0.1706 0.0005395     0.0005318
psihat[11]  0.3850768 0.1434 0.0004535     0.0004535
psihat[12]  0.4045535 0.1571 0.0004968     0.0004968

2. Quantiles for each variable:

              2.5%     25%       50%     75%   97.5%
psihat[1]   0.71077  0.93713  1.055e+00  1.17396  1.39790
psihat[2]  -0.29363 -0.16415 -9.638e-02 -0.02903  0.09930
psihat[3]   0.33118  0.52467  6.259e-01  0.72745  0.92130
psihat[4]  -0.18022 -0.05110  1.650e-02  0.08461  0.21636
psihat[5]   0.70986  0.94582  1.069e+00  1.19249  1.42771
psihat[6]  -0.22786 -0.09487 -2.527e-02  0.04412  0.17784
psihat[7]  -0.40709 -0.21658 -1.169e-01 -0.01781  0.17203
psihat[8]  -0.68017 -0.48413 -3.809e-01 -0.27814 -0.07929
psihat[9]   0.24014  0.41393  5.061e-01  0.59770  0.77286
psihat[10] -0.33409 -0.11488  3.103e-05  0.11490  0.33498
psihat[11]  0.10319  0.28846  3.846e-01  0.48160  0.66673
psihat[12]  0.09856  0.29790  4.045e-01  0.51043  0.71278
```