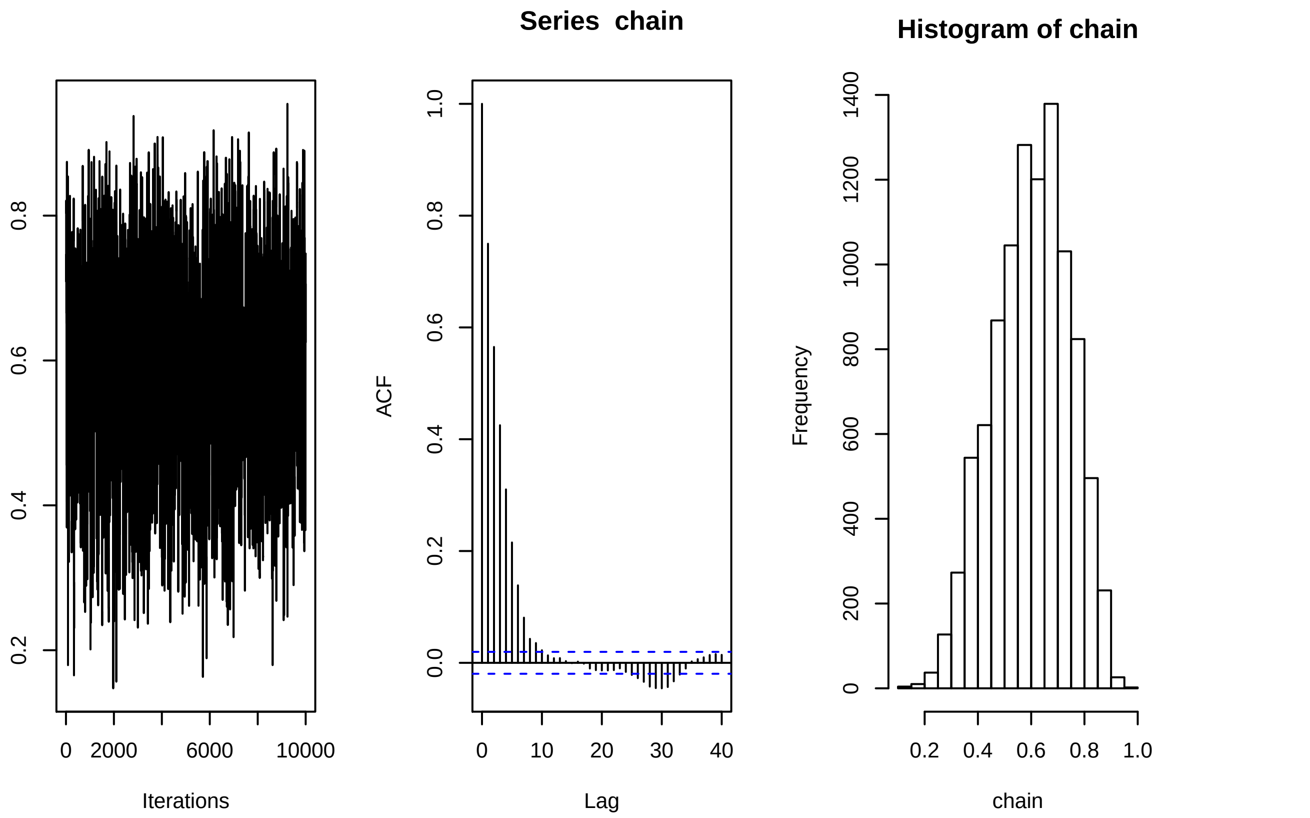
Final 37810

Shiting Zhu, Lijing Wang, Jingting Li

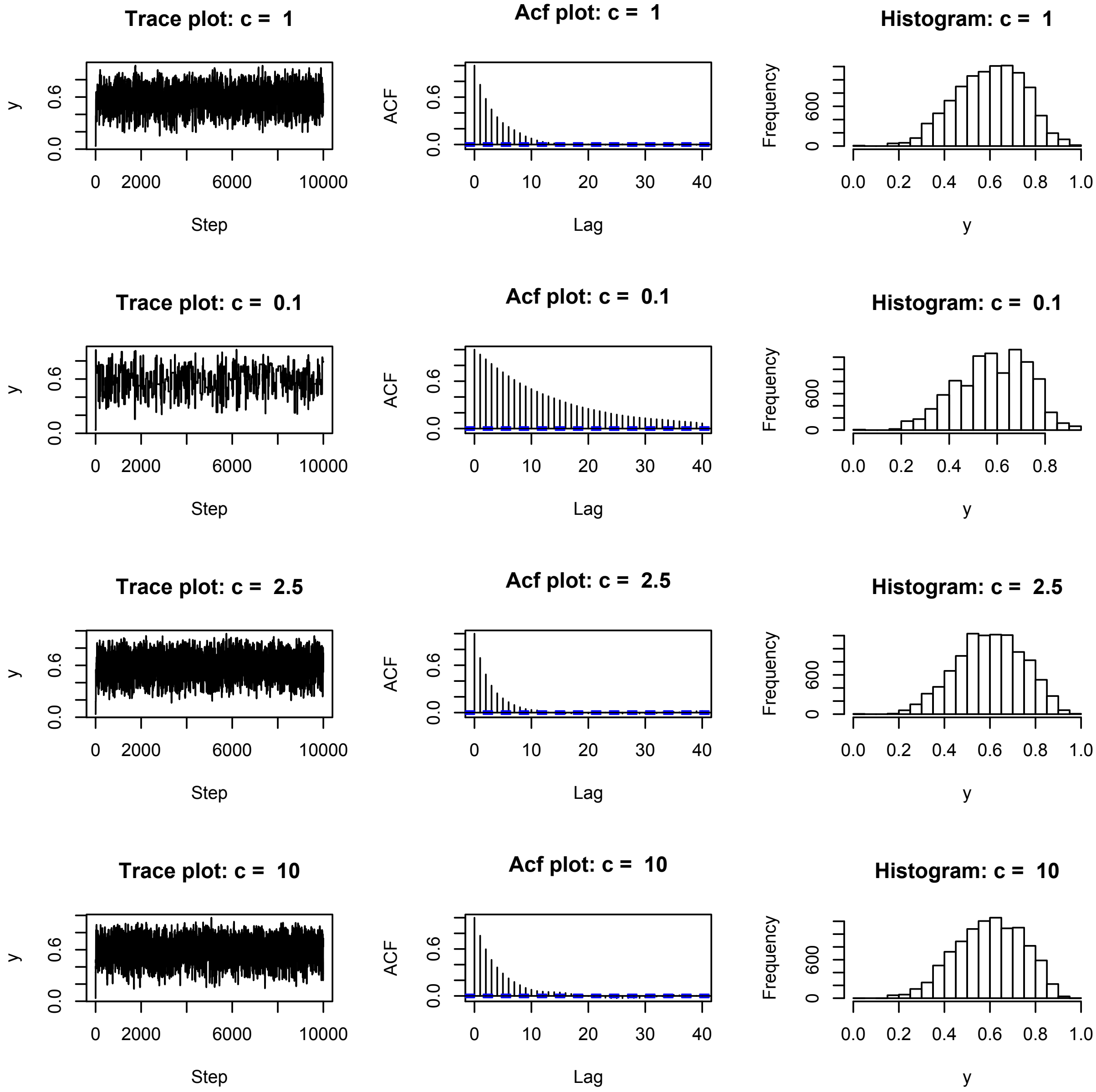
November 1, 2015

Question 1

```
library(coda)
Alpha <- 6
Beta <- 4
# phi cannot be 0 or 1
phi <- function(c,oldphi){
  newphi = 0
  while (newphi == 0 || newphi == 1){
  newphi = rbeta(1,c*oldphi,c*(1-oldphi))
  }
  return(newphi)
}

run_metropolis_MCMC <- function(startvalue,c,iterations){
  chain = rep(0, iterations+1)
  chain[1] = startvalue
  for (i in 1:iterations){
    phi = phi(c,chain[i])
    proposal = dbeta(chain[i],c*phi,c*(1-phi))/dbeta(phi,c*chain[i],c*(1-chain[i]))
    posterior = dbeta(phi,Alpha,Beta)/dbeta(chain[i],Alpha,Beta)
    probab = proposal*posterior
    if (runif(1) < probab){
      chain[i+1] = phi
    }else{
      chain[i+1] = chain[i]
    }
  }
  return(chain)
}

startvalue = runif(1)
chain = run_metropolis_MCMC(startvalue,1, 10000)
acceptance = 1-mean(duplicated(chain))

par(mfrow=c(1,3))  #1 row, 3 columns
traceplot(as.mcmc(chain)); acf(chain); hist(chain)  #plot commands
```



```
Cs <- c(1, 0.1, 2.5, 10)
result <- sapply(Cs, run_metropolis_MCMC, startvalue = startvalue,iterations = 10000)


graph <- function(Cs){
  n = length(Cs)
  par(mfrow = c(n, 3))
  for( i in 1:n ) {
  traceplot(as.mcmc(result[,i]), type="l", main = paste("Trace plot: c = ", Cs[i]), xlab="Step", ylab="
  acf(result[,i], main = paste("Acf plot: c = ", Cs[i]))
  hist(result[,i], main = paste("Histogram: c = ", Cs[i]), xlab="y")
  }
}

# Always got error complaining plot exceeds margin.
# graph(Cs)
```



Gibbs Part

Gibbs Sampling

```
Gibbs_<-function(x0,y0,iterations,B=5,burnIn=0)
## 5 parameters are needed in this function, with B=5 and burnIn=0 by default
{
  if(x0>0&&x0<B&&y0>0&&y0<B)
## to check whether the starting values are in the domain.
  {
    x<-c(x0,rep(NA,iterations-1))
## Initialize the Markov chain
```

```
    y<-c(y0,rep(NA,iterations-1))
## Initialize the Markov chain
    for(i in 1:(iterations-1))
    {
      x[i+1]<-(-log(1-runif(1)*(1-exp(-y[i]*B)))/y[i])
## use inverse transform sampling to draw sample from conditional distribution
## p(x^{i+1}|y^{i})
      y[i+1]<-(-log(1-runif(1)*(1-exp(-x[i+1]*B)))/x[i+1])
## use inverse transform sampling to draw sample from conditional distribution
## p(y^{i+1}|x^{i+1})
    }
    if(burnIn>0)
    {
        x<-x[-(1:burnIn)]
        y<-y[-(1:burnIn)]
        print(length(x))
## discard the first bunch of draws for the burn-in process
    }
    return(data.frame(x,y))
  }
 else
   stop("Initial values incorrect")
## print the information for incorrect starting values
}
```