STAT 679 HW2

Shuo Niu

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# Question 3 Part C

### Simulate Data

number = 100  
# x1  
x1 <- rpois(n = number,lambda = exp(-1))  
# x2  
x2 <- rep(0,number)   
for(i in 1:number) x2[i] <- rpois(1,exp(-1-0.5\*x1[i]))  
# x3  
x3 <- rep(0,number)   
for(i in 1:number) x3[i] <- rpois(1,exp(-1-0.5\*x2[i]))  
# x4  
x4 <- rep(0,number)   
for(i in 1:number) x4[i] <- rpois(1,exp(-1-0.5\*x1[i]-0.5\*x3[i]))

### Algorithm for Parameter Estimation

# theta\_1  
model1 <- glm(x1~1,family = poisson())  
res <- model1$coefficients  
names(res) = c("x1")  
print(res)  
  
# theta\_2 theta\_12  
model2 <- glm(x2~x1,family = poisson())  
res <- model2$coefficients  
names(res) = c("x2","x12")  
print(res)  
  
# theta\_3 theta\_23  
model3 <- glm(x3~x2,family = poisson())  
res <- model3$coefficients  
names(res) = c("x3","x23")  
print(res)  
# theta\_4 theta\_14 theta\_34  
model4 <- glm(x2~x1+x3,family = poisson())  
res <- model4$coefficients  
names(res) = c("x4","x14","x34")  
print(res)

### Parameter Estimation With n = 100

## x1   
## -1.021651

## x2 x12   
## -0.7540081 -0.4848207

## x3 x23   
## -1.210481 -0.163108

## x4 x14 x34   
## -0.73332472 -0.47236028 -0.09244032

### Parameter Estimation With n = 10000

## x1   
## -0.9786982

## x2 x12   
## -0.9945885 -0.4873089

## x3 x23   
## -0.9824617 -0.5286428

## x4 x14 x34   
## -0.8586345 -0.4821315 -0.5427216

# Question 6 Part D

#### Algorithm for Graph 1

fdis1 <- function(x){  
 return (exp(sum(x)+0.5\*(x[1]\*x[2]+x[1]\*x[3]+x[1]\*x[4])))  
}  
  
metropolis\_1 <- function(n=100){  
 res <- matrix(rep(0,n\*4),ncol = 4)  
 x = res[1,]  
 for(i in 2:n){  
 newx = rbinom(4,1,0.5)  
   
 u = runif(1)  
 a <- min(1,fdis1(newx)/fdis1(x))  
 if (u < a) x = newx  
 res[i,] = x  
 }  
 return (res)  
}

#### Algorithm for Graph 1

fdis2 <- function(x){  
 return (exp(sum(x)+0.5\*(x[1]\*x[2]+x[2]\*x[3]+x[3]\*x[4]+x[1]\*x[4])))  
}  
  
metropolis\_2 <- function(n=100){  
 res <- matrix(rep(0,n\*4),ncol = 4)  
 x = res[1,]  
 for(i in 2:n){  
 newx = rbinom(4,1,0.5)  
   
 u = runif(1)  
 a <- min(1,fdis2(newx)/fdis2(x))  
 if (u < a) x = newx  
 res[i,] = x  
 }  
 return (res)  
}

#### Result for graph1

## [1] "Graph1 with 100 simulations, ths marginal probability of each x\_i ==1 are: "

## [1] 0.87 0.70 0.82 0.78

## [1] "Graph1 with 1000 simulations, ths marginal probability of each x\_i ==1 are: "

## [1] 0.894 0.837 0.810 0.854

## [1] "Graph1 with 10000 simulations, ths marginal probability of each x\_i ==1 are: "

## [1] 0.9030 0.8274 0.8190 0.8143

#### Result for graph2

## [1] "Graph2 with 100 simulations, ths marginal probability of each x\_i ==1 are: "

## [1] 0.86 0.91 0.88 0.92

## [1] "Graph2 with 1000 simulations, ths marginal probability of each x\_i ==1 are: "

## [1] 0.836 0.810 0.809 0.841

## [1] "Graph2 with 10000 simulations, ths marginal probability of each x\_i ==1 are: "

## [1] 0.8650 0.8598 0.8668 0.8667