S2208 MATH8050 Data Analysis - Section 001: Homework 7 Due on 10/26/22

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```
# load packages

library(ggplot2)
library(stats)
library(ISLR2)
library(AR)

sessionInfo()
```

Solutions

Question1

1a

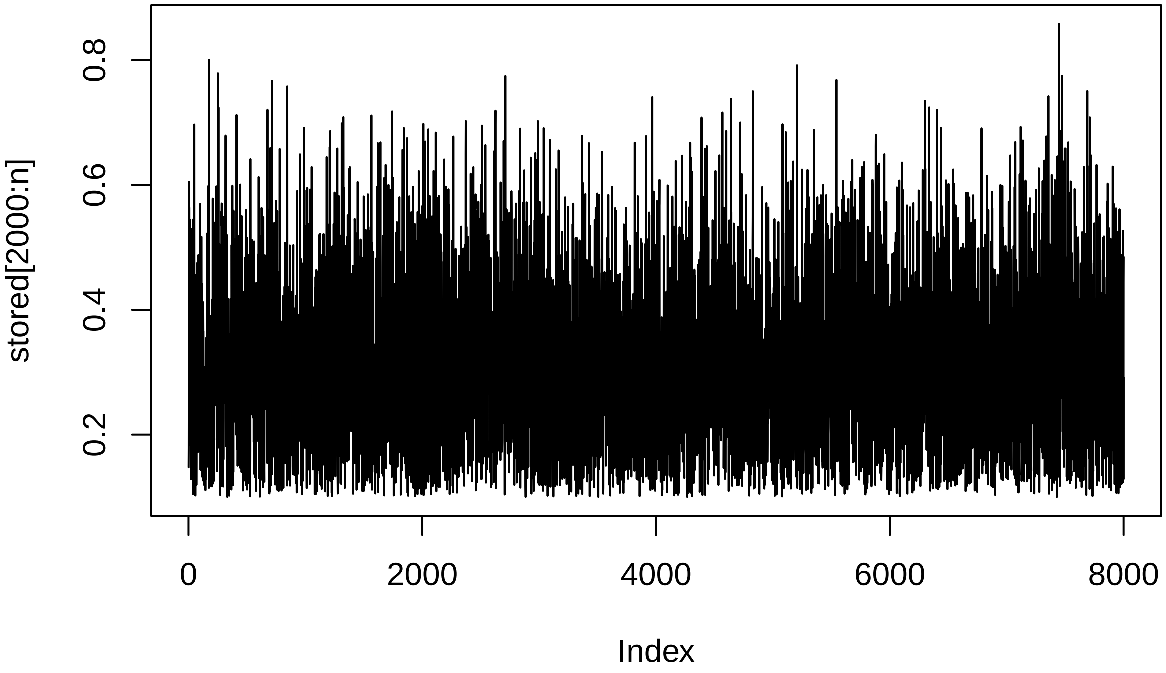
```
set.seed(150)

f<-function(x,a=2.7,b=6.3){
  return((x^(a-1))*((1-x)^(b-1)))
}
```

```
set.seed(150)

n <- 10^4
stored <- rep(NA,n)
accept.count <- 0
accepted <- rep(NA,n)

while(TRUE){
  previous <- rbeta(1,2,6)
  if(previous>=0.1 && previous<=0.9){
    break;
  }
}
```

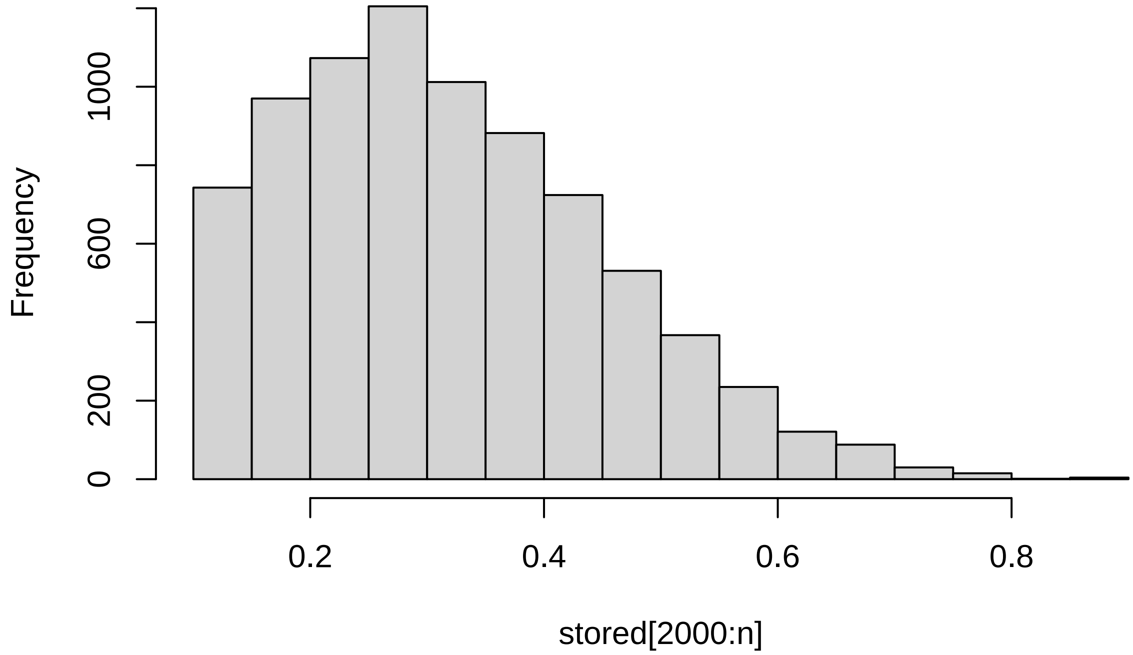
```
for(i in 1:n){
  while(TRUE){
    present_value=rbeta(1,2,6)
    if(present_value>=0.1 && present_value<=0.9){
      break;
    }
  }

  ratio=min(1,(f(present_value)/dbeta(present_value,2,6))/
              (f(previous)/dbeta(previous,2,6)))
  accept=runif(1) < ratio
  stored[i]<-ifelse(accept,present_value,previous)
  previous=stored[i]
  if(accept){
    accepted[i]=present_value
  }
}

acceptance <- length(accepted[!is.na(accepted)])/n

acceptance
```

```
## [1] 0.845
```

```
plot(stored[2000:n],type='l')
```



```r
hist(stored[2000:n],main="")
```

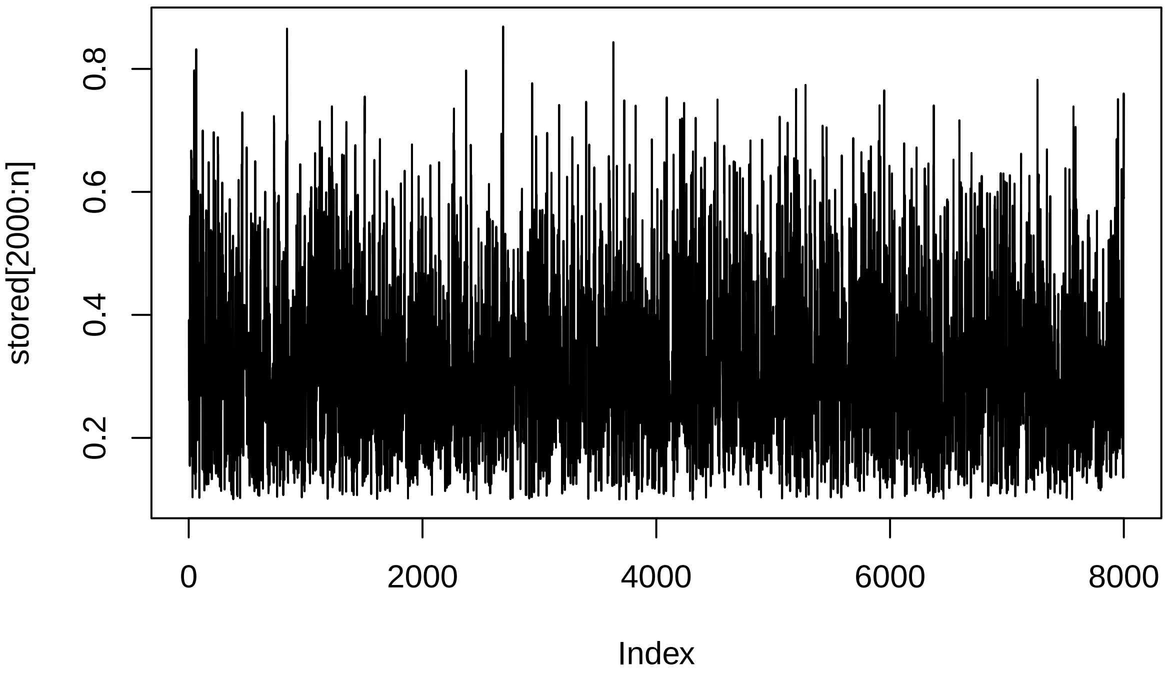


1b

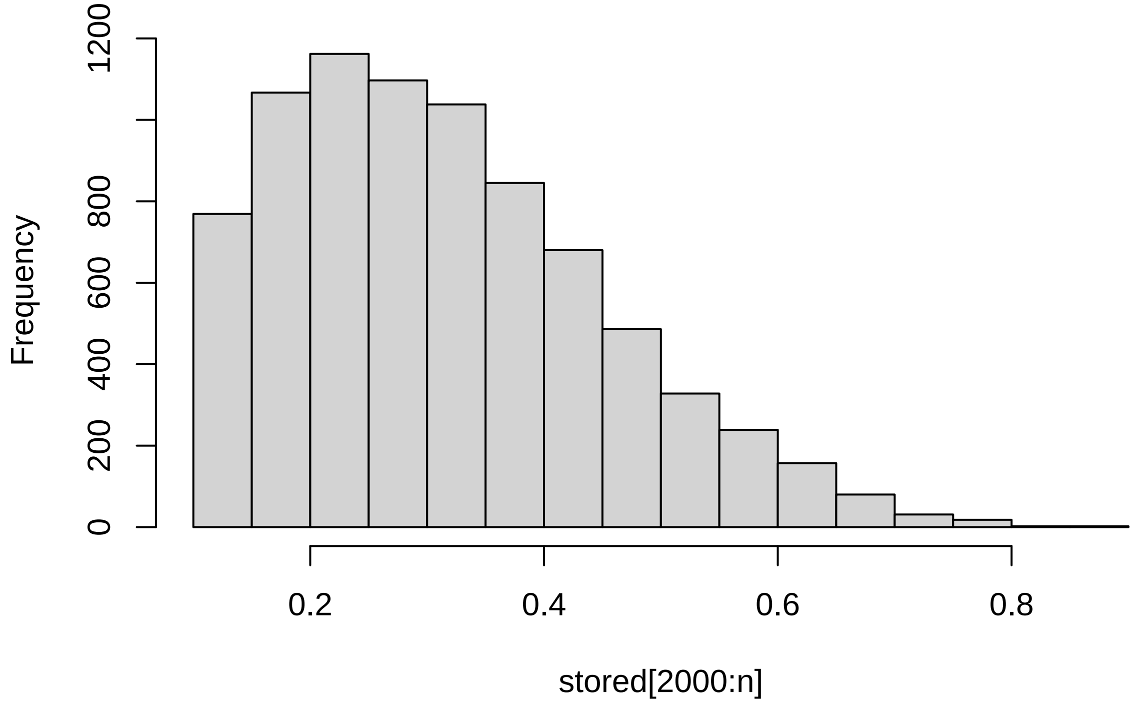
```r
n = 10^4
stored <- rep(NA, n)
accept.count=0
accepted1<-rep(NA,n)
previous=runif(1,0.1,0.9)
for(i in 1:n){
  present_value = runif(1,0.1,0.9)
  ratio <- min(1, (f(present_value)/1) / (f(previous)/1))
  accept <- runif(1) < ratio
  stored[i] <- ifelse(accept, present_value, previous)
  previous <- stored[i]

  if(accept){
    accepted1[i] <- present_value
  }
}

acceptance <- length(accepted[!is.na(accepted)])/n

acceptance
```

```
## [1] 0.845
```

```
plot(stored[2000:n], type='l')
```



```
hist(stored[2000:n],main="")
```



1c

```
length(accepted[accepted>0.5])/length(accepted)
```

```
## [1] 0.2293
```

Therefore, $P(X > 0.5) = 0.5629$

```
length(accepted1[accepted1>0.5])/length(accepted1)
```

```
## [1] 0.5526
```

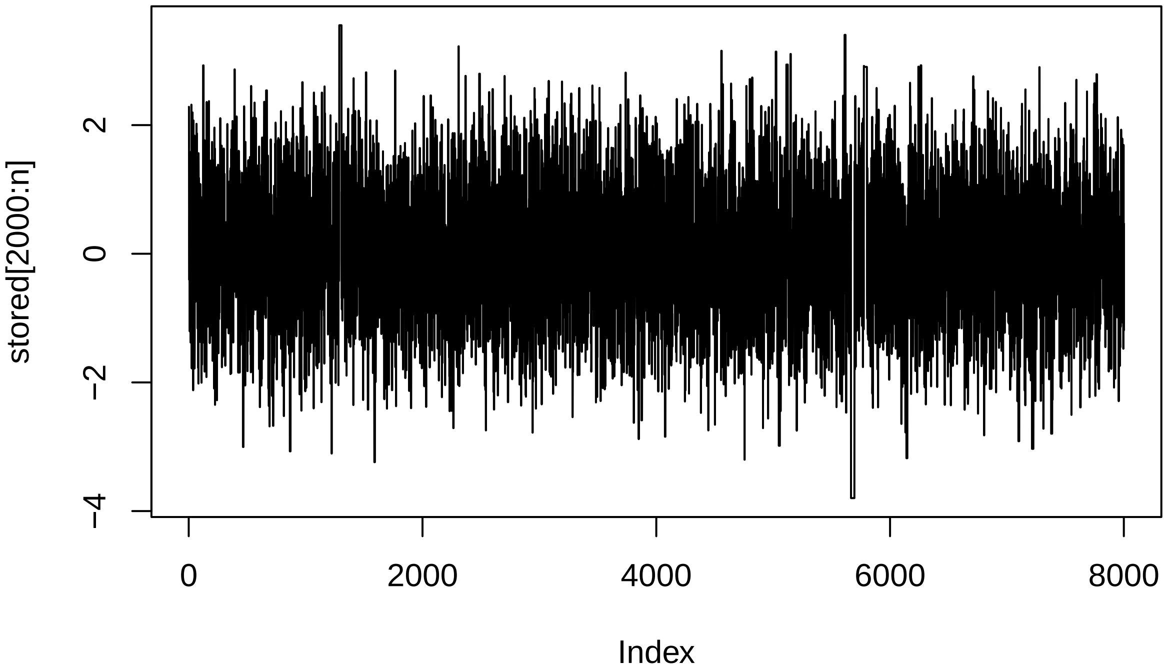
Therefore, $P(X > 0.5) = 0.5617$

Question2

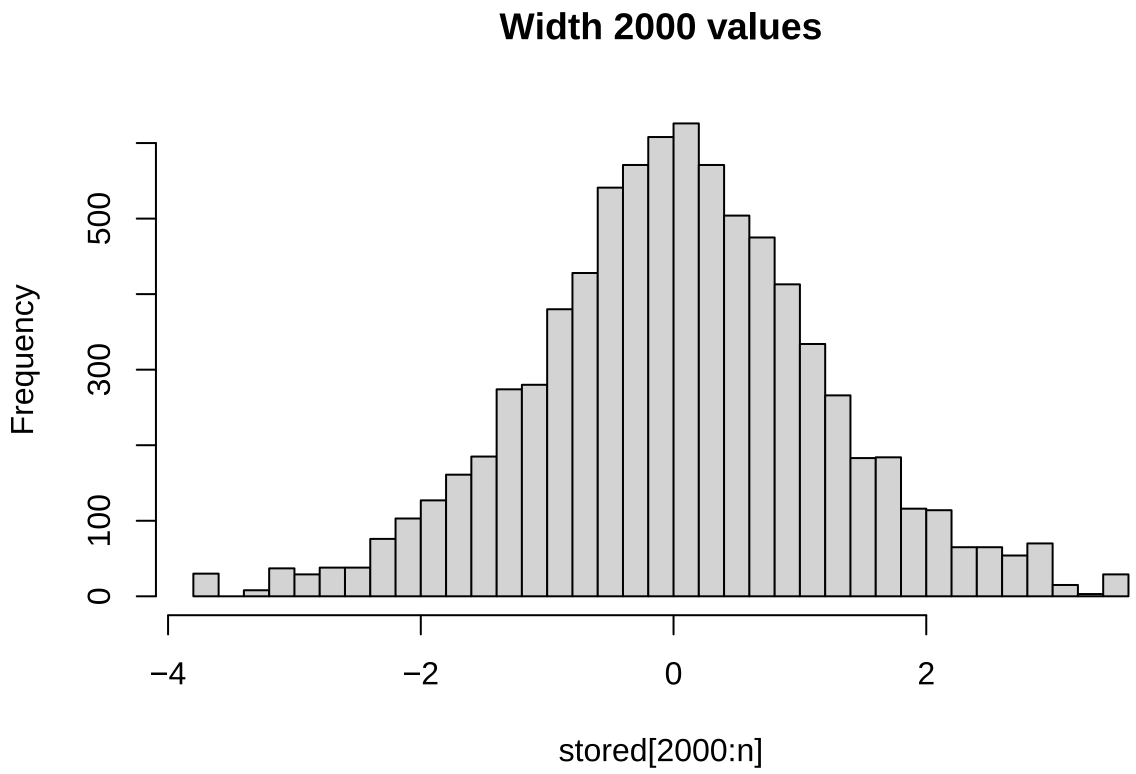
2a

```
v <- function(v1,x){
 val<-gamma((v1+1)/2)/(gamma(v1/2))
 val2<-1/sqrt(v1*pi)
 val3<-(1+(x^2)/v1)^(-(v1+1)/2)
 final<-val*val2*val3
 return(final)
}
```

```
n=10^4

stored<-rep(NA,n)
accept.count=0
accepted2<-rep(NA,n)
previous=rnorm(1)
for (i in 1:n)
{
present_value=rnorm(1)
 ratio=min(1,(v(4,present_value)/dnorm(present_value))/
              (v(4,previous)/dnorm(previous)))
  accept=runif(1) < ratio
  stored[i]<-ifelse(accept,present_value,previous)
  previous=stored[i]
  if(accept)
  {
  accepted2[i]=present_value
  }
}

plot(stored[2000:n], type='l')
```

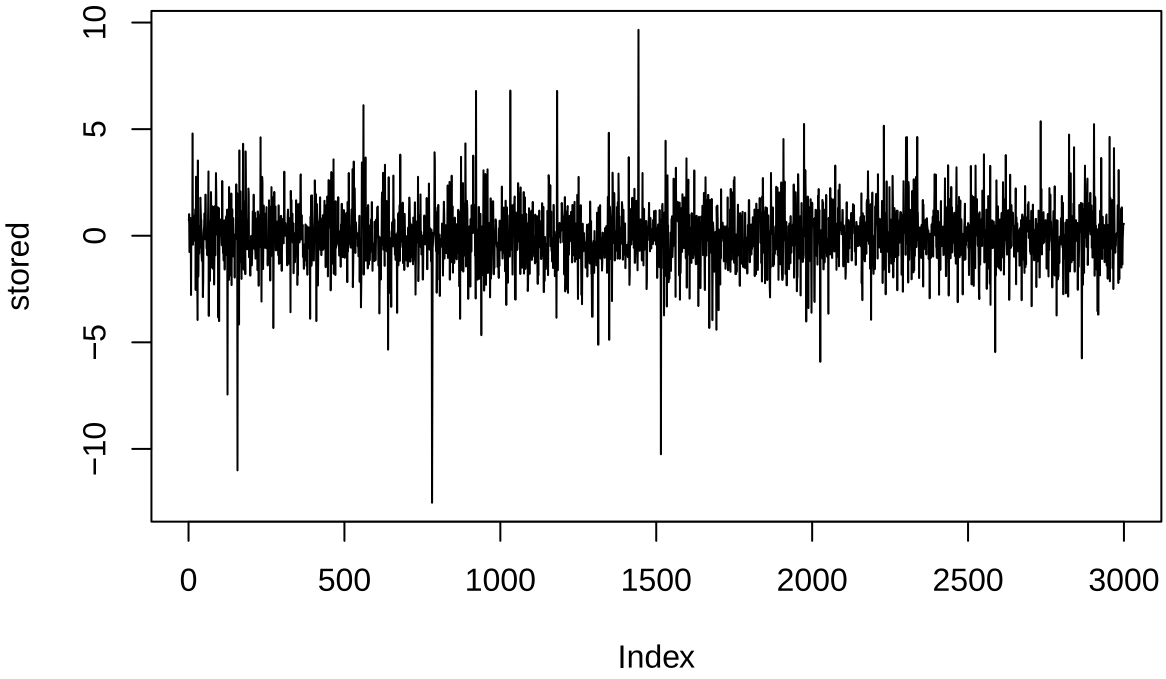


```
hist(stored[2000:n],40,main= "Width 2000 values")
```

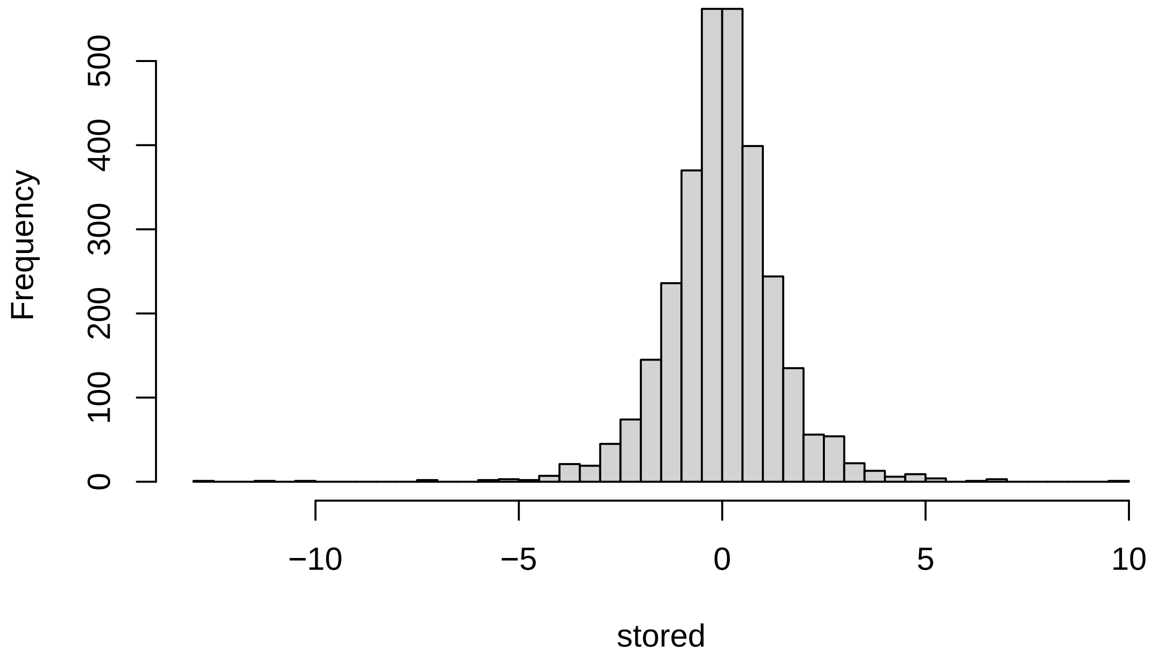


2b

```
n <- 3000
stored <- rep(NA,n)
accept.count <- 0
accepted3 <- rep(NA,n)

previous=rt(1,2)
for (i in 1:n){
  present_value=rt(1,2)
  ratio=min(1,(v(4,present_value)/v(2,present_value))/
              (v(4,previous)/v(2,previous)))
  accept = runif(1) < ratio
  stored[i]<-ifelse(accept,present_value,previous)
  previous=stored[i]
  if(accept){
    accepted3[i]=present_value
  }
}

plot(stored, type = 'l')
```



```
hist(stored,50,main="")
```



2c

Credible interval for (a)

```
x <- accepted2[!is.na(accepted2)]
quantile(x,probs=c(0.025,0.975))
```

```
##      2.5%     97.5%
## -1.941413  2.028265
```

Credible interval for (b)

```
x2 <- accepted3[!is.na(accepted3)]
quantile(x,probs=c(0.025,0.975))
```

```
##      2.5%     97.5%
## -1.941413  2.028265
```

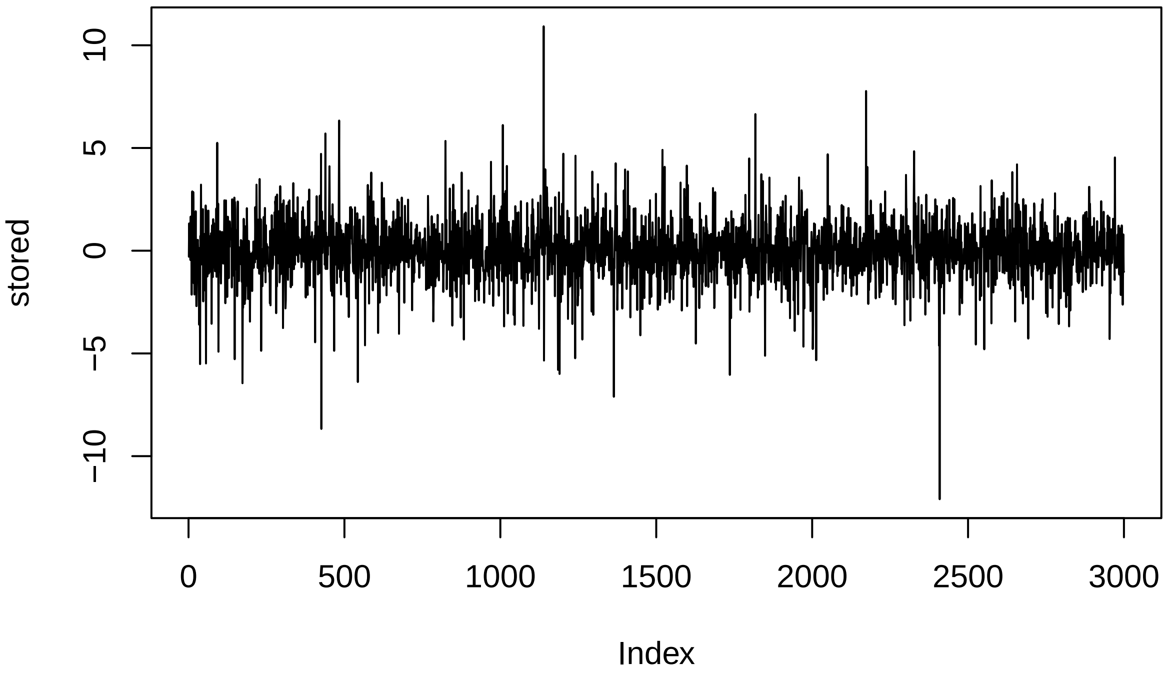
```
mean(x)
```

```
## [1] 0.02274672
```

```
mean(x2)
```

```
## [1] -0.004200693
```

```
n=3000

stored<-rep(NA,n)
accept.count=0
accepted3<-rep(NA,n)

previous=rt(1,2)
for (i in 1:n){
present_value=rt(1,2)
  ratio=min(1,dt(present_value,4,log = TRUE)+dt(previous,2,log=T)-
               dt(present_value,2,log = TRUE)-dt(previous,4,log=T))
  accept=log(runif(1)) < ratio
  stored[i]<-ifelse(accept, present_value,previous)
  previous=stored[i]
  if(accept){
  accepted3[i]=present_value
  }
}

plot(stored,type='l')
```


stored
Index