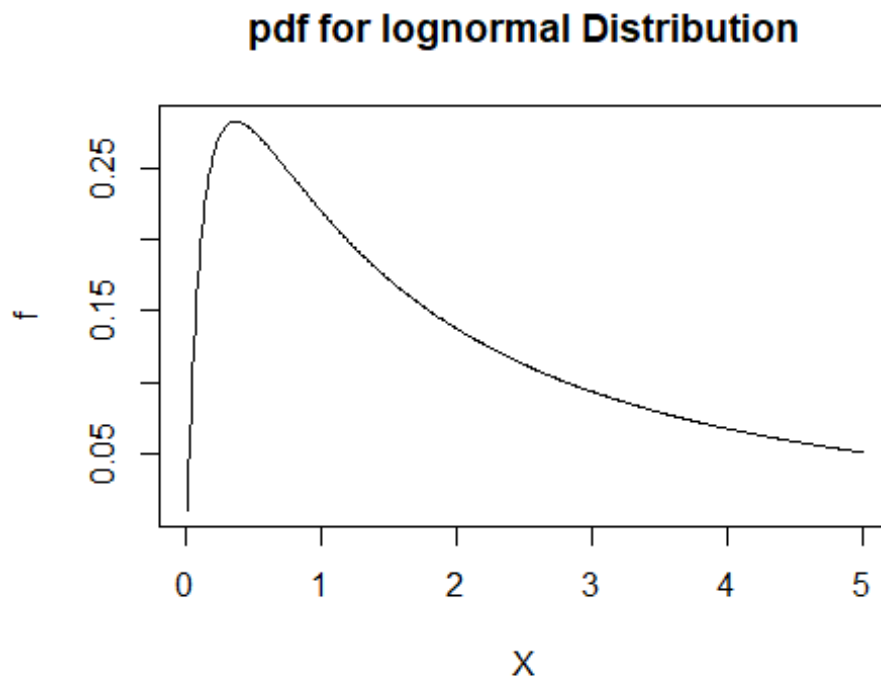


# Lognormal Distribution

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```
### pdf for Lognormal
mu=1
sigma_sqr=2
x=seq(0.01,5,by=0.01)
f=1/(sqrt(sigma_sqr)*sqrt(2*pi))*(exp(-1/2*((log(x)-
mu)/sqrt(sigma_sqr))^2))*(1/x)
plot(x,f,type="l",xlab="X",ylab="f",main="pdf for lognormal Distribution")
```



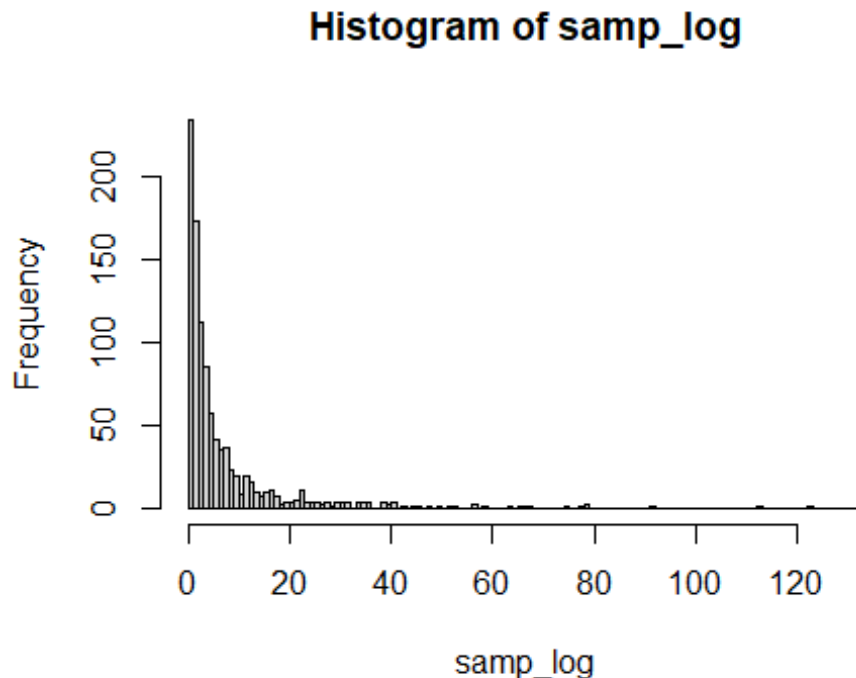
##### To draw the sample from lognormal distribution using normal distribution

```
n=1000
sigma=sqrt(2)
samp=rnorm(n,1,sd=sigma)
samp_log=exp(samp)
mean(samp_log)
```

```
## [1] 7.010207
```

```
var(samp_log)
```

```
## [1] 156.4339
hist(samp_log,"FD")
```



```
estimator=sum(log(samp_log))/n

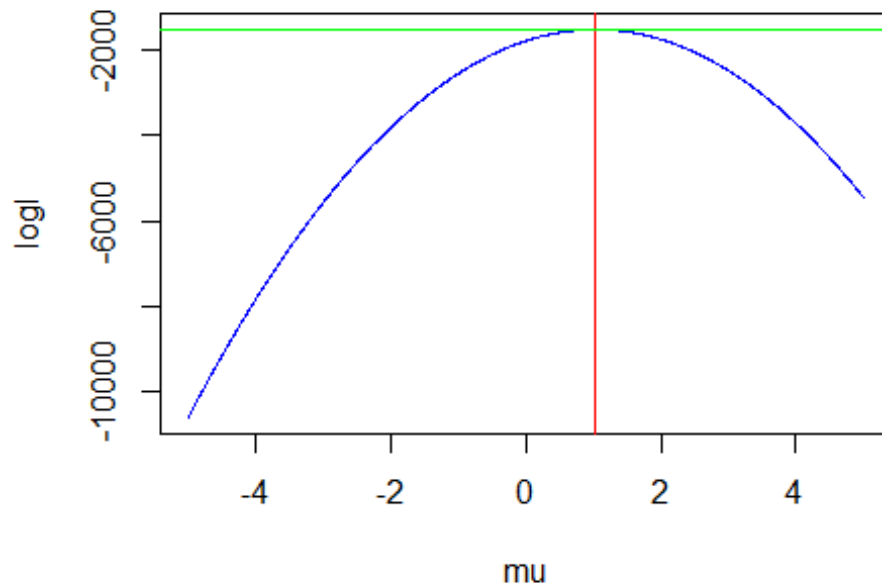
##### Obtain MLE without using formula
p=seq(-5,5,by=0.01)   ### parameter values
l=length(p)
logl=c()

for(i in 1:l)
{
logl[i]=-sum(log(samp_log))-(1/2)*sum(((log(samp_log)-p[i])/sigma)^2)
}
m=max(logl)
ind=which(logl==m)
mle=p[ind]
mle

## [1] 1.03

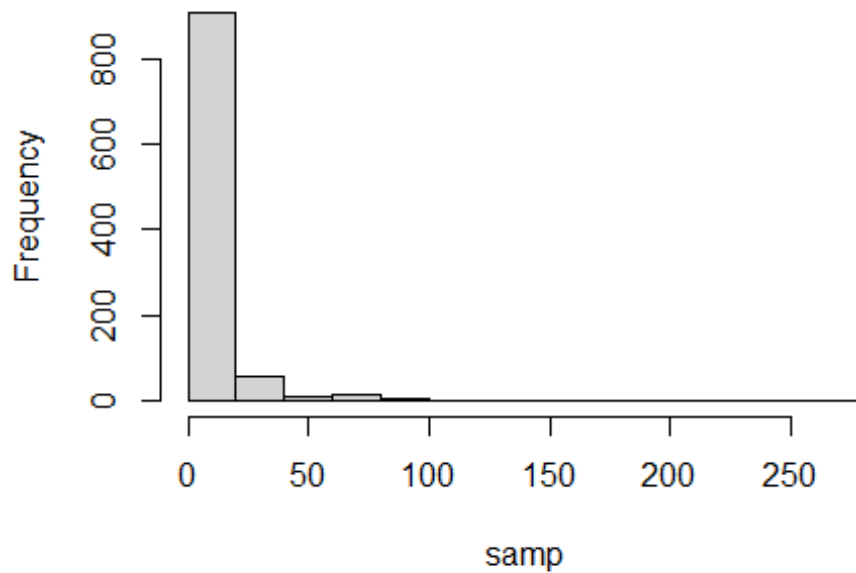
plot(p,logl,type="l",col="blue",xlab="mu",ylab="logl",main="MLE for lognormal
Distri.")
abline(v=mle,col="red")
abline(h=m,col="green")
```

### MLE for lognormal Distri.



```
##### Draw random sample from Lognormal distribution using rlnorm
command
n=1000
mu=1
sigma_sqr=2
samp=rlnorm(n,1,sqrt(2))
hist(samp)
```

**Histogram of samp**



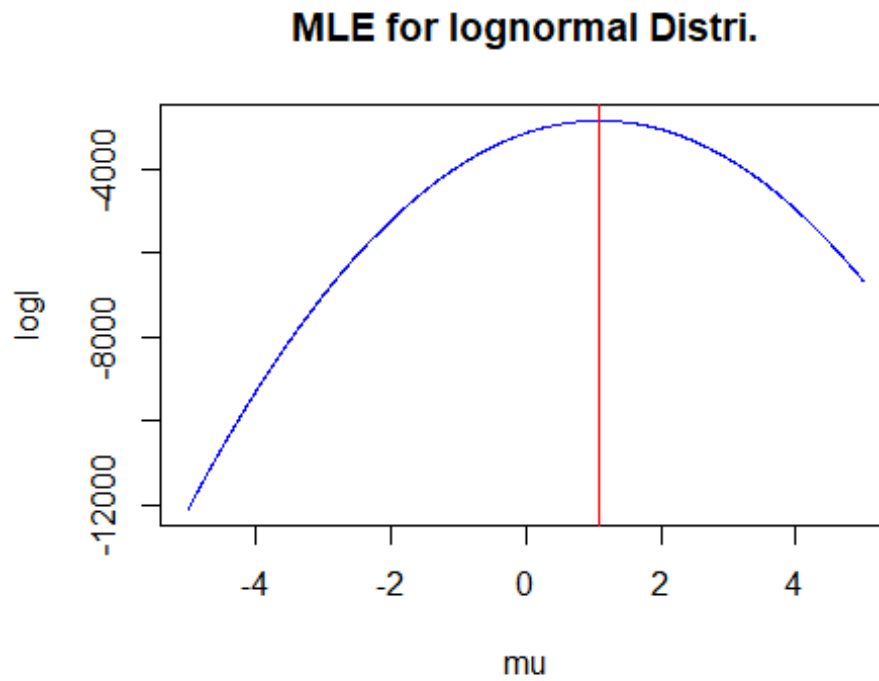
```
mean(samp)
## [1] 8.238077

var(samp)
## [1] 359.1467

sigma=sqrt(2)
estimator=sum(log(samp))/n
#### Obtain MLE (sample draw by using rlnorm command)
p=seq(-5,5,by=0.01) ### parameter values
l=length(p)
logl=c()
sigma=sqrt(2)
for(i in 1:l)
{
logl[i]=-sum(log(samp))-n*log(sigma*sqrt(2*pi))-(1/2)*sum(((log(samp)-
p[i])/sigma)^2)
}
m=max(logl)
ind=which(logl==m)
mle=p[ind]
mle

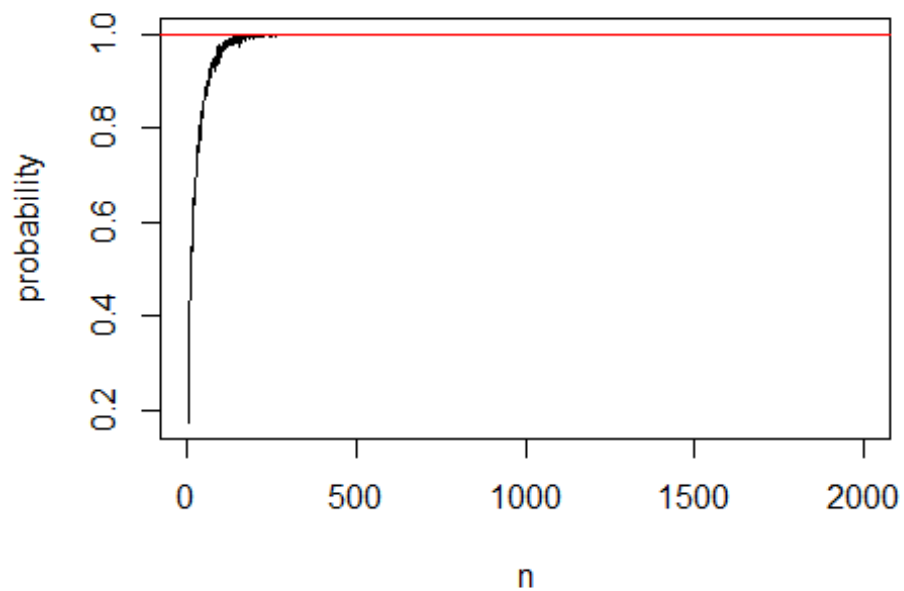
## [1] 1.09
```

```
plot(p,logl,type="l",col="blue",xlab="mu",ylab="logl",main="MLE for lognormal
Distri.")
abline(v=mle,col="red")
```

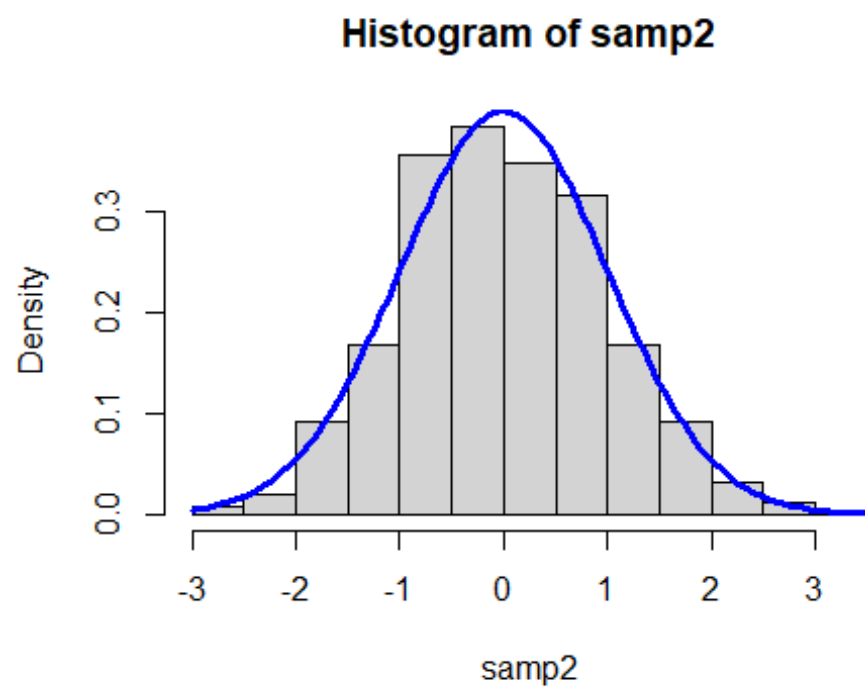


```
##### verify consistency property
#### convergence in probability
n=2000
prob=c()
mu=1
eps=0.3
sigma=sqrt(2)
it=500
for(i in 1:n)
{
  est=c()
  for(j in 1:it)
  {
    samp=rlnorm(i,1,sqrt(2))
    est[j]=sum(log(samp))/i
  }
  samp1=abs(est-mu)
  prob[i]=length(which(samp1<=eps))/it
  #print(i)
}
plot(1:n,prob,type="l",xlab="n",ylab="probability",main="convergence in
probability")
abline(h=1,col="red")
```

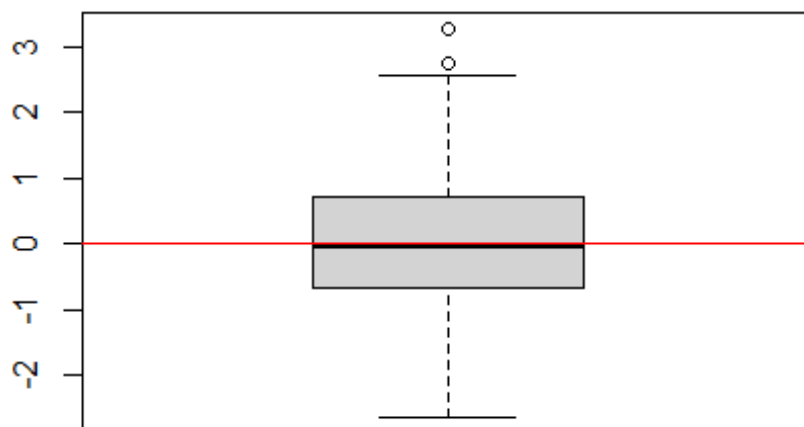
## convergence in probability



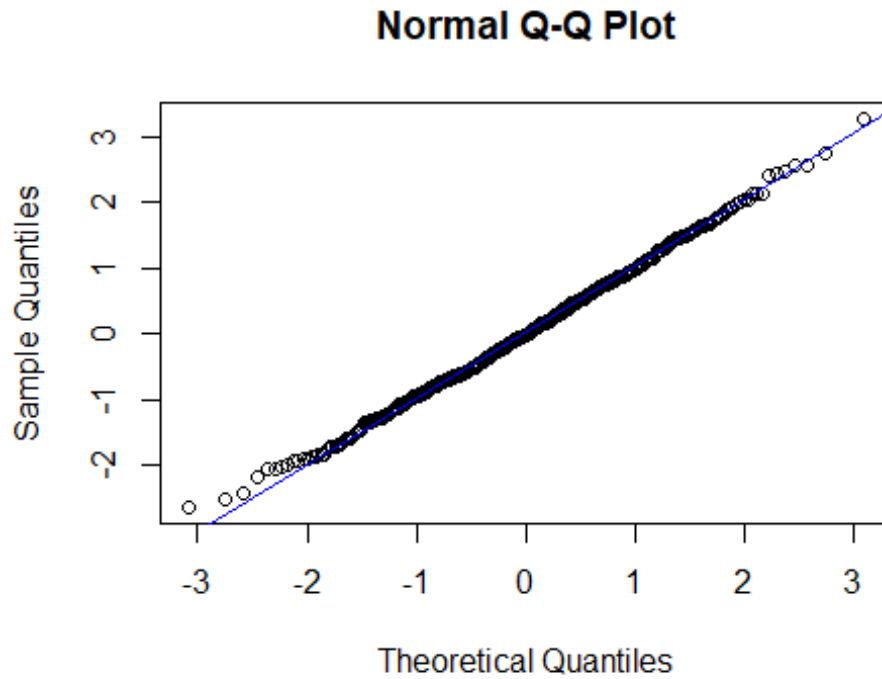
```
##### for Asymptotic normality
n=1000
it=500
samp2=c()
mu=1
sigma_sqr=2
for(i in 1:it)
{
  samp=rlnorm(n,1,sqrt(sigma_sqr))
  tn=sum(log(samp))/n
  samp2[i]=sqrt(n*(1/2))*(tn-mu)
}
hist(samp2,prob=TRUE)
x=seq(-3,3,by=0.01)
curve(dnorm(x),lwd=3,col="blue",add=TRUE)
```



```
##### using boxplot  
boxplot(samp2)  
abline(h=0,col="red")
```



```
#####
qqnorm(samp2)
qqline(samp2,col="blue")
```



```
##### To find CI based on simulation
alp=0.05  ### we want 95% CI
Q=qnorm(1-alp/2,lower.tail=TRUE)
mu=1
sigma_sqr=2
sigma=sqrt(sigma_sqr)
### Draw sample
n=1000
it=2000
tn=c()
for(i in 1:it)
{
  samp1=rlnorm(n,mu,sigma)
  tn[i]=sum(log(samp1))/n
}
sort_tn=sort(tn)
### for Lower bound take obs of [it*alp/2]
Lb_ind=it*(alp/2)
a=sort_tn[Lb_ind]
print(a)

## [1] 0.9099673
```



```
### for upper bound
Ub_ind=it*(1-(alp/2))
b=sort_tn[Ub_ind]
print(b)
```

```
## [1] 1.08463
```

```
#####
#####
```

The lowe bound is 0.9111 and upper bound is 1.0871