CENTRAL UNIVERSITY OF SOUTH BIHAR

DATA SCIENCE AND APPLIED STATISTICS

(SIDS ASSIGNMENT)

SEMESTER - II

[SESSION: 2023-2025]

SUBMITTED TO

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Lab Problem-1

Let $x1, x2 \ldots\ldots xn$ be random sample from $N(\mu, \sigma^2)$ where n=30,50,60 and $\mu = -2, 0.2, \sigma^2 = 4$ then show T1=sample mean is MVUE, In comparison with T2=sample median.

```
M=0
Med=0
for(i in 1:1000){
  x=rnorm(30,-2,4)
  M[i]=mean(x)
  Med[i]=median(x)
  Mean=c(M)
  Median=c(Med)
}
mean(Mean)

## [1] -1.990801

mean(Median)

## [1] -1.99167

V_mean=var(Mean)
V_median=var(Median)
V_mean

## [1] 0.5700001

V_median

## [1] 0.8533776

M=0
Med=0
for(i in 1:1000){
  x=rnorm(50,-2,4)
  M[i]=mean(x)
  Med[i]=median(x)
  Mean=c(M)
  Median=c(Med)
}
mean(Mean)
```

```
## [1] -2.010509

mean(Median)

## [1] -2.016698

V_mean=var(Mean)
V_median=var(Median)
V_mean

## [1] 0.3292908

V_median

## [1] 0.4868359

M=0
Med=0
for(i in 1:1000){
  x=rnorm(60,-2,4)
  M[i]=mean(x)
  Med[i]=median(x)
  Mean=c(M)
  Median=c(Med)
}
mean(Mean)

## [1] -2.011126

mean(Median)

## [1] -1.996596

V_mean=var(Mean)
V_median=var(Median)
V_mean

## [1] 0.2493991

V_median

## [1] 0.3899442
```

Conclusion

Since the mean and median of observed sample is approx -2, conclude that mean and median is the unbiased estimator of generated sample. Also, the variance of mean is less than the variance of median,so mean is the minimum variance unbiased estimator.

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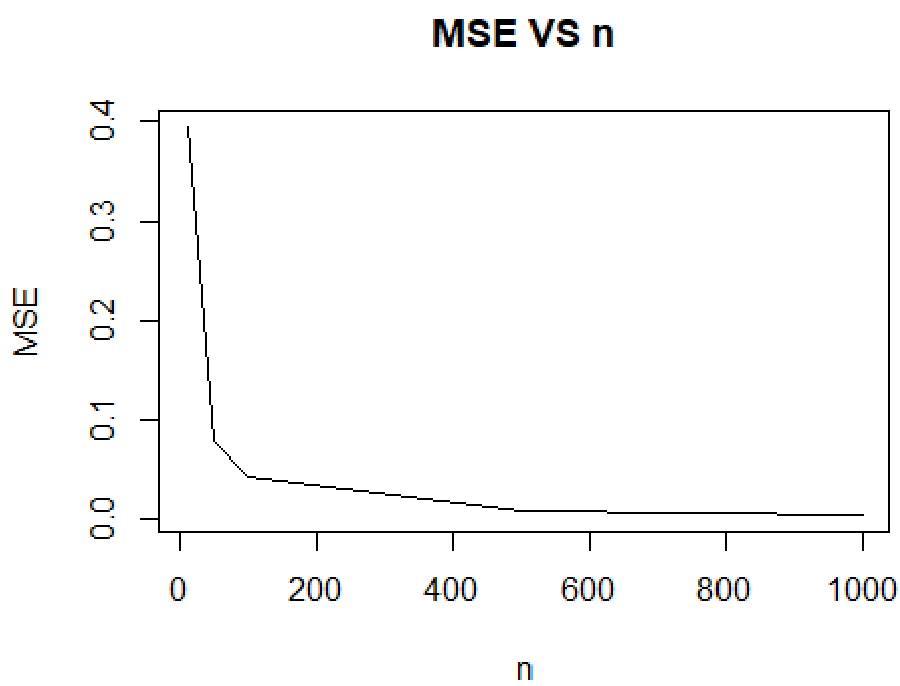
Lab problem-2

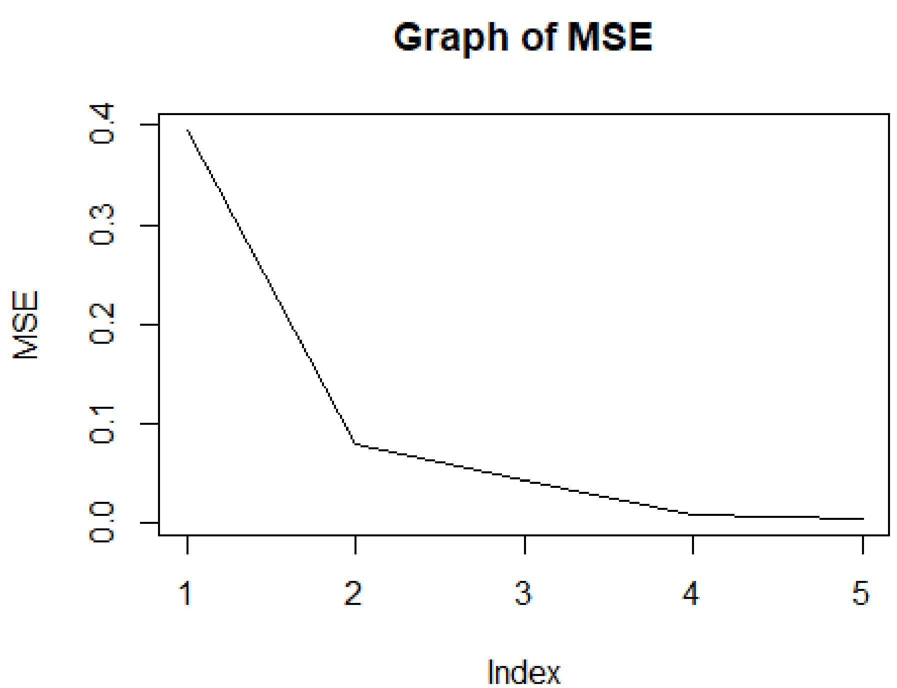
Let \$ X{exp()}\$ then show that $\acute{x}$ is parameter θ, Also plot the graph of MSE for varies n.

```
n=c(10,50,100,500,1000)
Theta=0.5

M1=c(0)
for(i in 1:1000){
  Y1=rexp(n[1],0.5)
  M1[i]=mean(Y1)
  M1=c(M1)
}
Mean_M1=mean(M1)
Var_M1=var(M1)
Mean_M1

## [1] 1.998824

Var_M1

## [1] 0.3949734

M2=c(0)
for(i in 1:1000){
  Y2=rexp(n[2],0.5)
  M2[i]=mean(Y2)
  M2=c(M2)
}
Mean_M2=mean(M2)
Var_M2=var(M2)
Mean_M2

## [1] 2.018911

Var_M2

## [1] 0.07873411

M3=c(0)
for(i in 1:1000){
  Y3=rexp(n[3],0.5)
  M3[i]=mean(Y3)
  M3=c(M3)
```

```
}
Mean_M3=mean(M3)
Var_M3=var(M3)
Mean_M3

## [1] 1.997803

Var_M3

## [1] 0.04175563

M4=c(0)
for(i in 1:1000){
  Y4=rexp(n[4],0.5)
  M4[i]=mean(Y4)
  M4=c(M4)
}
Mean_M4=mean(M4)
Var_M4=var(M4)
Mean_M4

## [1] 1.994475

Var_M4

## [1] 0.008115649

M5=c(0)
for(i in 1:1000){
  Y5=rexp(n[5],0.5)
  M5[i]=mean(Y5)
  M5=c(M5)
}
Mean_M5=mean(M5)
Var_M5=var(M5)
Mean_M5

## [1] 1.999166

Var_M5

## [1] 0.004207102

#ploting graph for MSE
MSE=c(Var_M1,Var_M2,Var_M3,Var_M4,Var_M5)
plot(n,MSE,main="MSE VS n",type="l")
```




```r
plot(MSE,main="Graph of MSE",type="l")
```



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Lab problem-3

Generate a random sample of size 40 from exponential distribution

$$f(x;\theta)=\theta e^{-\theta x}$$

$\theta=0.5,0.2$ estimate the population parameter by using fisherscoring methad for the value $\epsilon=0.002$ also calculate number of iteration.

```
rm(list=ls())
sam_x=rexp(40,0.5)
theta_g1=0.01
x_bar1=mean(sam_x)
x_bar1

## [1] 2.120643

theta_f1=theta_g1+theta_g1^2*(1/theta_g1-x_bar1)
theta_f1

## [1] 0.01978794

count=1
while(abs(theta_f1-theta_g1)>0.002){
  count=count+1
  theta_g1=theta_f1
  theta_f1=theta_g1+theta_g1^2*(1/theta_g1-x_bar1)
}
print(count)

## [1] 9

print(theta_f1)

## [1] 0.471547

sam_y=rexp(40,0.2)
theta_g2=0.01
x_bar2=mean(sam_y)
x_bar2

## [1] 5.368385

theta_f2=theta_g2+theta_g2^2*(1/theta_g2-x_bar2)
theta_f2
```

```
## [1] 0.01946316

count=1
while(abs(theta_f2-theta_g2)>0.002){
  count=count+1
  theta_g2=theta_f2
  theta_f2=theta_g2+theta_g2^2*(1/theta_g2-x_bar2)
}
print(count)

## [1] 8

print(theta_f2)

## [1] 0.1862756
```

Conclusion

1. For θ=0.5,the number of iteration is 9
   For θ=0.2,the number of iteration is 8

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Lab Problem-4

Let $x1, x2 \ldots . xn$ be random sample from $N(\theta, \sigma^2)$ where $\sigma^2 = 4, 16, 25$ then compute the minimum sample size for $\epsilon = 0.01, 0.001$ and $\delta = 0.002, 0.004$

```
epsilon=c(0.01,0.001)
delta=c(0.002,0.004)
sigma_sq=c(4,16,25)

P1=round((sigma_sq[1]/(delta[1]*epsilon[1]^2))+1)
options(scipen=P1)
P1

## [1] 20000001

P2=round((sigma_sq[1]/(delta[1]*epsilon[2]^2))+1)
options(scipen=P2)
P2

## [1] 2000000001

P3=round((sigma_sq[1]/(delta[2]*epsilon[1]^2))+1)
options(scipen=P3)
P3

## [1] 10000001

P4=round((sigma_sq[1]/(delta[2]*epsilon[2]^2))+1)
options(scipen=P4)
P4

## [1] 1000000001

P5=round((sigma_sq[2]/(delta[1]*epsilon[1]^2))+1)
options(scipen=P5)
P5
```

```
## [1] 80000001
```

```r
P6=round((sigma_sq[2]/(delta[1]*epsilon[2]^2))+1)
options(scipen=P6)
P6
```

```
## Warning in print.default(x): NAs introduced by coercion to integer range

## [1] 8e+09

## Warning in print.default(x): NAs introduced by coercion to integer range
```

```r
P7=round((sigma_sq[2]/(delta[2]*epsilon[1]^2))+1)
options(scipen=P7)
P7
```

```
## [1] 40000001
```

```r
P8=round((sigma_sq[2]/(delta[2]*epsilon[2]^2))+1)
options(scipen=P8)
P8
```

```
## Warning in print.default(x): NAs introduced by coercion to integer range

## [1] 4e+09

## Warning in print.default(x): NAs introduced by coercion to integer range
```

```r
P9=round((sigma_sq[3]/(delta[1]*epsilon[1]^2))+1)
options(scipen=P9)
P9
```

```
## [1] 125000001
```

```r
P10=round((sigma_sq[3]/(delta[1]*epsilon[2]^2))+1)
options(scipen=P10)
P10
```

```
## Warning in print.default(x): NAs introduced by coercion to integer range

## [1] 1.25e+10

## Warning in print.default(x): NAs introduced by coercion to integer range
```

```r
P11=round((sigma_sq[3]/(delta[2]*epsilon[1]^2))+1)
options(scipen=P11)
P11
```

```
## [1] 62500001
```

```r
P12=round((sigma_sq[3]/(delta[2]*epsilon[2]^2))+1)
options(scipen=P12)
P12
```

```
## Warning in print.default(x): NAs introduced by coercion to integer range
## [1] 6.25e+09
## Warning in print.default(x): NAs introduced by coercion to integer range
```