Statistical computing hw2

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Problem 1

(a)

```
#Q1(a)
set.seed(123456)
h <- function(x) exp(-x)/(1+x^2)
integrate(h,0,1)
```

```
## 0.5247971 with absolute error < 5.8e-15
```

```
n=1e6
x<-runif(n,0,1)
(1-0)*mean(h(x))
```

```
## [1] 0.5250281
```

(b)

```
#Q1(b)
set.seed(12345)
x<-rexp(n=1000)
fx<-function(x){
  return(exp(-x)/(1+x^2))
}
w <- fx(x) / exp(-x)
mean(w * x) / mean(w)
```

```
## [1] 0.5351034
```

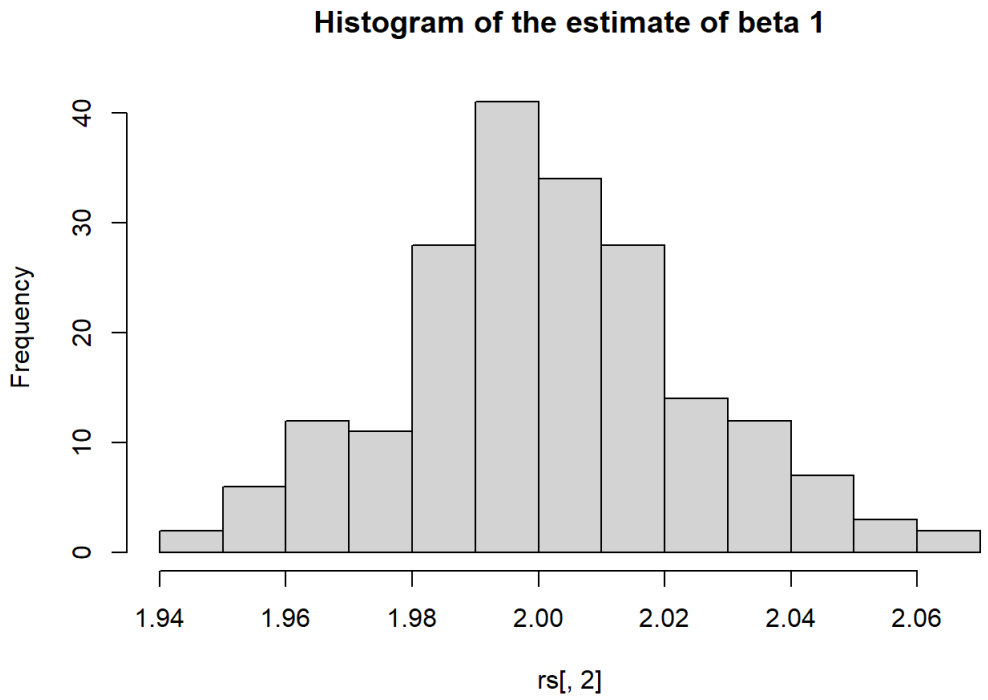
Problem 2

(a)

```
#Q2(a)
set.seed(787638)
rs=NULL
XS<-NULL
YS<-NULL
res<- NULL
for(i in 1:200){
  e<-rnorm(500,0,1)
  X<-rnorm(500,0,2)
  Y<-1+2*X+e
  XS<-rbind(XS,X)
  YS<-rbind(YS,Y)
  mod<-lm(Y~X)
  residu<-resid(mod)
  res<-rbind(res, residu)
  rs<-rbind(rs,coef(mod))
}
mean(rs[,2])
```

```
## [1] 2.001404
```

```
hist(rs[,2], main='Histogram of the estimate of beta 1')
```



(c)

```
#Q2(c)

#method1(Take average)
var(rs[,2])
```

```
## [1] 0.0005290695
```

```
#method2(empirical)
empvar=NULL
for(i in 1:200){
  empvar<-cbind(empvar,1/sum(XS[i,]^2))
}
mean(empvar)
```

```
## [1] 0.0005051891
```

(d)

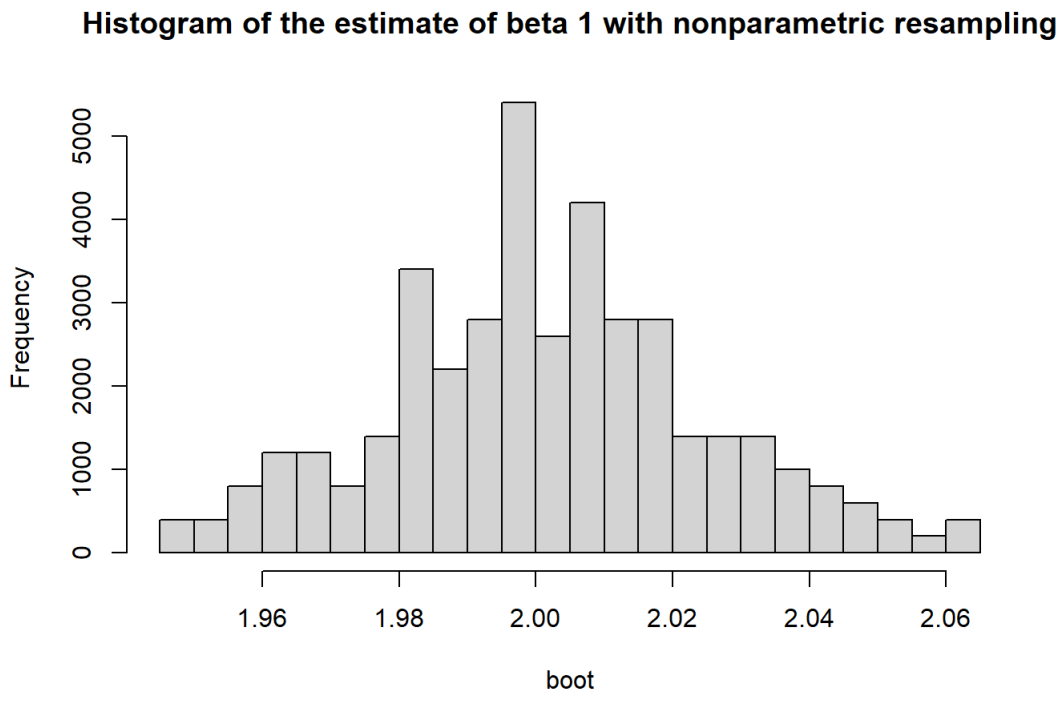
```
#Q2(d)
#random X (nonparametric resampling)

boot=NULL
for(i in 1:200){
  bstar=NULL
  for(j in 1:200){
    Xstar=NULL
    Ystar=NULL
    Xstar <- XS[j,sample(1:500,size=500,replace=F,set.seed(6723*i*j))]
    Ystar<-YS[j,sample(1:500,size=500,replace=F,set.seed(6723*i*j))]
    model<-lm(Ystar~Xstar)
    bstar <- rbind( bstar,coef(model) )
  }
  boot<-append(boot,bstar[,2])

}
var(boot)
```

```
## [1] 0.0005264373
```

```
hist(boot, main='Histogram of the estimate of beta 1 with nonparametric resampling')
```

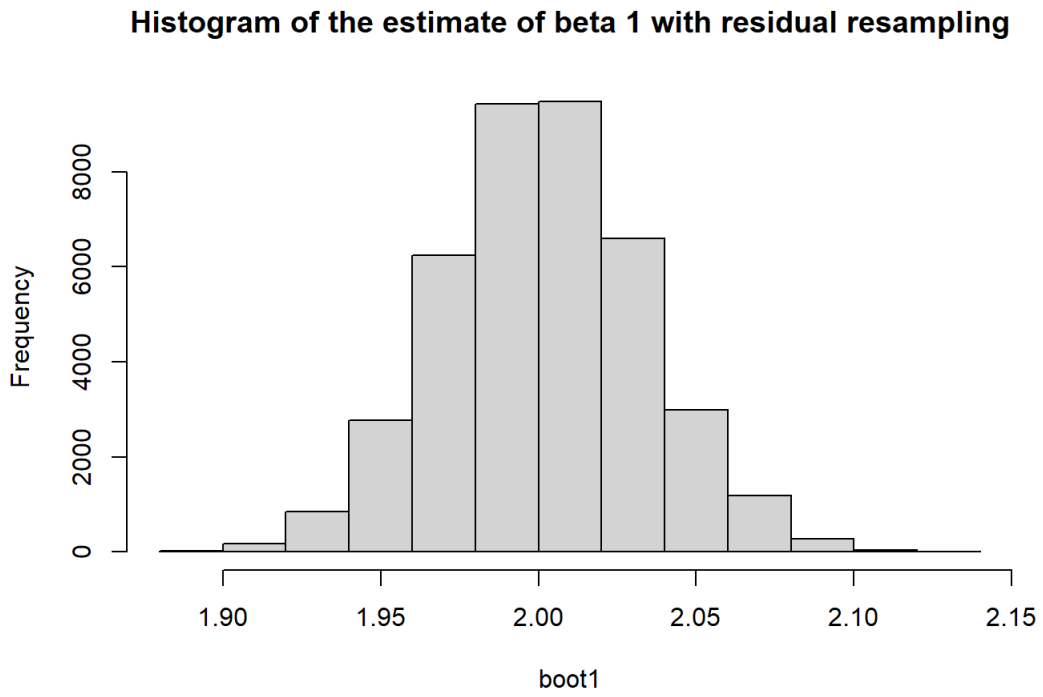



```
# Fixed X (residual resampling)
boot1=NULL
for(i in 1:200){
  bstar1=NULL
  for(j in 1:200){
    Xstar1=NULL
    Ystar1=NULL
    Xstar1 <- XS[j,sample(1:500,size=500,replace=F,set.seed(1986*i*j))]
    resid = res
    newY<-res[j,]+(rs[j,2]*Xstar1+rs[j,1])
    model2<-lm(newY~Xstar1)
    bstar1 <- rbind( bstar1,coef(model2) )
  }
  boot1<-append(boot1,bstar1[,2])
}

var(boot1)
```

```
## [1] 0.001017509
```

```
hist(boot1, main='Histogram of the estimate of beta 1 with residual resampling')
```



(e)

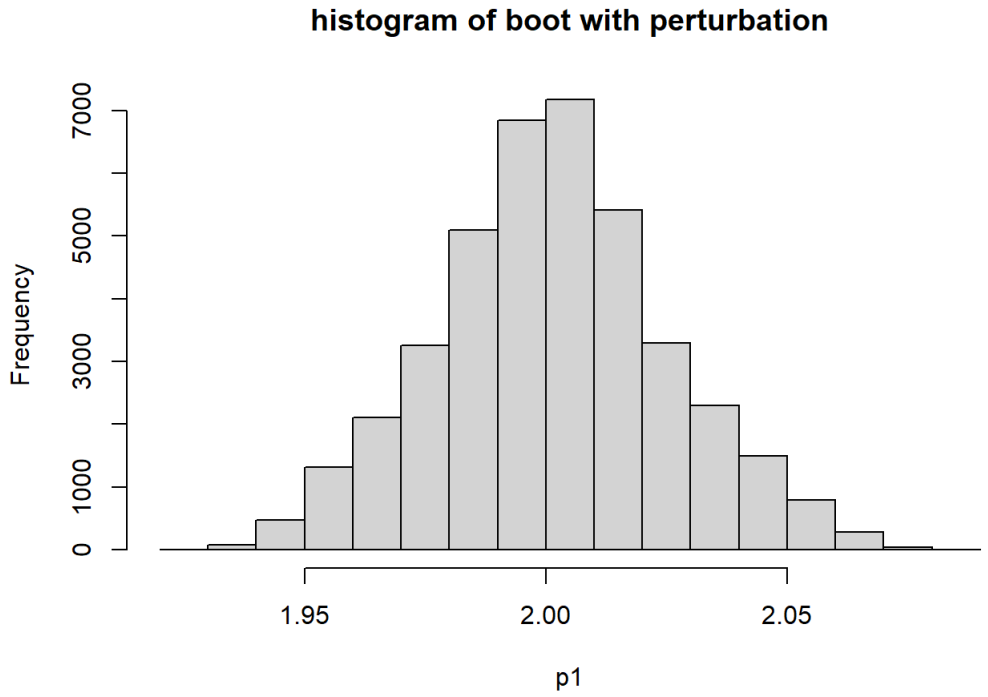
```
#Q2(e)
library(OTclust)
```

```
## Warning: package 'OTclust' was built under R version 4.0.5
```

```
# install.packages('OTclust')
q2da<-as.matrix(boot)
p1<-perturb(q2da,0)
var(p1)
```

```
##              [,1]
## [1,] 0.0005802581
```

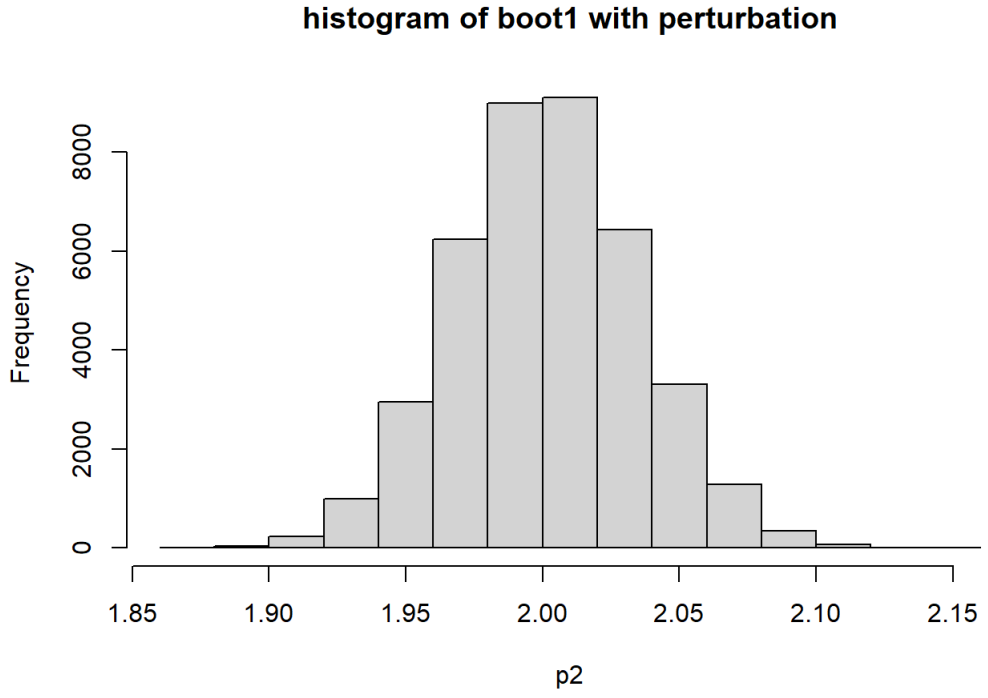
```
hist(p1, main='histogram of boot with perturbation')
```




```
q2db<-as.matrix(boot1)
p2<-perturb(q2db,0)
var(p2)
```

```
##             [,1]
## [1,] 0.001121274
```

```
hist(p2, main='histogram of boot1 with perturbation')
```




```
q2ca<-as.matrix(rs[,2])
p3<-perturb(q2ca,0)
var(p3)
```

```
##              [,1]
## [1,] 0.0006099797
```

```
hist(p3, main='histogram of asymptotic variance with perturbation')
```