

Homework2

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HW 2

```
#problem 1
set.seed(1234)
p=0.1
sigma=1
c1=2
c2=5
c3=10
n=20
beta <- rep(1,n)

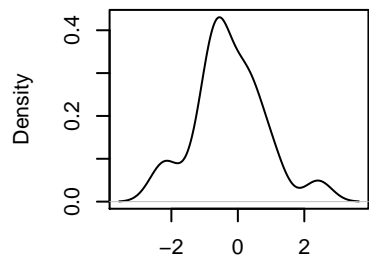
#generate two sets of random numbers: one from N(0, sigma) (this is this pool for normal numbers),
e1=rnorm(n, mean=0, sd=sigma)
e2=rnorm(n, mean=0, sd=c1*sigma)

e3=rnorm(n, mean=0, sd=sigma)
e4=rnorm(n, mean=0, sd=c2*sigma)

e5=rnorm(n, mean=0, sd=sigma)
e6=rnorm(n, mean=0, sd=c3*sigma)

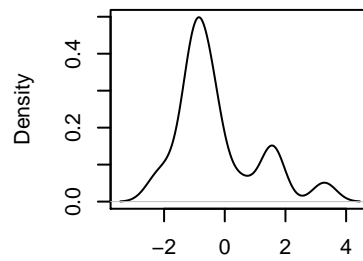
#sample n*(1-p) from e1 and n*p from e2
e_a=c(sample(e1, n*(1-p)), sample(e2, n*p))
e_b=c(sample(e3, n*(1-p)), sample(e4, n*p))
e_c=c(sample(e5, n*(1-p)), sample(e6, n*p))
#distinguished by different c values
par(mfrow=c(2,3))
plot(density(e_a))
plot(density(e_b))
plot(density(e_c))
hist(e_a)
hist(e_b)
hist(e_c)
```

density.default(x = e_a)



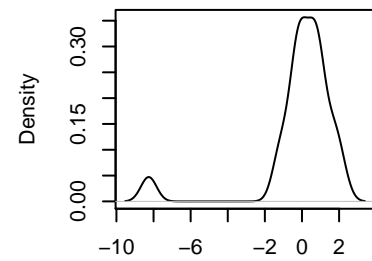
N = 20 Bandwidth = 0.4083

density.default(x = e_b)



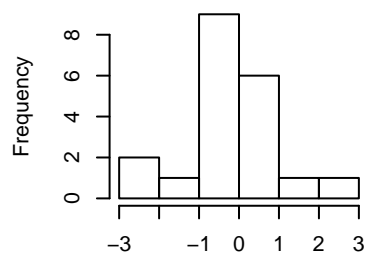
N = 20 Bandwidth = 0.39

density.default(x = e_c)



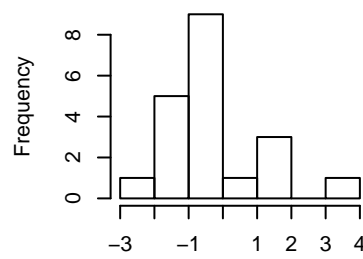
N = 20 Bandwidth = 0.4229

Histogram of e_a



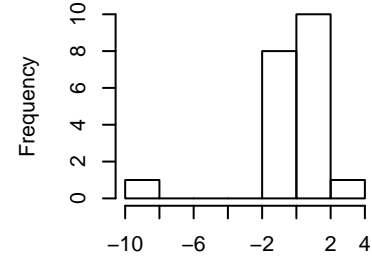
e_a

Histogram of e_b



e_b

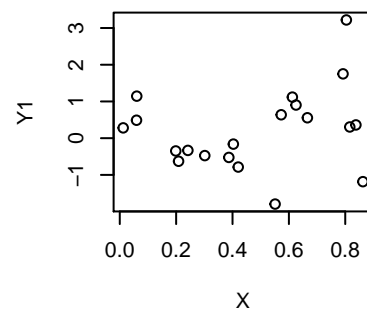
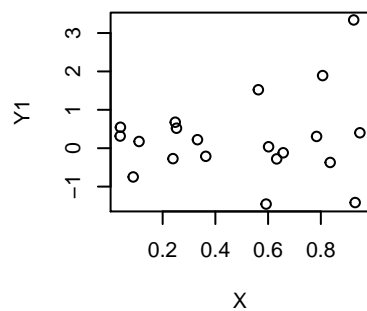
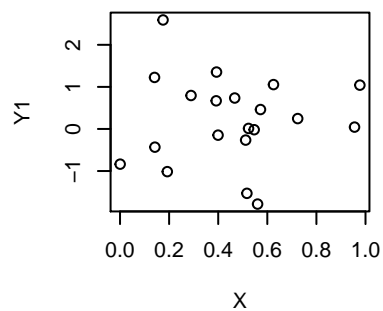
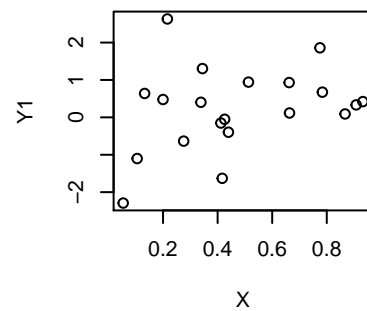
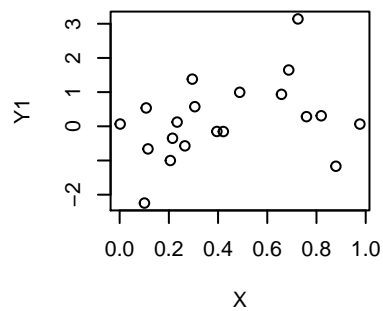
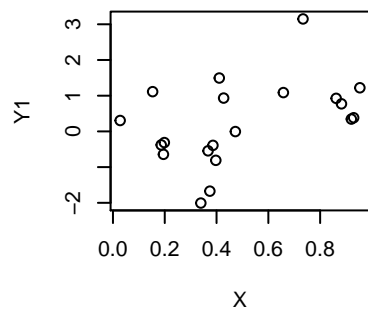
Histogram of e_c



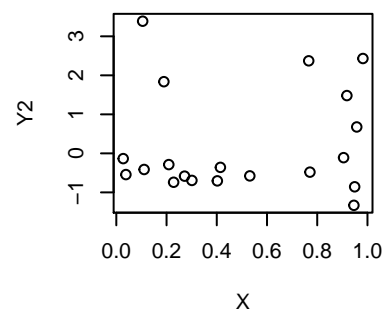
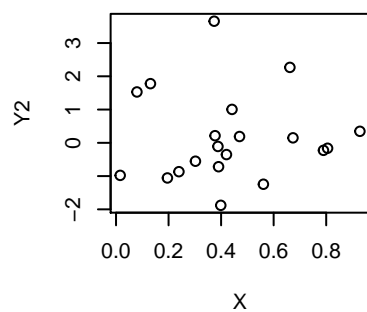
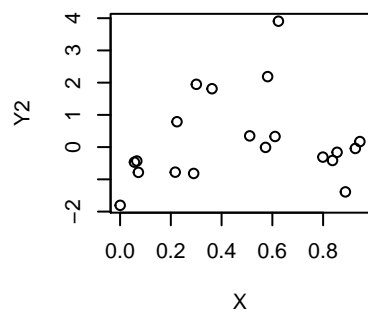
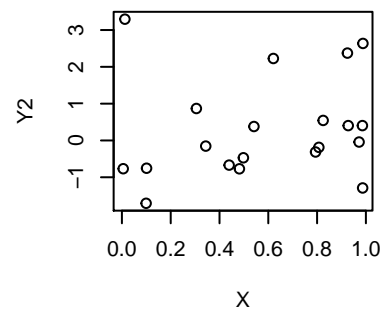
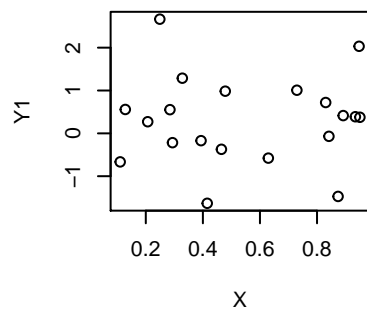
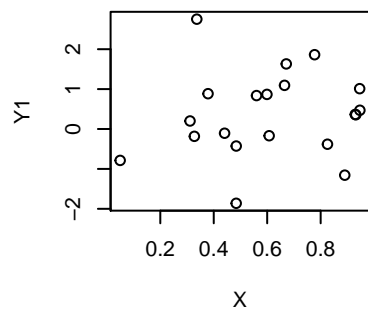
e_c

#2-----

```
for (i in 1:8)
{
  X=runif(n, min=0, max=1)
  Y1=beta[1]*X+sample(e_a,n)
  plot(X,Y1)
}
```



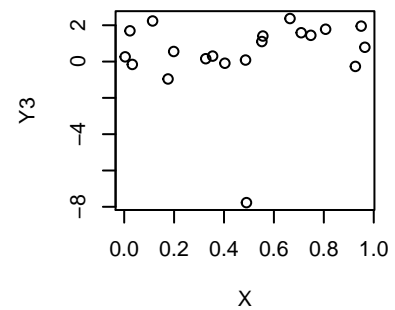
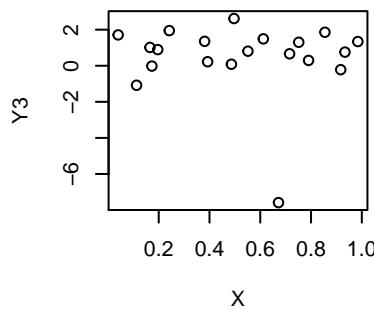
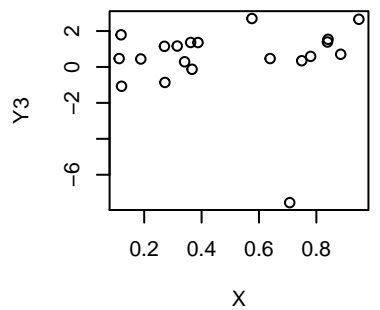
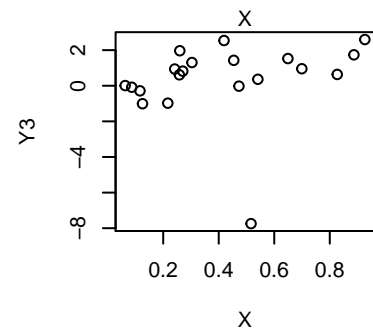
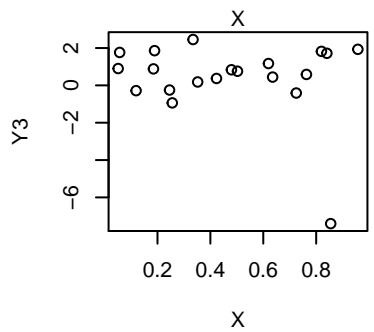
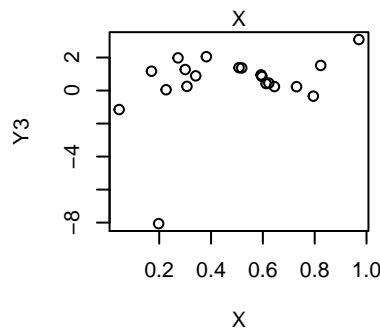
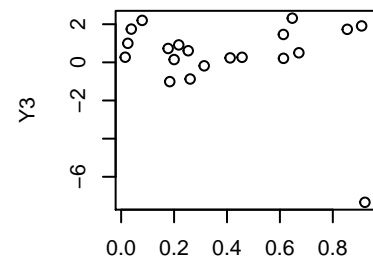
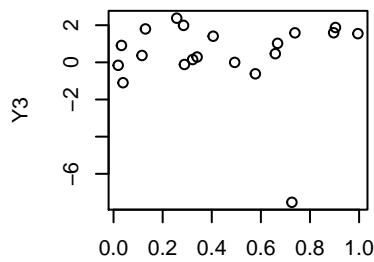
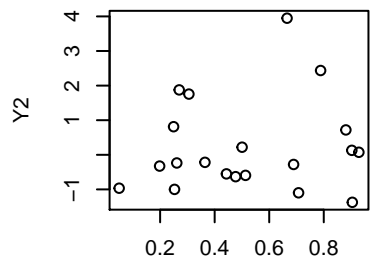
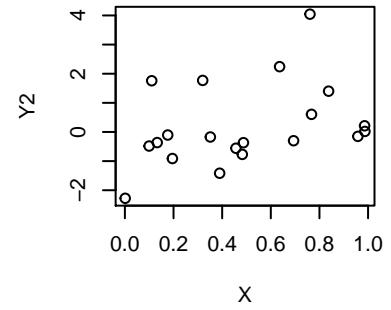
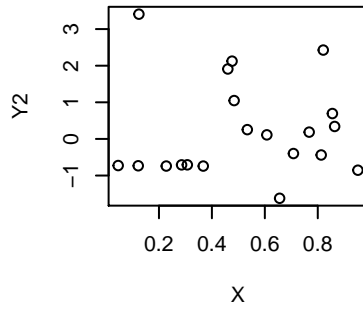
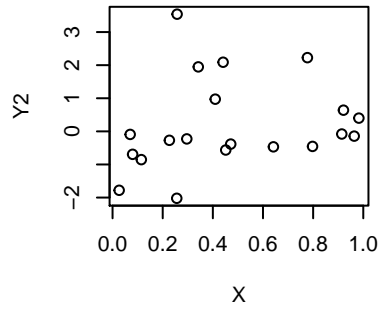
```
for (i in 1:8)
{
  X=runif(n, min=0, max=1)
  Y2=beta[1]*X+sample(e_b,n)
  plot(X,Y2)
}
```



```

for (i in 1:8)
{
  X=runif(n, min=0, max=1)
  Y3=beta[1]*X+sample(e_c,n)
  plot(X,Y3)
}

```



```

#3,#4
beta_hat_0=c()
sigma_hat_0=c()
beta_hat1=c()
sigma_hat1=c()
beta_hat2=c()
sigma_hat2=c()

#taking beta_0 to be the origin

for (j in 1:n)
{
X=runif(n, min=0, max=1)
Y1=beta[1]*X+sample(e_a,n)
LM1=summary(lm(Y1~X))
beta_hat_0[j]=LM1$coefficients[2, 1] #LM stores a lot of info
sigma_hat_0[j]=LM1$sigma
}

for (j in 1:n)
{
X=runif(n, min=0, max=1)
Y2=beta[1]*X+sample(e_b,n)
LM2=summary(lm(Y2~X))
beta_hat1[j]=LM2$coefficients[2, 1] #LM stores a lot of info
sigma_hat1[j]=LM2$sigma
}

for (j in 1:n)
{
X=runif(n, min=0, max=1)
Y3=beta[1]*X+sample(e_c,n)
LM3=summary(lm(Y3~X))
beta_hat2[j]=LM3$coefficients[2, 1] #LM stores a lot of info
sigma_hat2[j]=LM3$sigma
}

hist(beta_hat_0)
hist(sigma_hat_0)

BETA=c(beta_hat_0,beta_hat1,beta_hat2)
SIGMA=c(sigma_hat_0,sigma_hat1,sigma_hat2)
print(sd(BETA))

```

```
## [1] 1.342188
```

```
print(sd(SIGMA))
```

```
## [1] 0.4529026
```

```
#-----
```

```
beta=0.1
```

```
W=c()
```

```

res=c()

for (j in 1:n)
{
  X=runif(n, min=0, max=1)
  Y3=beta[1]*X+sample(e_c,n)
  LM3=summary(lm(Y3~X))
  beta_hat2[j]=LM3$coefficients[2, 1] #LM stores a lot of info
  sigma_hat2[j]=LM3$sigma

}
for (i in 1:n)
{
  W[i]=X[i]/sum(X^2)
}

s=sum(abs(Y3-LM3$fitted.values))/n
CV=2*s*sqrt(sum(W^2)) # critical value
for (j in 1:n)
{
  res[j]=beta_hat2[j]>CV
  alpha.hat=mean(res)
# proportion of rejection when H0 is true
}

print(alpha.hat)

```

```
## [1] 0.65
```

```

#-----
beta=seq(0.2,1,length=10)
W=NULL
res=c()
n=10

for (j in 1:n)
{
  X=runif(n, min=0, max=1)
  Y=beta[j]*X+sample(e_c,n)
  LM=summary(lm(Y~X))
  beta_hat2[j]=LM$coefficients[2, 1] #LM stores a lot of info

s=sum(abs(Y-LM$fitted.values))/n
for (i in 1:n)
{
  W[i]=X[i]/sum(X^2)
}

CV=2*s*sqrt(sum(W^2)) # critical value

```

```

res[j]=beta_hat2[j]>CV
alpha.hat[j]=mean(res) #power[m]
# proportion of rejection when H0 is true
}

```

```
plot(beta~alpha.hat)
```

