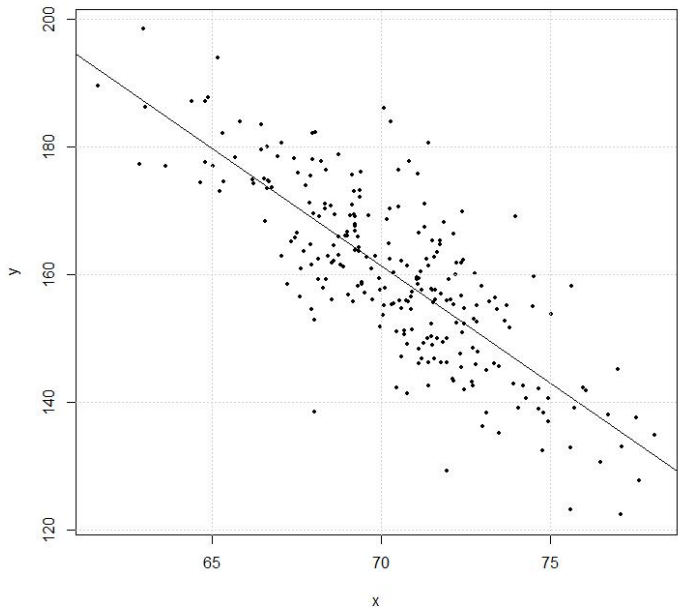
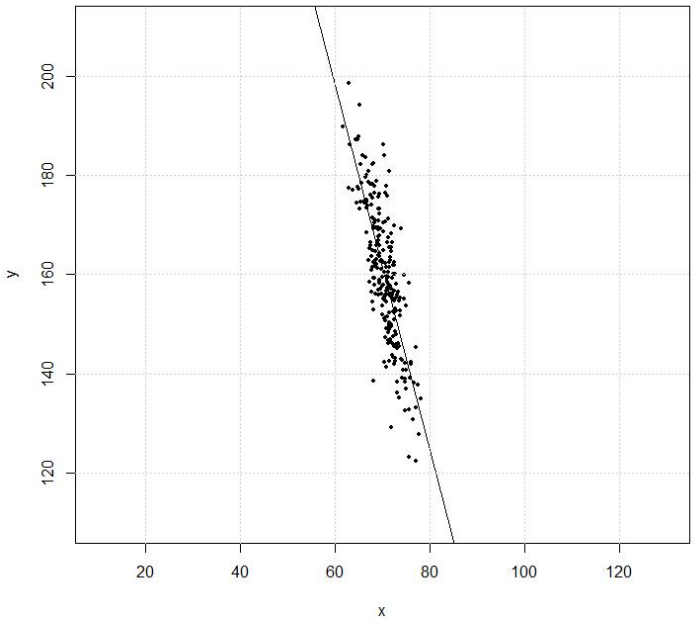
br.r

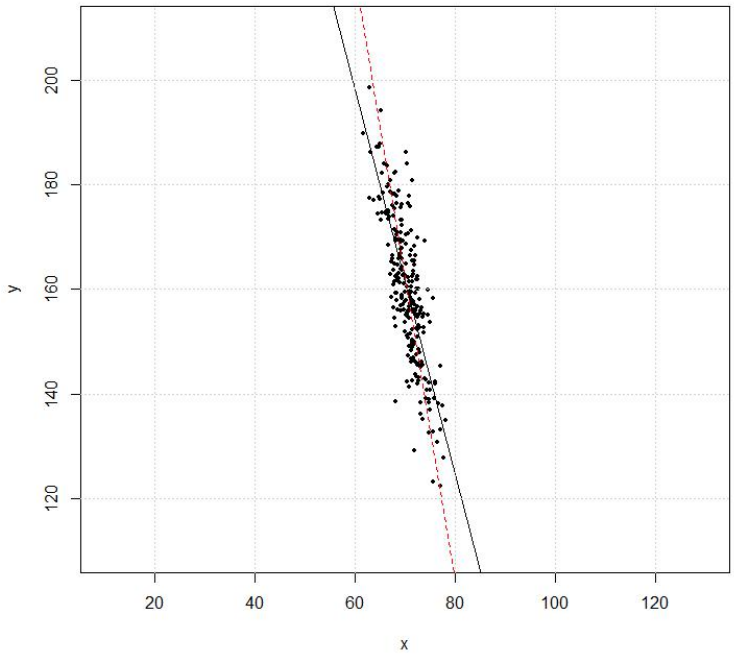
```
n = 250
mx = 70
sdx = 3
my = 162
sdy = 14
rho = -0.80
mu = c(mx,my)
mu
# [1]  70 162
cova = rho*sdx*sdy
cova
# [1] -33.6
aux = c(sdx^2,cova,cova,sdy^2)
sigma = matrix(aux,nrow=2)
sigma
#      [,1]  [,2]
#[1,]   9.0 -33.6
#[2,] -33.6 196.0
library(MASS)
d0 = mvrnorm(n,mu,sigma)
d0 = data.frame(d0)
x = d0[,1]
y = d0[,2]
plot(y~x,pch=19,cex=0.6)
```



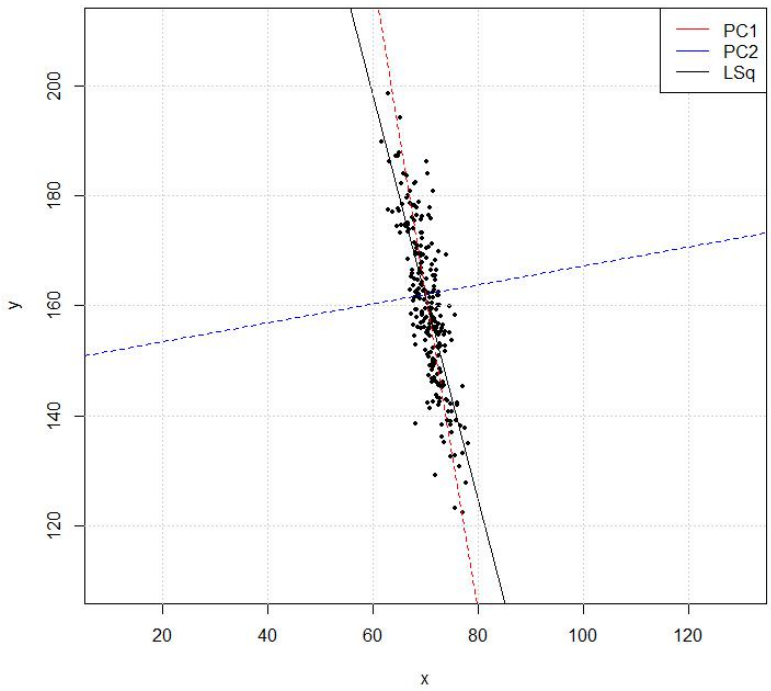
```
m1 = lm(y~x)
abline(m1)
grid()

# same scaling
plot(y~x,pch=19,cex=0.6,xlim=c(10,130),ylim=c(110,210))
abline(m1)
grid()
```




```
# principal components

pc1 = prcomp(d0)
rot = pc1$rotation
rot

# 1st PC axis, largest variance
slope1 = rot[2,1]/rot[1,1]
int1 = my - mx*slope1
abline(int1,slope1,col="red",lty=2)
```




```
# 2nd PC axis, smallest variance
slope2 = rot[2,2]/rot[1,2]
int2 = my - mx*slope2
abline(int2,slope2,col="blue",lty=2)
legend("topright",c("PC1","PC2","LSq"),col=c("red","blue",1),lty=c(1,1,1))
```




```
# enclose 95% of obs in an ellipse
```

```
library(mixtools)
ellipse(mu,sigma,0.05,2000,col="red")
```