```r
### semaine 1-3 ###
# Tension-Age
age=c(35,45,55,65,75)
tension=c(114,124,143,158,166)

reg=lm(tension~age)
plot(age,tension,type="p", lwd=3);
abline(reg,col="red", lwd=2)
# resultats d'estimation
summary(reg)
# analyse de la variance
anova(reg)
1-31.6/(1904.4+31.6)
1-var(residuals(reg))/var(tension)
1-var(residuals(reg))*4/var(tension)/3

plot(reg, which=2)

# type reg
typeof(reg)
typeof(age)
# contenue reg
attributes(reg)

# \hat mu, \hat beta, \hat sigma
mu=reg$coef[1]
beta=reg$coef[2]
sig=summary(reg)[[6]]
sqrt(sum(reg$residuals^2)/3)
# \hat Y
reg$fitted.values
# \hat epsilon
reg$residuals
tension-reg$fitted.values

# IC
x = as.data.frame(cbind(tension,age))
p1=predict(reg,x,interval="confidence",level=0.8,se.fit=TRUE)
p2=predict(reg,x,interval="prediction",level=0.8,se.fit=TRUE)

# p1$fit=p2$fit
p1$fit
p2$fit
attributes(p1)

# calcul de p1$se.fit
vx=sum(age*age)/5-mean(age)^2
sigmu=summary(reg)[[4]][1,2]
sigbeta=summary(reg)[[4]][2,2]
sig=summary(reg)[[6]]
se1=sqrt(sigmu^2+age[1]^2*sigbeta^2-2*age[1]*sig^2*sum(age)/25/vx)
se2=sqrt(sigmu^2+age[2]^2*sigbeta^2-2*age[2]*sig^2*sum(age)/25/vx)
se3=sqrt(sigmu^2+age[3]^2*sigbeta^2-2*age[3]*sig^2*sum(age)/25/vx)
se4=sqrt(sigmu^2+age[4]^2*sigbeta^2-2*age[4]*sig^2*sum(age)/25/vx)
se5=sqrt(sigmu^2+age[5]^2*sigbeta^2-2*age[5]*sig^2*sum(age)/25/vx)
c(se1,se2,se3,se4,se5)
p1$se.fit

# p1$se.fit[1]=p1$se.fit[5]? p1$se.fit[2]=p1$se.fit[4]?
sigbeta^2*45+10*sigbeta^2-sig^2*sum(age)/25/vx
sigbeta^2*35+20*sigbeta^2-sig^2*sum(age)/25/vx

# calcul de IC
reg$fitted.values
p1$fit[,1]
p1$fit[,1]+qt(0.1,3)*p1$se.fit
p1$fit[,2]
p1$fit[,1]-qt(0.1,3)*p1$se.fit
p1$fit[,3]
```

```r
sig=summary(reg)[[6]]
p1$fit[,1]+qt(0.1,3)*sqrt(p1$se.fit^2+sig^2)
p2$fit[,2]
p1$fit[,1]-qt(0.1,3)*sqrt(p1$se.fit^2+sig^2)
p2$fit[,3]

### semaine 6 ###
LakeHuron
plot(LakeHuron)
(temps = time(LakeHuron))
reg.lac = lm(LakeHuron~temps)
abline(reg.lac,col="red")
summary(reg.lac)
resi = residuals(reg.lac)
1-var(resi)/var(LakeHuron)

### semaine 7 ###
# colinearite #
load("C:/Users/Admin/Documents/cours/maef/2017/DM.RData")

n = length(X)
plot(X,Y)

reg1 = lm(Y~X)
summary(reg1)

lnY=log(Y)
reg2 = lm(lnY~X)
summary(reg2)

fitted.values(reg1)[1:10]
exp(fitted.values(reg2))[1:10]

(pseudoR=1-sum((Y-exp(fitted.values(reg2)))^2)/sum((Y-mean(Y))^2))

### semaine 8 ###
# LakeHuron + AR(1) #
plot(LakeHuron);(temps = time(LakeHuron))
reg.lac = lm(LakeHuron~temps)
summary(reg.lac);

par(mfrow=c(2,2))
plot(reg.lac,which=1)
plot(reg.lac,which=2)
plot(reg.lac,which=3)
plot(reg.lac,which=4)

t = (temps-mean(temps))^2
reg2.lac = lm(LakeHuron~temps+t)
summary(reg2.lac)

par(mfrow=c(2,2))
plot(reg2.lac,which=1)
plot(reg2.lac,which=2)
plot(reg2.lac,which=3)
plot(reg2.lac,which=4)

par(mfrow=c(2,2))
plot(LakeHuron);abline(reg.lac,col = "blue")
reg2.fit = reg2.lac$fitted.values
lines(as.vector(temps),reg2.fit,col="red")
plot(reg.lac,which=1)
plot(reg2.lac,which=1)

par(mfrow=c(2,2))
plot(reg.lac,which=1)
plot(reg2.lac,which=1)
plot(reg.lac$residuals,ylim=c(-3,3))
```

```r
plot(reg2.lac$residuals,ylim=c(-3,3))
#####################
resi = reg2.lac$residuals
par(mfrow=c(1,2))
plot(as.vector(temps),reg2.lac$residuals,type='l',xlab="année",ylab='résidu')
abline(h=0,col="red")

plot(rnorm(98),type='l',xlab="année",ylab='résidu')
abline(h=0,col="red")

###
n =length(resi)
plot(resi[-n],resi[-1],xlab="résidu en t-1",asp=1,
     ylab='résidu en t')
lag.plot(rev(resi),do.lines=F)
lag.plot(rev(resi),9,layout=c(3,3),do.lines=FALSE)
##########
require(fBasics)
# test de normailite
shapiroTest(resi)
#############
require(caschrono)
Box.test.2(resi,nlag=1:5,type="Ljung-Box",decim=2)
Box.test.2(rnorm(100),nlag=1:5,type="Ljung-Box",decim=2)

# AR1
reg.resi=lm(resi[-n]~resi[-1]-1)
coef(reg.resi)
summary(reg.resi)
resi.z=residuals(reg.resi)
1-var(resi.z)/var(LakeHuron)

shapiroTest(resi.z)
Box.test.2(resi.z,nlag=1:5,type="Ljung-Box",decim=2)

armaselect(resi, nbmod = 5)

arma.res=arima(resi,order=c(2,0,0),include.mean=F,method="CSS")
resi.inno = residuals(arma.res)

shapiroTest(resi.inno)
Box.test.2(resi.inno,nlag=1:5,type="Ljung-Box",decim=2)
```