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### regressio simple
temps = time(LakeHuron)
reg.lac = lm(LakeHuron~temps)
summary(reg.lac)
### etude des residus
par(mfrow=c(1,2))
plot(reg.lac,which=1)
plot(reg.lac,which=2)

t = (temps-mean(temps))^2
reg.lac2 = lm(LakeHuron~temps+t)
summary(reg.lac2)

plot(reg.lac2)

par(mfrow=c(2,2))
plot(reg.lac2)

plot(reg.lac2,which=1)
plot(reg.lac2,which=2)

#####
#resi = residuals(reg.lac)
resi = residuals(reg.lac2)
lag.plot(rev(resi),9,layout=c(3,3),do.lines=FALSE)
require(caschrono)
Box.test.2(resi,nlag=c(3,6,9),type="Ljung-Box",decim=2)
n =length(resi)
summary(lm(resi[-1]~resi[-n]-1))
require(forecast)
(mod.lac2=Arima(resi,order=c(1,0,0),include.mean=FALSE))
sqrt(0.4832)
(mod.lac=Arima(LakeHuron,order=c(1,0,0),xreg=cbind(temps,t),method='ML'))
sqrt(0.498)

t_stat(mod.lac2)
t_stat(mod.lac)

resi.inno=residuals(mod.lac)
lag.plot(rev(resi.inno),9,layout=c(3,3),do.lines=FALSE)
resi.inno2=residuals(mod.lac2)
lag.plot(rev(resi.inno2),9,layout=c(3,3),do.lines=FALSE)

Box.test.2(resi.inno,nlag=c(3,6,9),type="Ljung-Box",decim=2)

Box.test.2(resi.inno2,nlag=c(3,6,9),type="Ljung-Box",decim=2)

## estimation
# y = ts(resi)
armaselect(resi,nbmod = 5)
(mod.lac3 = Arima(LakeHuron, order = c(2, 0, 0), xreg = cbind(temps,t)))
t_stat(mod.lac3)

Box.test.2(residuals(mod.lac3),nlag=c(3,6,9),type="Ljung-Box",decim=2)

armaselect(residuals(mod.lac3),nbmod = 5)

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