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#### Lac Huron
LakeHuron
plot(LakeHuron)
plot(rnorm(100),type="l")
(temp = time(LakeHuron))
reg.lac = lm(LakeHuron~temp)
abline(reg.lac,col="red")
summary(reg.lac)
resi = residuals(reg.lac)
1-var(resi)/var(LakeHuron)
# comparaison avec BB
par(mfrow=c(1,2))
plot(as.vector(temp),resi,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")
## etude des residus
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)

###
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(resi,do.lines=F)

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)
Box.test.2(resi,nlag=c(1,2,3),type="Ljung-Box",decim=2)
Box.test.2(rnorm(100),nlag=c(3,6,9),type="Ljung-Box",decim=2)

##### estimation #####
summary(lm(resi[-1]~resi[-n]-1))

require(forecast)
(mod.lac2=Arima(resi,order=c(1,0,0),include.mean=FALSE))
sqrt(0.5027)
(mod.lac=Arima(LakeHuron,order=c(1,0,0),xreg=temp,method='ML'))
sqrt(0.5122)

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.inno,nlag=c(1,2,3),type="Ljung-Box",decim=2)

Box.test.2(resi.inno2,nlag=c(3,6,9),type="Ljung-Box",decim=2)
Box.test.2(resi.inno2,nlag=c(1,2,3),type="Ljung-Box",decim=2)
## estimation
armaselect(LakeHuron,nbmod = 5)
(mod.lac3 = Arima(LakeHuron, order = c(2, 0, 0), xreg = temp))
t_stat(mod.lac3)

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