set.seed(123)

ar1 = arima.sim(list(order=c(1,0,0), ar=0.5), n=200)

plot(ar1)

acf(ar1)

pacf(ar1)

set.seed(123)

ma.sim = arima.sim(list(order=c(0,0,1), ma=-0.5), n=200)

plot(ma.sim)

acf(ma.sim)

pacf(ma.sim)

url1 = "http://www.metoffice.gov.uk/hadobs/hadcrut4/data/current/time\_series/HadCRUT.4.3.0.0.annual\_ns\_avg.txt"

#use text editor to determine widths

temp = read.fwf(url1, widths=c(4,3,6),sep="")

head(temp)

tail(temp)

names(temp)=c("Year","Temperature")

T = ts(temp$Temperature, frequency=1, start=c(1850), end=c(2015))

#could do fixed width as well

url2 = "http://cdiac.ornl.gov/ftp/ndp030/CSV-FILES/global.1751\_2011.csv"

co2 = read.csv(file=url2,skip=2,header=FALSE, col.names=c("Year",

"Total","3","4","5","6","7","8"))

#colClasses

str(co2)

co2 = co2[,1:2]

head(co2)

tail(co2)

E = ts(co2$Total, frequency=1, start=c(1751), end=c(2011))

library(dynlm)

library(forecast)

library(tseries)

library(vars)

SurfaceTemp = window(T, start=c(1920), end=c(2011))

Emissions = window(E, start=c(1920), end=c(2011))

climate = cbind(SurfaceTemp, Emissions)

plot(climate, main="Temp Anomalies and CO2 Emissions")

cor(climate)

par(mfrow=c(2,2))

acf(climate[,1], main="Temp")

pacf(climate[,1], main="Temp")

acf(climate[,2], main="CO2")

pacf(climate[,2], main="CO2")

ccf(climate[,2],climate[,1], main="CCF")

adf.test(climate[,1])

adf.test(climate[,2])

T2 = window(T, start=1970)

plot(T2)

train = window(T2,end=2007)

test = window(T2,start=2008)

fit.holt=holt(train, h=8, initial="optimal")

summary(fit.holt)

plot(forecast(fit.holt))

lines(test, type="o")

fit.holtd=holt(train, h=8,initial="optimal", damped=TRUE)

summary(fit.holtd)

plot(forecast(fit.holtd),main="Holt Damped")

lines(test, type="o")

fit.arima = auto.arima(train)

summary(fit.arima)

plot(forecast(fit.arima, h=8))

lines(test, type="o")

mape1 = sum(abs((test-fit.holtd$mean)/test))/8

mape1

mape2 = sum(abs((test-forecast(fit.arima)$mean)/test))/8

mape2

T3=window(T2, start=1990)

plot(T3, ylim=c(0.1,0.8))

lines(forecast(fit.holt)$mean, type="o",pch=2,lty="dotted")

lines(forecast(fit.holtd)$mean, type="o",pch=5,lty=6)

lines(forecast(fit.arima,h=8)$mean, type="o",pch=7,lty="dashed")

legend("topleft", lty=c("solid","dotted","dashed"), pch=c(1,2,5,7),

c("Data","Holt","HoltDamped","ARIMA"))

#Dynlm Model

y = window(climate[,1],start=1945)

x = window(climate[,2],start=1945)

fit.lm = lm(y~x)

summary(fit.lm)

plot.ts(fit.lm$residuals)

acf(fit.lm$residuals)

dwtest(fit.lm)

ccf(x,y)

fit.dyn = dynlm(y~x+L(x,1:6)+L(y,c(1,4)))

summary(fit.dyn)

#######update model

fit.dyn2 = dynlm(y~L(x,c(5,6))+L(y,c(1,4)))

summary(fit.dyn2)

plot(fit.dyn2$residuals)

acf(fit.dyn2$residuals)

dwtest(fit.dyn2)

plot(y, ylab="Surface Temperature")

lines(fitted(fit.dyn2), pch=2, lty="dashed")

legend("topleft", lty=c("solid","dashed"), c("Actual","Predicted"))

######granger causality

ndiffs(x, test="kpss")

ndiffs(y, test="kpss")

granger = cbind(y,x)

dGranger = diff(granger)

lag=VARselect(dGranger, lag.max=10)

lag$selection

lag5 = VAR(dGranger, p=5)

summary(lag5)

serial.test(lag5,type="PT.asymptotic")

summary(lag5, equation="y")

x2y = causality(lag5,cause="x")

y2x = causality(lag5,cause="y")

x2y$Granger

y2x$Granger

#grangertest(y ~ x, order=5, data=dGranger)

#grangertest(x ~ y , order=5, data=dGranger)

predict(lag5, n.ahead=10, ci=0.95)

plot(forecast(lag5))