ETW3420
Principles of Forecasting and Applications

Topic 6 Post-Tutorial Activity Part 2

Instructions

- Perform and complete the following tasks before answering the Quiz questions on Moodle.

Question 1

Use R to simulate and plot some data from simple ARIMA models.

(a) Use the following R code to generate data from an AR(1) model with $\phi_1 = 0.6$ and $\sigma^2 = 1$. Let $T = 500$. The process starts with $y_1 = 0$.


```r
#Set sample size
T = 500

#Create a time series vector to store the 500 values of the data set
y <- ts(numeric(T))

#Setting y_1 = 0
y[1] = 0

#Set the value of phi_1
phi = 0.6

#Simulate vector of error terms from a standard normal distribution
set.seed(123) #set seed number; to ensure we all have the same simulated values
e <- rnorm(T)

#Simulate AR(1) process
for (i in 2:T) {
  y[i] = phi*y[i-1]+ e[i]
}
```


(b) Produce a time plot along with its ACF and PACF for the series. How do the plots change as you change the value of ϕ_1?

(c) Use the following R code to generate data from an MA(1) model with $\theta_1 = 0.6$ and $\sigma^2 = 1$. Let $T = 500$.

```
#Set sample size
T = 500

#Create a time series vector to store the 500 values of the data set
y <- ts(numeric(T))

#Setting y_1 = 0
y[1] = 0

#Set the value of theta
theta = 0.6

#Simulate vector of error terms from a standard normal distribution
set.seed(123) #set seed number; to ensure we all have the same simulated values
e <- rnorm(T)

#Simulate MA(1) process
for (i in 2:T) {
  y[i] = theta*e[i-1]+ e[i]
}
```


(d) Produce a time plot along with its ACF and PACF for the series. How do the plots change as you change the value of θ_1?

(e) Generate data from an ARMA(1,1) model with $\phi_1 = 0.6$, $\theta_1 = 0.6$ and $\sigma^2 = 1$. Let $T = 500$. The process starts with $y_1 = 0$.

```
#Set sample size
T = 500

#Create a time series vector to store the 500 values of the data set
y <- ts(numeric(T))

#Setting y_1 = 0
y[1] = 0

#Set the value of phi and theta
phi = 0.6
theta = 0.6

#Simulate vector of error terms from a standard normal distribution
set.seed(123) #set seed number; to ensure we all have the same simulated values
```

```
e <- rnorm(T)

#Simulate ARMA(1,1) process
for (i in 2:T) {
  y[i] = phi*y[i-1] + theta*e[i-1]+ e[i]
}
```

(f) Plot the ACF and PACF of the simulated ARMA(1,1) process. Consider which other possible data generating processes these plots resemble.

Question 2

(a) Plot the annual bituminous coal production in the United States from 1920 to 1968 (data set `bicoal`). Also plot its ACF and PACF.

(b) You decide to fit the following model to the series:

$$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \phi_3 y_{t-3} + \theta_1 e_{t-1} + e_t$$

where y_t is the coal production in year t and e_t is a white noise series. What sort of ARIMA model is this (i.e., what are p, d, and q)?

(c) Explain why this model was chosen using the ACF and PACF.