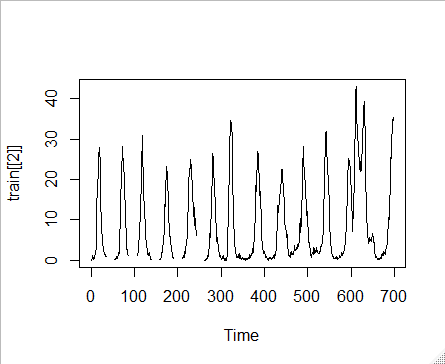
Time series Homework 6

104304033 統計四 劉書宏

Chapter 5

42.



In this plot, we can see that the data has strong seasonality and no trend, so I use seasonal adjustment then mean to do the missing value imputation.

After imputation, trying to find ARIMA model.

Series: train\_season

ARIMA(2,0,1) with non-zero mean

Coefficients:

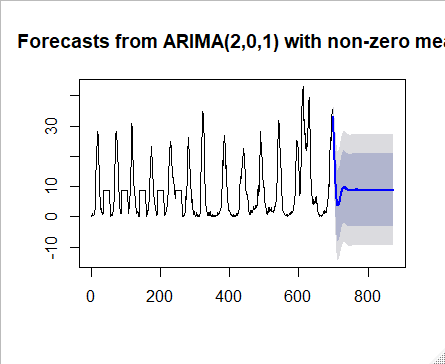
ar1 ar2 ma1 mean

1.7889 -0.8271 -0.4314 8.8413

s.e. 0.0321 0.0314 0.0496 1.0266

sigma^2 estimated as 3.365: log likelihood=-1413.79

AIC=2837.59 AICc=2837.68 BIC=2860.33



We can see that the forecasts of the last data are similar, but the data has strong seasonality. I think that using mean imputation with seasonal adjustment is still no good for this data.

52.

*̂yt* = 25 + 0*.*8*yt*−1 − 0*.*2*𝜀t*−1 + *𝜀t*

(a)

at T = 100, forecast y100 = 130 and real y100 = 140

so T = 101 , y101 = 25 + 0.8 \* 140 + 10 = 147

y102 = 25 + 0.8 \* 147 – 0.2 \* 10 = 140.6

y103 = 25 + 0.8 \* 140.6 = 137.48

y104 = 25 + 0.8 \* 137.48 = 134.984

(b)

the shape of this model is decreasing.

(c)

y101 = 132

y102 = 25 + 0.8 \* 132 = 130.6

y103 = 25 + 0.8 \* 130.6 = 129.48

(d)

variance = 1.5

at T = 101 like (a) y101 = 147 and we need to find 95% confidence interval = 147 ± 1.96 \* 1.5 ^0.5 = (144.5995,149.4005)

55.

AR(1):

In AR(1), we only depend on the last point, so the shape of AR(1) model depend on the coefficient, if coefficient are larger than 1, the forecast value will be increasing, on the opposite, decreasing.

AR(2):

In AR(2), we consider the y(t-1) and y(t-2),  If both φ1φ1 and φ2φ2 are positive, the output will resemble a low pass filter, with the high frequency part of the noise decreased.

If φ1  is positive while φ2  is negative, then the process favors changes in sign between terms of the process. The output oscillates. This can be likened to edge detection or detection of change in direction.

MA(1):

The notation MA(1) refers to the moving average model of order 1:

MA(2)

ARMA(1,1)

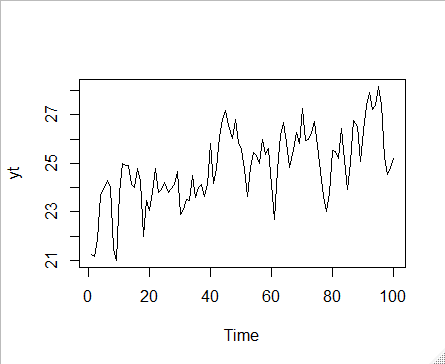
IMA(1,1)

ARIMA(1,1,0)

56.

yt = 25 + 0.8yt−1 + 𝜀t

(a)



using R commend arima.sim to generate 100 points from this formula.

try to use auto.arima to verify the data are AR(1).

Series: yt

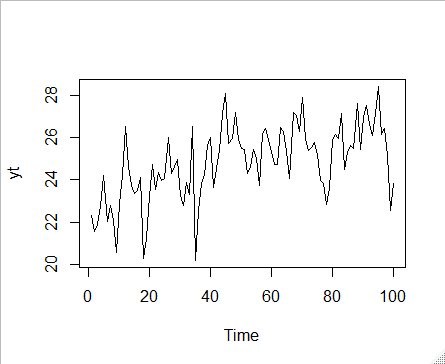
ARIMA(0,1,0)

sigma^2 estimated as 1.005: log likelihood=-140.73

AIC=283.46 AICc=283.5 BIC=286.05

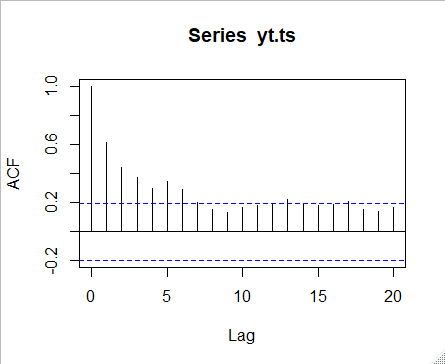
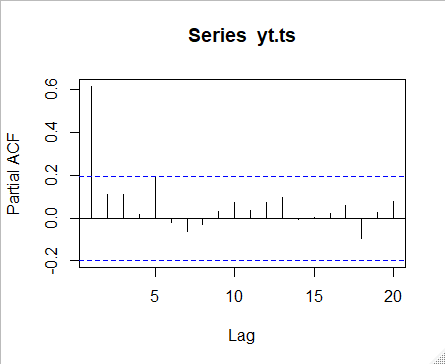
As the result, we can see that the best fit model is AR(1).

(b)



we can see that the plot has a little difference from the (a) plot.

(c)

(d)

60

*yt* = 25 + 0*.*6*yt*−1 + 0*.*25*yt*−2 + *𝜀t*.

(a) ACF and PACF

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | acf | pacf |  | acf | pacf |
| 0.00 | 1.00 | 0.80 | 26.00 | 0.04 | 0.00 |
| 1.00 | 0.80 | 0.25 | 27.00 | 0.03 | (0.00) |
| 2.00 | 0.73 | 0.00 | 28.00 | 0.03 | 0.00 |
| 3.00 | 0.64 | (0.00) | 29.00 | 0.03 | (0.00) |
| 4.00 | 0.57 | (0.00) | 30.00 | 0.02 | 0.00 |
| 5.00 | 0.50 | (0.00) | 31.00 | 0.02 | 0.00 |
| 6.00 | 0.44 | (0.00) | 32.00 | 0.02 | 0.00 |
| 7.00 | 0.39 | 0.00 | 33.00 | 0.02 | 0.00 |
| 8.00 | 0.34 | 0.00 | 34.00 | 0.01 | 0.00 |
| 9.00 | 0.30 | 0.00 | 35.00 | 0.01 | (0.00) |
| 10.00 | 0.27 | (0.00) | 36.00 | 0.01 | 0.00 |
| 11.00 | 0.24 | 0.00 | 37.00 | 0.01 | 0.00 |
| 12.00 | 0.21 | (0.00) | 38.00 | 0.01 | (0.00) |
| 13.00 | 0.18 | 0.00 | 39.00 | 0.01 | (0.00) |
| 14.00 | 0.16 | 0.00 | 40.00 | 0.01 | (0.00) |
| 15.00 | 0.14 | (0.00) | 41.00 | 0.01 | 0.00 |
| 16.00 | 0.13 | (0.00) | 42.00 | 0.01 | (0.00) |
| 17.00 | 0.11 | 0.00 | 43.00 | 0.00 | (0.00) |
| 18.00 | 0.10 | (0.00) | 44.00 | 0.00 | 0.00 |
| 19.00 | 0.09 | (0.00) | 45.00 | 0.00 | (0.00) |
| 20.00 | 0.08 | 0.00 | 46.00 | 0.00 | (0.00) |
| 21.00 | 0.07 | 0.00 | 47.00 | 0.00 | 0.00 |
| 22.00 | 0.06 | (0.00) | 48.00 | 0.00 | (0.00) |
| 23.00 | 0.05 | (0.00) | 49.00 | 0.00 | 0.00 |
| 24.00 | 0.05 | (0.00) | 50.00 | 0.00 |  |

(b)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | acf\_t | pacf\_t | acf | pacf |
| 0 | 1 | 0.8 | 1 | 0.6 |
| 1 | 0.8 | 0.25 | 0.6 | 0 |
| 2 | 0.73 | 0 | 0.36 | 0 |
| 3 | 0.638 | -8.22E-17 | 0.216 | 0 |
| 4 | 0.5653 | -7.63E-17 | 0.1296 | 0 |
| 5 | 0.49868 | -3.41E-17 | 0.07776 | 0 |
| 6 | 0.440533 | -1.07E-16 | 0.046656 | 0 |
| 7 | 0.3889898 | 1.48E-16 | 0.0279936 | 0 |
| 8 | 0.3435271 | 4.11E-18 | 0.0167962 | 0 |
| 9 | 0.3033637 | 1.85E-17 | 0.0100777 | 0 |
| 10 | 0.2679 | -7.81E-17 | 0.0060466 | 0 |
| 11 | 0.2365809 | 2.06E-18 | 0.003628 | 0 |
| 12 | 0.2089236 | -2.06E-18 | 0.0021768 | 0 |
| 13 | 0.1844994 | 4.93E-17 | 0.0013061 | 0 |
| 14 | 0.1629305 | 1.23E-17 | 0.0007836 | 0 |
| 15 | 0.1438832 | -2.36E-17 | 0.0004702 | 0 |
| 16 | 0.1270625 | -1.13E-17 | 0.0002821 | 0 |
| 17 | 0.1122083 | 1.44E-17 | 0.0001693 | 0 |
| 18 | 0.0990906 | -1.85E-17 | 0.0001016 | 0 |
| 19 | 0.0875064 | -1.13E-17 | 6.09E-05 | 0 |
| 20 | 0.0772765 | 1.44E-17 | 3.66E-05 | 0 |
| 21 | 0.0682425 | 2.06E-18 | 2.19E-05 | 0 |
| 22 | 0.0602646 | -1.34E-17 | 1.32E-05 | 0 |
| 23 | 0.0532194 | -7.20E-18 | 7.90E-06 | 0 |
| 24 | 0.0469978 | -4.63E-18 | 4.74E-06 | 0 |
| 25 | 0.0415035 | 1.59E-17 | 2.84E-06 | 0 |
| 26 | 0.0366516 | 3.60E-18 | 1.71E-06 | 0 |
| 27 | 0.0323668 | -1.54E-18 | 1.02E-06 | 0 |
| 28 | 0.028583 | 3.60E-18 | 6.14E-07 | 0 |
| 29 | 0.0252415 | -9.77E-18 | 3.68E-07 | 0 |
| 30 | 0.0222907 | 2.57E-19 | 2.21E-07 | 0 |
| 31 | 0.0196848 | 4.88E-18 | 1.33E-07 | 0 |
| 32 | 0.0173835 | 5.14E-19 | 7.96E-08 | 0 |
| 33 | 0.0153513 | 1.80E-18 | 4.78E-08 | 0 |
| 34 | 0.0135567 | 2.83E-18 | 2.87E-08 | 0 |
| 35 | 0.0119718 | -7.07E-18 | 1.72E-08 | 0 |
| 36 | 0.0105723 | 7.71E-19 | 1.03E-08 | 0 |
| 37 | 0.0093363 | 4.24E-18 | 6.19E-09 | 0 |
| 38 | 0.0082449 | -1.61E-18 | 3.71E-09 | 0 |
| 39 | 0.007281 | -1.03E-18 | 2.23E-09 | 0 |
| 40 | 0.0064298 | -3.85E-19 | 1.34E-09 | 0 |
| 41 | 0.0056781 | 8.99E-19 | 8.02E-10 | 0 |
| 42 | 0.0050143 | -1.80E-18 | 4.81E-10 | 0 |
| 43 | 0.0044281 | -9.64E-19 | 2.89E-10 | 0 |
| 44 | 0.0039105 | 2.09E-18 | 1.73E-10 | 0 |
| 45 | 0.0034533 | -9.64E-20 | 1.04E-10 | 0 |
| 46 | 0.0030496 | -3.53E-19 | 6.24E-11 | 0 |
| 47 | 0.0026931 | 1.09E-18 | 3.74E-11 | 0 |
| 48 | 0.0023783 | -1.28E-18 | 2.25E-11 | 0 |
| 49 | 0.0021002 | 3.21E-19 | 1.35E-11 | 0 |
| 50 | 0.0018547 |  | 8.08E-12 |  |

we can see that the AR(1) acf and pacf are smaller than AR(2)’s.

(c)

still the value about AR(1) are too small.

R code

### this is homework 6

library(imputeTS)

library(forecast)

###

## 42

#a

data = read.csv("B23.csv")

train = data[1:698,]

test = data[699:874,]

# Seasonal Adjustment then Mean

train\_ts = ts(train[[2]])

train\_season = na.seasplit(train\_ts, algorithm = "mean")

model = auto.arima(train\_season)

plot(forecast(model, h = 176))

#56 yt = 25 + 0.8 \* yt-1 + et

##a

xt <- arima.sim(list(order = c(1,0,0), ar = 0.8), n = 100)

yt <- xt + 25

plot.ts(yt)

model = auto.arima(yt)

##b

x = rnorm(100, mean = 0, sd = 1)

yt = yt + x

plot.ts(yt)

##c

yt.ts = ts(yt)

acf(yt.ts)

pacf(yt.ts)

###60

##a theoretical acf and pacf

acf\_t = ARMAacf(ar=c(0.6, 0.25), lag.max=50)

pacf\_t = ARMAacf(ar=c(0.6, 0.25), lag.max=50, pacf = TRUE)

write.csv(acf\_t, file = "acf\_t.csv")

write.csv(pacf\_t, file = "pacf\_t.csv")

##b AR(1)

acf\_s = ARMAacf(ar=c(0.6), lag.max=50)

pacf\_s = ARMAacf(ar=c(0.6), lag.max=50, pacf = TRUE)

write.csv(acf\_s, file = "acf\_s.csv")

write.csv(pacf\_s, file = "pacf\_s.csv")