# homework 6

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## Problem 1

(a)

```
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
```

```
## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
Rday<-read.csv("DailyLogRet-intc9608.txt",sep = "",skip = 2)
day <- ymd(Rday$date)
a = 1

Rmon <- rep(0,156)
count <- rep(0,156)
for(i in 1996:2008 ){
 for(j in 1:12){
   data = 0
   n =0
    for(k in 1:3274){
      if(year(day[k])==i & month(day[k])==j){
        data = data+Rday$rtn[k]
        n = n+1
      }
      Rmon[a] = data
      count[a] = n
    }
    a = a+1
  }
}
Rmon
```

```
##   [1] -0.013699  0.065503 -0.027011  0.181176  0.111511 -0.025071  0.029423
##   [8]  0.063809  0.182767  0.147855  0.148947  0.038207  0.219642 -0.129293
##  [15] -0.015724  0.102468 -0.002666 -0.062963  0.266319  0.008622  0.006631
##  [22] -0.163335  0.013446 -0.094221  0.147141  0.106189 -0.126723  0.040166
##  [29] -0.118845  0.044594  0.135982 -0.161752  0.196092  0.044883  0.194083
##  [36]  0.107574  0.183240 -0.149892 -0.000643  0.039656 -0.113916  0.108967
##  [43]  0.155890  0.182175 -0.093192  0.054005 -0.002534  0.077845  0.205101
##  [50]  0.140807  0.164638 -0.015535  0.004544  0.078451  0.005738  0.121390
##  [57] -0.543175  0.107835 -0.140987 -0.204036  0.223211 -0.244502 -0.051490
```

```
##  [64]  0.211793 -0.125551  0.088299  0.027776 -0.053142 -0.293604  0.193664
##  [71]  0.299709 -0.032086  0.117700 -0.196893  0.071999 -0.054451 -0.019767
##  [78] -0.377424  0.056101 -0.097383 -0.168568  0.259466  0.200794 -0.285841
##  [85]  0.018604  0.099994 -0.048002  0.128772  0.132513  0.003538  0.186436
##  [92]  0.142823 -0.033524  0.183653  0.021333 -0.041813 -0.046772 -0.039105
##  [99] -0.065970 -0.052653  0.107360 -0.031368 -0.114865 -0.129804 -0.054459
## [106]  0.107763  0.009768  0.047804 -0.039428  0.072043 -0.030400  0.013990
## [113]  0.140886 -0.033736  0.044572 -0.049504 -0.040759 -0.046726  0.133255
## [120] -0.064905 -0.151963 -0.024828 -0.055966  0.027824 -0.095500  0.056483
## [127] -0.047339  0.091748  0.052160  0.038683  0.010298 -0.054137  0.038052
## [134] -0.047194 -0.036050  0.118772  0.037781  0.070853 -0.000574  0.094916
## [141]  0.005423  0.042601 -0.021447  0.025062 -0.213285 -0.044072  0.064082
## [148]  0.055255  0.050201 -0.071684  0.037863  0.039335 -0.183812 -0.123568
## [155] -0.118912  0.078969
```

(b)

```
#find the ACF value at lag 1
acf(Rday$rtn,lag.max =1, plot = F)
```

```
##
## Autocorrelations of series 'Rday$rtn', by lag
##
##      0      1
##  1.000 -0.044
```

```
r1 =-0.044
vart <- rep(0,156)
a = 1
for(i in 1: 156){
  sum = 0
  for( j in 1: count[i]){
    sum = sum+(Rday$rtn[a]-Rmon[i]/count[i])^2
    a =a +1
  }

  vart[i] <- (1+ 2*r1)/(count[i]-1)*sum
}
 vart
```

```
##   [1] 1.065245e-03 2.532310e-04 5.842005e-04 4.556822e-04 2.602146e-04
##   [6] 2.503194e-04 5.201839e-04 2.794737e-04 3.111962e-04 5.089541e-04
##  [11] 4.422684e-04 6.148096e-04 3.392970e-04 4.445702e-04 3.732631e-04
##  [16] 5.216405e-04 7.186794e-04 2.737350e-04 5.447446e-04 4.764906e-04
##  [21] 4.199913e-04 1.456627e-03 5.471747e-04 4.672696e-04 3.742878e-04
##  [26] 4.112526e-04 9.545261e-04 4.758318e-04 3.888684e-04 6.634493e-04
##  [31] 4.670564e-04 7.091810e-04 8.518386e-04 4.883052e-04 4.743127e-04
##  [36] 9.297189e-04 9.809180e-04 1.050647e-03 6.829172e-04 9.639130e-04
##  [41] 8.567854e-04 1.123824e-03 6.736237e-04 5.433252e-04 6.605664e-04
##  [46] 1.171371e-03 6.251340e-04 6.203689e-04 1.994614e-03 6.872010e-04
##  [51] 7.593204e-04 2.452774e-03 1.834458e-03 7.667027e-04 6.799972e-04
##  [56] 4.993063e-04 3.222718e-03 2.450620e-03 2.251633e-03 2.903525e-03
##  [61] 1.349846e-03 1.201201e-03 2.616614e-03 5.049441e-03 7.111077e-04
##  [66] 7.798064e-04 8.077311e-04 8.405398e-04 2.148072e-03 1.267660e-03
##  [71] 5.735516e-04 5.421576e-04 8.582765e-04 6.303721e-04 8.560743e-04
##  [76] 5.641410e-04 1.308111e-03 2.842063e-03 2.473751e-03 1.820779e-03
```

```
##  [81] 1.254773e-03 3.064689e-03 1.041480e-03 5.025200e-04 9.390189e-04
##  [86] 3.813793e-04 9.495033e-04 7.061757e-04 5.423265e-04 3.662838e-04
##  [91] 5.851532e-04 2.704361e-04 4.167494e-04 2.407281e-04 3.040823e-04
##  [96] 3.078542e-04 2.012243e-04 3.767505e-04 4.049643e-04 2.595677e-04
## [101] 1.515378e-04 2.232387e-04 7.701786e-04 3.151487e-04 4.415835e-04
## [106] 3.153186e-04 2.381802e-04 3.197254e-04 1.487394e-04 2.033292e-04
## [111] 1.536916e-04 1.449262e-04 5.509603e-05 1.494313e-04 2.267442e-04
## [116] 1.066174e-04 1.534294e-04 9.076291e-05 2.367675e-04 1.480204e-04
## [121] 7.284860e-04 1.649761e-04 7.402076e-05 1.463542e-04 2.021607e-04
## [126] 3.032137e-04 6.259258e-04 1.826668e-04 2.165402e-04 1.640383e-04
## [131] 2.614879e-04 7.552764e-05 3.379458e-04 1.377233e-04 1.187753e-04
## [136] 1.577829e-04 1.258231e-04 2.551618e-04 4.109195e-04 3.085031e-04
## [141] 1.170915e-04 2.618829e-04 4.850049e-04 2.926694e-04 1.708315e-03
## [146] 4.391725e-04 4.993506e-04 4.789535e-04 3.367228e-04 3.920141e-04
## [151] 4.615271e-04 2.796273e-04 1.347975e-03 2.686054e-03 2.147038e-03
## [156] 1.583236e-03
```

(c)

```
summary(Rday$rtn) # day summary
```

```
##       Min.    1st Qu.     Median       Mean    3rd Qu.       Max.
## -0.2203300 -0.0147847  0.0003130  0.0006583  0.0152928  0.2012290
```

```
summary(Rmon) # month summary
```

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
## -0.54317 -0.05000  0.01630  0.01382  0.10340  0.29971
```

(d)

```
lnvart <- log(vart)
summary(vart)
```

```
##      Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
## 0.0000551 0.0002780 0.0004867 0.0007387 0.0008529 0.0050494
```

```
summary(lnvart)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  -9.806  -8.188  -7.628  -7.596  -7.067  -5.288
```

```
## N = 156 for var and ln var
```

(e)

```
library(TSA)
```

```
##
## Attaching package: 'TSA'
```

```
## The following objects are masked from 'package:stats':
##
##     acf, arima
```

```
## The following object is masked from 'package:utils':
##
##     tar
```

```
eacf(lnvart, ar.max = 10, ma.max = 10)
```

```
## AR/MA
##    0 1 2 3 4 5 6 7 8 9 10
## 0  x x x x x x x x x x x
## 1  x o o o o o o o o o o
## 2  x x o o o o o x o o o
## 3  x x o o o o o x o o o
## 4  x x x x o o o o o o o
## 5  x x o x o o o o o o o
## 6  x x o x o x o o o o o
## 7  x x o x o o o o o o o
## 8  x x o x x o o o o o o
## 9  x o o x o o o x x o o
## 10 x o o x o o o x x o o
```

```
est <- arima(lnvart, order=c(13,0,1), include.mean = T)
est
```

```
##
## Call:
## arima(x = lnvart, order = c(13, 0, 1), include.mean = T)
##
## Coefficients:
##          ar1     ar2     ar3     ar4     ar5     ar6      ar7      ar8     ar9
##       0.4306  0.1408  0.1260  0.0073  0.1430  0.0954  -0.0707  -0.0911  0.1127
## s.e.  0.4137  0.1764  0.1094  0.1037  0.0904  0.1149   0.1024   0.0972  0.1049
##         ar10    ar11    ar12     ar13      ma1  intercept
##       0.0387  0.0305  0.1071  -0.1860  -0.0442    -7.4812
## s.e.  0.0989  0.0891  0.0906   0.0854   0.4206     0.3360
##
## sigma^2 estimated as 0.3011:  log likelihood = -128.75,  aic = 287.49
```

```
T = length(lnvart)
(pmax = floor(12 * (T/100)^(1/4)))
```

```
## [1] 13
```

```
estt = (0.9553-1)/0.028

estlnvart <- rep(0,142)
for (t in 15: 156){
  sum = 0
  for(i in 1:pmax){
    sum=sum+0.9553*(lnvart[t-i]-lnvart[t-i-1])
  }
 estlnvart[t-14] = -0.7596+(0.9553-1)*lnvart[t-1]+sum+est$residuals[t]
}
estlnvart
```

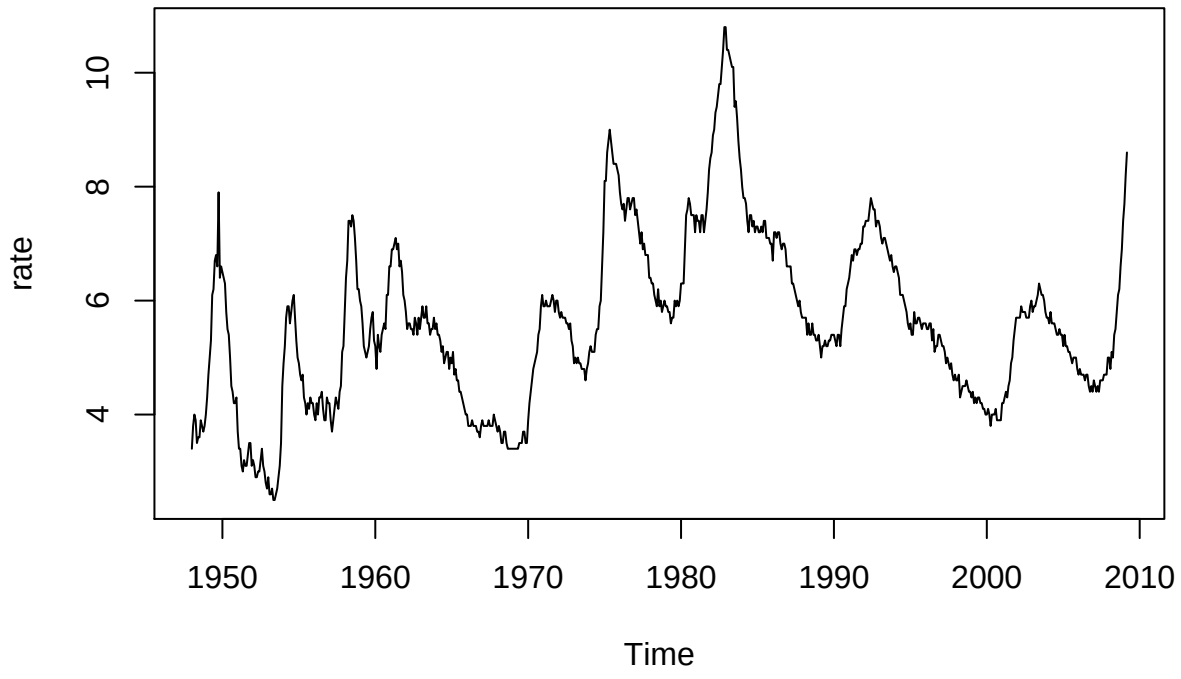
```
##   [1] -1.49214549  0.18192313 -0.05278762 -0.66450929 -0.13846083  0.40979482
##   [7] -0.70210896  0.96111004  0.76245902 -0.53499277 -0.71343147 -1.10308754
##  [13]  0.45845291 -0.15371806 -0.46274521 -0.09476048 -0.82401791  0.31129929
##  [19]  0.05679269 -0.23355248 -0.20151057 -0.99526245  0.43867364  0.52225958
##  [25]  0.19500560  0.55937957 -0.38214121  0.23753132  0.23758758 -0.74932591
##  [31] -0.28162860  0.11552711 -0.55512658 -0.44413489  0.95253871 -0.06175974
##  [37] -0.88689020  0.24260260  1.31874190 -0.41745226 -0.97879992 -1.30867042
##  [43]  0.82810707  1.50751124  1.32120936  0.86943941  0.60340995  0.04528697
```

```
##  [49] -0.57225749  1.70571302  0.33836491 -2.00365490 -1.51584191 -0.54815287
##  [55]  0.00576224  0.94816216 -1.74164783 -2.17550987 -1.64228096 -1.92478715
##  [61] -1.17485913 -0.97392403 -0.63732073 -0.64605976  1.34494995  0.74200790
##  [67]  0.09797215  0.93325784 -0.65536550 -1.75219468 -0.53092628 -0.62230106
##  [73] -0.92524659 -0.31662203 -0.97246300 -1.04749132 -1.51159408 -2.63965438
##  [79] -2.46752007 -2.55643595 -1.70715881 -2.64834673 -2.17986371 -0.87784866
##  [85] -1.17785541 -0.62302625 -2.31805392 -1.88979686 -0.13538550  0.06017379
##  [91] -0.87717254  0.02760166 -0.98845562 -0.57593902 -1.27323637 -1.28690387
##  [97] -0.74178031 -1.55246551 -2.60194023 -1.79523804 -0.16864911 -0.75894647
## [103] -2.37094438 -1.47504557 -1.18969150 -1.06535621  0.64721204 -0.23818867
## [109] -1.24448789 -1.48339692 -0.13978437  0.03841552  2.07215318  0.55098700
## [115] -0.60655371 -0.35653339 -0.46693629 -0.66469255 -0.85329391  0.21573742
## [121] -2.24326787 -1.13989336 -0.02981488 -0.15865522  0.37820507  0.18815819
## [127] -1.84604806 -0.56277649  0.39658895  0.58032871  1.08172923  2.46412254
## [133]  0.02732161  0.49597977  0.43427525  0.03893011  0.63649590 -0.18935800
## [139]  0.75230860  2.07661394  3.13719293  1.72914908
```

## Problem 2

(a)

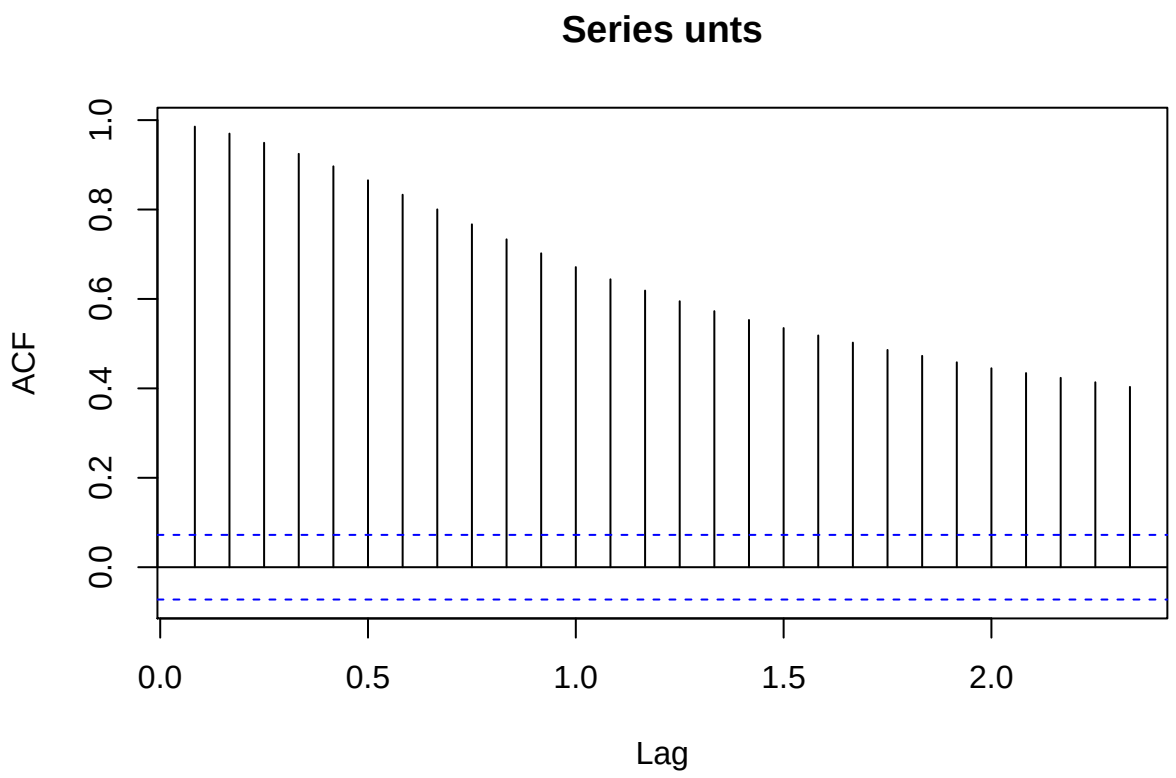
```
unem<-read.csv("m-unrate.txt",sep = "")
unts <- ts(unem$Rate, start=c(1948,1), freq = 12)
plot(unts, ylab='rate') #ts plot
```



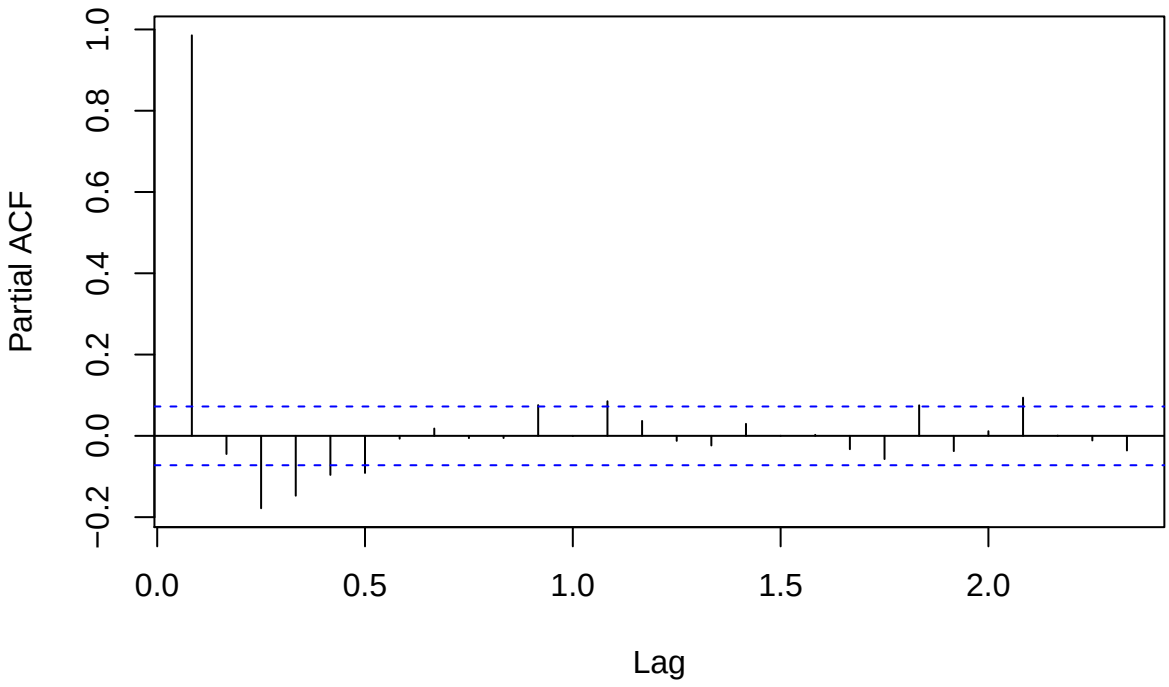

```
summary(unts) #summary
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   2.500   4.500   5.500   5.607   6.600  10.800
```

```r
acf(unts) # acf plot
```




```r
pacf(unts)# pacf plot
```




```
eacf(unts, ar.max = 10, ma.max = 10)
```

```
## AR/MA
##    0 1 2 3 4 5 6 7 8 9 10
## 0  x x x x x x x x x x x
## 1  x x x x x x x x x o x
## 2  x x o o x o o o x o o
## 3  x x o o x o x o o o o
## 4  x x o x x o o o o o o
## 5  x x o x x o o o o o o
## 6  o x o x x x o o o o o
## 7  o x x o x x o o o o o
## 8  x x o o x x o o o o o
## 9  x o x x x o x x o o o
## 10 o o x x x o x x o o o
```

(b)

```
est1 <-arima(unts, order=c(2,0,2), include.mean = T)
est2 <-arima(unts, order=c(3,0,2), include.mean = T)#ARMA(3,2) perfered
est3 <-arima(unts, order=c(2,0,3), include.mean = T)
est1
```

```
##
## Call:
## arima(x = unts, order = c(2, 0, 2), include.mean = T)
##
## Coefficients:
```

```
##          ar1      ar2      ma1     ma2  intercept
##       1.8351  -0.8424  -0.8517  0.2401     5.6678
## s.e.  0.0361   0.0358   0.0494  0.0367     0.3788
##
## sigma^2 estimated as 0.03958:  log likelihood = 141.6,  aic = -273.19
```

```
est2
```

```
##
## Call:
## arima(x = unts, order = c(3, 0, 2), include.mean = T)
##
## Coefficients:
##          ar1      ar2     ar3      ma1     ma2  intercept
##       2.6172  -2.3549  0.7345  -1.6062  0.8235     5.6520
## s.e.  0.0606   0.1273  0.0680   0.0624  0.0667     0.4862
##
## sigma^2 estimated as 0.03946:  log likelihood = 142.55,  aic = -273.1
```

```
est3
```

```
##
## Call:
## arima(x = unts, order = c(2, 0, 3), include.mean = T)
##
## Coefficients:
##          ar1     ar2     ma1     ma2     ma3  intercept
##       0.0382  0.9388  1.0027  0.2691  0.2567     5.8949
## s.e.  0.0175  0.0174  0.0409  0.0465  0.0325     0.7940
##
## sigma^2 estimated as 0.04241:  log likelihood = 115.9,  aic = -219.8
```

```
Box.test(est1$residuals, lag = 13, type = "Ljung-Box", fitdf=2+2)
```

```
##
##  Box-Ljung test
##
## data:  est1$residuals
## X-squared = 28.365, df = 9, p-value = 0.0008286
```

```
Box.test(est2$residuals, lag = 13, type = "Ljung-Box", fitdf=2+3)
```

```
##
##  Box-Ljung test
##
## data:  est2$residuals
## X-squared = 38.088, df = 8, p-value = 7.252e-06
```

```
Box.test(est3$residuals, lag = 13, type = "Ljung-Box", fitdf=3+2)
```

```
##
##  Box-Ljung test
##
## data:  est3$residuals
## X-squared = 78.865, df = 8, p-value = 8.271e-14
```

(c)

```
pred.dat <- predict(est2, n.ahead=4)
pred.dat
```

```
## $pred
##           Apr      May      Jun      Jul
## 2009 8.770181 8.934577 9.065678 9.146673
##
## $se
##             Apr       May       Jun       Jul
## 2009 0.1986400 0.2824785 0.3589321 0.4388648
```

(d) yes, since he AR polynomial relate to the behavior of stochastic cycles.

(e)

```
library(FinTS)
```

```
## Loading required package: zoo
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

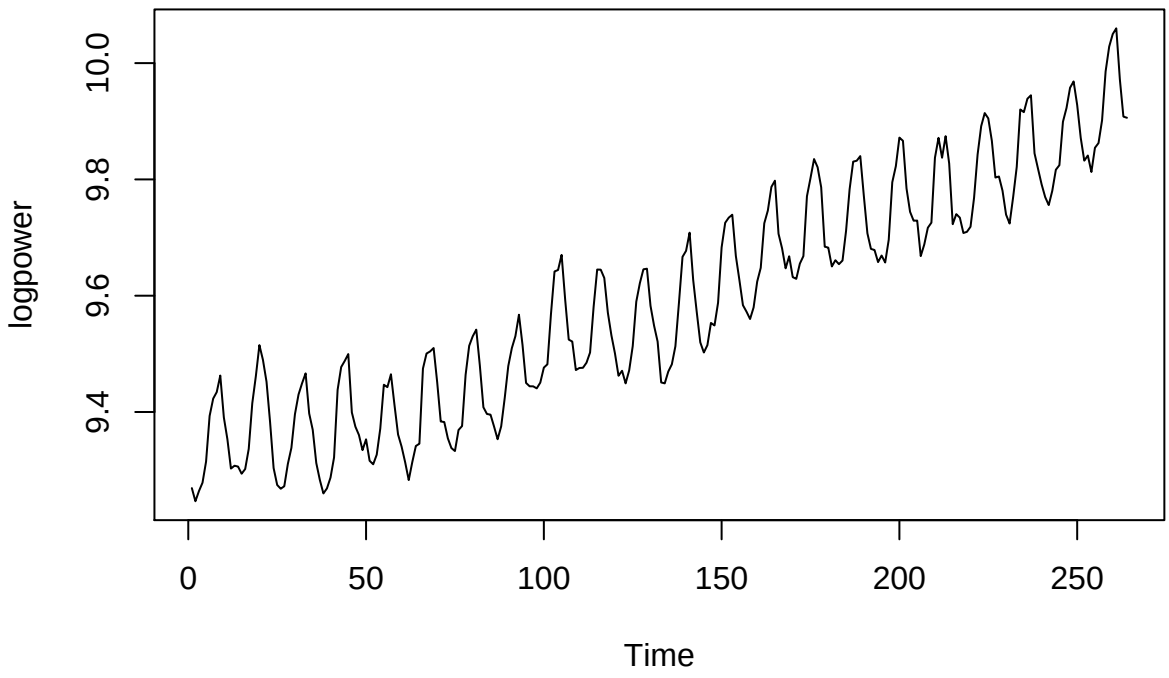
```
dif12 = diff(unts, lag=12)
dif = diff(unts); ddif12 = diff(dif, lag=12)
fit <- ARIMA(dif, order=c(3,0,2),seasonal=list(order=c(0,0,2), period=6), Box.test.lag=15)
fit$Box.test
```

```
##
##  Box-Ljung test (lag = 15)
##
## data:  fit$resid
## X-squared = 11.227, df = 8, p-value = 0.1892
```

```
## the corresponding period is 6
```

## Problem 3

```
ele<-read.csv("power6.txt")
elets <- ts(ele$power)
plot(elets, ylab='logpower')
```




```
summary(elets)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   9.246   9.440   9.576   9.590   9.741  10.060
```

```
eacf(elets, ar.max = 10, ma.max = 10)
```

```
## AR/MA
##    0 1 2 3 4 5 6 7 8 9 10
## 0  x x x x x x x x x x x
## 1  x x o x x x x x o x x
## 2  x x o x o o x x o o o
## 3  x o x x o o o x x o o
## 4  x x x x o o o x x o o
## 5  x o x x o o o x o o o
## 6  x o o x x x x x o x o
## 7  x x o x x o o x o o o
## 8  x o x x x o x x o o o
## 9  x x x x x x x x o x o
## 10 x x o x x x x x o x o
```

```
est <-arima(unts, order=c(2,0,2), include.mean = T)
est
```

```
##
## Call:
## arima(x = unts, order = c(2, 0, 2), include.mean = T)
##
```

```
## Coefficients:
##          ar1      ar2      ma1     ma2  intercept
##       1.8351  -0.8424  -0.8517  0.2401     5.6678
## s.e.  0.0361   0.0358   0.0494  0.0367     0.3788
##
## sigma^2 estimated as 0.03958:  log likelihood = 141.6,  aic = -273.19
```

```
Box.test(est$residuals, lag = 13, type = "Ljung-Box", fitdf=2+2)
```

```
##
##  Box-Ljung test
##
## data:  est$residuals
## X-squared = 28.365, df = 9, p-value = 0.0008286
```

```
fit <- ARIMA(dif, order=c(2,0,2),seasonal=list(order=c(0,1,1), period=11), Box.test.lag=14)
fit$Box.test
```

```
##
##  Box-Ljung test (lag = 14)
##
## data:  fit$resid
## X-squared = 31.864, df = 9, p-value = 0.0002102
```