hw1

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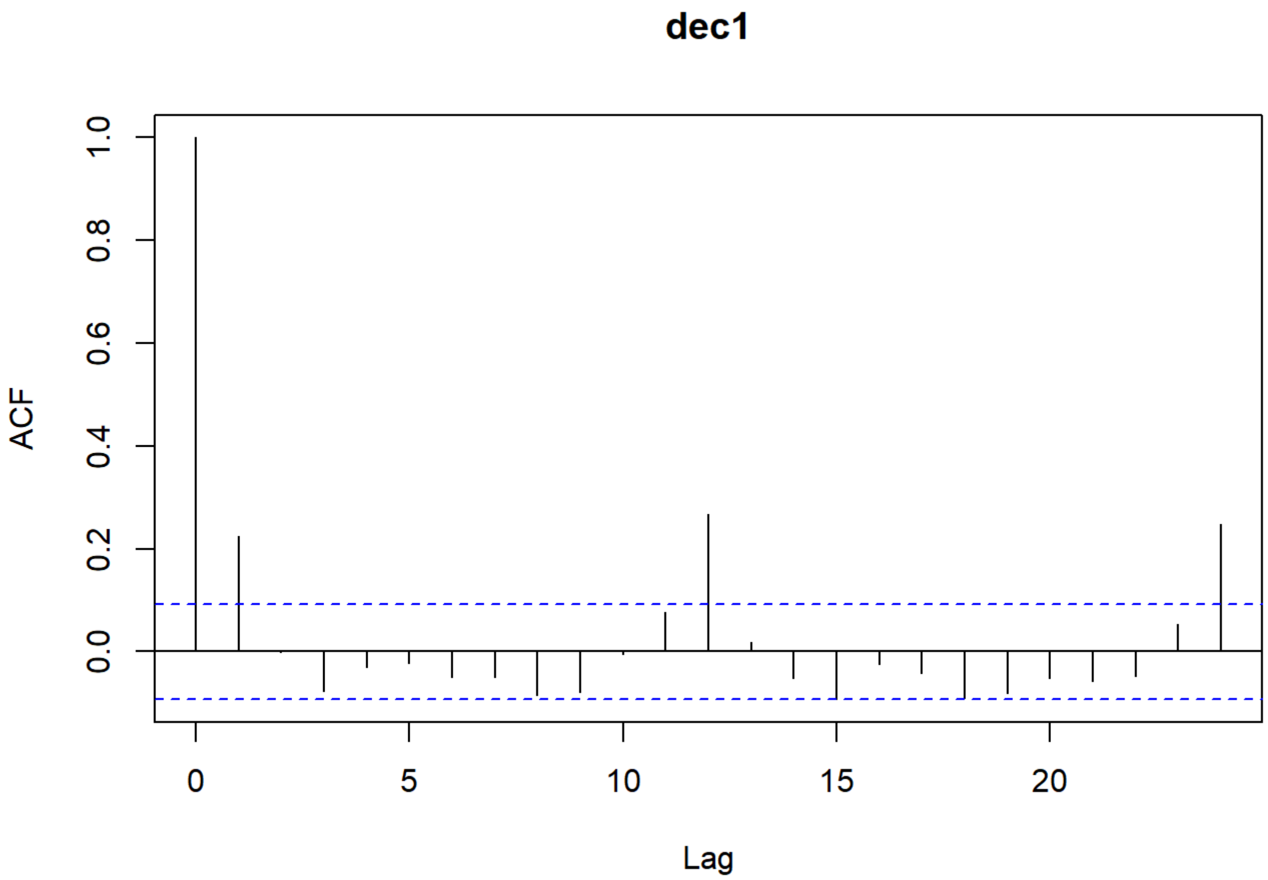
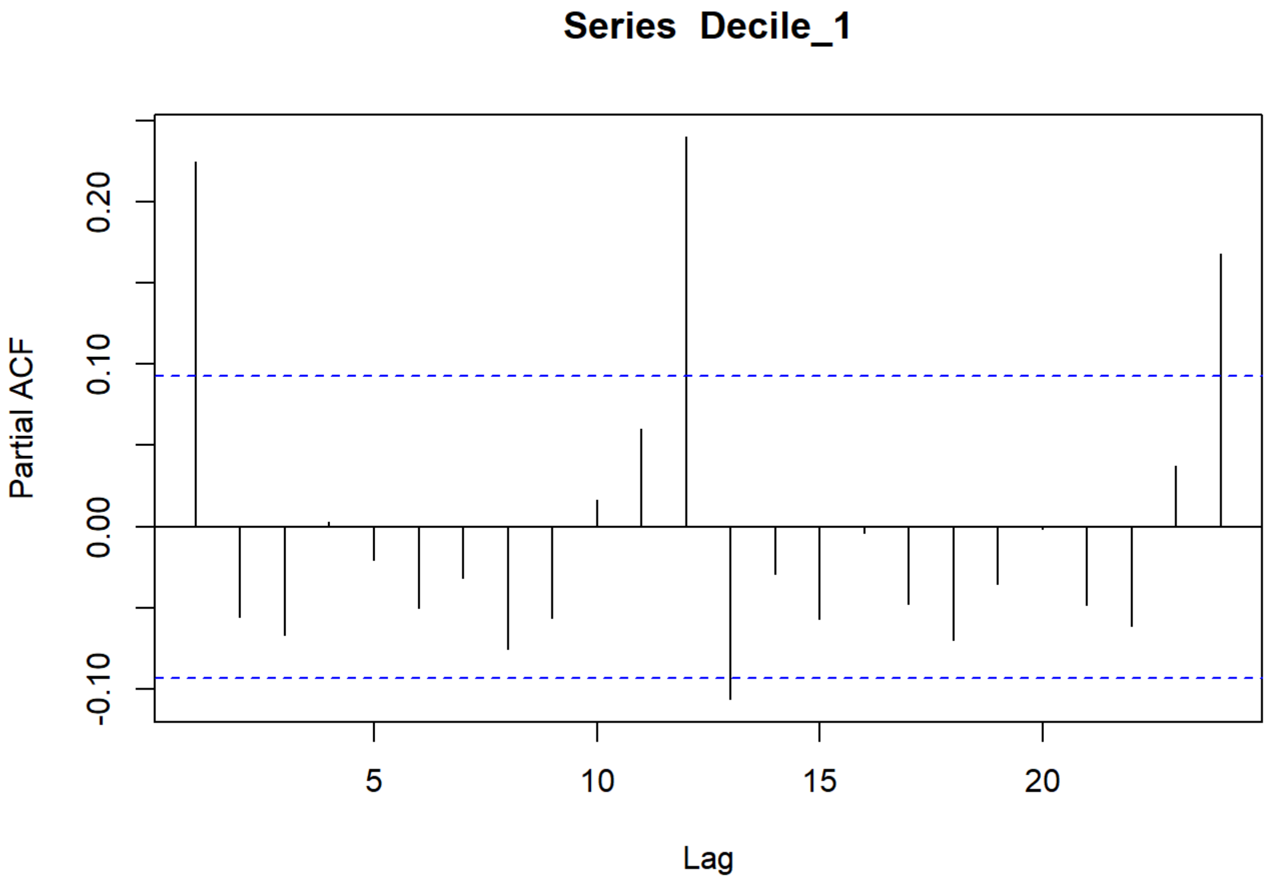
1.

```
# 1
# (a)

df = read.table("C://Users//张铭韬//Desktop//学业//港科大//MSDM5053时间序列//作业//assignment 1//m-dec19.txt",header=T)
Decile_1 = df[2]
acf_values = acf(Decile_1, lag.max = 24)
```




```
pacf_values = pacf(Decile_1, lag.max = 24)
```



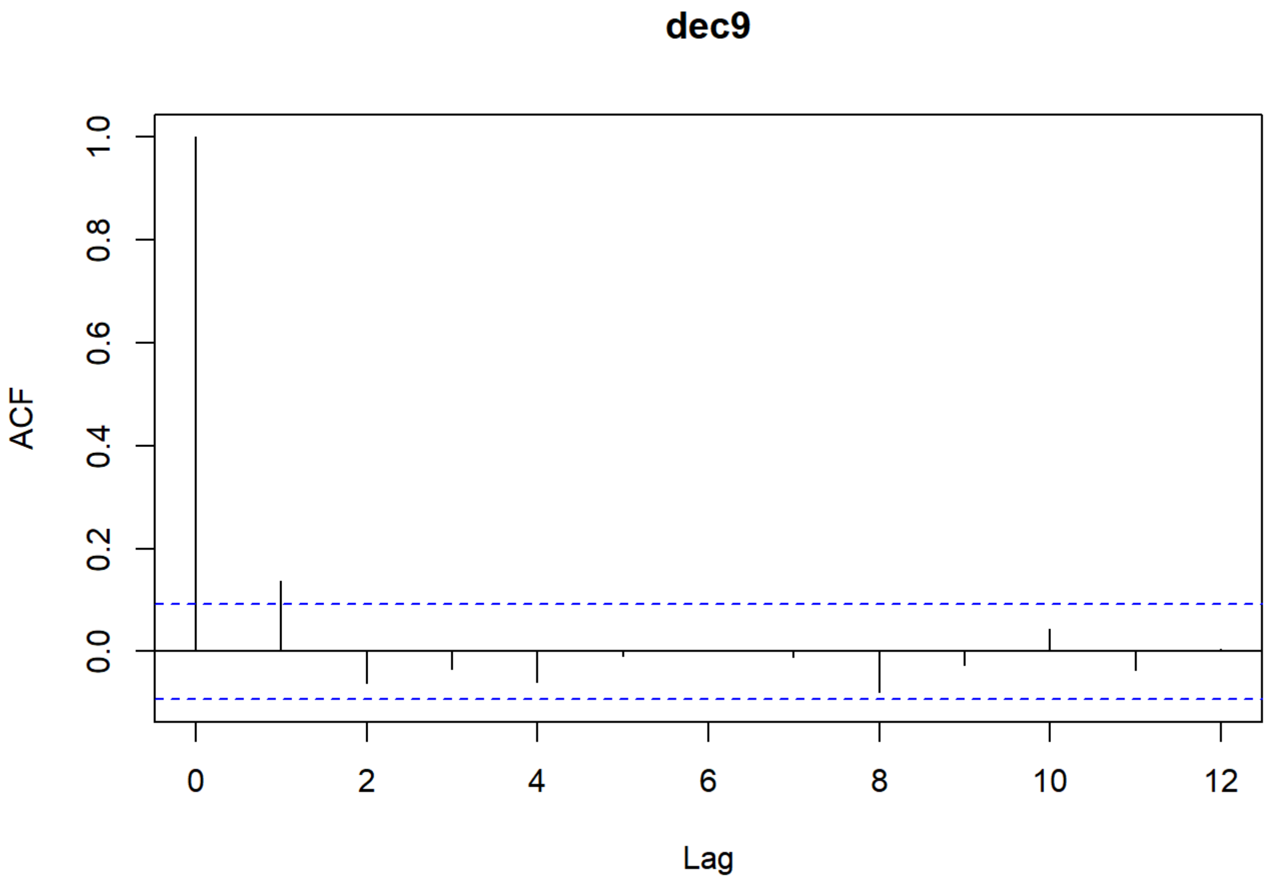

```
# (b)
Box.test(Decile_1,lag=12,type="Ljung")
```

```
##
##  Box-Ljung test
##
## data:  Decile_1
## X-squared = 69.652, df = 12, p-value = 3.72e-10
```

```
# p value is small enough to make sure the first 12 lags of ACF are not all zero.
```

2.

```
# 2
# (a)
Decile_9 = df[3]
acf_values_2 = acf(Decile_9, lag.max = 12)
```




```
# (b)
Box.test(Decile_9,lag=12,type="Ljung")
```

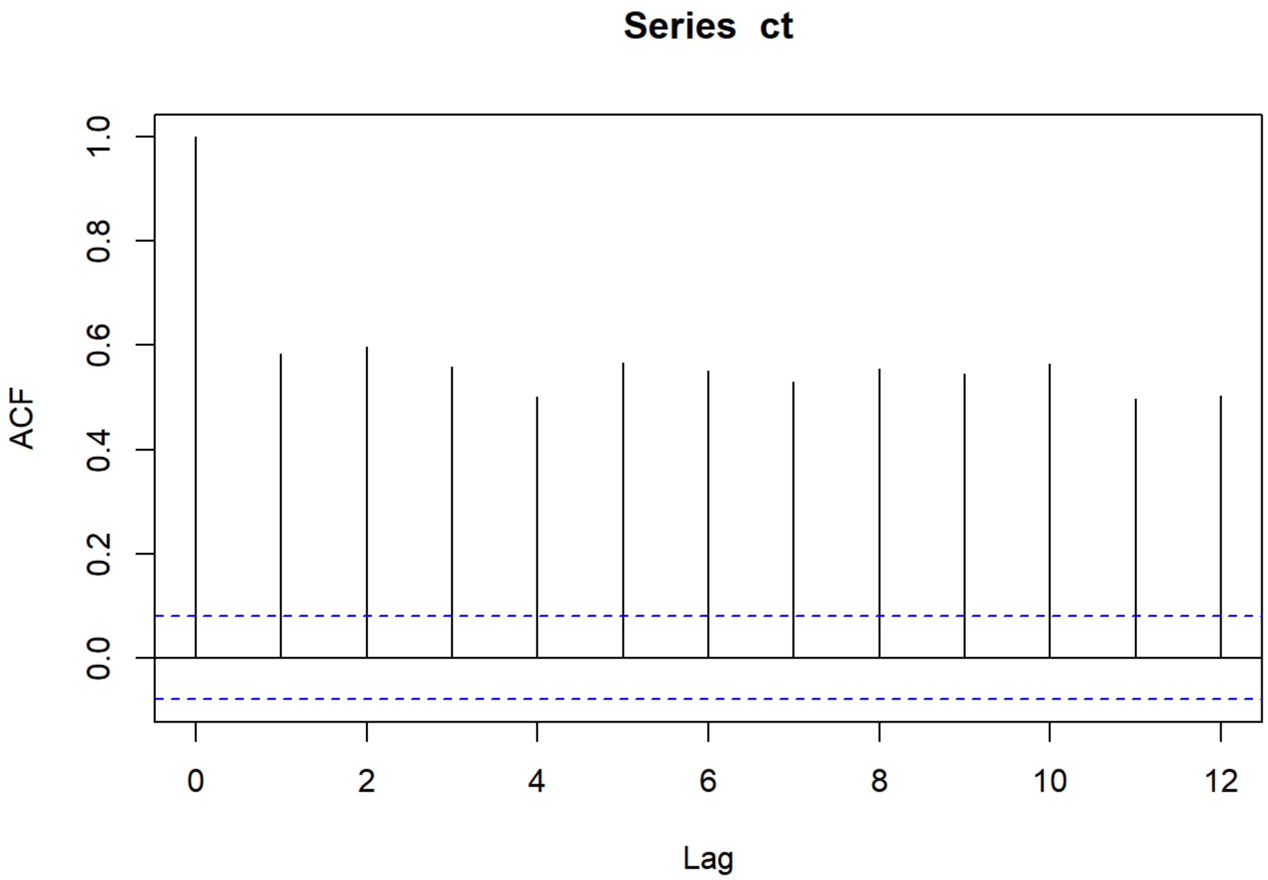
```
##
##  Box-Ljung test
##
## data:  Decile_9
## X-squared = 16.812, df = 12, p-value = 0.1568
```

```
# p value is larger than 0.05 so we accept H0: the first 12 lags of ACF are all zero.
```

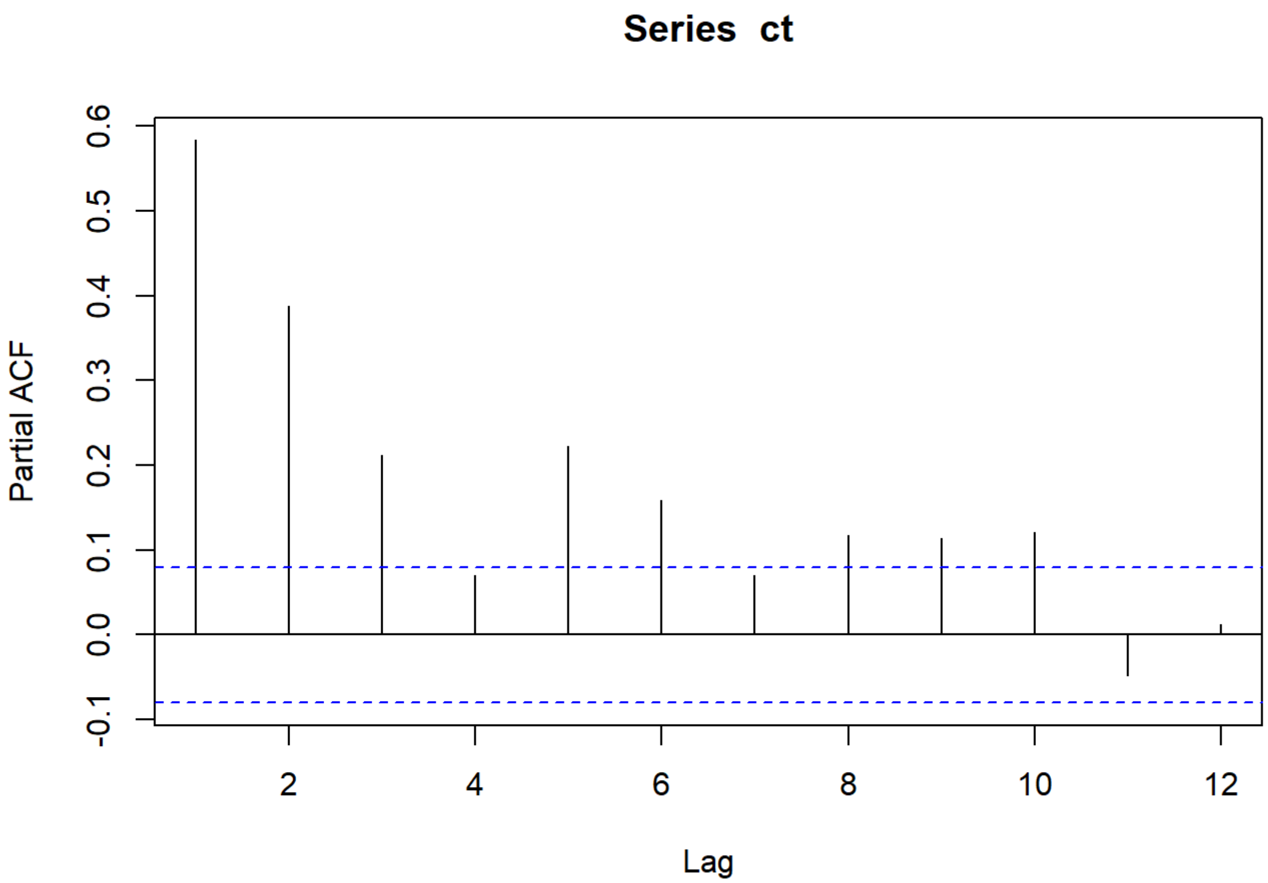
3.

```
# 3
df3 = read.table("C://Users//张铭韬//Desktop//学业//港科大//MSDM5053时间序列//作业//assignment 1//m-cpileng.txt",header=F)
Xt = df3$V4
ct = 100 * (log(Xt[2:length(Xt)]) - log(Xt[1:length(Xt)-1]))
```

```
# (a)
acf_values = acf(ct, lag.max = 12)
```




```
pacf_values = pacf(ct, lag.max = 12)
```

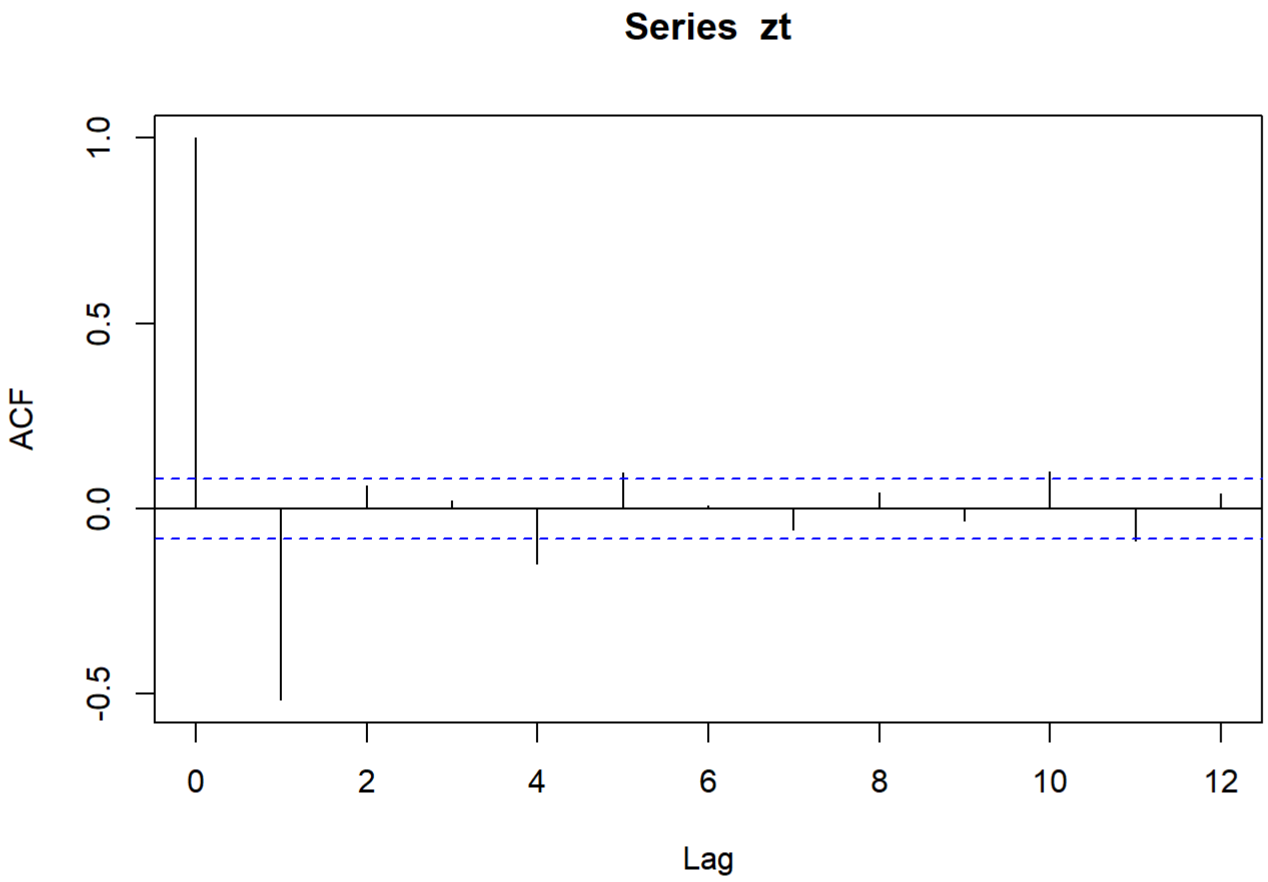


```
Box.test(ct,lag=12,type="Ljung")
```

```
##
##  Box-Ljung test
##
## data:  ct
## X-squared = 2186.6, df = 12, p-value < 2.2e-16
```

```
# p value is small enough to make sure the first 12 lags of ACF are not all zero.
```

```
# (b)
zt = ct[2:length(ct)] - ct[1:length(ct)-1]
acf_values2 = acf(zt, lag.max = 12)
```




```
# (c)
model_ct = arima(ct,order=c(1,0,5))
model_ct
```

```
##
## Call:
## arima(x = ct, order = c(1, 0, 5))
##
## Coefficients:
##          ar1      ma1     ma2      ma3      ma4     ma5  intercept
##       0.9782  -0.8160  0.0652  -0.0997  -0.1062  0.1913     0.3247
## s.e.  0.0094   0.0409  0.0511   0.0518   0.0478  0.0416     0.0755
##
## sigma^2 estimated as 0.03388:  log likelihood = 163.6,  aic = -311.21
```

4.

```
# 4
df4 = read.table("C://Users//张铭韬//Desktop//学业//港科大//MSDM5053时间序列//作业//assignment 1//q-gnprate.txt",header=F)
```

```
# (a)
model_q = arima(df4, order = c(3, 0, 0))
model_q
```

```
##
## Call:
## arima(x = df4, order = c(3, 0, 0))
##
## Coefficients:
##          ar1     ar2      ar3  intercept
##       0.4172  0.2003  -0.1648     0.0168
## s.e.  0.0636  0.0679   0.0642     0.0011
##
## sigma^2 estimated as 9.313e-05:  log likelihood = 769.83,  aic = -1529.67
```

```
# (b)
model_q$coef
```

```
##        ar1        ar2         ar3   intercept
##  0.41722420  0.20026008 -0.16483819  0.01684486
```

```
p1=c(1,-model_q$coef[1:3])
# 多项式求根
s1=polyroot(p1)
s1
```

```
## [1]  1.542932+0.928342i -1.870974-0.000000i  1.542932-0.928342i
```

```
# which implies the existence of stochastic cycles
Mod(s1)
```

```
## [1] 1.800683 1.870974 1.800683
```

```
k=2*pi/acos(1.542932/1.800683)
k
```

```
## [1] 11.60009
```

```
# the average period of business cycle is about 11.6 quarters.
```

```
# (c)
fore=predict(model_q, 4)
fore
```

```
## $pred
## Time Series:
## Start = 240
## End = 243
## Frequency = 1
## [1] 0.01400900 0.01612416 0.01666423 0.01709263
##
## $se
## Time Series:
## Start = 240
## End = 243
## Frequency = 1
## [1] 0.009650591 0.010456878 0.011063314 0.011086901
```

```
fore$pred
```

```
## Time Series:
## Start = 240
## End = 243
## Frequency = 1
## [1] 0.01400900 0.01612416 0.01666423 0.01709263
```

```
fore$se
```

```
## Time Series:
## Start = 240
## End = 243
## Frequency = 1
## [1] 0.009650591 0.010456878 0.011063314 0.011086901
```

5.

```
# 5
```

```
# (a)
model_D9 = arima(Decile_9, order = c(0, 0, 1))
model_D9
```

```
##
## Call:
## arima(x = Decile_9, order = c(0, 0, 1))
##
## Coefficients:
##          ma1  intercept
##       0.1593     0.0109
## s.e.  0.0499     0.0029
##
## sigma^2 estimated as 0.0027:  log likelihood = 683.03,  aic = -1360.07
```

```
# (b)
# 参数显著性检验
# t统计量
t = abs(model_D9$coef)/sqrt(diag(model_D9$var.coef))
# 自由度
df_t = dim(Decile_9)[1]-length(model_D9$coef)
# pt()
pt(t,df_t,lower.tail = F)
```

```
##          ma1    intercept
## 7.615426e-04 7.719253e-05
```

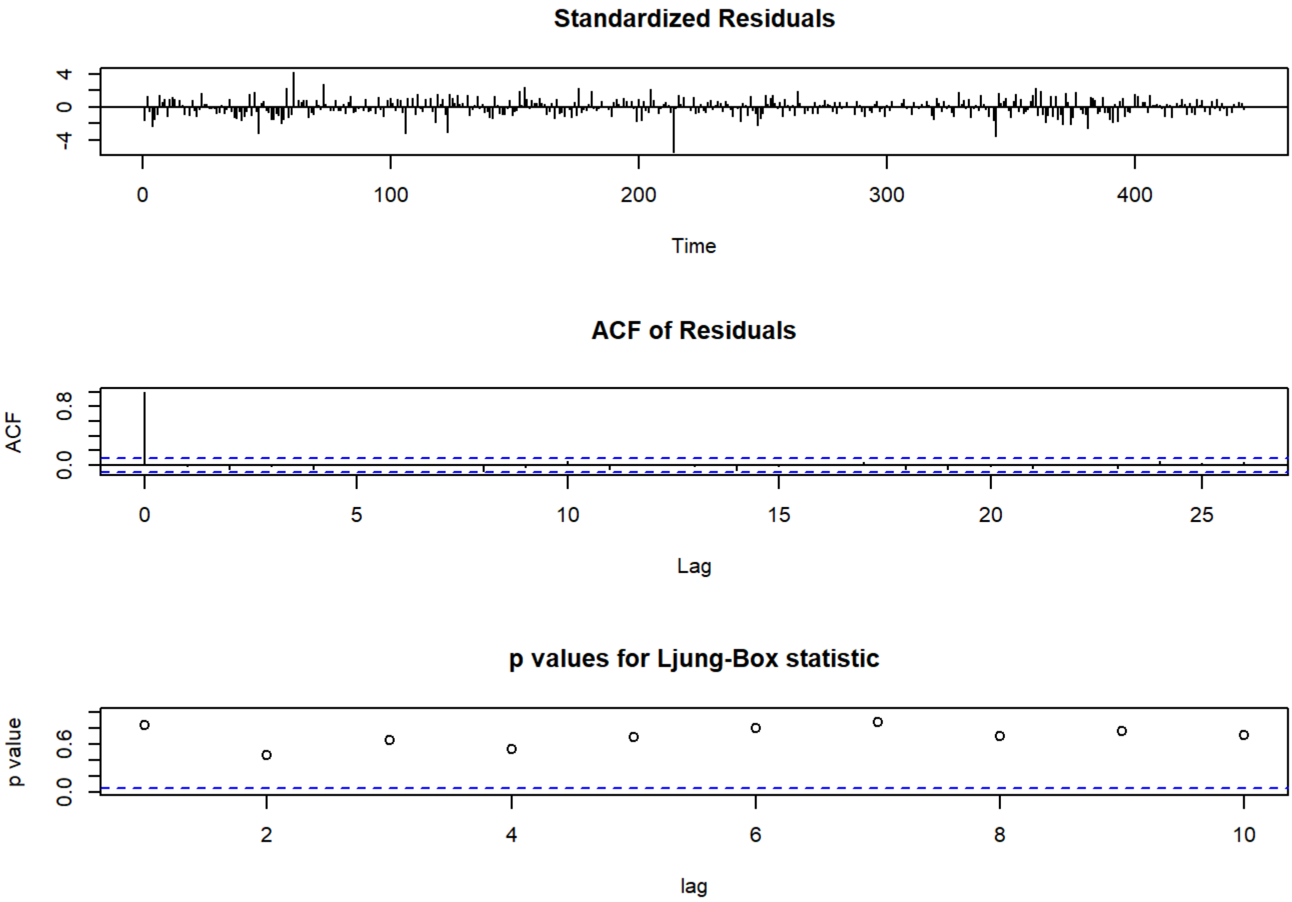
```
# p<0.05, 显著

# 零均值、等方差、正态性 检验
summary(model_D9)
```

```
##           Length Class  Mode
## coef        2    -none- numeric
## sigma2      1    -none- numeric
## var.coef    4    -none- numeric
## mask        2    -none- logical
## loglik      1    -none- numeric
## aic         1    -none- numeric
## arma        7    -none- numeric
## residuals 444    ts     numeric
## call        3    -none- call
## series      1    -none- character
## code        1    -none- numeric
## n.cond      1    -none- numeric
## nobs        1    -none- numeric
## model      10    -none- list
```

```
Box.test(model_D9$residuals,type="Ljung")
```

```
##
##  Box-Ljung test
##
## data:  model_D9$residuals
## X-squared = 0.044513, df = 1, p-value = 0.8329
```

```
tsdiag(model_D9)
```




```
# The standardized residuals are basically distributed near the zero horizontal line and in the range of -3~3;
# the autocorrelation function quickly drops to within the two dotted lines;
# the P values of the Ljung-Box statistics are all greater than 0.05
# therefore, the model passes the test.
```

```
# (c)
fore=predict(model_D9, 4)
fore
```

```
## $pred
## Time Series:
## Start = 445
## End = 448
## Frequency = 1
## [1] 0.009037387 0.010909688 0.010909688 0.010909688
##
## $se
## Time Series:
## Start = 445
## End = 448
## Frequency = 1
## [1] 0.05195749 0.05261292 0.05261292 0.05261292
```