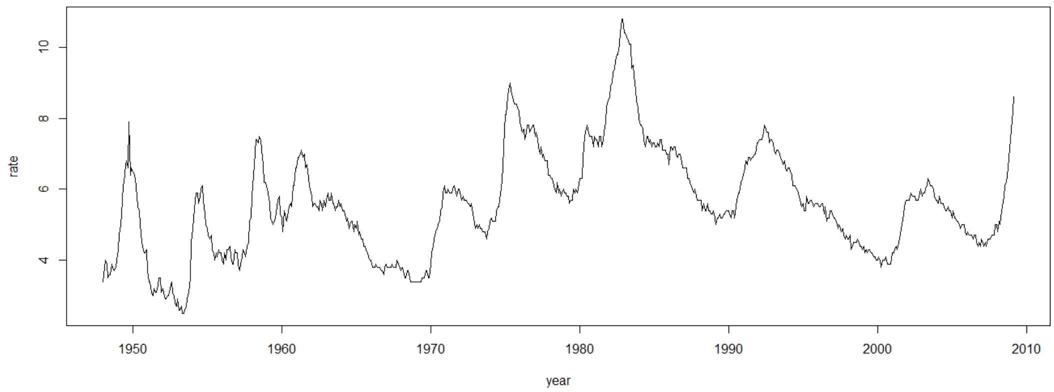
时间序列分析Lab2 实验报告

2.3

读入数据后，画出失业率时序图，可以发现每隔一段时间就会出现一个峰值，表明可能存在商业周期或者季节性的影响。



接着进行平稳性检验：

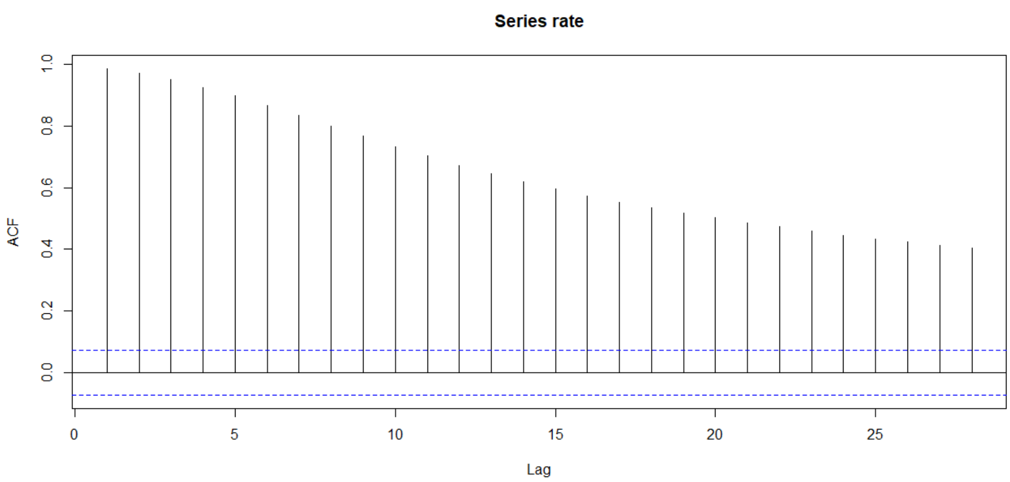
```
	Augmented Dickey-Fuller Test

data:  rate
Dickey-Fuller = -3.7921, Lag order = 9, p-value = 0.01939
alternative hypothesis: stationary
```

表明该序列是平稳的，接下来进行白噪声检验：

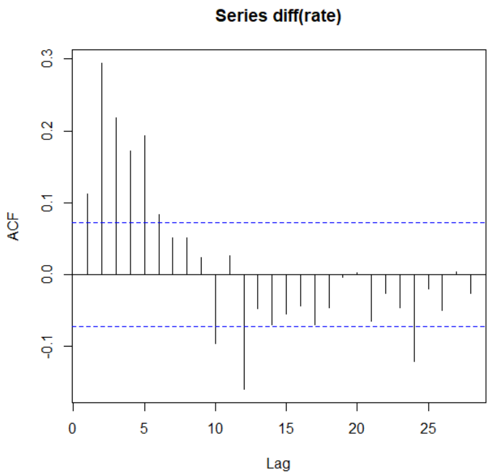
```
	Box-Ljung test

data:  rate
X-squared = 3865.1, df = 6, p-value < 2.2e-16

	Box-Ljung test

data:  rate
X-squared = 6405.9, df = 12, p-value < 2.2e-16
```

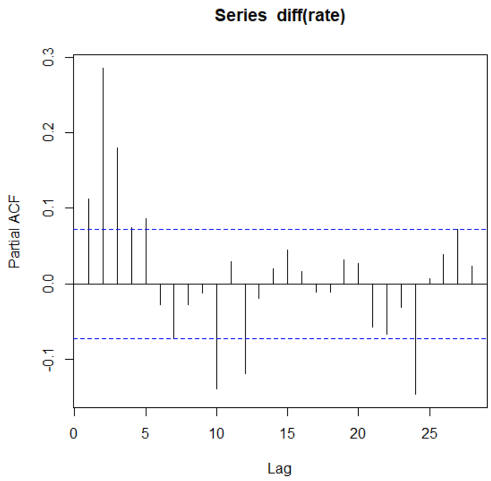
p值均小于5%，该序列非白噪声序列，可以进行建模。

首先观察序列的ACF图：

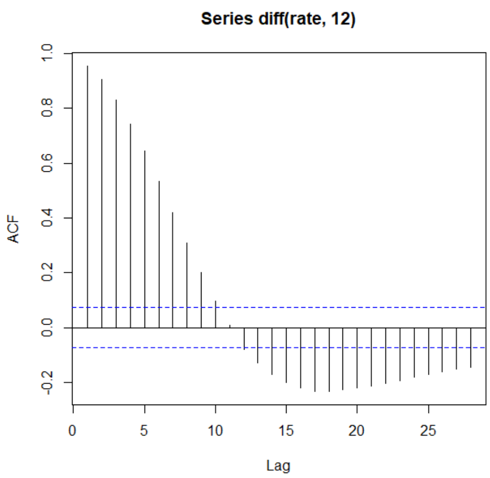


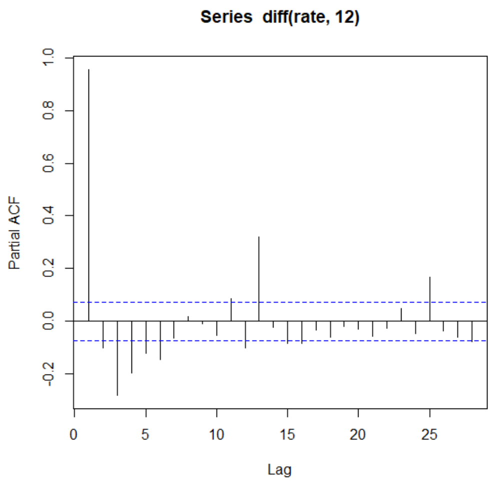
序列ACF衰减缓慢，因此对序列做一阶差分，再观察其ACF和PACF：





差分序列相关性的幅度很小，并且12阶和24阶存在相关性，表明即使数据经过季节性调整，仍存在一些季节性。接着绘制12阶的ACF和PACF也证实了这一点：





由于原始序列的ACF与PACF图不是很好判断，使用ar函数的极大似然法确定阶数为11，建立AR(11)模型：

$r_t = 5.66 + 0.99r_{t-1} + 0.24r_{t-2} - 0.07r_{t-3} - 0.06r_{t-4} + 0.03r_{t-5} - 0.13r_{t-6} - 0.04r_{t-7} + 0.05r_{t-8} - 0.01r_{t-9} - 0.13r_{t-10} + 0.13r_{t-11} + a_t$

且$\sigma_a^2 \approx 0.03867$。对参数进行显著性检验：

阶数	1	2	3	4	5	6	7	8	9	10	11
p-value	0.000	0.000	0.092	0.127	0.289	0.015	0.217	0.163	0.393	0.015	0.002

改进模型：

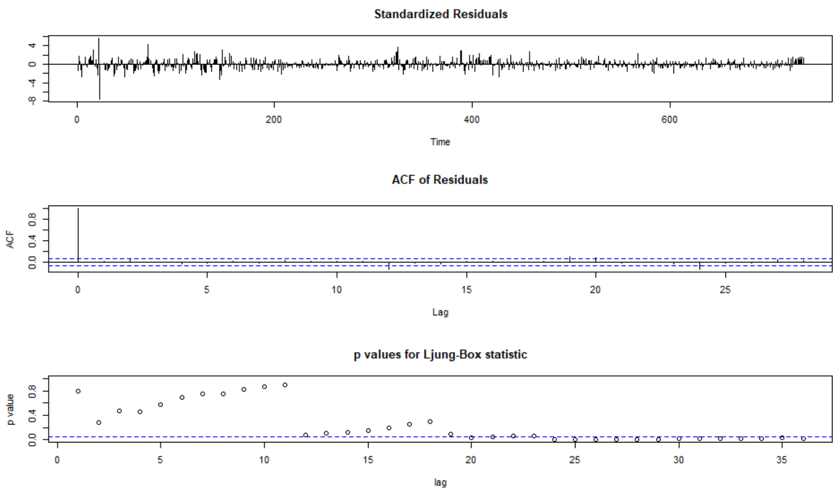
$$r_t = 5.66 + 0.98r_{t-1} + 0.17r_{t-2} - 0.17r_{t-6} - 0.12r_{t-10} + 0.13r_{t-11} + a_t$$

且$\sigma_a^2 \approx 0.03904$。

拟合模型的特征根包含共轭复根，因此它表明存在商业环。 每对复数根提供一个商业环。 例如，根 0.721 ± 1.087i 和模 1.305 给出周期 k = 2π/ cos−1(0.721/1.305) = 6.38 个月。

- 根$0.721 \pm 1.087i$和模1.305给出周期：$k = 2\pi/cos^{-1}(0.721/1.305) = 6.38$个月；
- 根$-1.143 \pm 0.399i$和模1.210给出周期：$k = 2\pi/cos^{-1}(-1.143/1.210) = 2.24$个月；
- 根$-0.772 \pm 0.974i$和模1.243给出周期：$k = 2\pi/cos^{-1}(-0.772/1.243) = 2.80$个月；
- 根$0.014 \pm 1.212i$和模1.212给出周期：$k = 2\pi/cos^{-1}(0.014/1.212) = 4.03$个月；
- 根$1.136 \pm 0.201i$和模1.153给出周期：$k = 2\pi/cos^{-1}(1.136/1.153) = 36.54$个月。

对该AR(11)模型进行检验：

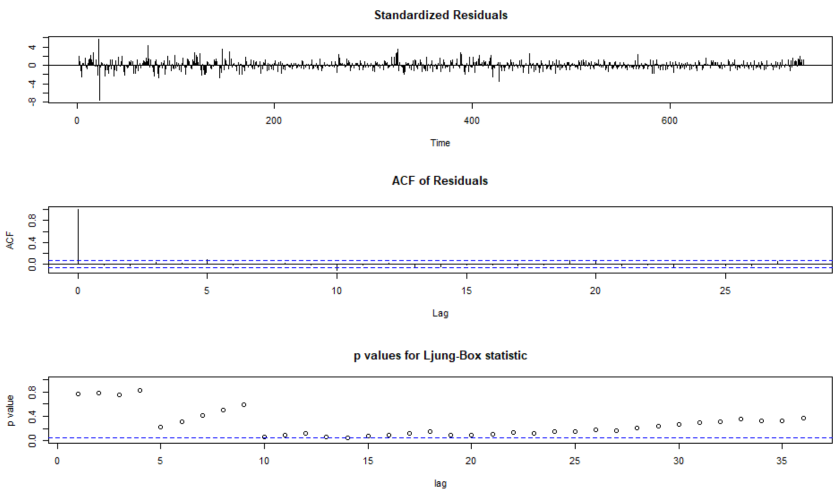


可以看到 AR(11) 模型的残差仍然具有一些较小的序列相关性。

为了处理季节性滞后的序列相关性，也可以采用季节模型：

$$(1-0.58B-0.24B^2)(1-0.56B^{12})x_t=(1-0.58B)(1-0.82B^{12})a_t$$

且$\sigma_a^2\approx 0.03725$。且该模型不存在商业环。模型检验如下：



残差不存在序列相关性。

最后分别用这两个模型进行预测：

```
$pred
Time Series:
Start = 736
End = 739
Frequency = 1
[1] 8.796765 8.981996 9.112555 9.246428

$se
Time Series:
Start = 736
End = 739
Frequency = 1
[1] 0.1975856 0.2767134 0.3556580 0.4358310
```

```
$pred
Time Series:
Start = 736
End = 739
Frequency = 1
[1] 8.841844 9.017154 9.126917 9.231977

$se
Time Series:
Start = 736
End = 739
Frequency = 1
[1] 0.1930098 0.2728039 0.3632395 0.4508560
```

代码：

```
#2.3
library(fBasics)
library(tseries)
library(forecast)
library(fUnitRoots)
da=read.table("D:/USTC/时间序列分析/data/m-unrate.txt",header=T)
rate=da[,4]
plot(ts(rate, start = c(1948, 1), frequency = 12), xlab = 'year', ylab = 'rate')

adf.test(rate)
for(i in 1:2) print(Box.test(rate,type = "Ljung-Box",lag=6*i))

acf(rate)
par(mfrow = c(1, 2))
```

```r
acf(diff(rate))
pacf(diff(rate))
acf(diff(rate, 12))
pacf(diff(rate, 12))

m=ar(rate, method = 'mle')
m$order

m1=arima(rate, order = c(11, 0, 0))
m1

t1=0.0539/0.0527
pt(t1,df=12,lower.tail=F)

m1 = arima(rate, order = c(11, 0, 0), fixed = c(NA, NA, 0, 0, 0, NA, 0, 0, 0, NA, NA, NA))
m1

m2 = arima(rate, order = c(2, 1, 1), seasonal = list(order = c(1, 0, 1), period = 12))
m2

tsdiag(m1, gof = 36)
tsdiag(m2, gof = 36)
predict(m1, 4)
predict(m2, 4)
```

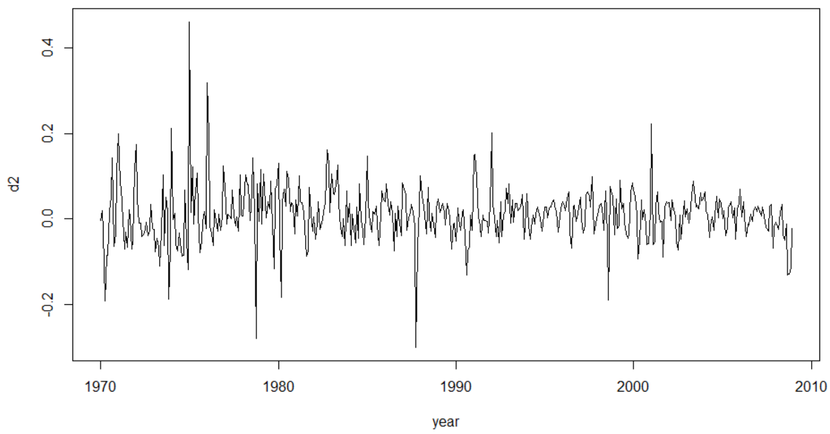
2.4

(a) 对Decile2和Decile10分别进行检验：

```
> Box.test(d2,  lag = 12, type = 'Ljung')

        Box-Ljung test

data:  d2
X-squared = 55.736, df = 12, p-value = 1.335e-07

> Box.test(d10, lag = 12, type = 'Ljung')

        Box-Ljung test

data:  d10
X-squared = 10.687, df = 12, p-value = 0.5559
```

则对Decile2而言拒绝原假设，前12个间隔的自相关系数不显著为0；对Decile10而言不拒绝原假设。

(b) Decile2时序图如下：



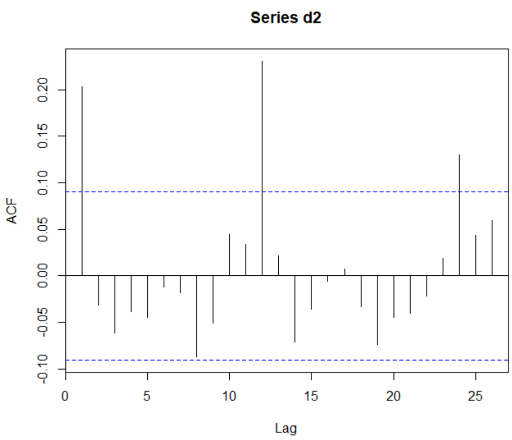
先进行平稳性检验：

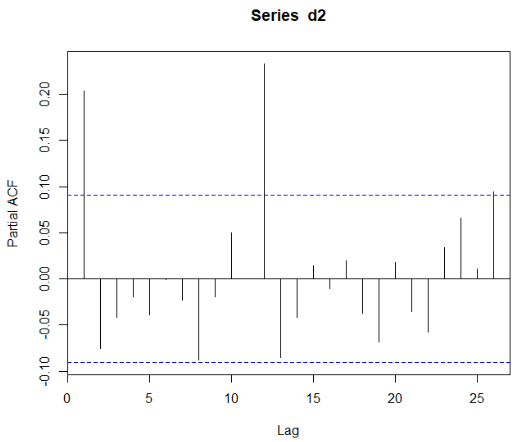
```
        Augmented Dickey-Fuller Test

data:  d2
Dickey-Fuller = -8.738, Lag order = 7, p-value = 0.01
alternative hypothesis: stationary
```

序列平稳，接下来进行白噪声检验：

```
Box-Ljung test

data:  d2
X-squared = 55.736, df = 12, p-value = 1.335e-07
```

序列不是白噪声序列，可以进行建模，绘制ACF和PACF：

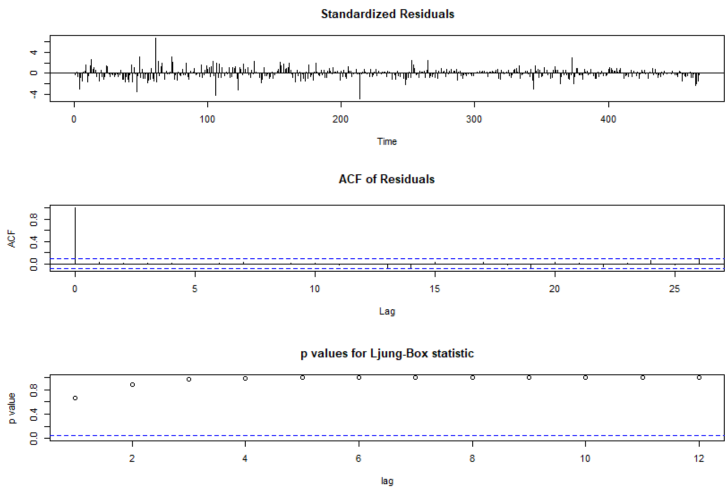




不便于确定阶数，使用ar函数的极大似然法确定阶数为12，建立AR(12)模型：

$r_t = 0.01 + 0.21r_{t-1} - 0.08r_{t-2} - 0.04r_{t-3} - 0.003r_{t-4} - 0.04r_{t-5} - 0.002r_{t-6} - 0.003r_{t-7} - 0.08r_{t-8} - 0.02r_{t-9} + 0.07r_{t-10} - 0.05r_{t-11} +$

且$\sigma_a^2 \approx 0.003771$。对模型进行检验：



残差不存在序列相关性。

（c）预测如下：

```
$pred
Time Series:
Start = 469
End = 480
Frequency = 1
 [1]  1.101801e-02  2.168344e-02  1.827985e-02  1.625908e-02  2.740593e-02  1.615496e-02 -1.313376e-03
 [8]  2.565188e-03 -2.745673e-02 -2.918551e-02 -2.501148e-02 -5.641547e-05

$se
Time Series:
Start = 469
End = 480
Frequency = 1
 [1] 0.06140474 0.06274765 0.06278199 0.06288786 0.06289420 0.06294301 0.06295157 0.06295195 0.06310736
[10] 0.06318306 0.06330522 0.06330589
```

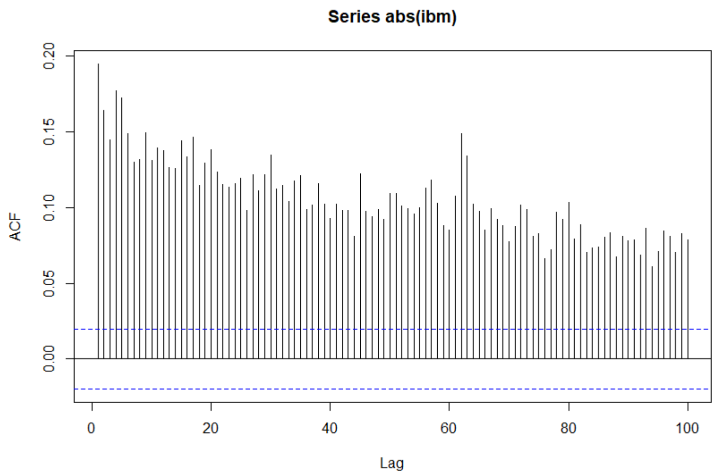
代码：

```
library(fBasics)
library(tseries)
library(forecast)
library(fUnitRoots)

da = read.table("D:/USTC/时间序列分析/data/m-deciles08.txt", header = T)
d2  = da[, 3]
d10 = da[, 5]
Box.test(d2,  lag = 12, type = 'Ljung')
Box.test(d10, lag = 12, type = 'Ljung')
plot(ts(d2, start = c(1970, 1), frequency = 12), xlab = 'year', ylab = 'd2')
```

```r
adf.test(d2)
Box.test(d2,type = "Ljung",lag=12)
par(mfrow = c(1, 2))
acf(d2)
pacf(d2)
m=ar(d2, method = 'mle')
m$order
m1 = arima(d2, order = c(12, 0, 0))
m1
tsdiag(m1, gof = 12)
predict(m1, 1)
predict(m1, 12)
```

2.5

读取并绘制：



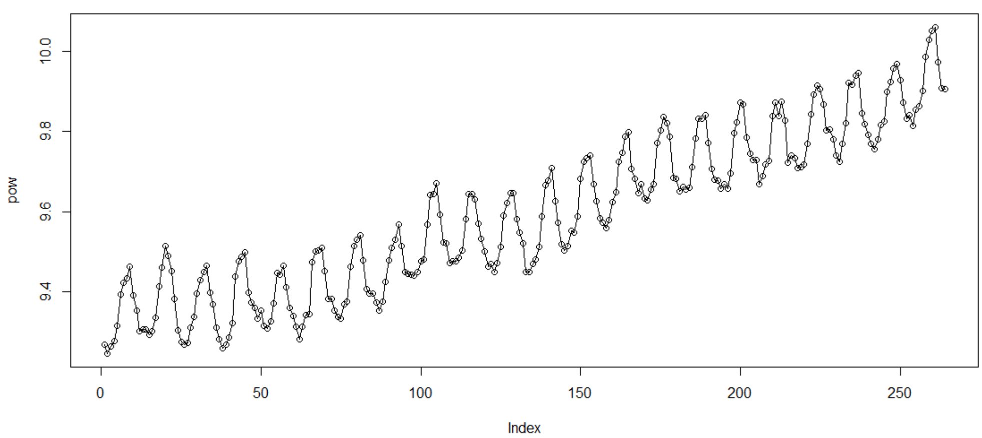
ACF 的幅度不大，但衰减缓慢。 这些特征表明绝对收益中存在长范围相依。

代码：

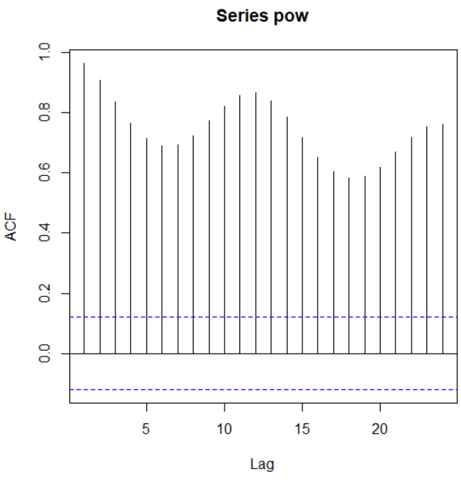
```r
library(fBasics)
da = read.table("D:/USTC/时间序列分析/data/d-ibm3dx7008.txt", header = T)
ibm = da$rtn
acf(abs(ibm), lag = 100)
```

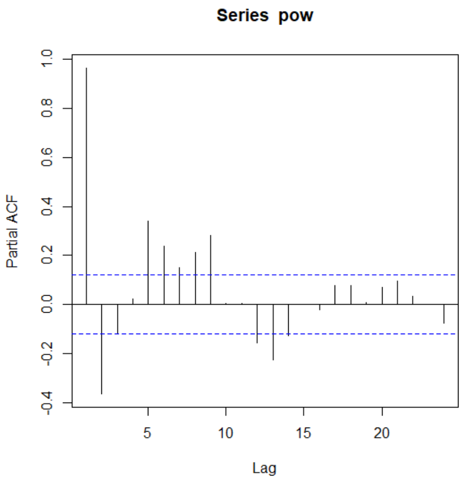
2.6

读入数据并绘制时序图：

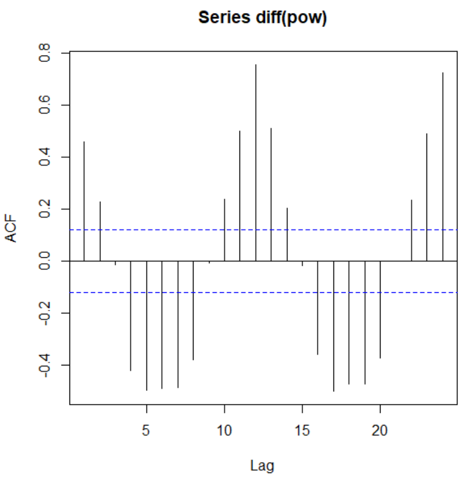


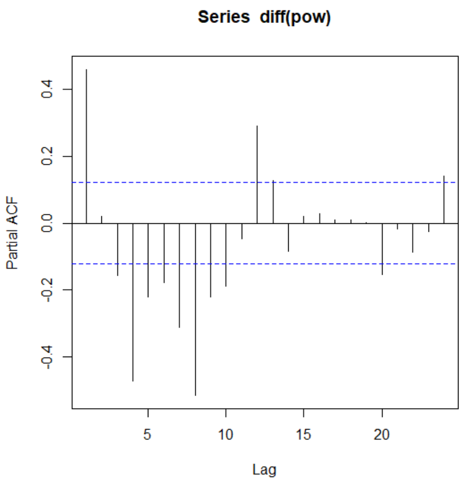
可以看到有很强的季节性成分以及非平稳性。绘制ACF和PACF：



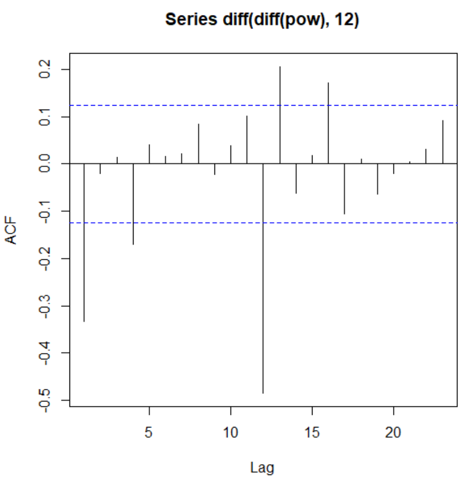


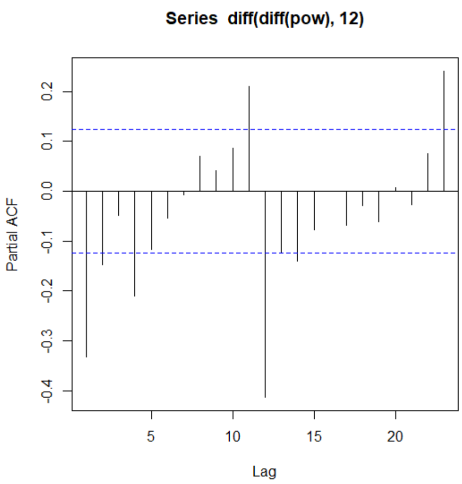
ACF表现出季节性，一阶差分ACF,PACF：





可以看到很强的季节性，季节性一阶差分ACF,PACF：

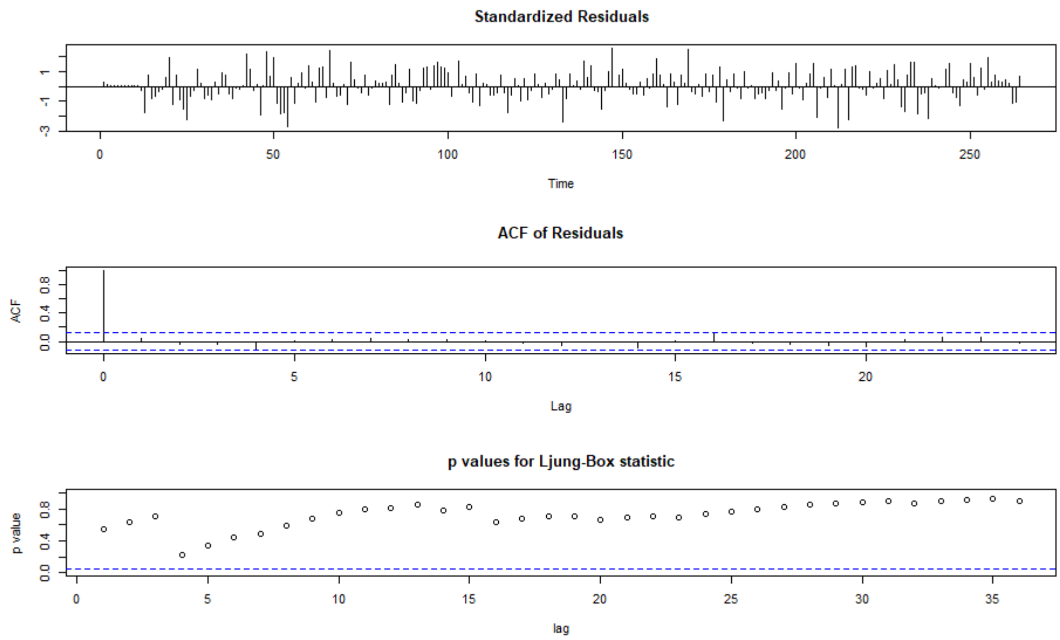




建立如下航空模型：

$$(1-B)(1-B^{12})x_t = (1-0.487B)(1-0.966B^{12})a_t$$

且$\sigma_a^2 \approx 0.0003337$。对模型进行检验：



残差不存在序列相关性。

预测如下：

```
$pred
Time Series:
Start = 265
End = 288
Frequency = 1
 [1]  9.882315  9.867492  9.873761  9.892808  9.921631 10.006038 10.046234 10.063123 10.072570
[10] 10.006692  9.951904  9.928664  9.910806  9.895983  9.902252  9.921299  9.950123 10.034529
[19] 10.074725 10.091614 10.101061 10.035183  9.980395  9.957155

$se
Time Series:
Start = 265
End = 288
Frequency = 1
 [1] 0.01845143 0.02073927 0.02279866 0.02468686 0.02644055 0.02808495 0.02963826 0.03111412
 [9] 0.03252307 0.03387347 0.03517206 0.03642438 0.03789603 0.03918050 0.04042417 0.04163071
[17] 0.04280325 0.04394451 0.04505688 0.04614244 0.04720304 0.04824032 0.04925577 0.05025070
```

代码：

```
library(fBasics)
library(tseries)
library(forecast)
library(fUnitRoots)
da = read.table("D:/USTC/时间序列分析/data/power6.txt", header = F)
pow = da[, 1]
plot(pow, type = 'o', ylab = 'pow')
adf.test(pow)
Box.test(pow,type='Ljung',lag=12)
par(mfrow = c(1, 2))
acf(pow)
pacf(pow)
acf(diff(pow))
pacf(diff(pow))
acf(diff(pow, 12))
pacf(diff(pow, 12))
acf(diff(diff(pow), 12))
pacf(diff(diff(pow), 12))
# FIXME
m1 = arima(pow, order = c(0, 1, 1), seasonal = list(order = c(0, 1, 1), period = 12))
m1
tsdiag(m1, gof = 36)
predict(m1, 24)
```