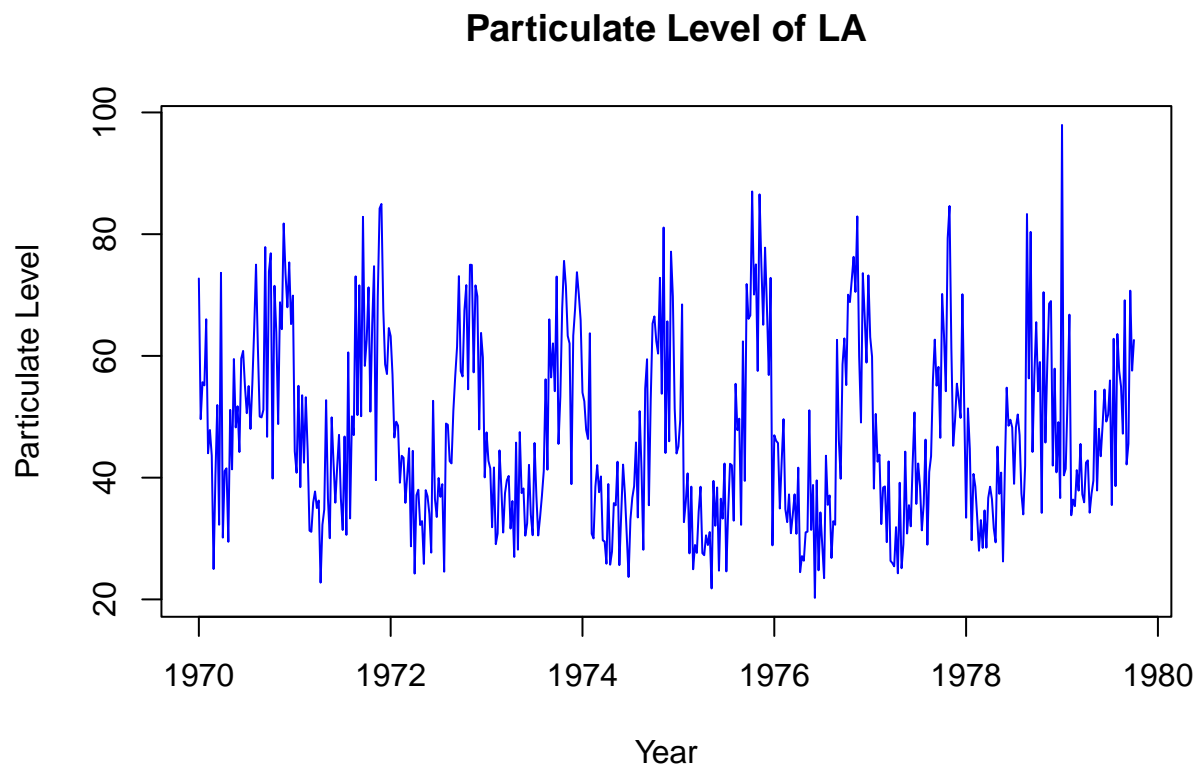


Final project

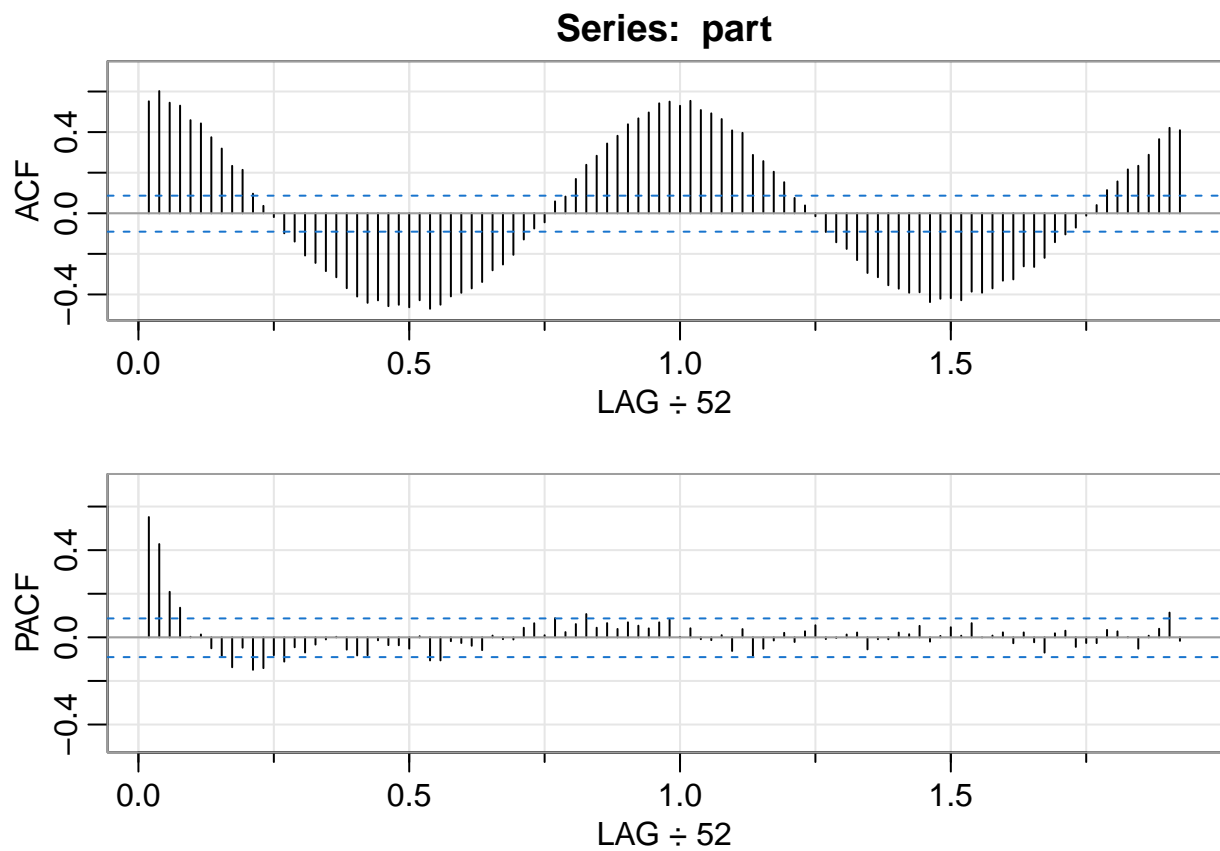
Junjie Peng

2021/12/16

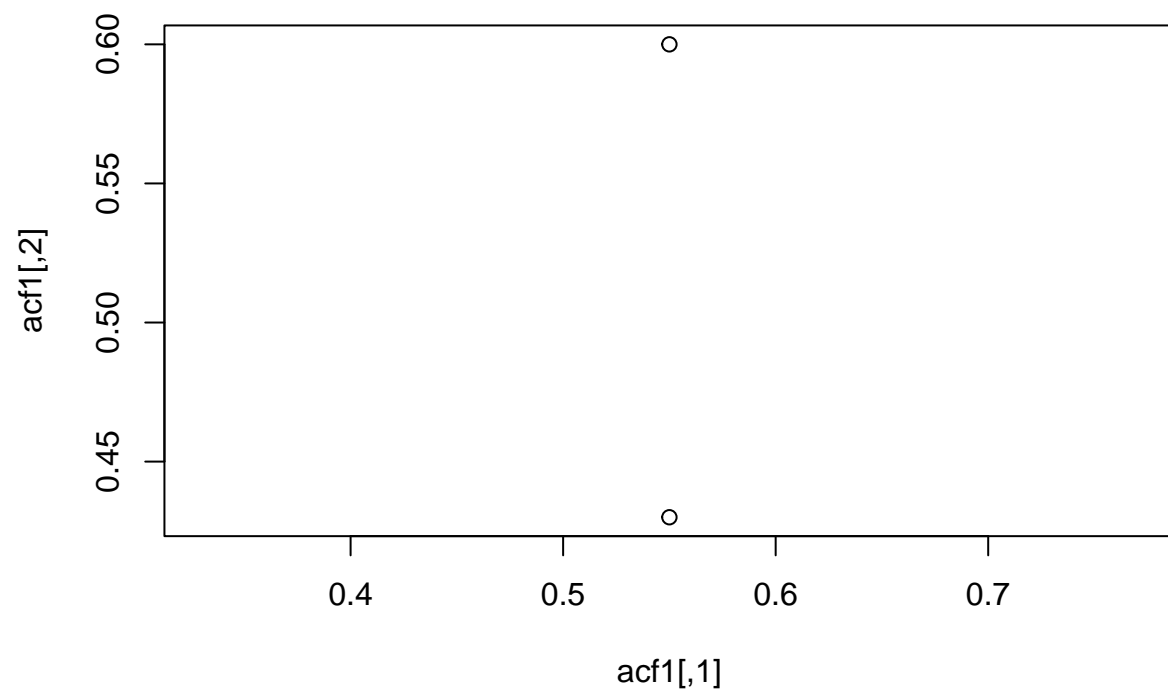
```
library(astsa)
data(part)
plot(part, xlab="Year", ylab="Particulate Level", col="blue", main="Particulate Level of LA")
```



```
acf1 = acf2(part,100)
```

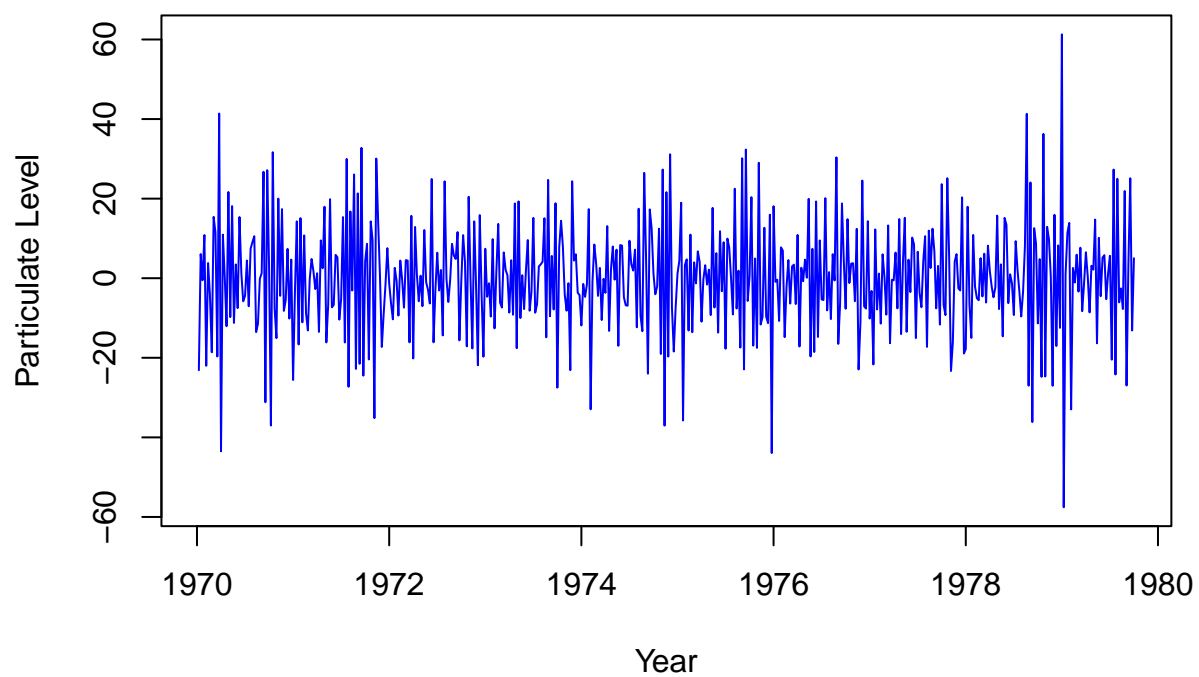


```
plot(acf1)
```

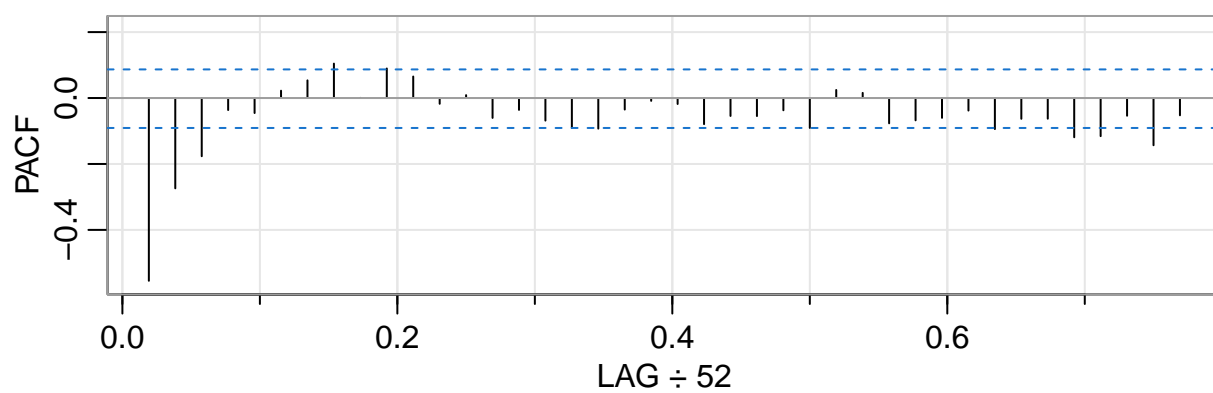
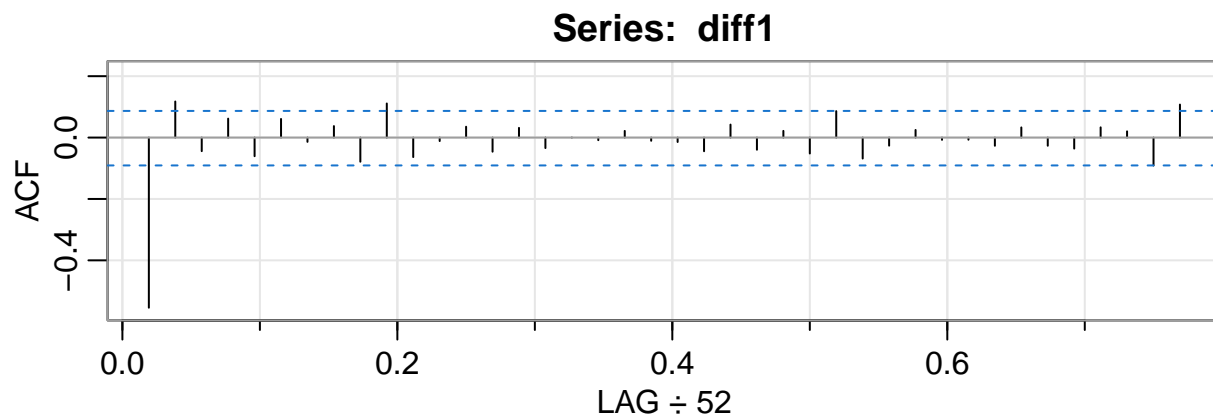


```
diff1 = diff(part)
plot(diff1, xlab="Year", ylab="Particulate Level", col="blue", main="Particulate Level of LA")
```

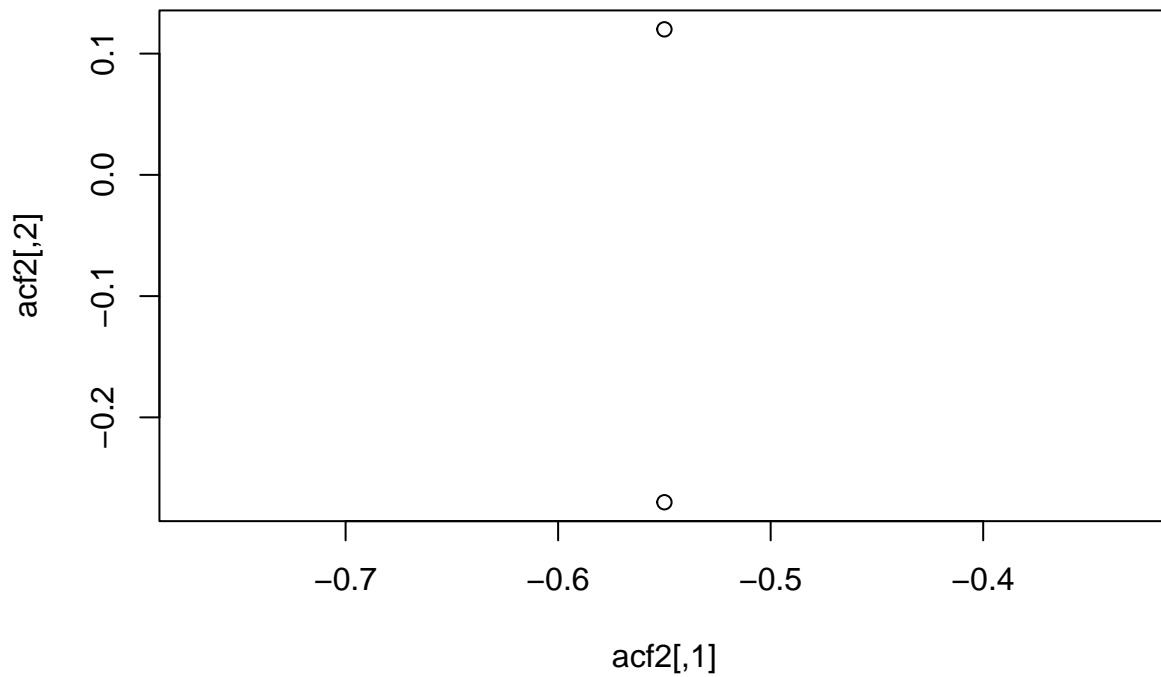
Particulate Level of LA



```
acf2 = acf2(diff1,max.lag=40)
```



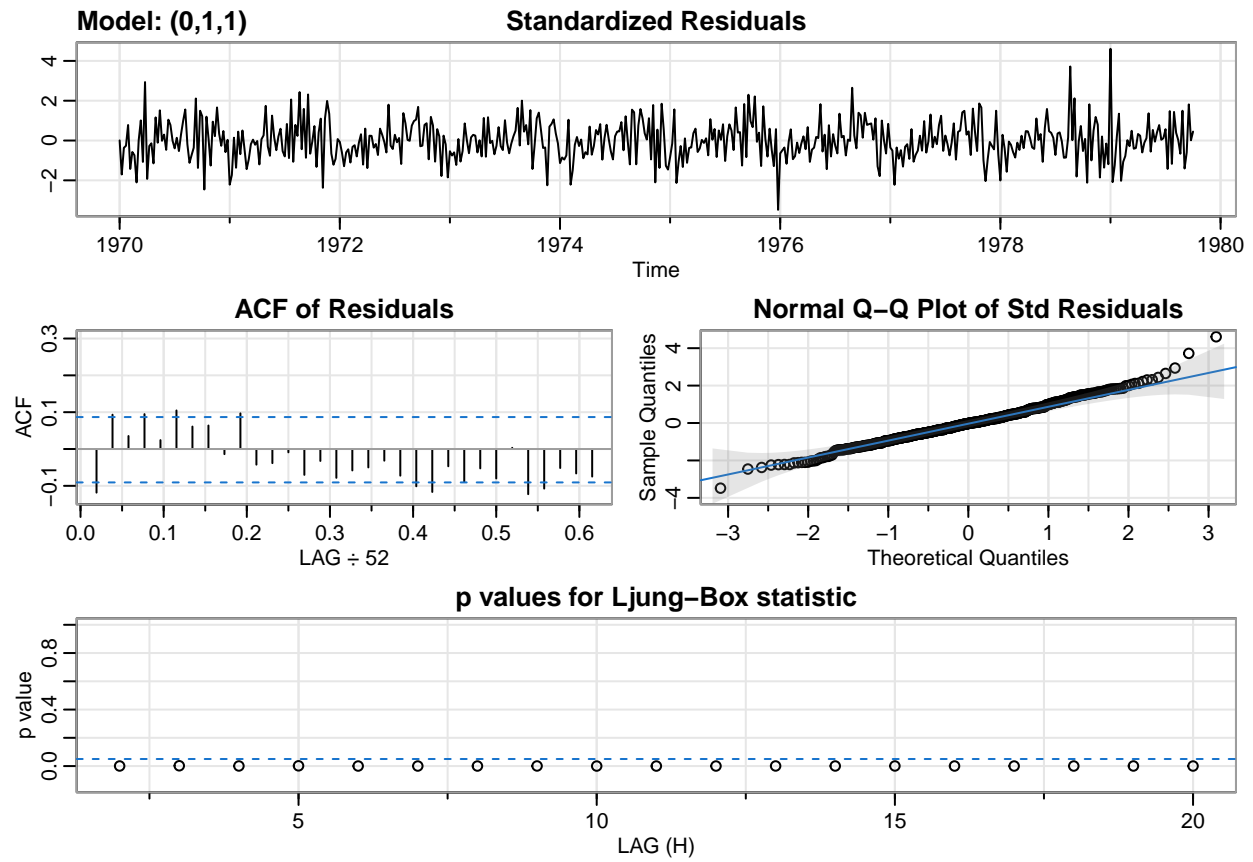
```
plot(acf2)
```



```
# first model ARIMA(0,1,1) or ARIMA(1,1,1)
```

```
ARIMA1 = sarima(part, 0,1,1, details = TRUE)
```

```
## initial value 2.658350
## iter 2 value 2.443989
## iter 3 value 2.438417
## iter 4 value 2.436966
## iter 5 value 2.436796
## iter 6 value 2.436793
## iter 7 value 2.436792
## iter 8 value 2.436792
## iter 8 value 2.436792
## iter 8 value 2.436792
## final value 2.436792
## converged
## initial value 2.435162
## iter 2 value 2.435144
## iter 3 value 2.435138
## iter 3 value 2.435138
## iter 3 value 2.435138
## final value 2.435138
## converged
```



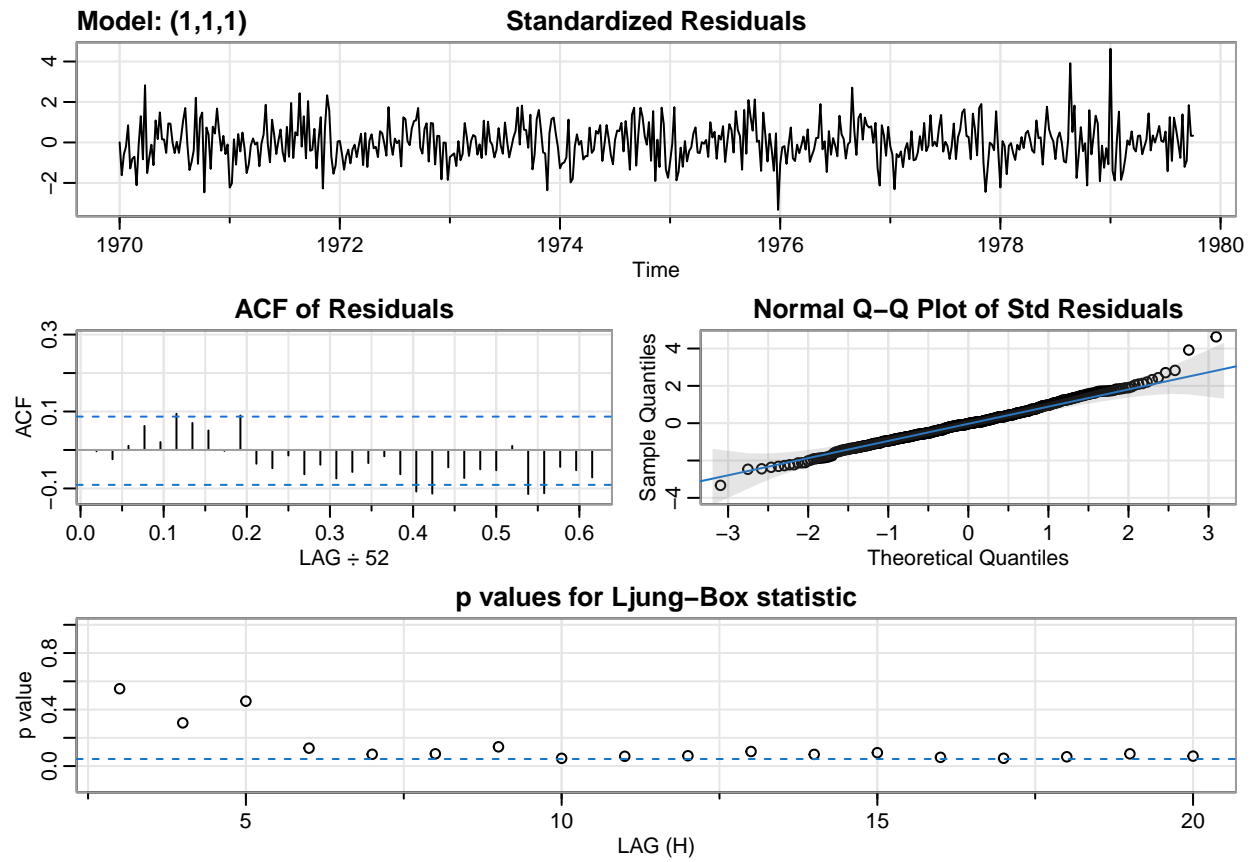
ARIMA1

```
## $fit
##
## Call:
## arima(x = xdata, order = c(p, d, q), seasonal = list(order = c(P, D, Q), period = S),
##       xreg = constant, transform.pars = trans, fixed = fixed, optim.control = list(trace = trc,
##       REPORT = 1, reltol = tol))
##
## Coefficients:
##           ma1  constant
##        -0.6410  -0.0005
## s.e.    0.0279   0.1826
##
## sigma^2 estimated as 130.2:  log likelihood = -1954.02,  aic = 3914.03
##
## $degrees_of_freedom
## [1] 505
##
## $ttable
##      Estimate      SE  t.value p.value
## ma1      -0.6410 0.0279 -22.9570 0.0000
## constant -0.0005 0.1826  -0.0027 0.9979
##
## $AIC
## [1] 7.719987
```

```
##  
## $AICc  
## [1] 7.720034  
##  
## $BIC  
## [1] 7.745007
```

```
ARIMA2 = sarima(part, 1,1,1, details = TRUE)
```

```
## initial value 2.656747  
## iter 2 value 2.477600  
## iter 3 value 2.425108  
## iter 4 value 2.420577  
## iter 5 value 2.417888  
## iter 6 value 2.417125  
## iter 7 value 2.417056  
## iter 8 value 2.417052  
## iter 8 value 2.417052  
## final value 2.417052  
## converged  
## initial value 2.419684  
## iter 2 value 2.419681  
## iter 3 value 2.419680  
## iter 4 value 2.419679  
## iter 5 value 2.419679  
## iter 5 value 2.419679  
## iter 5 value 2.419679  
## final value 2.419679  
## converged
```

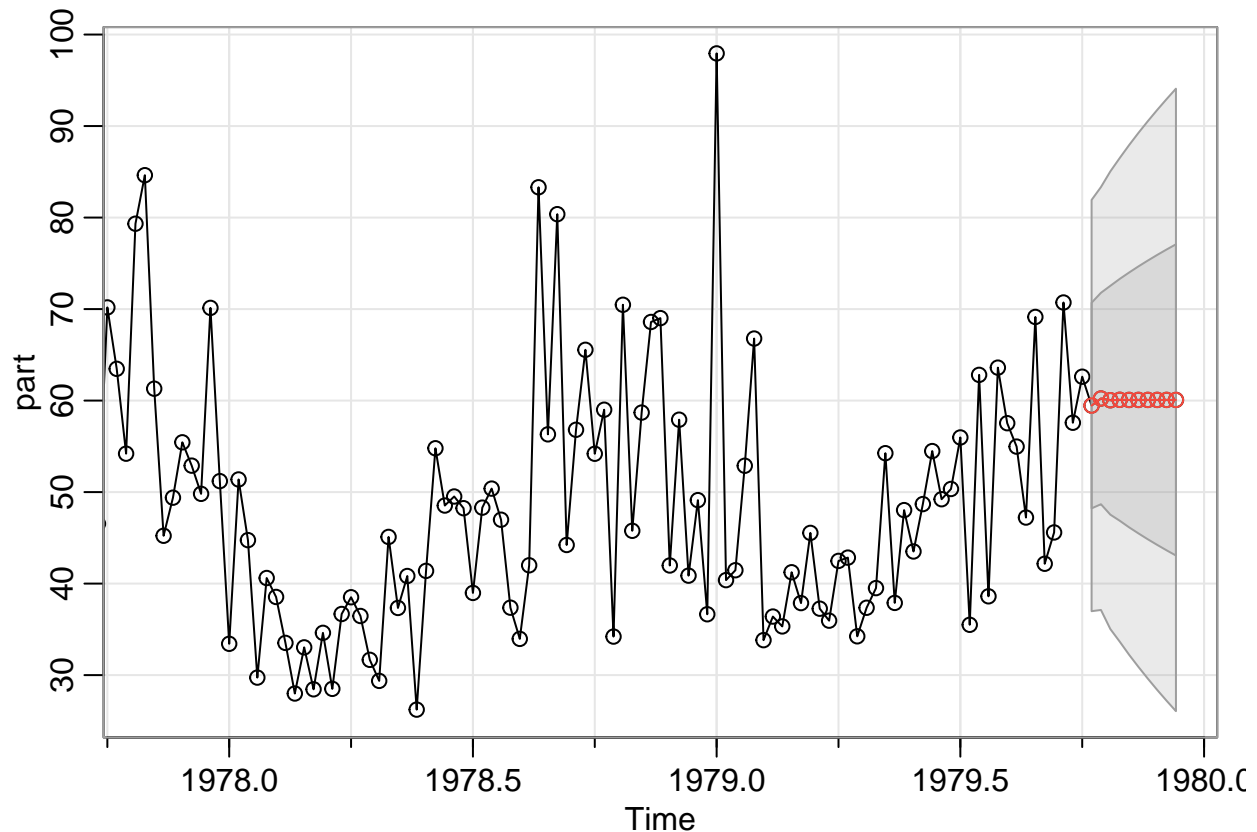



ARIMA2

```
## $fit
##
## Call:
## arima(x = xdata, order = c(p, d, q), seasonal = list(order = c(P, D, Q), period = S),
##       xreg = constant, transform.pars = trans, fixed = fixed, optim.control = list(trace = trc,
##       REPORT = 1, reltol = tol))
##
## Coefficients:
##          ar1          ma1    constant
##       -0.2444   -0.5162   -0.0004
## s.e.    0.0594    0.0489    0.1945
##
## sigma^2 estimated as 126.2:  log likelihood = -1946.18,  aic = 3900.36
##
## $degrees_of_freedom
## [1] 504
##
## $ttable
##      Estimate      SE  t.value p.value
## ar1      -0.2444 0.0594  -4.1152  0.0000
## ma1      -0.5162 0.0489 -10.5484  0.0000
## constant -0.0004 0.1945  -0.0023  0.9982
##
## $AIC
```

```
## [1] 7.693015
##
## $AICc
## [1] 7.693109
##
## $BIC
## [1] 7.726376
```

```
pred1 = sarima.for(part, 10, 1,1,1)
```

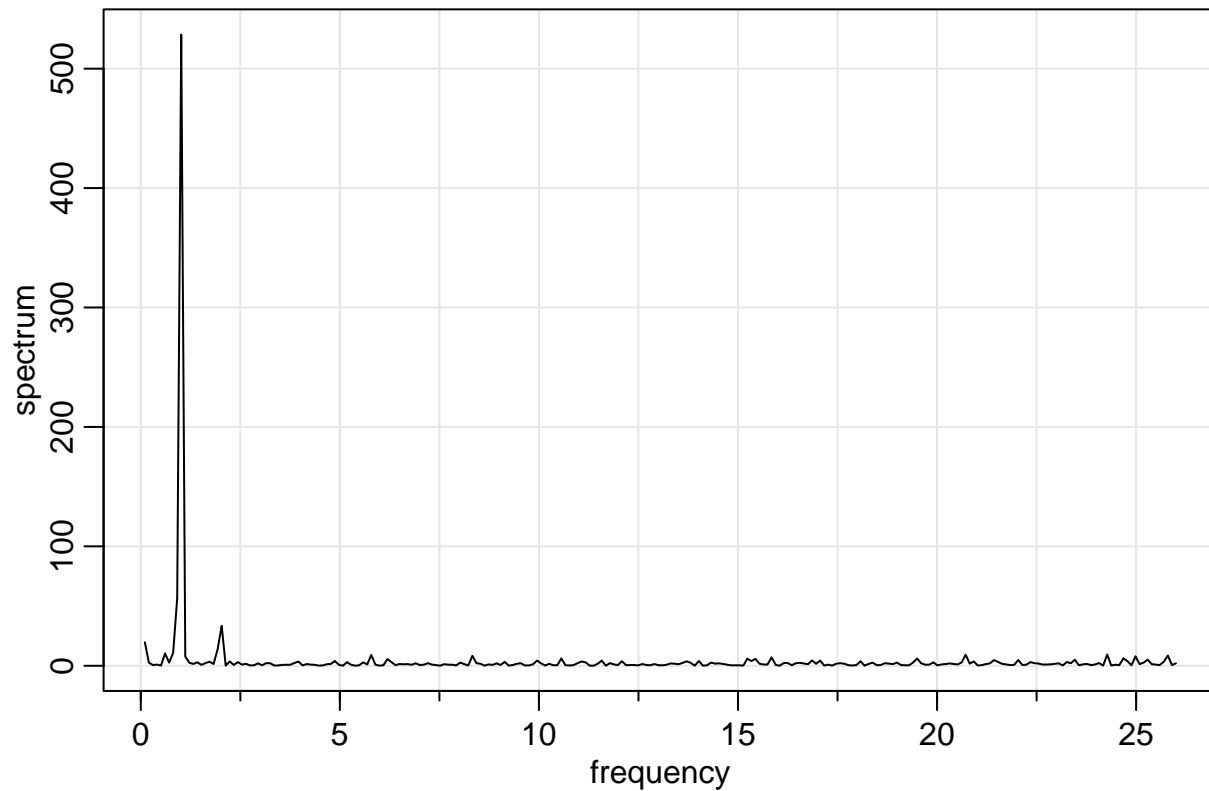


```
upper <- pred1$pred + qnorm(0.95) * pred1$se
lower <- pred1$pred - qnorm(0.95) * pred1$se
(data.frame("Prediction" = pred1$pred,
"PI 90% Lower Bound" = lower, "PI 90% Upper Bound" = upper))
```

##	Prediction	PI.90..Lower.Bound	PI.90..Upper.Bound
## 1	59.45651	40.97575	77.93727
## 2	60.22659	41.22333	79.22985
## 3	60.03786	39.47314	80.60258
## 4	60.08344	38.35325	81.81362
## 5	60.07175	37.17162	82.97189
## 6	60.07406	36.07594	84.07218
## 7	60.07295	35.02142	85.12448
## 8	60.07268	34.01110	86.13425
## 9	60.07220	33.03809	87.10630
## 10	60.07177	32.09898	88.04456

```
part.per = mvspec(part, log="no")
```

Series: part | Raw Periodogram | taper = 0



```
P1 = part.per$details[order(part.per$details[,3], decreasing="TRUE"),]
P1[1,1];P1[2,1];P1[3,1]
```

```
## frequency
## 1.0156
```

```
## frequency
## 0.9141
```

```
## frequency
## 2.0312
```

```
1/P1[1,1];1/P1[2,1];1/P1[3,1]
```

```
## frequency
## 0.9846396
```

```
## frequency
## 1.093972
```

```
## frequency
## 0.4923198
```

```

part.u1 = 2*P1[1,3]/qchisq(0.1,2)
part.u2 = 2*P1[2,3]/qchisq(0.1,2)
part.u3 = 2*P1[3,3]/qchisq(0.1,2)
part.l1 = 2*P1[1,3]/qchisq(0.9,2)
part.l2 = 2*P1[2,3]/qchisq(0.9,2)
part.l3 = 2*P1[3,3]/qchisq(0.9,2)

result = data.frame(DF=c(P1[1,1],P1[2,1],P1[3,1]),Spec=c(P1[1,3],P1[2,3],P1[3,3]), Upper=c(part.u1, par
result

```

```

##      DF      Spec      Upper      Lower
## 1 1.0156 528.5134 5016.2378 229.53045
## 2 0.9141  56.5113  536.3613  24.54255
## 3 2.0312  33.5363  318.3005  14.56463

```