STAT429 HW05

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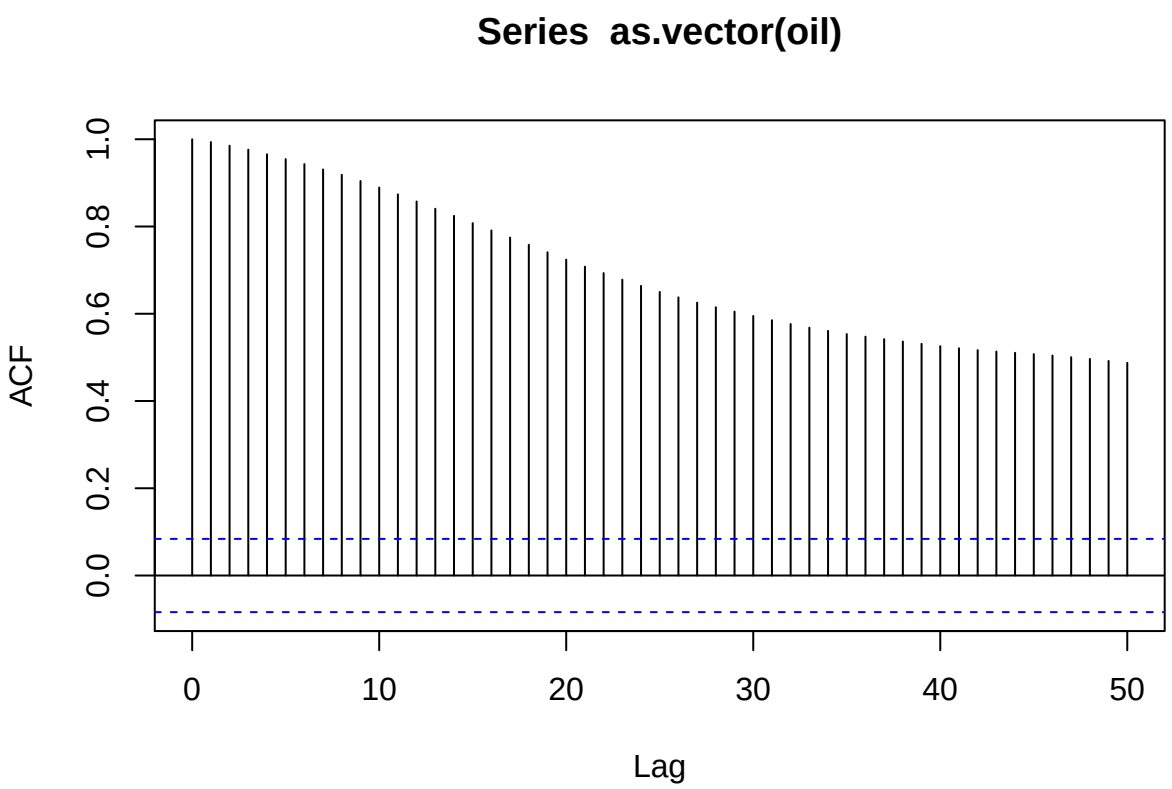
Question1

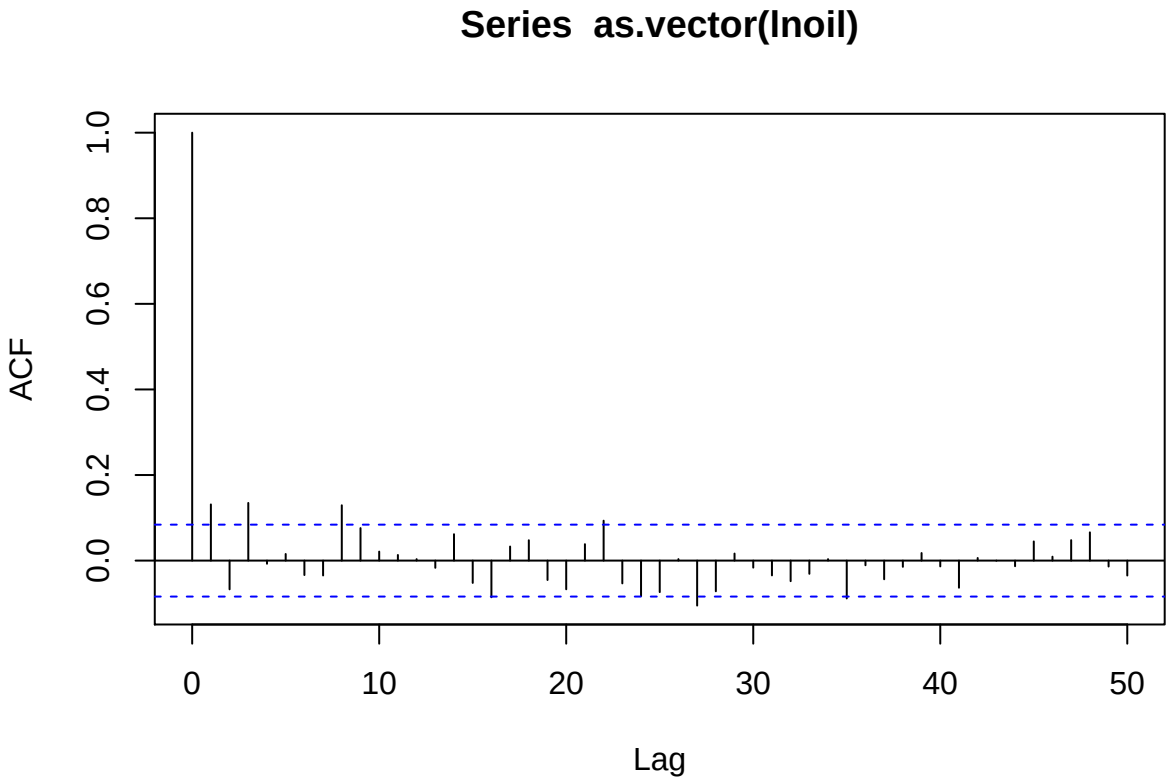
```
library(astsa)
```

```
## Warning: package 'astsa' was built under R version 3.4.3
```

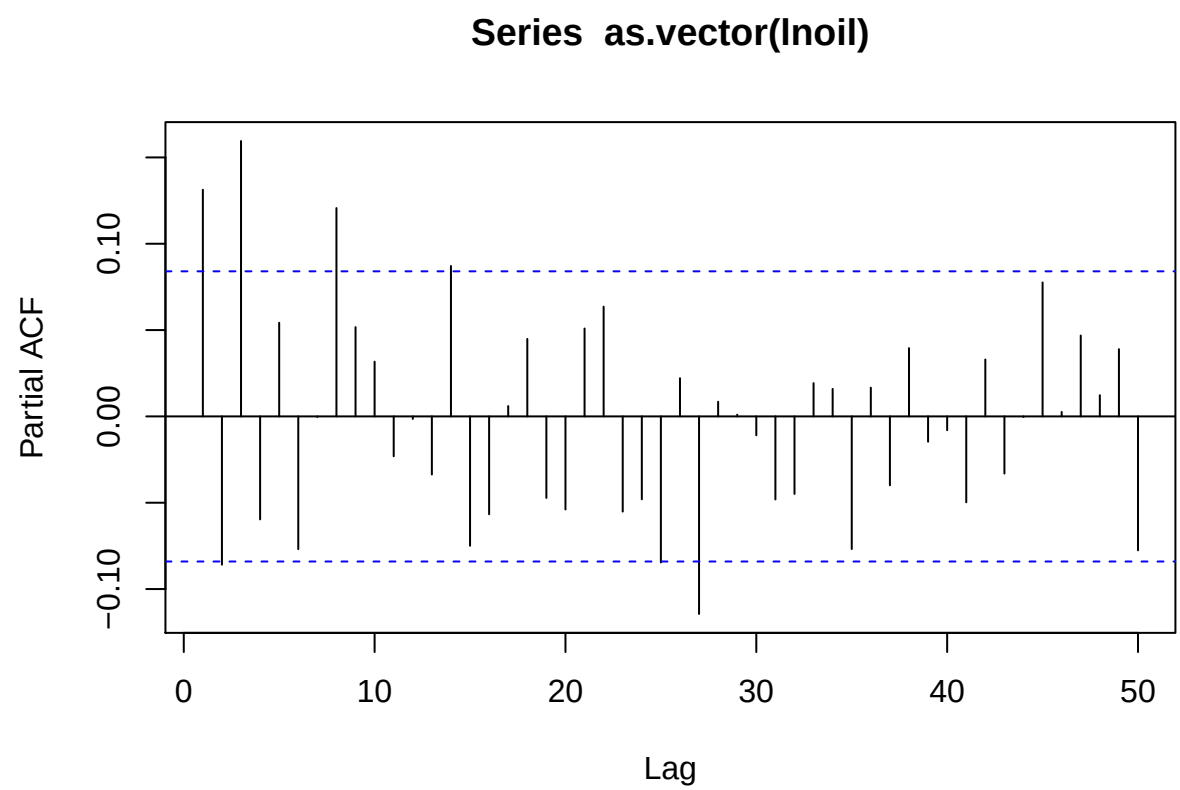
```
data(oil)
acf(as.vector(oil),50)
```




```
lnoil=diff(log(oil))
acf(as.vector(lnoil), 50)
```

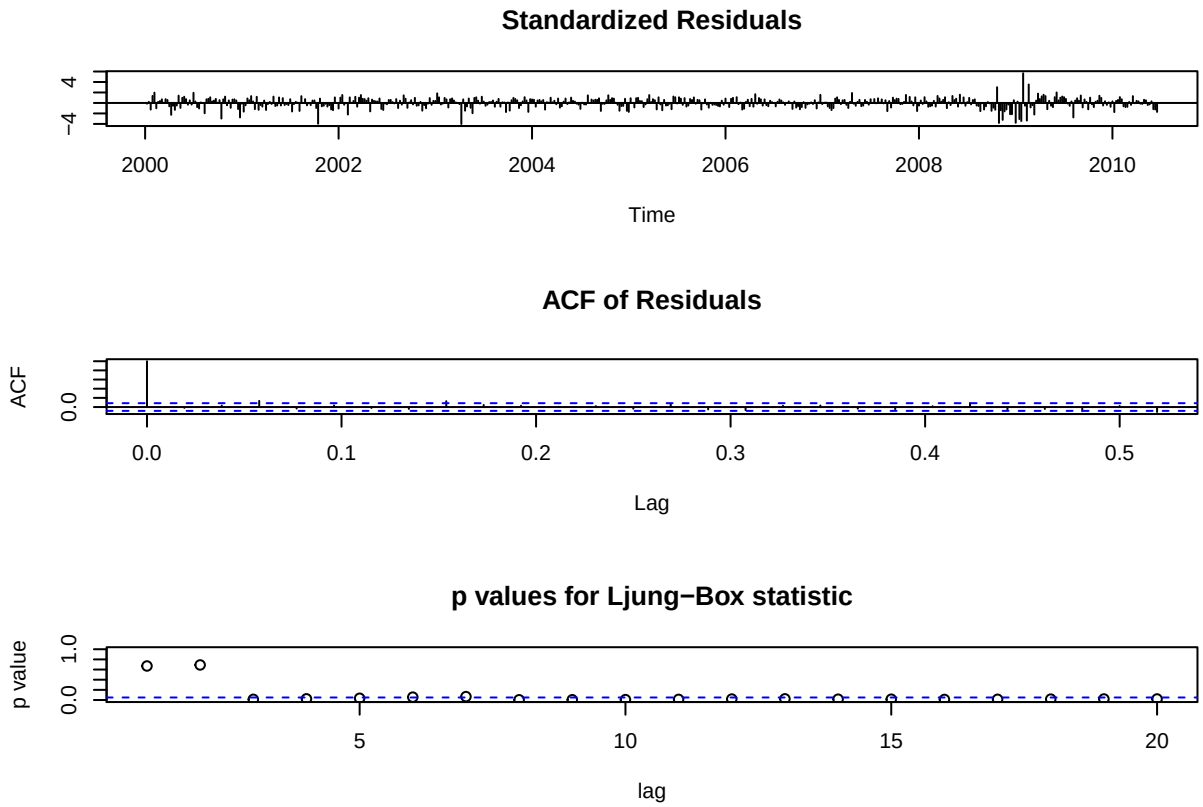



```
pacf(as.vector(lnoil), 50)
```

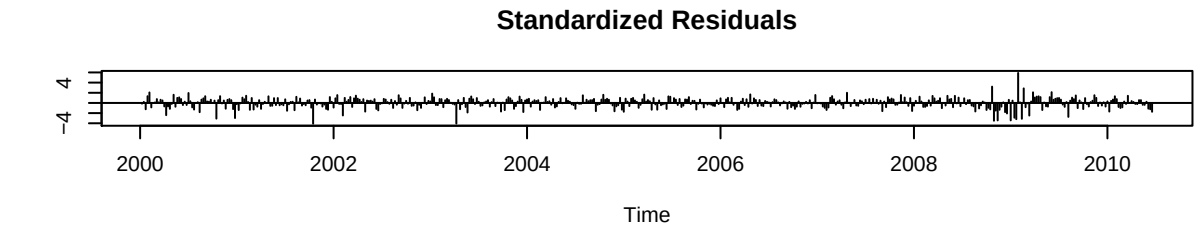


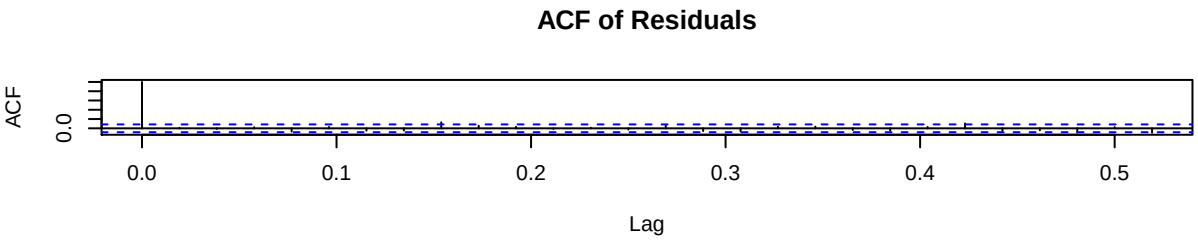
If you see acf and pacf, we can say that ACF is cutting off at lag 2 and PACF is taking off. This suggest that this follows the MA(2). We can also say that ACF is taking off and PACF is cutting off at lag 3. This suggest that this follows the AR(3) model.

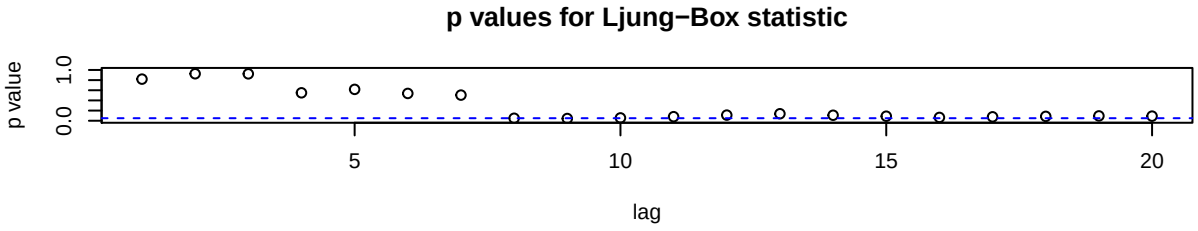
```
lnoil.ma = arima(lnoil, order = c(0, 0, 2))
lnoil.ar = arima(lnoil, order = c(3, 0, 0))
tsdiag(lnoil.ma, gof.lag = 20)
```




```
tsdiag(lnoil.ar,gof.lag = 20)
```







As for MR(2) model, there may be outliers, with a few values exceeding 4 standard deviations in magnitude. The ACF of the standardized residuals shows no apparent departure from the model assumptions, and the Q-statistic is not significant before lag 3. As for AR(3) model, there may be outliers, with a few values exceeding 4 standard deviations in magnitude. The ACF of the standardized residuals shows no apparent departure from the model assumptions, and the Q-statistic is not significant before lag 8.

Question2

```
data("unemp")
diffunemp=diff(diff(unemp),12)
crit2<-array(0,dim=c(3,3,3,3))
for (p in 1:3)
{
for (q in 1:3)
{
for (P in 1:3)
{
for (Q in 1:3)
{
diffunemp.fit = arima(diffunemp, order=c(p-1,0,q-1), seasonal=list(order=c(P-1,0,Q-1), period=12))
crit2[p,q,P,Q]<-diffunemp.fit$aic
}
}
}
}
```

```
## Warning in log(s2): NaNs produced
```

```
crit2
```

```
## , , 1, 1
##
##          [,1]     [,2]     [,3]
## [1,] 3419.539 3411.354 3383.891
## [2,] 3405.183 3384.662 3376.838
## [3,] 3374.559 3375.372 3377.072
##
## , , 2, 1
##
##          [,1]     [,2]     [,3]
## [1,] 3322.446 3316.259 3288.660
## [2,] 3311.298 3291.771 3284.859
## [3,] 3280.670 3282.300 3283.327
##
## , , 3, 1
##
##          [,1]     [,2]     [,3]
## [1,] 3283.343 3273.353 3254.174
## [2,] 3267.230 3252.267 3251.287
## [3,] 3248.229 3250.049 3249.801
##
## , , 1, 2
##
##          [,1]     [,2]     [,3]
## [1,] 3258.861 3253.583 3234.492
## [2,] 3249.859 3236.315 3233.718
## [3,] 3229.774 3231.739 3231.863
##
## , , 2, 2
##
##          [,1]     [,2]     [,3]
## [1,] 3259.460 3253.929 3235.305
## [2,] 3250.128 3236.786 3234.632
## [3,] 3230.689 3232.672 3232.626
##
## , , 3, 2
##
##          [,1]     [,2]     [,3]
## [1,] 3258.652 3251.998 3235.385
## [2,] 3247.846 3235.611 3237.515
## [3,] 3231.094 3233.080 3232.875
##
## , , 1, 3
##
##          [,1]     [,2]     [,3]
## [1,] 3259.043 3253.325 3235.025
## [2,] 3249.460 3236.286 3234.355
## [3,] 3230.454 3232.440 3232.340
##
## , , 2, 3
##
##          [,1]     [,2]     [,3]
```

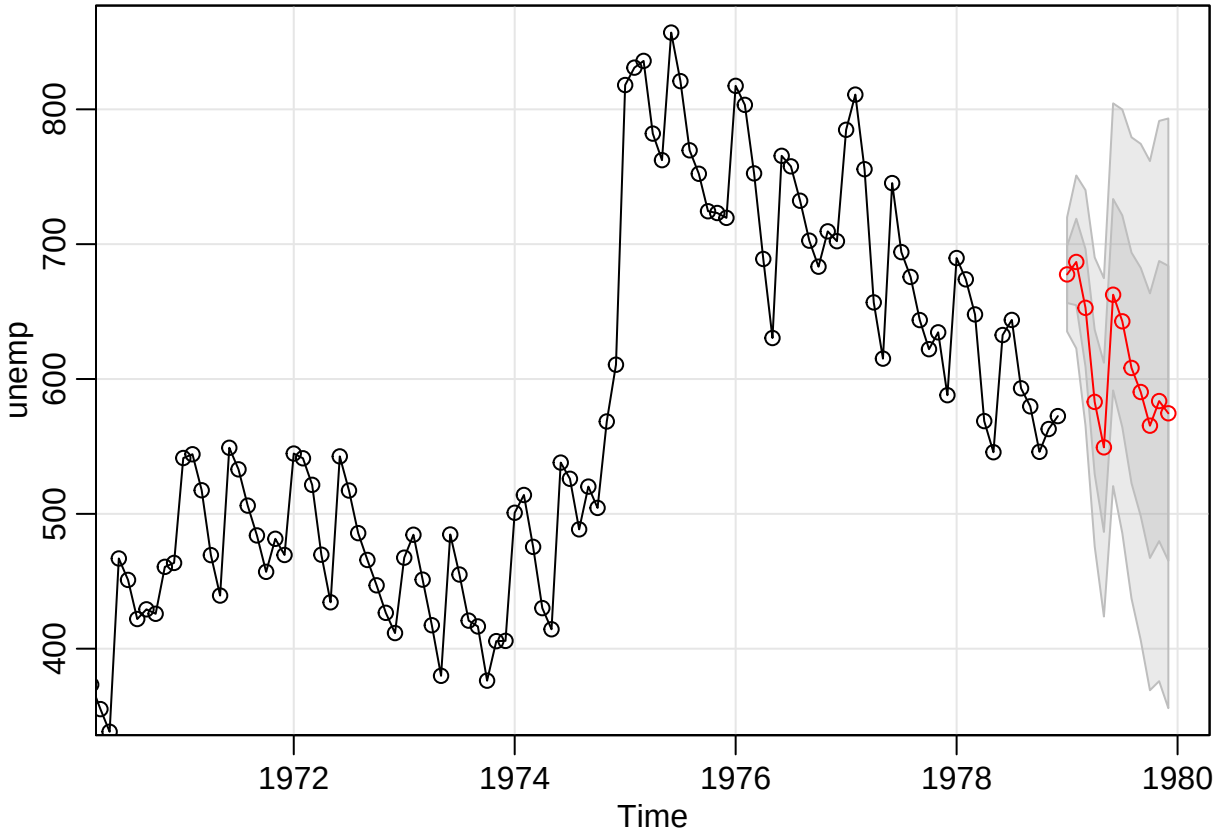
```
## [1,] 3259.786 3253.689 3236.140
## [2,] 3249.730 3237.033 3235.452
## [3,] 3231.697 3233.687 3233.520
##
## , , 3, 3
##
##          [,1]     [,2]     [,3]
## [1,] 3258.420 3251.466 3236.438
## [2,] 3247.489 3236.004 3239.351
## [3,] 3232.260 3234.222 3233.966
```

```
min(crit2)
```

```
## [1] 3229.774
```

This shows that (p,q,P,Q)=(3,1,1,3) has the smallest aic.

```
sarima.for(unemp,12,2,1,0,0,1,2,12)
```




```
## $pred
##           Jan      Feb      Mar      Apr      May      Jun      Jul
## 1979 677.5513 686.7912 652.7795 583.0211 549.3147 662.5118 642.7664
##           Aug      Sep      Oct      Nov      Dec
## 1979 608.2130 590.3420 565.4004 583.6466 574.5622
##
## $se
##           Jan       Feb       Mar       Apr       May       Jun       Jul
## 1979  21.16420  32.06423  43.64559  53.58155  62.73035  70.96907  78.53826
##           Aug       Sep       Oct       Nov       Dec
## 1979  85.51834  92.02056  98.11602 103.86822 109.32507
```

Question3

(a)

```
data(jj)
trend =time(jj) - 1970
Q =factor(cycle(jj) )
reg1 =lm(log(jj)~0 + trend + Q, na.action=NULL)# no interceptsummary(reg1)
summary(reg1)
```

```
##
## Call:
## lm(formula = log(jj) ~ 0 + trend + Q, na.action = NULL)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.29318 -0.09062 -0.01180  0.08460  0.27644
##
## Coefficients:
##       Estimate Std. Error t value Pr(>|t|)
## trend 0.167172   0.002259   74.00   <2e-16 ***
## Q1    1.052793   0.027359   38.48   <2e-16 ***
## Q2    1.080916   0.027365   39.50   <2e-16 ***
## Q3    1.151024   0.027383   42.03   <2e-16 ***
## Q4    0.882266   0.027412   32.19   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1254 on 79 degrees of freedom
## Multiple R-squared:  0.9935, Adjusted R-squared:  0.9931
## F-statistic:  2407 on 5 and 79 DF,  p-value: < 2.2e-16
```

(b) $1.052793 + 1.080916 + 1.151024 + 0.882266 = 4.166999$

(c) It decreases by β_4???β_3=???0.268758 and by $(0.269/1.151024)??100 = 23.37049\%$

(d)

```
reg2 =lm(log(jj)~ trend + Q, na.action=NULL)
summary(reg2)
```

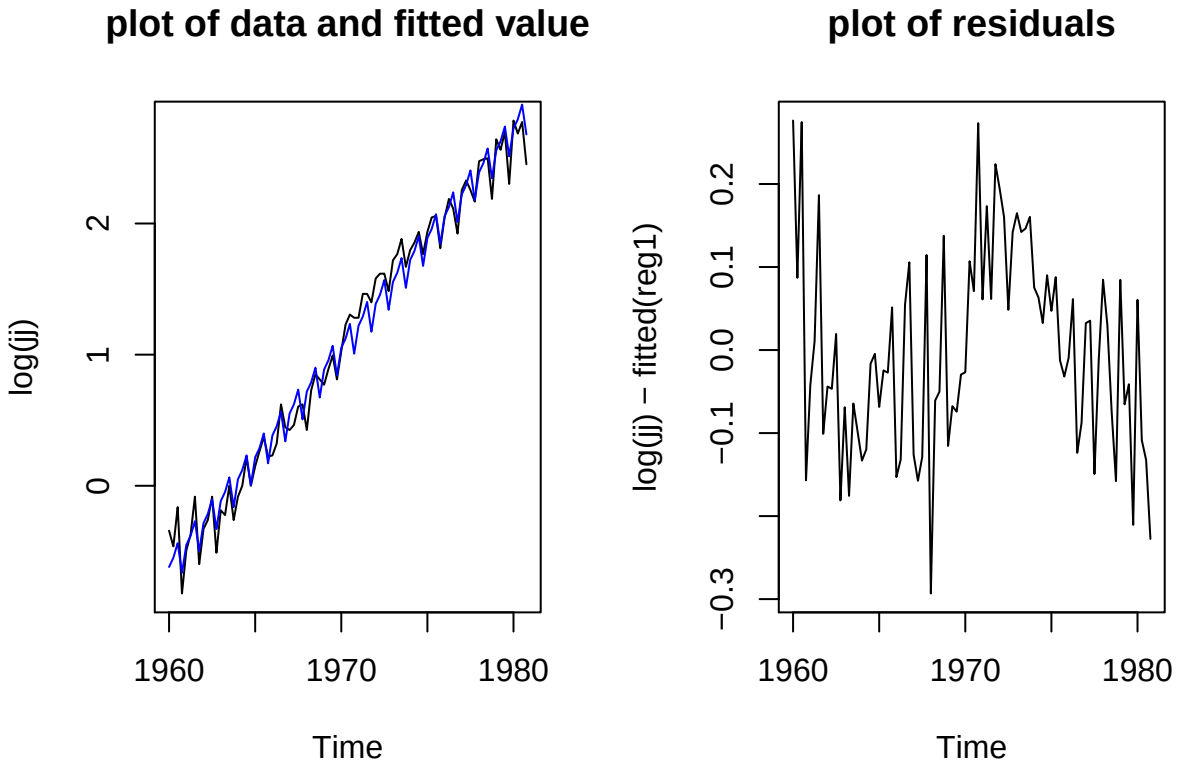
```
##
## Call:
## lm(formula = log(jj) ~ trend + Q, na.action = NULL)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.29318 -0.09062 -0.01180  0.08460  0.27644
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.052793   0.027359  38.480  < 2e-16 ***
## trend        0.167172   0.002259  73.999  < 2e-16 ***
## Q2           0.028123   0.038696   0.727   0.4695
## Q3           0.098231   0.038708   2.538   0.0131 *
## Q4          -0.170527   0.038729  -4.403 3.31e-05 ***
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1254 on 79 degrees of freedom
## Multiple R-squared:  0.9859, Adjusted R-squared:  0.9852
## F-statistic:  1379 on 4 and 79 DF,  p-value: < 2.2e-16
```

Intecept is now the same with coefficient of Q1. This is not good because all qurters have intercept.

(e)

```
par(mfrow=c(1,2))
plot(log(jj), main="plot of data and fitted value")
lines(fitted(reg1), col="blue")
plot(log(jj)-fitted(reg1), main="plot of residuals")
```



The right graph shows that residuals do not follow any pattern. Hence it looks like white.