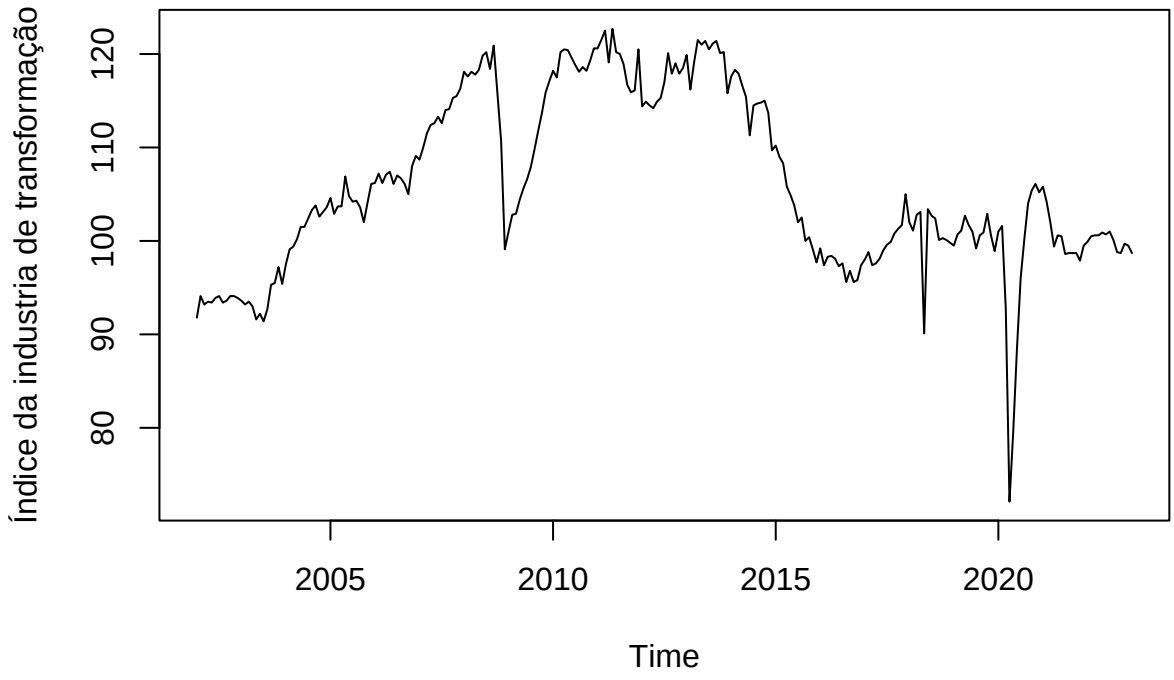
Atividade 2 - Raíz Unitária

Rodrigo Cabral

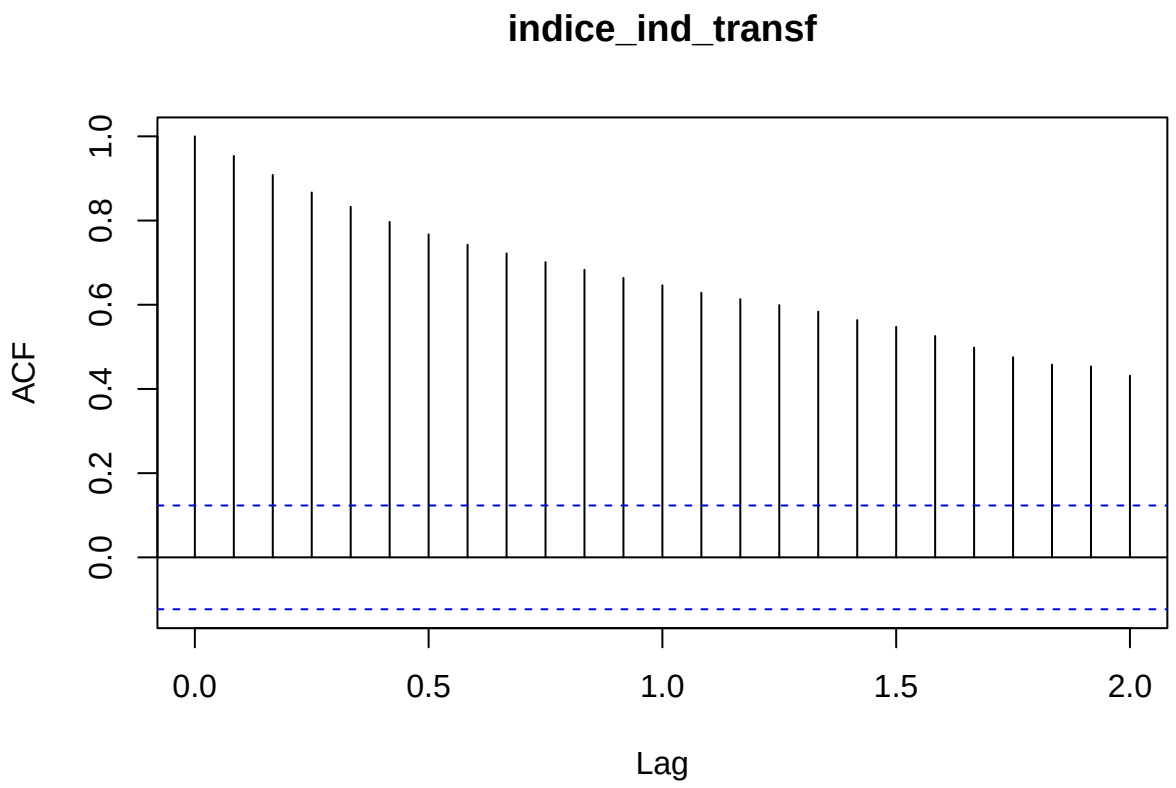
21/04/2023

#Índice de produção da industria de transformação

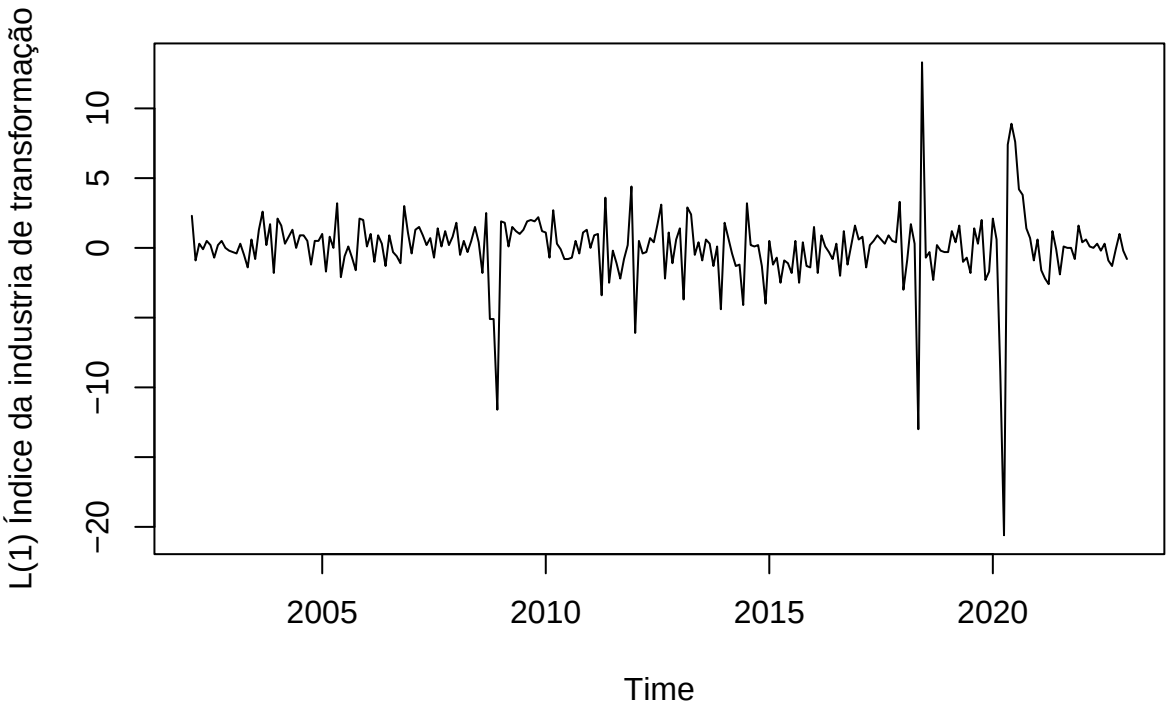
```
library(readxl)

ind=read_excel('indice_industria_transf.xlsx')

ind = ts(ind[,2],start=c(2002,1),freq=12)

plot(ind,ylab='Índice da industria de transformação')
```



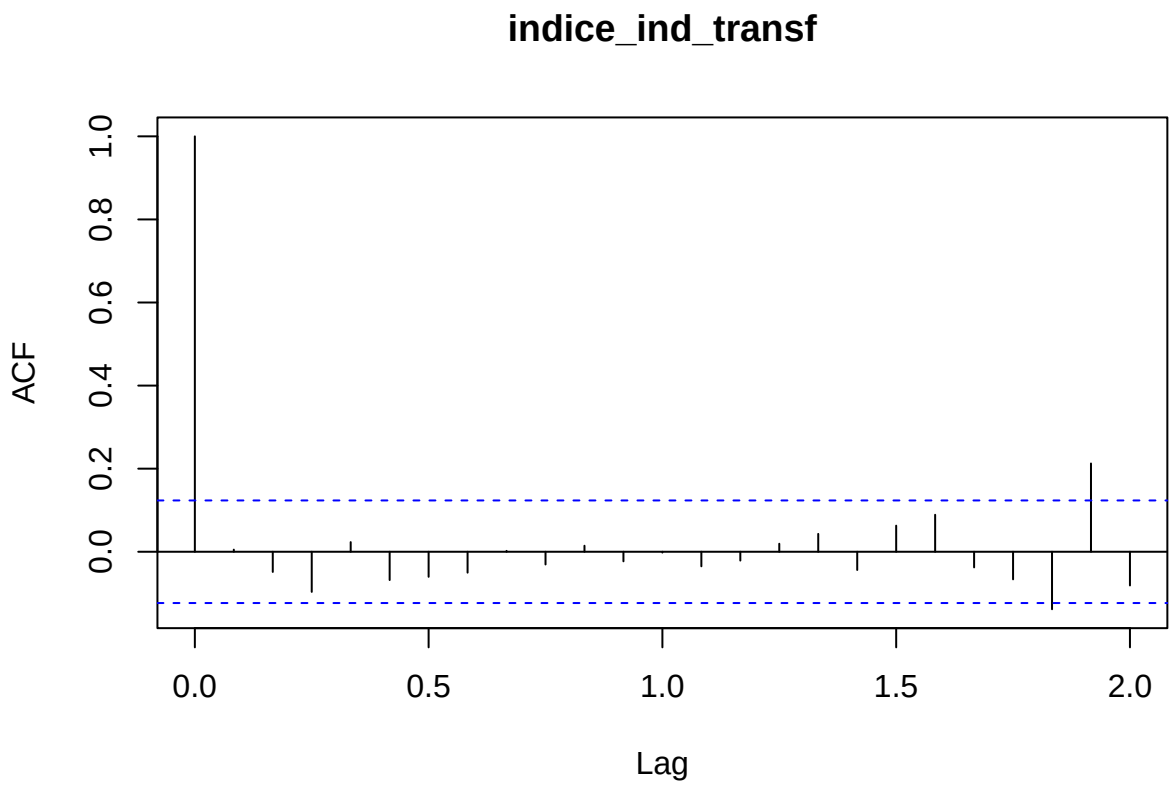

```
acf(ind)
```




```
#Primeira Diferença
dind=diff(ind)
plot(dind,ylab='L(1) Índice da industria de transformação')
```


L(1) Índice da industria de transformação
−20
−10
0
5
10
2005
2010
2015
2020
Time

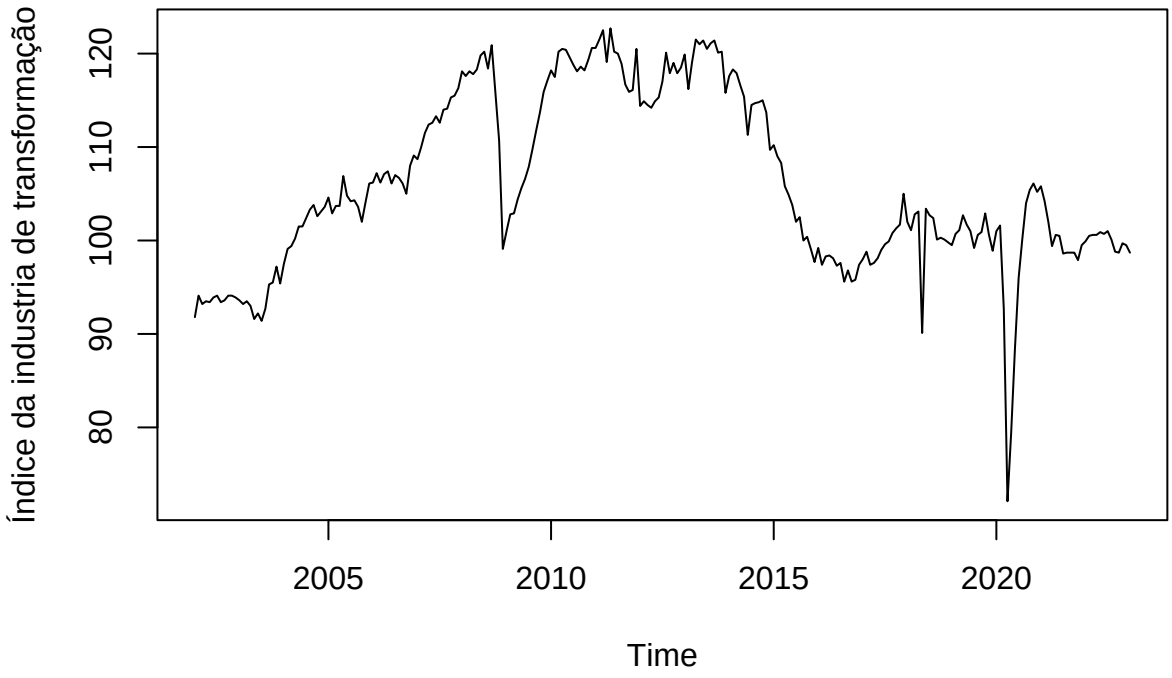
```
acf(dind)
```



Teste de Raiz Unitária

Leitura dos Dados - india Industrial

```
library(readxl)

ind=read_excel('indice_industria_transf.xlsx')

y = ts(ind[,2],start=c(2002,1),freq=12)

plot(y,ylab='Índice da industria de transformação')
```



Teste de RU ADF

```
#install.packages('urca')
library(urca)
```

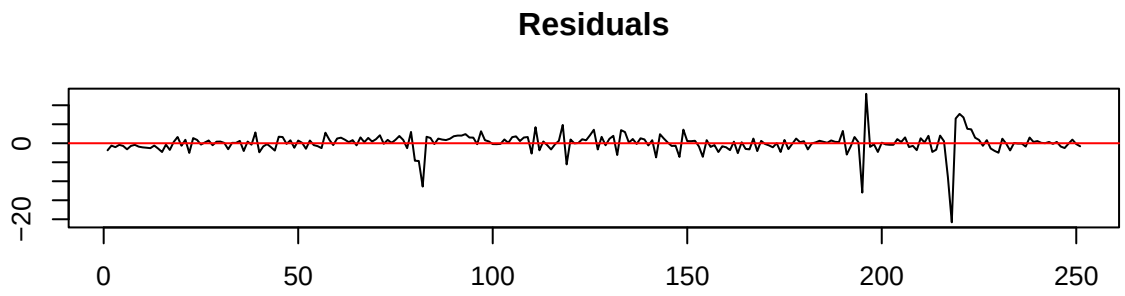
```
## Warning: package 'urca' was built under R version 4.2.3
```

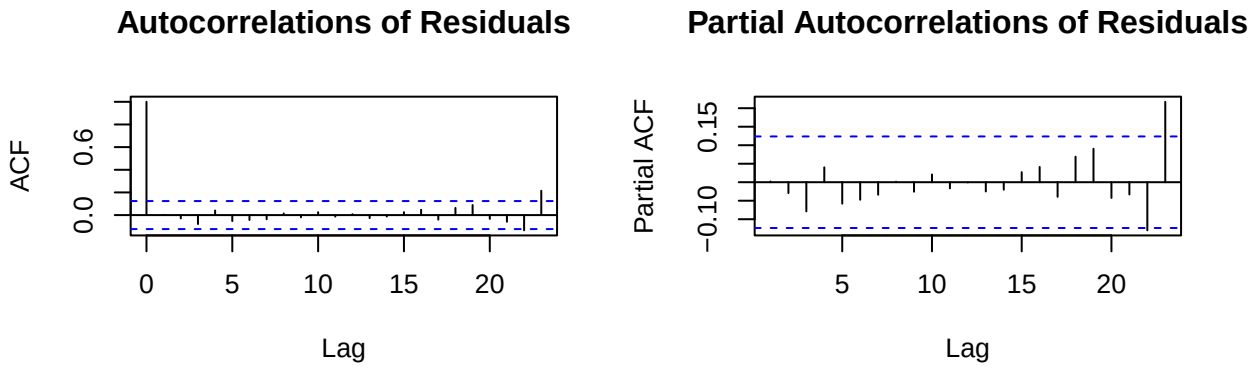
```
#Modelo com constante

ind.df1 =ur.df(y,type='trend',lags=1, selectlags = 'BIC')
summary(ind.df1)
```

```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression trend
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)
##
```

```
## Residuals:
##      Min       1Q   Median       3Q      Max
## -20.8017  -0.8426   0.1229   1.0012  13.0126
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  5.288705   2.003028   2.640  0.00881 **
## z.lag.1     -0.046598   0.018267  -2.551  0.01135 *
## tt          -0.002588   0.002320  -1.115  0.26578
## z.diff.lag   0.022538   0.063231   0.356  0.72181
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.638 on 247 degrees of freedom
## Multiple R-squared:  0.02814,    Adjusted R-squared:  0.01634
## F-statistic: 2.384 on 3 and 247 DF,  p-value: 0.06987
##
##
## Value of test-statistic is: -2.551 2.3857 3.5725
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -3.98 -3.42 -3.13
## phi2  6.15  4.71  4.05
## phi3  8.34  6.30  5.36
```

```
plot(ind.df1)
```

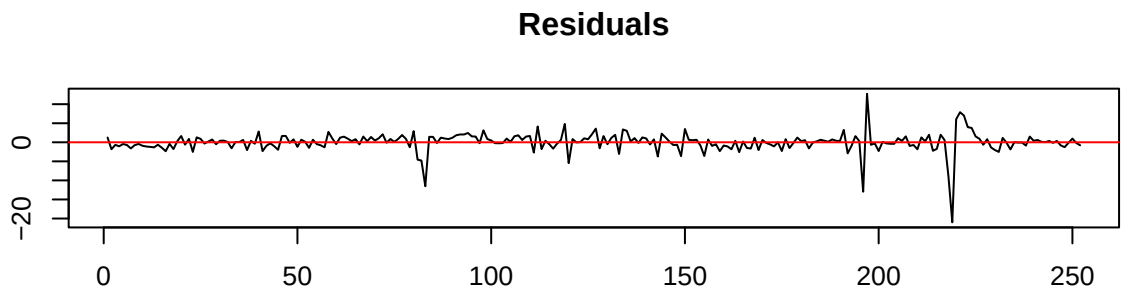


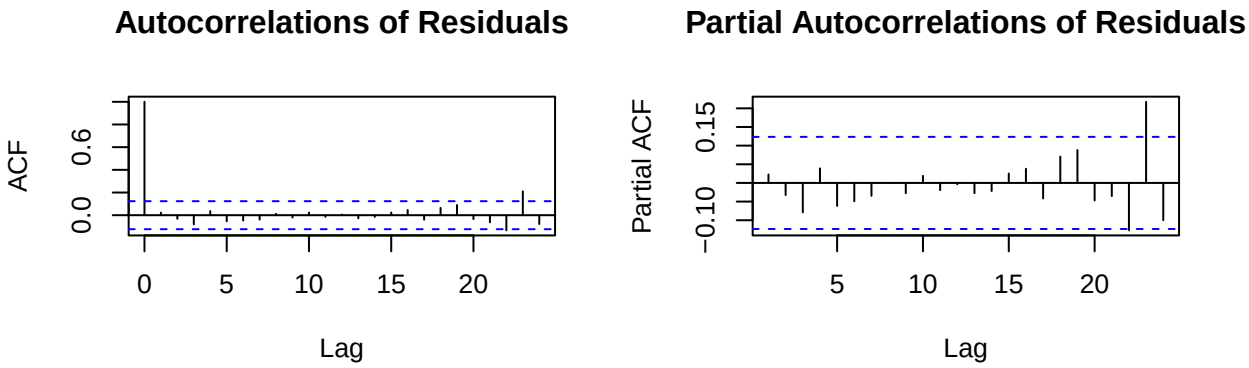


Aplicando o teste ADF e analisando o resultando para a estatística T = -2,43, tem-se que não pode-se rejeitar a H0, logo a série possui pelo menos uma raíz unitária.

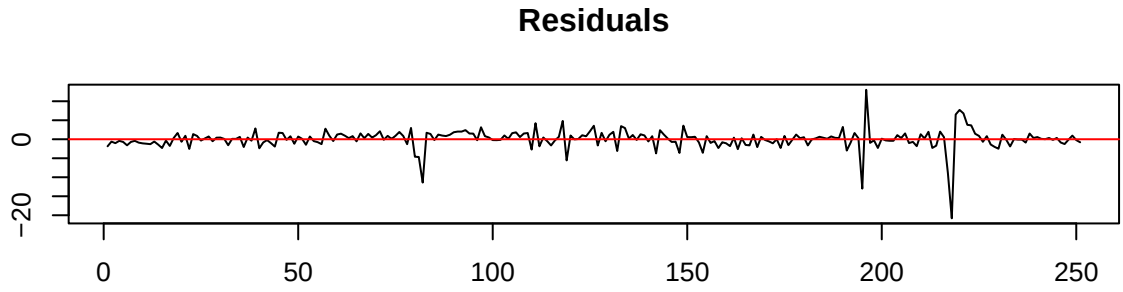
Teste ADF - indice Industria de transformação

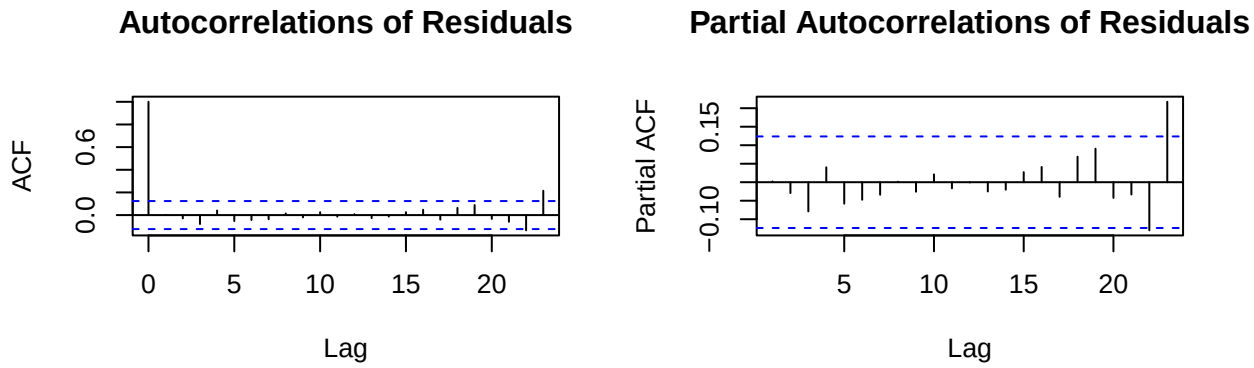
```
ind.df1=ur.df(y,type='trend',lags=0)
plot(ind.df1)
```






```
ind.df2=ur.df(y,type='trend',lags=1)
plot(ind.df2)
```



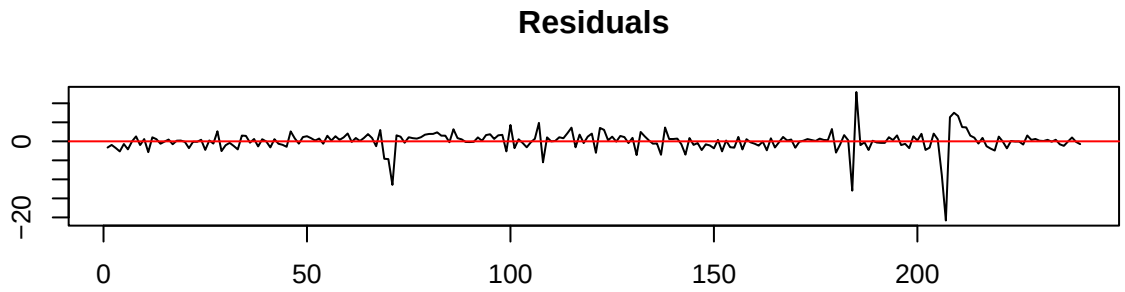


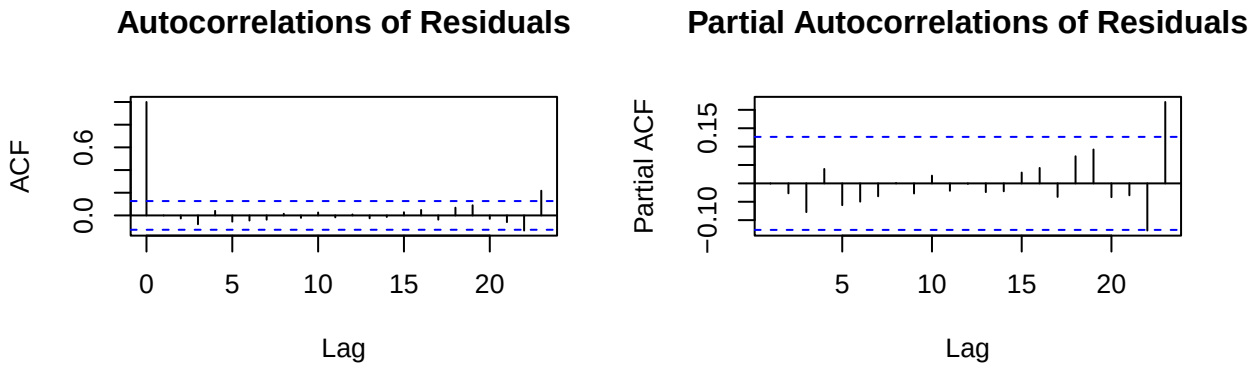

```
summary(ind.df2)
```

```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression trend
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -20.8017  -0.8426   0.1229   1.0012  13.0126
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  5.288705   2.003028   2.640  0.00881 **
## z.lag.1     -0.046598   0.018267  -2.551  0.01135 *
## tt          -0.002588   0.002320  -1.115  0.26578
## z.diff.lag   0.022538   0.063231   0.356  0.72181
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Residual standard error: 2.638 on 247 degrees of freedom
## Multiple R-squared:  0.02814,    Adjusted R-squared:  0.01634
## F-statistic: 2.384 on 3 and 247 DF,  p-value: 0.06987
##
##
## Value of test-statistic is: -2.551 2.3857 3.5725
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -3.98 -3.42 -3.13
## phi2  6.15  4.71  4.05
## phi3  8.34  6.30  5.36
```

```
ind.df2=ur.df(y,type='trend',lags=12,selectlags = 'AIC')
plot(ind.df2)
```






```
summary(ind.df2)
```

```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression trend
```

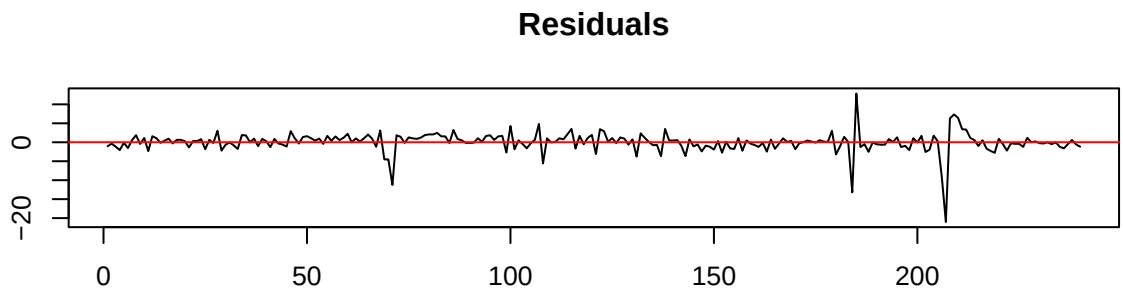
```
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -20.8110  -0.7834   0.1846   1.0781  12.9659
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  6.579117   2.244808   2.931  0.00371 **
## z.lag.1     -0.056466   0.019935  -2.833  0.00502 **
## tt          -0.004057   0.002593  -1.565  0.11902
## z.diff.lag   0.027559   0.064570   0.427  0.66991
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.687 on 236 degrees of freedom
## Multiple R-squared:  0.0359, Adjusted R-squared:  0.02365
## F-statistic:  2.93 on 3 and 236 DF,  p-value: 0.03436
##
##
## Value of test-statistic is: -2.8326 2.9311 4.3892
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -3.98 -3.42 -3.13
## phi2  6.15  4.71  4.05
## phi3  8.34  6.30  5.36
```

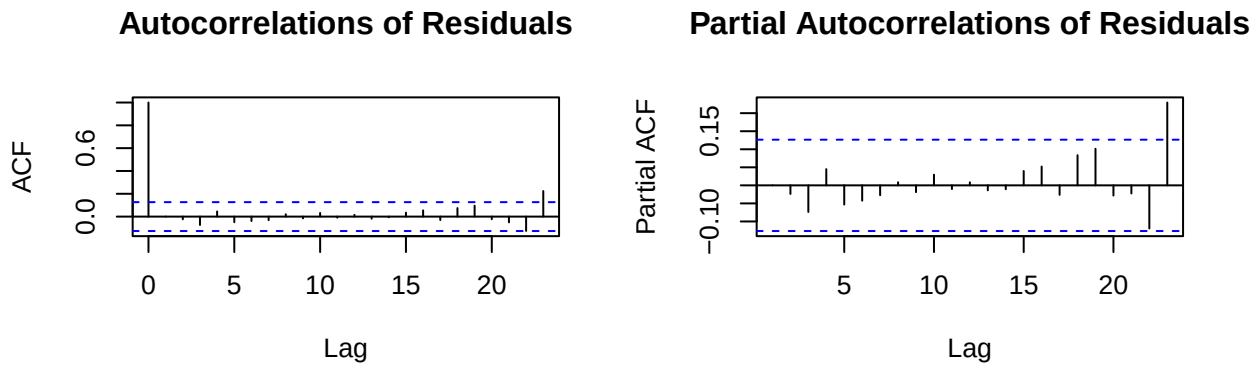
```
ind.df2=ur.df(y,type='trend',lags=12,selectlags = 'BIC')
plot(ind.df2)
summary(ind.df2)
```

```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression trend
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -20.8110  -0.7834   0.1846   1.0781  12.9659
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  6.579117   2.244808   2.931  0.00371 **
## z.lag.1     -0.056466   0.019935  -2.833  0.00502 **
```

```
## tt          -0.004057   0.002593  -1.565  0.11902
## z.diff.lag   0.027559   0.064570   0.427  0.66991
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.687 on 236 degrees of freedom
## Multiple R-squared:  0.0359, Adjusted R-squared:  0.02365
## F-statistic:  2.93 on 3 and 236 DF,  p-value: 0.03436
##
##
## Value of test-statistic is: -2.8326 2.9311 4.3892
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -3.98 -3.42 -3.13
## phi2  6.15  4.71  4.05
## phi3  8.34  6.30  5.36
```

```
ind.df3=ur.df(y,type='drift',lags=12,selectlags = 'BIC')
plot(ind.df3)
```



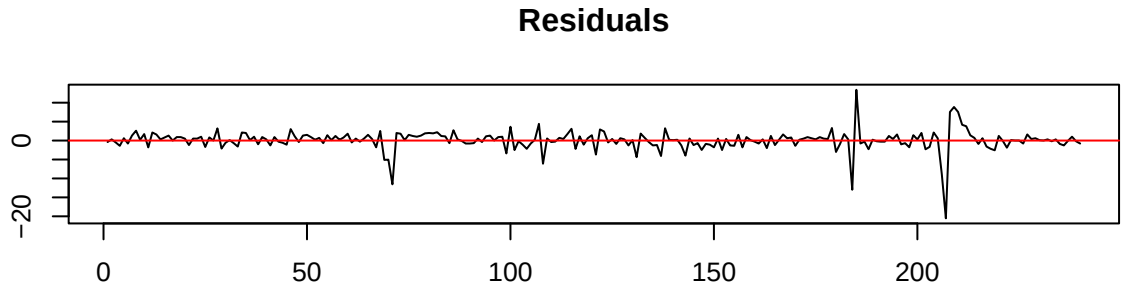


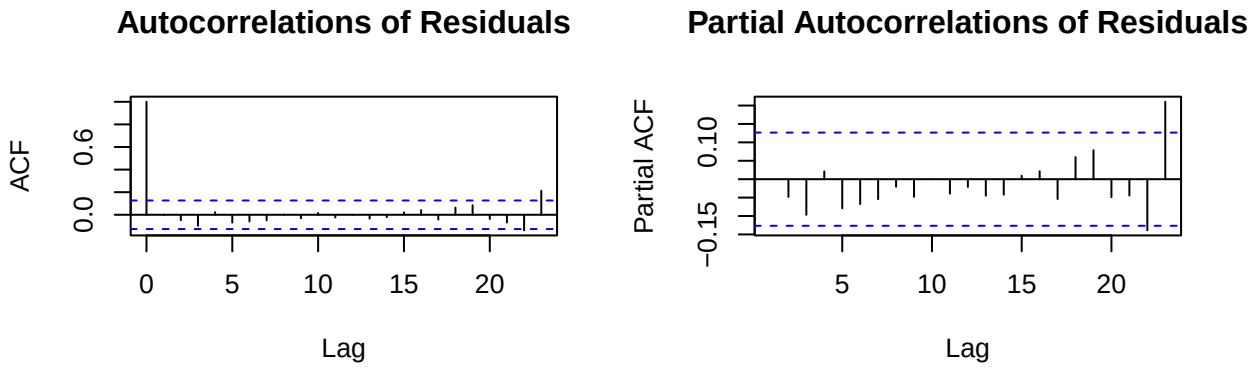

```
summary(ind.df3)
```

```
##
## ###############################################
```

```
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression drift
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 + 1 + z.diff.lag)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21.0353  -0.8492   0.1275   1.0717  12.8587
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  5.19084    2.06829   2.510   0.0128 *
## z.lag.1     -0.04849    0.01933  -2.508   0.0128 *
## z.diff.lag   0.02929    0.06476   0.452   0.6515
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.695 on 237 degrees of freedom
## Multiple R-squared:  0.0259, Adjusted R-squared:  0.01768
## F-statistic: 3.151 on 2 and 237 DF,  p-value: 0.04459
##
##
## Value of test-statistic is: -2.5084 3.1534
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau2 -3.44 -2.87 -2.57
## phi1  6.47  4.61  3.79
```

```
ind.df4=ur.df(y,type='none',lags=12,selectlags='BIC')
plot(ind.df4)
```



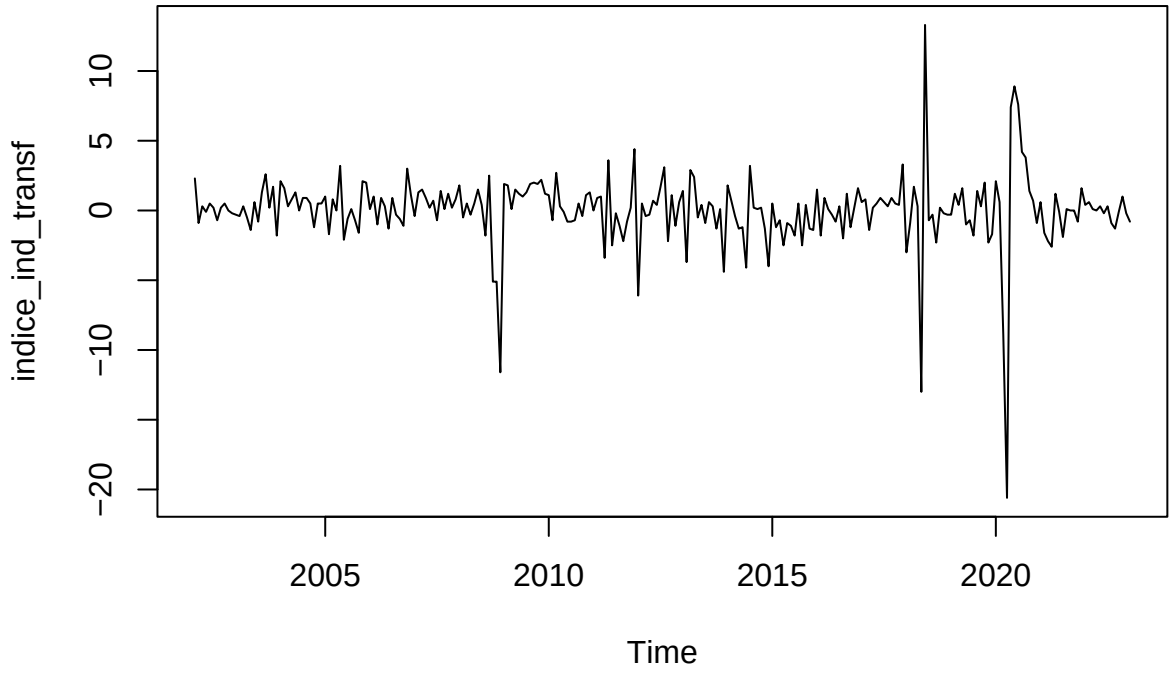



```
summary(ind.df4)
```

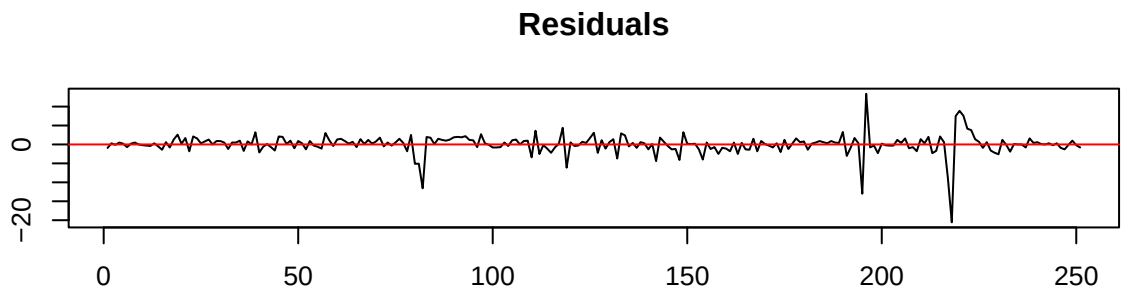
```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression none
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 - 1 + z.diff.lag)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -20.5263  -0.7844   0.2648   1.0989  13.4010
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## z.lag.1    -0.0001465  0.0016438  -0.089    0.929
## z.diff.lag  0.0067531  0.0648415   0.104    0.917
##
## Residual standard error: 2.725 on 238 degrees of freedom
## Multiple R-squared:  7.739e-05,  Adjusted R-squared:  -0.008325
## F-statistic: 0.00921 on 2 and 238 DF,  p-value: 0.9908
```

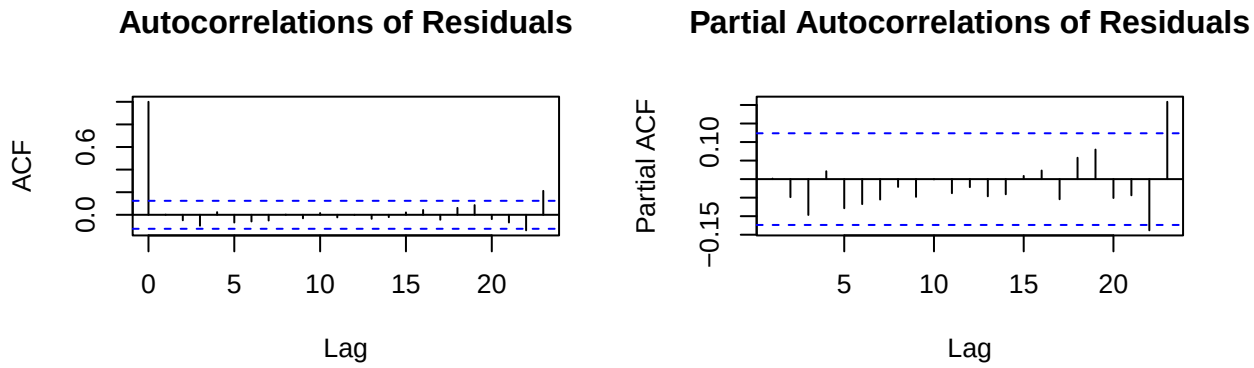
```
##
##
## Value of test-statistic is: -0.0891
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.58 -1.95 -1.62
```

```
#teste em relação a variação da série
dind=diff(y)

plot(dind)
```




```
dind.df=ur.df(dind,type='none',lags=0)
plot(dind.df)
```



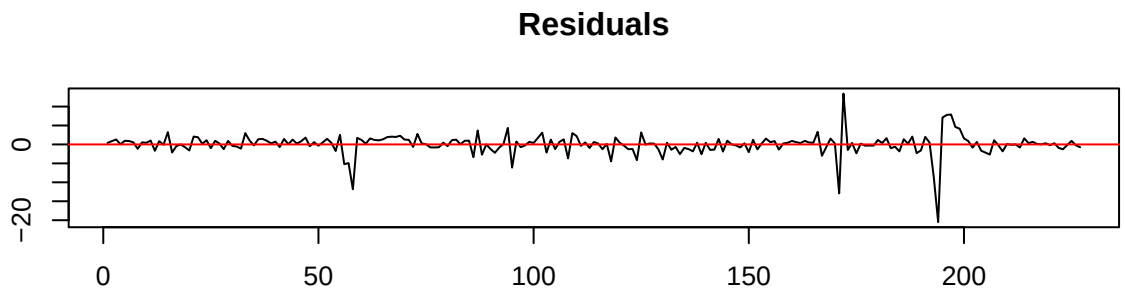


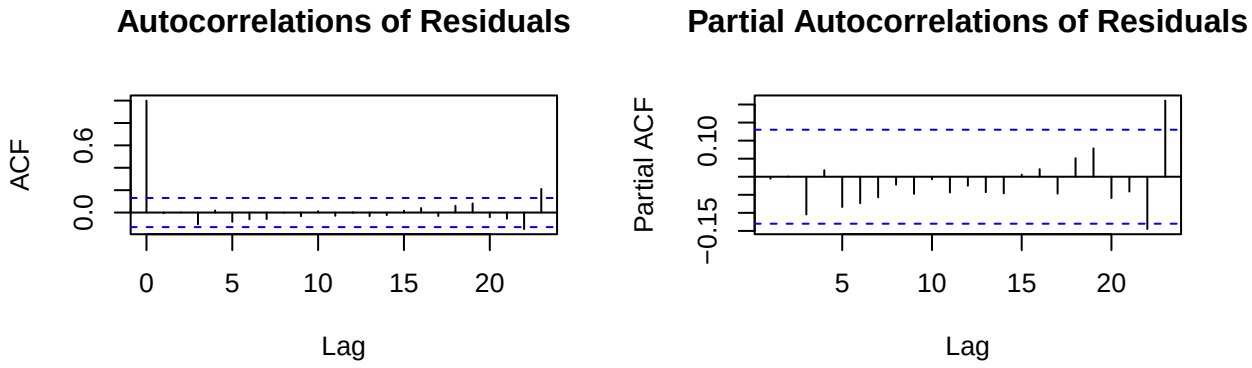

```
summary(dind.df)
```

```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression none
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 - 1)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -20.5534  -0.7987   0.2063   0.9984  13.3680
##
## Coefficients:
##         Estimate Std. Error t value Pr(>|t|)
## z.lag.1 -0.99477    0.06316  -15.75   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.66 on 250 degrees of freedom
## Multiple R-squared:  0.498,  Adjusted R-squared:  0.496
```

```
## F-statistic:   248 on 1 and 250 DF,  p-value: < 2.2e-16
##
##
## Value of test-statistic is: -15.7495
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.58 -1.95 -1.62
```

```
dind.df1=ur.df(dind,type='none',lags=24,selectlags='BIC')
plot(dind.df1)
```






```
summary(dind.df1)
```

```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression none
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 - 1 + z.diff.lag)
##
```

```
## Residuals:
##      Min       1Q   Median       3Q      Max
## -20.4995  -0.8164   0.2487   1.0452  13.4169
##
## Coefficients:
##            Estimate Std. Error t value Pr(>|t|)
## z.lag.1    -1.04406    0.09361  -11.15   <2e-16 ***
## z.diff.lag  0.05186    0.06646    0.78    0.436
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.779 on 225 degrees of freedom
## Multiple R-squared:  0.498,  Adjusted R-squared:  0.4935
## F-statistic: 111.6 on 2 and 225 DF,  p-value: < 2.2e-16
##
##
## Value of test-statistic is: -11.1529
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.58 -1.95 -1.62
```

Para a série diferenciada uma vez L(1), nota-se que o teste de estatística T=-11.153 está a esquerda de tau1 5%, assim rejeita-se a hipótese nula, logo a série diferenciada uma vez não possui raíz unitária e é estacionária.

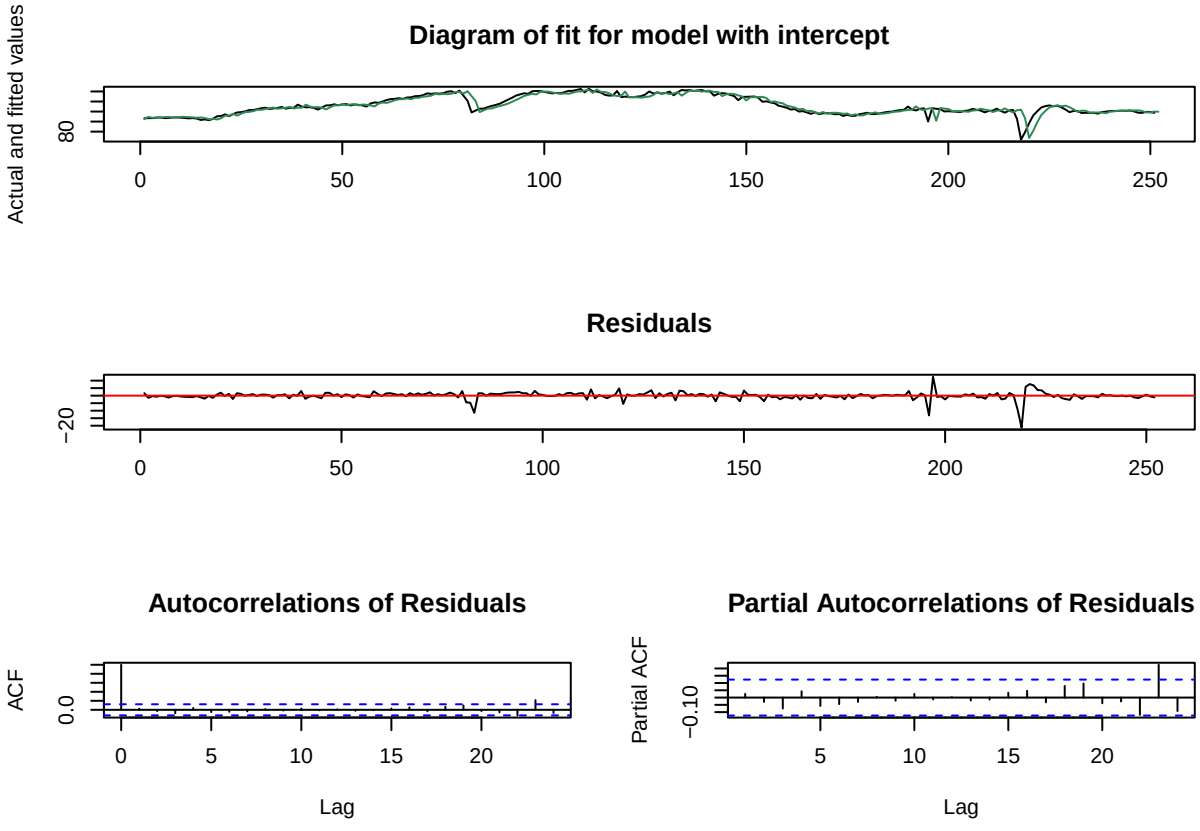
Teste de PP

```
#Série índice da industria de transformação
#modelo com constante
library(urca)

ind.pp = ur.pp(y,type='Z-tau',model='constant',lags='short')
plot(ind.pp)
summary(ind.pp)
```

```
##
## ###################################
## # Phillips-Perron Unit Root Test #
## ###################################
##
## Test regression with intercept
##
##
## Call:
## lm(formula = y ~ y.l1)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21.2151  -0.8128   0.1043   1.0784  12.5701
##
```

```
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.70897    1.89820   2.481   0.0138 *
## y.l1         0.95584    0.01784  53.585   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.632 on 250 degrees of freedom
## Multiple R-squared:  0.9199, Adjusted R-squared:  0.9196
## F-statistic:  2871 on 1 and 250 DF,  p-value: < 2.2e-16
##
##
## Value of test-statistic, type: Z-tau  is: -2.4113
##
##          aux. Z statistics
## Z-tau-mu             2.417
##
## Critical values for Z statistics:
##                      1pct      5pct     10pct
## critical values -3.457766 -2.873097 -2.572877
```

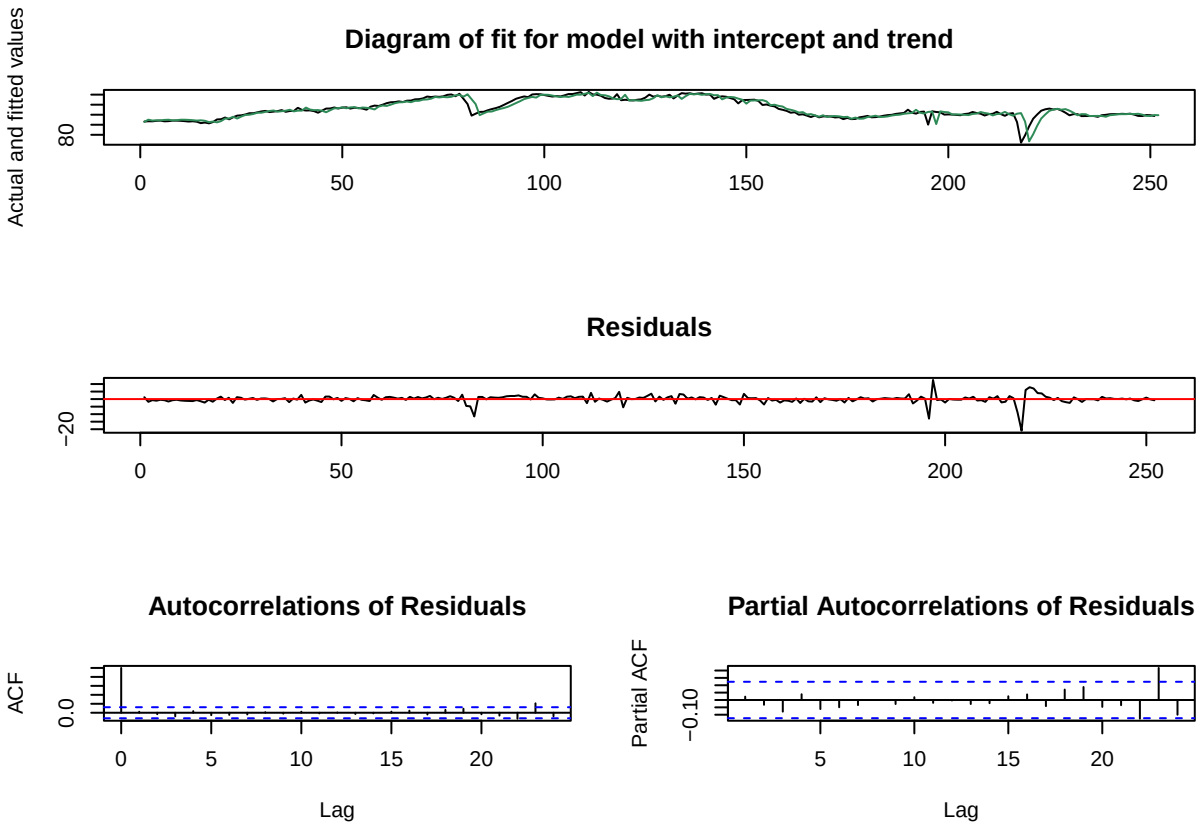
```
y.pp = ur.pp(y,type='Z-alpha',model='constant',lags='short')
plot(y.pp)
```



```
summary(y.pp)
```

```
##
## ###################################
## # Phillips-Perron Unit Root Test #
## ###################################
##
## Test regression with intercept
##
##
## Call:
## lm(formula = y ~ y.l1)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21.2151  -0.8128   0.1043   1.0784  12.5701
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.70897    1.89820   2.481   0.0138 *
## y.l1         0.95584    0.01784  53.585   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.632 on 250 degrees of freedom
## Multiple R-squared:  0.9199, Adjusted R-squared:  0.9196
## F-statistic:  2871 on 1 and 250 DF,  p-value: < 2.2e-16
##
##
## Value of test-statistic, type: Z-alpha  is: -10.4919
##
##          aux. Z statistics
## Z-tau-mu             2.417
```

```
#Modelo com constante e tendência

ind.pp1= ur.pp(y, type='Z-tau',model='trend',lags='short')
plot(ind.pp1)
```




```
summary(ind.pp1)
```

```
##
## ###################################
## # Phillips-Perron Unit Root Test #
## ###################################
##
## Test regression with intercept and trend
##
##
## Call:
## lm(formula = y ~ y.l1 + trend)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -20.9948  -0.8299   0.1365   1.0239  12.7230
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.986121   1.910496   2.610  0.00961 **
## y.l1         0.953236   0.017953  53.097  < 2e-16 ***
## trend       -0.002756   0.002294  -1.202  0.23067
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

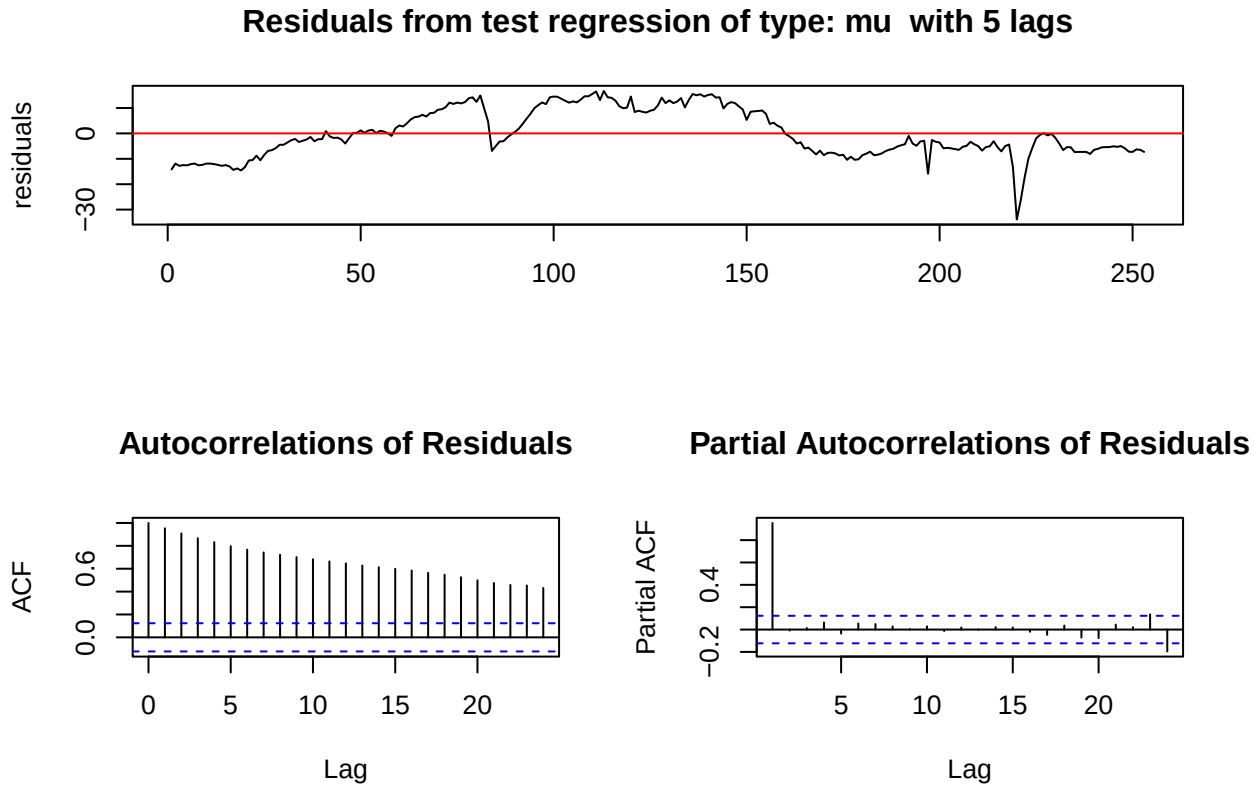
```
## Residual standard error: 2.63 on 249 degrees of freedom
## Multiple R-squared:  0.9204, Adjusted R-squared:  0.9197
## F-statistic:  1439 on 2 and 249 DF,  p-value: < 2.2e-16
##
##
## Value of test-statistic, type: Z-tau  is: -2.528
##
##            aux. Z statistics
## Z-tau-mu              2.9051
## Z-tau-beta           -1.2412
##
## Critical values for Z statistics:
##                       1pct      5pct     10pct
## critical values -3.997694 -3.428909 -3.137615
```

```
ind.pp2=ur.pp(y,type='Z-tau',model='constant',lags='short')
summary(ind.pp2)
```

```
##
## ###################################
## # Phillips-Perron Unit Root Test #
## ###################################
##
## Test regression with intercept
##
##
## Call:
## lm(formula = y ~ y.l1)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21.2151  -0.8128   0.1043   1.0784  12.5701
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.70897    1.89820   2.481   0.0138 *
## y.l1         0.95584    0.01784  53.585   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.632 on 250 degrees of freedom
## Multiple R-squared:  0.9199, Adjusted R-squared:  0.9196
## F-statistic:  2871 on 1 and 250 DF,  p-value: < 2.2e-16
##
##
## Value of test-statistic, type: Z-tau  is: -2.4113
##
##          aux. Z statistics
## Z-tau-mu             2.417
##
## Critical values for Z statistics:
##                       1pct      5pct     10pct
## critical values -3.457766 -2.873097 -2.572877
```

Teste KPSS

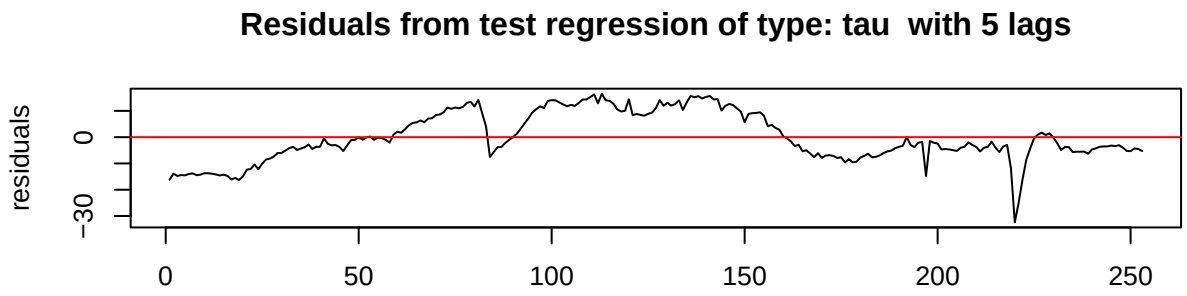
```
#indice Industria de transformação
ind.kpss=ur.kpss(y,type='mu',lags='short')
plot(ind.kpss)
```

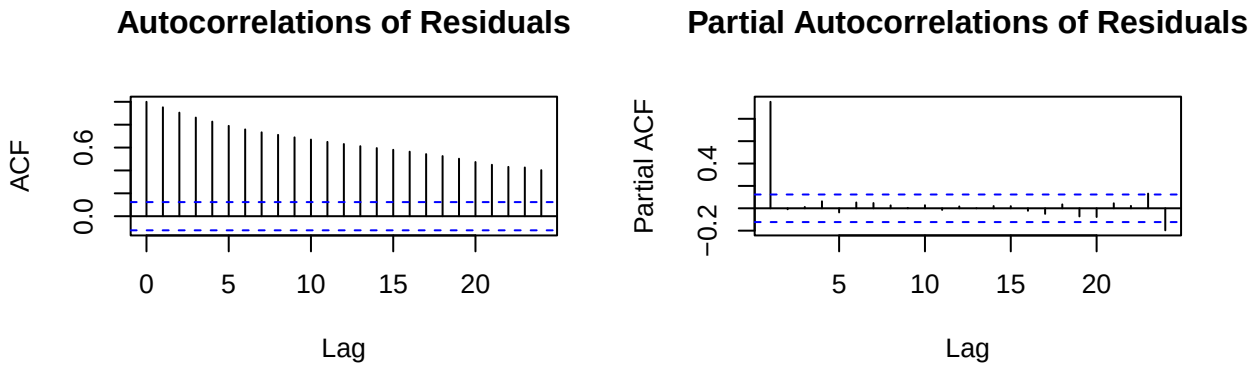



```
summary(ind.kpss)
```

```
##
## ########################
## # KPSS Unit Root Test #
## ########################
##
## Test is of type: mu with 5 lags.
##
## Value of test-statistic is: 0.8883
##
## Critical value for a significance level of:
##                 10pct  5pct 2.5pct  1pct
## critical values 0.347 0.463  0.574 0.739
```

```
#indice Industria de transformação
ind.kpss2=ur.kpss(y,type='tau',lags='short')
plot(ind.kpss2)
```



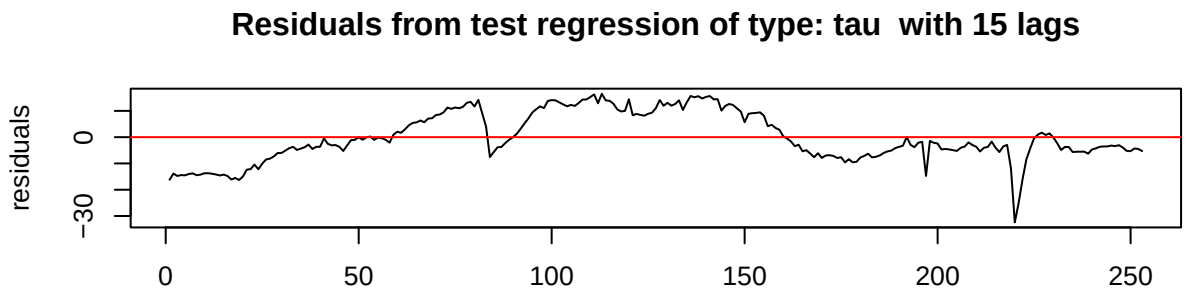


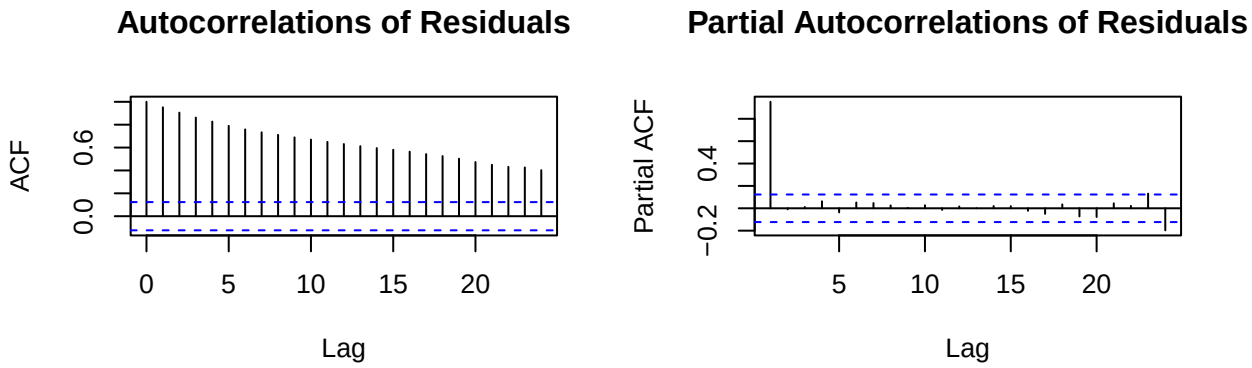

```
summary(ind.kpss2)
```

```
##
## ########################
## # KPSS Unit Root Test #
## ########################
##
## Test is of type: tau with 5 lags.
##
## Value of test-statistic is: 0.7832
##
## Critical value for a significance level of:
##                 10pct  5pct 2.5pct  1pct
## critical values 0.119 0.146  0.176 0.216
```

```
#install.packages('forecast')
#library(forecast)
#ndiffs(ind)
```

```
#indice Industria de transformação

ind.kpss1=ur.kpss(y,type='tau',lags='long')
plot(ind.kpss1)
```

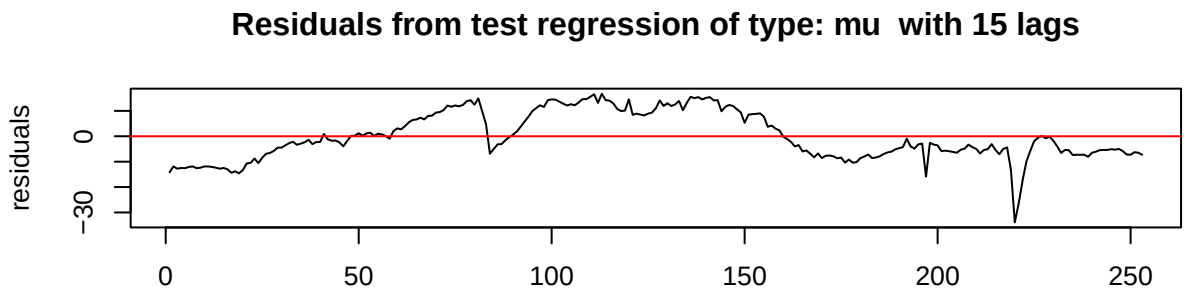


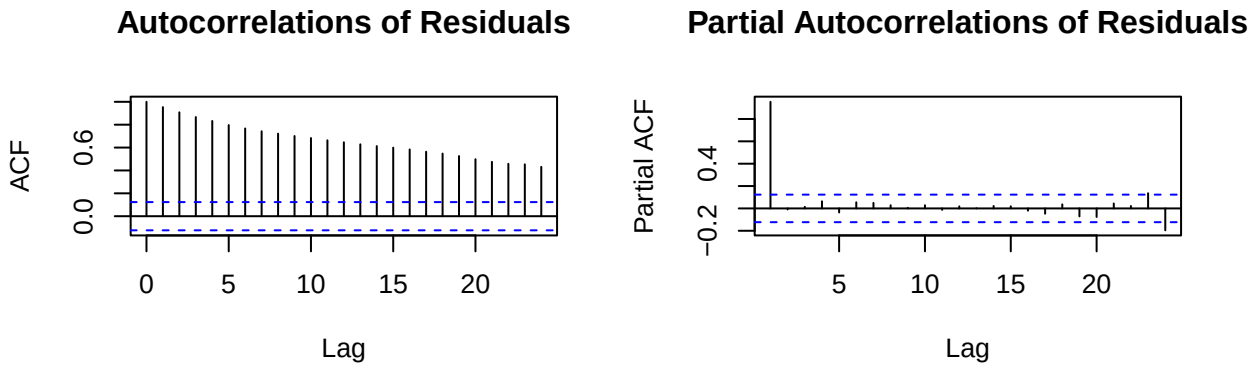



```
summary(ind.kpss1)
```

```
##
## ########################
## # KPSS Unit Root Test #
## ########################
##
## Test is of type: tau with 15 lags.
##
## Value of test-statistic is: 0.3332
##
## Critical value for a significance level of:
##                 10pct  5pct 2.5pct  1pct
## critical values 0.119 0.146  0.176 0.216
```

```
ind.kpss2=ur.kpss(y,type='mu',lags='long')
plot(ind.kpss2)
```






```
summary(ind.kpss2)
```

```
##
## ########################
## # KPSS Unit Root Test #
## ########################
##
## Test is of type: mu with 15 lags.
##
## Value of test-statistic is: 0.3757
##
## Critical value for a significance level of:
##                 10pct  5pct 2.5pct  1pct
## critical values 0.347 0.463  0.574 0.739
```