Pronóstico de cuentas

El objetivo de este documento es realizar un pronóstico de las cuentas G-H,I,R-S,T,O, P Y Q, según la clasificación CIIU revisión 4, las cuales, desde el cambio del DANE a la metodología del 2015, tienen una agregación tal que se limita la aplicación de la metodología desarrollada por la Universidad de Antioquia para establecer las tasas de distribución de los municipios para estas cuentas.

El pronóstico se basa en la metodología presentada en Enders (2008).

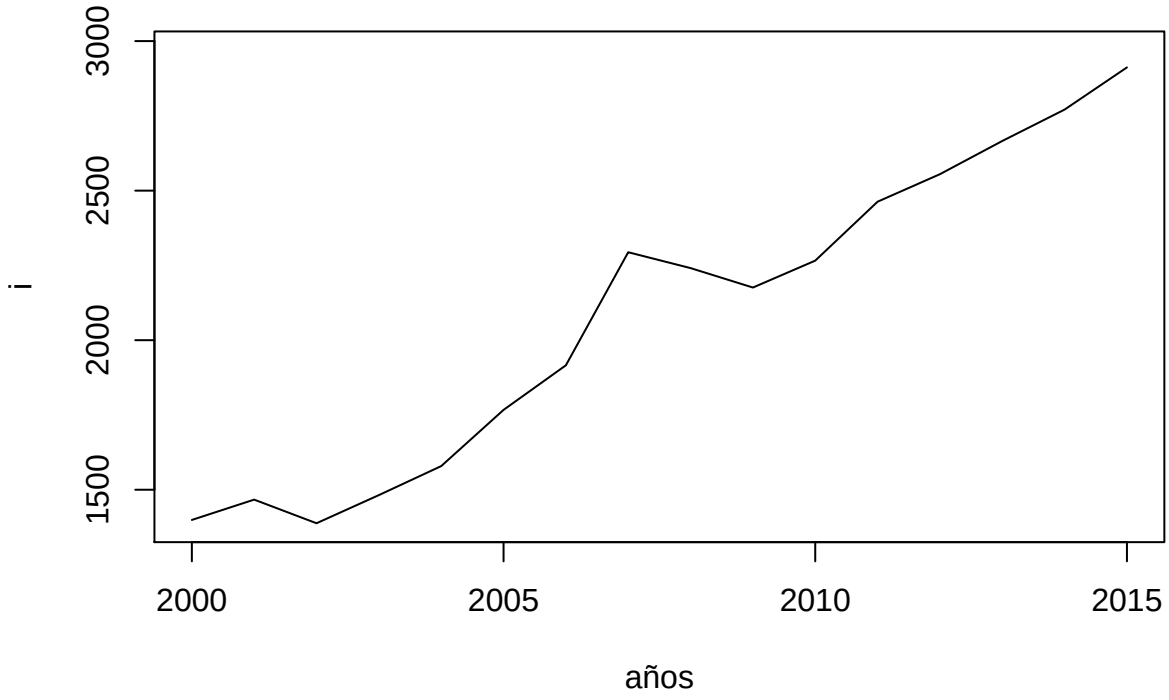
```
library(readxl)
library(tidyverse)
library(urca)
```

```
cuentas <- read_excel("C:/Users/josej/Desktop/Gobernación/Tareas/Pronostico G+H+I/cuentas_base2005.xlsx
glimpse(cuentas)
```

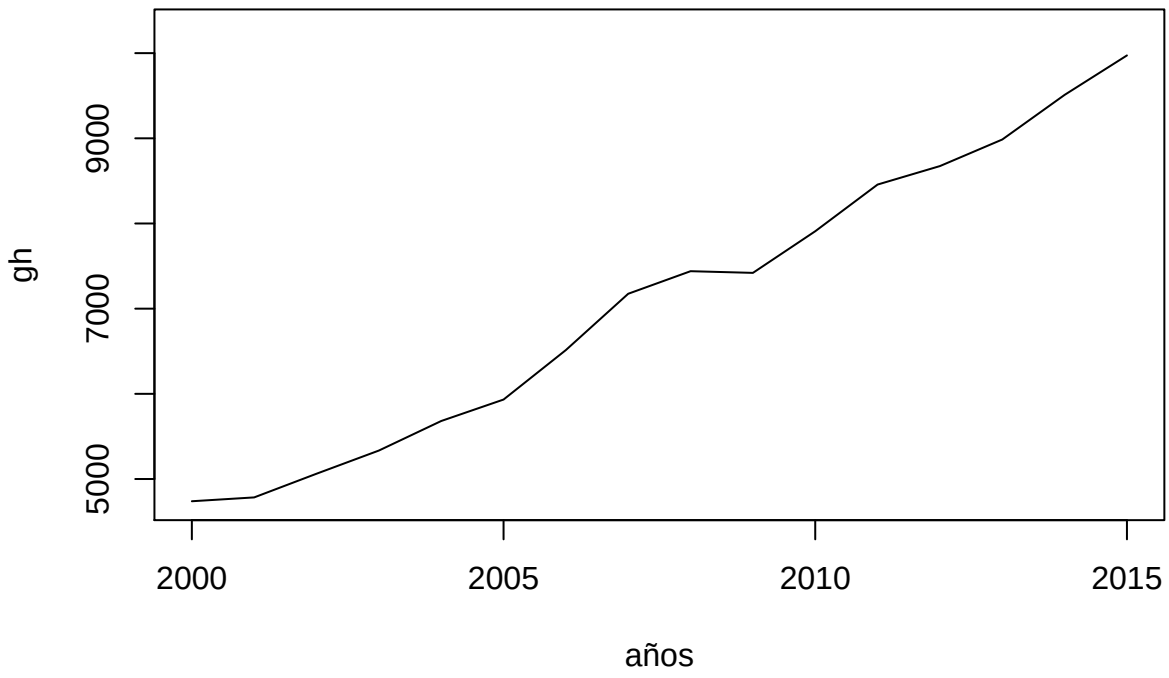
```
## Observations: 17
## Variables: 14
## $ años      <chr> "2000", "2001", "2002", "2003", "2004", "2005", "2006", "20...
## $ gh        <dbl> 4739, 4784, 5062, 5334, 5681, 5933, 6514, 7175, 7440, 7420,...
## $ i         <dbl> 1399, 1467, 1388, 1482, 1579, 1767, 1916, 2294, 2241, 2176,...
## $ o         <dbl> 1803, 1752, 1715, 1637, 1646, 1735, 1878, 2016, 2051, 2260,...
## $ p         <dbl> 2041, 1968, 1938, 2047, 2183, 2294, 2282, 2446, 2428, 2551,...
## $ q         <dbl> 807, 811, 840, 921, 962, 1126, 1195, 1174, 1133, 1164, 1215...
## $ total_opq <dbl> 4651, 4531, 4493, 4605, 4791, 5155, 5355, 5636, 5612, 5975,...
## $ rs        <dbl> 719, 722, 692, 690, 756, 899, 989, 1082, 1129, 1118, 1134, ...
## $ t_cuentas <dbl> 410, 407, 412, 415, 433, 439, 442, 454, 447, 456, 456, 475,...
## $ cafe      <dbl> 469, 479, 578, 571, 539, 505, 506, 534, 486, 382, 420, 384,...
## $ otros     <dbl> 1417, 1413, 1471, 1392, 1463, 1706, 1642, 1853, 1813, 1820,...
## $ pecuaria  <dbl> 1056, 954, 1154, 1183, 1206, 1268, 1350, 1373, 1343, 1348, ...
## $ pesca     <dbl> 14, 15, 9, 8, 8, 9, 10, 13, 15, 14, 13, 17, 19, 20, 20, 19,...
## $ total_a   <dbl> 2956, 2861, 3212, 3154, 3216, 3488, 3508, 3773, 3657, 3564,...
```

Pronóstico de G+H+I

```
plot(i~años,data=cuentas,type="l")
```




```
plot(gh~años,data=cuentas,type="l")
```



Como puede observarse, las series no son estacionarias en media (no tienen una media constante en el tiempo), pero son estables en varianza (su dispersión en torno a la media no aumenta o disminuye siguiendo un patrón en el tiempo).

A continuación se realiza una prueba para establecer el orden de integración de la serie (número de veces que se debe diferenciar las serie para obtener una serie estacionaria).

División I

```
summary(ur.df(cuentas$i,type="trend",lags=1))
```

```
##
## ###############################################
## # 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
## -89.672 -34.350 -12.942   6.213 263.692
```

```
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 1131.2480   311.7787   3.628  0.00397 **
## z.lag.1       -0.9491     0.2772  -3.424  0.00568 **
## tt           104.9889    30.5661   3.435  0.00558 **
## z.diff.lag     0.4466     0.2465   1.812  0.09736 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 89.53 on 11 degrees of freedom
## Multiple R-squared:  0.5192, Adjusted R-squared:  0.3881
## F-statistic:  3.96 on 3 and 11 DF,  p-value: 0.03866
##
##
## Value of test-statistic is: -3.4242 7.1555 5.9295
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

El estadístico tau3 implica que se rechaza la hipótesis nula de raíz unitaria al 10% (el término del componente autoregresivo de la ecuación de prueba es distinto de cero). La prueba de significancia individual del intercepto y la tendencia implican que ambos son estadísticamente distintos de cero. Es posible que el modelo que describe la serie tenga una tendencia determinística cuadrática o lineal.

Se inicia usando una tendencia lineal.

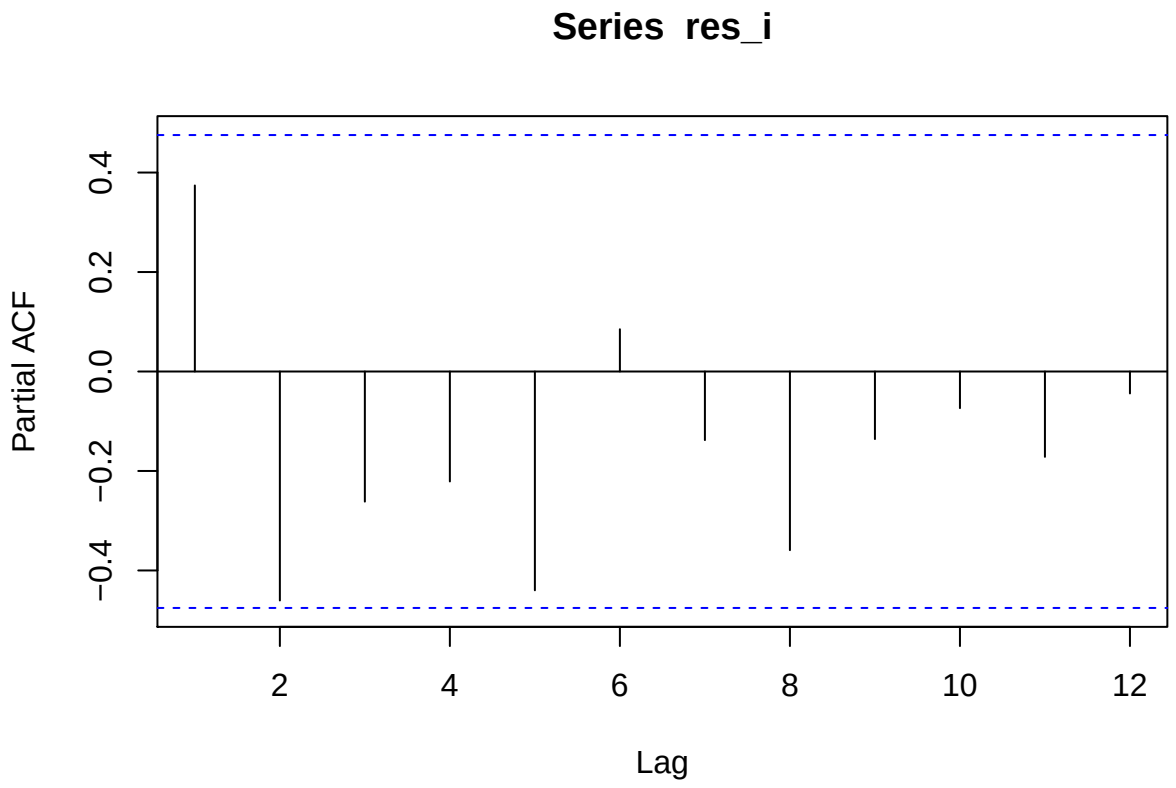
```
cuentas$t <- 1:17
modelo_i <- lm(i~t,data=cuentas)
res_i <- resid(modelo_i)
summary(ur_res_i <- ur.df(res_i,type="none",lags=1))
```

```
##
## ###############################################
## # 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
## -115.744  -40.937  -26.935    3.127  245.427
##
## Coefficients:
##            Estimate Std. Error t value Pr(>|t|)
## z.lag.1     -0.9238     0.2611  -3.538  0.00364 **
## z.diff.lag   0.4637     0.2328   1.992  0.06776 .
```

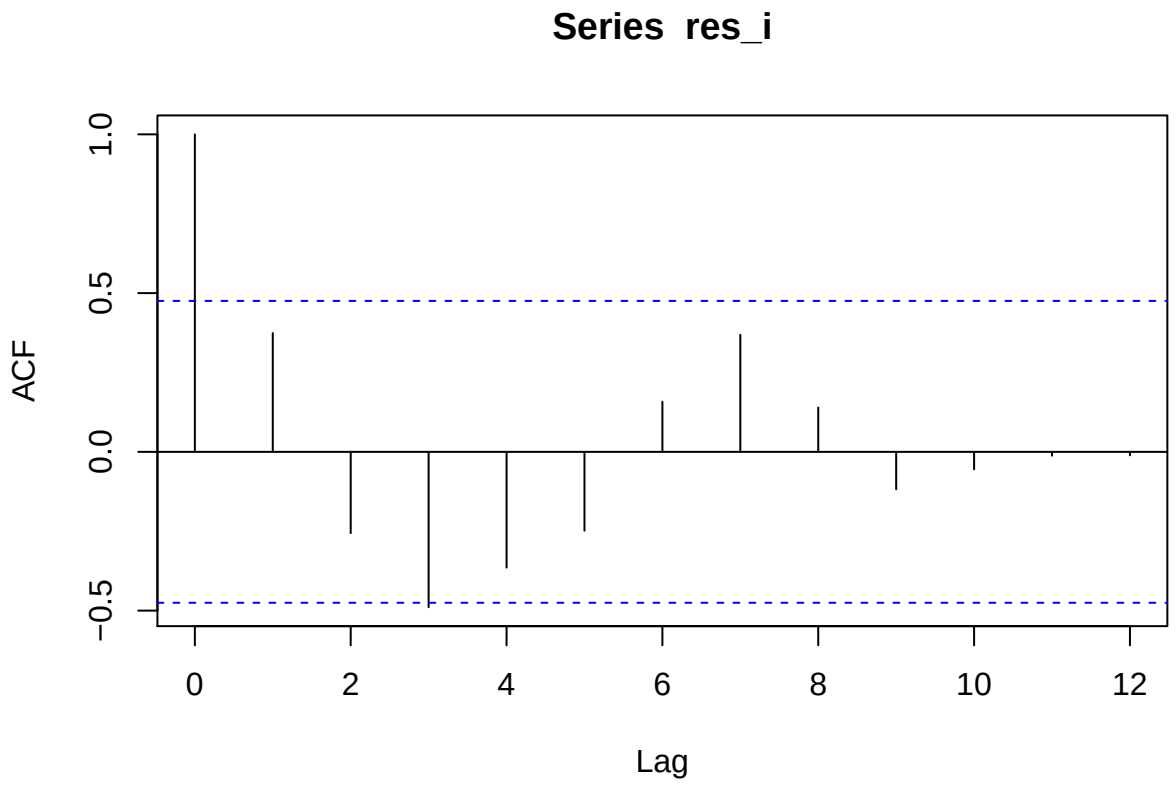
```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 84.88 on 13 degrees of freedom
## Multiple R-squared:  0.4911, Adjusted R-squared:  0.4128
## F-statistic: 6.272 on 2 and 13 DF,  p-value: 0.0124
##
##
## Value of test-statistic is: -3.5377
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.66 -1.95  -1.6
```

Los residuales del modelo son estacionarios; se rechaza la hipótesis nula de raíz unitaria.

```
pacf(res_i)
```




```
acf(res_i)
```



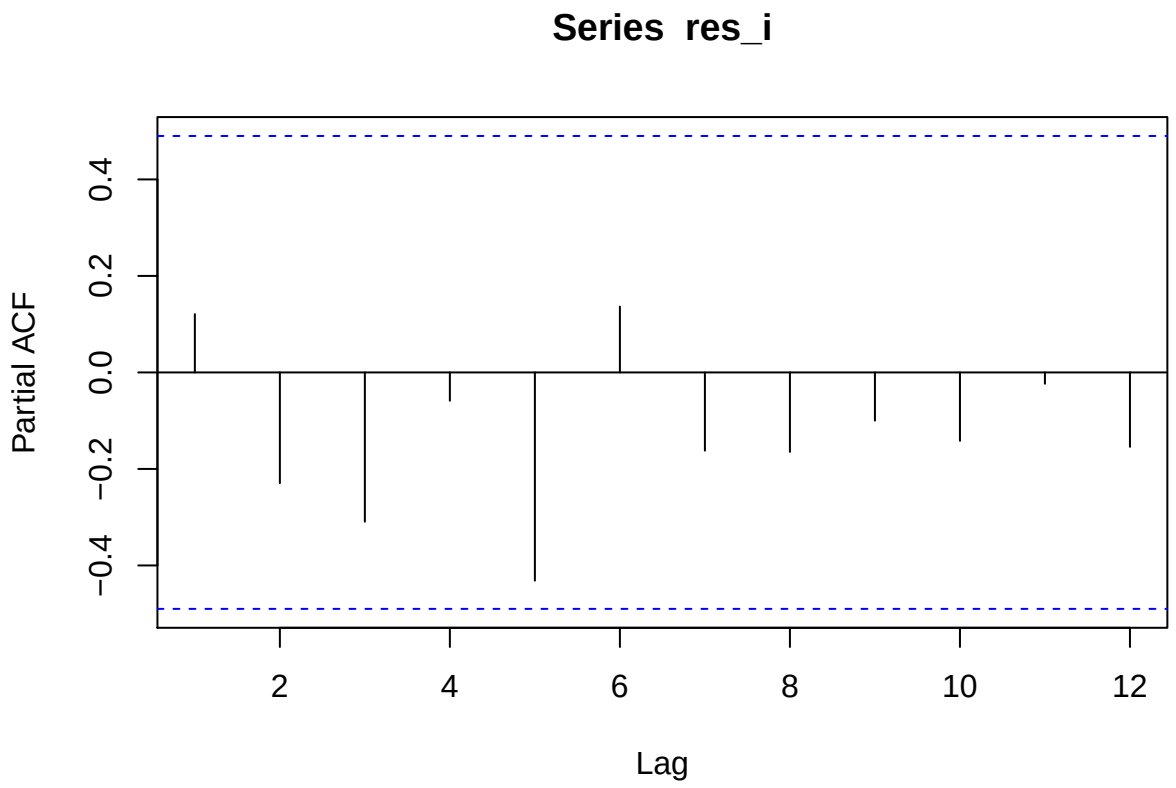
Se observa autocorrelación en el modelo; se introduce un componente autoregresivo.

```
entrenamiento <-data.frame("i"=cuentas$i[2:17],"i_rezago"=cuentas$i[1:16],"t"=cuentas$t[2:17])
modelo_i <- lm(i~t+i_rezago,data=entrenamiento)
res_i <- resid(modelo_i)
summary(ur_res_i <- ur.df(res_i,type="none",lags=1))
```

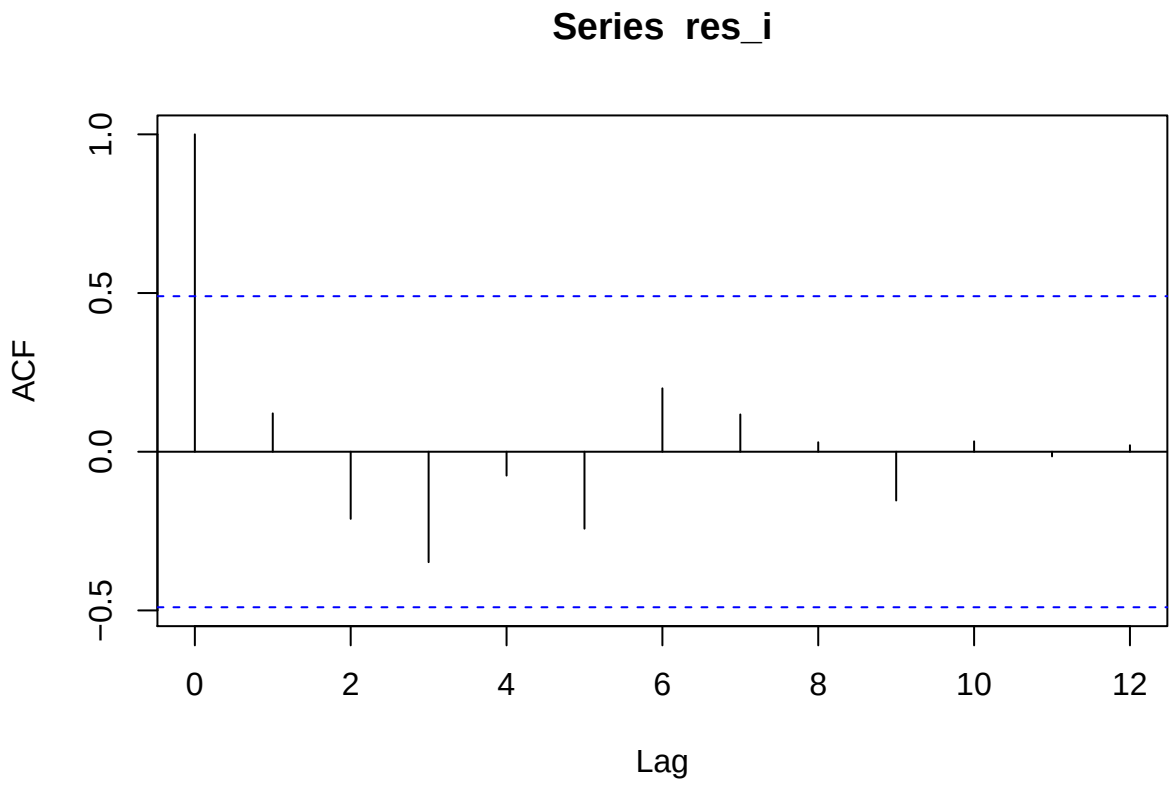
```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression none
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 - 1 + z.diff.lag)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -80.34 -34.32 -15.31  14.56 277.21
##
## Coefficients:
##            Estimate Std. Error t value Pr(>|t|)
## z.lag.1     -1.0242     0.3429  -2.987   0.0113 *
## z.diff.lag   0.2446     0.2585   0.946   0.3627
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 87.91 on 12 degrees of freedom
## Multiple R-squared:  0.4707, Adjusted R-squared:  0.3825
## F-statistic: 5.335 on 2 and 12 DF,  p-value: 0.022
##
##
## Value of test-statistic is: -2.9872
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.66 -1.95  -1.6
```

```
pacf(res_i)
```




```
acf(res_i)
```



El modelo es el correcto.

División G+H

```
summary(ur.df(cuentas$gh,type="trend",lags=1))
```

```
##
## ###############################################
## # 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
## -216.28  -62.53   31.53   58.13  187.03
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 4334.9574  1052.2325   4.120  0.00170 **
## z.lag.1       -1.0491     0.2732  -3.840  0.00275 **
```

```
## tt           387.7839   100.1791   3.871  0.00260 **
## z.diff.lag     0.4445     0.2131   2.085  0.06112 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 128.3 on 11 degrees of freedom
## Multiple R-squared:  0.5816, Adjusted R-squared:  0.4674
## F-statistic: 5.096 on 3 and 11 DF,  p-value: 0.01881
##
##
## Value of test-statistic is: -3.8396 12.7274 7.5178
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

El estadístico tau3 indica que se rechaza la hipótesis nula de raíz unitaria al 5%. Se inicia con una tendencia lineal.

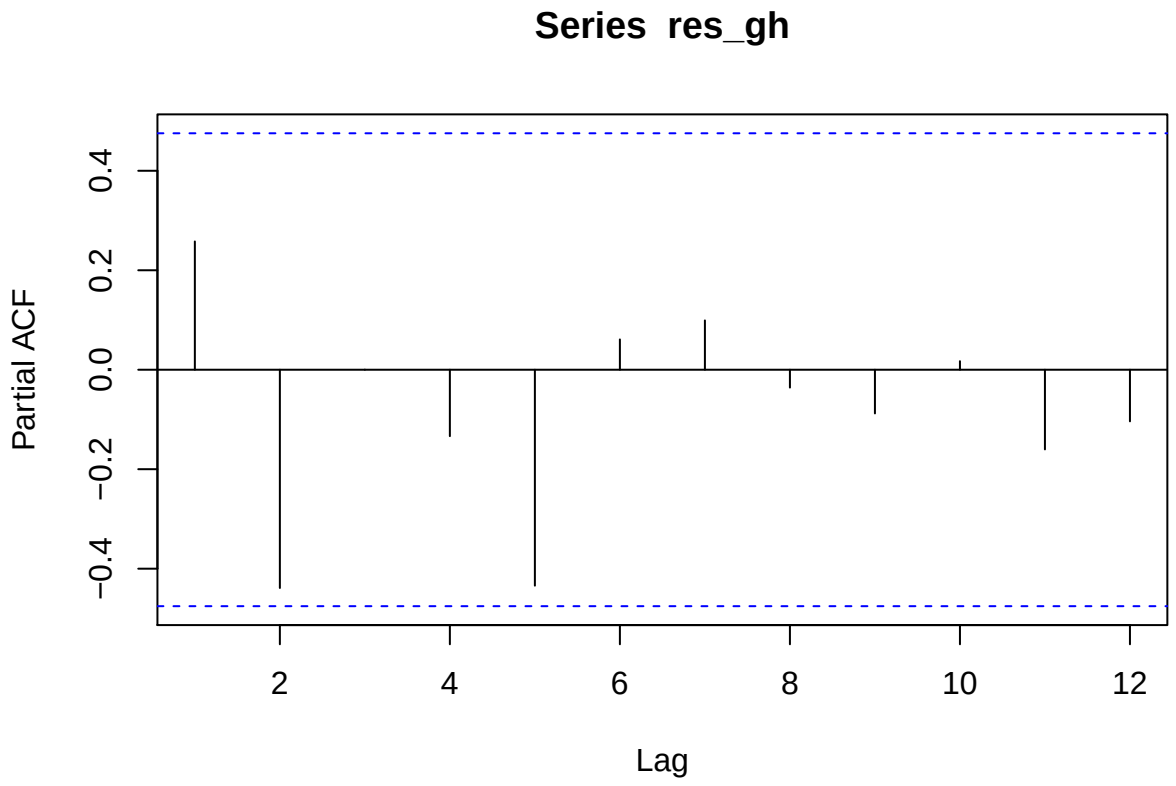
```
modelo_gh <- lm(gh~t,data=cuentas)
res_gh <- resid(modelo_gh)
summary(ur_res_i <- ur.df(res_i,type="none",lags=1))
```

```
##
## ###############################################
## # 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
## -80.34 -34.32 -15.31  14.56 277.21
##
## Coefficients:
##            Estimate Std. Error t value Pr(>|t|)
## z.lag.1     -1.0242     0.3429  -2.987   0.0113 *
## z.diff.lag   0.2446     0.2585   0.946   0.3627
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 87.91 on 12 degrees of freedom
## Multiple R-squared:  0.4707, Adjusted R-squared:  0.3825
## F-statistic: 5.335 on 2 and 12 DF,  p-value: 0.022
##
##
## Value of test-statistic is: -2.9872
```

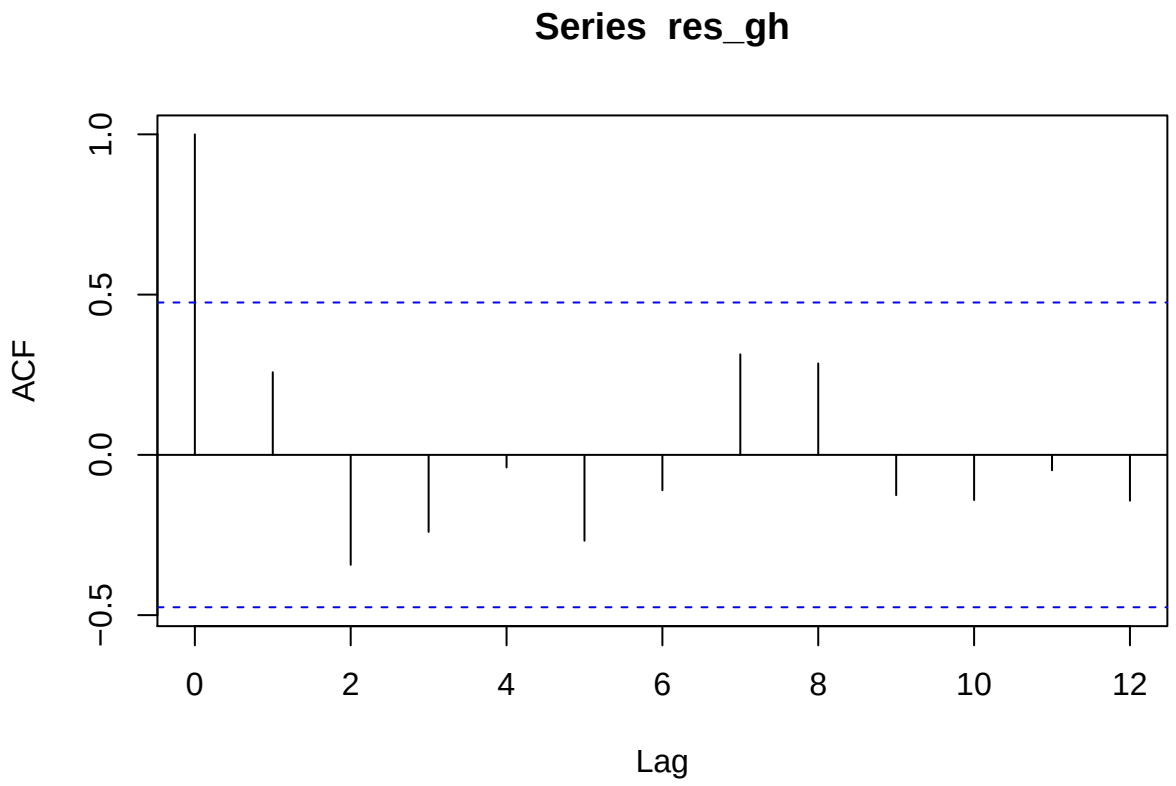
```
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.66 -1.95  -1.6
```

Los residuales del modelo son estacionarios; se rechaza la hipótesis nula de raíz unitaria.

```
pacf(res_gh)
```




```
acf(res_gh)
```



El modelo está bien especificado. Se procede a pronosticar.

Pronóstico

```
prediccion_2017 <- data.frame("i_rezago"=cuentas$i[17],"t"=c(18))
i_2017 <- predict(modelo_i,prediccion_2017)
prediccion_2018 <- data.frame("i_rezago"=c(cuentas$i[17],i_2017),"t"=c(18,19))
i_2018 <- data.frame("i"=predict(modelo_i,prediccion_2018),"año"=c(2017,2018))
i_2018
```

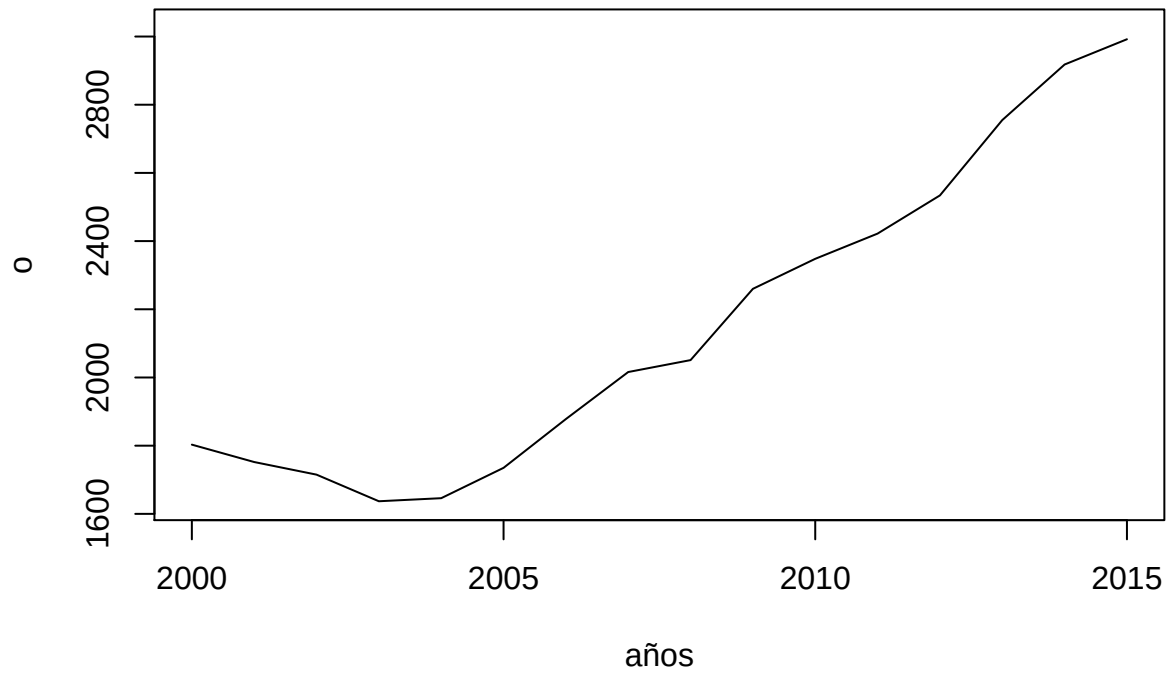
```
##          i  año
##   3102.926 2017
## 1 3222.385 2018
```

```
gh_2018 <- data.frame("gh"=predict(modelo_gh,prediccion_2018["t"]),"año"=c(2017,2018))
gh_2018
```

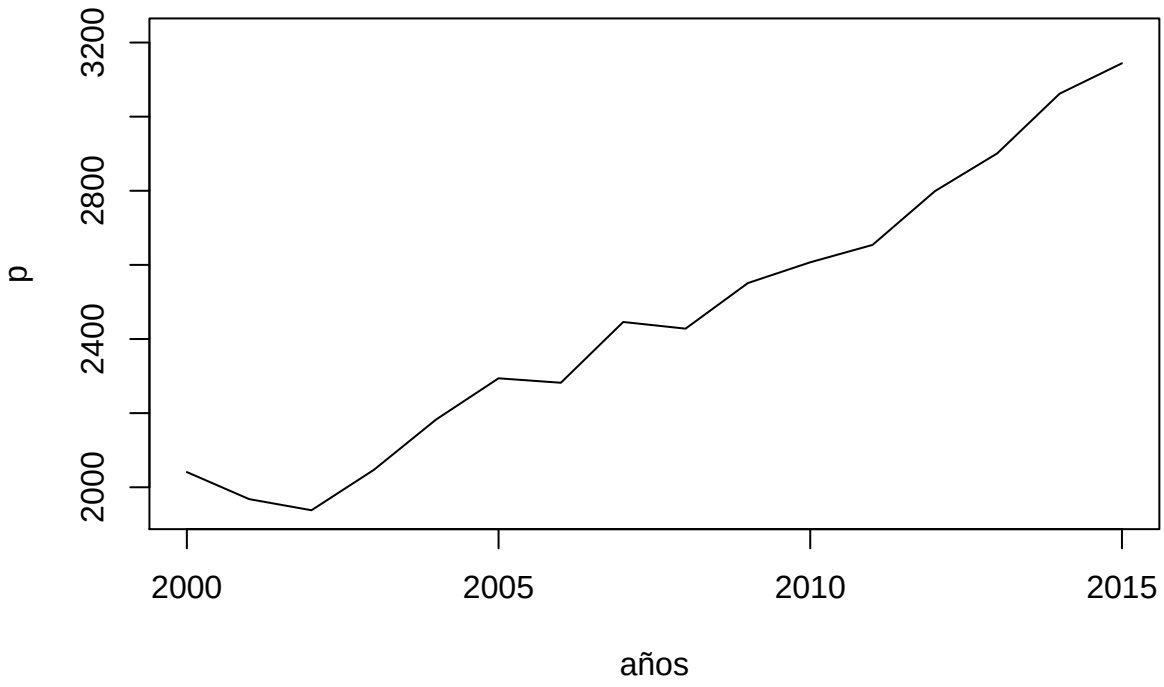
```
##         gh  año
##   10557.75 2017
## 1 10921.15 2018
```

Pronóstico de O+P+Q

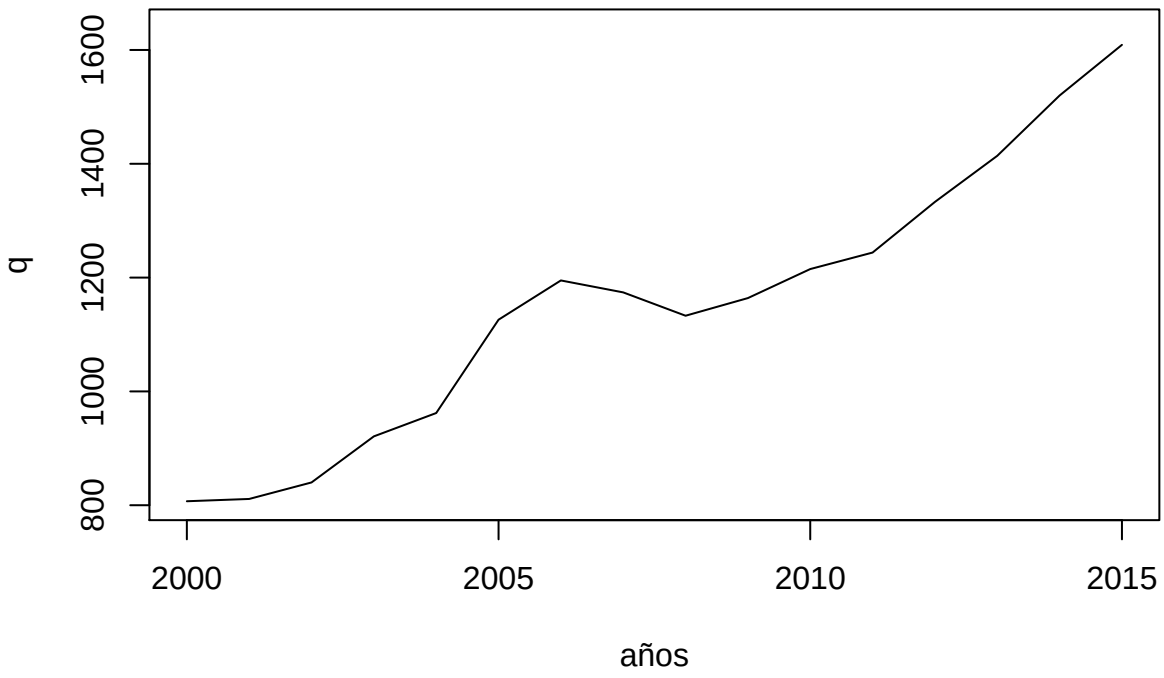
```
plot(o~años,data=cuentas,type="l")
```




```
plot(p~años,data=cuentas,type="l")
```




```
plot(q~años,data=cuentas,type="l")
```



Como puede observarse, las series, aparentemente, no son estacionarias en media (no tienen una media constante en el tiempo), pero son estables en varianza (su dispersión en torno a la media no aumenta o disminuye siguiendo un patrón en el tiempo).

A continuación se realiza una prueba para establecer el orden de integración de la serie (número de veces que se debe diferenciar las serie para obtener una raíz unitaria).

División O

```
summary(ur.df(cuentas$o,type="trend",lags=1))
```

```
##
## ###############################################
## # 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
## -78.391 -36.025  -9.803  34.621  84.552
```

```
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 536.2835   164.1633   3.267  0.00751 **
## z.lag.1      -0.4137     0.1285  -3.220  0.00817 **
## tt           48.3779    14.5589   3.323  0.00680 **
## z.diff.lag    0.1746     0.2380   0.734  0.47858
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 56.82 on 11 degrees of freedom
## Multiple R-squared:  0.6437, Adjusted R-squared:  0.5465
## F-statistic: 6.623 on 3 and 11 DF,  p-value: 0.008085
##
##
## Value of test-statistic is: -3.2196 5.4533 5.5465
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

Se hacen las siguientes observaciones:

1. Por el estadístico tau3, no se rechaza la hipótesis nula de raíz unitaria.
2. Por el estadístico phi3, no se rechaza la hipótesis nula de raíz unitaria y no tendencia determinística de manera que la tendencia no pertenece al modelo.

Se debe realizar una prueba sin tendencia.

```
summary(ur.df(cuentas$o,type="drift",lags=1))
```

```
##
## ###############################################
## # 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
## -105.905  -52.578    1.952   34.245  146.326
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  63.393566 110.909671   0.572   0.5782
## z.lag.1      -0.009335   0.055922  -0.167   0.8702
## z.diff.lag    0.526466   0.288890   1.822   0.0934 .
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 77.01 on 12 degrees of freedom
## Multiple R-squared:  0.286,  Adjusted R-squared:  0.167
## F-statistic: 2.403 on 2 and 12 DF,  p-value: 0.1325
##
##
## Value of test-statistic is: -0.1669 1.4476
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau2 -3.75 -3.00 -2.63
## phi1  7.88  5.18  4.12
```

De lo anterior se infiere que no se rechaza la hipótesis nula de raíz unitaria y, adicionalmente, no se rechaza la hipótesis nula de raíz unitaria y no intercepto.

Se procede a realizar una prueba sin tendencia e intercepto.

```
summary(ur.df(cuentas$o,type="none",lags=1))
```

```
##
## ###############################################
## # 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
## -98.582 -58.571   4.129  41.206 148.834
##
## Coefficients:
##            Estimate Std. Error t value Pr(>|t|)
## z.lag.1     0.02168    0.01317   1.646   0.1237
## z.diff.lag  0.44862    0.24808   1.808   0.0937 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 74.99 on 13 degrees of freedom
## Multiple R-squared:  0.6478, Adjusted R-squared:  0.5936
## F-statistic: 11.95 on 2 and 13 DF,  p-value: 0.001134
##
##
## Value of test-statistic is: 1.6459
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.66 -1.95  -1.6
```

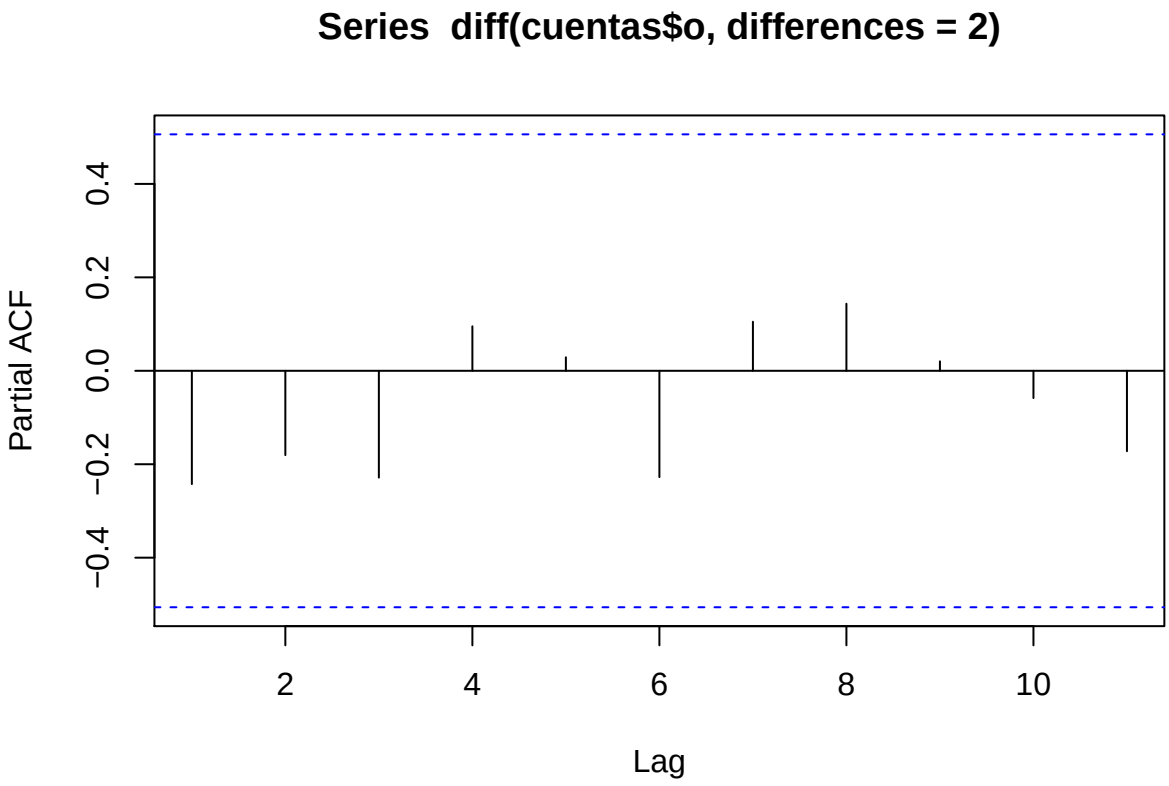
Entonces, no se rechaza la hipótesis nula de raíz unitaria. Se realiza una prueba sobre la primera diferencia de la serie.

```
summary(ur.df(diff(cuentas$o,differences=2),type="trend",lag=1))
```

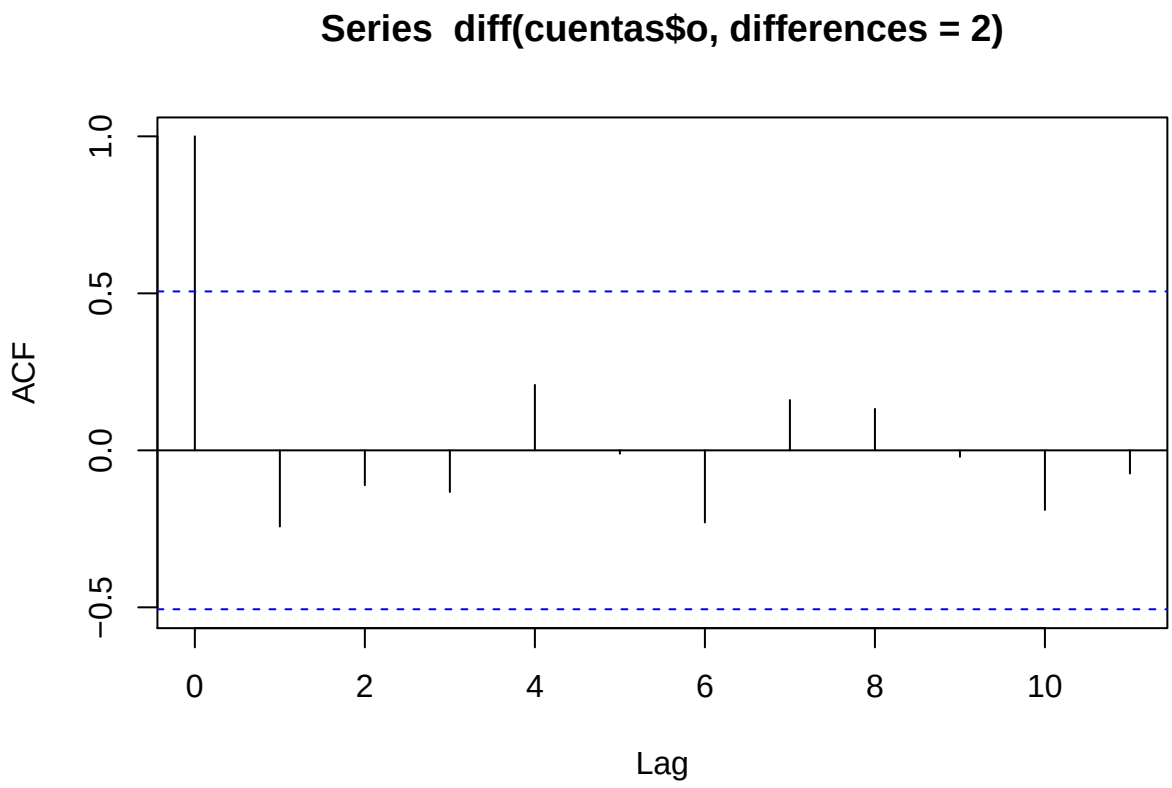
```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression trend
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -129.425  -37.239   -7.329   35.885  140.366
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 114.5776    58.5693   1.956  0.08213 .
## z.lag.1      -1.7996     0.4892  -3.678  0.00509 **
## tt          -12.0810     6.4844  -1.863  0.09534 .
## z.diff.lag    0.3333     0.3029   1.101  0.29967
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 83.86 on 9 degrees of freedom
## Multiple R-squared:  0.7408, Adjusted R-squared:  0.6544
## F-statistic: 8.576 on 3 and 9 DF,  p-value: 0.005272
##
##
## Value of test-statistic is: -3.6783 4.7976 7.1768
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

Entonces la serie tiene dos raíces unitarias.

```
pacf(diff(cuentas$o,differences=2))
```




```
acf(diff(cuentas$o,differences=2))
```



El proceso es ruido blanco. No es posible estimar un modelo.

División P

```
summary(ur.df(cuentas$p,type="trend",lags=1))
```

```
##
## ###############################################
## # 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
## -79.052 -37.308  -3.362  42.604  64.199
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) 1384.08960  501.95646   2.757   0.0186 *
```

```
## z.lag.1       -0.76947    0.28976  -2.655   0.0224 *
## tt            67.88327   24.03075   2.825   0.0165 *
## z.diff.lag     0.02242    0.22639   0.099   0.9229
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 53.43 on 11 degrees of freedom
## Multiple R-squared:  0.4482, Adjusted R-squared:  0.2977
## F-statistic: 2.979 on 3 and 11 DF,  p-value: 0.07811
##
##
## Value of test-statistic is: -2.6555 9.5866 4.4181
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

No se rechaza la hipótesis nula de raíz unitaria, ni la hipótesis nula de no tendencia determinística ni raíz unitaria. Se procede a hacer la prueba sin tendencia.

```
summary(ur.df(cuentas$p,type="drift",lag=1))
```

```
##
## ###############################################
## # 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
## -115.54  -40.80   17.78   50.51   76.12
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -4.62502  127.53312  -0.036    0.972
## z.lag.1       0.03994    0.05428   0.736    0.476
## z.diff.lag   -0.15831    0.27311  -0.580    0.573
##
## Residual standard error: 67.19 on 12 degrees of freedom
## Multiple R-squared:  0.04796,    Adjusted R-squared:  -0.1107
## F-statistic: 0.3022 on 2 and 12 DF,  p-value: 0.7446
##
##
## Value of test-statistic is: 0.7359 6.5691
##
## Critical values for test statistics:
```

```
##       1pct  5pct 10pct
## tau2 -3.75 -3.00 -2.63
## phi1  7.88  5.18  4.12
```

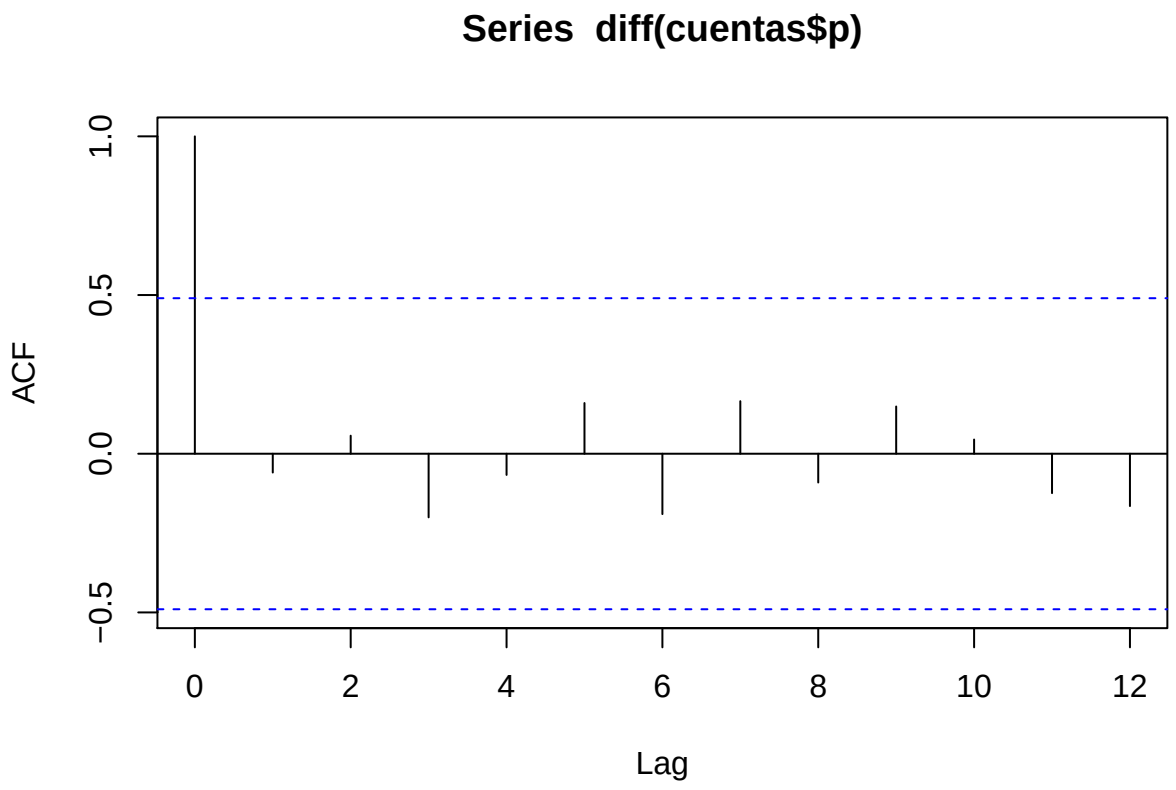
No se rechaza la hipótesis nula de raíz unitaria, pero se rechaza la hipótesis nula de raíz unitaria y no intercepto. Es decir que la serie tiene una raíz unitaria, y tendencia lineal. Se procede a hacer la prueba sobre la primera diferencia de la serie.

```
summary(ur.df(diff(cuentas$p),type="trend",lag=1))
```

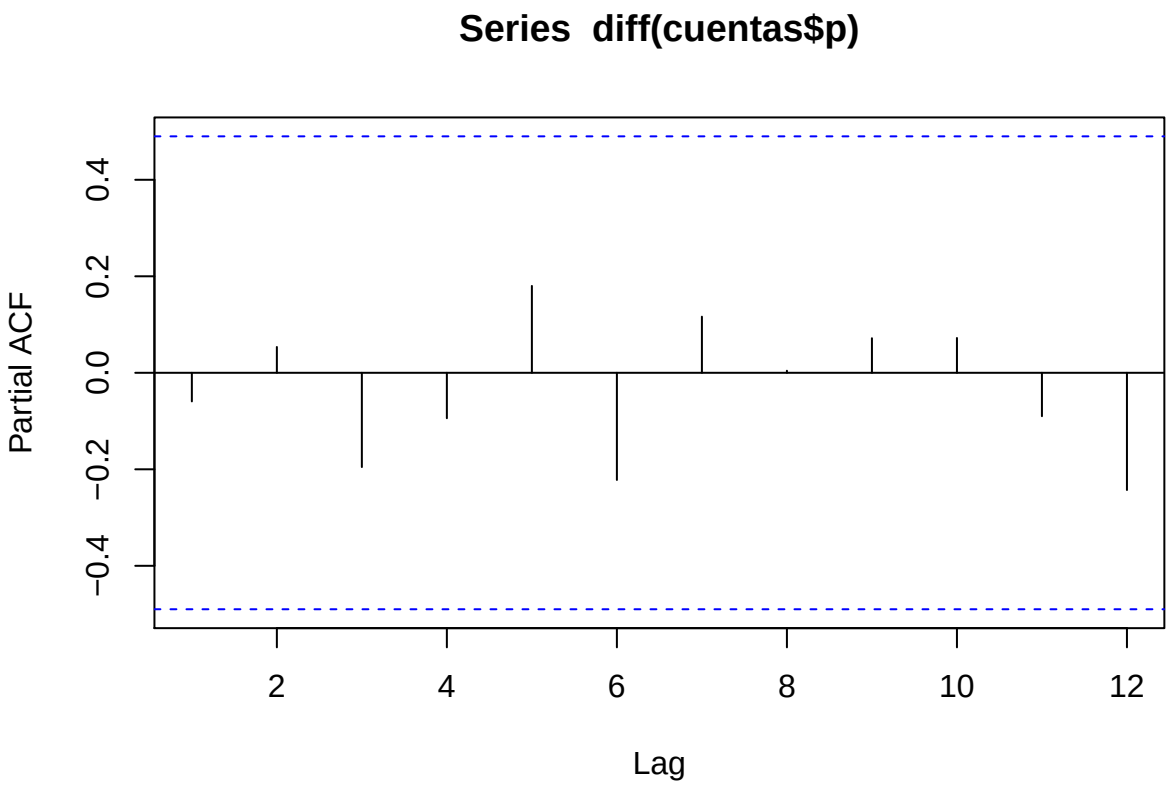
```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression trend
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -78.363 -33.277   1.136  35.942  68.255
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 108.06808   37.63383   2.872  0.01662 *
## z.lag.1      -1.49403    0.39601  -3.773  0.00365 **
## tt            2.83634    4.68968   0.605  0.55878
## z.diff.lag    0.04196    0.24055   0.174  0.86500
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 57.42 on 10 degrees of freedom
## Multiple R-squared:  0.7725, Adjusted R-squared:  0.7043
## F-statistic: 11.32 on 3 and 10 DF,  p-value: 0.001484
##
##
## Value of test-statistic is: -3.7727 6.153 8.8258
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

Se rechaza la hipótesis nula de raíz unitaria. Se analizan las funciones de autocorrelación y autocorrelación parcial para determinar los componentes del modelo ARIMA.

```
acf(diff(cuentas$p))
```




```
pacf(diff(cuentas$p))
```



El proceso es ruido blanco, no se puede estimar un modelo.

División Q

```
summary(ur.df(cuentas$q,type="trend",lags=1))
```

```
##
## ###############################################
## # 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
## -57.331 -23.272  -4.457  13.269 104.625
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 432.4232   151.6827   2.851   0.0158 *
```

```
## z.lag.1      -0.5542     0.2100  -2.639   0.0231 *
## tt           26.8009    10.4411   2.567   0.0262 *
## z.diff.lag    0.6355     0.2621   2.424   0.0337 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 42.76 on 11 degrees of freedom
## Multiple R-squared:  0.4436, Adjusted R-squared:  0.2918
## F-statistic: 2.923 on 3 and 11 DF,  p-value: 0.08149
##
##
## Value of test-statistic is: -2.6386 4.3162 3.4827
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

Se hacen las siguientes observaciones:

1. No se rechaza la hipótesis nula de raíz unitaria.
2. No se rechaza la hipótesis nula de raíz unitaria y no tendencia determinística de manera que la tendencia no pertenece al modelo.

Se debe estimar una prueba sin tendencia.

```
summary(ur.df(cuentas$q,type="drift",lags=1))
```

```
##
## ###############################################
## # 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
## -81.000 -25.503   3.299  25.035 106.190
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 74.90873   72.72684   1.030    0.323
## z.lag.1     -0.03271    0.06451  -0.507    0.621
## z.diff.lag   0.35034    0.28742   1.219    0.246
##
## Residual standard error: 51.77 on 12 degrees of freedom
## Multiple R-squared:  0.1103, Adjusted R-squared:  -0.03799
## F-statistic: 0.7438 on 2 and 12 DF,  p-value: 0.496
```

```
##
##
## Value of test-statistic is: -0.5069 2.1695
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau2 -3.75 -3.00 -2.63
## phi1  7.88  5.18  4.12
```

De lo anterior se infiere que no se rechaza la hipótesis nula de raíz unitaria y, adicionalmente, no se rechaza la hipótesis nula de raíz unitaria y no intercepto.

Se procede a realizar una prueba sin tendencia e intercepto.

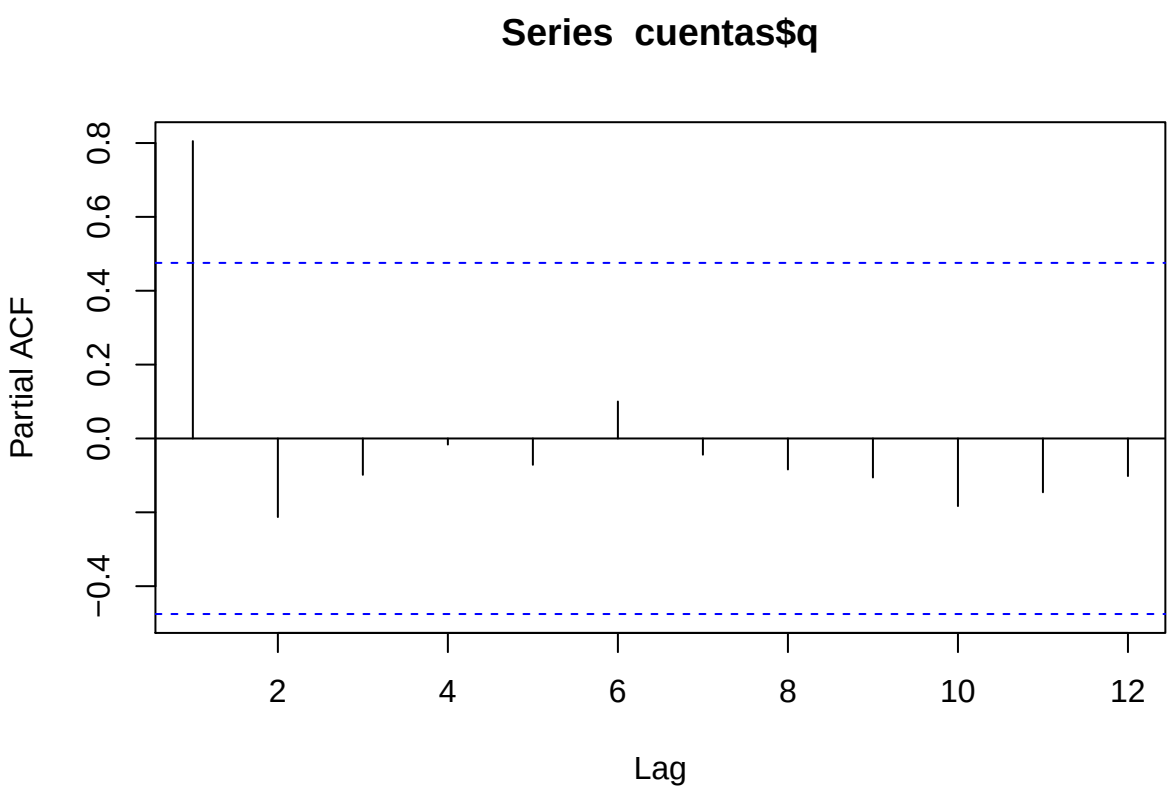
```
summary(ur.df(cuentas$q,type="none",lags=1))
```

```
##
## ###############################################
## # 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
## -78.725 -19.289   5.429  25.476 121.811
##
## Coefficients:
##            Estimate Std. Error t value Pr(>|t|)
## z.lag.1     0.03131    0.01734   1.806   0.0941 .
## z.diff.lag  0.29430    0.28289   1.040   0.3171
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 51.89 on 13 degrees of freedom
## Multiple R-squared:  0.5718, Adjusted R-squared:  0.5059
## F-statistic: 8.679 on 2 and 13 DF,  p-value: 0.004036
##
##
## Value of test-statistic is: 1.8063
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.66 -1.95  -1.6
```

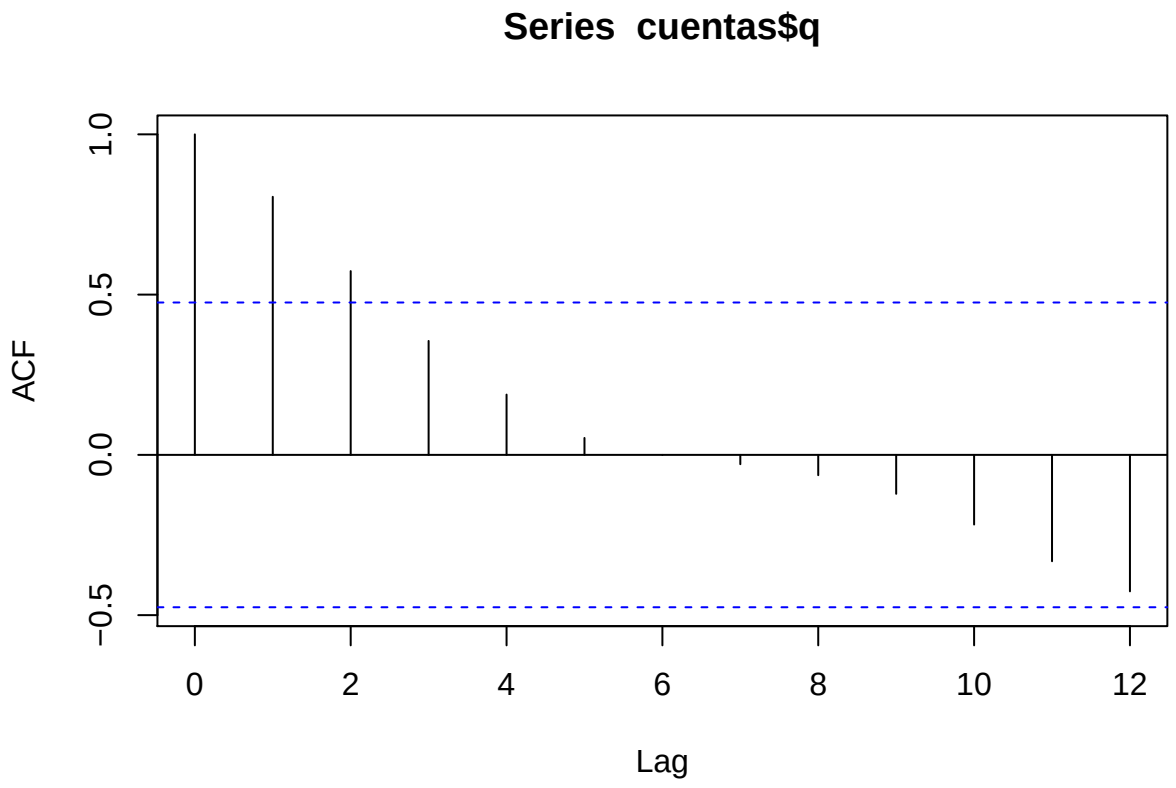
Entonces, se rechaza la hipótesis nula de raíz unitaria.

Se verifican las funciones ACF y PACF para determinar la posibilidad de estimar un modelo ARMA.

```r
pacf(cuentas$q)
```




```r
acf(cuentas$q)
```



Se sospecha un proceso AR(1).

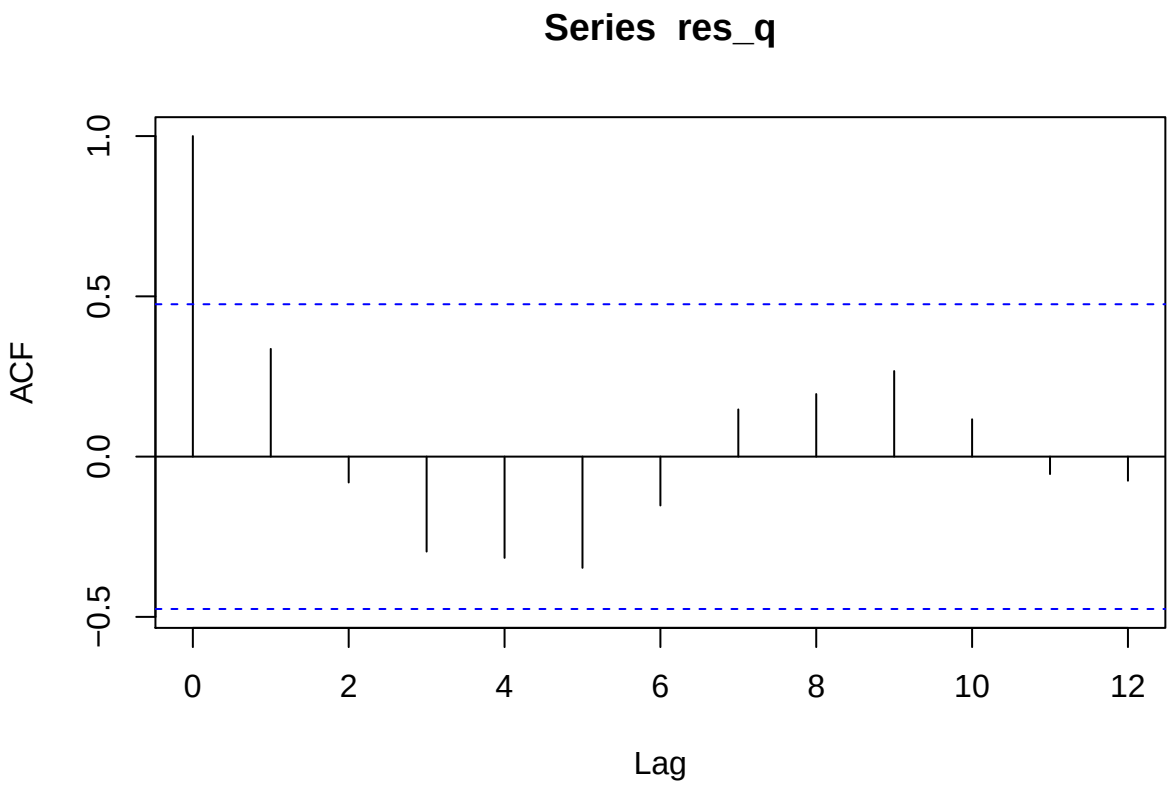
```
modelo_q <- arima(cuentas$q,order=c(1,0,0))
res_q <- resid(modelo_q)
summary(ur.df(res_q,type="drift",lag=1))
```

```
##
## ###############################################
## # 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
## -62.88 -28.86 -15.50  23.38 121.16
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  45.4373    20.5960   2.206   0.0476 *
## z.lag.1      -0.8437     0.3122  -2.702   0.0192 *
## z.diff.lag    0.2253     0.2787   0.808   0.4347
```

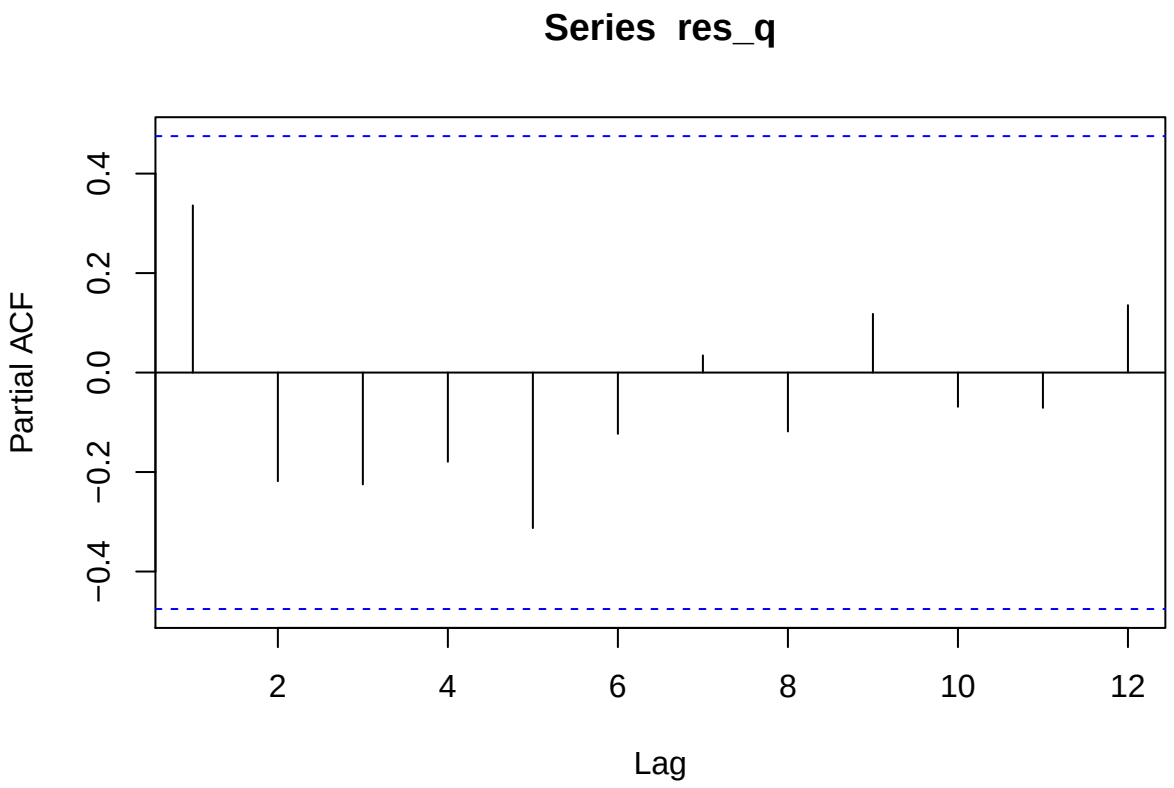
```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 50.95 on 12 degrees of freedom
## Multiple R-squared:  0.3984, Adjusted R-squared:  0.2981
## F-statistic: 3.973 on 2 and 12 DF,  p-value: 0.04741
##
##
## Value of test-statistic is: -2.7024 3.6736
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau2 -3.75 -3.00 -2.63
## phi1  7.88  5.18  4.12
```

Los residuales son estacionarios.

```
acf(res_q)
```



```
pacf(res_q)
```



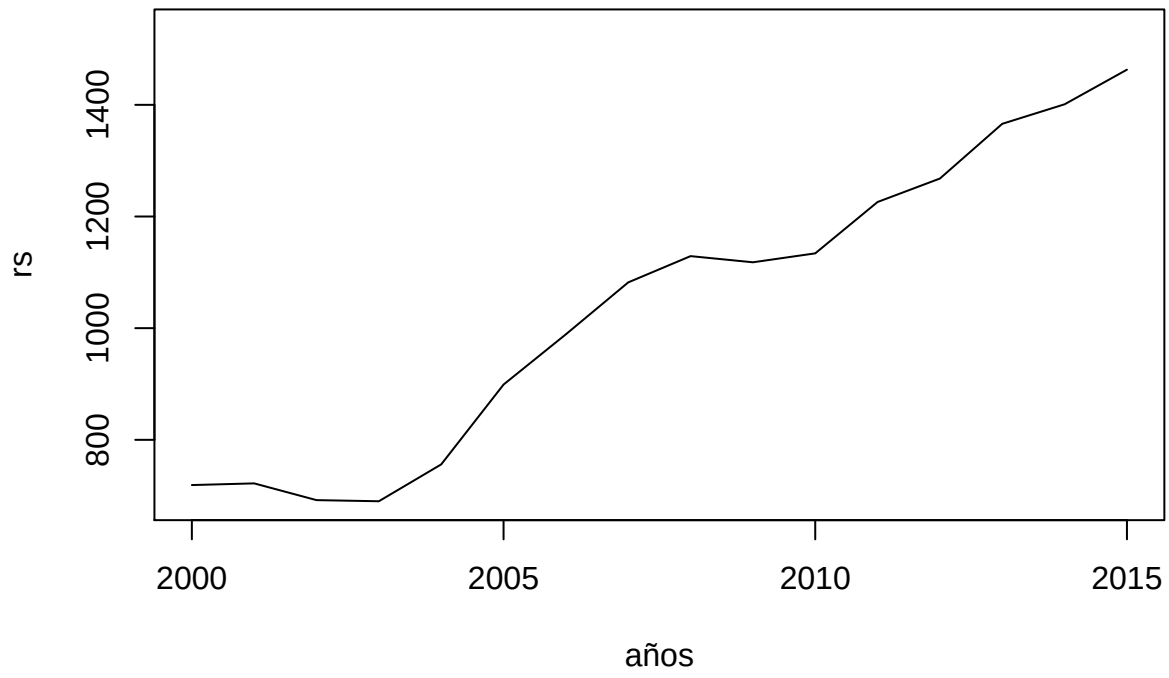
El modelo especificado es correcto. Se procede a realizar el pronóstico.

Pronóstico

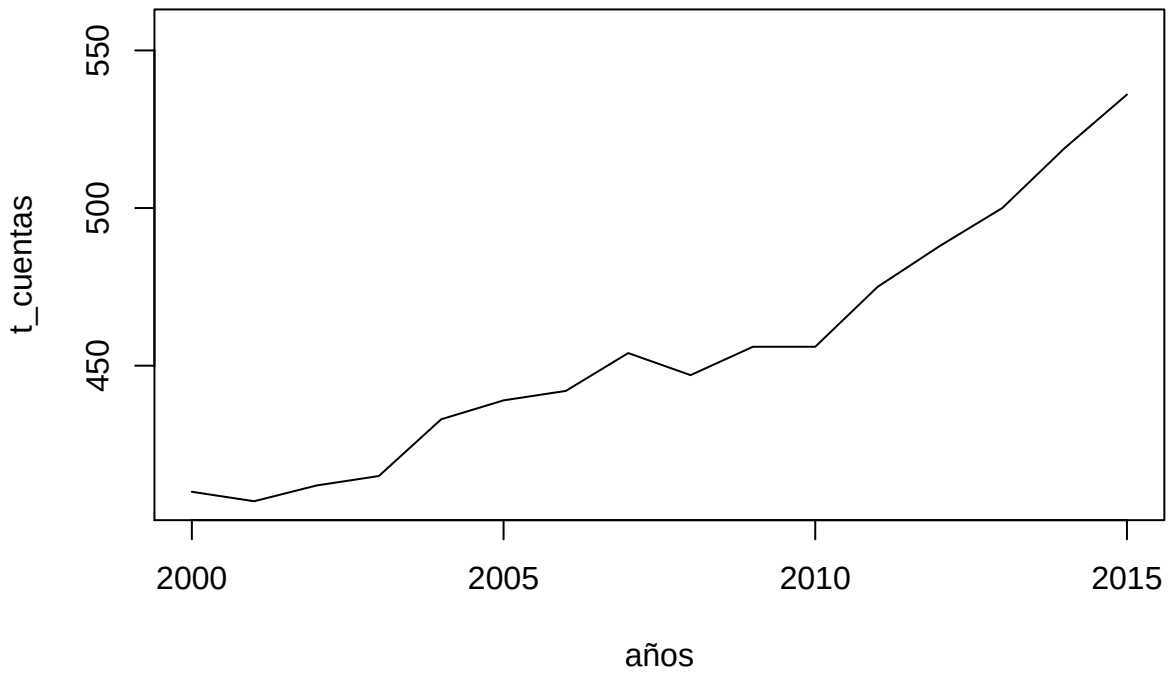
Al no poder realizar un pronóstico de las secciones O y P, no es posible obtener la participación de cada una dentro del total.

Pronóstico R+S+T

```
plot(rs~años,data=cuentas,type="l")
```




```
plot(t_cuentas~años,data=cuentas,type="l")
```



Las series son estables en varianza, aparentemente, no son estacionarias en media.

División R+S

```
summary(ur.df(cuentas$rs,type="trend",lag=1))
```

```
##
## ###############################################
## # 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
## -46.657 -15.312  -2.866  23.963  45.308
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 416.2475    94.7884   4.391  0.00108 **
```

```
## z.lag.1      -0.7299     0.1740  -4.196  0.00150 **
## tt           42.5438    10.0600   4.229  0.00141 **
## z.diff.lag    0.6168     0.1791   3.445  0.00548 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 29.81 on 11 degrees of freedom
## Multiple R-squared:  0.6862, Adjusted R-squared:  0.6006
## F-statistic: 8.018 on 3 and 11 DF,  p-value: 0.004122
##
##
## Value of test-statistic is: -4.1955 9.0881 8.9641
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

Se rechaza la hipótesis nula de raíz unitaria.

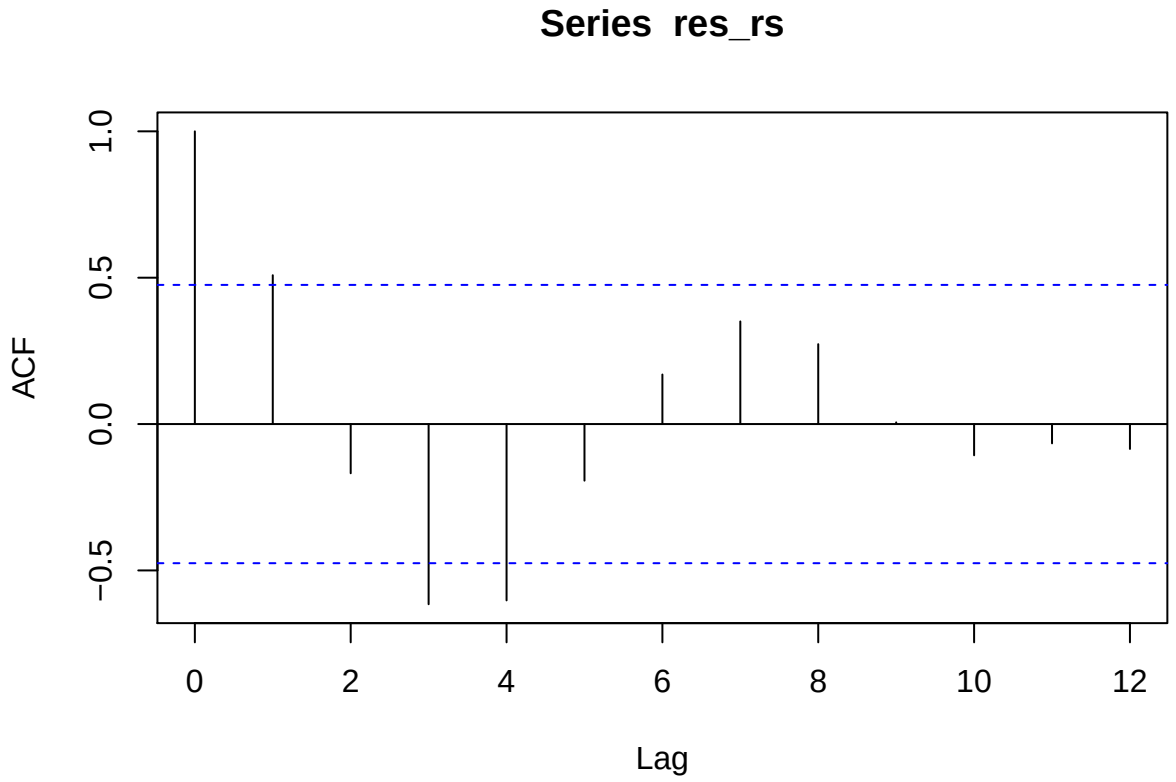
```
modelo_rs <- lm(rs~t,data=cuentas)
res_rs <- resid(modelo_rs)
summary(ur.df(res_rs,type="trend",lag=1))
```

```
##
## ###############################################
## # 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
## -46.657 -15.312  -2.866  23.963  45.308
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -20.3200    18.8001  -1.081  0.30289
## z.lag.1      -0.7299     0.1740  -4.196  0.00150 **
## tt            1.8980     1.8575   1.022  0.32880
## z.diff.lag    0.6168     0.1791   3.445  0.00548 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 29.81 on 11 degrees of freedom
## Multiple R-squared:  0.6862, Adjusted R-squared:  0.6006
## F-statistic: 8.018 on 3 and 11 DF,  p-value: 0.004122
##
```

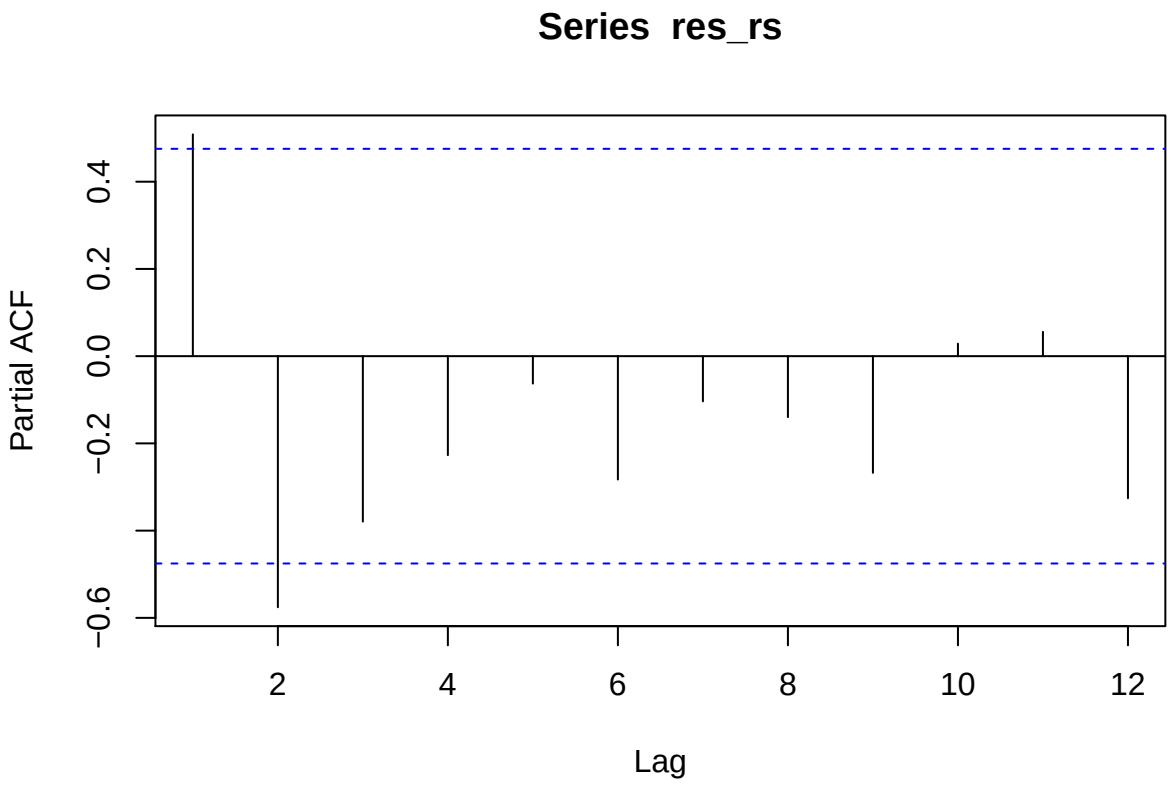
```
##
## Value of test-statistic is: -4.1955 5.983 8.9641
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

Los residuales son estacionarios.

```
acf(res_rs)
```




```
pacf(res_rs)
```



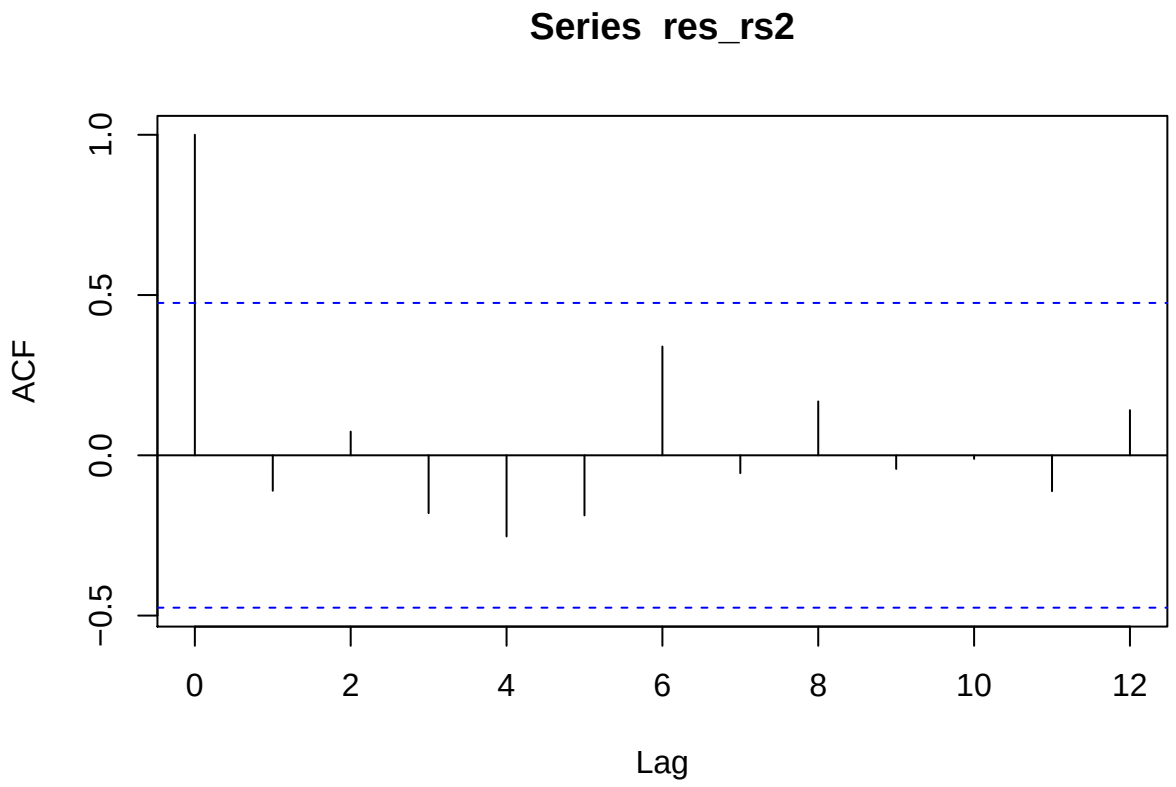
El modelo tiene autocorrelación residual. Se estima un modelo AR(2).

```
modelo_rs2 <- arima(cuentas$rs,order=c(2,0,0))
res_rs2 <- resid(modelo_rs2)
summary(ur.df(res_rs2,type="none",lags=1))
```

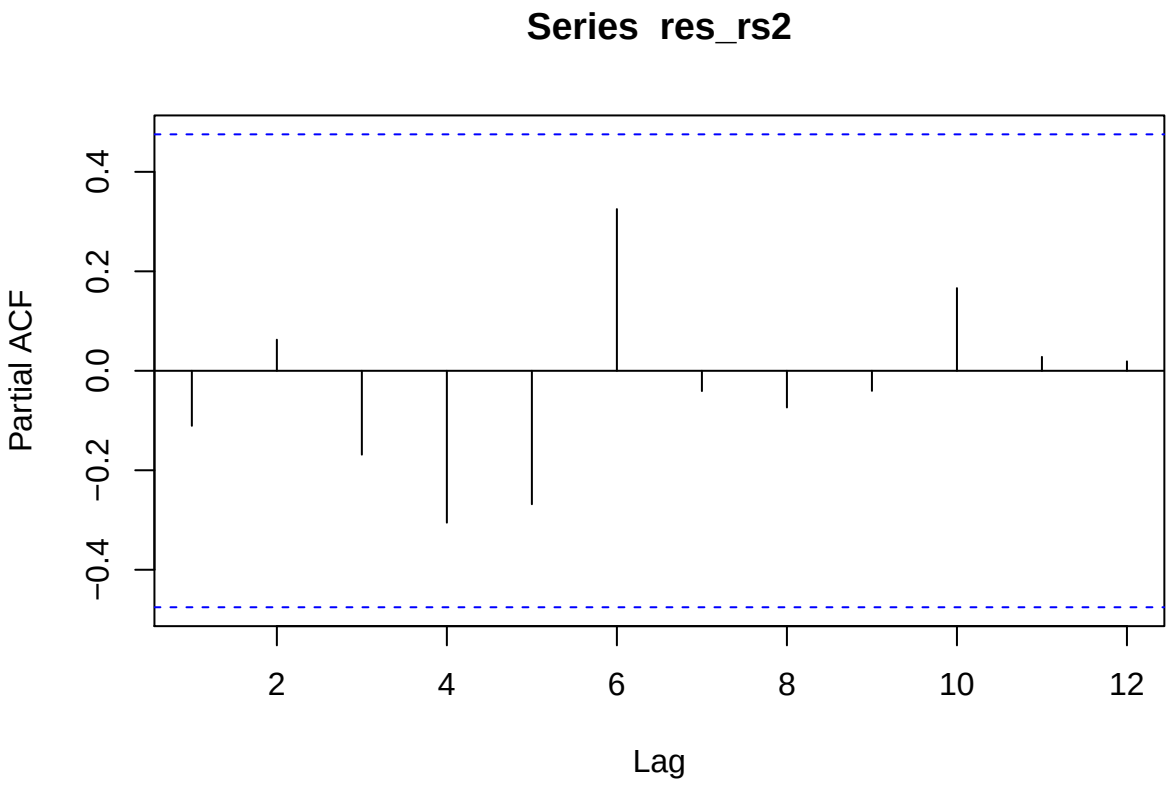
```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression none
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 - 1 + z.diff.lag)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -50.35 -23.55  10.12  51.40  86.47
##
## Coefficients:
##            Estimate Std. Error t value Pr(>|t|)
## z.lag.1     -0.9300     0.4182  -2.224   0.0445 *
## z.diff.lag  -0.1215     0.2781  -0.437   0.6693
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 49.24 on 13 degrees of freedom
## Multiple R-squared:  0.5284, Adjusted R-squared:  0.4558
## F-statistic: 7.283 on 2 and 13 DF,  p-value: 0.007555
##
##
## Value of test-statistic is: -2.224
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.66 -1.95  -1.6
```

```
acf(res_rs2)
```




```
pacf(res_rs2)
```



El modelo es correcto.

División T

```
summary(ur.df(cuentas$t_cuentas,type="trend",lags=1))
```

```
##
## ###############################################
## # 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
## -14.991  -2.887   1.359   3.358  13.024
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -41.8680    92.4373  -0.453    0.659
```

```
## z.lag.1       0.1116     0.2403   0.464    0.652
## tt            0.3698     1.8972   0.195    0.849
## z.diff.lag   -0.3129     0.3402  -0.920    0.377
##
## Residual standard error: 7.52 on 11 degrees of freedom
## Multiple R-squared:  0.3396, Adjusted R-squared:  0.1595
## F-statistic: 1.886 on 3 and 11 DF,  p-value: 0.1905
##
##
## Value of test-statistic is: 0.4643 5.1425 2.6947
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

No se rechaza la hipótesis nula de raíz unitaria, y no se rechaza la hipótesis nula de raíz unitaria y no tendencia e intercepto. Se procede a realizar la prueba sin tendencia.

```
summary(ur.df(cuentas$t_cuentas,type="drift",lag=1))
```

```
##
## ###############################################
## # 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
## -15.064  -2.716   1.125   3.492  13.001
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -58.94692   28.27536  -2.085   0.0591 .
## z.lag.1       0.15653    0.06489   2.412   0.0328 *
## z.diff.lag   -0.33765    0.30271  -1.115   0.2865
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7.212 on 12 degrees of freedom
## Multiple R-squared:  0.3373, Adjusted R-squared:  0.2269
## F-statistic: 3.054 on 2 and 12 DF,  p-value: 0.08468
##
##
## Value of test-statistic is: 2.412 8.3653
##
## Critical values for test statistics:
```

```
##       1pct  5pct 10pct
## tau2 -3.75 -3.00 -2.63
## phi1  7.88  5.18  4.12
```

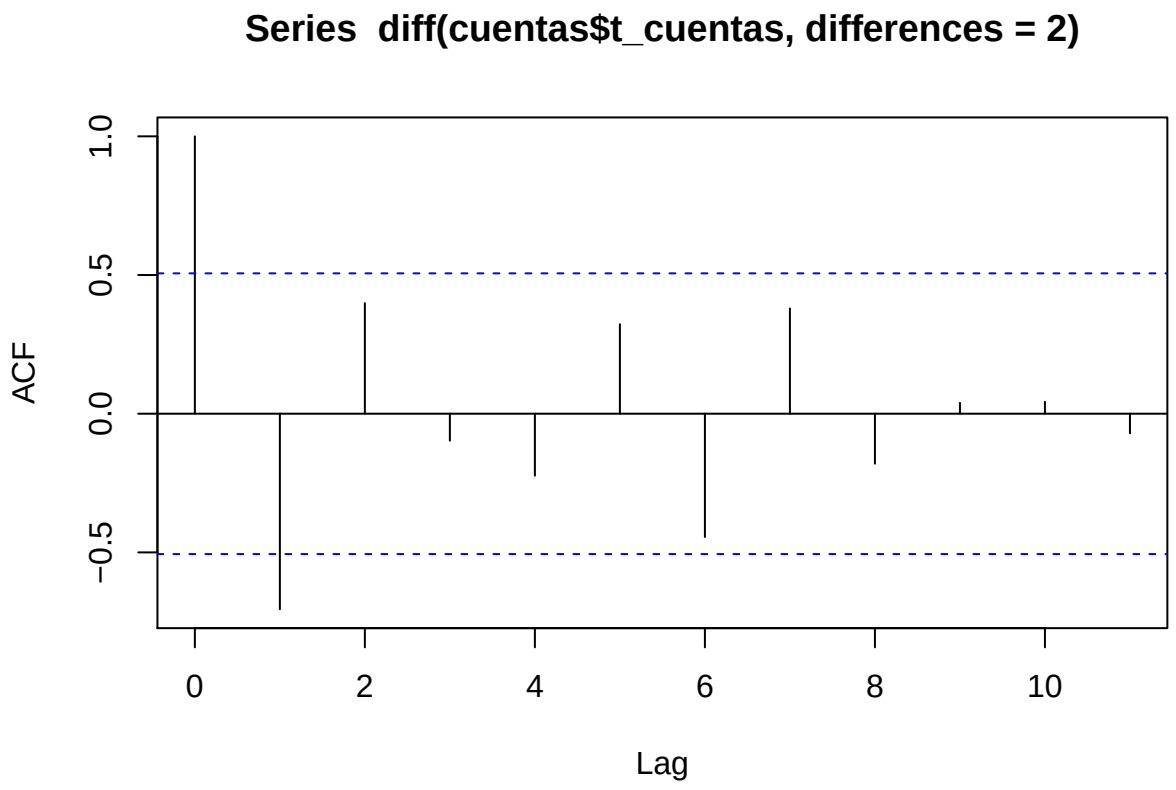
Entonces, no se rechaza la hipótesis nula de raíz unitaria, pero se rechaza la hipótesis nula de raíz unitaria y no intercepto. Es decir que el modelo tiene intercepto. Se realiza la prueba de raíz unitaria a la primera diferencia de la serie.

```
summary(ur.df(diff(cuentas$t_cuentas,differences=2),type="trend",lag=1))
```

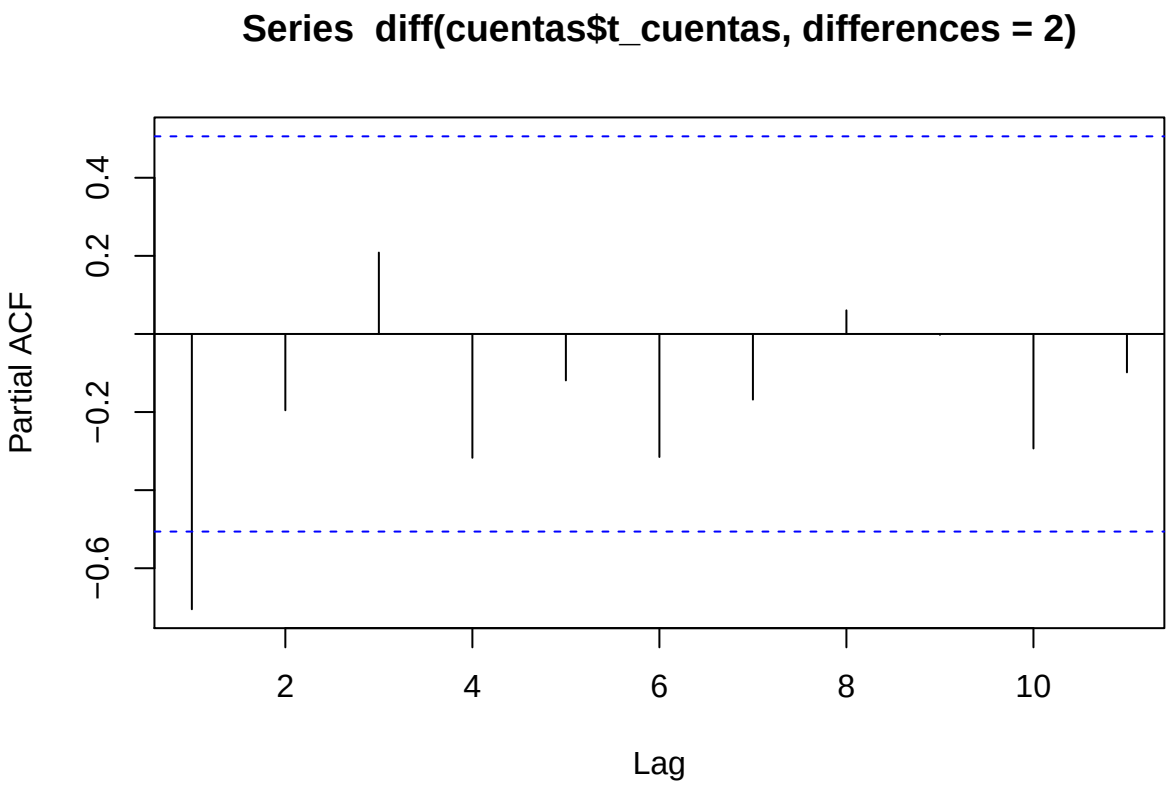
```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression trend
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -13.832  -1.660  -0.297   1.981  13.920
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   0.5564     5.9317   0.094  0.92732
## z.lag.1      -2.0903     0.5961  -3.507  0.00665 **
## tt            0.2501     0.6713   0.372  0.71815
## z.diff.lag    0.2157     0.3199   0.674  0.51719
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 9.033 on 9 degrees of freedom
## Multiple R-squared:  0.8662, Adjusted R-squared:  0.8216
## F-statistic: 19.42 on 3 and 9 DF,  p-value: 0.0002861
##
##
## Value of test-statistic is: -3.5065 4.1059 6.1566
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

Tras realizar el procedimiento múltiples veces, se concluyen dos raíces unitarias.

```
acf(diff(cuentas$t_cuentas,differences=2))
```




```
pacf(diff(cuentas$t_cuentas,differences=2))
```



Se sospecha que la serie diferenciada sigue un proceso AR(1).

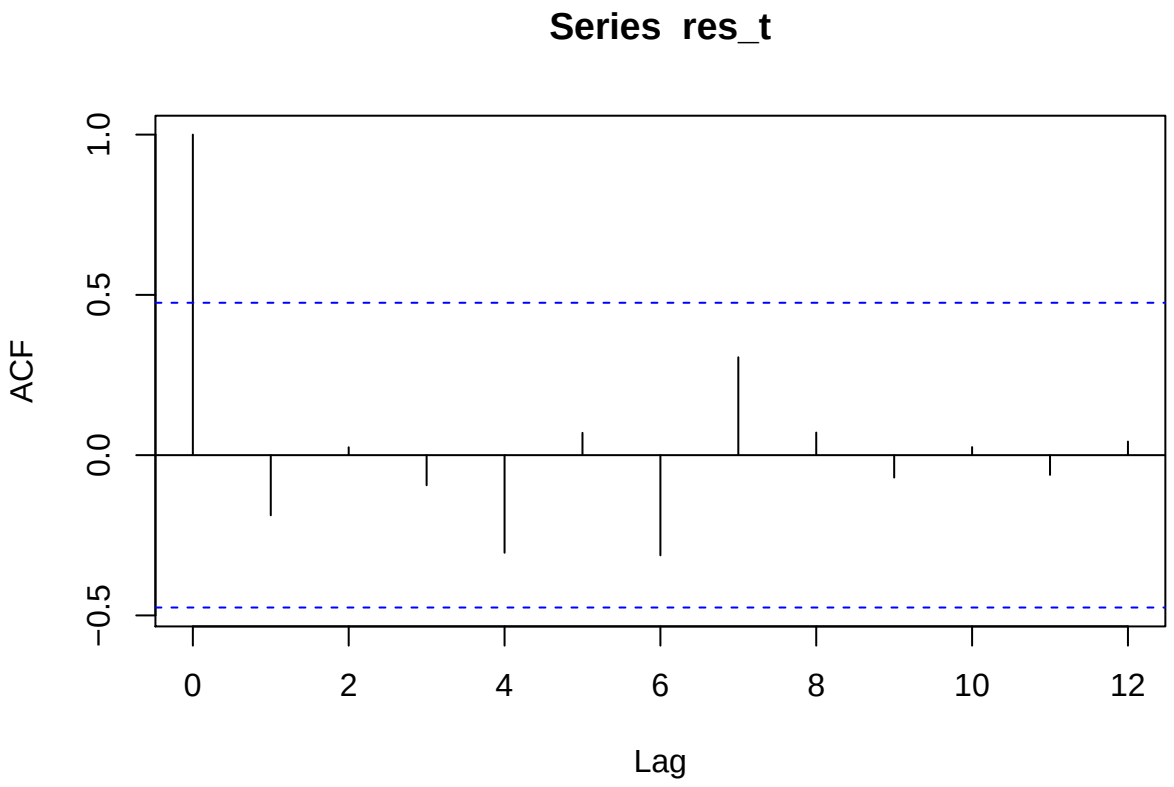
```
modelo_t <- arima(cuentas$t_cuentas,order=c(1,2,0))
res_t <- resid(modelo_t)
summary(ur.df(res_t,type="drift",lag=1))
```

```
##
## ###############################################
## # 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
## -14.554  -2.003   1.054   2.845  11.599
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  2.79818    2.25816   1.239    0.239
## z.lag.1     -1.20948    0.44185  -2.737    0.018 *
## z.diff.lag   0.01205    0.28630   0.042    0.967
```

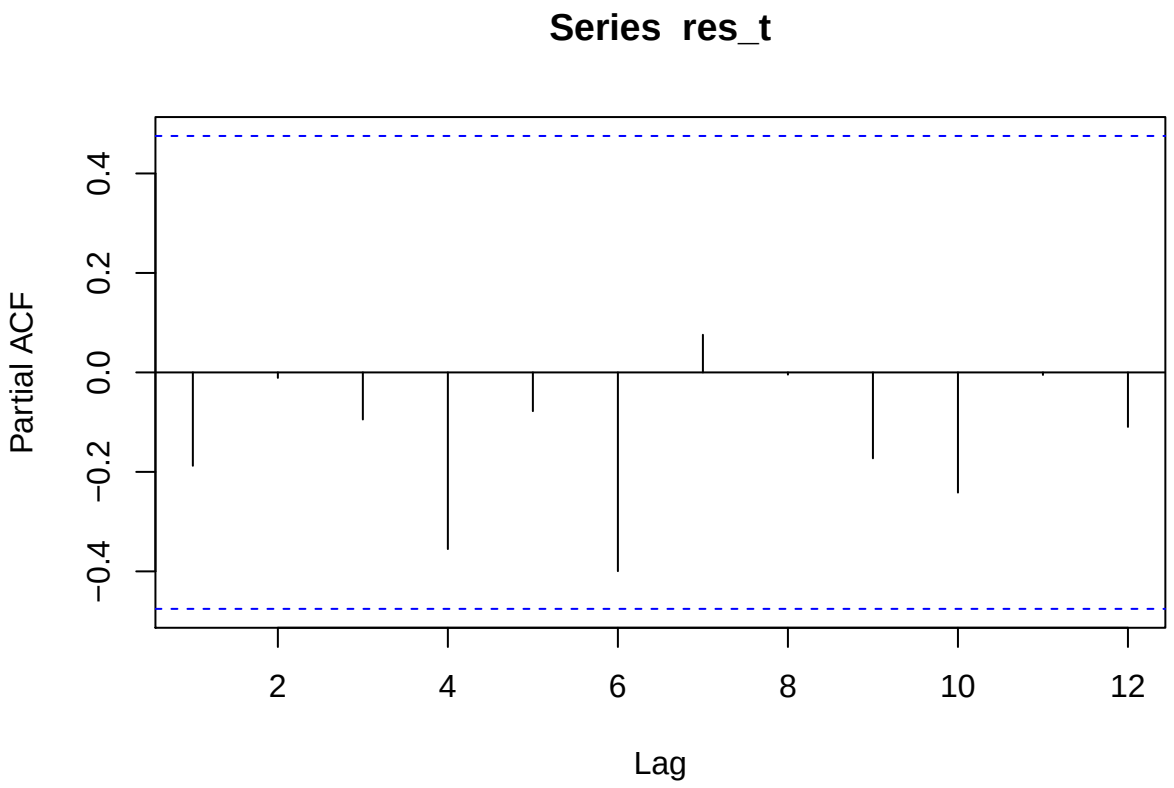
```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.007 on 12 degrees of freedom
## Multiple R-squared:    0.6,  Adjusted R-squared:  0.5334
## F-statistic: 9.001 on 2 and 12 DF,  p-value: 0.004095
##
##
## Value of test-statistic is: -2.7373 3.7579
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau2 -3.75 -3.00 -2.63
## phi1  7.88  5.18  4.12
```

Los residuales son estacionarios.

```
acf(res_t)
```



```
pacf(res_t)
```



El modelo es correcto. Se procede a la predicción.

Pronóstico

```
rs_2018 <- data.frame("rs"=predict(modelo_rs2,2)$pred,"año"=c(2017,2018))
rs_2018
```

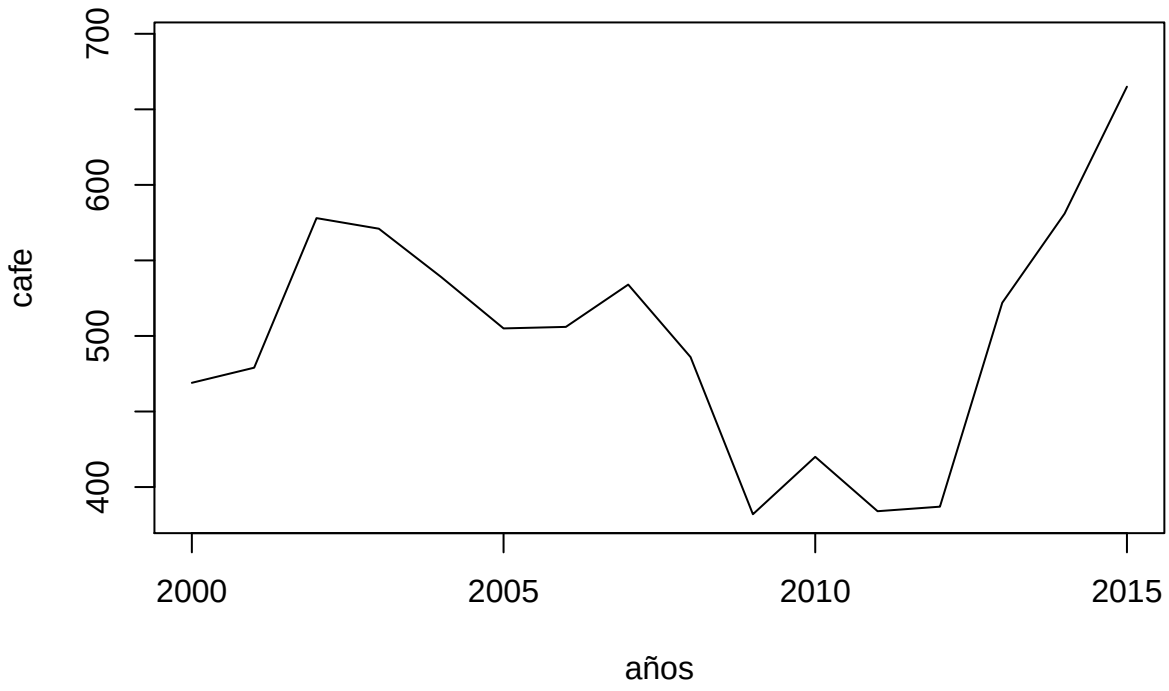
```
##         rs  año
## 1 1579.983 2017
## 2 1598.648 2018
```

```
t_2018 <- data.frame("t"=predict(modelo_t,2)$pred,"año"=c(2017,2018))
t_2018
```

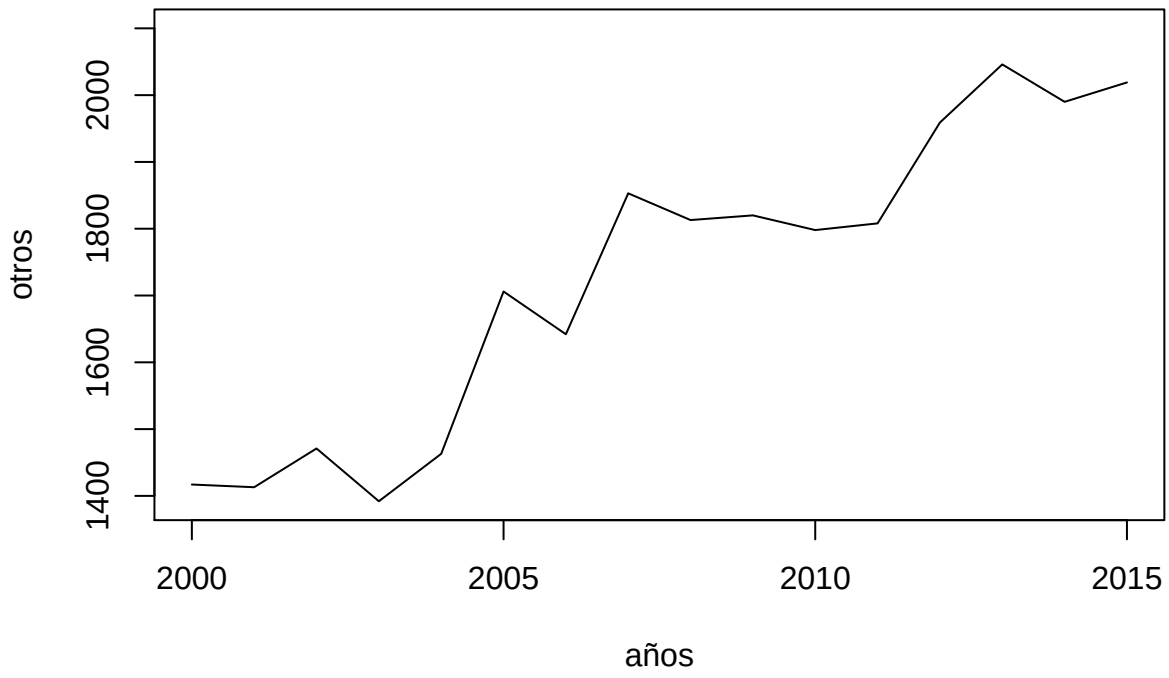
```
##          t  año
## 1 575.3361 2017
## 2 595.4463 2018
```

Pronóstico de cuenta A

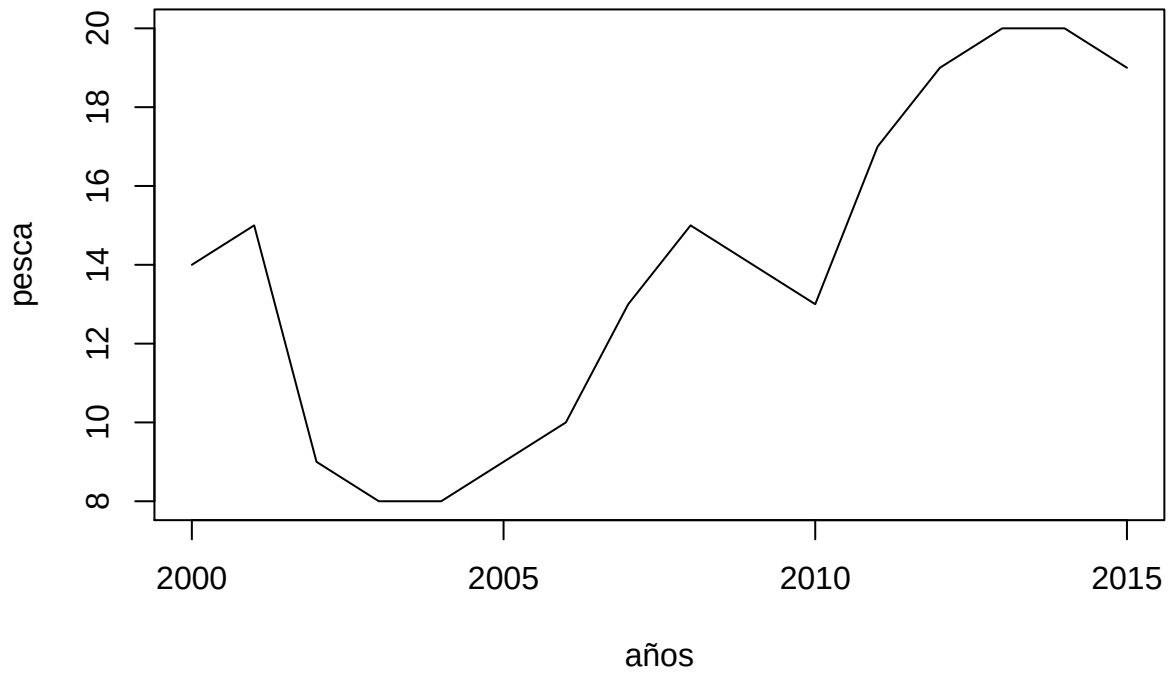
```
plot(cafe~años,type="l",data=cuentas)
```



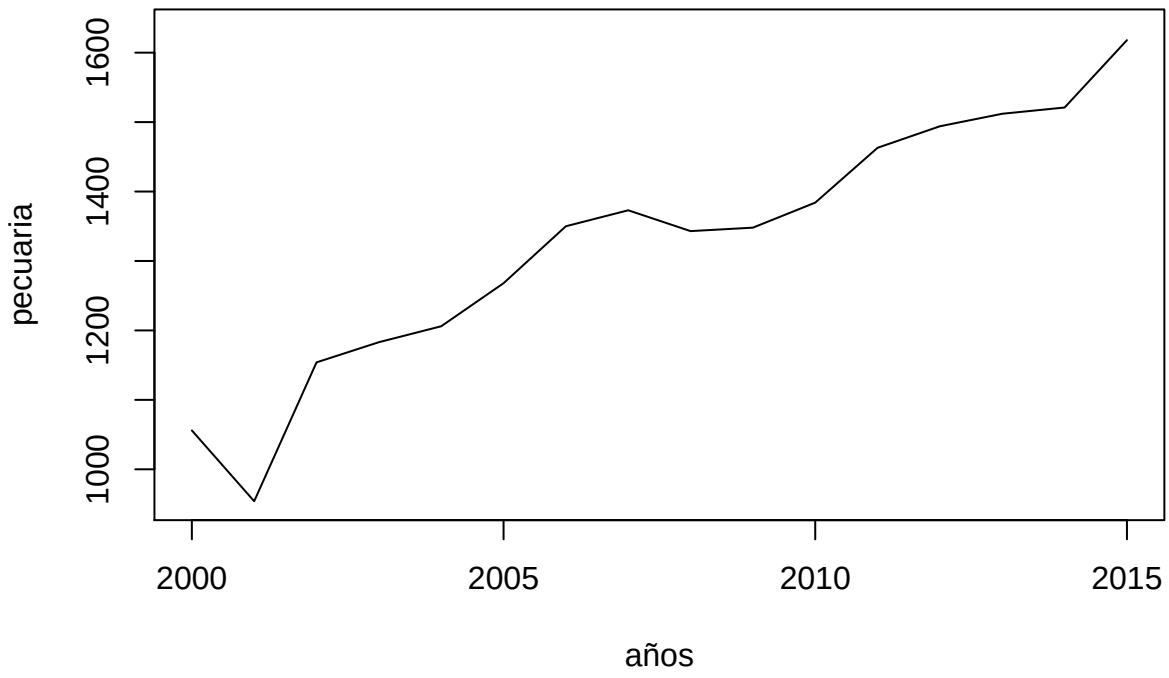

```
plot(otros~años,data=cuentas,type="l")
```




```
plot(pesca~años,type="l",data=cuentas)
```




```
plot(pecuaria~años,type="l",data=cuentas)
```



De los gráficos anteriores se observa que las series son estables en varianza, pero, aparentemente, no son estacionarias en media. Se procede a realizar la prueba de raíz unitaria y a modelar cada división de la cuenta.

Otros cultivos y sivicultura

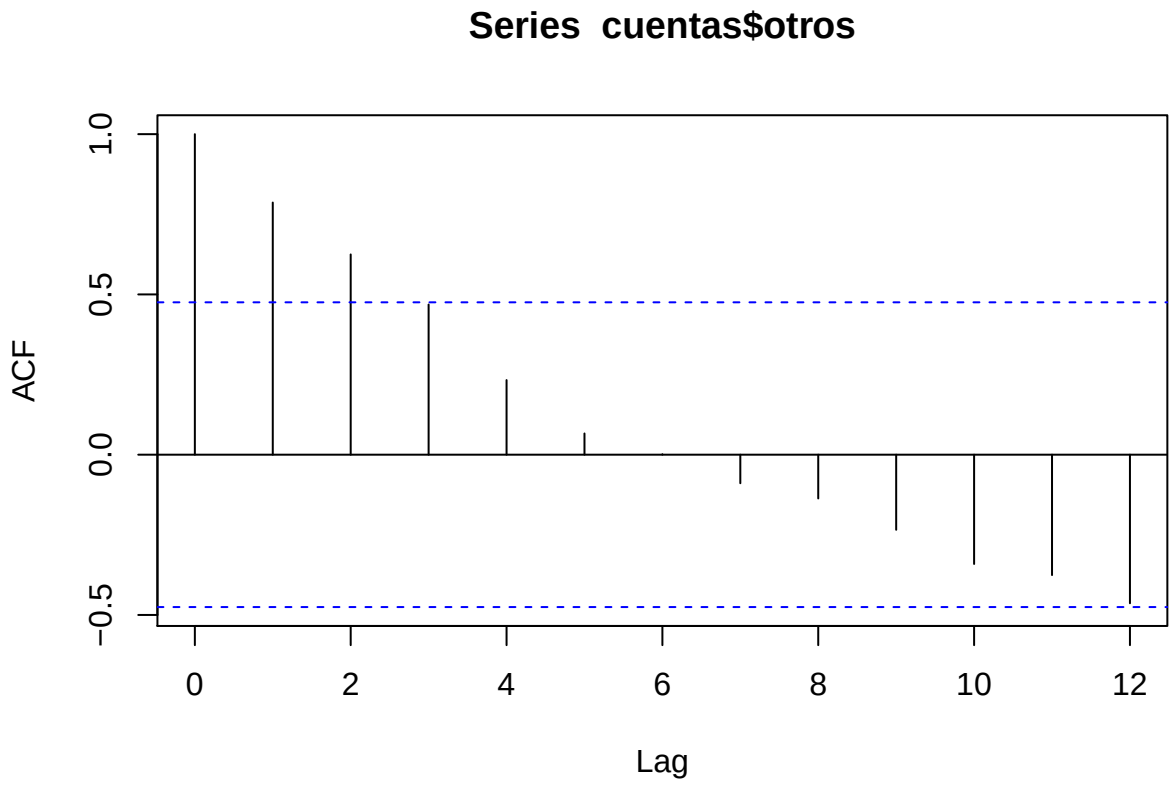
```
summary(ur.df(cuentas$otros,type="none",lag=1))
```

```
##
## ###############################################
## # 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
## -106.39  -62.05  -24.66   51.15  220.57
##
## Coefficients:
```

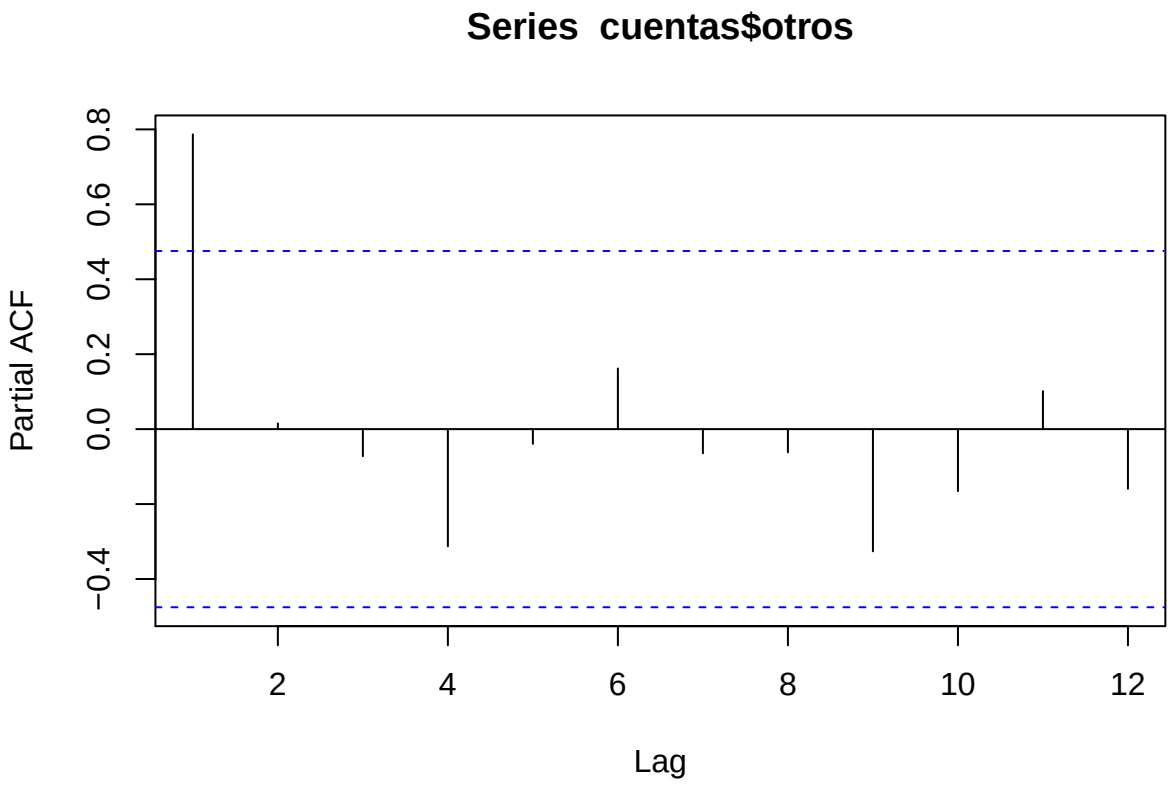
```
##             Estimate Std. Error t value Pr(>|t|)
## z.lag.1      0.03287    0.01552   2.118    0.054 .
## z.diff.lag -0.36138    0.26532  -1.362    0.196
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 96.47 on 13 degrees of freedom
## Multiple R-squared:  0.2688, Adjusted R-squared:  0.1563
## F-statistic: 2.389 on 2 and 13 DF,  p-value: 0.1307
##
##
## Value of test-statistic is: 2.1178
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.66 -1.95  -1.6
```

Se rechaza la hipótesis nula de raíz unitaria.

```
acf(cuentas$otros)
```




```
pacf(cuentas$otros)
```



La serie sigue un proceso AR(1).

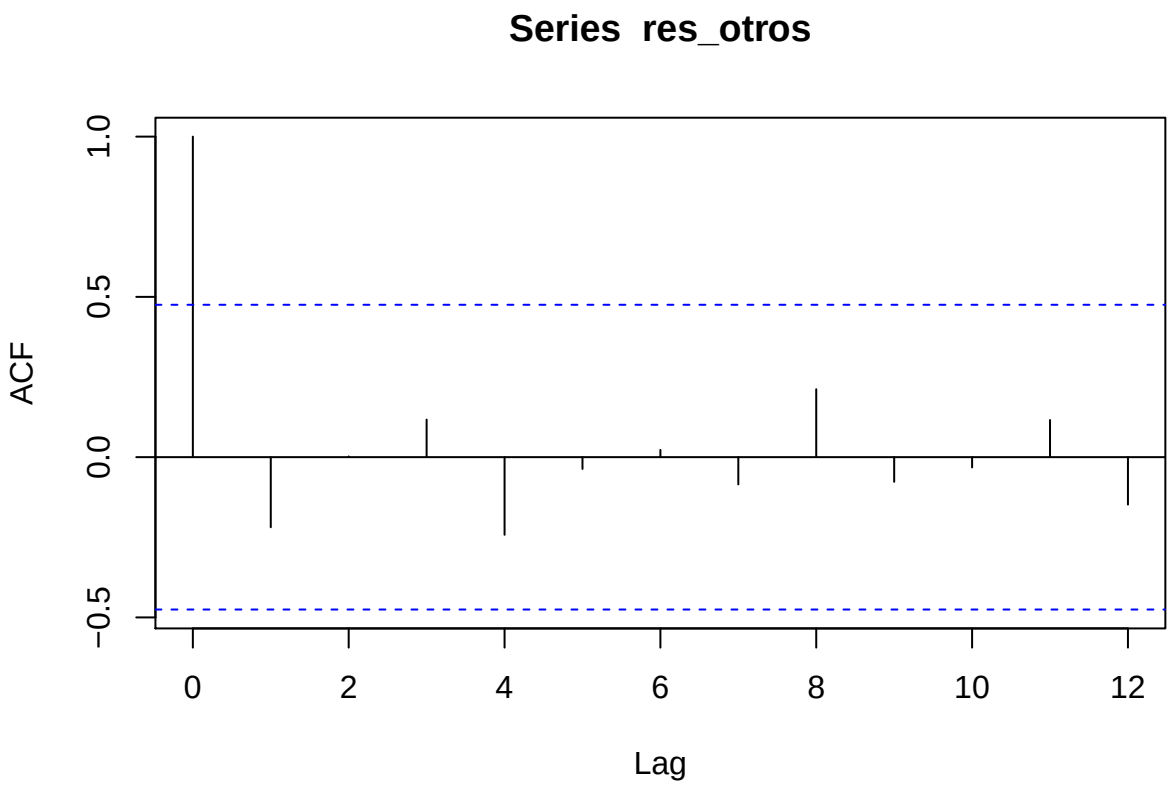
```
modelo_otros <- arima(cuentas$otros,order=c(1,0,0))
res_otros <- resid(modelo_otros)
summary(ur.df(res_otros,type="drift",lag=1))
```

```
##
## ###############################################
## # 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
## -146.04  -49.16  -41.57   72.92  174.46
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  60.5028    28.3983   2.131  0.05451 .
## z.lag.1      -1.4317     0.4221  -3.392  0.00535 **
## z.diff.lag    0.0725     0.2565   0.283  0.78226
```

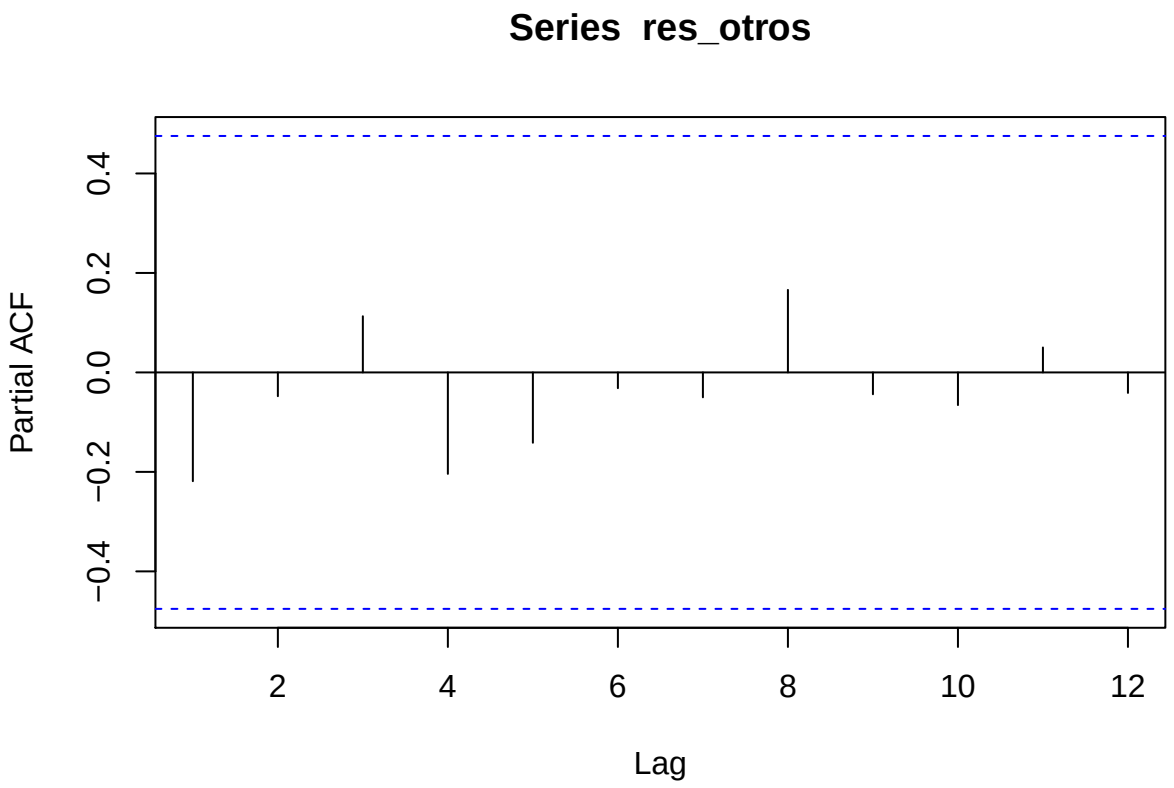
```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 96.47 on 12 degrees of freedom
## Multiple R-squared:  0.6744, Adjusted R-squared:  0.6202
## F-statistic: 12.43 on 2 and 12 DF,  p-value: 0.001191
##
##
## Value of test-statistic is: -3.3917 5.9234
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau2 -3.75 -3.00 -2.63
## phi1  7.88  5.18  4.12
```

Los residuales son estacionarios.

```
acf(res_otros)
```



```
pacf(res_otros)
```



El modelo especificado es correcto.

Producción pecuaria

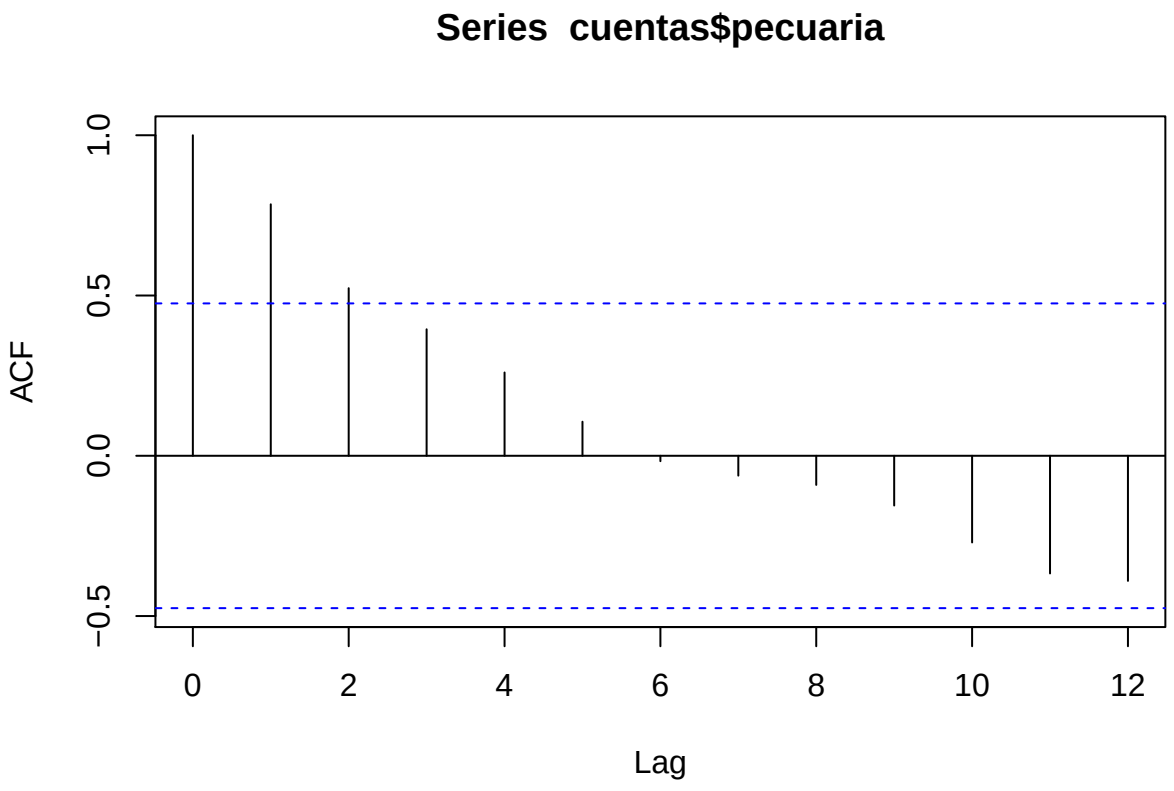
```
summary(ur.df(cuentas$pecuaria,type="trend",lag=1))
```

```
##
## ###############################################
## # 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
## -35.558 -24.880   1.087  13.227  53.221
##
```

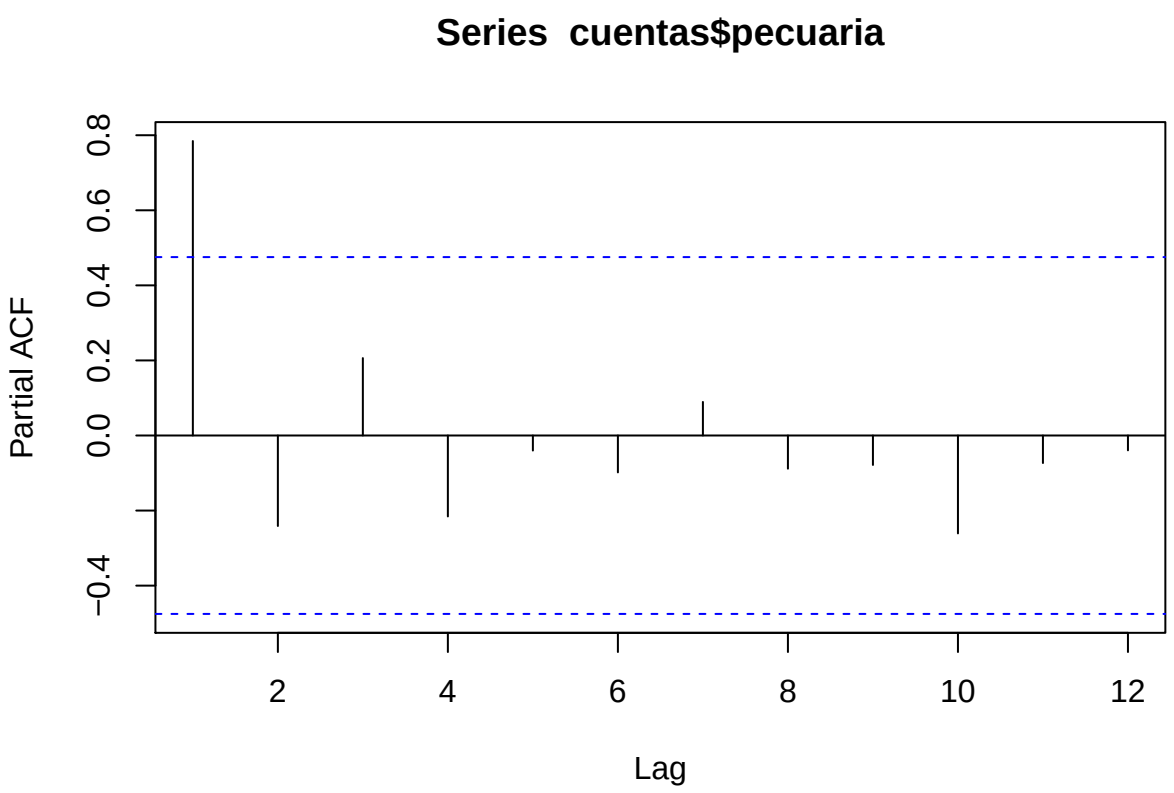
```
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) 1015.90621  224.19076   4.531 0.000856 ***
## z.lag.1       -0.92503    0.22373  -4.135 0.001659 **
## tt            29.98198    8.36335   3.585 0.004282 **
## z.diff.lag     0.09553    0.17113   0.558 0.587867
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 31.83 on 11 degrees of freedom
## Multiple R-squared:  0.7286, Adjusted R-squared:  0.6546
## F-statistic: 9.844 on 3 and 11 DF,  p-value: 0.001899
##
##
## Value of test-statistic is: -4.1346 19.9914 10.4249
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

Se rechaza la hipótesis nula de raíz unitaria, y se rechaza la hipótesis nula de raíz unitaria y no tendencia.

```
acf(cuentas$pecuaria)
```



```r
pacf(cuentas$pecuaria)
```



La serie sigue un proceso AR(1).

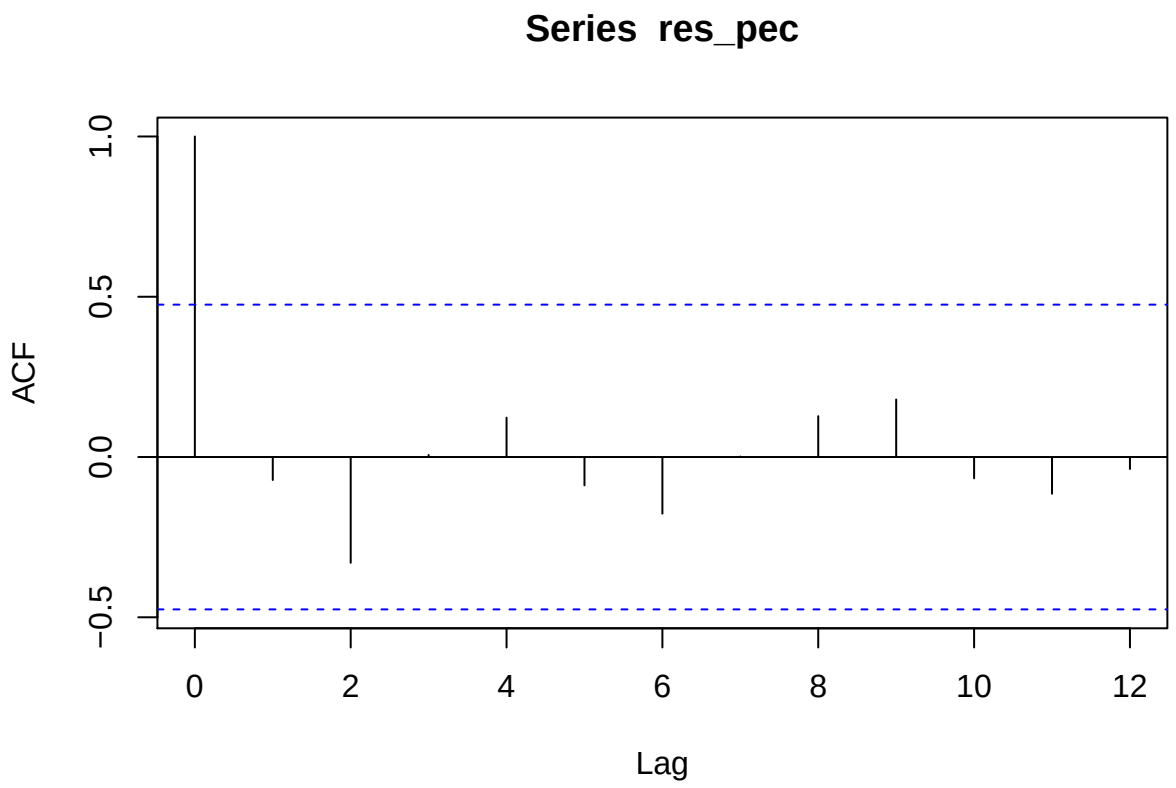
```r
modelo_pec <- arima(cuentas$pecuaria,order=c(1,0,0))
res_pec <- resid(modelo_pec)
summary(ur.df(res_pec,type="trend",lag=1))
```

```
##
## ###############################################
## # 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
## -67.027 -22.041   6.547  25.330  53.413
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
```

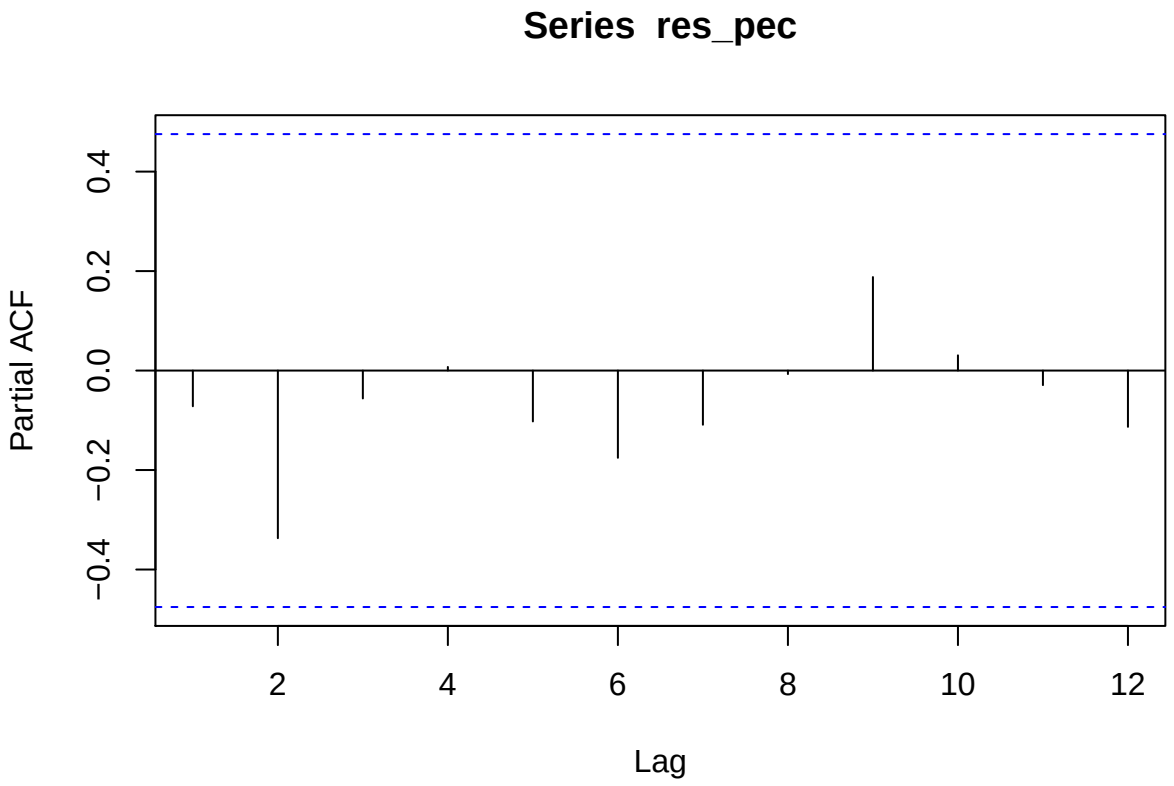
```
## (Intercept)  72.0833    24.2920   2.967   0.0128 *
## z.lag.1      -1.7738     0.2445  -7.254 1.63e-05 ***
## tt           -0.3878     2.4995  -0.155   0.8795
## z.diff.lag    0.3648     0.1606   2.271   0.0442 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 40.43 on 11 degrees of freedom
## Multiple R-squared:  0.873,  Adjusted R-squared:  0.8383
## F-statistic:  25.2 on 3 and 11 DF,  p-value: 3.141e-05
##
##
## Value of test-statistic is: -7.2544 19.6599 28.417
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

Los residuales son estacionarios.

```
acf(res_pec)
```



```r
pacf(res_pec)
```



El modelo especificado es correcto.

Pesca

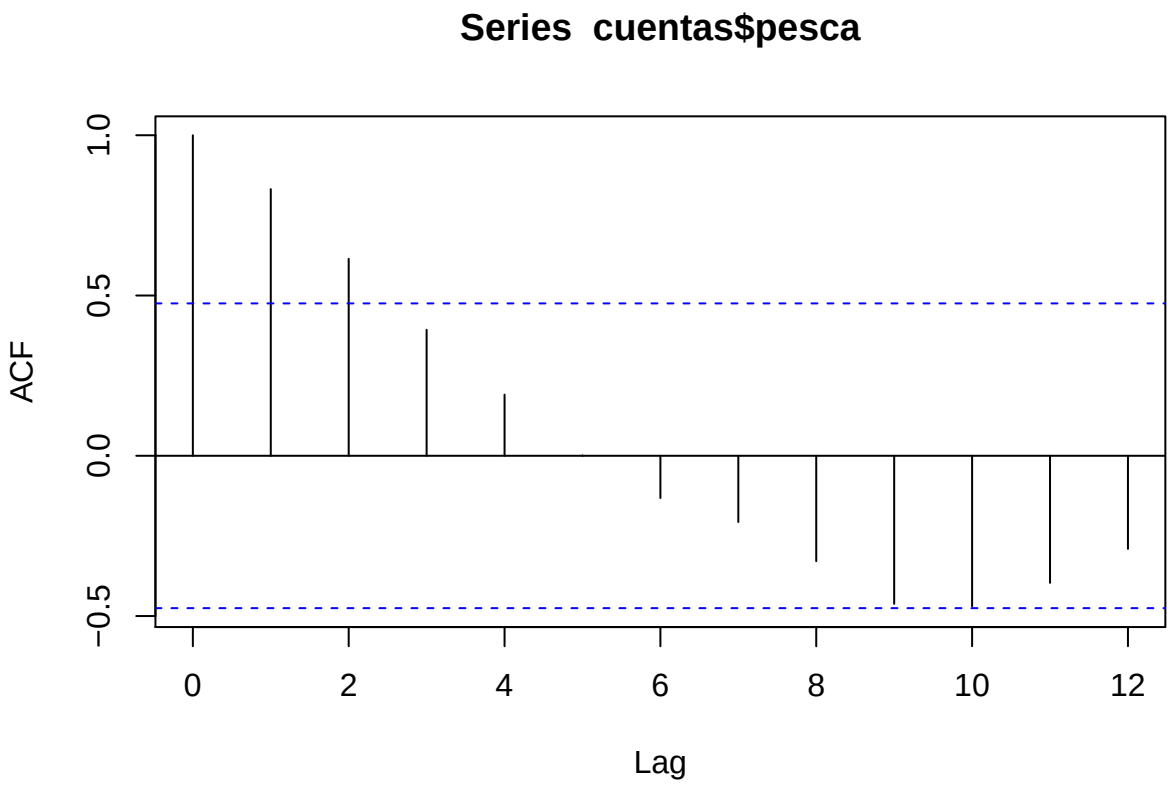
```r
summary(ur.df(cuentas$pesca,type="trend",lag=1))
```

```
##
## ###############################################
## # 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
## -1.5607 -0.9347 -0.3578  0.9466  1.9014
##
```

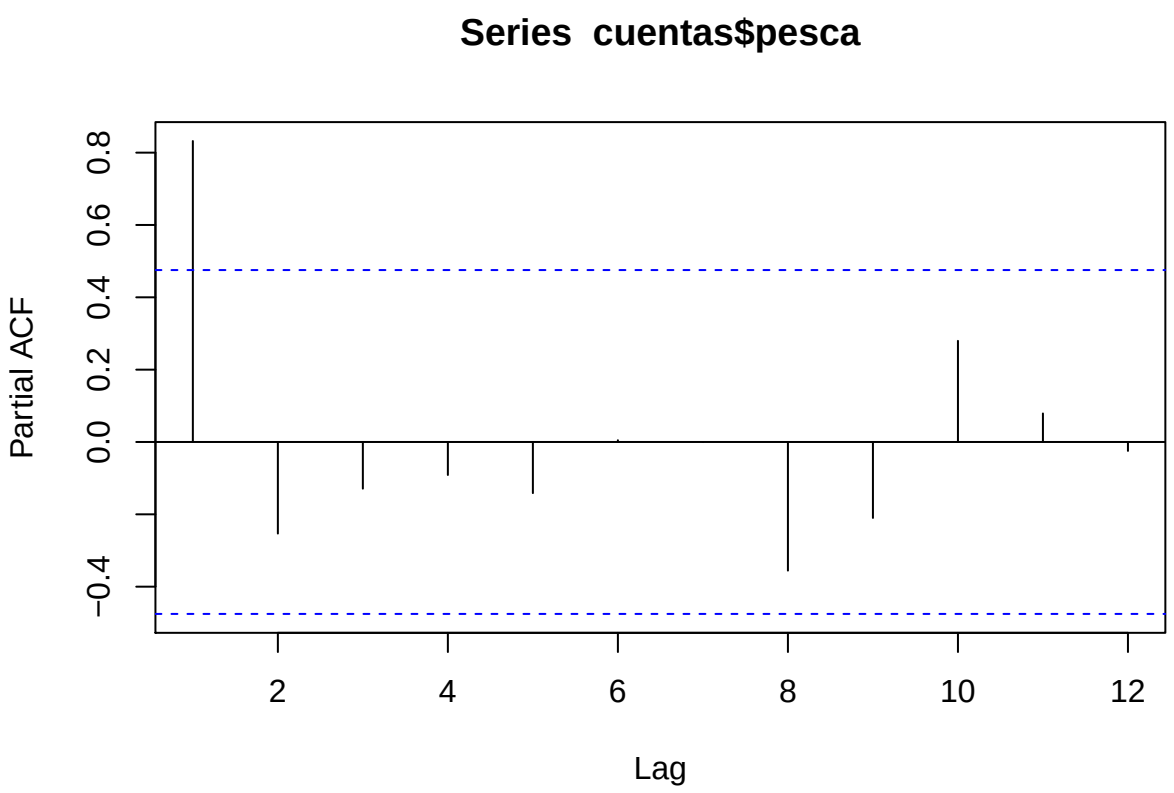
```
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   4.3071     1.2229   3.522 0.004780 **
## z.lag.1      -0.7842     0.1397  -5.611 0.000158 ***
## tt            0.7537     0.1343   5.613 0.000157 ***
## z.diff.lag    0.3055     0.1553   1.967 0.074889 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.258 on 11 degrees of freedom
## Multiple R-squared:  0.7676, Adjusted R-squared:  0.7042
## F-statistic: 12.11 on 3 and 11 DF,  p-value: 0.0008266
##
##
## Value of test-statistic is: -5.6115 11.7198 17.3826
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

Se rechaza la hipótesis nula de raíz unitaria, y se rechaza la hipótesis nula de raíz unitaria y no tendencia.

```
acf(cuentas$pesca)
```



```r
pacf(cuentas$pesca)
```



Se sospecha que la serie sigue un proceso AR(1).

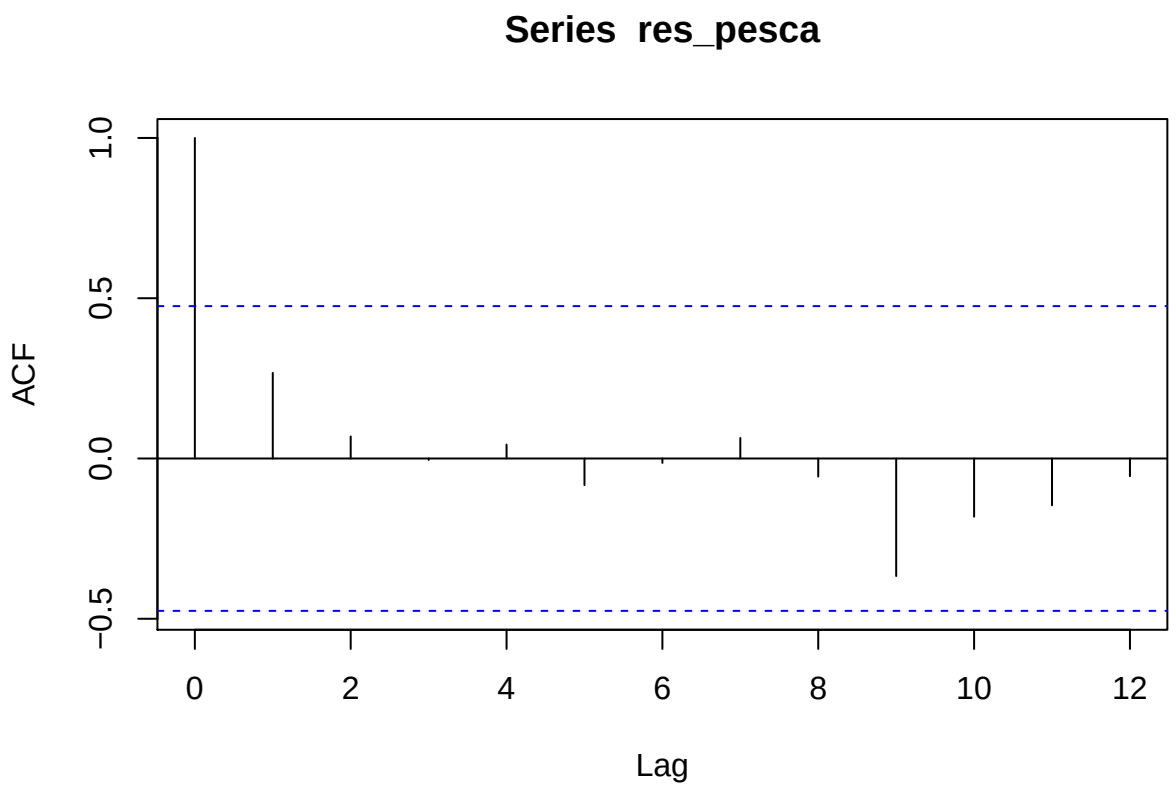
```r
modelo_pesca <- arima(cuentas$pesca,order=c(1,0,0))
res_pesca <- resid(modelo_pesca)
summary(ur.df(res_pesca,type="none",lag=1))
```

```
##
## ###############################################
## # 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
## -6.2566 -0.5164  0.2223  1.0080  4.0016
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
```

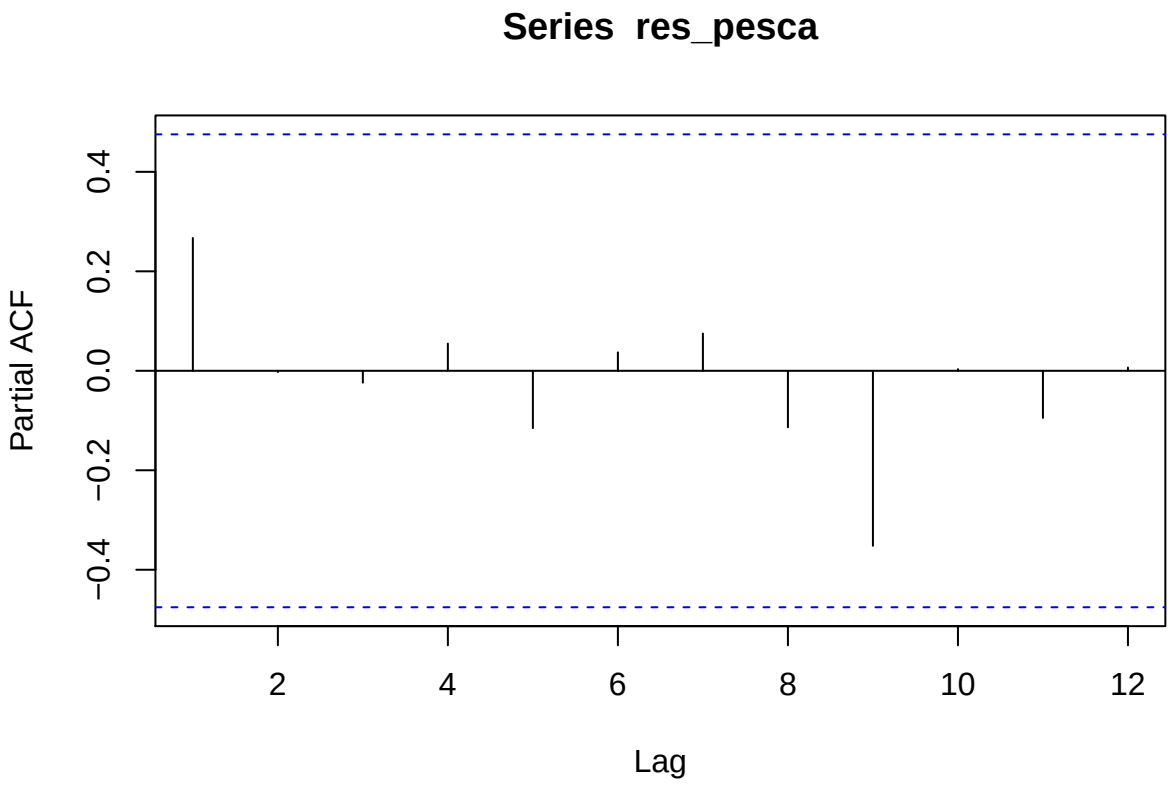
```
## z.lag.1    -0.726279   0.332811  -2.182    0.048 *
## z.diff.lag  0.005511   0.275661   0.020    0.984
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.283 on 13 degrees of freedom
## Multiple R-squared:  0.3624, Adjusted R-squared:  0.2643
## F-statistic: 3.694 on 2 and 13 DF,  p-value: 0.05366
##
##
## Value of test-statistic is: -2.1823
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.66 -1.95  -1.6
```

Los residuales del modelo son estacionarios.

```
acf(res_pesca)
```




```
pacf(res_pesca)
```



El modelo especificado es correcto.

Total

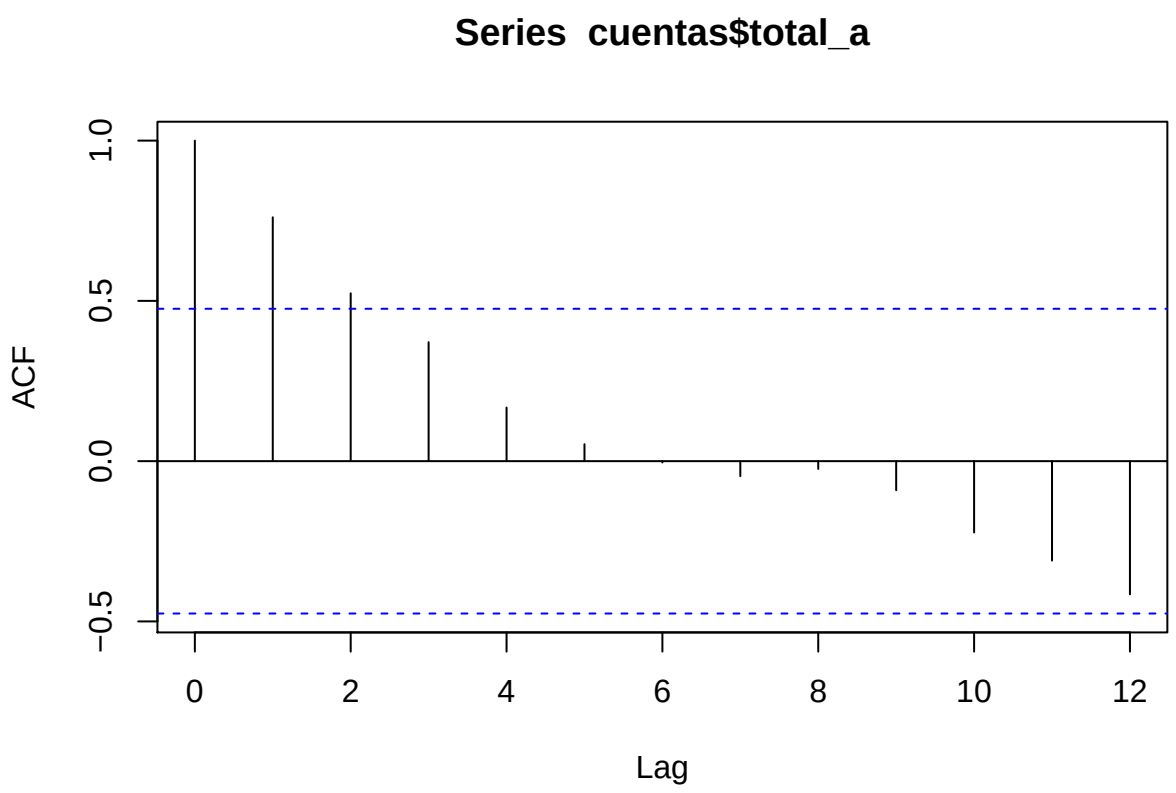
```
summary(ur.df(cuentas$total_a,type="none",lag=1))
```

```
##
## ###############################################
## # 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
## -271.16  -68.74  -14.90  104.87  210.12
##
## Coefficients:
##            Estimate Std. Error t value Pr(>|t|)
## z.lag.1     0.03753    0.01206   3.111  0.00827 **
```

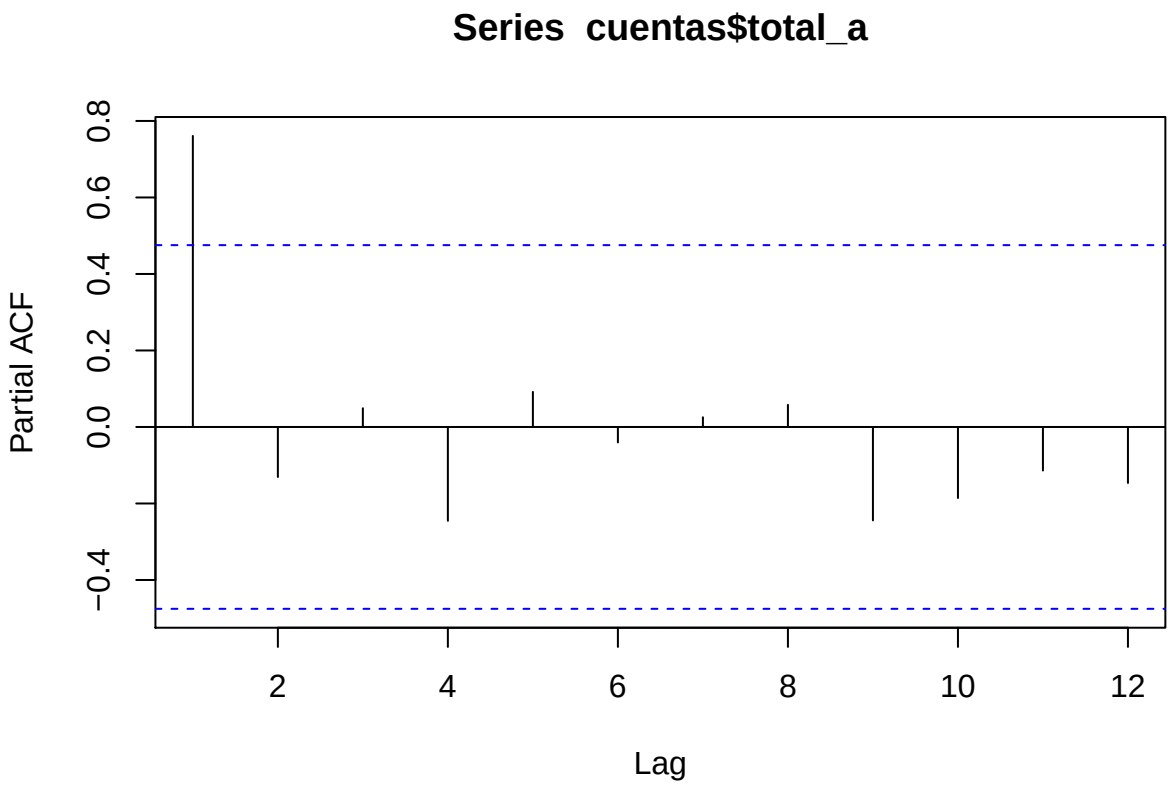
```
## z.diff.lag -0.35288    0.25295  -1.395  0.18638
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 141.4 on 13 degrees of freedom
## Multiple R-squared:  0.4305, Adjusted R-squared:  0.3429
## F-statistic: 4.913 on 2 and 13 DF,  p-value: 0.02575
##
##
## Value of test-statistic is: 3.111
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.66 -1.95  -1.6
```

Se rechaza la hipótesis nula de raíz unitaria.

```
acf(cuentas$total_a)
```



```r
pacf(cuentas$total_a)
```



La serie sigue un proceso AR(1).

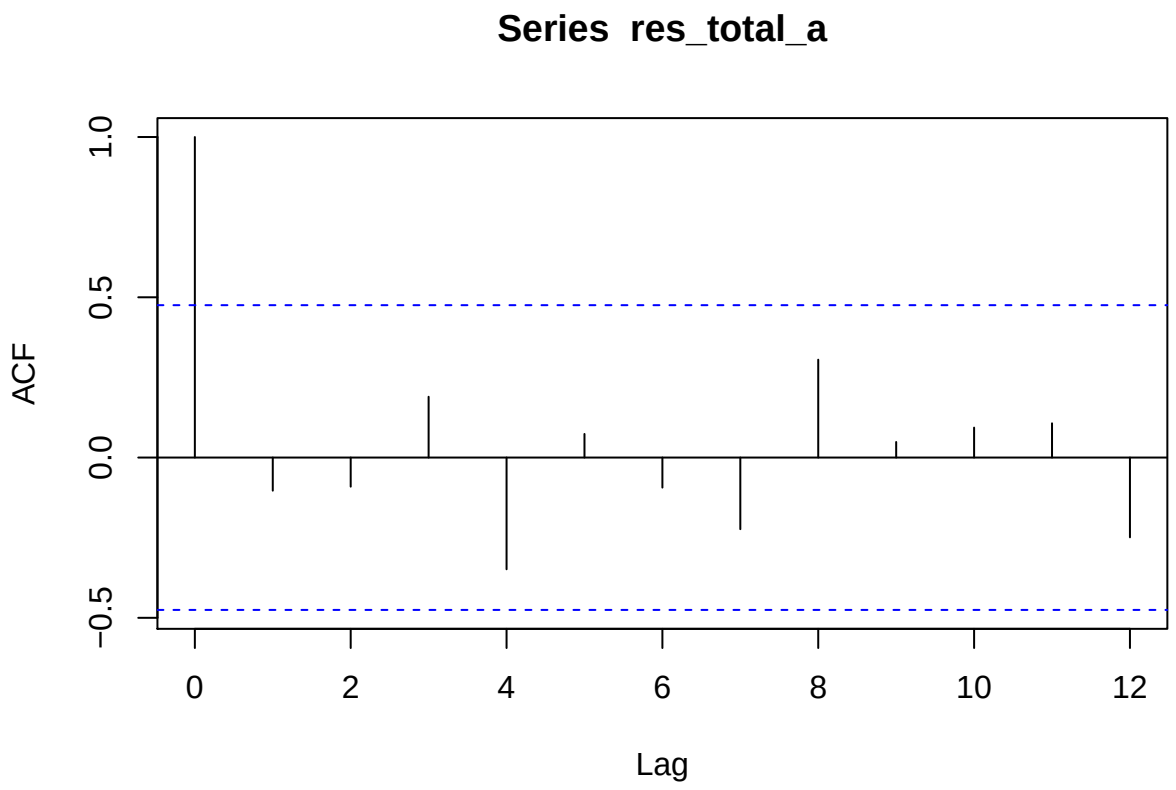
```r
modelo_total_a <-arima(cuentas$total_a,order=c(1,0,0))
res_total_a <- resid(modelo_total_a)
summary(ur.df(res_total_a,type="trend",lag=1))
```

```
##
## ###############################################
## # 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
## -234.221  -92.179   -7.843  116.137  179.117
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
```

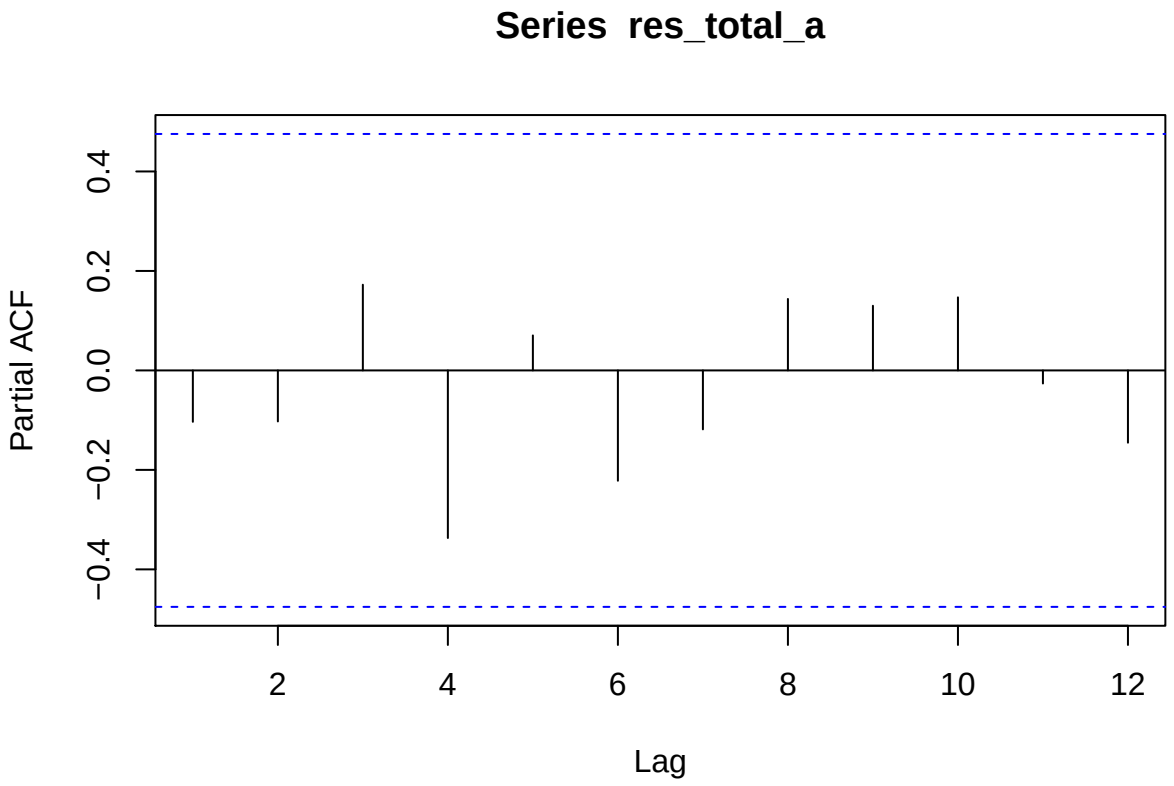
```
## (Intercept)  82.4260    87.2723   0.944  0.36521
## z.lag.1      -1.5571     0.4070  -3.826  0.00281 **
## tt            7.0214     9.3409   0.752  0.46802
## z.diff.lag    0.1834     0.2549   0.719  0.48692
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 145.5 on 11 degrees of freedom
## Multiple R-squared:  0.7085, Adjusted R-squared:  0.629
## F-statistic: 8.913 on 3 and 11 DF,  p-value: 0.002781
##
##
## Value of test-statistic is: -3.826 5.2929 7.5482
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -4.38 -3.60 -3.24
## phi2  8.21  5.68  4.67
## phi3 10.61  7.24  5.91
```

Los residuales del modelo son estacionarios.

```
acf(res_total_a)
```



```
pacf(res_total_a)
```



El modelo especificado es correcto.

Pronóstico

```
pronostico_otros_2018 <- data.frame("Otros"=predict(modelo_otros,2)$pred,"Año"=c(2017,2018))
pronostico_pec_2018 <- data.frame("Pecuarias"=predict(modelo_pec,2)$pred,"Año"=c(2017,2018))
pronostico_pesc_2018 <- data.frame("Pesca"=predict(modelo_pesca,2)$pred,"Año"=c(2017,2018))
pronostico_total_2018 <- data.frame("Total"=predict(modelo_total_a,2)$pred,"Año"=c(2017,2018))
```

Bibliografía

Enders, Walter (2008). Applied Time Series Econometrics. Wiley.