Séries Temporais

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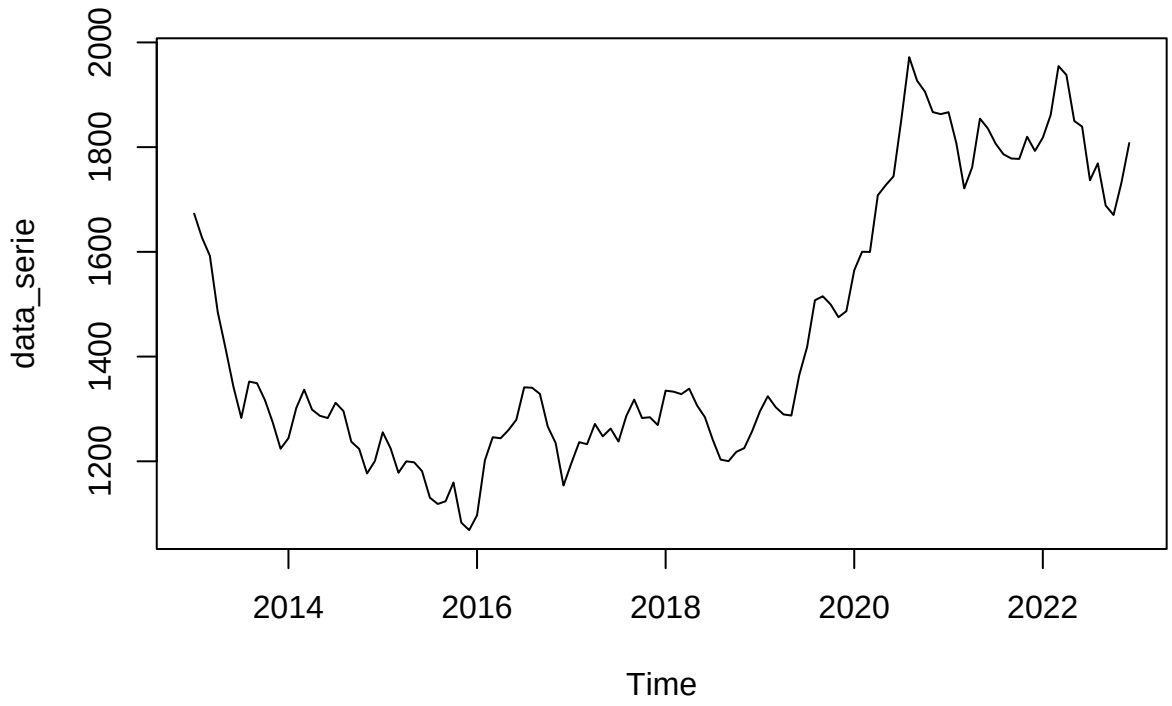
Sumário


```
# BIBLIOTECAS

suppressMessages(library(forecast))
suppressMessages(library(tseries))
suppressMessages(library(lubridate))
suppressMessages(library(tidyverse))
suppressMessages(library(readr))
suppressMessages(library(ggpubr))
```

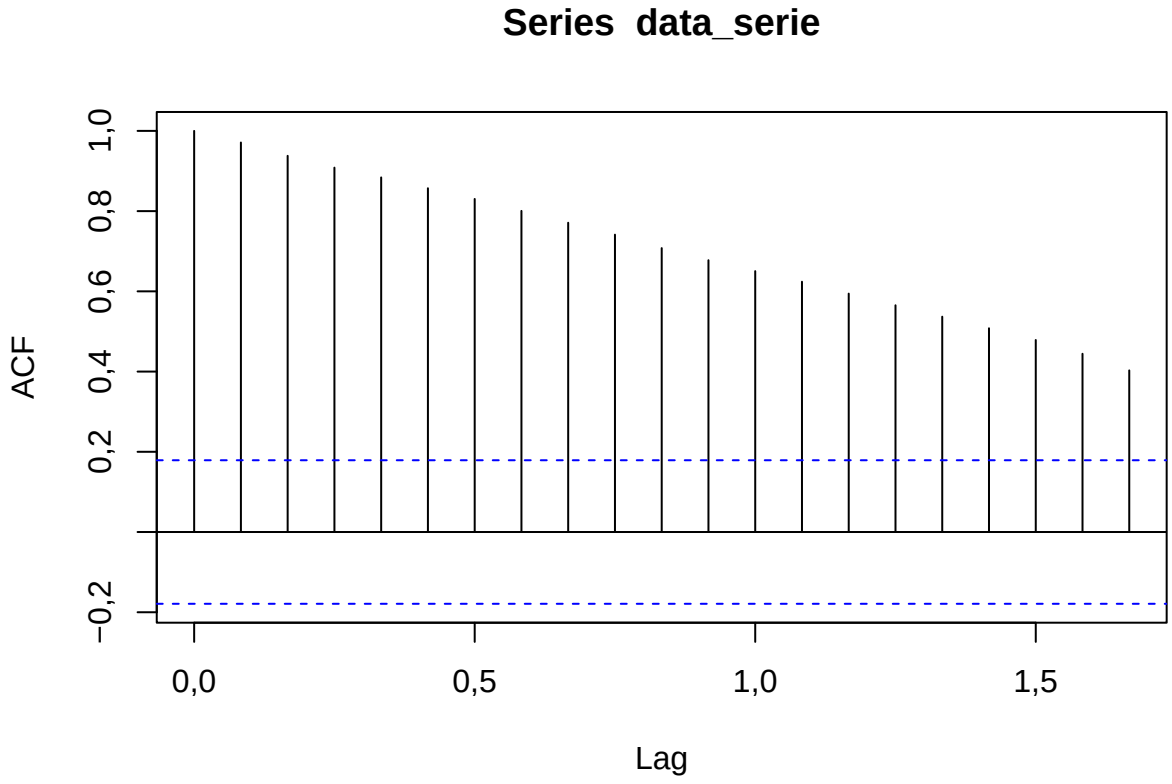
```
#DADOS

dados<- read_csv("dados/Gold Price (2013-2023).csv")
```

```
## Rows: 2583 Columns: 7
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (3): Date, Vol., Change %
## num (4): Price, Open, High, Low
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
dados <- dados |>
  mutate(Date = as.Date(Date, format = "%m/%d/%Y"))

media_mensal <- dados |>
  mutate(Month = floor_date(Date, "month")) |>
  group_by(Month) |>
  summarise(Average_Price = mean(Price, na.rm = TRUE))
#View(media_mensal)


data_serie<-ts(media_mensal$Average_Price, frequency=12, start=c(2013,1))
plot(data_serie)
```




```
acf(data_serie)
```



1 Introdução

```
# verificar - Sazonalidade, raiz unitaria e tendencia

source("functions.R")
```

```r
tend_determ(data_serie)
```

```
## $CS
##
##  Cox Stuart test
##
## data:  ts
## statistic = 47, n = 60, p-value = 0,000012
## alternative hypothesis: non randomness
##
##
## $CeST
##
##  Cox and Stuart Trend test
##
## data:  ts
## z = 5,38, n = 120, p-value = 0,000000076
## alternative hypothesis: monotonic trend
##
##
## $MannKT
##
##  Mann-Kendall trend test
##
## data:  ts
## z = 7,32, n = 120, p-value = 0,00000000000024
## alternative hypothesis: true S is not equal to 0
## sample estimates:
##            S         varS          tau
##   3230,00000 194366,66667      0,45238
##
##
## $MannK
## tau = 0,452, 2-sided pvalue =<0,0000000000000002
##
## $KPSST
##
##  KPSS Test for Trend Stationarity
##
## data:  ts
## KPSS Trend = 0,444, Truncation lag parameter = 4, p-value = 0,01
##
##
## $Tabela
##                 Testes            H0 p_valor Conclusao
## 1           Cox Stuart NAO tendencia    0,00 Tendencia
## 2 Cox and Stuart Trend NAO tendencia    0,00 Tendencia
## 3   Mann-Kendall Trend NAO tendencia    0,00 Tendencia
## 4         Mann-Kendall NAO tendencia    0,00 Tendencia
## 5  KPSS Test for Trend NAO tendencia    0,01 Tendencia
```

```r
raiz_unit(data_serie)
```

```
## $ADF
##
##  Augmented Dickey-Fuller Test
##
```

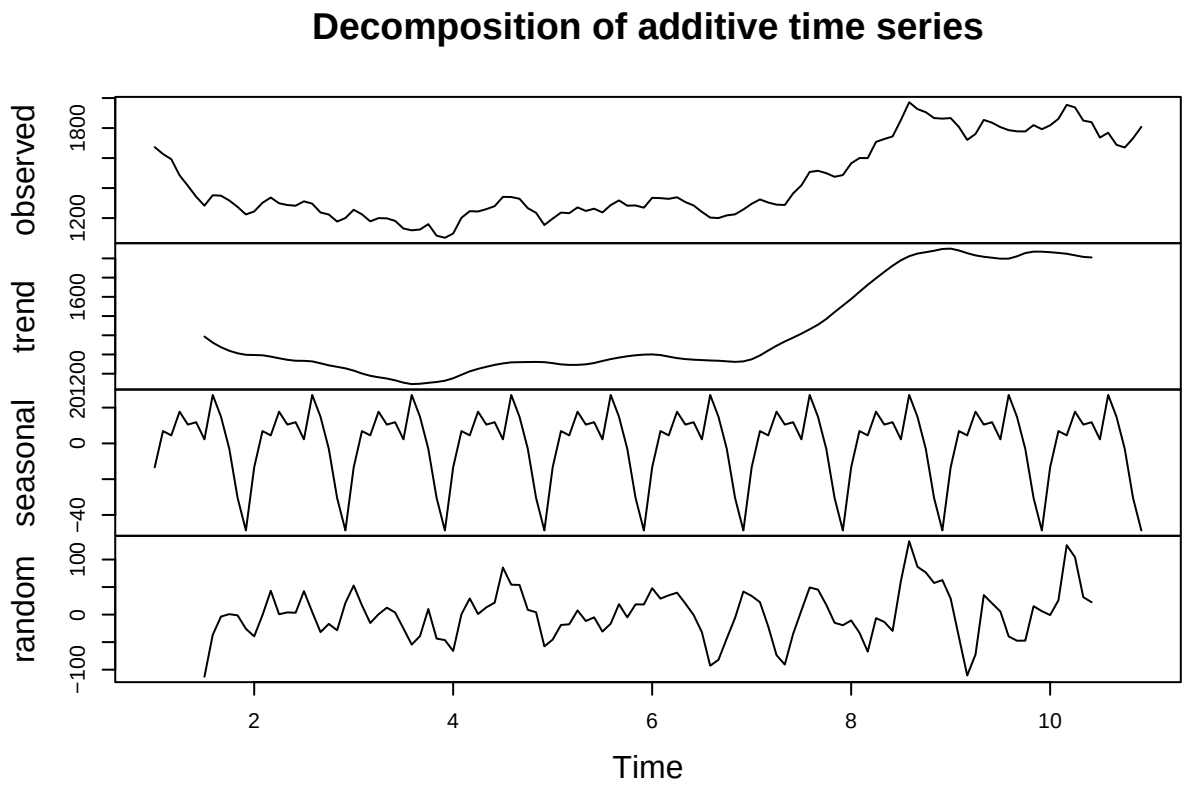
```
## data:  ts
## Dickey-Fuller = -2,53, Lag order = 4, p-value = 0,36
## alternative hypothesis: stationary
##
##
## $PP
##
##  Phillips-Perron Unit Root Test
##
## data:  ts
## Dickey-Fuller Z(alpha) = -10,2, Truncation lag parameter = 4, p-value =
## 0,53
## alternative hypothesis: stationary
##
##
## $KPSSL
##
##  KPSS Test for Level Stationarity
##
## data:  ts
## KPSS Level = 1,65, Truncation lag parameter = 4, p-value = 0,01
##
##
## $Tabela
##                       Testes            H0 p_valor Conclusao
## 1   Augmented Dickey-Fuller     Tendencia  0,3553 Tendencia
## 2 Phillips-Perron Unit Root     Tendencia  0,5252 Tendencia
## 3       KPSS Test for Level NAO tendencia  0,0100 Tendencia
```

```
sazonalidade(data_serie)
```

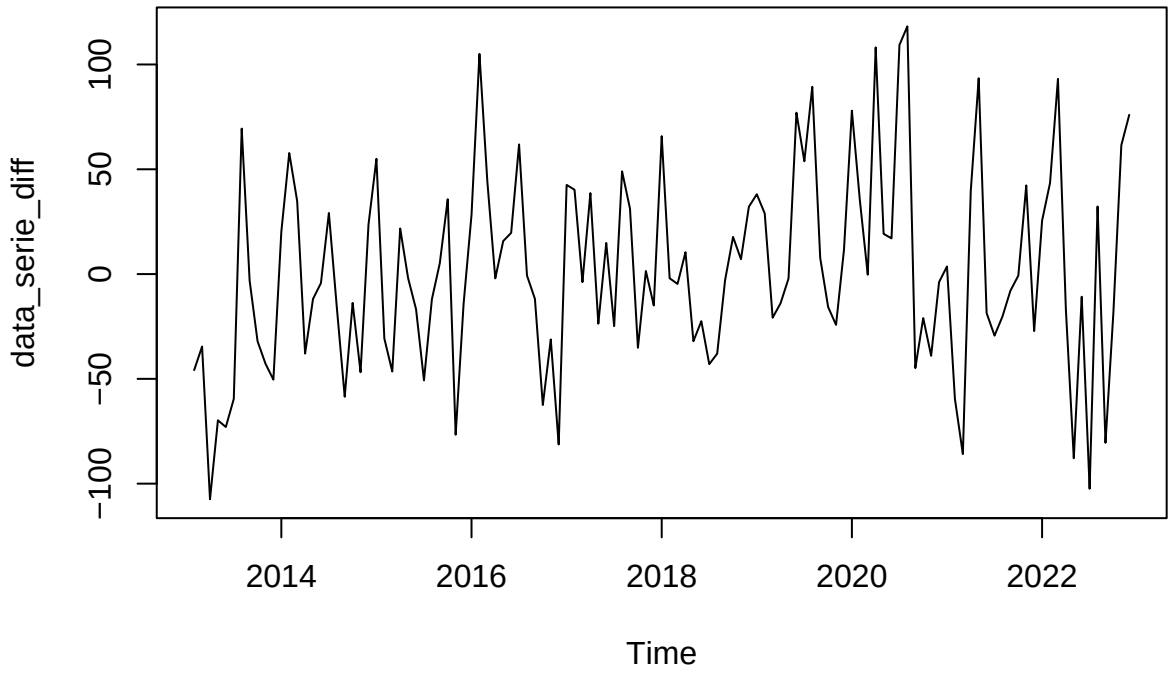
```
## $KrusW
## Test used:  Kruskall Wallis
##
## Test statistic:  1,78
## P-value:  0,99913
##
## $Fried
## Test used:  Friedman rank
##
## Test statistic:  6,26
## P-value:  0,85536
##
## $Tabela
##            Testes          H0 p_valor   Conclusao
## 1 Kruskall Wallis NAO Sazonal  0,9991 NAO Sazonal
## 2   Friedman rank NAO Sazonal  0,8554 NAO Sazonal
```

```
# resultado -
```

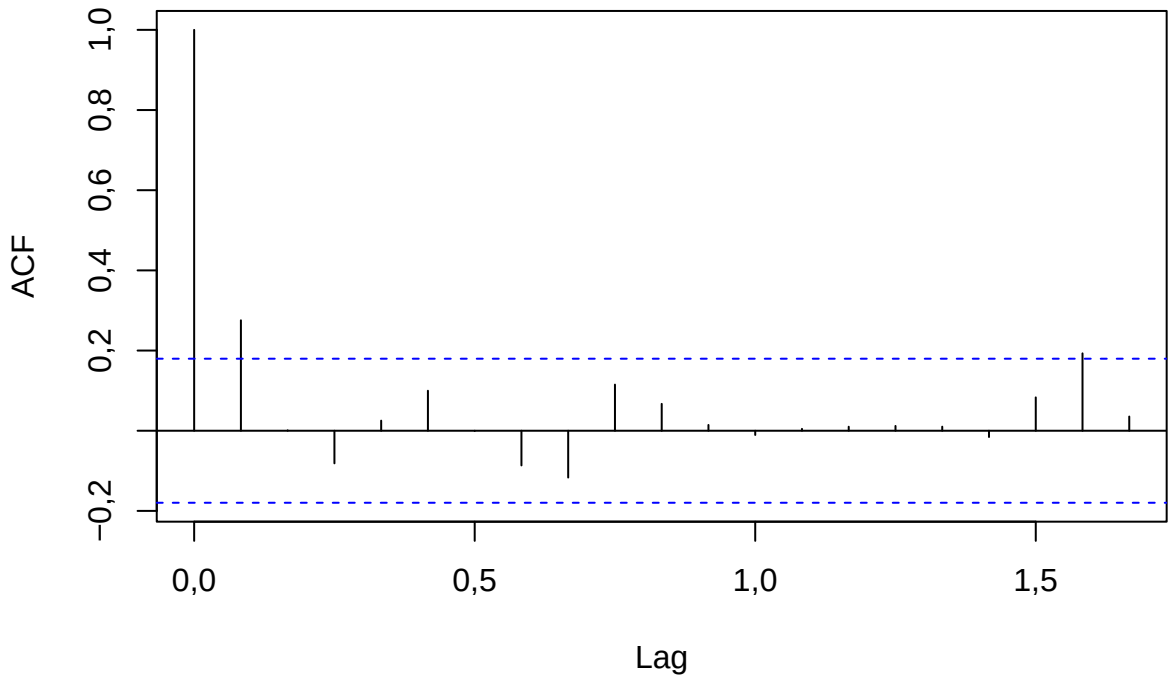
```
decomposicao <- decompose(ts(data_serie, frequency = 12))

plot(decomposicao)
```




```r
# diferenciação

data_serie_diff<-diff(data_serie,differences = 1)
plot(data_serie_diff)
```




```r
acf(data_serie_diff)
```




```
adf.test(data_serie_diff, alternative = "stationary")
```

```
## Warning in adf.test(data_serie_diff, alternative = "stationary"): p-value
## smaller than printed p-value
```

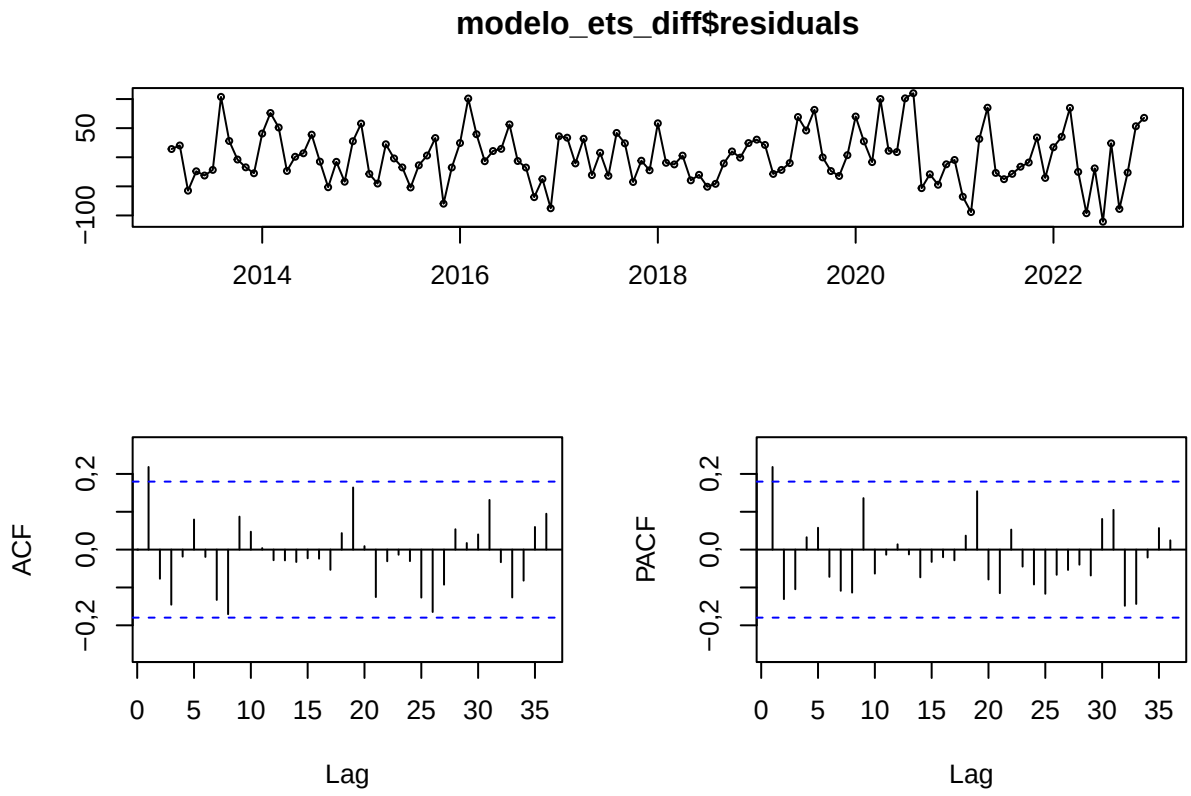
```
##
##  Augmented Dickey-Fuller Test
##
## data:  data_serie_diff
## Dickey-Fuller = -4,69, Lag order = 4, p-value = 0,01
## alternative hypothesis: stationary
```

```
modelo_ets_diff <- ets(data_serie_diff)
summary(modelo_ets_diff)
```

```
## ETS(A,Ad,N)
##
## Call:
## ets(y = data_serie_diff)
##
##   Smoothing parameters:
##     alpha = 0,0001
##     beta  = 0,0001
##     phi   = 0,9242
##
##   Initial states:
##     l = -65,5464
##     b = 6,0409
##
##   sigma:  46,183
##
##    AIC   AICc    BIC
## 1487,8 1488,5 1504,4
```

```
##
## Training set error measures:
##                     ME   RMSE    MAE    MPE   MAPE    MASE    ACF1
## Training set 0,50617 45,202 35,701 131,48 159,97 0,68433 0,21828
```

```
tsdisplay(modelo_ets_diff$residuals)
```




```
Box.test(modelo_ets_diff$residuals,lag=10)
```

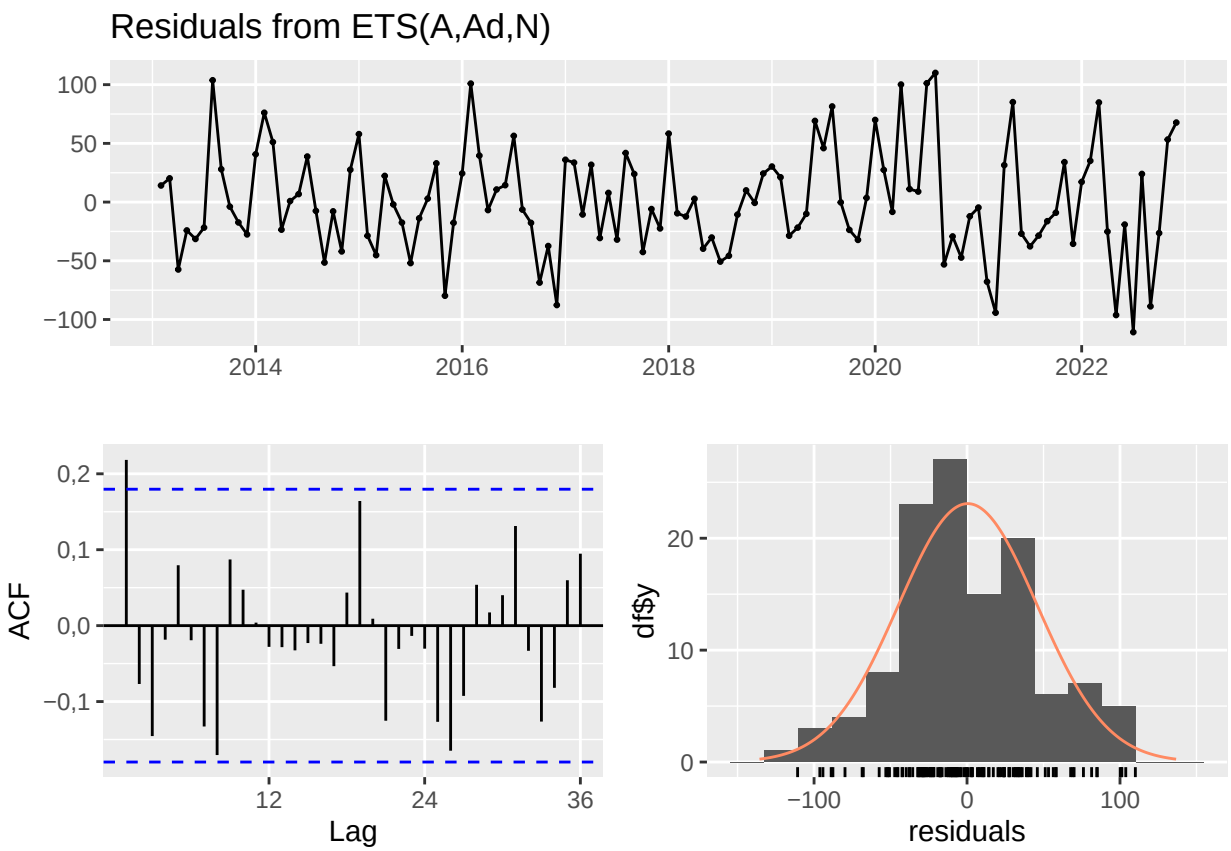
```
##
##  Box-Pierce test
##
## data:  modelo_ets_diff$residuals
## X-squared = 16,5, df = 10, p-value = 0,087
```

```
modelo_ets_diff$residuals
```

```
##             Jan        Feb        Mar        Apr        May        Jun
## 2013              14,12946   20,22131  -57,41252  -24,13566  -31,40980
## 2014   40,71497   76,10358   51,12244  -23,51323    0,86405    6,82505
## 2015   57,91449  -28,68149  -45,20510   22,32042   -2,02093  -17,48959
## 2016   24,43701  100,92609   39,58155   -6,80870   10,72597   14,40050
## 2017   36,04997   33,62247  -10,58163   31,79052  -30,61782    7,82504
## 2018   58,32987   -9,54952  -12,30680    2,80384  -39,70881  -30,18274
## 2019   30,29191   21,13318  -28,64307  -21,72949   -9,99239   69,14809
## 2020   69,98490   27,40122   -8,31674  100,11391   11,11899    8,94000
## 2021   -4,64789  -67,81683  -94,20703   31,44889   85,13816  -26,92388
## 2022   17,17343   35,15506   84,82869  -25,13503  -96,21016  -19,12575
##             Jul        Aug        Sep        Oct        Nov        Dec
## 2013  -21,73655  103,76262   27,98512   -3,89188  -17,35485  -27,52747
## 2014   38,80982   -7,51057  -51,50134   -7,86337  -42,02190   27,52754
## 2015  -51,96896  -13,80588    2,96861   33,01587  -79,76880  -17,64533
## 2016   56,40026   -6,42242  -17,70485  -68,56052  -37,42179  -87,69247
```

```
## 2017  -31,95352   41,80430   23,91871  -42,50350   -5,93001  -22,42585
## 2018  -50,69755  -45,71806  -10,65010    9,97740   -0,66553   24,35861
## 2019   45,94816   81,45412   -0,24419  -23,67482  -32,19730    3,59510
## 2020  101,20447  110,03534  -53,08140  -29,24463  -47,26376  -12,09811
## 2021  -37,69338  -28,53683  -16,28300   -9,03702   34,01472  -35,51087
## 2022 -110,75338   23,96227  -88,79620  -26,38162   53,27265   67,74599
```

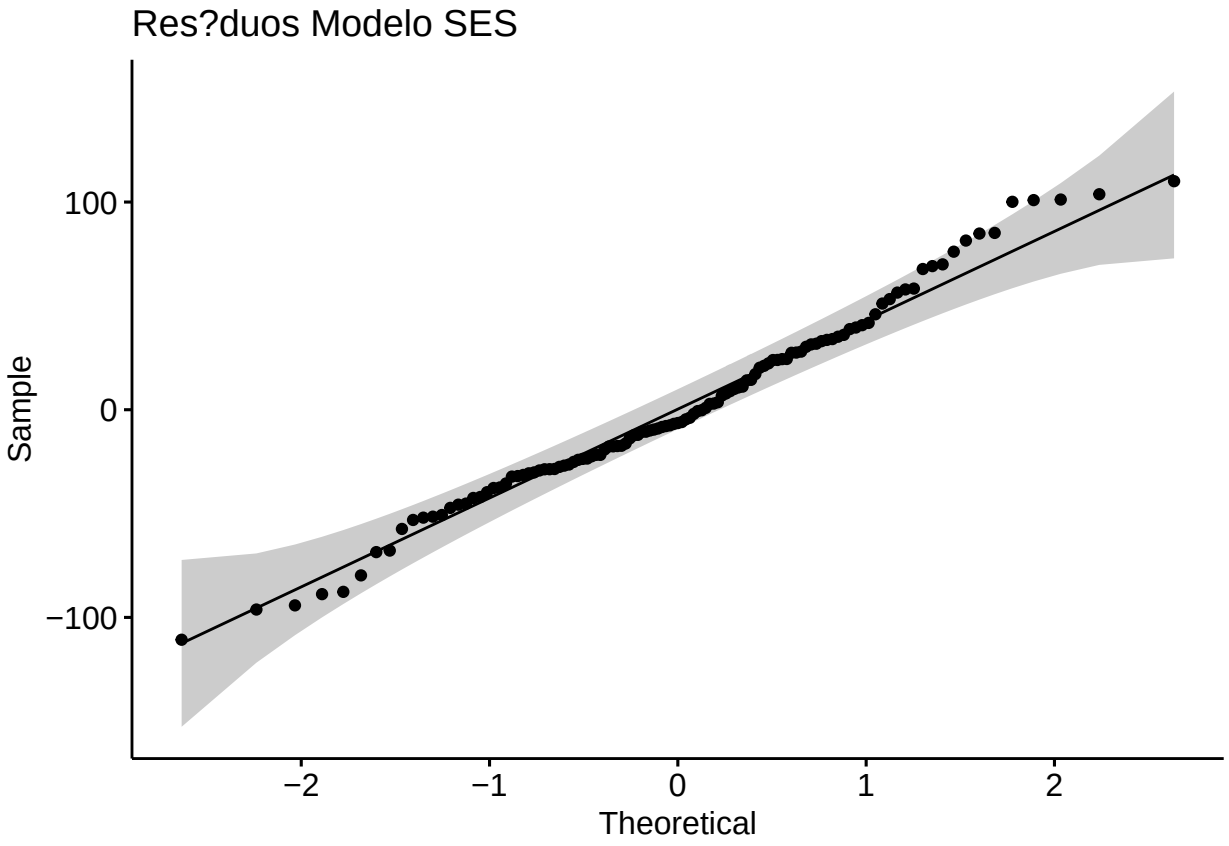
```
checkresiduals(modelo_ets_diff)
```




```
##
##  Ljung-Box test
##
## data:  Residuals from ETS(A,Ad,N)
## Q* = 25,1, df = 24, p-value = 0,4
##
## Model df: 0.   Total lags used: 24
```

```
ggqqplot(modelo_ets_diff$residuals)+ggtitle("Res?duos Modelo SES")
```

```
## Don't know how to automatically pick scale for object of type <ts>. Defaulting
## to continuous.
## Don't know how to automatically pick scale for object of type <ts>. Defaulting
## to continuous.
## Don't know how to automatically pick scale for object of type <ts>. Defaulting
## to continuous.
```




```
tend_determ(data_serie_diff)
```

```
## $CS
##
##  Cox Stuart test
##
## data:  ts
## statistic = 39, n = 59, p-value = 0,018
## alternative hypothesis: non randomness
##
##
## $CeST
##
##  Cox and Stuart Trend test
##
## data:  ts
## z = 1,96, n = 119, p-value = 0,05
## alternative hypothesis: monotonic trend
##
##
## $MannKT
##
##  Mann-Kendall trend test
##
## data:  ts
## z = 2,06, n = 119, p-value = 0,039
## alternative hypothesis: true S is not equal to 0
## sample estimates:
##            S         varS          tau
##    899,00000 189567,00000      0,12804
```

```
##
##
## $MannK
## tau = 0,128, 2-sided pvalue =0,0392
##
## $KPSST
##
##  KPSS Test for Trend Stationarity
##
## data:  ts
## KPSS Trend = 0,112, Truncation lag parameter = 4, p-value = 0,1
##
##
## $Tabela
##                  Testes            H0 p_valor     Conclusao
## 1           Cox Stuart NAO tendencia  0,0183     Tendencia
## 2 Cox and Stuart Trend NAO tendencia  0,0502 NAO tendencia
## 3   Mann-Kendall Trend NAO tendencia  0,0392     Tendencia
## 4         Mann-Kendall NAO tendencia  0,0392     Tendencia
## 5  KPSS Test for Trend NAO tendencia  0,1000 NAO tendencia
```

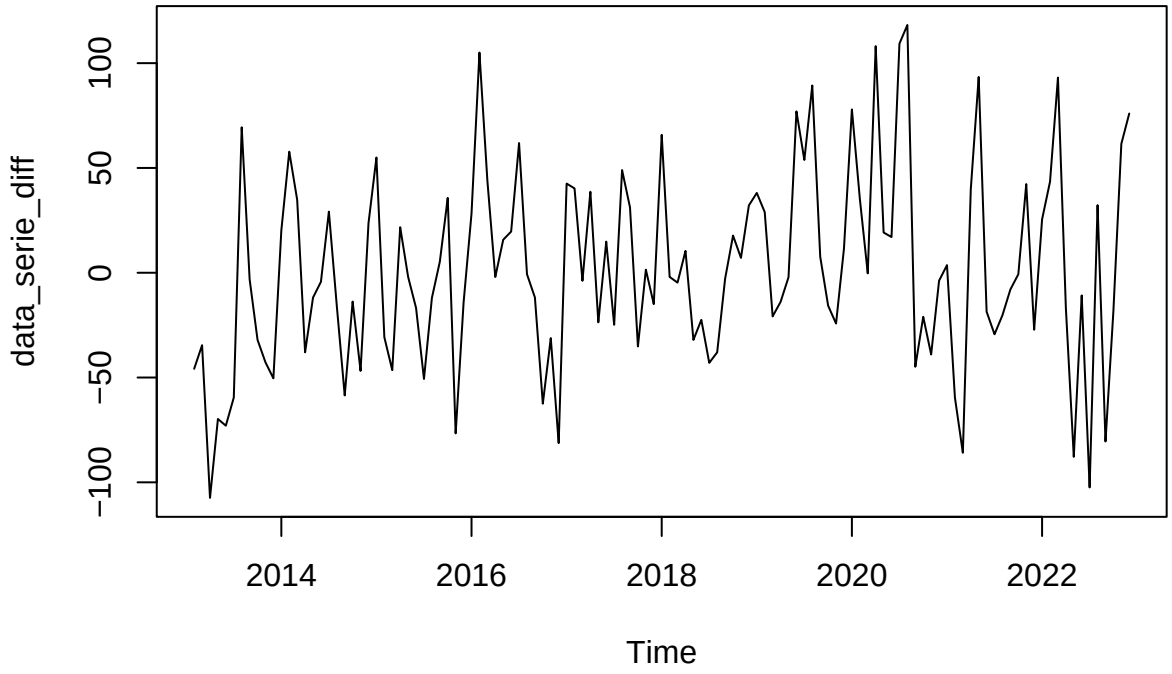
```
raiz_unit(data_serie_diff)
```

```
## $ADF
##
##  Augmented Dickey-Fuller Test
##
## data:  ts
## Dickey-Fuller = -4,69, Lag order = 4, p-value = 0,01
## alternative hypothesis: stationary
##
##
## $PP
##
##  Phillips-Perron Unit Root Test
##
## data:  ts
## Dickey-Fuller Z(alpha) = -78,8, Truncation lag parameter = 4, p-value =
## 0,01
## alternative hypothesis: stationary
##
##
## $KPSSL
##
##  KPSS Test for Level Stationarity
##
## data:  ts
## KPSS Level = 0,392, Truncation lag parameter = 4, p-value = 0,081
##
##
## $Tabela
##                       Testes            H0 p_valor     Conclusao
## 1   Augmented Dickey-Fuller     Tendencia  0,0100 NAO tendencia
## 2 Phillips-Perron Unit Root     Tendencia  0,0100 NAO tendencia
## 3       KPSS Test for Level NAO tendencia  0,0807 NAO tendencia
```

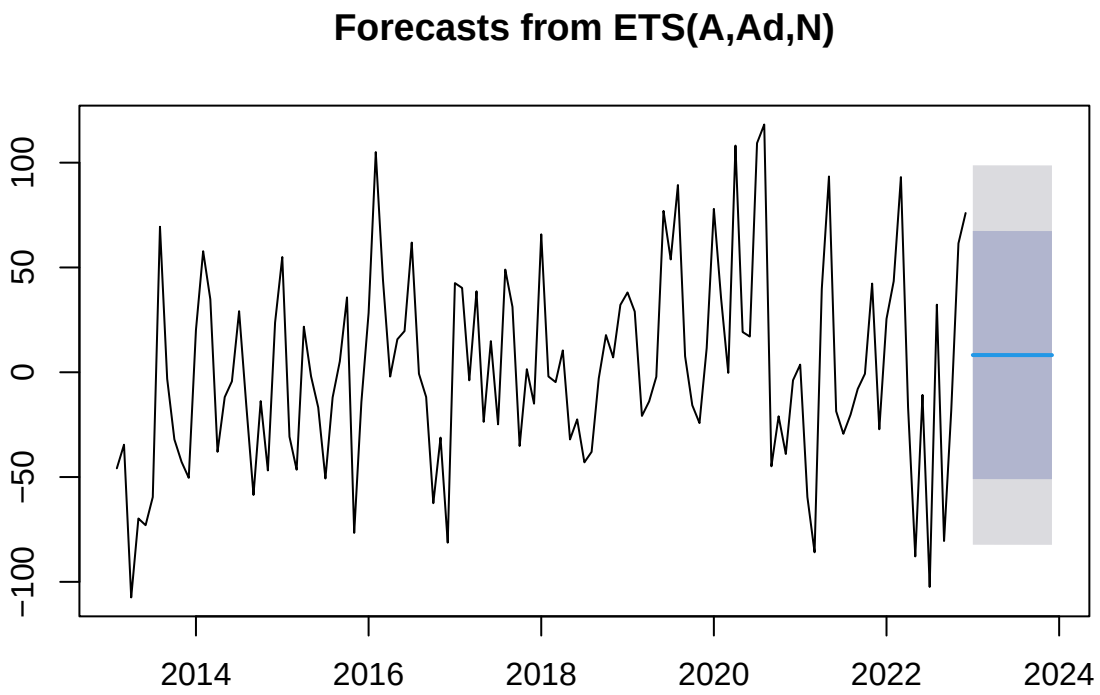
```r
sazonalidade(data_serie_diff)
```

```
## $KrusW
## Test used:  Kruskall Wallis
##
## Test statistic:  16,51
## P-value:  0,12312
##
## $Fried
## Test used:  Friedman rank
##
## Test statistic:  14,59
## P-value:  0,20206
##
## $Tabela
##            Testes          H0 p_valor   Conclusao
## 1 Kruskall Wallis NAO Sazonal  0,1231 NAO Sazonal
## 2   Friedman rank NAO Sazonal  0,2021 NAO Sazonal
```

```r
plot(data_serie_diff)
```




```r
previsao <- forecast(data_serie_diff, h = 12)
plot(previsao)
```


Forecasts from ETS(A,Ad,N)
100
50
0
−50
−100
2014
2016
2018
2020
2022
2024