Lista_02

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Carregando bibliotecas

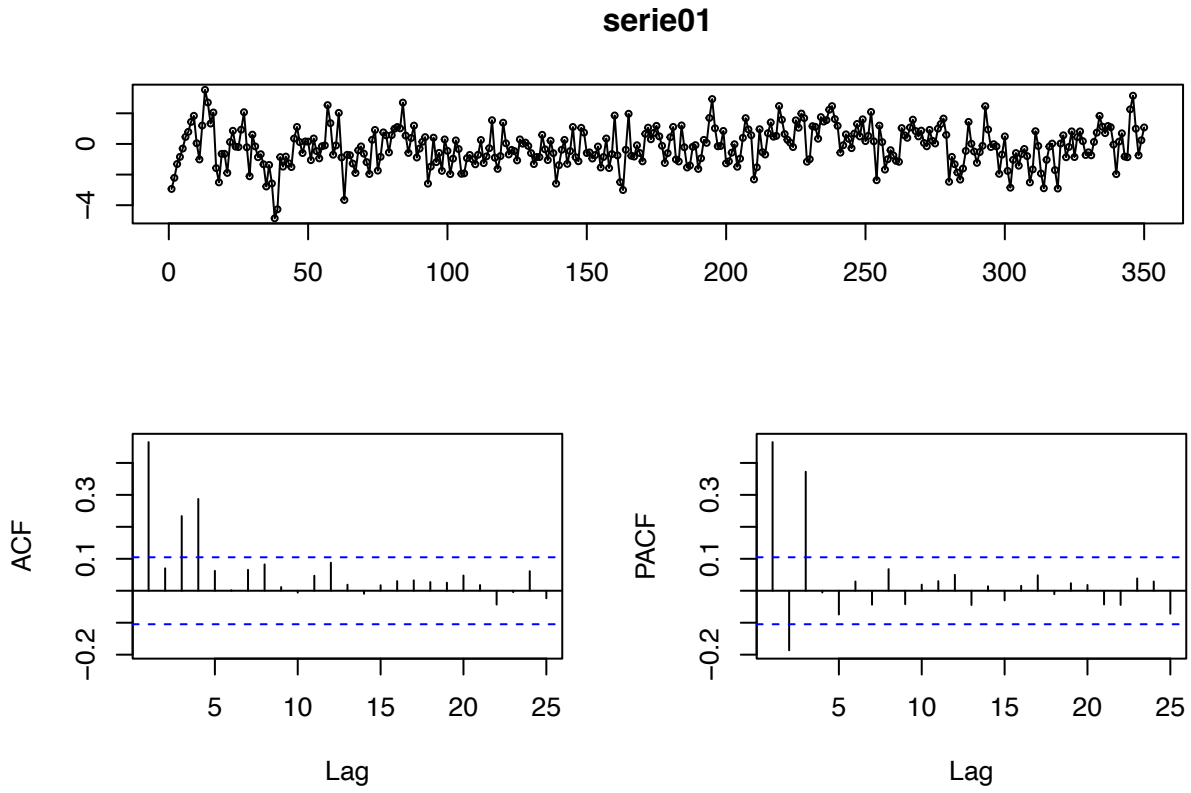
```
knitr::opts_chunk$set(warning = FALSE, message = FALSE)

library(forecast)
library(lmtest)
library(readxl)
```

1. Baseando-se nos procedimentos vistos no curso, faça a modelagem das séries $1, 2, 3$ e 4. Utilizando os modelos escolhidos para cada uma, calcule as previsões para $l = 1, 2$ e 3 passos à frente. Escreva as equações de previsão de cada série utilizando os parâmetros estimados. Comente cada caso.

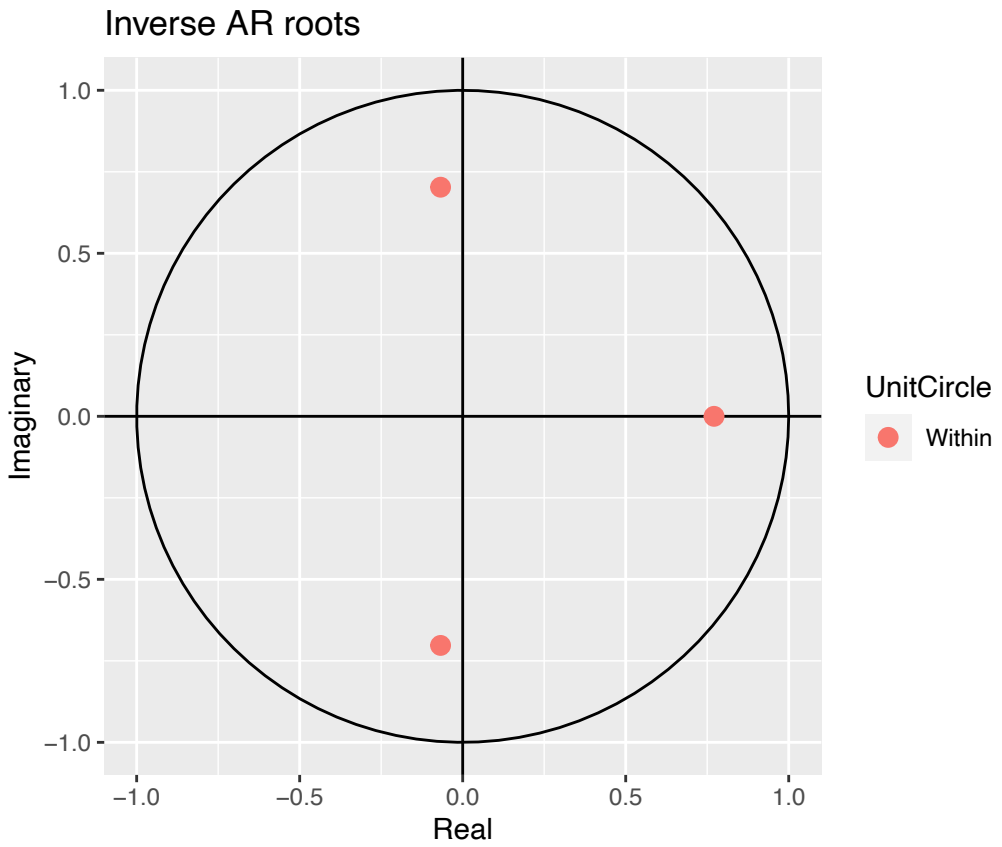
Série_01

Modelo AR(3)

```
serie01 <- scan("./Dados/Series/serie1.csv")
tsdisplay(serie01)
```



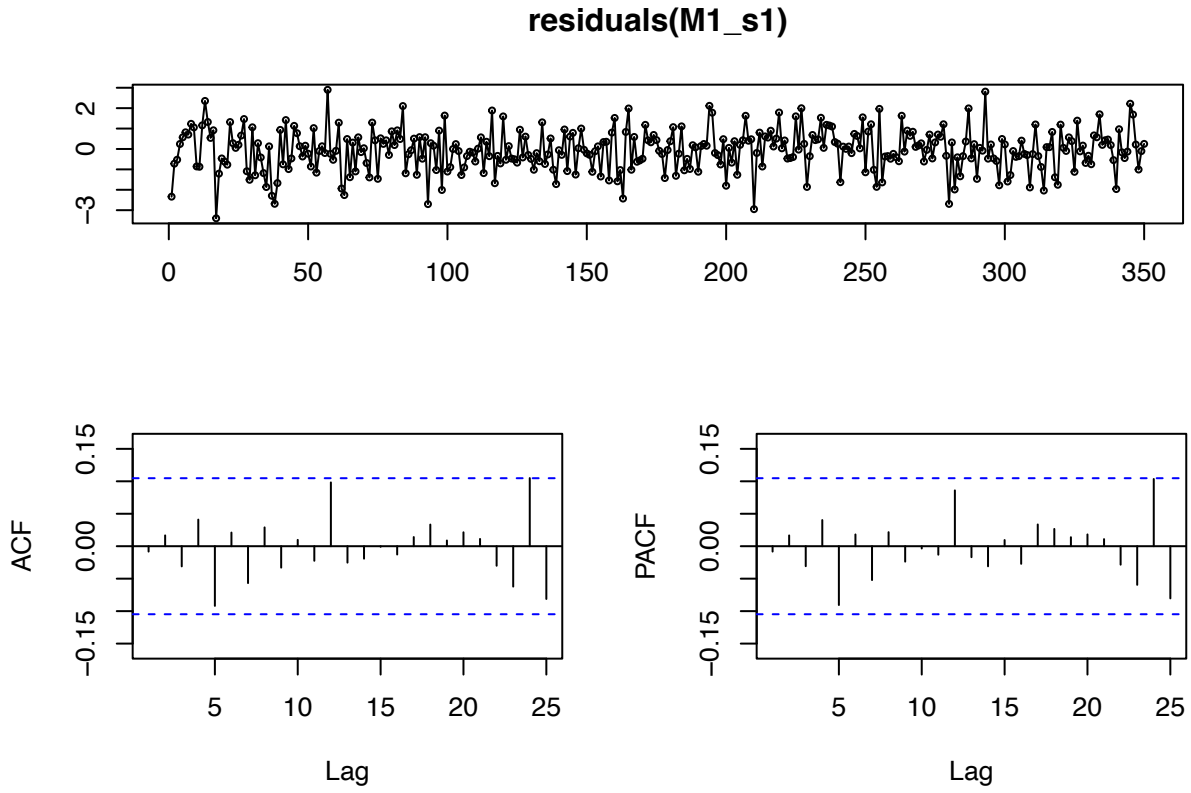

```
M1_s1 <- Arima(serie01, order=c(3,0,0), include.mean = FALSE) # Modelo AR(3) média = 0
autoplot(M1_s1) # Raízes inversas caem dentro do círculo unitário
```




```
coeftest(M1_s1) # Coeficientes são estatísticamente significantes
```

```
##
## z test of coefficients:
##
##      Estimate Std. Error z value  Pr(>|z|)
## ar1  0.635417   0.049520 12.8315 < 2.2e-16 ***
## ar2 -0.393856   0.056136 -7.0161 2.282e-12 ***
## ar3  0.384269   0.049576  7.7512 9.105e-15 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tsdisplay(residuals(M1_s1)) # Resíduo é Ruído Branco
```



Equação modelo AR(3)

$$y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + \phi_3 y_{t-3} + \epsilon_t$$

Encontrando equações de previsão para l = 1, 2 e 3

$$y_T(1) = \phi_1 y_T + \phi_2 y_{T-1} + \phi_3 y_{T-2}$$

$$y_T(2) = \phi_1 y_{T(1)} + \phi_2 y_T + \phi_3 y_{T-1}$$

$$y_T(3) = \phi_1 y_{T(2)} + \phi_2 y_{T(1)} + \phi_3 y_T$$

Substituindo valores estimados dos coeficientes

$$y_T(1) = 0,6354 y_T - 0,3938 y_{t-1} + 0,3842 y_{t-2}$$

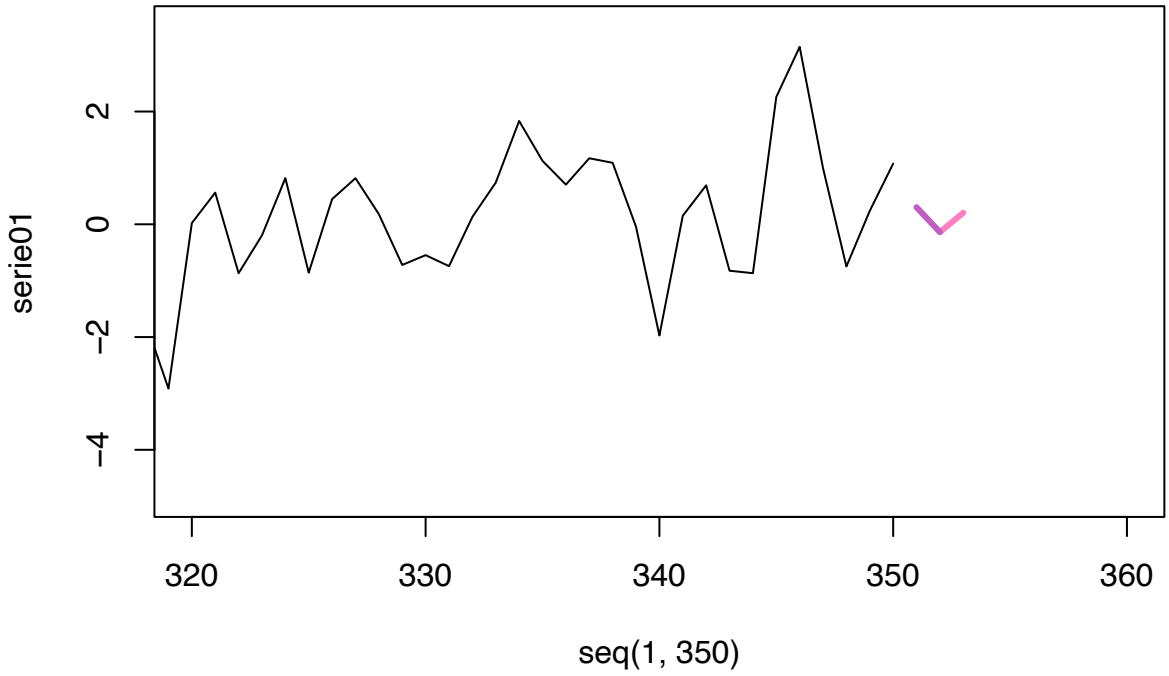
$$y_T(2) = 0,6354 y_{T(1)} - 0,3938 y_T + 0,3842 y_{T-1}$$

$$y_T(3) = 0,6354 y_{T(2)} - 0,3938 y_{T(1)} + 0,3842 y_T$$

```r
forecast(M1_s1, h = 3)
```

```
##     Point Forecast     Lo 80    Hi 80     Lo 95    Hi 95
## 351      0.3025850 -1.007668 1.612838 -1.701275 2.306445
## 352     -0.1399293 -1.692320 1.412461 -2.514106 2.234247
## 353      0.2057075 -1.346737 1.758152 -2.168552 2.579967
```

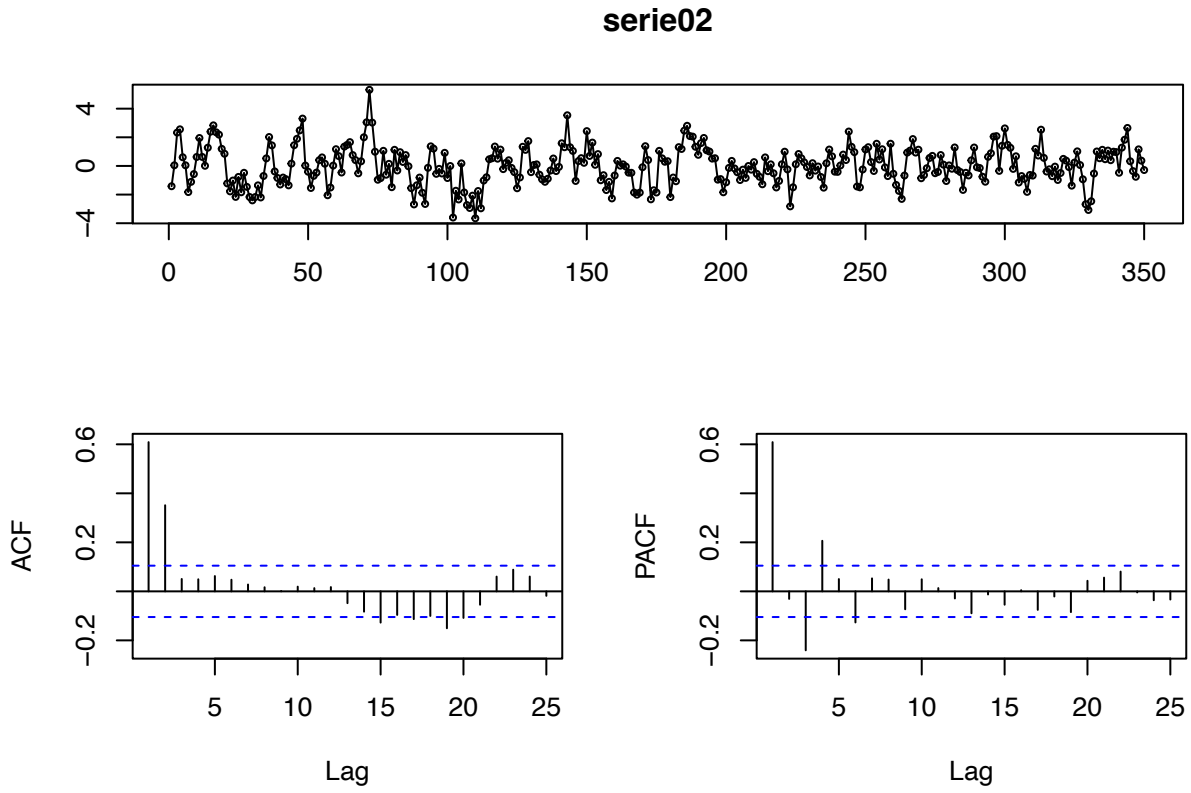
```r
plot(seq(1, 350), serie01, type = "l", xlim = c(320, 360))
lines(forecast(M1_s1, h = 1)$mean, lwd = 3, col = rgb(0.5,0,0, alpha = 0.5))
lines(forecast(M1_s1, h = 2)$mean, lwd = 3, col = rgb(0,0.5,1, alpha = 0.5))
lines(forecast(M1_s1, h = 3)$mean, lwd = 3, col = rgb(1,0,0.5, alpha = 0.5))
```



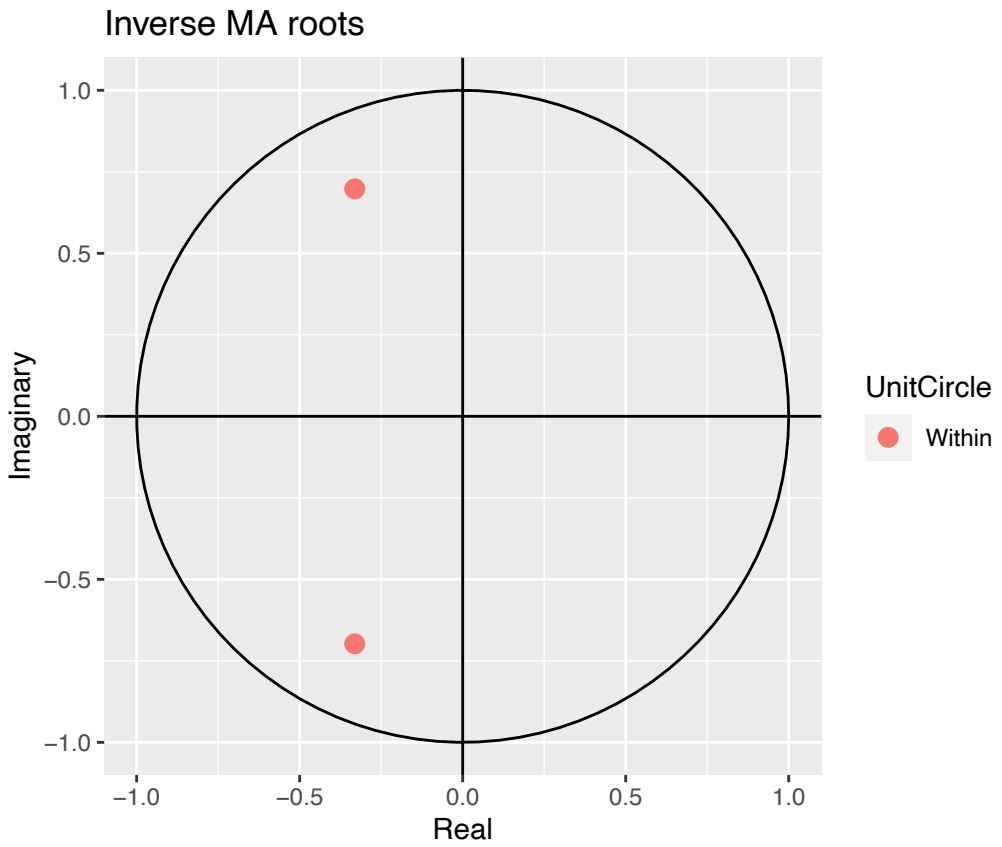
Serie_02

Modelo MA(2)

```r
serie02 <- scan("./Dados/Series/serie2.csv")
tsdisplay(serie02)
```



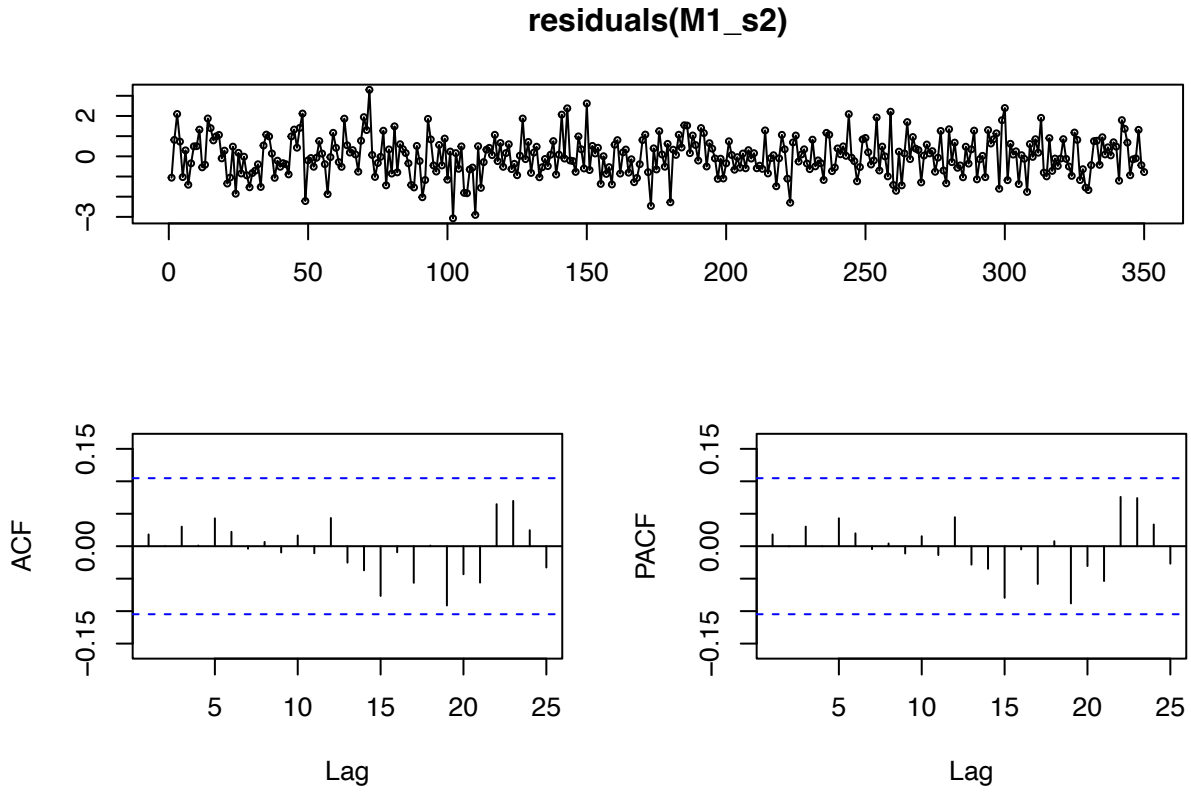

```
M1_s2 <- Arima(serie02, order=c(0,0,2), include.mean = FALSE) # Modelo MA(2) média = 0
autoplot(M1_s2) # Raízes inversas caem dentro do círculo unitário
```




```
coeftest(M1_s2) # Coeficientes são estatísticamente significantes
```

```
##
## z test of coefficients:
##
##     Estimate Std. Error z value  Pr(>|z|)
## ma1 0.662046   0.042356  15.630 < 2.2e-16 ***
## ma2 0.596160   0.042899  13.897 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tsdisplay(residuals(M1_s2)) # Resíduo é Ruído Branco
```



Equação modelo MA(2)

$$y_t = \theta_1 \epsilon_{t-1} + \theta_2 \epsilon_{t-2} + \epsilon_t$$

Encontrando equações de previsão para l = 1, 2 e 3

$$y_T(1) = \theta_1 \epsilon_T + \theta_2 \epsilon_{T-1}$$

$$y_T(2) = \theta_2 \epsilon_T$$

$$y_T(3) = 0$$

Substituindo valores estimados dos coeficientes

$$y_T(1) = 0,6620\epsilon_T + 0,5962\epsilon_{T-1}$$

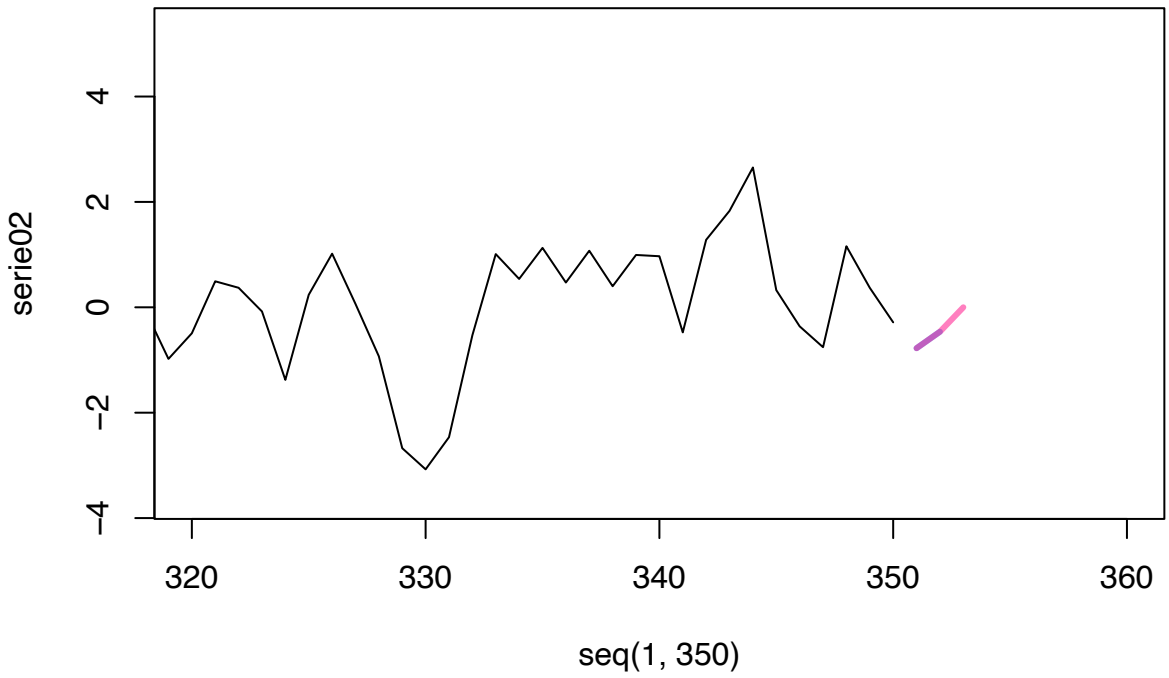
$$y_T(2) = 0,5962\epsilon_T$$

$$y_T(3) = 0$$

```r
forecast(M1_s2, h = 3)
```

```
##     Point Forecast     Lo 80     Hi 80     Lo 95    Hi 95
## 351     -0.7761947 -2.032164 0.4797749 -2.697034 1.144645
## 352     -0.4632019 -1.969478 1.0430739 -2.766852 1.840448
## 353      0.0000000 -1.682114 1.6821137 -2.572571 2.572571
```

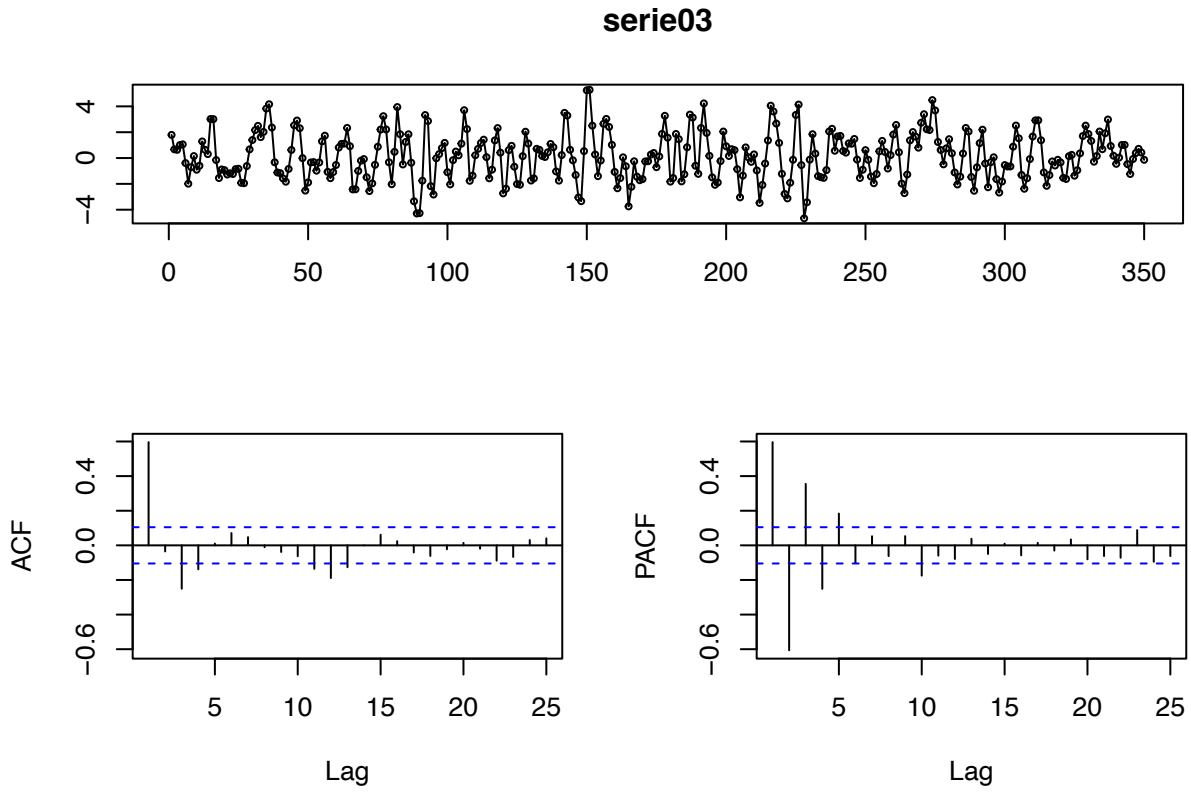
```r
plot(seq(1, 350), serie02, type = "l", xlim = c(320, 360))
lines(forecast(M1_s2, h = 1)$mean, lwd = 3, col = rgb(0.5,0,0, alpha = 0.5))
lines(forecast(M1_s2, h = 2)$mean, lwd = 3, col = rgb(0,0.5,1, alpha = 0.5))
lines(forecast(M1_s2, h = 3)$mean, lwd = 3, col = rgb(1,0,0.5, alpha = 0.5))
```



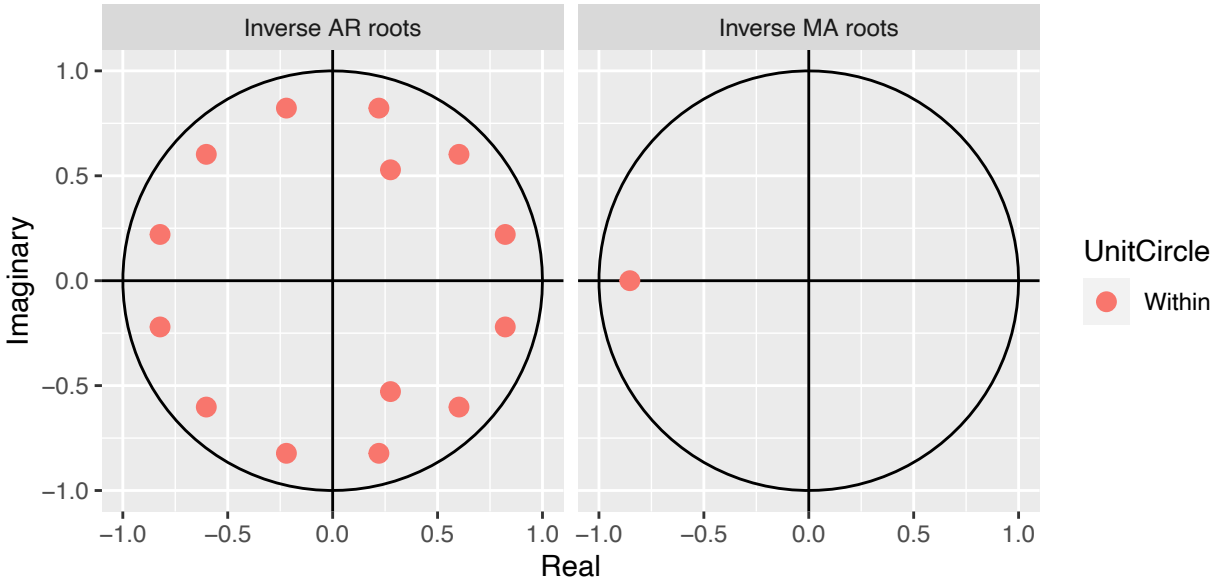
Série_03

Modelo SARMA$(2,1)\mathbf{x}(1,0)_{12}$

```r
serie03 <- scan("./Dados/Series/serie3.csv")
tsdisplay(serie03)
```



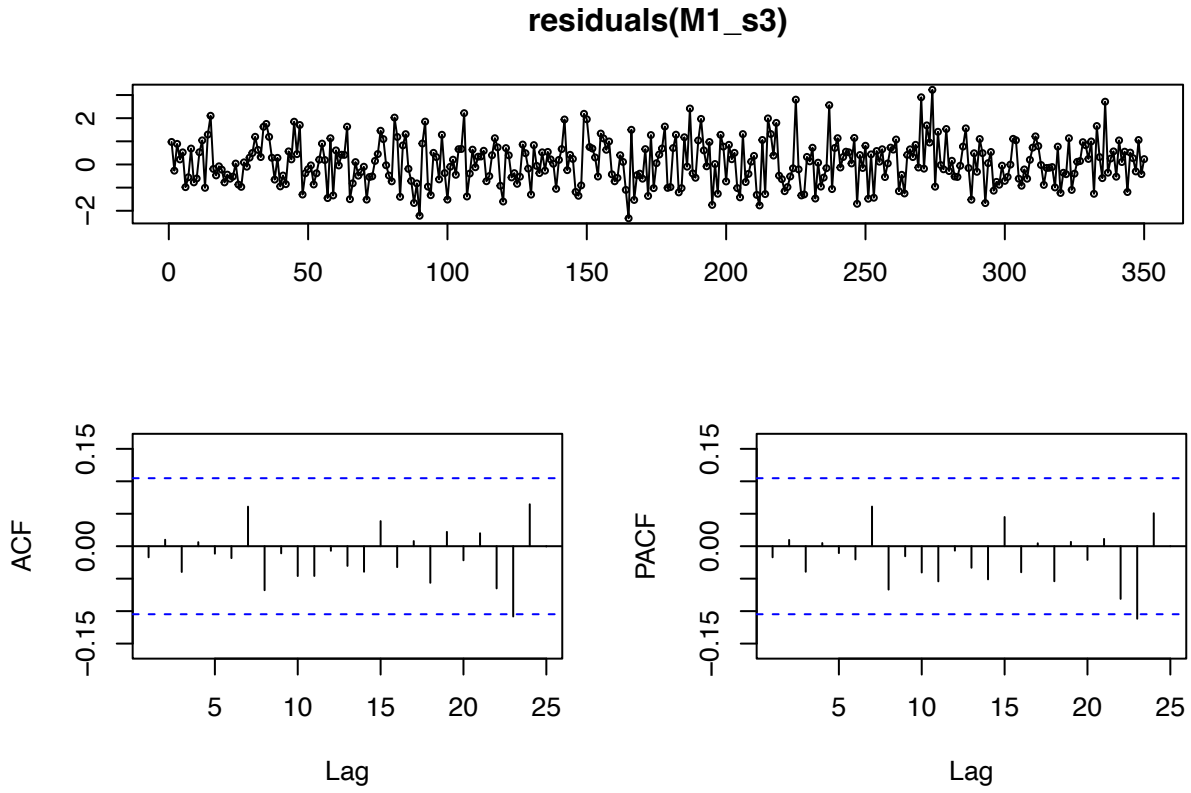

```
# Modelo SARMA(2,1)x(1,0)_12 média = 0
M1_s3 <- Arima(serie03, order=c(2,0,1),
               seasonal = list(order = c(1,0,0), period = 12),
               include.mean = FALSE)
autoplot(M1_s3) # Raízes inversas caem dentro do círculo unitário
```




```
coeftest(M1_s3) # Coeficientes são estatísticamente significantes
```

```
##
## z test of coefficients:
##
##       Estimate Std. Error z value  Pr(>|z|)
## ar1   0.551389   0.056190  9.8130 < 2.2e-16 ***
## ar2  -0.355327   0.055328 -6.4222 1.343e-10 ***
## ma1   0.852654   0.038158 22.3451 < 2.2e-16 ***
## sar1 -0.145524   0.052739 -2.7593  0.005792 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tsdisplay(residuals(M1_s3)) # Resíduo é Ruído Branco
```



Equação modelo SARMA$(2,1)\mathbf{x}(1,0)_{12}$

$$y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + \theta_1 \epsilon_{t-1} + \phi_1^{12} y_{t-12} + \epsilon_t$$

Encontrando equações de previsão para l = 1, 2 e 3

$$y_T(1) = \phi_1 y_T + \phi_2 y_{T-1} + \phi_1^{12} y_T + \theta_1 \epsilon_T$$

$$y_T(2) = \phi_1 y_{T(1)} + \phi_2 y_T + \phi_1^{12} y_{T(1)}$$

$$y_T(3) = \phi_1 y_{T(2)} + \phi_2 y_{T(1)} + \phi_1^{12} y_{T(2)}$$

Substituindo valores estimados dos coeficientes

$$y_T(1) = 0,0.5514 y_T - 0,3553 y_{T-1} - 0,1455 y_T + 0,8526 \epsilon_T$$

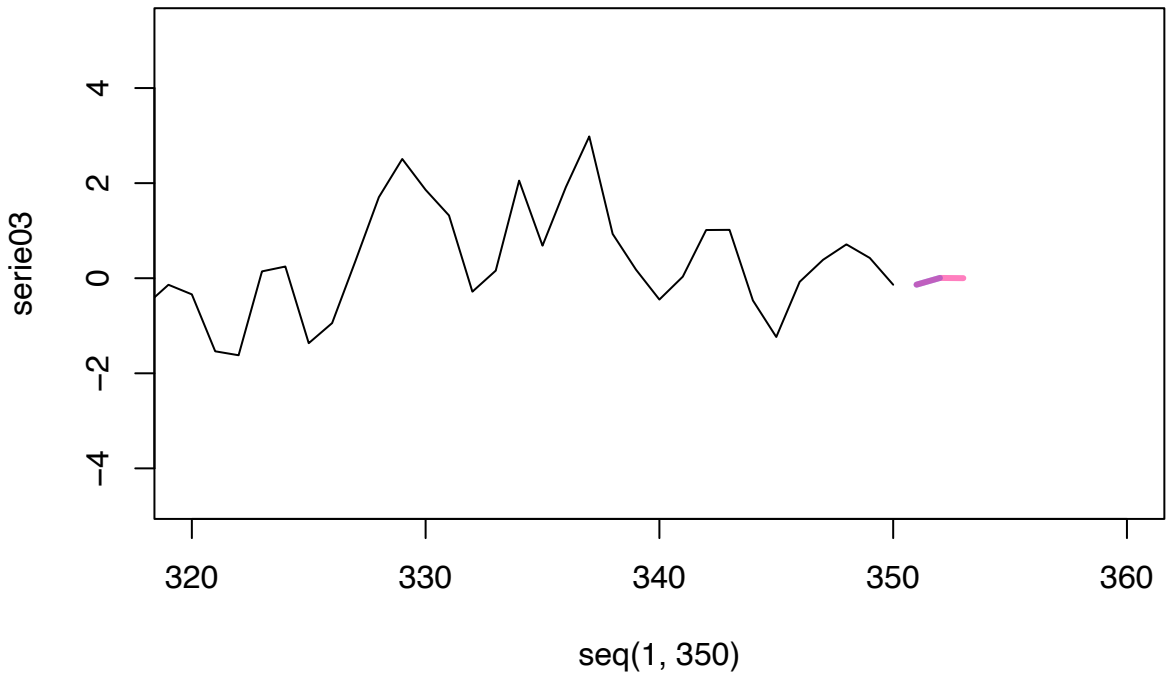
$$y_T(2) = 0,0.5514 y_{T(1)} - 0,3553 y_T - 0,1455 y_{T(1)}$$

$$y_T(3) = 0,0.5514 y_{T(2)} - 0,3553 y_{T(1)} - 0,1455 y_{T(2)}$$

```r
forecast(M1_s3, h = 3)
```

```
##     Point Forecast     Lo 80    Hi 80     Lo 95    Hi 95
## 351   -0.135017861 -1.385707 1.115671 -2.047782 1.777746
## 352    0.005535478 -2.150348 2.161419 -3.291604 3.302675
## 353    0.001007625 -2.217607 2.219622 -3.392071 3.394086
```

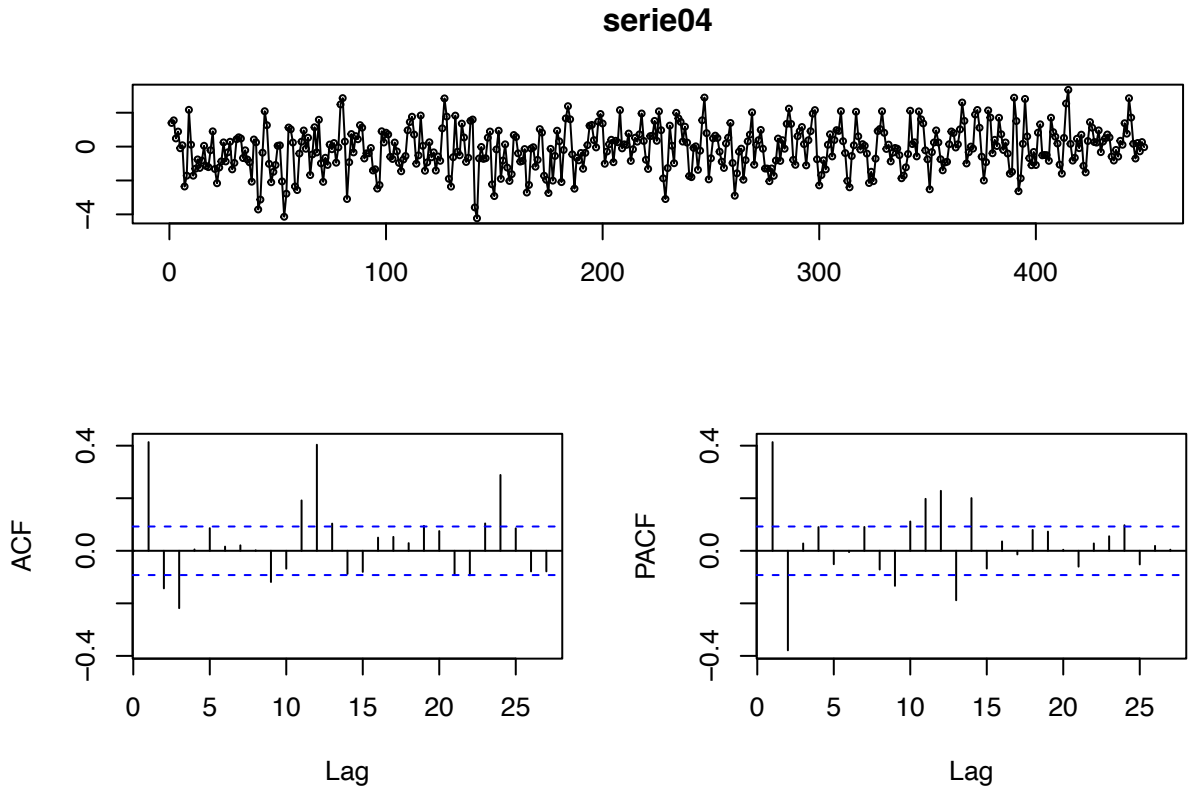
```r
plot(seq(1, 350), serie03, type = "l", xlim = c(320, 360))
lines(forecast(M1_s3, h = 1)$mean, lwd = 3, col = rgb(0.5,0,0, alpha = 0.5))
lines(forecast(M1_s3, h = 2)$mean, lwd = 3, col = rgb(0,0.5,1, alpha = 0.5))
lines(forecast(M1_s3, h = 3)$mean, lwd = 3, col = rgb(1,0,0.5, alpha = 0.5))
```



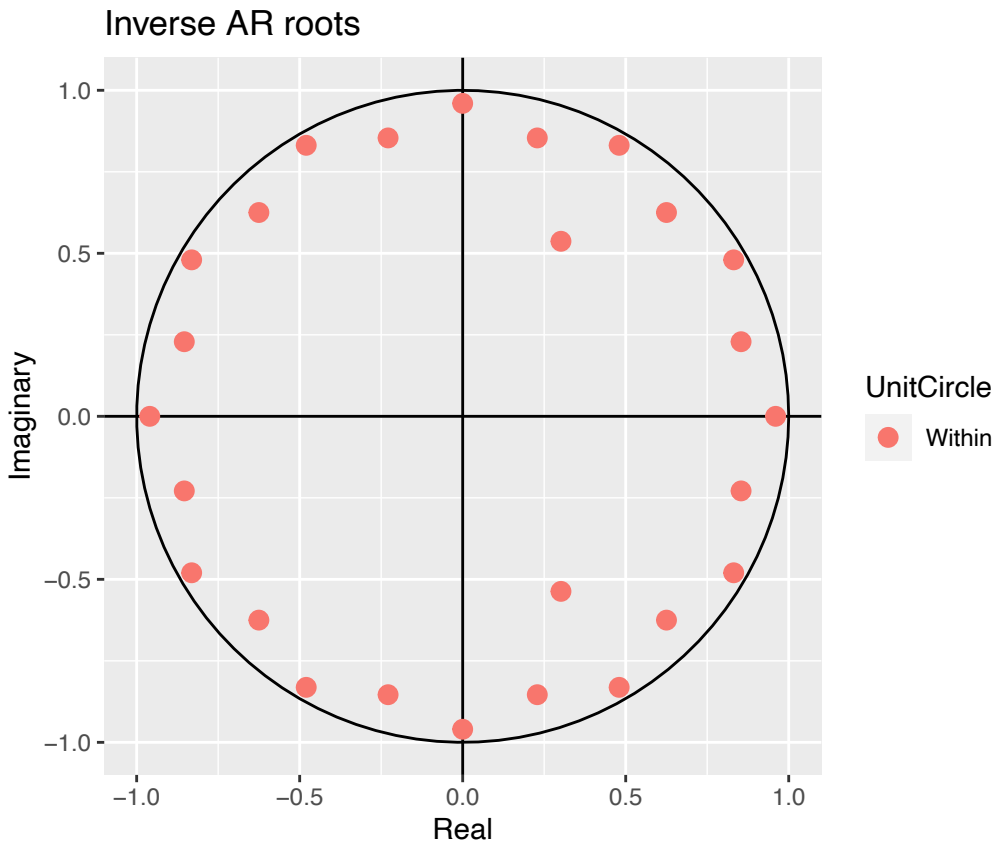
Série_04

Modelo SARMA$(2,0)\mathbf{x}(2,0)_{12}$

```r
serie04 <- scan("./Dados/Series/serie4.csv")
tsdisplay(serie04)
```



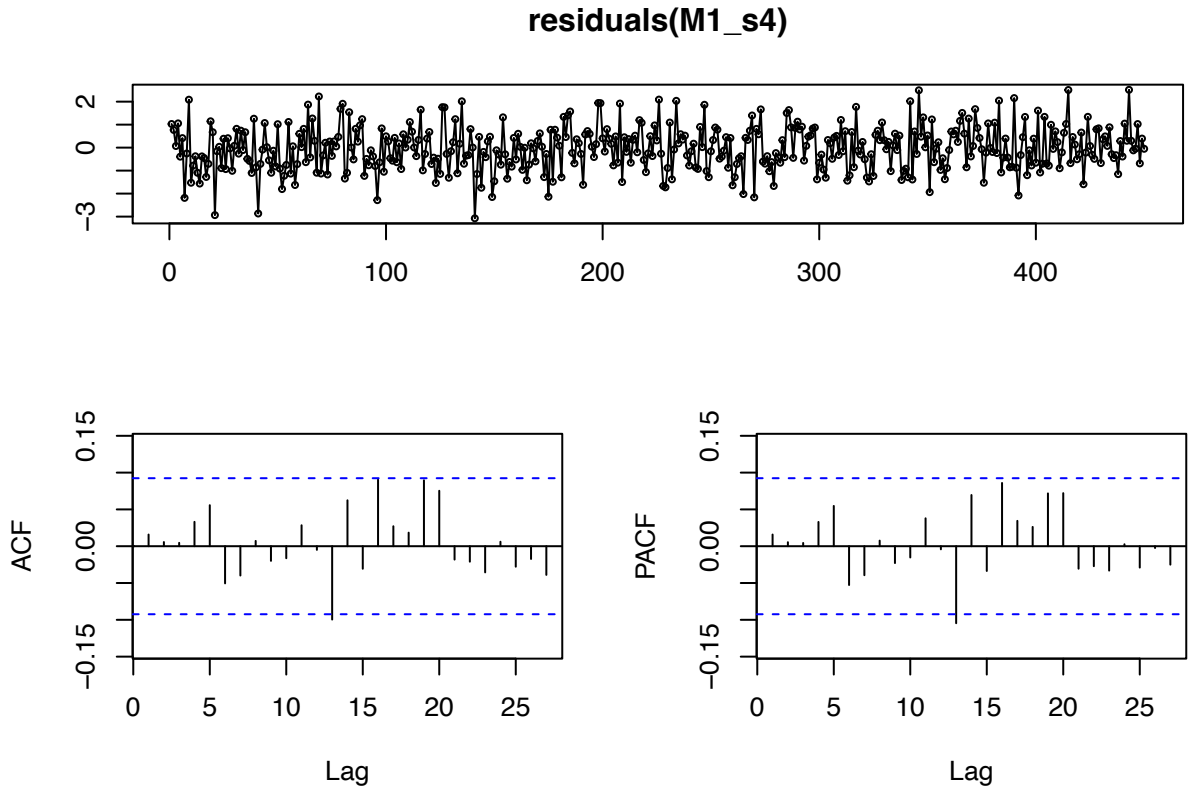

```r
# Modelo SARMA(2,0)x(2,0)_12 média = 0
M1_s4 <- Arima(serie04, order=c(2,0,0),
               seasonal = list(order = c(2,0,0), period = 12),
               include.mean = FALSE)
autoplot(M1_s4) # Raízes inversas caem dentro do círculo unitário
```




```
coeftest(M1_s4) # Coeficientes são estatísticamente significantes
```

```
##
## z test of coefficients:
##
##       Estimate Std. Error z value  Pr(>|z|)
## ar1   0.602942   0.043654 13.8120 < 2.2e-16 ***
## ar2  -0.379146   0.043756 -8.6650 < 2.2e-16 ***
## sar1  0.383900   0.047817  8.0286  9.86e-16 ***
## sar2  0.139348   0.048113  2.8963  0.003776 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tsdisplay(residuals(M1_s4)) # Resíduo é Ruído Branco (lag 13 julgo ser correlação expúria)
```



Equação modelo SARMA$(2,0)\mathbf{x}(2,0)_{12}$

$$y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + \phi_1^{12} y_{t-12} + \phi_2^{12} y_{t-24} + \epsilon_t$$

Encontrando equações de previsão para l = 1, 2 e 3

$$y_T(1) = \phi_1 y_T + \phi_2 y_{T-1} + \phi_1^{12} y_T + \phi_2^{12} y_{T-12}$$

$$y_T(2) = \phi_1 y_{T(1)} + \phi_2 y_T + \phi_1^{12} y_{T(1)} + \phi_2^{12} y_T$$

$$y_T(3) = \phi_1 y_{T(2)} + \phi_2 y_{T(1)} + \phi_1^{12} y_{T(2)} + \phi_2^{12} y_{T(1)}$$

Substituindo valores estimados dos coeficientes

$$y_T(1) = 0,6029 y_T - 0,3791 y_{T-1} + 0,3839 y_T + 0,1393 y_{T-12}$$

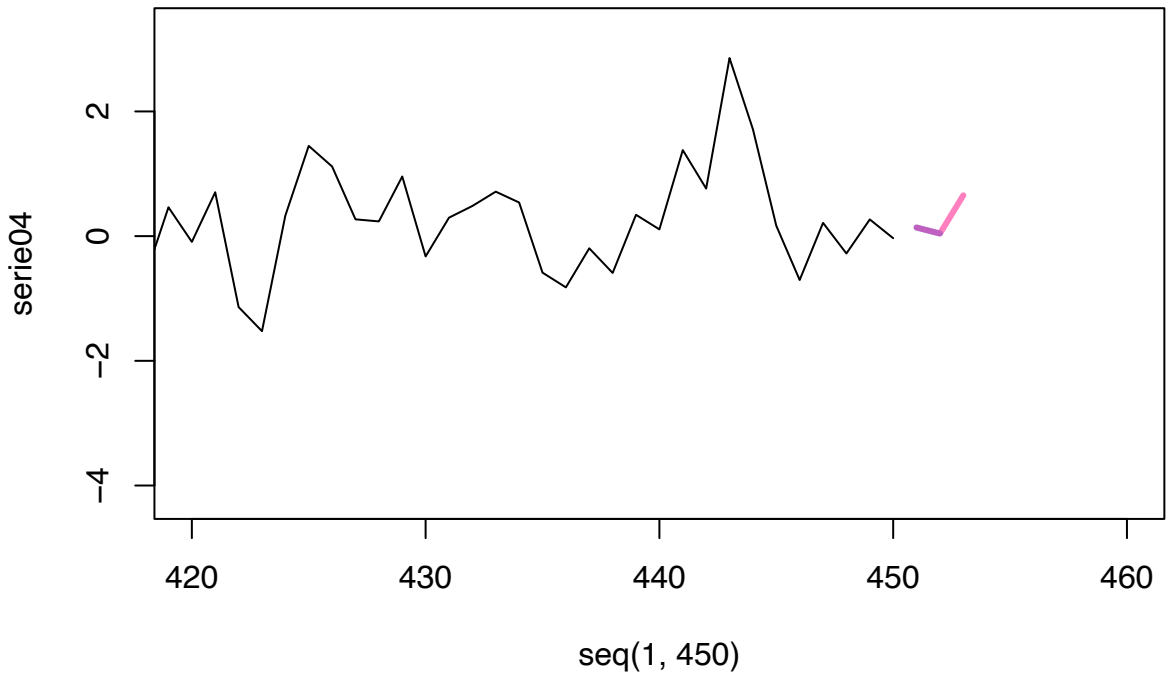
$$y_T(2) = 0,6029 y_{T(1)} - 0,3791 y_T + 0,3839 y_{T(1)} + 0,1393 y_T$$

$$y_T(3) = 0,6029 y_{T(2)} - 0,3791 y_{T(1)} + 0,3829 y_{T(2)} + 0,1393 y_{T(1)}$$

```r
forecast(M1_s4, h = 3)
```

```
##     Point Forecast      Lo 80    Hi 80     Lo 95    Hi 95
## 451     0.13797462 -1.1003338 1.376283 -1.755855 2.031804
## 452     0.04148724 -1.4044939 1.487468 -2.169950 2.252925
## 453     0.65493798 -0.7911723 2.101048 -1.556697 2.866573
```

```r
plot(seq(1, 450), serie04, type = "l", xlim = c(420, 460))
lines(forecast(M1_s4, h = 1)$mean, lwd = 3, col = rgb(0.5,0,0, alpha = 0.5))
lines(forecast(M1_s4, h = 2)$mean, lwd = 3, col = rgb(0,0.5,1, alpha = 0.5))
lines(forecast(M1_s4, h = 3)$mean, lwd = 3, col = rgb(1,0,0.5, alpha = 0.5))
```

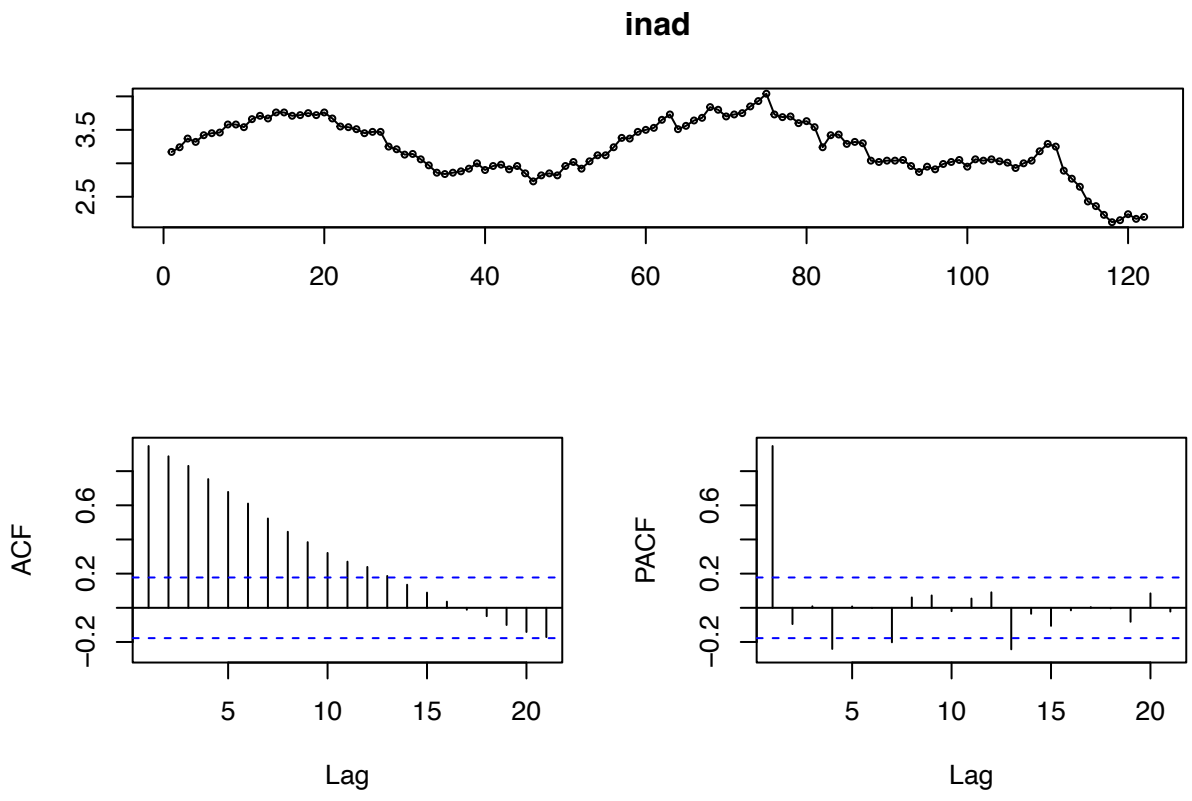


2. Para as séries Inadimplência no Crédito e Câmbio Contratado, realize os seguintes procedimentos:

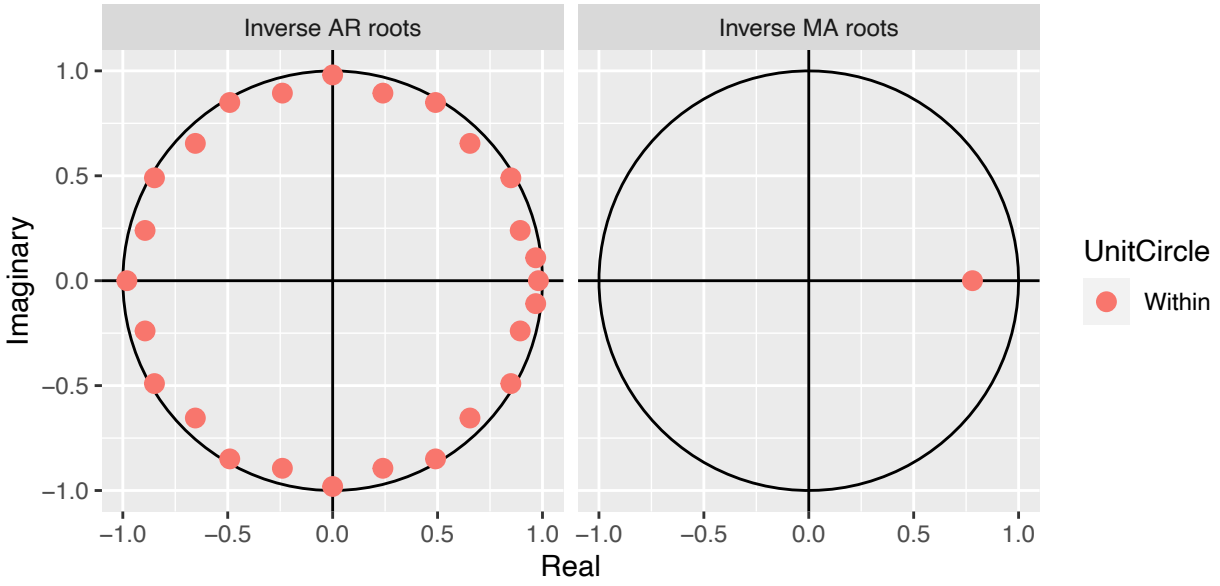
a. Modele as duas séries seguindo os procedimentos utilizados no item (1), desconsiderando as 4 últimas observações de cada série. Obs: se, por exemplo, a série "Inad" possuir 300 observações você poderá utilizar Inad[1:296] na linha de comando de estimação do R.

Série Inadimplência

```
inad <- read_xls("./Dados/Series/Inad_Credito2011.03.xls", col_names = FALSE)$...1
inad <- inad[1:(length(inad)-4)]
tsdisplay(inad)
```



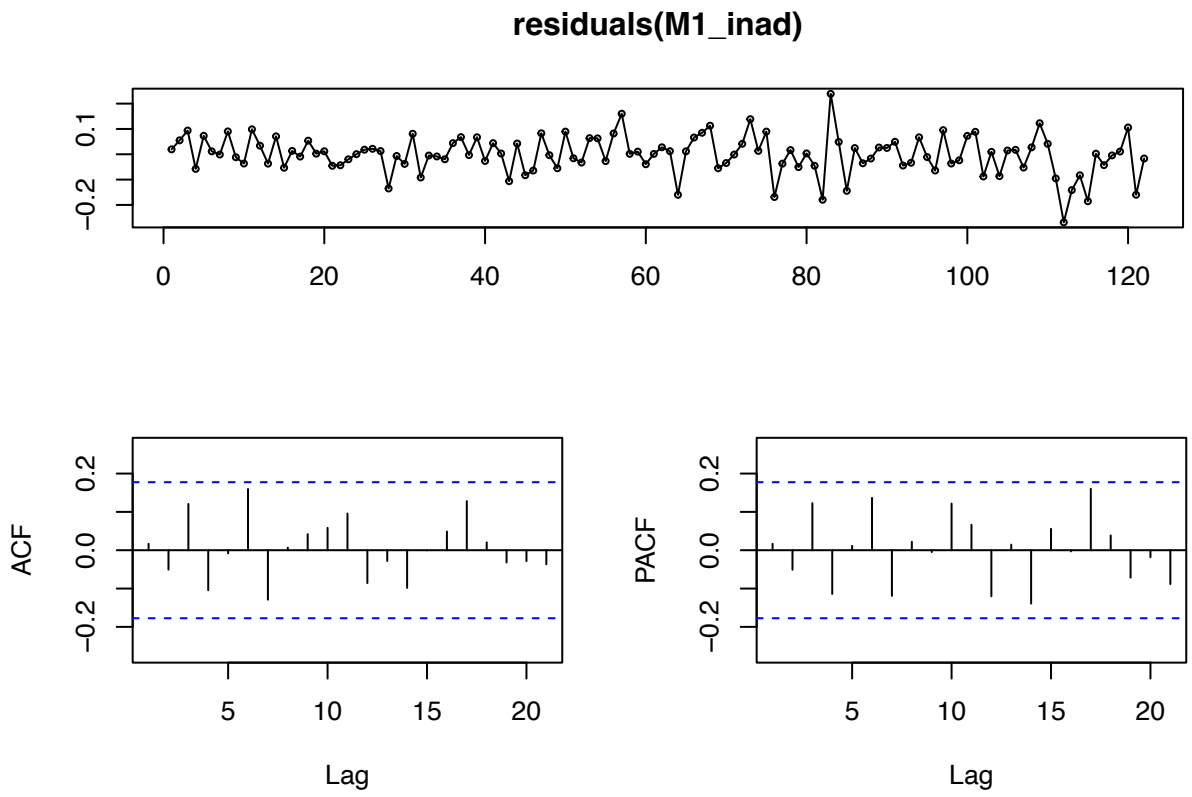

```
# Modelo SARMA(2,1)x(2,0)_12
M1_inad <- Arima(inad, order=c(2,0,1),
                 seasonal = list(order = c(2,0,0), period = 12),
                 include.mean = TRUE)
autoplot(M1_inad) # Raízes inversas caem dentro do círculo unitário
```



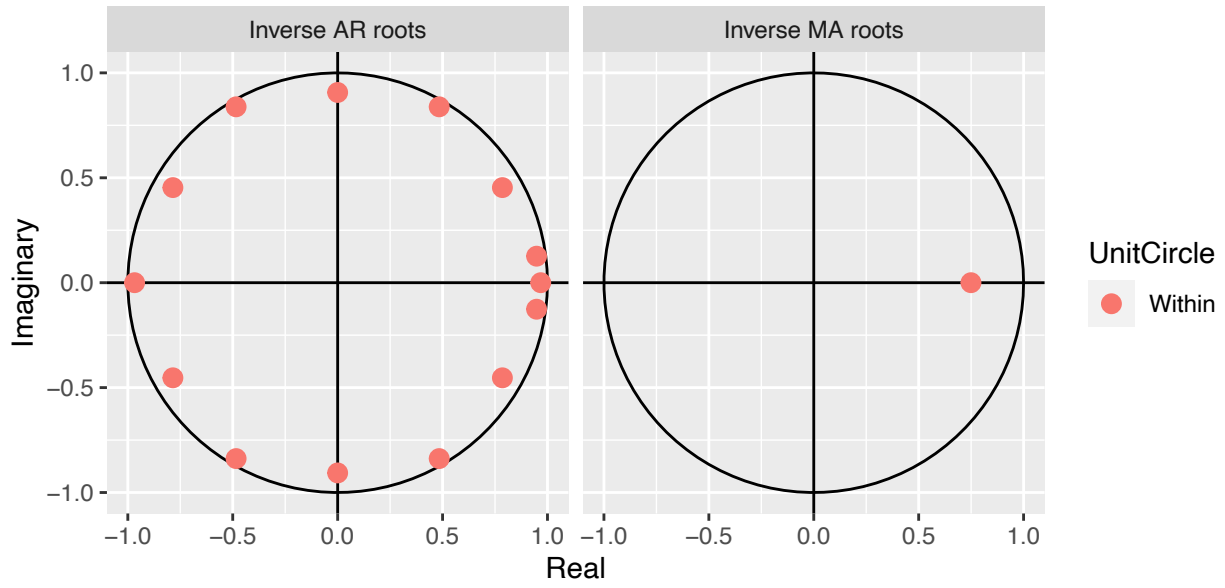

```
coeftest(M1_inad) # Coeficientes são estatísticamente significantes
```

```
##
## z test of coefficients:
##
##            Estimate Std. Error  z value  Pr(>|z|)
## ar1        1.935534   0.041399  46.7536 < 2.2e-16 ***
## ar2       -0.948508   0.040426 -23.4630 < 2.2e-16 ***
## ma1       -0.780296   0.082462  -9.4625 < 2.2e-16 ***
## sar1       0.395934   0.093623   4.2290 2.347e-05 ***
## sar2       0.312397   0.096226   3.2465  0.001168 **
## intercept  3.024662   0.313763   9.6400 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tsdisplay(residuals(M1_inad)) # Resíduo é Ruído Branco
```



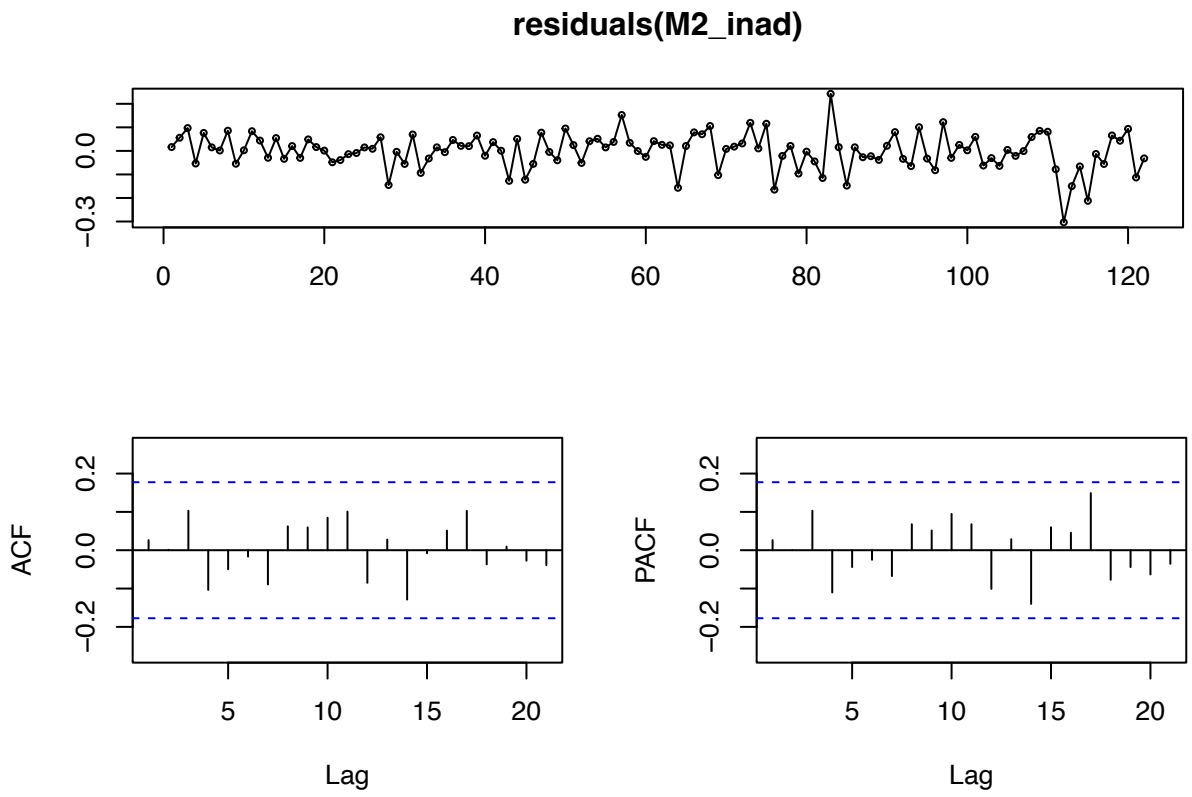

```
# Modelo SARMA(2,1)x(2,0)_06
M2_inad <- Arima(inad, order=c(2,0,1),
                 seasonal = list(order = c(2,0,0), period = 6),
                 include.mean = TRUE)
autoplot(M2_inad) # Raízes inversas caem dentro do círculo unitário
```



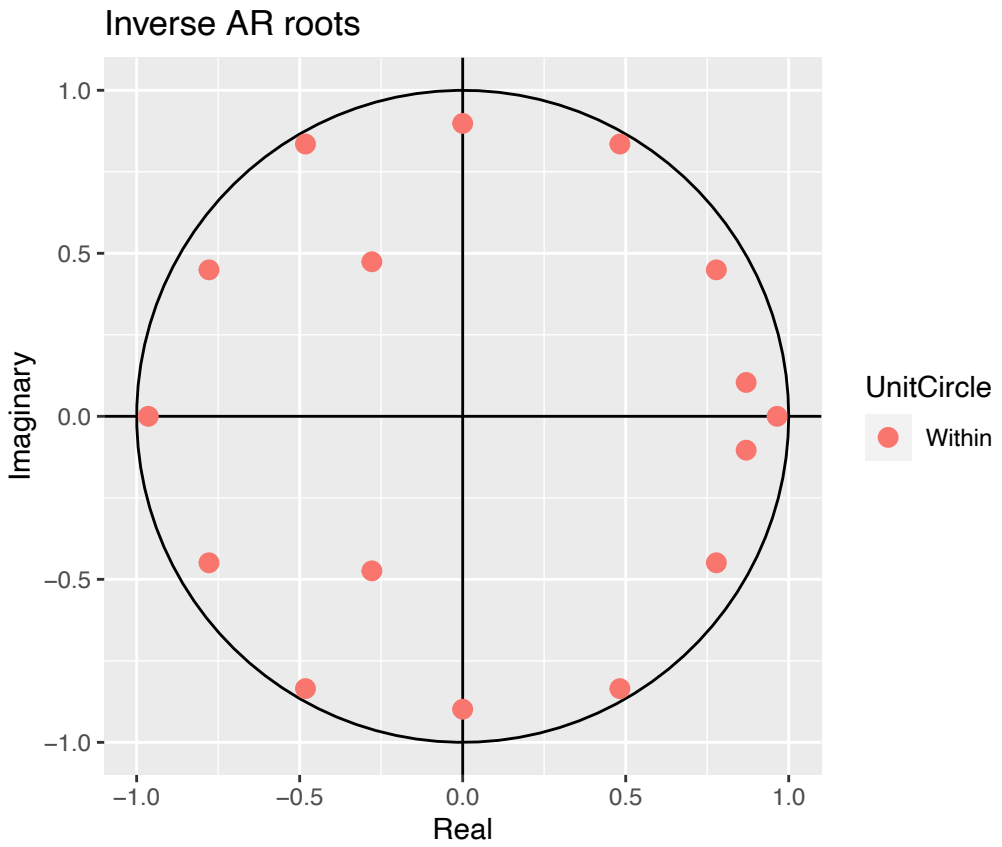

```
coeftest(M2_inad) # Coeficientes são estatísticamente significantes
```

```
##
## z test of coefficients:
##
##            Estimate Std. Error  z value  Pr(>|z|)
## ar1        1.896129   0.077123  24.5859 < 2.2e-16 ***
## ar2       -0.914790   0.073475 -12.4503 < 2.2e-16 ***
## ma1       -0.749194   0.134562  -5.5676 2.582e-08 ***
## sar1       0.266659   0.085422   3.1217  0.001798 **
## sar2       0.456387   0.090772   5.0278 4.960e-07 ***
## intercept  3.052967   0.289588  10.5424 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tsdisplay(residuals(M2_inad)) # Resíduo é Ruído Branco
```



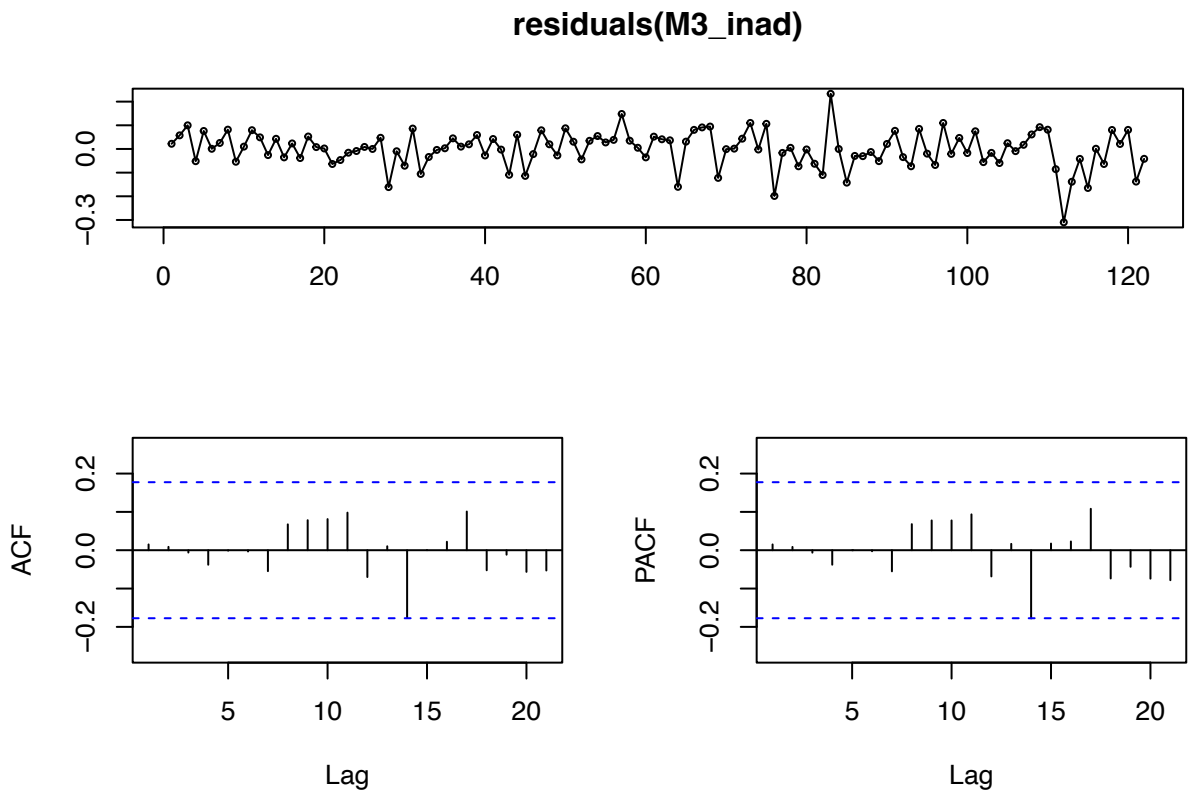

```
# Modelo SARMA(4,0)x(2,0)_06
M3_inad <- Arima(inad, order=c(4,0,0),
                 seasonal = list(order = c(2,0,0), period = 6),
                 include.mean = TRUE)
autoplot(M3_inad) # Raízes inversas caem dentro do círculo unitário
```




```
coeftest(M3_inad) # Coeficientes são estatísticamente significantes
```

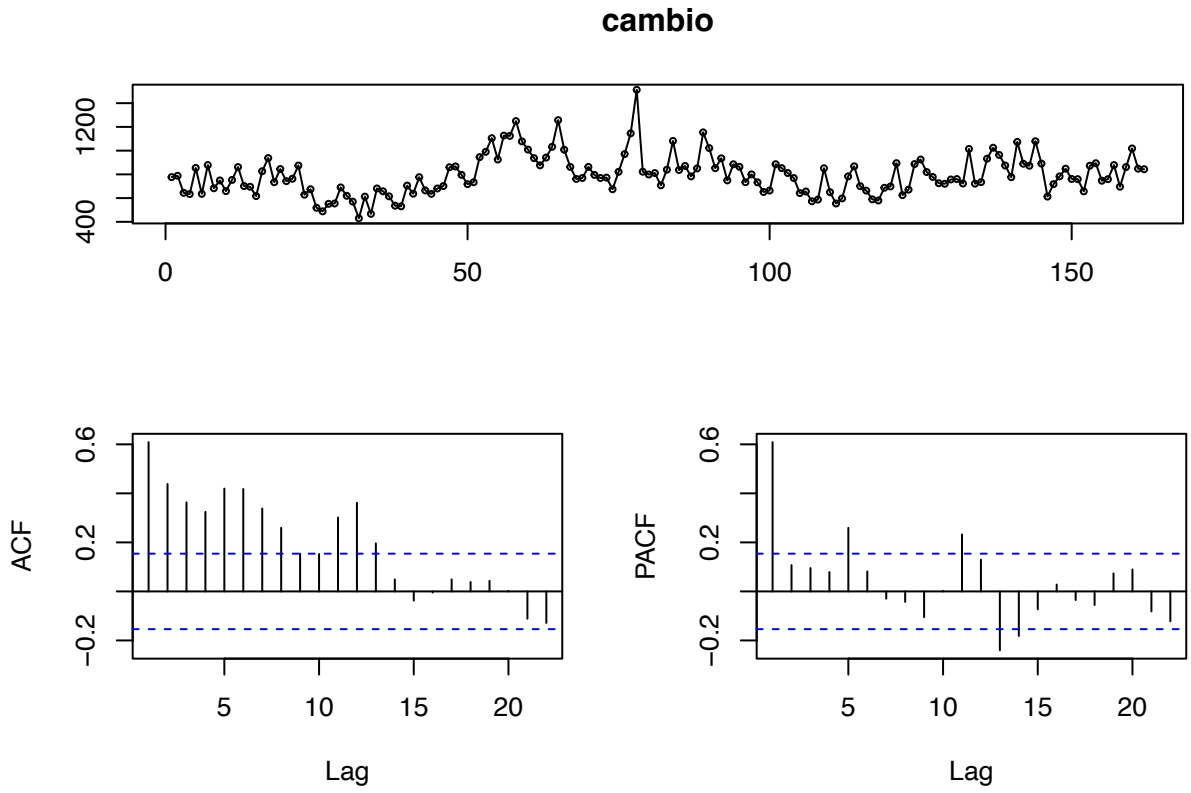
```
##
## z test of coefficients:
##
##            Estimate Std. Error z value  Pr(>|z|)
## ar1        1.182085   0.088336 13.3817 < 2.2e-16 ***
## ar2       -0.100469   0.141917 -0.7079  0.478982
## ar3        0.098496   0.145913  0.6750  0.499655
## ar4       -0.231805   0.093949 -2.4674  0.013611 *
## sar1       0.278553   0.087779  3.1733  0.001507 **
## sar2       0.423201   0.092428  4.5787 4.678e-06 ***
## intercept  2.987847   0.376460  7.9367 2.077e-15 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tsdisplay(residuals(M3_inad)) # Resíduo é Ruído Branco
```

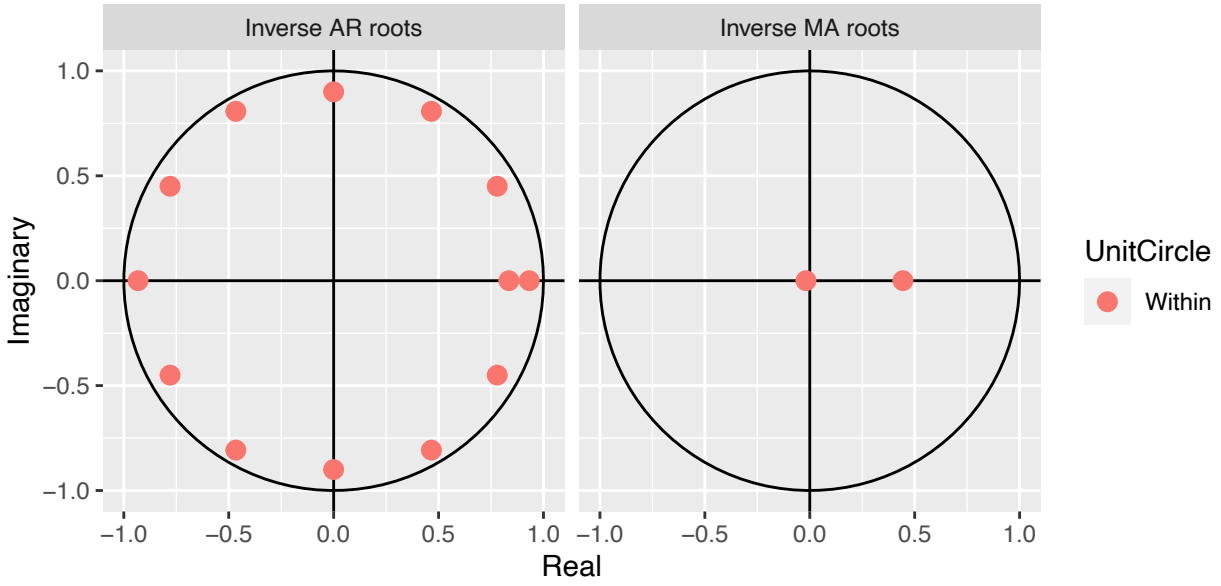


Série Câmbio Contratado

```
cambio <- scan("./Dados/Series/Cambio_Contratado_2005.01.csv")
cambio <- cambio[1:(length(cambio)-4)]

tsdisplay(cambio)
```



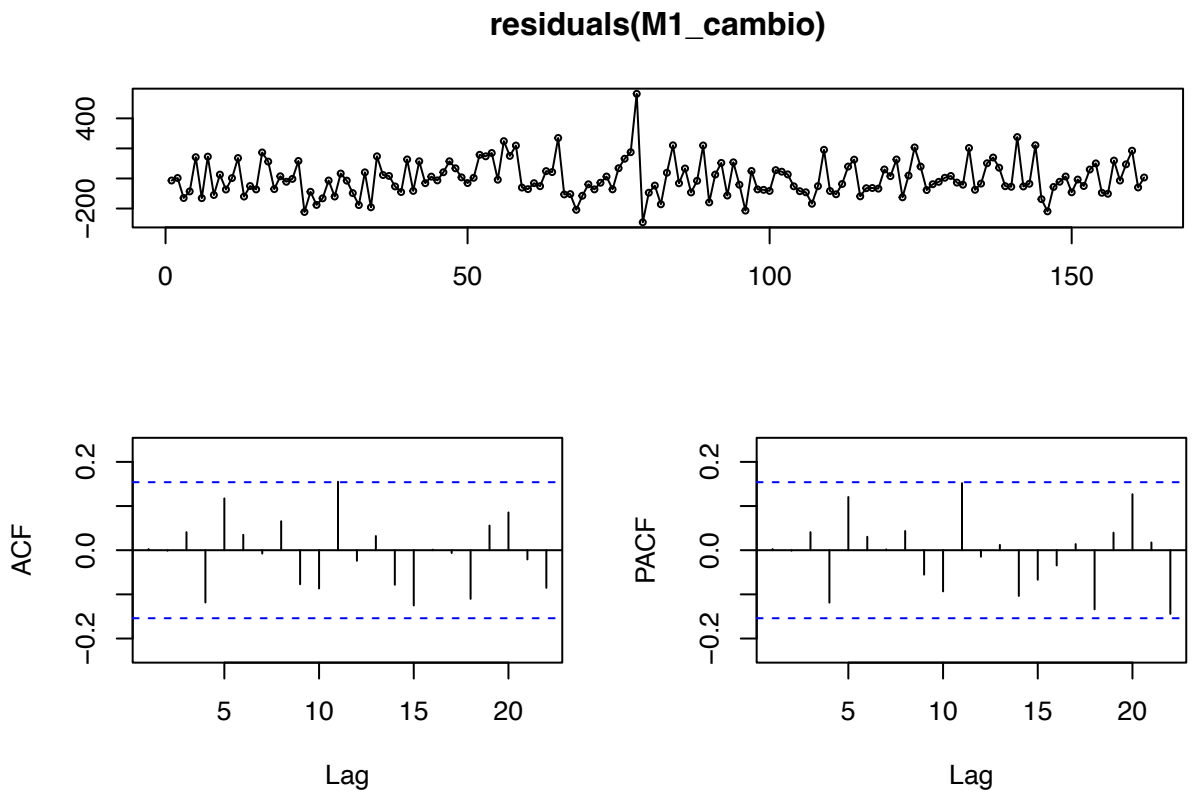

```
# Modelo SARMA(1,2)x(2,0)_06
M1_cambio <- Arima(cambio, order = c(1,0,2),
                   seasonal = list(order = c(2,0,0), period = 6),
                   include.mean = TRUE)
autoplot(M1_cambio) # Raízes inversas caem dentro do círculo unitário
```



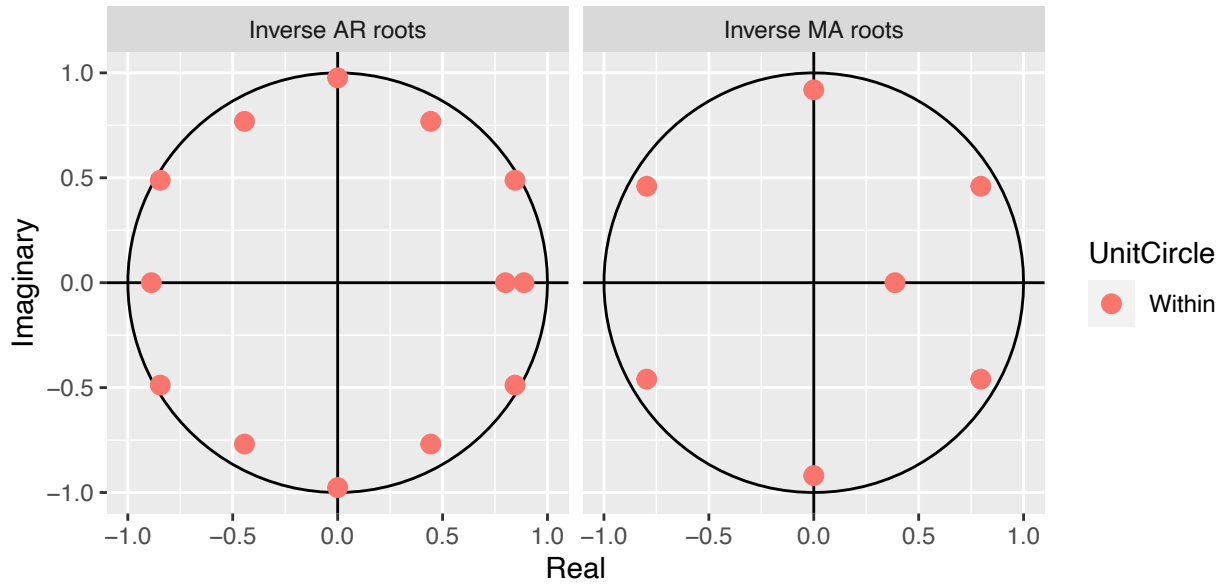

```
coeftest(M1_cambio) # Coeficientes são estatísticamente significantes
```

```
##
## z test of coefficients:
##
##              Estimate  Std. Error z value  Pr(>|z|)
## ar1         0.8352905   0.0827614 10.0928 < 2.2e-16 ***
## ma1        -0.4261543   0.1129231 -3.7738 0.0001608 ***
## ma2        -0.0079605   0.1036559 -0.0768 0.9387851
## sar1        0.1244974   0.0763155  1.6314 0.1028160
## sar2        0.3490941   0.0778668  4.4832 7.353e-06 ***
## intercept 796.4636273  56.1743810 14.1784 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tsdisplay(residuals(M1_cambio)) # Resíduo é Ruído Branco
```



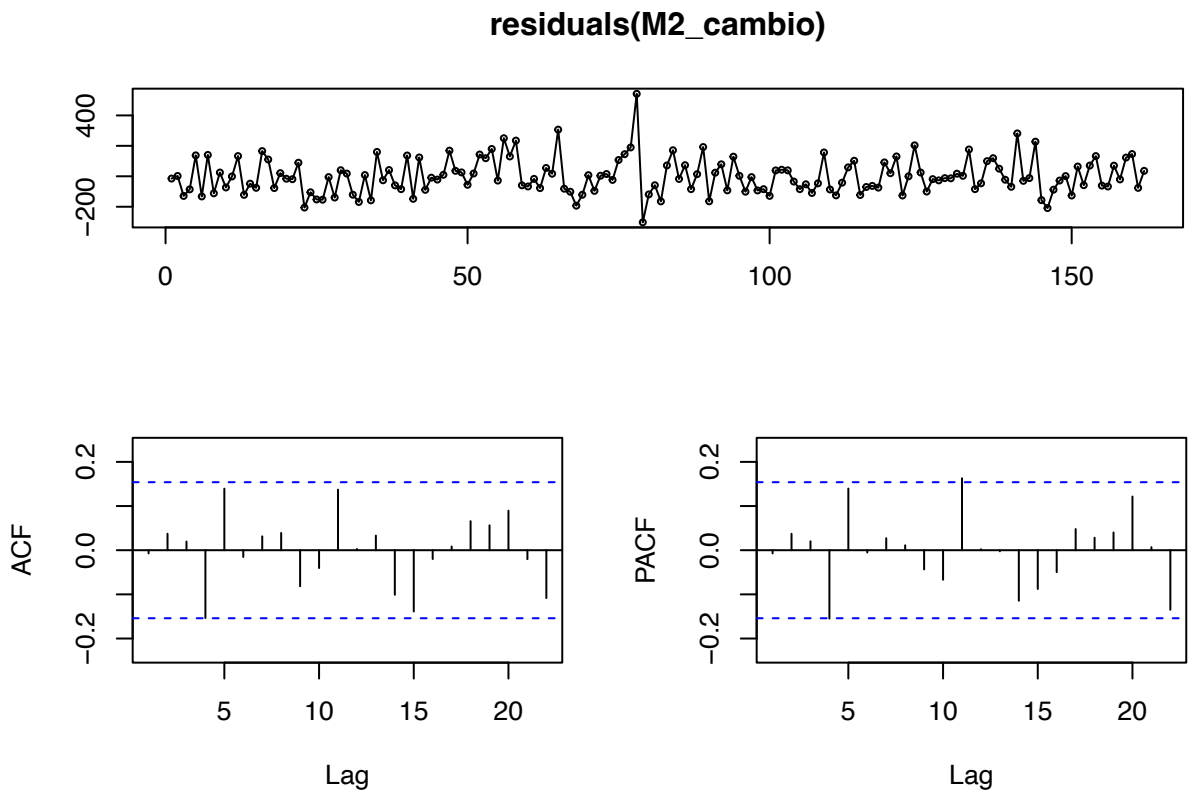

```
# Modelo SARMA(1,1)x(2,1)_06
M2_cambio <- Arima(cambio, order = c(1,0,1),
                   seasonal = list(order = c(2,0,1), period = 6),
                   include.mean = TRUE)
autoplot(M2_cambio) # Raízes inversas caem dentro do círculo unitário
```



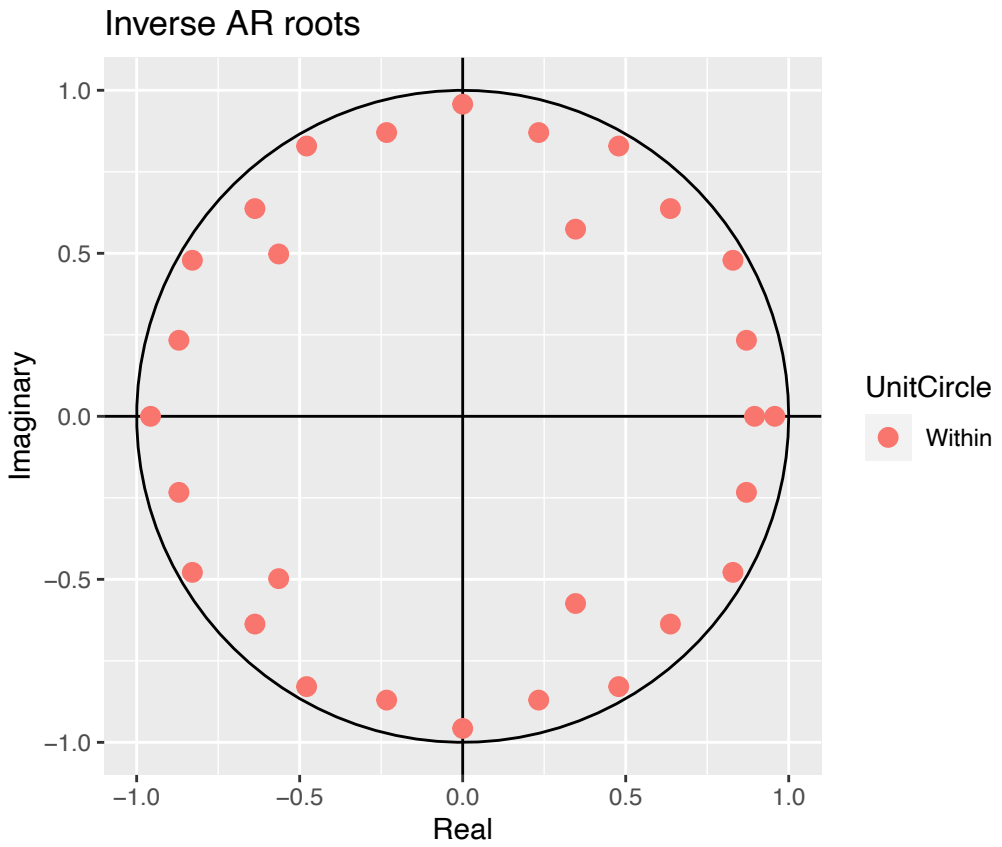

```
coeftest(M2_cambio) # Coeficientes são estatísticamente significantes
```

```
##
## z test of coefficients:
##
##             Estimate Std. Error z value  Pr(>|z|)
## ar1         0.799781   0.077174 10.3633 < 2.2e-16 ***
## ma1        -0.387160   0.118460 -3.2683 0.0010820 **
## sar1       -0.375738   0.151711 -2.4767 0.0132617 *
## sar2        0.424126   0.072306  5.8657 4.473e-09 ***
## sma1        0.603185   0.169857  3.5511 0.0003836 ***
## intercept 797.841905  44.914248 17.7637 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tsdisplay(residuals(M2_cambio)) # Resíduo é Ruído Branco
```



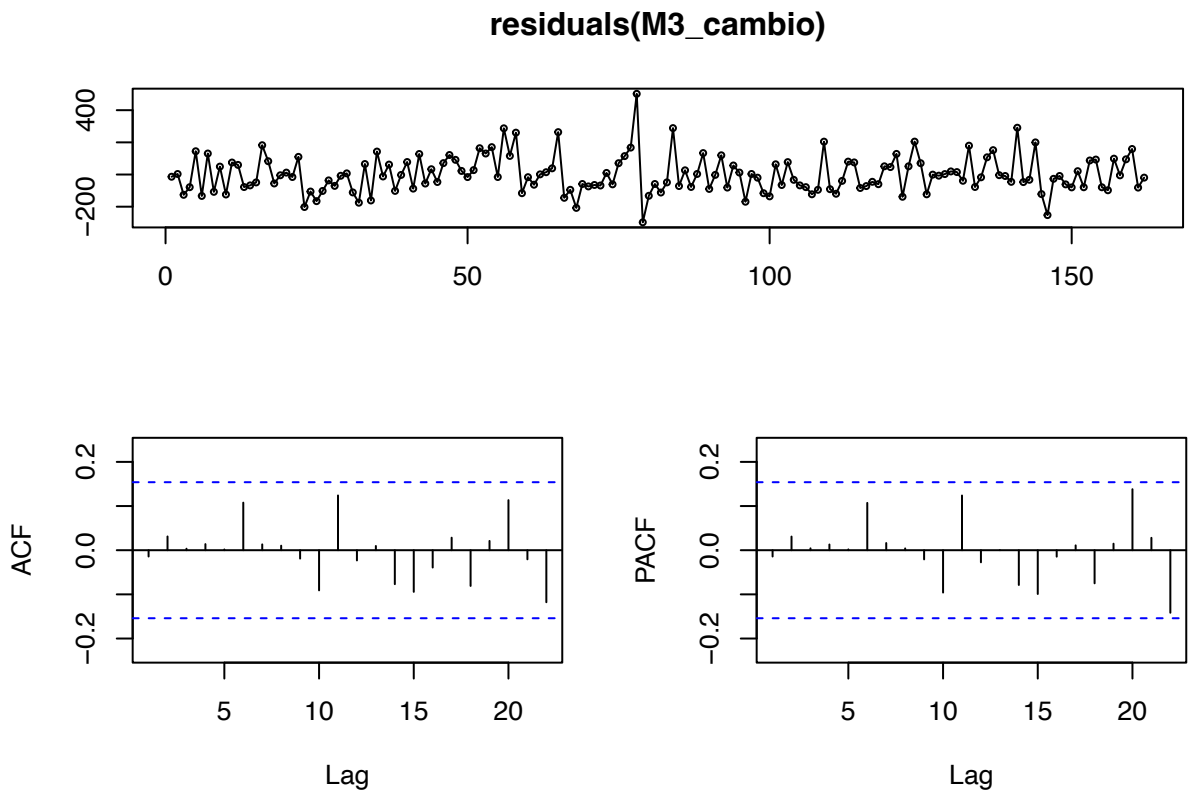

```
# Modelo SARMA(5,0)x(2,0)_12
M3_cambio <- Arima(cambio, order = c(5,0,0),
                   seasonal = list(order = c(2,0,0), period = 12),
                   include.mean = TRUE)
autoplot(M3_cambio) # Raízes inversas caem dentro do círculo unitário
```




```
coeftest(M3_cambio) # Coeficientes são estatísticamente significantes
```

```
##
## z test of coefficients:
##
##             Estimate Std. Error z value  Pr(>|z|)
## ar1         0.459180   0.076864  5.9739 2.316e-09 ***
## ar2         0.156173   0.086506  1.8053 0.0710216 .
## ar3         0.094642   0.085324  1.1092 0.2673375
## ar4        -0.151535   0.086667 -1.7485 0.0803833 .
## ar5         0.227920   0.077514  2.9404 0.0032780 **
## sar1        0.305798   0.080880  3.7809 0.0001563 ***
## sar2        0.169748   0.083833  2.0248 0.0428835 *
## intercept 798.525841  71.432235 11.1788 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tsdisplay(residuals(M3_cambio)) # Resíduo é Ruído Branco
```



b. Utilizando os 3 melhores modelos candidatos ao DGP de cada série, calcule as previsões para l = 1,2,3 e 4 passos à frente.

Série Inadimplência

```
(P1_inad <- forecast(M1_inad, h = 4)) # Modelo SARMA(2,1)x(2,0)_12
```

```
##     Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 123       2.196938 2.098443 2.295433 2.046304 2.347573
## 124       2.038390 1.887897 2.188883 1.808231 2.268549
## 125       2.051488 1.854690 2.248285 1.750512 2.352464
## 126       2.034084 1.793997 2.274170 1.666903 2.401264
```

```
(P2_inad <- forecast(M2_inad, h = 4)) # Modelo SARMA(2,1)x(2,0)_06
```

```
##     Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 123       2.184051 2.084589 2.283514 2.031936 2.336166
## 124       2.038039 1.886691 2.189388 1.806572 2.269507
## 125       2.047744 1.851248 2.244241 1.747229 2.348260
## 126       2.080492 1.843069 2.317915 1.717385 2.443599
```

```
(P3_inad <- forecast(M3_inad, h = 4)) # Modelo SARMA(4,0)x(2,0)_06
```

```
##     Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 123       2.201471 2.101907 2.301035 2.049201 2.353741
## 124       2.051355 1.897197 2.205513 1.815591 2.287120
## 125       2.058350 1.857261 2.259439 1.750811 2.365889
## 126       2.092450 1.841210 2.343689 1.708212 2.476687
```

Série Câmbio Contratado

```
(P1_cambio <- forecast(M1_cambio, h = 4)) # Modelo SARMA(1,2)x(2,0)_06
```

```
##     Point Forecast    Lo 80     Hi 80    Lo 95    Hi 95
## 163       844.8848 690.2665  999.5031 608.4165 1081.353
## 164       777.8655 610.8067  944.9243 522.3711 1033.360
## 165       866.8151 691.9660 1041.6642 599.4065 1134.224
## 166       887.7021 707.6172 1067.7871 612.2860 1163.118
```

```
(P2_cambio <- forecast(M2_cambio, h = 4)) # Modelo SARMA(1,1)x(2,1)_06
```

```
##     Point Forecast    Lo 80     Hi 80    Lo 95    Hi 95
## 163       832.7577 680.5975  984.9180 600.0487 1065.467
## 164       812.7758 648.1712  977.3803 561.0349 1064.517
## 165       913.6567 741.5634 1085.7499 650.4628 1176.851
## 166       901.4072 724.6901 1078.1243 631.1418 1171.673
```

```
(P3_cambio <- forecast(M3_cambio, h = 4)) # Modelo SARMA(5,0)x(2,0)_12
```

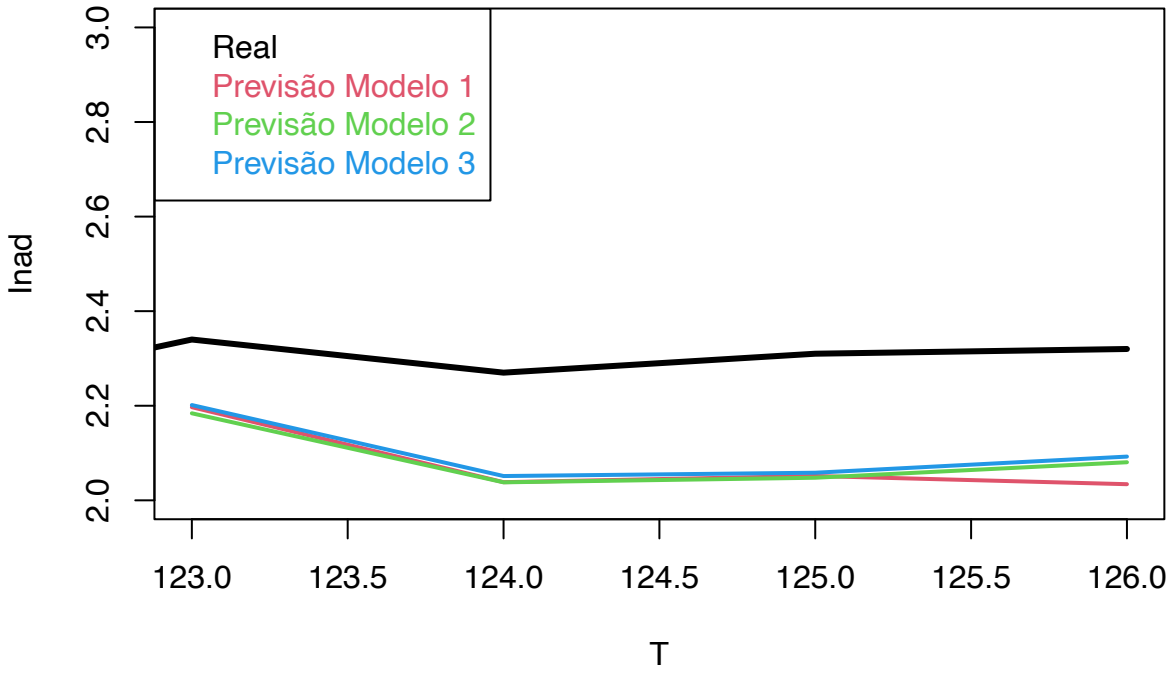
```
##     Point Forecast    Lo 80     Hi 80    Lo 95    Hi 95
## 163       808.6744 657.6436  959.7051 577.6928 1039.656
## 164       751.6787 585.4868  917.8706 497.5101 1005.847
## 165       918.7409 743.5485 1093.9333 650.8072 1186.675
## 166       862.0333 679.6862 1044.3804 583.1574 1140.909
```

c. Crie um gráfico utilizando o R para comparar os valores das previsões de cada modelo com os valores reais observados de cada série.

Série Inadimplência

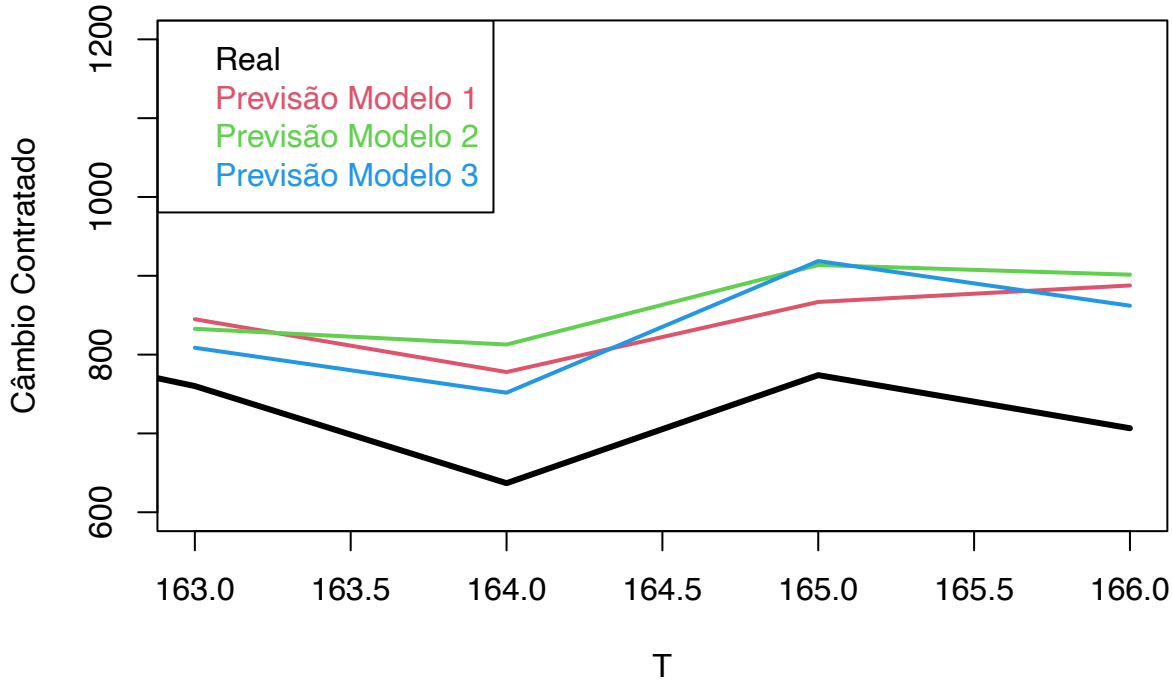
```
inad_reais <- read_xls("./Dados/Series/Inad_Credito2011.03.xls",
                       col_names = FALSE)$...1
plot(seq(1:126),inad_reais, type = "l", xlim = c(123, 126), ylim = c(2,3),
     lwd = 3, col = 1, xlab = "T", ylab = "Inad")
lines(P1_inad$mean, lwd = 2, col = 2)
```

```
lines(P2_inad$mean, lwd = 2, col = 3)
lines(P3_inad$mean, lwd = 2, col = 4)
legend("topleft", legend =
         c("Real", "Previsão Modelo 1", "Previsão Modelo 2","Previsão Modelo 3"),
       text.col = c(1, 2, 3, 4))
```



Série Câmbio Contratado

```
cambio_reais <- scan("./Dados/Series/Cambio_Contratado_2005.01.csv")
plot(seq(1:166),cambio_reais, type = "l", xlim = c(163, 166), ylim = c(600, 1200),
     lwd = 3, col = 1, xlab = "T", ylab = "Câmbio Contratado")
lines(P1_cambio$mean, lwd = 2, col = 2)
lines(P2_cambio$mean, lwd = 2, col = 3)
lines(P3_cambio$mean, lwd = 2, col = 4)
legend("topleft", legend =
         c("Real", "Previsão Modelo 1", "Previsão Modelo 2","Previsão Modelo 3"),
       text.col = c(1, 2, 3, 4))
```



d. Utilizando a estatística Erro Quadrático Médio (EQM) indique qual foi o melhor modelo para prever os valores das séries. Verifique se o melhor modelo previsor é o mesmo modelo que seria escolhido na Etapa III da Escolha do algoritmo de modelagem baseado nas estatísticas AIC e BIC e no critério da parcimônia. Comente os resultados.

Série Inadimplência

```
cat("SARMA(2,1)x(2,0)_12: AIC",M1_inad$aic, "| BIC",M1_inad$bic,"\n")
```

```
## SARMA(2,1)x(2,0)_12: AIC -260.8079 | BIC -241.1797
```

```
cat("SARMA(2,1)x(2,0)_06: AIC",M2_inad$aic, "| BIC",M2_inad$bic,"\n")
```

```
## SARMA(2,1)x(2,0)_06: AIC -261.4592 | BIC -241.8311
```

```
cat("SARMA(4,0)x(2,0)_06: AIC",M3_inad$aic, "| BIC",M3_inad$bic,"\n")
```

```
## SARMA(4,0)x(2,0)_06: AIC -260.554 | BIC -238.1219
```

Série Câmbio Contratado

```
cat("SARMA(1,2)x(2,0)_06: AIC",M1_cambio$aic, "| BIC",M1_cambio$bic,"\n")
```

```
## SARMA(1,2)x(2,0)_06: AIC 2022.975 | BIC 2044.588
```

```
cat("SARMA(1,1)x(2,1)_06: AIC",M2_cambio$aic, "| BIC",M2_cambio$bic,"\n")
```

```
## SARMA(1,1)x(2,1)_06: AIC 2018.592 | BIC 2040.205
```

```
cat("SARMA(5,0)x(2,0)_12: AIC",M3_cambio$aic, "| BIC",M3_cambio$bic,"\n")
```

```
## SARMA(5,0)x(2,0)_12: AIC 2018.345 | BIC 2046.133
```