Q7_Regression

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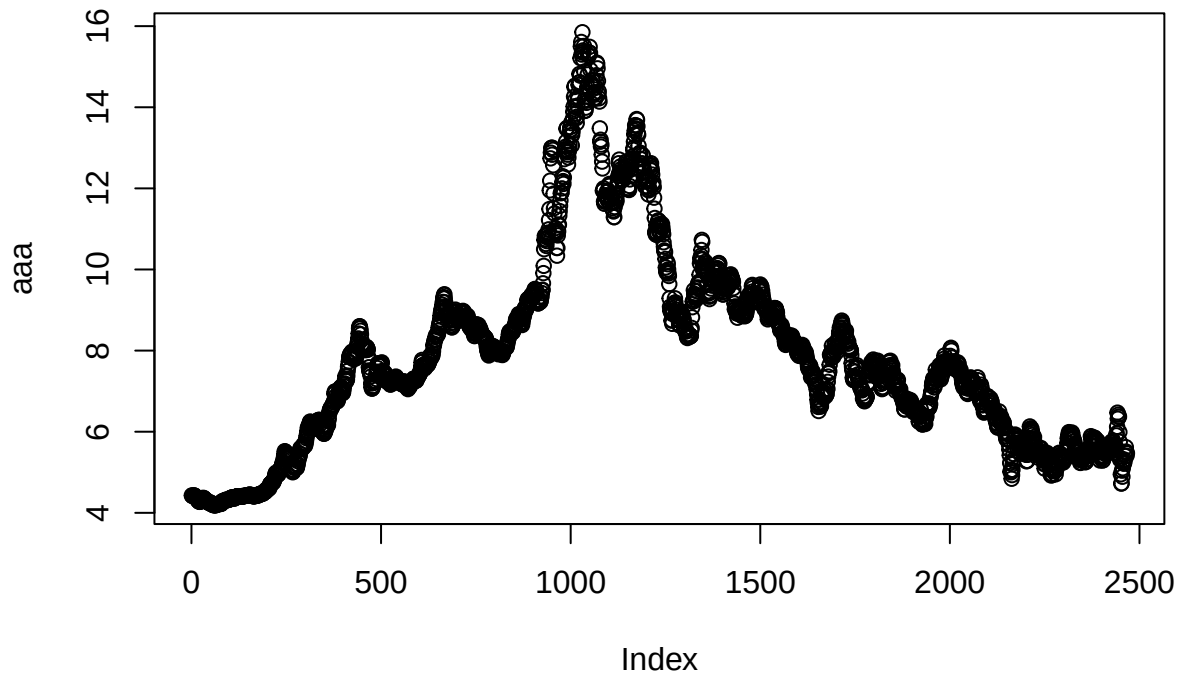
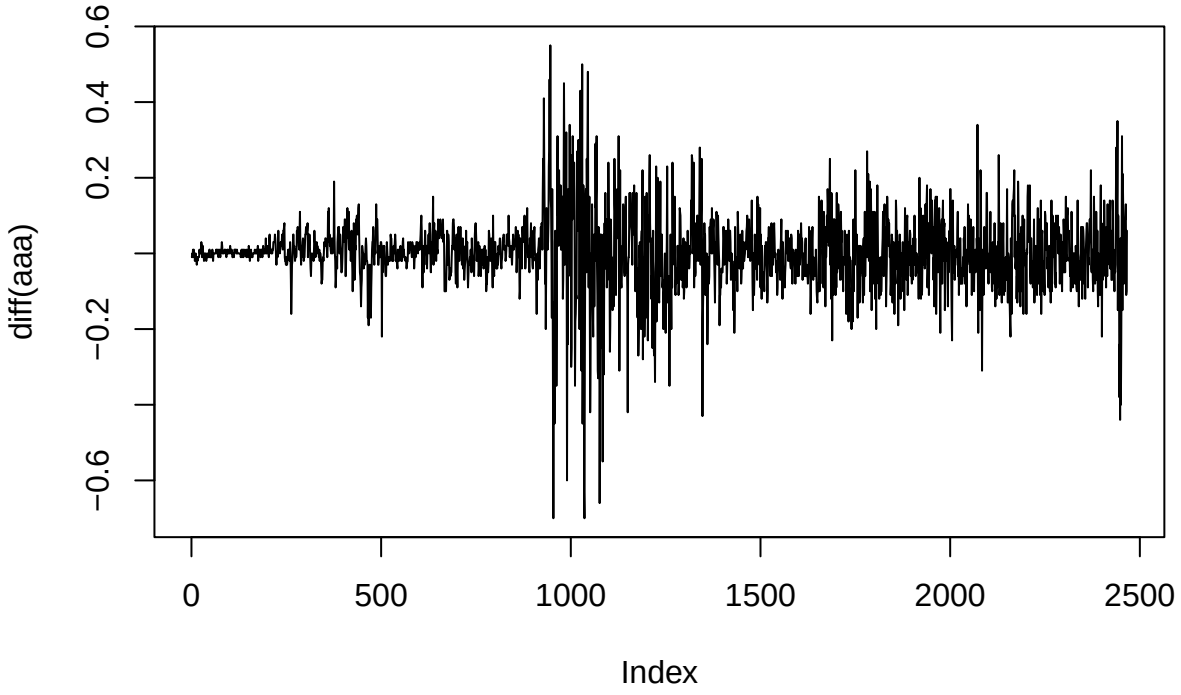
Date preparation => Removing non-stationarity

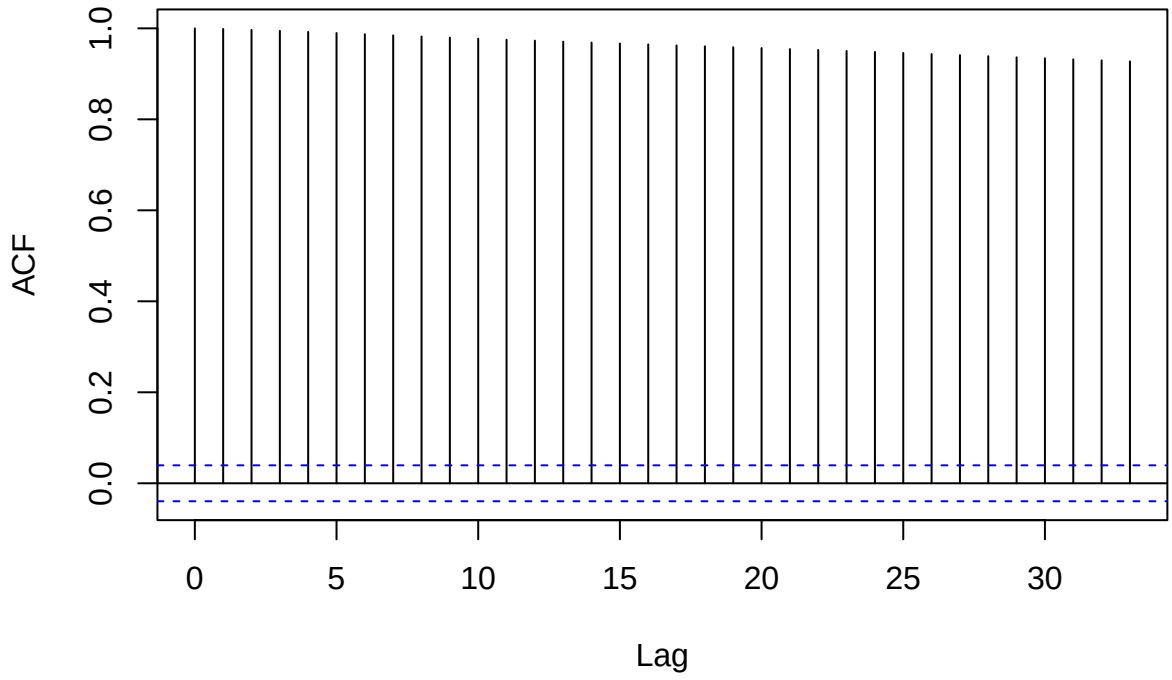
```
df=read.table("w-Aaa.txt",sep = "")

aaa = df$V4

plot(aaa)
```



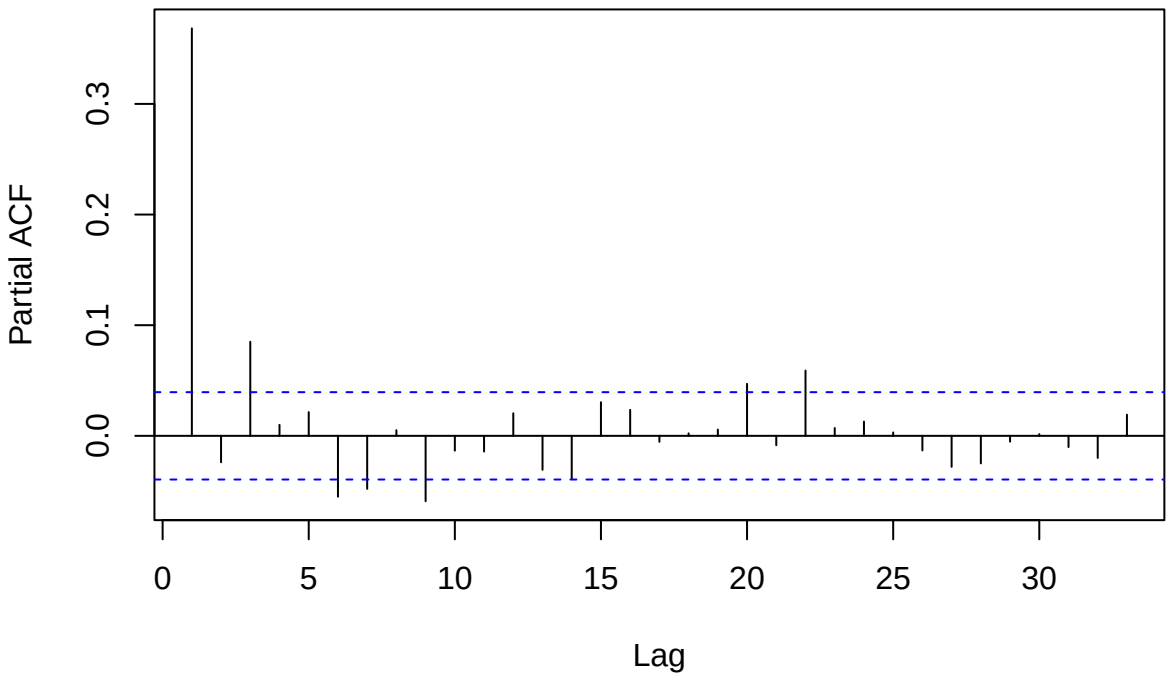

```
plot(diff(aaa),type="l")
```



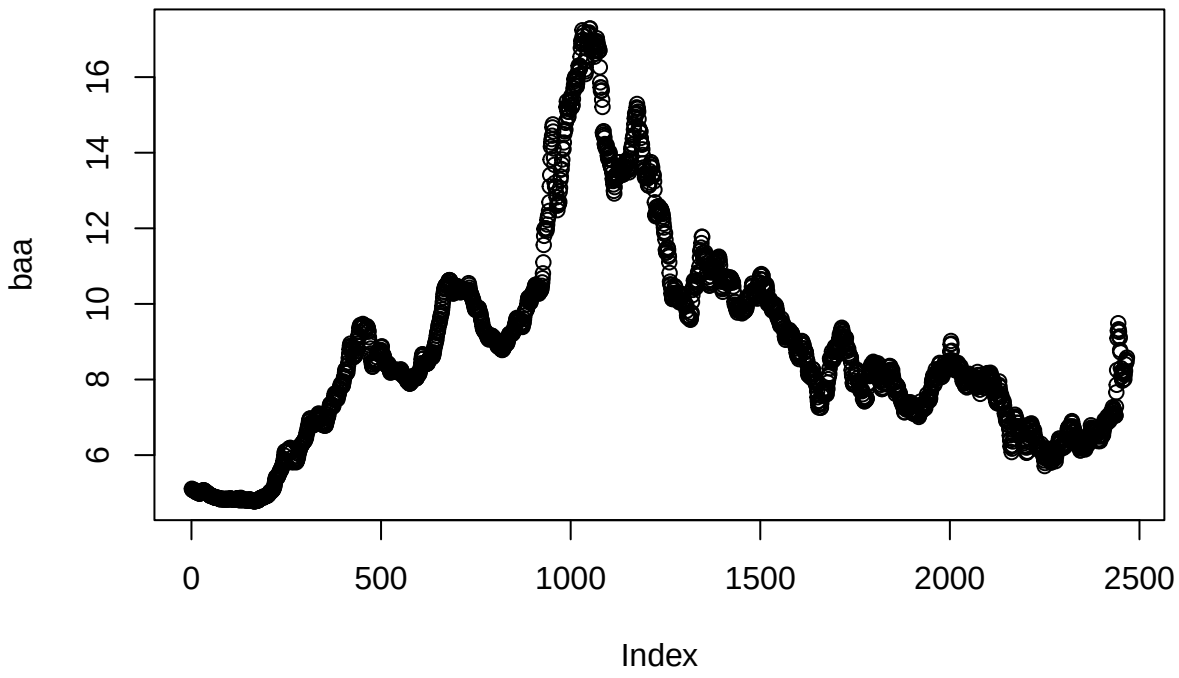

```
acf(aaa)
```



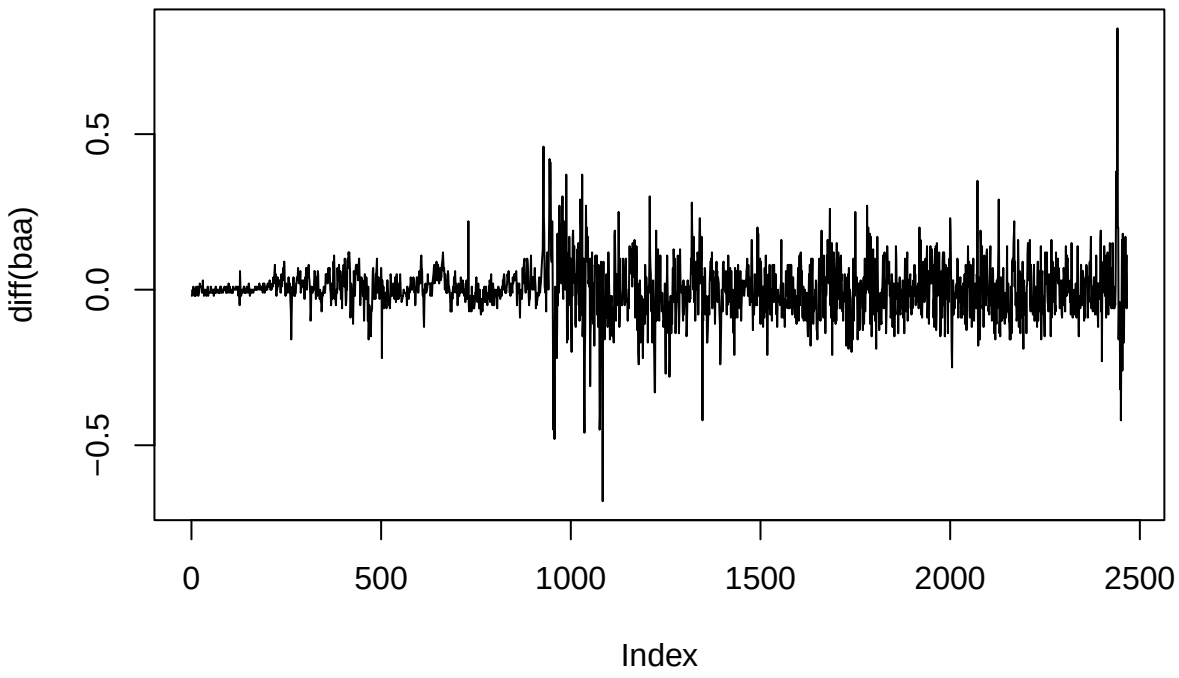

```
pacf(diff(aaa))
```



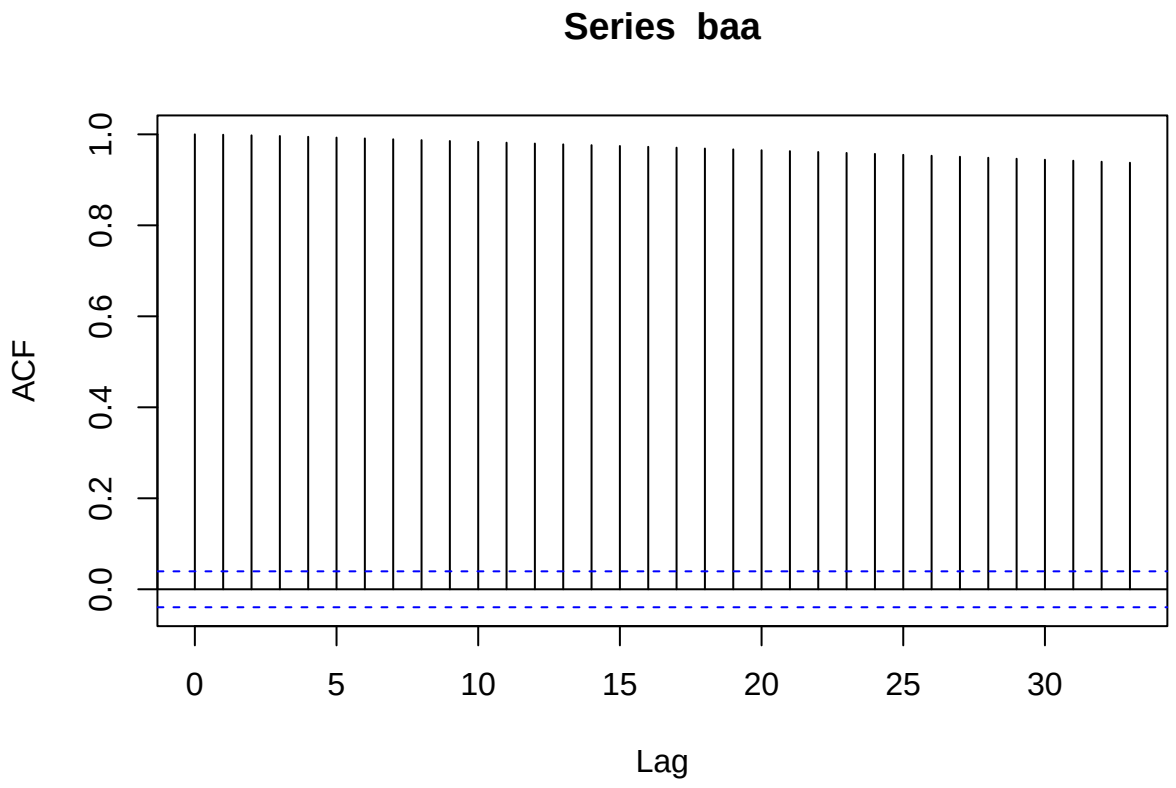

```
df=read.table("w-Baa.txt",sep = "")

baa = df$V4

plot(baa)
```



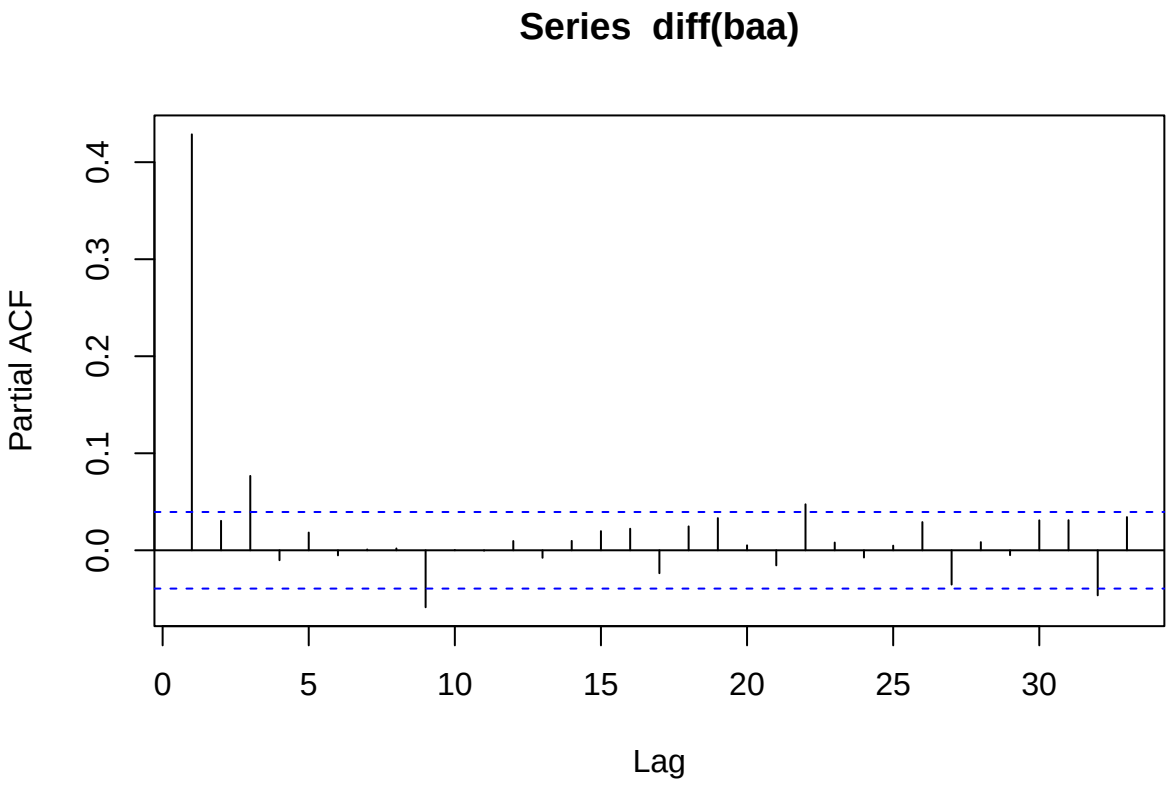

```
plot(diff(baa),type="l")
```



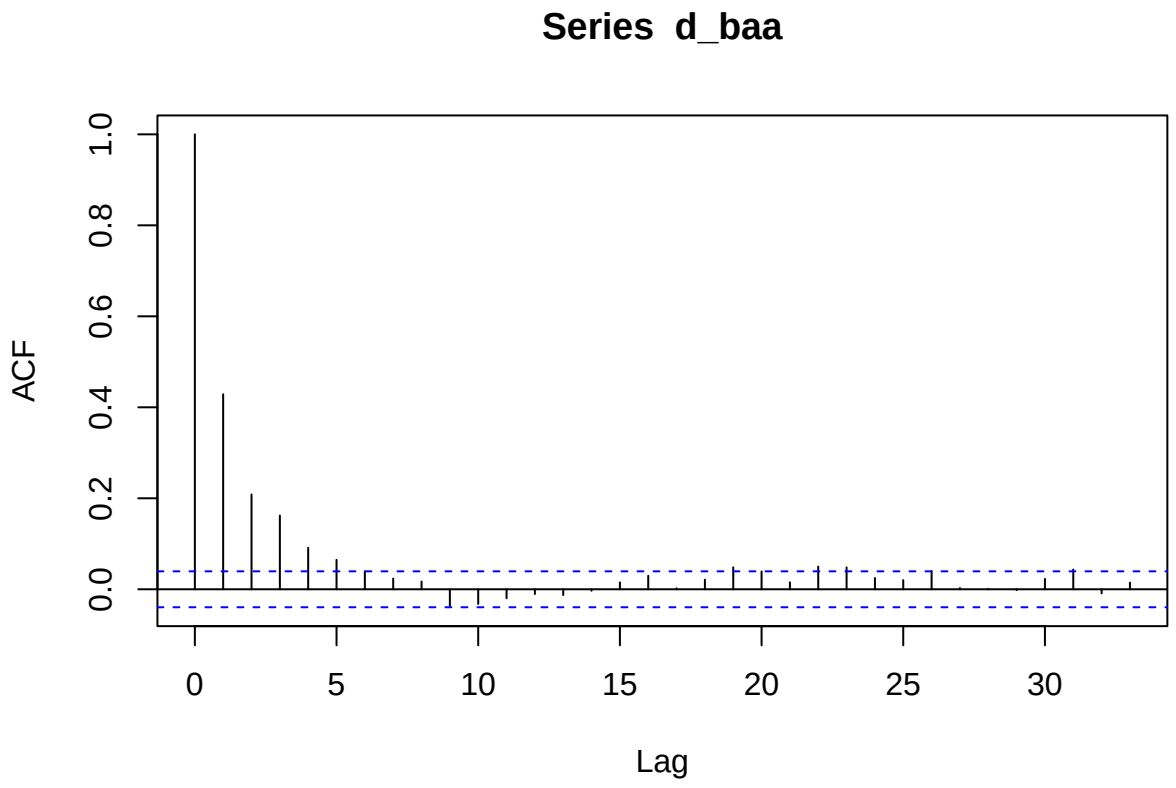

```
acf(baa)
```



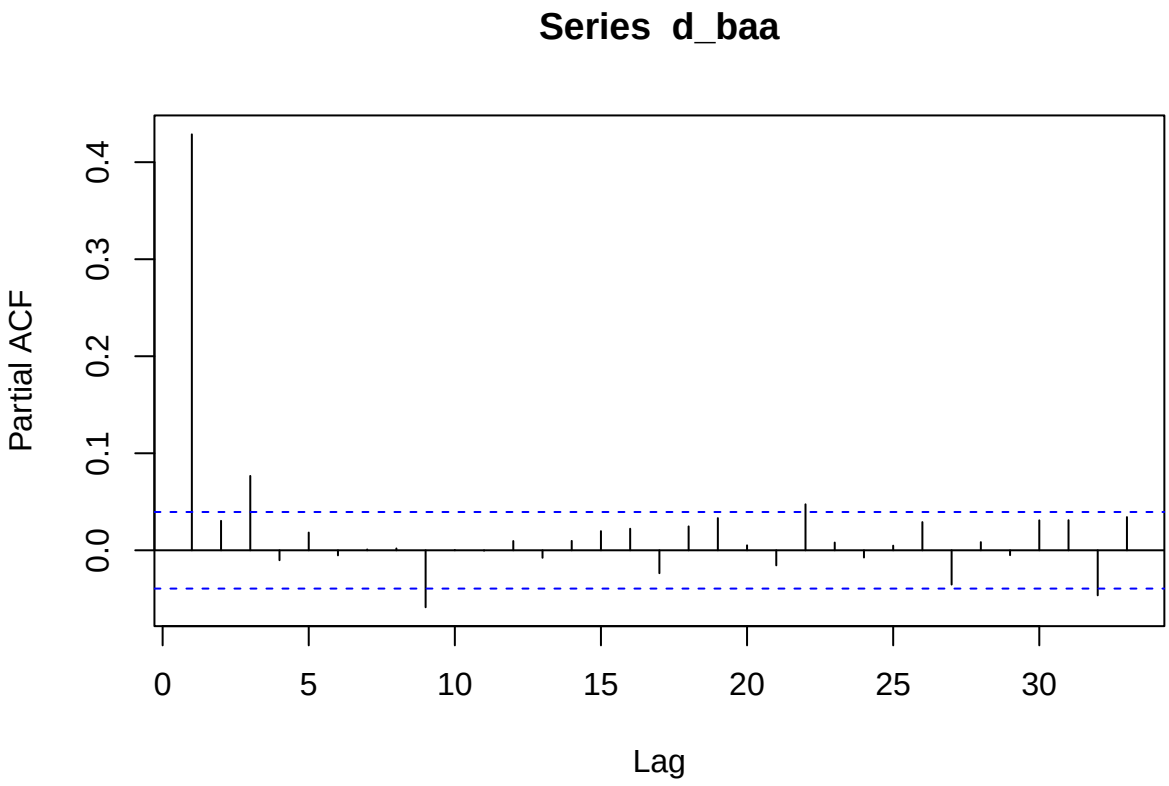

```
pacf(diff(baa))
```



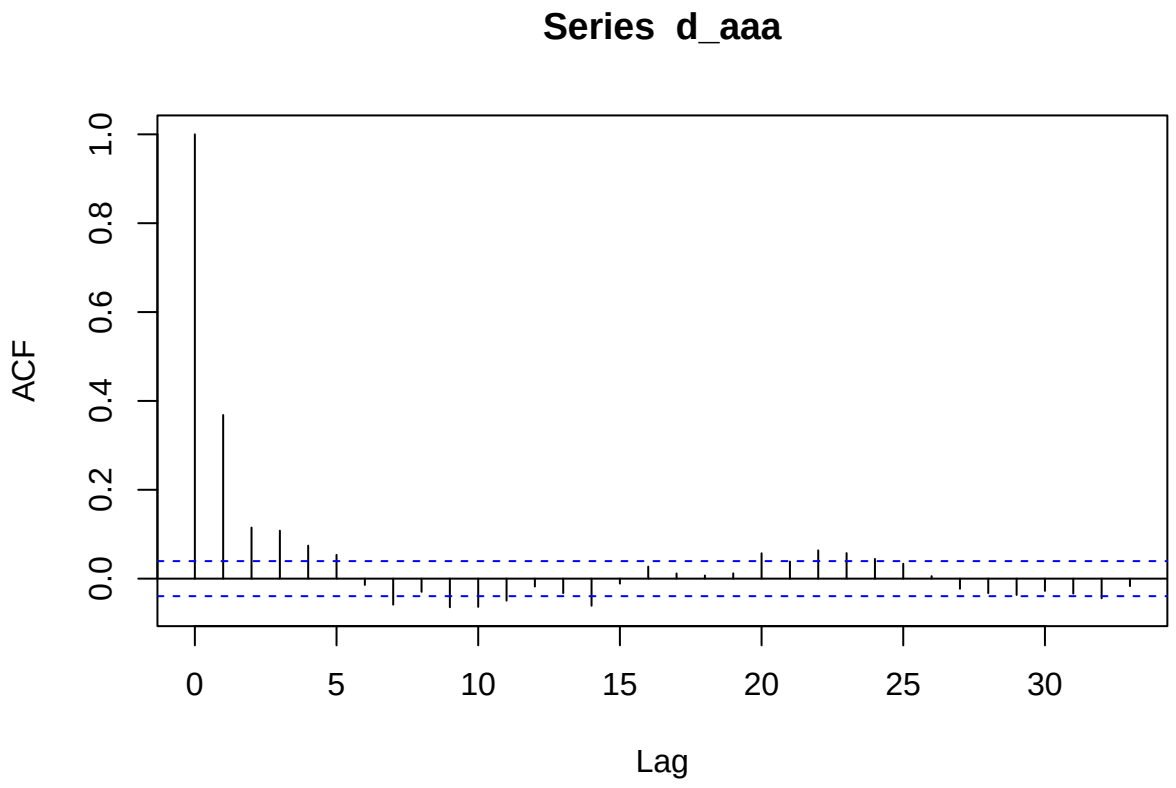

```
d_baa = diff(baa)
d_aaa = diff(aaa)

acf(d_baa)
```



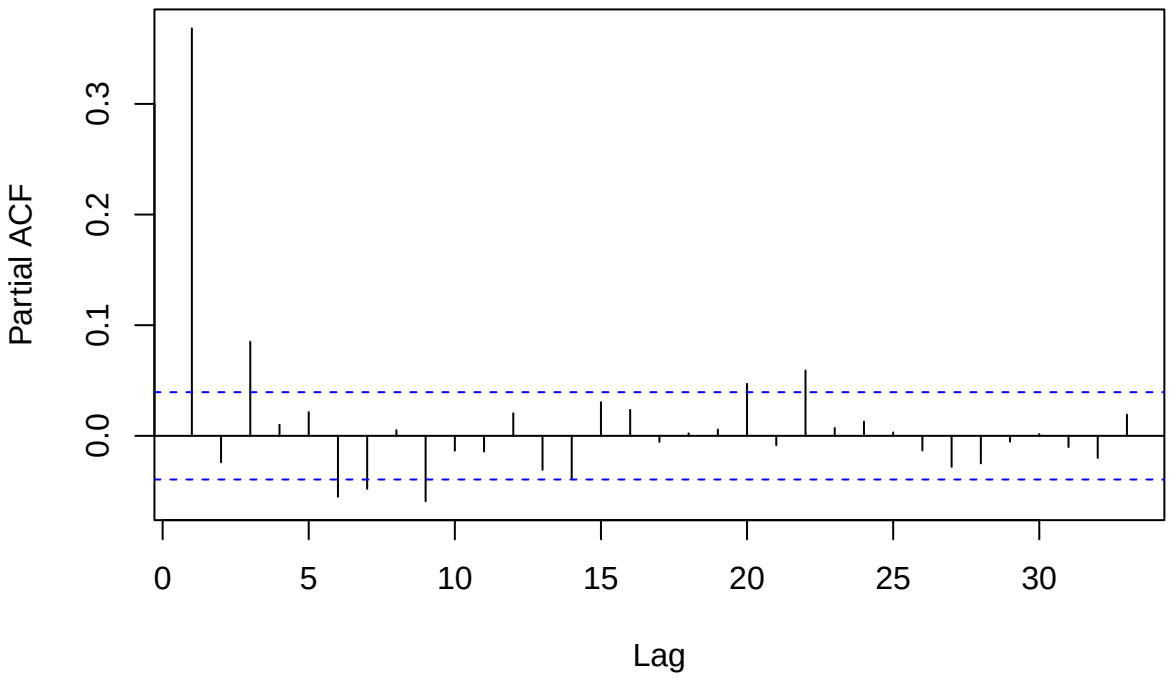

```
pacf(d_baa)
```




```
acf(d_aaa)
```



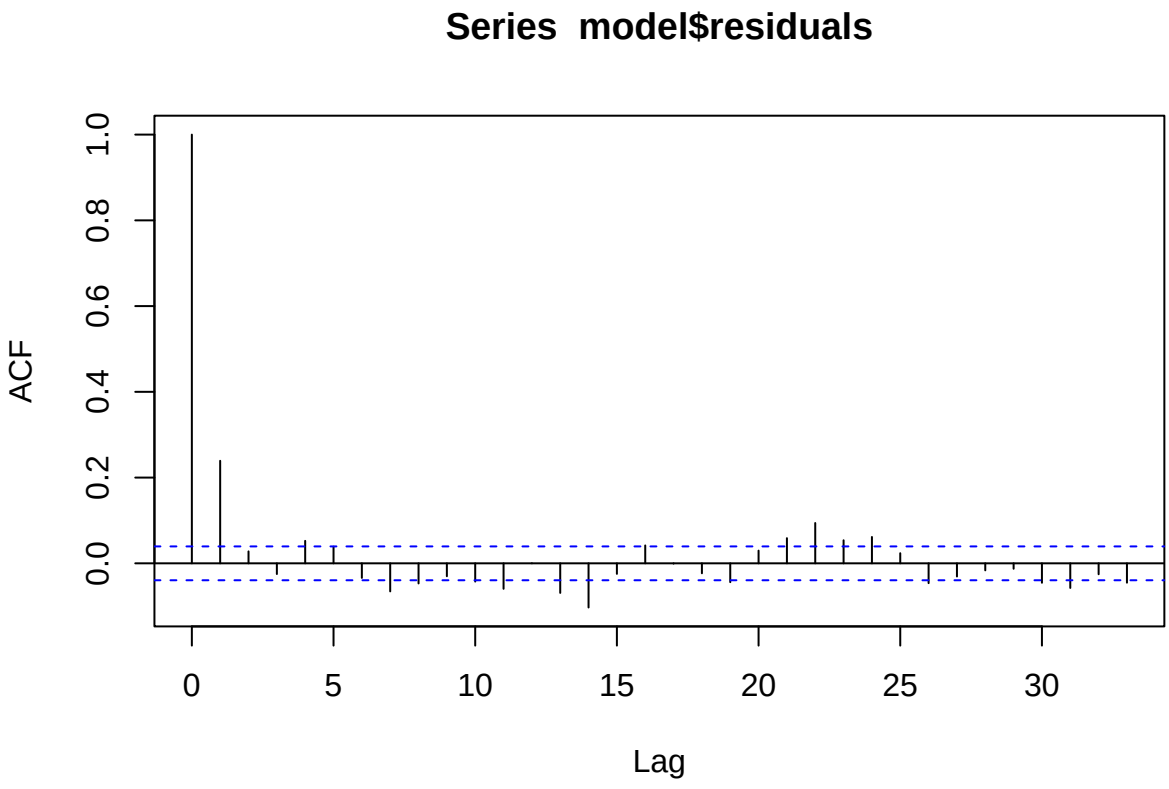

```
pacf(d_aaa)
```



Simple regression model and model checking

```
##
## Call:
## arima(x = d_aaa, order = c(0, 0, 0), xreg = d_baa, include.mean = F)
##
## Coefficients:
##         d_baa
##       0.9461
## s.e.  0.0126
##
## sigma^2 estimated as 0.002851:  log likelihood = 3726.22,  aic = -7448.45

## Warning in adfTest(model$residuals, lags = 2, type = ("c")): p-value smaller
## than printed p-value

##
## Title:
##  Augmented Dickey-Fuller Test
##
## Test Results:
##   PARAMETER:
##     Lag Order: 2
##   STATISTIC:
##     Dickey-Fuller: -27.2846
```

```
##   P VALUE:
##     0.01
##
## Description:
##  Tue Oct  8 23:02:59 2024 by user: kamin

## Warning in adfTest(model$residuals, lags = 2, type = ("ct")): p-value smaller
## than printed p-value

##
## Title:
##  Augmented Dickey-Fuller Test
##
## Test Results:
##   PARAMETER:
##     Lag Order: 2
##   STATISTIC:
##     Dickey-Fuller: -27.3062
##   P VALUE:
##     0.01
##
## Description:
##  Tue Oct  8 23:02:59 2024 by user: kamin
```



Try joint estimation with MA(1)

```
##
## Call:
## arima(x = d_aaa, order = c(0, 0, 1), xreg = d_baa, include.mean = F)
##
## Coefficients:
##          ma1   d_baa
##       0.2335  0.9436
## s.e.  0.0185  0.0132
##
## sigma^2 estimated as 0.00269:  log likelihood = 3797.81,  aic = -7589.62
```

```
## [1] 0.7117952
```

```
## Warning in adfTest(new_model1$residuals, lags = 2, type = ("c")): p-value
## smaller than printed p-value
```

```
##
## Title:
##  Augmented Dickey-Fuller Test
##
## Test Results:
##   PARAMETER:
##     Lag Order: 2
##   STATISTIC:
##     Dickey-Fuller: -29.1319
##   P VALUE:
##     0.01
##
## Description:
##  Tue Oct  8 23:02:59 2024 by user: kamin
```

```
## Warning in adfTest(new_model1$residuals, lags = 2, type = ("ct")): p-value
## smaller than printed p-value
```

```
##
## Title:
##  Augmented Dickey-Fuller Test
##
## Test Results:
##   PARAMETER:
##     Lag Order: 2
##   STATISTIC:
##     Dickey-Fuller: -29.1527
##   P VALUE:
##     0.01
##
## Description:
##  Tue Oct  8 23:02:59 2024 by user: kamin
```

Try joint estimation with AR(1)

```
##
## Call:
## arima(x = d_aaa, order = c(1, 0, 0), xreg = d_baa, include.mean = T)
##
## Coefficients:
##          ar1  intercept   d_baa
##       0.2392    -0.0009  0.9473
## s.e.  0.0195     0.0014  0.0133
##
## sigma^2 estimated as 0.002687:  log likelihood = 3799.21,  aic = -7590.42
```

```
## [1] 0.7121225
```

```
## Warning in adfTest(new_model2$residuals, lags = 2, type = ("c")): p-value
## smaller than printed p-value
```

```
##
## Title:
##  Augmented Dickey-Fuller Test
##
## Test Results:
##   PARAMETER:
```

```
##     Lag Order: 2
##   STATISTIC:
##     Dickey-Fuller: -30.3965
##   P VALUE:
##     0.01
##
## Description:
##  Tue Oct  8 23:03:00 2024 by user: kamin

## Warning in adfTest(new_model2$residuals, lags = 2, type = ("ct")): p-value
## smaller than printed p-value

##
## Title:
##  Augmented Dickey-Fuller Test
##
## Test Results:
##   PARAMETER:
##     Lag Order: 2
##   STATISTIC:
##     Dickey-Fuller: -30.4162
##   P VALUE:
##     0.01
##
## Description:
##  Tue Oct  8 23:03:00 2024 by user: kamin
```

Conclusion: Based on the information criteria (AIC), I chose the joint estimation with AR(1) term.

The final relationship is: d_aaa_t = 0.2394 * d_aaa_[t-1] + 0.9472 * d_baa_t + epsilon. Where the epsilon is the forecast error (no guarantee to be iid).