TSE Assignment 2

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1. ETF Data Analysis

(a) Use the R "quantmod" library to draw the backward-adjusted closing prices of the ETFs with ticker symbols EWA and EWC from 2012-02-02 to 2020-02-02. These two ETFs represent two equity baskets, the MSCI Australia and the MSCI Canada. Plot the two time series in one plot and comment.

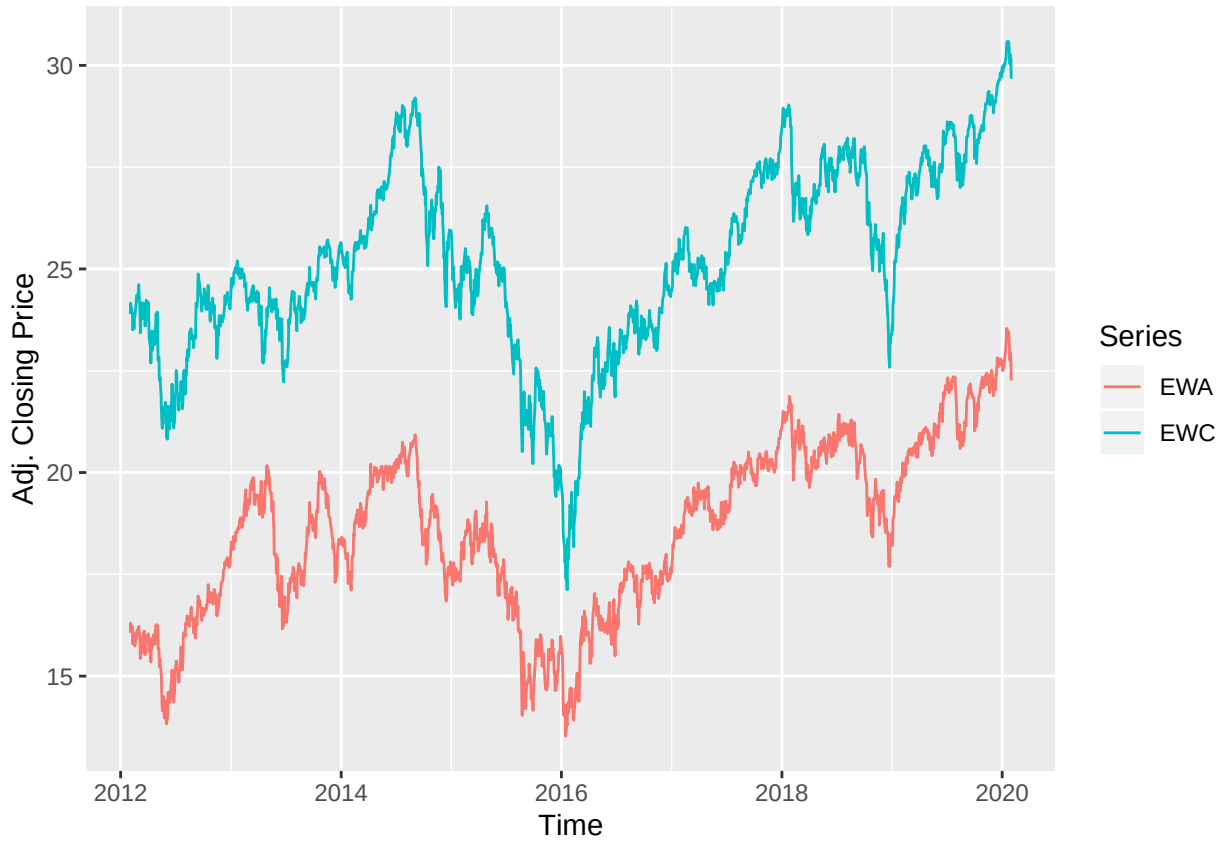
```
library(quantmod)

# Load the data from quantmod
getSymbols("EWA",src="yahoo")
```

```
## [1] "EWA"
```

```
getSymbols("EWC",src="yahoo")
```

```
## [1] "EWC"
```

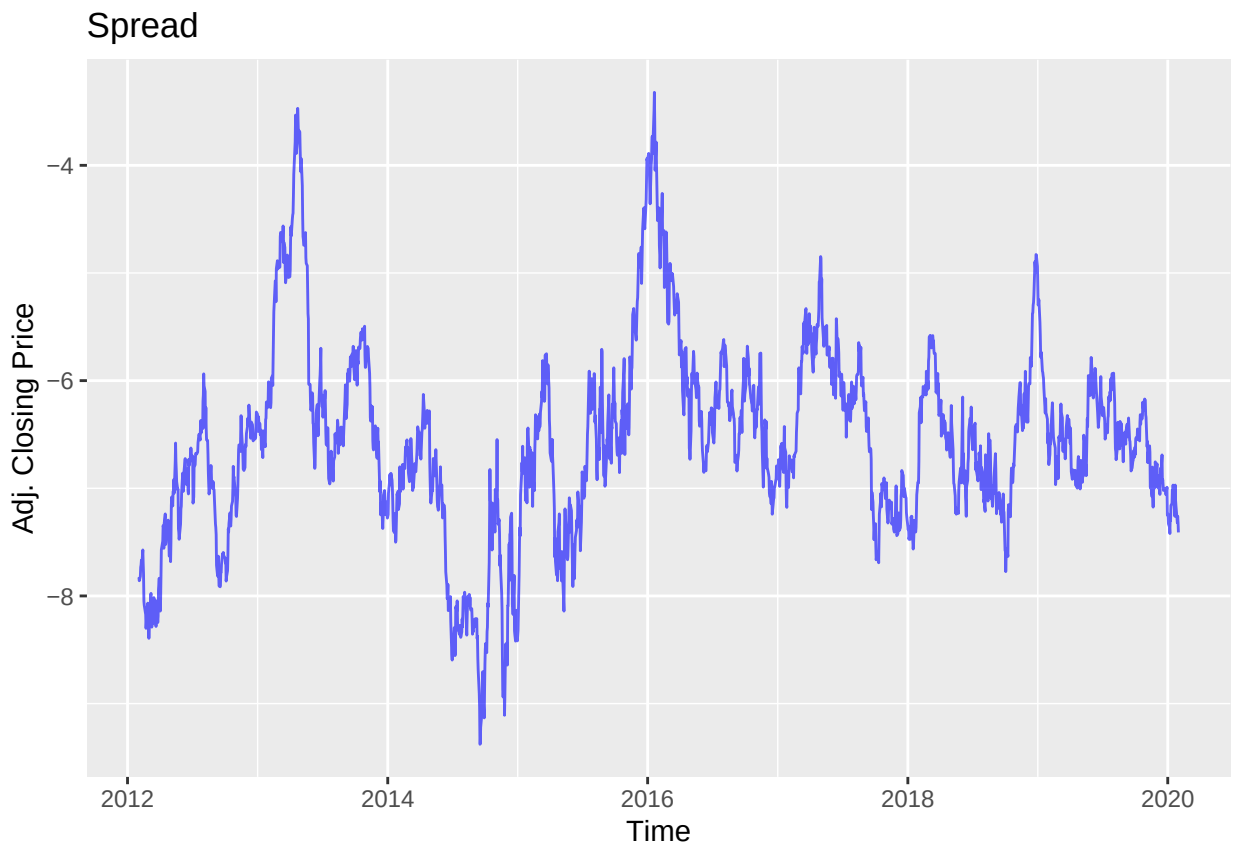
```
# clean up
ewa <- EWA %>% .[,6] %>% window(start = "2012-02-02", end = "2020-02-02") %>%
  set_colnames("EWA") %>% as_tibble(rownames = "time")
ewc <- EWC %>% .[,6] %>% window(start = "2012-02-02", end = "2020-02-02")  %>%
  set_colnames("EWC")%>% as_tibble(rownames = "time")
data <- full_join(ewa, ewc, by = "time") %>% mutate(time = as.Date(time))

# reshape and plot
data %>% pivot_longer(-time, "Series") %>%
  ggplot(aes(x = time, y = value, color = Series)) + geom_line() +
  ylab("Adj. Closing Price") + xlab("Time")
```



The two series seem to be heavily positively correlated.Furthermore, both series show a positive trend which leads to the impression of both series not being stationary. However the two series appear to be co-stationary.

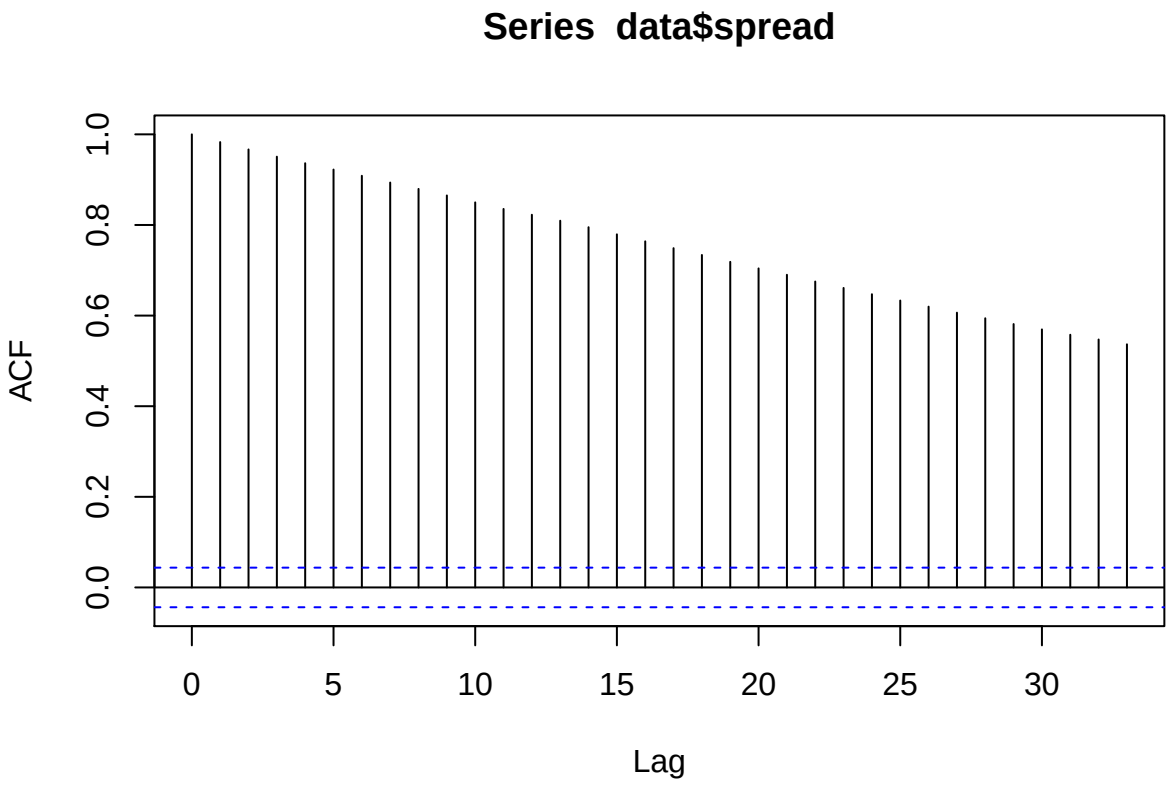
(b) Calculate the spread of the two times series, plot it and calculate ACF and PACF. Comment. Name two ARIMA(p,d,q) models that could suit the data according to the plots.

```
data <- data %>% mutate(spread = EWA - EWC)
data %>% ggplot(aes(x = time, y = spread)) + geom_line(color = "blue", alpha = 0.6) +
  ylab("Adj. Closing Price") + xlab("Time") + ggtitle("Spread")
```



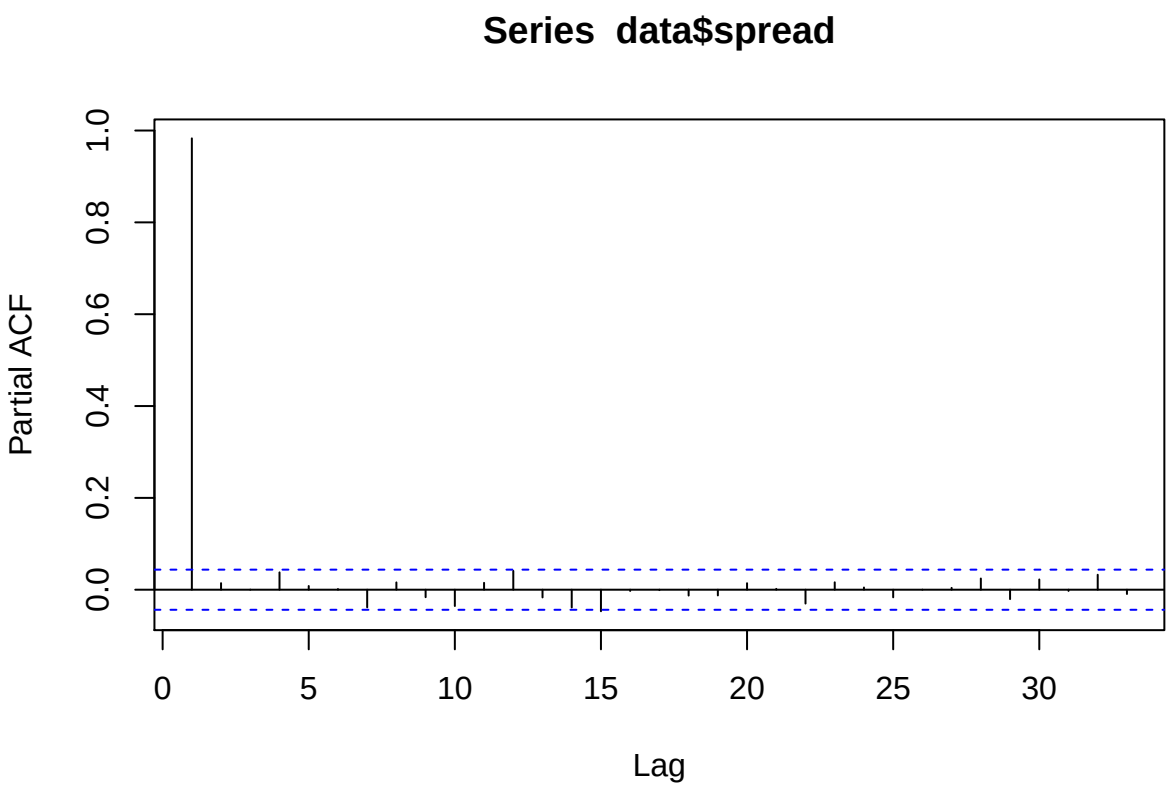
COntrary to the two series individually, the spread seems to be stationary. This is a furhter hint to costationarity of the two series.

```
acf(data$spread)
```



The spread shows strong autocorrelation.

```
pacf(data$spread)
```



The spread shows some significant partial autocorrelation. This hints to the existance of

(c) Conduct an Augmented Dickey Fuller test on all three time series using the R library "urca". Explain which set-up you choose in the testing procedure (lag length and regression setting) using economic and econometric arguments. Comment on the results.

```
library(urca)
library(broom)


adf_res <- data %>% select(-time) %>%
  imap(~ur.df(.x, lag = 5, type = "none", selectlags = "AIC")@testreg %>% tidy() %>% filter(!grepl("dif
  do.call(what = bind_rows) %>% select(series, statistic, p.value)

pander(adf_res)
```

series	statistic	p.value
EWA	0.5895	0.5556
EWC	0.4029	0.6871
spread	-0.5501	0.5823

We can not reject a unit root for any of the series.

(d) What kind of econometric relationship do the EWA and EWC series adhere to? Explain in a few words the Johansen test. Conduct a Johansen test (command "ca.jo" in the "urca" library) and comment on your results.

```r
library(urca)
library(broom)

ca.jo(data %>% select(EWA, EWC))
```

```
##
## ###############################################################
## # Johansen-Procedure Unit Root / Cointegration Test #
## ###############################################################
##
## The value of the test statistic is: 3.4759 20.5372
```