Homework 4

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Question 1

Part A

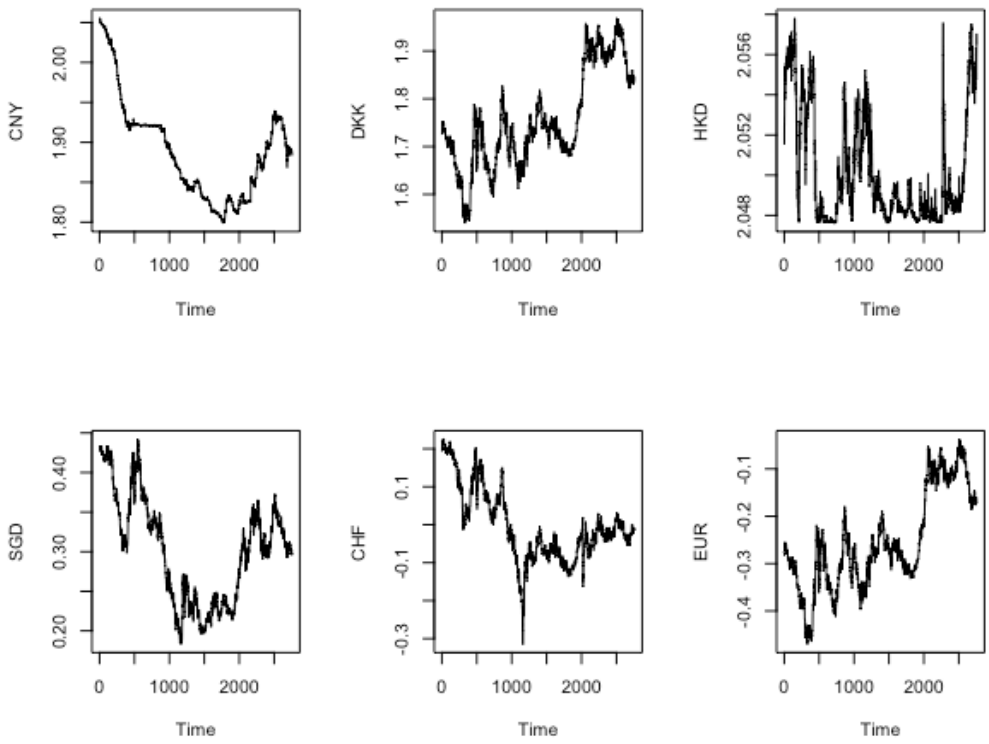
With the loop of linear regression, I conduted df test on all the 6 series. The result shows that the log price of DKK, HKD, SGD, EUR are not stationary but CHY and CHF are stationary.

> The output is redundant so it would be better to post an example.

```
[1] "------- EUR -------"

Call:
lm(formula = y ~ x - 1)

Residuals:
      Min        1Q    Median        3Q       Max
-0.046390 -0.003391 -0.000134  0.003296  0.029859

Coefficients:
    Estimate Std. Error t value Pr(>|t|)
x -0.0003949  0.0004415  -0.894    0.371

Residual standard error: 0.006349 on 2756 degrees of freedom
Multiple R-squared:  0.0002902, Adjusted R-squared:  -7.251e-05
F-statistic: 0.8001 on 1 and 2756 DF,  p-value: 0.3711
```

> The coefficient of the log price of EUR is not statistically significant when $\alpha = 0.05$ so the serie is an $I(1)$ process.

Part B

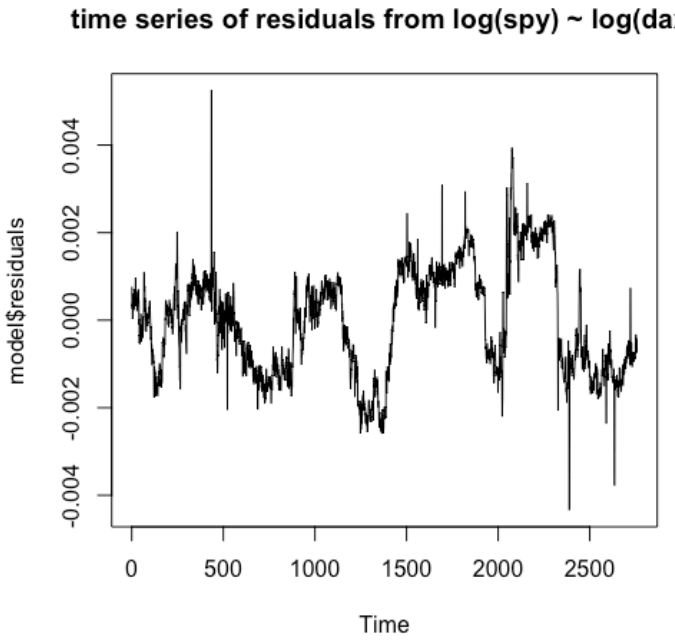


The time series plot of CNY shows that the serie might not be stationary since there is a clear decreasing trend then an increasing trend. The reason for the failure of DF Test is that the test becomes less powerful with the presense of trend.

Question 2

Part A

The time series plot of the residual of the regression model is shown below and I can conclude the serie is visually stationary.



The DF Test shows that the residual serie is stationary so DKK and EUR are cointegrated and the cointegrating vector is [1, -0.997].

```
Call:
lm(formula = DKK ~ EUR, data = lcurr)

Residuals:
       Min         1Q     Median         3Q        Max
-0.0043365 -0.0010378  0.0000105  0.0008908  0.0052477

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 2.007e+00  6.199e-05   32382   <2e-16 ***
EUR         9.973e-01  2.264e-04    4406   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.001225 on 2756 degrees of freedom
Multiple R-squared:  0.9999,    Adjusted R-squared:  0.9999
F-statistic: 1.941e+07 on 1 and 2756 DF,  p-value: < 2.2e-16


Call:
lm(formula = diff(res) ~ res[1:(length(res) - 1)] - 1)

Residuals:
       Min         1Q     Median         3Q        Max
-0.0042044 -0.0001386 -0.0000044  0.0001392  0.0045520

Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
res[1:(length(res) - 1)] -0.032735   0.004833  -6.773 1.53e-11 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.0003109 on 2756 degrees of freedom
Multiple R-squared:  0.01637,   Adjusted R-squared:  0.01602
F-statistic: 45.88 on 1 and 2756 DF,  p-value: 1.535e-11
```

Part B

Both the two strategies lose money. The basic strategy loses $0.106 and the reinforcement strategy loses $6.854.

The code for basic strategy and reinforcement strategy are listed below.

```
### basic
n1 = n2 = 0 # initial volume
count = 0 # trading counts
status = -1 # first time trade
for(i in 1:2758){
  dkk = df[i,1]
  eur = df[i,2]
  port = dkk-0.997*eur
  if((port >= c1+c2) & (status==0 | status==-1)){
    n1 = n1 - 1/exp(dkk)
    n2 = n2 + 0.997/exp(eur)
    count = count + 1
    status = 1
  } else if ((port <= c1-c2) & (status==1 | status==-1)) {
    n1 = n1 + 1/exp(dkk)
    n2 = n2 - 0.997/exp(eur)
    count = count + 1
    status = 0
  }
}
n1*exp(df[2758,1])+n2*exp(df[2758,2])-0.02*count


### reinforcement
n1 = n2 = 0 # initial volume
count = 0 # trading counts
for(i in 1:2758){
  dkk = df[i,1]
  eur = df[i,2]
  port = dkk-0.997*eur
  if(port >= (c1+c2)){
    n1 = n1 - 1/exp(dkk)
    n2 = n2 + 0.997/exp(eur)
    count = count + 1
  } else if (port <= (c1-c2)) {
    n1 = n1 + 1/exp(dkk)
    n2 = n2 - 0.997/exp(eur)
    count = count + 1
  }
}
n1*exp(df[2758,1])+n2*exp(df[2758,2])-0.02*count

```

Question 3