Wielowymiarowe Modele Ekonometrii Finansowej

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Część I

Bazy Danych

- stooq.pl
- finance.yahoo.com
- datamarket.com
- bossa
- econstats

Zadanie 1

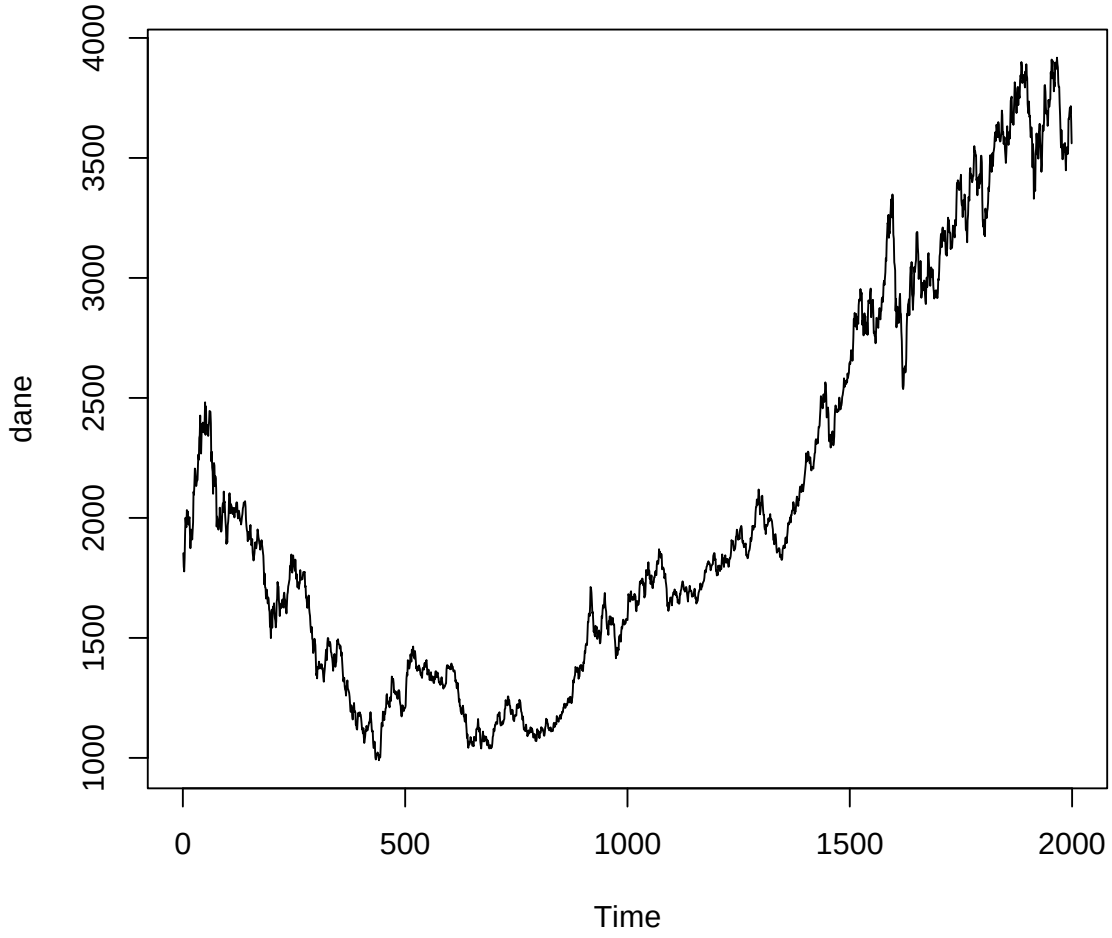
- Ściagnij plik notowań dla Bitcoin USD (BTC-USD) z okresu od 05-03-2016 do 05-03-2021
- Upewnij się, że dane w kolumnie są typu liczbowego
- Narysuj wykres danych
- Dodatkowe Informacje: finance.yahoo; pracujemy w Excelu

Zadanie 2

- Załaduj plik danych Wig20_2000do2007.csv
- Oblicz logarytmiczne stopy zwrotu (pracujemy na kursach zamknięcia)
- Narysuj ceny i logarytmiczne stopy zwrotu (jeden ekran 2 wykresy)
- Oblicz i zinterpretuj podstawowe statystyki opisowe
- Dlaczego często modelujemy stopy zwrotu, a nie ceny?
- Narysuj i podaj interpretacje ACF dla cen i stóp zwrotu oraz ich kwadratów
- Oceń występowanie efektu ARCH
  - wnioskowanie na podstawie rysunków
  - testy statystyczne

Wskazowki:
setwd()
dane<- read.csv2(file="Wig20_2000do2007.csv",dec=",")
dane<-ts(dane[,4])
lnrdane<- #logarytmiczne stopy zwrotu
library(psych)# wykorzystaj describe() do obliczenia statystyk opisowych
acf(?)#Autocorrelation Function
library(TSA)#zmiana pakietu do rysowania acf
TSA::acf()#Narysuj bez opóźnienia w 0
Box.test() # wersja Ljung; lag= 20 lub do dyskusji
McLeod.Li.test()
library(MTS)
archTest()

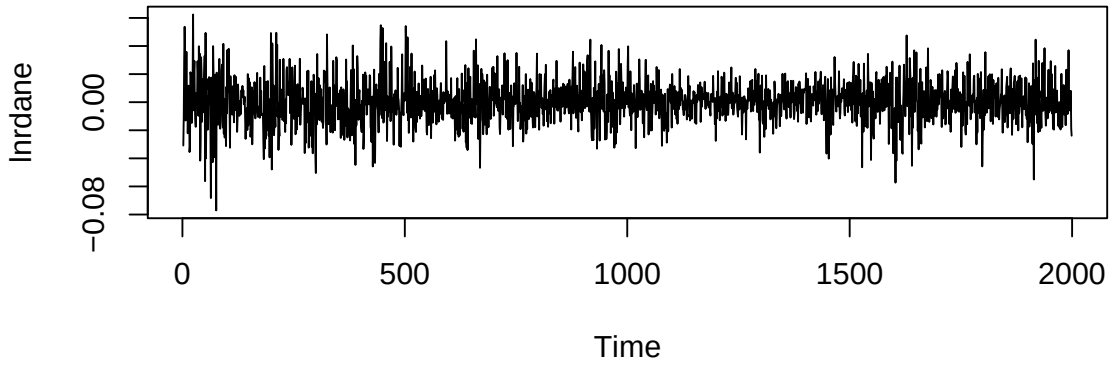
Rozwiązanie zadania 2

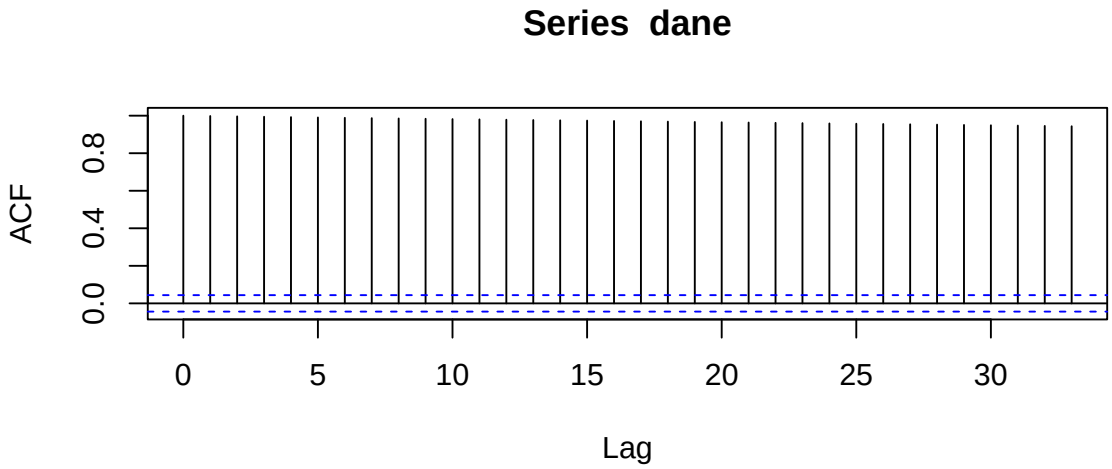


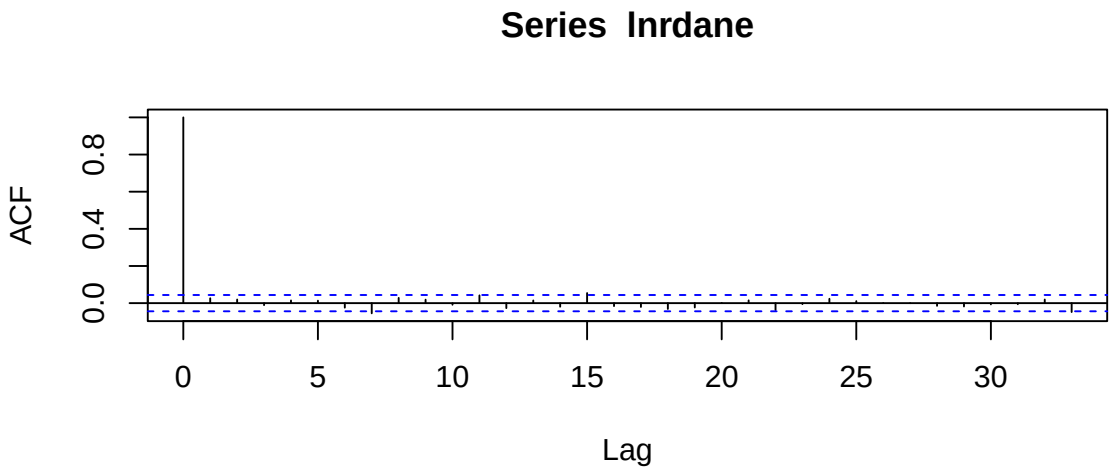

```
##                  X1
## vars        1.0000000
## n        1999.0000000
## mean     2037.1221411
## sd        811.8572246
## median   1801.4300000
## trimmed  1953.9834791
## mad       740.3363100
## min       990.2300000
## max      3917.8700000
## range    2927.6400000
## skew        0.7728156
## kurtosis   -0.6143705
## se         18.1582195
```

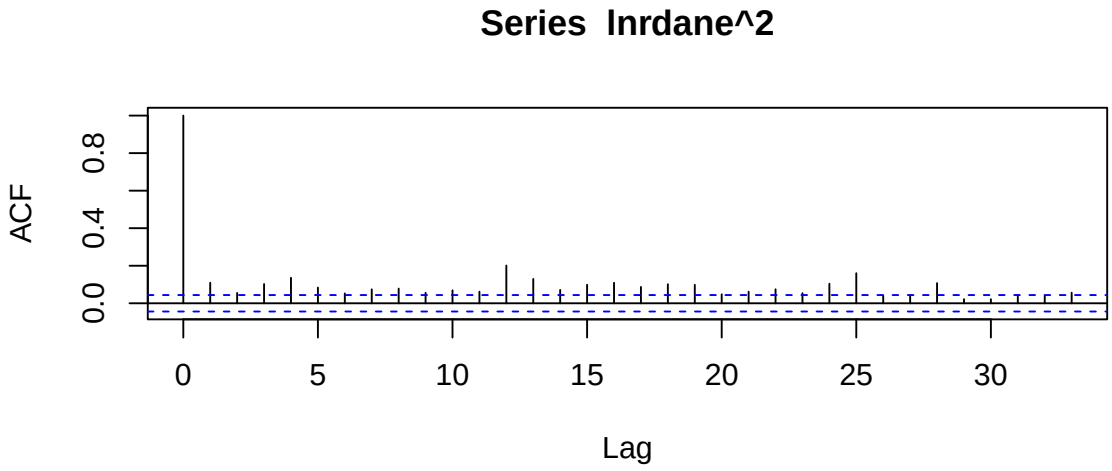
```
##                    X1
## vars      1.000000e+00
## n         1.998000e+03
## mean      3.269534e-04
```

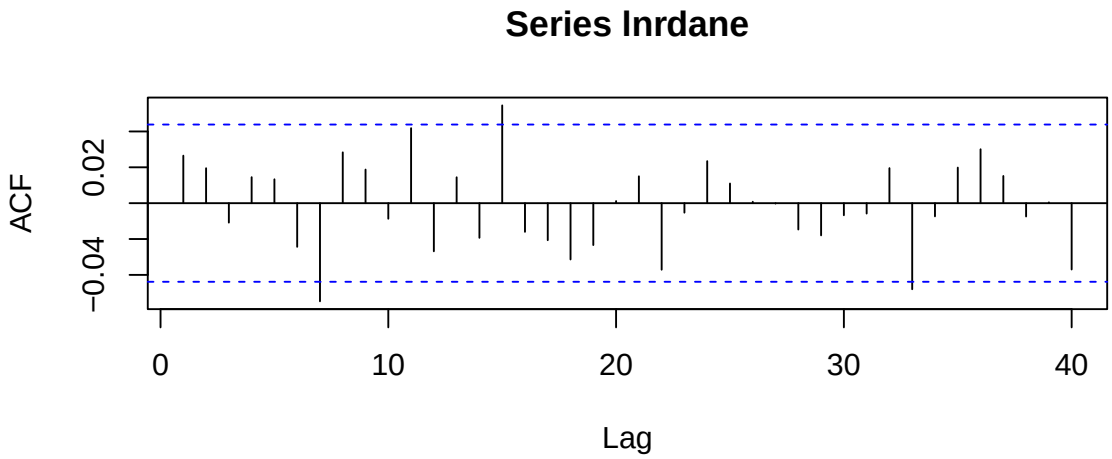
```
## sd         1.554302e-02
## median     2.455809e-04
## trimmed    2.507795e-04
## mad        1.275988e-02
## min       -7.705723e-02
## max        6.246071e-02
## range      1.395179e-01
## skew       8.626955e-04
## kurtosis   1.293533e+00
## se         3.477265e-04
```

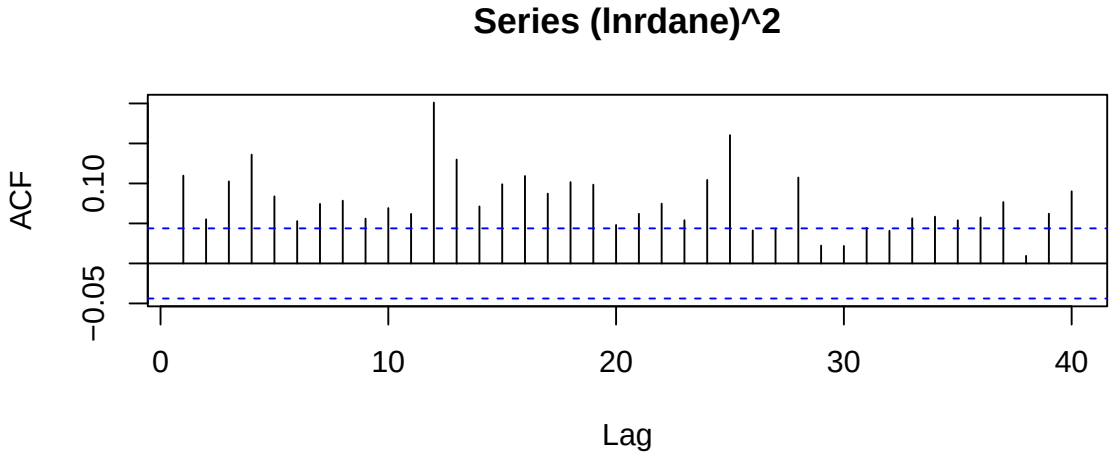





Series lnrdane
ACF
0.0
0.4
0.8
0
5
10
15
20
25
30
Lag


Series lnrdane^2
ACF
0.0
0.4
0.8
0
5
10
15
20
25
30
Lag

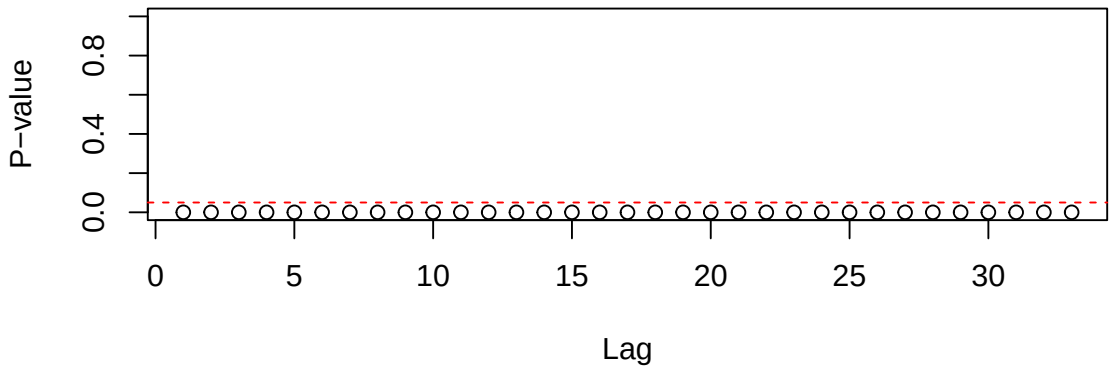


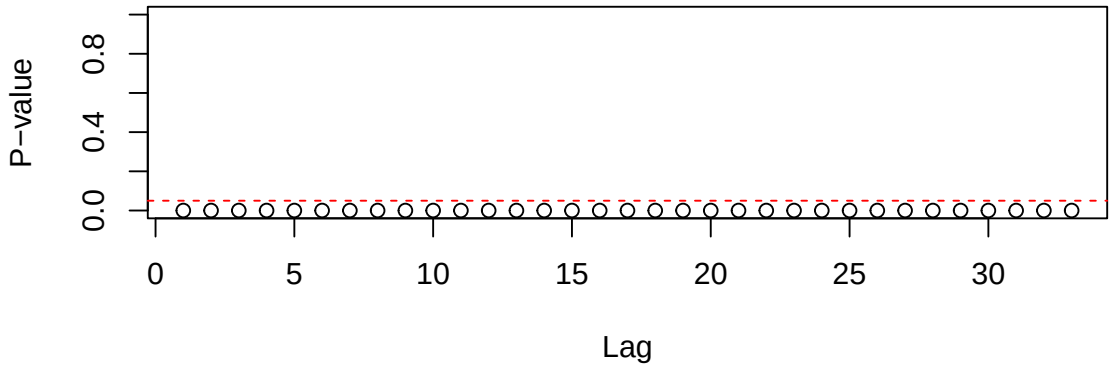



```
##
##  Box-Ljung test
##
## data:  lnrdane
## X-squared = 29.463, df = 20, p-value = 0.07904
```

```
##
##  Box-Ljung test
##
## data:  lnrdane^2
## X-squared = 384.98, df = 20, p-value < 2.2e-16
```

```
## $p.values
##  [1] 9.155079e-07 2.768742e-07 4.316858e-11 0.000000e+00 0.000000e+00
##  [6] 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00
## [11] 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00
## [16] 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00
## [21] 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00
## [26] 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00
## [31] 0.000000e+00 0.000000e+00 0.000000e+00
```






```
## $p.values
##  [1] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

```
## Q(m) of squared series(LM test):
## Test statistic:  147.4539  p-value:  0
## Rank-based Test:
## Test statistic:  133.5223  p-value:  0
```

Jednowymiarowe modele GARCH

Zadanie 3

- Wczytaj plik DAX_2006_2016_ost.xlsx
- Oceń występowanie efektu ARCH
- Dopasuj modele GARCH do danych:
  - ARMA-sGARCH z warunkowym rozkładem normalnym
  - ARMA-sGARCH z war. rozkładem studenta
  - ARMA-GJR-GARCH z war. skośnym rozkładem studenta
  - Ocen który model jest lepszy na podstawie kryteriow informacyjnych
  - Analiza estymatorów parametrów

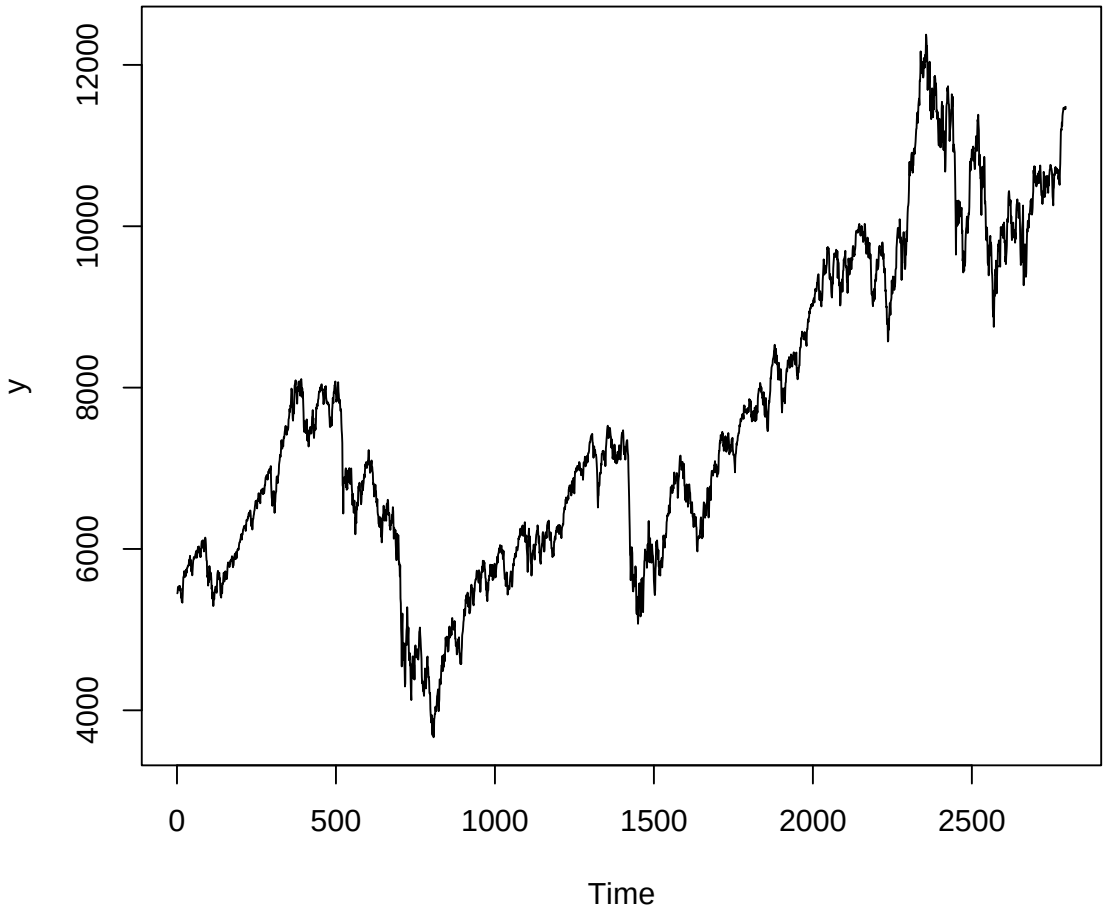
- Oblicz/Narysuj:
  - wykres surowych reszt
  - wykres wariancji warunkowych
  - wykres odchylen warunkowych
- Wykonaj diagnostykę reszt
- Dla najlepszego modelu wykonaj prognozę

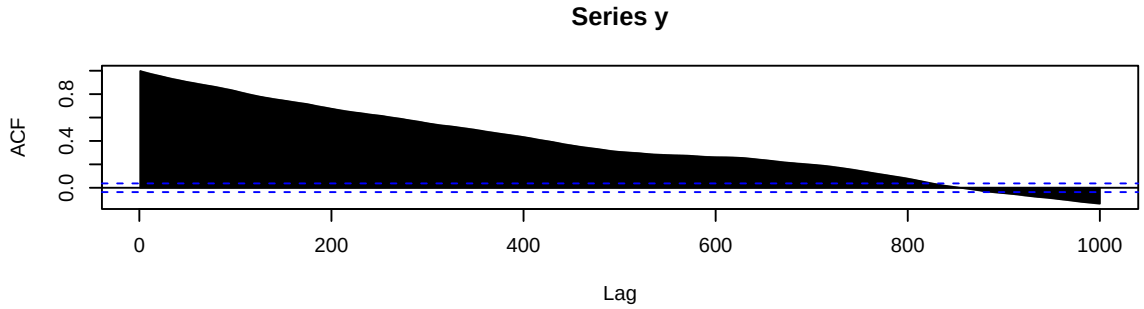
Wskazówki: Introduction to rugarch
library(rugarch)
library(readxl)
DAX_2006_2016_ost <- read_excel("Dane/DAX_2006_2016_ost.xlsx")
y<-ts(DAX_2006_2016_ost[,2])
yGARCH_spec <- ugarchspec(variance.model=list(model=?, garchOrder=?), mean.model = list(armaOrder = ?, include.mean = TRUE), distribution.model=?)
yGARCH_fit<-ugarchfit(data = y, spec = yGARCH_spec, solver = "hybrid")
plot(yGARCH_fit)#brak rysunku w rozwiazaniu

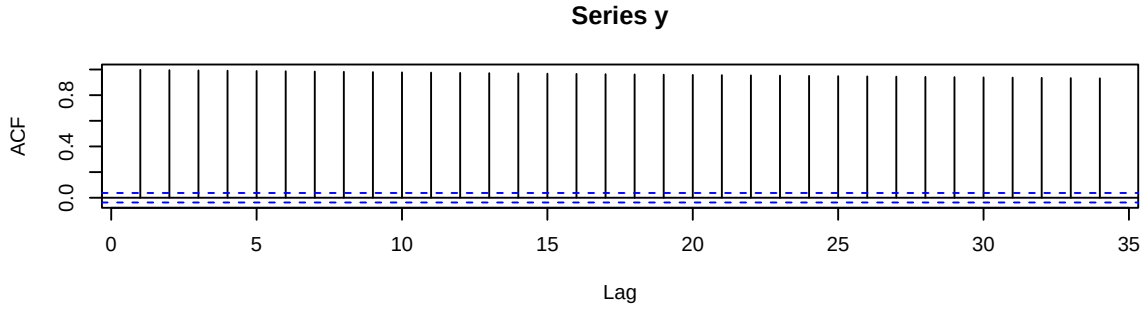
infocriteria()
names(yGARCH_fit@model)
names(yGARCH_fit@fit)
yGARCH_fit@fit$coef
plot(yGARCH_fit@fit$?,type="l")

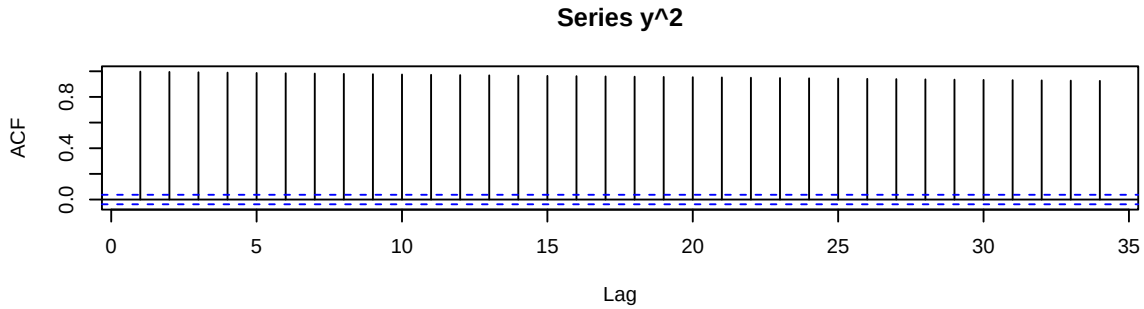
Wyznaczmy standaryzowane reszty z dopasowania:
library(car)
res_n<-fit_n@residuals/fit_n@sigma.t#Garch residuals (normal)
res_t<-fit_t@residuals/fit_t@sigma.t#Garch residuals (student)
plot(res_n-res_t)
qqPlot(res_n,dist=?)
qqPlot(res_t,dist=?)

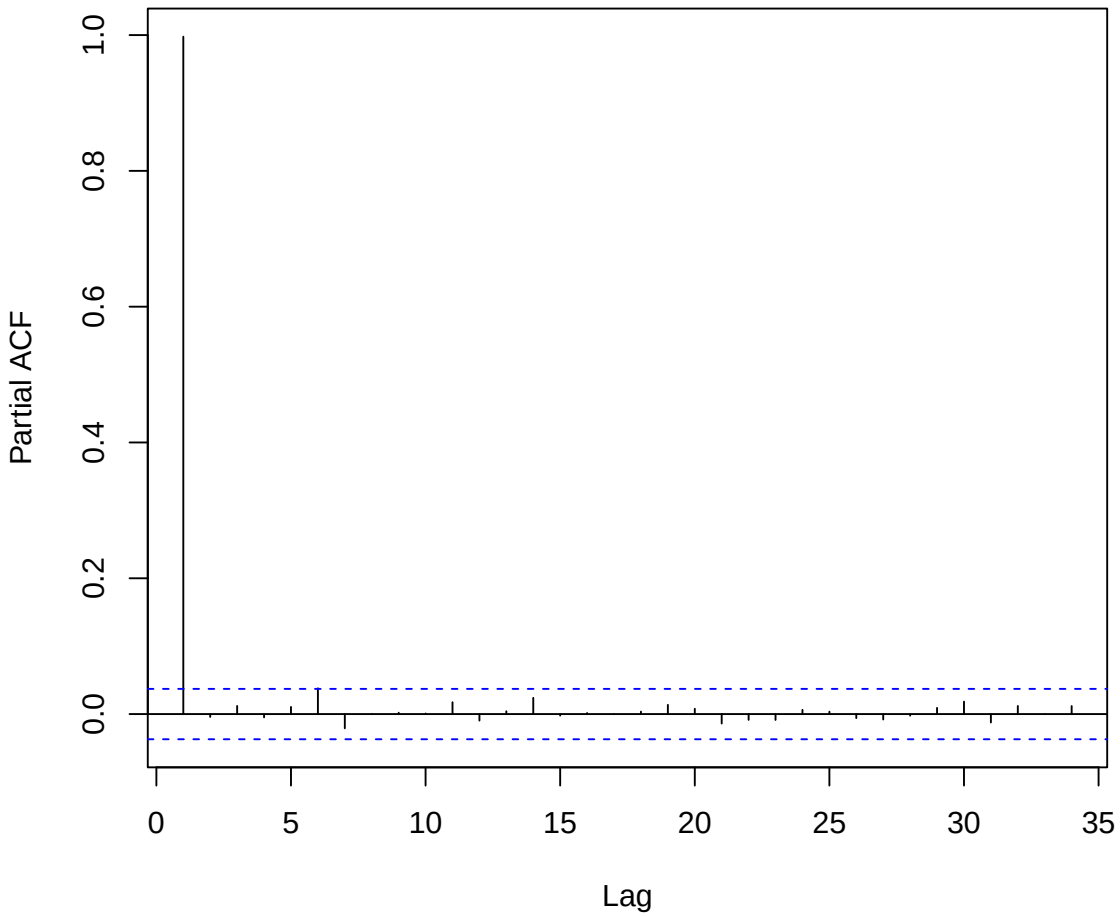
Forecast:
yGARCH_fit<-ugarchfit(data = y, spec = yGARCH_spec, out.sample=?, solver = "hybrid")
forecast <-ugarchforecast(yGARCH_fit, n.ahead=?, n.roll = ?,out.sample=?)
par(mfrow = c(1, 1))
plot(forecast, which = "all")


y
4000
6000
8000
10000
12000
0
500
1000
1500
2000
2500
Time


Series y
ACF
0.0
0.4
0.8
0
200
400
600
800
1000
Lag


Series y
ACF
0.0
0.4
0.8
0
5
10
15
20
25
30
35
Lag


Series y^2
ACF
0.0
0.4
0.8
0
5
10
15
20
25
30
35
Lag




```
##
##  Box-Ljung test
##
## data:  y
## X-squared = 13806, df = 5, p-value < 2.2e-16
```

```
##
##  Box-Ljung test
##
## data:  y^2
## X-squared = 13782, df = 5, p-value < 2.2e-16
```

```
##
## Akaike       12.07239
## Bayes        12.08301
## Shibata      12.07238
## Hannan-Quinn 12.07622
```

```
##
## *---------------------------------*
```

```
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## ----------------------------------
## GARCH Model  : sGARCH(1,1)
## Mean Model   : ARFIMA(1,0,0)
## Distribution : norm
##
## Optimal Parameters
## ------------------------------------
##          Estimate  Std. Error   t value Pr(>|t|)
## mu     1.6742e+04  4.2281e+03    3.9596  7.5e-05
## ar1    9.9954e-01  2.5300e-04 3958.2034  0.0e+00
## omega  8.0396e+03  2.8025e+02   28.6874  0.0e+00
## alpha1 2.2229e-01  2.9352e-02    7.5733  0.0e+00
## beta1  0.0000e+00  6.0500e-04    0.0000  1.0e+00
##
## Robust Standard Errors:
##          Estimate  Std. Error   t value Pr(>|t|)
## mu     1.6742e+04  6.1975e+03    2.7014 0.006906
## ar1    9.9954e-01  2.6300e-04 3804.5277 0.000000
## omega  8.0396e+03  6.0813e+02   13.2203 0.000000
## alpha1 2.2229e-01  4.8001e-02    4.6309 0.000004
## beta1  0.0000e+00  3.7900e-04    0.0000 1.000000
##
## LogLikelihood : -16866.16
##
## Information Criteria
## ------------------------------------
##
## Akaike       12.072
## Bayes        12.083
## Shibata      12.072
## Hannan-Quinn 12.076
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                    0.02936  0.8639
## Lag[2*(p+q)+(p+q)-1][2]   0.18657  0.9991
## Lag[4*(p+q)+(p+q)-1][5]   1.15499  0.9210
## d.o.f=1
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                  0.0006711  0.9793
## Lag[2*(p+q)+(p+q)-1][5] 0.0007787  1.0000
## Lag[4*(p+q)+(p+q)-1][9] 0.0008802  1.0000
## d.o.f=2
##
## Weighted ARCH LM Tests
```

```
## -----------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[3] 6.448e-05 0.500 2.000  0.9936
## ARCH Lag[5] 1.479e-04 1.440 1.667  1.0000
## ARCH Lag[7] 1.883e-04 2.315 1.543  1.0000
##
## Nyblom stability test
## -----------------------------------
## Joint Statistic:  8.8721
## Individual Statistics:
## mu     0.8584
## ar1    0.2061
## omega  5.9637
## alpha1 1.7499
## beta1  0.9699
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          1.28 1.47 1.88
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## -----------------------------------
##                    t-value    prob sig
## Sign Bias           1.3238 0.18567
## Negative Sign Bias  0.2768 0.78194
## Positive Sign Bias  1.3043 0.19225
## Joint Effect        8.0857 0.04427  **
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## -----------------------------------
##   group statistic p-value(g-1)
## 1    20     197.5    1.051e-31
## 2    30     216.1    1.662e-30
## 3    40     235.1    7.525e-30
## 4    50     249.6    1.124e-28
##
##
## Elapsed time : 19.9334
```

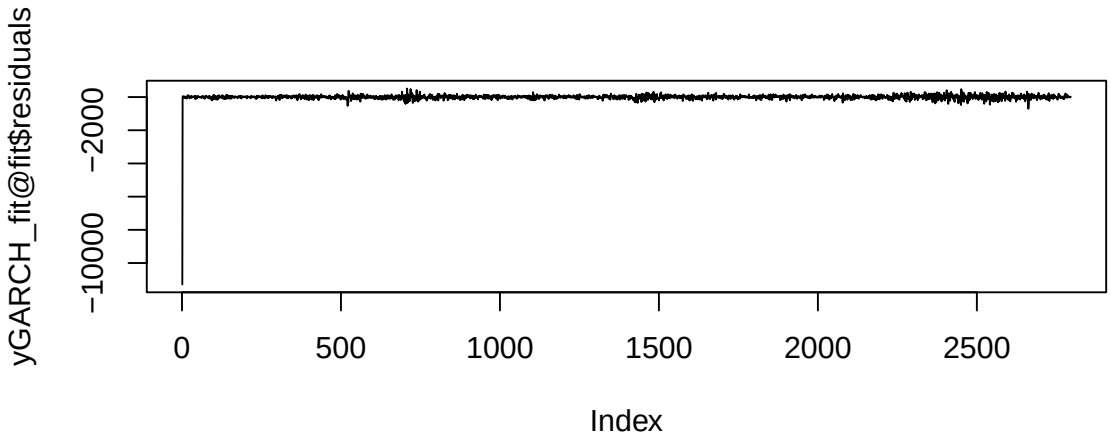
```
##  [1] "modelinc"   "modeldesc"  "modeldata"  "pars"       "start.pars"
##  [6] "fixed.pars" "maxOrder"   "pos.matrix" "fmodel"     "pidx"
## [11] "n.start"
```

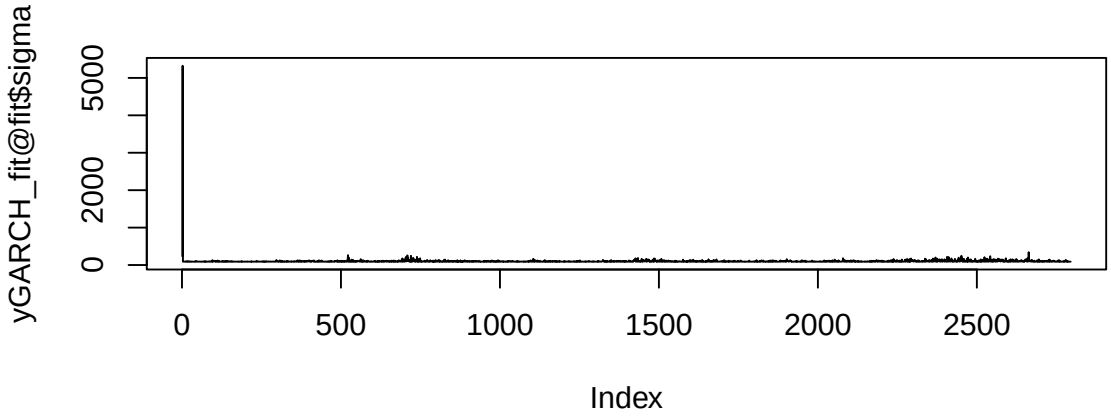
```
##  [1] "hessian"         "cvar"            "var"             "sigma"
##  [5] "condH"           "z"               "LLH"             "log.likelihoods"
##  [9] "residuals"       "coef"            "robust.cvar"     "A"
## [13] "B"               "scores"          "se.coef"         "tval"
## [17] "matcoef"         "robust.se.coef"  "robust.tval"     "robust.matcoef"
## [21] "fitted.values"   "convergence"     "kappa"           "persistence"
## [25] "timer"           "ipars"           "solver"
```

```
##           mu          ar1        omega       alpha1        beta1
## 1.674172e+04 9.995421e-01 8.039603e+03 2.222892e-01 3.177549e-11
```

```
##       ar1
```

```
## 0.9995421
```



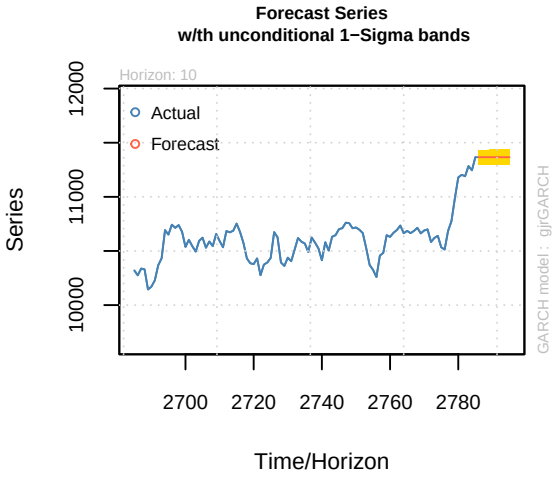


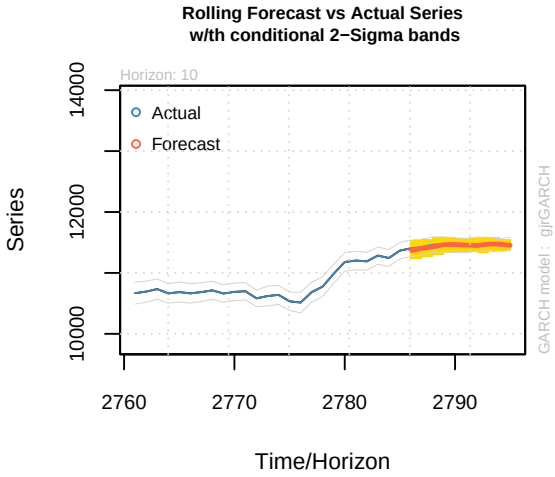

```
##
## Akaike       11.78787
## Bayes        11.80486
## Shibata      11.78785
## Hannan-Quinn 11.79400
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : gjrGARCH(1,1)
## Mean Model   : ARFIMA(1,0,0)
## Distribution : sstd
##
## Optimal Parameters
```

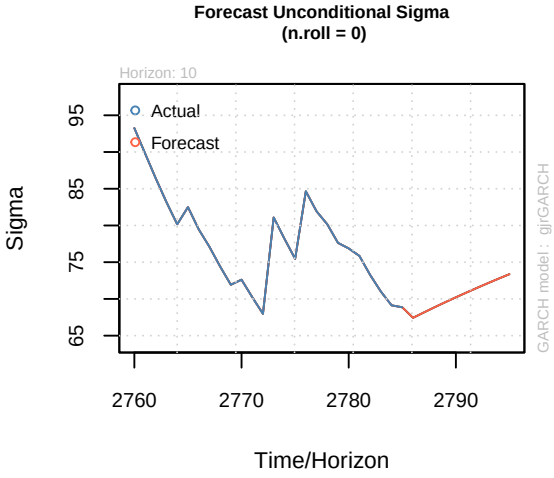
```
## ------------------------------------
##          Estimate  Std. Error    t value Pr(>|t|)
## mu     5.4317e+03   73.640292   73.75999 0.000000
## ar1    1.0000e+00    0.000567 1764.98629 0.000000
## omega  1.5917e+02   38.559165    4.12803 0.000037
## alpha1 3.2780e-03    0.009254    0.35419 0.723194
## beta1  9.0430e-01    0.012575   71.91545 0.000000
## gamma1 1.6586e-01    0.025291    6.55801 0.000000
## skew   8.8512e-01    0.021638   40.90579 0.000000
## shape  7.5736e+00    1.109048    6.82895 0.000000
##
## Robust Standard Errors:
##          Estimate  Std. Error   t value Pr(>|t|)
## mu     5.4317e+03   13.446578  403.9472 0.000000
## ar1    1.0000e+00    0.000646 1549.0653 0.000000
## omega  1.5917e+02   44.370446    3.5874 0.000334
## alpha1 3.2780e-03    0.011440    0.2865 0.774493
## beta1  9.0430e-01    0.013995   64.6182 0.000000
## gamma1 1.6586e-01    0.029843    5.5579 0.000000
## skew   8.8512e-01    0.017379   50.9300 0.000000
## shape  7.5736e+00    1.057408    7.1625 0.000000
##
## LogLikelihood : -16465.55
##
## Information Criteria
## ------------------------------------
##
## Akaike       11.788
## Bayes        11.805
## Shibata      11.788
## Hannan-Quinn 11.794
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                     0.2724  0.6017
## Lag[2*(p+q)+(p+q)-1][2]    0.3275  0.9920
## Lag[4*(p+q)+(p+q)-1][5]    2.3731  0.6028
## d.o.f=1
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      1.881  0.1702
## Lag[2*(p+q)+(p+q)-1][5]     2.927  0.4206
## Lag[4*(p+q)+(p+q)-1][9]     3.554  0.6650
## d.o.f=2
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[3]    0.9443 0.500 2.000  0.3312
## ARCH Lag[5]    1.1024 1.440 1.667  0.7028
```

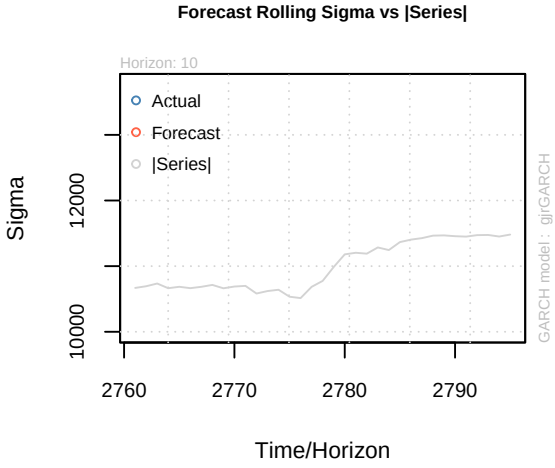
```
## ARCH Lag[7]    1.2625 2.315 1.543  0.8675
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  2.9408
## Individual Statistics:
## mu     0.00141
## ar1    0.44107
## omega  0.72881
## alpha1 0.85825
## beta1  0.77170
## gamma1 0.68595
## skew   0.25382
## shape  0.07983
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          1.89 2.11 2.59
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## ------------------------------------
##                    t-value    prob sig
## Sign Bias            1.029 0.30367
## Negative Sign Bias   1.237 0.21616
## Positive Sign Bias   1.704 0.08855   *
## Joint Effect         7.552 0.05624   *
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     29.77      0.05486
## 2    30     40.45      0.07691
## 3    40     57.45      0.02862
## 4    50     62.26      0.09663
##
##
## Elapsed time : 1.801423
##
## *-----------------------------------*
## *       GARCH Model Forecast        *
## *-----------------------------------*
## Model: gjrGARCH
## Horizon: 10
## Roll Steps: 10
## Out of Sample: 10
##
## 0-roll forecast [T0=2785-01-01]:
##      Series Sigma
## T+1   11366 67.43
## T+2   11366 68.15
## T+3   11366 68.85
## T+4   11366 69.54
```

```
## T+5   11366 70.22
## T+6   11366 70.88
## T+7   11366 71.52
## T+8   11366 72.15
## T+9   11366 72.77
## T+10  11366 73.37
```










```
##
## *----------------------------------*
## *       GARCH Model Forecast       *
## *----------------------------------*
## Model: gjrGARCH
## Horizon: 10
## Roll Steps: 10
## Out of Sample: 10
##
## 0-roll forecast [T0=2785-01-01]:
##      Series Sigma
## T+1   11366 67.43
```

```
## T+2   11366 68.15
## T+3   11366 68.85
## T+4   11366 69.54
## T+5   11366 70.22
## T+6   11366 70.88
## T+7   11366 71.52
## T+8   11366 72.15
## T+9   11366 72.77
## T+10  11366 73.37
```

Zadanie 4 - zadanie domowe

Dla wybranych szeregów czasowych wykonaj powyższe polecenia