Analiza kursu waluty w okresie od grudnia 2023 do maja 2024

Dane:

```
if(!file.exists('mstnbp.zip')) {
  download.file('https://info.bossa.pl/pub/metastock/waluty/mstnbp.zip','mstnbp.zip')
}
```

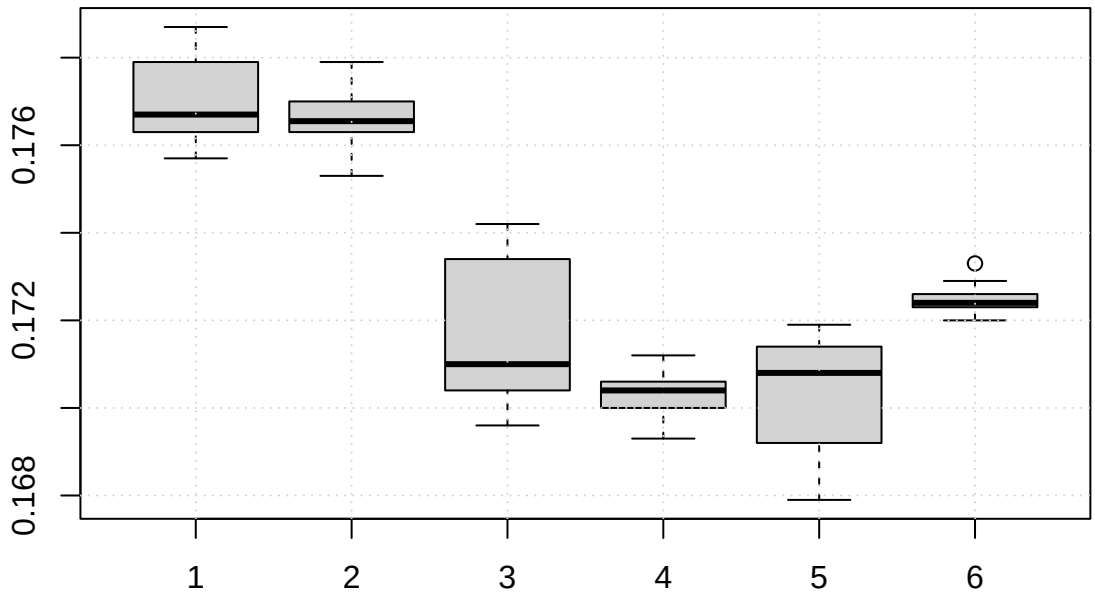
```
  unzip('mstnbp.zip', 'CZK.mst')
  df_CZK = read.csv('CZK.mst')

  df_CZK$X.DTYYYYMMDD. = as.Date.character(df_CZK$X.DTYYYYMMDD., format ='%Y%m%d')

  df_CZK1 = df_CZK[which(df_CZK$X.DTYYYYMMDD. >= '2023-12-01' & df_CZK$X.DTYYYYMMDD. <= '2023-12-31'),]
  df_CZK2 = df_CZK[which(df_CZK$X.DTYYYYMMDD. >= '2024-01-01' & df_CZK$X.DTYYYYMMDD. <= '2024-01-31'),]
  df_CZK3 = df_CZK[which(df_CZK$X.DTYYYYMMDD. >= '2024-02-01' & df_CZK$X.DTYYYYMMDD. <= '2024-02-29'),]
  df_CZK4 = df_CZK[which(df_CZK$X.DTYYYYMMDD. >= '2024-03-01' & df_CZK$X.DTYYYYMMDD. <= '2024-03-31'),]
  df_CZK5 = df_CZK[which(df_CZK$X.DTYYYYMMDD. >= '2024-04-01' & df_CZK$X.DTYYYYMMDD. <= '2024-04-30'),]
  df_CZK6 = df_CZK[which(df_CZK$X.DTYYYYMMDD. >= '2024-05-01' & df_CZK$X.DTYYYYMMDD. <= '2024-05-31'),]
```

Wykres pudełkowy ilustrujący rozkłady kursów dla analizowanych miesięcy:

```
  boxplot(df_CZK1$X.CLOSE., df_CZK2$X.CLOSE., df_CZK3$X.CLOSE., df_CZK4$X.CLOSE., df_CZK5$X.CLOSE., df_
  grid()
```




Testy przy założeniu normalnośći oraz bez tego założenia.

```
dane_anova_z = data.frame(
  dane = c(df_CZK1$X.CLOSE., df_CZK2$X.CLOSE., df_CZK3$X.CLOSE., df_CZK4$X.CLOSE., df_CZK5$X.CLOSE., df_
```

```
  proba = rep(c("1.gru", "2.sty", "3.luty", "4.mar", "5.kwie", "6.maj"),
              times = c(length(df_CZK1$X.CLOSE.), length(df_CZK2$X.CLOSE.), length(df_CZK3$X.CLOSE.),
                        length(df_CZK4$X.CLOSE.), length(df_CZK5$X.CLOSE.), length(df_CZK6$X.CLOSE.)))
)
```

```
aov_wyniki = aov(dane~proba, data = dane_anova_z)
summary(aov_wyniki)
```

```
##              Df    Sum Sq   Mean Sq F value Pr(>F)
## proba         5 0.0009667 1.934e-04   187.5 <2e-16 ***
## Residuals   118 0.0001217 1.030e-06
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
  bartlett.test(dane~proba, data = dane_anova_z)
```

```
##
##  Bartlett test of homogeneity of variances
##
## data:  dane by proba
## Bartlett's K-squared = 60.295, df = 5, p-value = 1.056e-11
```

```
  kruskal.test(dane~proba, dane_anova_z)
```

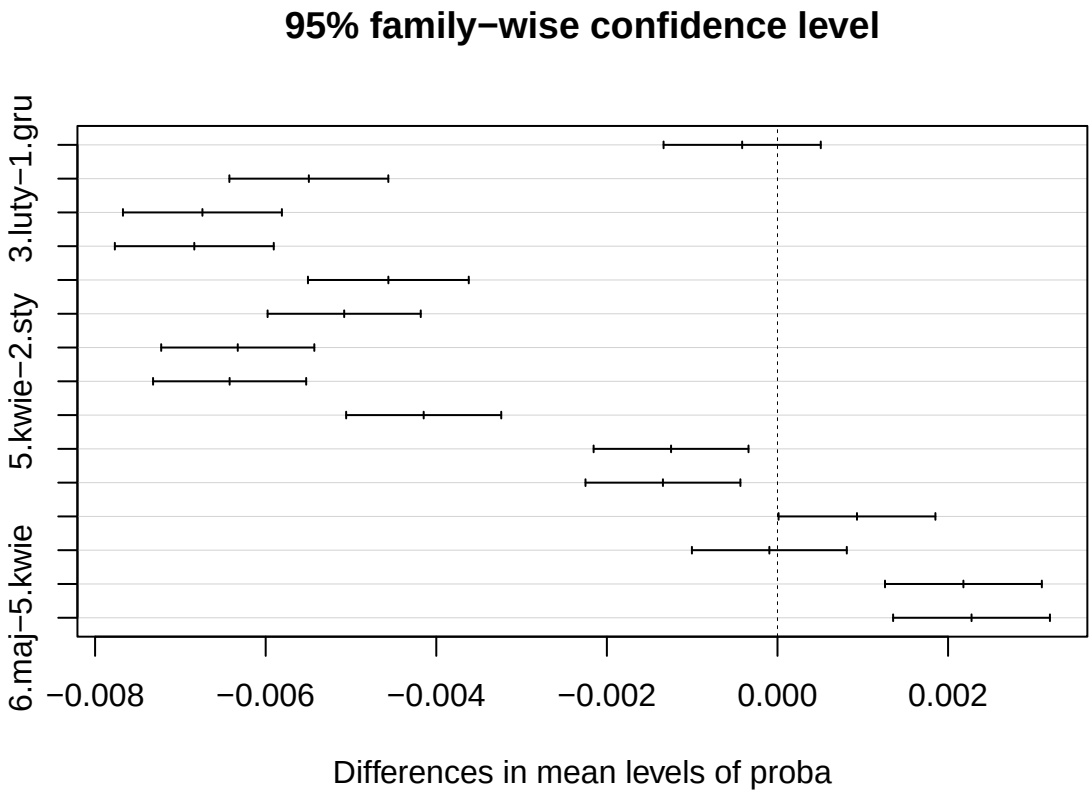
```
##
##  Kruskal-Wallis rank sum test
##
## data:  dane by proba
## Kruskal-Wallis chi-squared = 99.135, df = 5, p-value < 2.2e-16
```

Analiza odstępstw od średniej metodami Tukeya i Bonferroniego

```
  Tukey_wyniki = TukeyHSD(aov_wyniki)
  print(Tukey_wyniki)
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = dane ~ proba, data = dane_anova_z)
##
## $proba
##                         diff           lwr           upr     p adj
## 2.sty-1.gru   -0.0004141148 -1.335568e-03  0.0005073387 0.7834153
## 3.luty-1.gru  -0.0054939850 -6.425550e-03 -0.0045624199 0.0000000
## 4.mar-1.gru   -0.0067416040 -7.673169e-03 -0.0058100390 0.0000000
## 5.kwie-1.gru  -0.0068368421 -7.768407e-03 -0.0059052771 0.0000000
## 6.maj-1.gru   -0.0045618421 -5.504405e-03 -0.0036192796 0.0000000
## 3.luty-2.sty  -0.0050798701 -5.977470e-03 -0.0041822701 0.0000000
## 4.mar-2.sty   -0.0063274892 -7.225089e-03 -0.0054298891 0.0000000
## 5.kwie-2.sty  -0.0064227273 -7.320327e-03 -0.0055251272 0.0000000
## 6.maj-2.sty   -0.0041477273 -5.056736e-03 -0.0032387188 0.0000000
## 4.mar-3.luty  -0.0012476190 -2.155596e-03 -0.0003396418 0.0016290
## 5.kwie-3.luty -0.0013428571 -2.250834e-03 -0.0004348799 0.0005275
## 6.maj-3.luty   0.0009321429  1.288592e-05  0.0018513998 0.0448349
## 5.kwie-4.mar  -0.0000952381 -1.003215e-03  0.0008127392 0.9996450
## 6.maj-4.mar    0.0021797619  1.260505e-03  0.0030990188 0.0000000
## 6.maj-5.kwie   0.0022750000  1.355743e-03  0.0031942569 0.0000000
```

```r
plot(Tukey_wyniki)
```




```r
pairwise_none = pairwise.t.test(dane_anova_z$dane, dane_anova_z$proba, p.adj = 'none')
pairwise_none
```

```
##
##  Pairwise comparisons using t tests with pooled SD
##
## data:  dane_anova_z$dane and dane_anova_z$proba
##
##        1.gru   2.sty   3.luty  4.mar   5.kwie
## 2.sty  0.19545 -       -       -       -
## 3.luty < 2e-16 < 2e-16 -       -       -
## 4.mar  < 2e-16 < 2e-16 0.00012 -       -
## 5.kwie < 2e-16 < 2e-16 3.8e-05 0.76176 -
## 6.maj  < 2e-16 < 2e-16 0.00398 3.2e-10 7.1e-11
##
## P value adjustment method: none
```

```r
pairwise_bonf = pairwise.t.test(dane_anova_z$dane, dane_anova_z$proba, p.adj = 'bonf')
pairwise_bonf
```

```
##
##  Pairwise comparisons using t tests with pooled SD
##
## data:  dane_anova_z$dane and dane_anova_z$proba
##
```

```
##        1.gru   2.sty   3.luty  4.mar   5.kwie
## 2.sty  1.00000 -       -       -       -
## 3.luty < 2e-16 < 2e-16 -       -       -
## 4.mar  < 2e-16 < 2e-16 0.00179 -       -
## 5.kwie < 2e-16 < 2e-16 0.00056 1.00000 -
## 6.maj  < 2e-16 < 2e-16 0.05966 4.8e-09 1.1e-09
##
## P value adjustment method: bonferroni
```