ATP Data Analysis

2024-01-10

Instalacija potrebnih paketa.

```
# install.packages("dplyr")
# install.packages("lubridate")
# install.packages("ggplot2")
# install.packages("caret")
```

Učitavanje biblioteka.

```
library(dplyr)
library(lubridate)
library(ggplot2)
library(caret)
library(nortest)
```

Učitavanje i opis podataka

```
all_matches <- data.frame()
for (year in 1991:2023) {
  file_name <- paste0("dataset/atp_matches_", year, ".csv")
  matches_year <- read.csv(file_name, stringsAsFactors = FALSE)
  all_matches <- rbind(all_matches, matches_year)
}

dim(all_matches)
```

```
## [1] 104682     49
```

Skup podataka sadrži informacije o 104682 teniska meča održana od 1991. do 2023. godine uključivo. Svaki meč opisan je s 49 ispod navedenih značajki:

```
names(all_matches)
```

```
##  [1] "tourney_id"         "tourney_name"       "surface"
##  [4] "draw_size"          "tourney_level"      "tourney_date"
##  [7] "match_num"          "winner_id"          "winner_seed"
## [10] "winner_entry"       "winner_name"        "winner_hand"
## [13] "winner_ht"          "winner_ioc"         "winner_age"
## [16] "loser_id"           "loser_seed"         "loser_entry"
## [19] "loser_name"         "loser_hand"         "loser_ht"
## [22] "loser_ioc"          "loser_age"          "score"
## [25] "best_of"            "round"              "minutes"
```

```
## [28] "w_ace"              "w_df"               "w_svpt"
## [31] "w_1stIn"            "w_1stWon"           "w_2ndWon"
## [34] "w_SvGms"            "w_bpSaved"          "w_bpFaced"
## [37] "l_ace"              "l_df"               "l_svpt"
## [40] "l_1stIn"            "l_1stWon"           "l_2ndWon"
## [43] "l_SvGms"            "l_bpSaved"          "l_bpFaced"
## [46] "winner_rank"        "winner_rank_points" "loser_rank"
## [49] "loser_rank_points"
```

```
print(summary(all_matches))
```

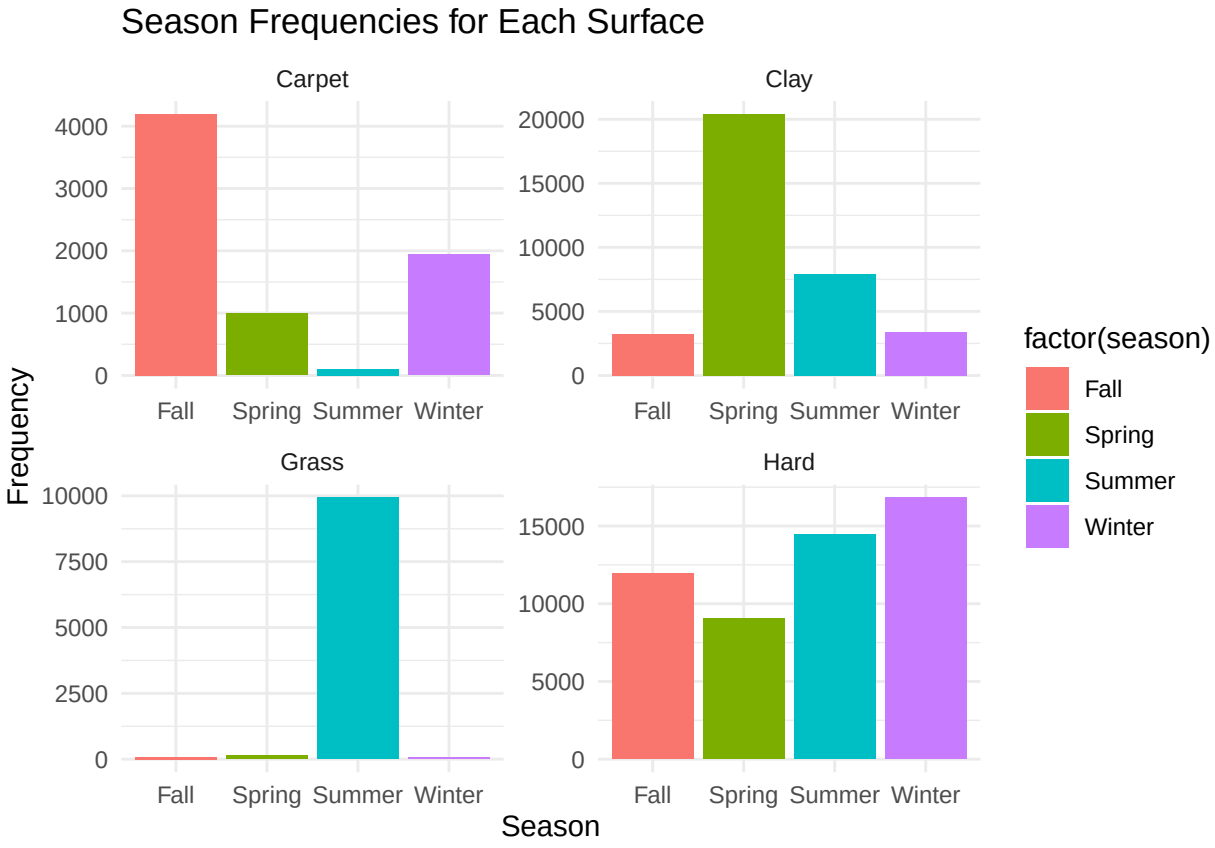
```
##   tourney_id        tourney_name         surface            draw_size
##  Length:104682      Length:104682      Length:104682      Min.   :  2.00
##  Class :character   Class :character   Class :character   1st Qu.: 32.00
##  Mode  :character   Mode  :character   Mode  :character   Median : 32.00
##                                                           Mean   : 53.52
##                                                           3rd Qu.: 64.00
##                                                           Max.   :128.00
##
##  tourney_level       tourney_date        match_num         winner_id
##  Length:104682      Min.   :19901231   Min.   :   1.00   Min.   :100284
##  Class :character   1st Qu.:19971006   1st Qu.:  10.00   1st Qu.:102148
##  Mode  :character   Median :20050815   Median :  24.00   Median :103602
##                     Mean   :20058134   Mean   :  72.47   Mean   :106703
##                     3rd Qu.:20140224   3rd Qu.:  73.00   3rd Qu.:104797
##                     Max.   :20230828   Max.   :1701.00   Max.   :211468
##
##   winner_seed    winner_entry       winner_name        winner_hand
##  Min.   : 1.00   Length:104682      Length:104682      Length:104682
##  1st Qu.: 3.00   Class :character   Class :character   Class :character
##  Median : 5.00   Mode  :character   Mode  :character   Mode  :character
##  Mean   : 6.92
##  3rd Qu.: 8.00
##  Max.   :35.00
##  NA's   :62282
##    winner_ht      winner_ioc          winner_age       loser_id
##  Min.   :160.0   Length:104682      Min.   :14.30   Min.   :100282
##  1st Qu.:180.0   Class :character   1st Qu.:23.00   1st Qu.:102154
##  Median :185.0   Mode  :character   Median :25.50   Median :103566
##  Mean   :185.7                      Mean   :25.77   Mean   :106814
##  3rd Qu.:190.0                      3rd Qu.:28.30   3rd Qu.:104919
##  Max.   :211.0                      Max.   :42.70   Max.   :212041
##  NA's   :2454                       NA's   :5
##    loser_seed    loser_entry         loser_name         loser_hand
##  Min.   : 1.00   Length:104682      Length:104682      Length:104682
##  1st Qu.: 4.00   Class :character   Class :character   Class :character
##  Median : 6.00   Mode  :character   Mode  :character   Mode  :character
##  Mean   : 8.29
##  3rd Qu.:11.00
##  Max.   :35.00
##  NA's   :81382
##     loser_ht      loser_ioc           loser_age        score
##  Min.   :160.0   Length:104682      Min.   :14.50   Length:104682
##  1st Qu.:180.0   Class :character   1st Qu.:23.00   Class :character
```

```
##  Median :185.0   Mode  :character   Median :25.70   Mode  :character
##  Mean   :185.2                      Mean   :25.88
##  3rd Qu.:190.0                      3rd Qu.:28.50
##  Max.   :211.0                      Max.   :46.00
##  NA's   :4855                       NA's   :18
##     best_of         round              minutes           w_ace
##  Min.   :3.000   Length:104682      Min.   :   0.0   Min.   :  0.000
##  1st Qu.:3.000   Class :character   1st Qu.:  75.0   1st Qu.:  3.000
##  Median :3.000   Mode  :character   Median :  96.0   Median :  5.000
##  Mean   :3.441                      Mean   : 103.8   Mean   :  6.526
##  3rd Qu.:3.000                      3rd Qu.: 125.0   3rd Qu.:  9.000
##  Max.   :5.000                      Max.   :1146.0   Max.   :113.000
##                                     NA's   :13036    NA's   :10207
##       w_df            w_svpt          w_1stIn          w_1stWon
##  Min.   : 0.000   Min.   :  0.00   Min.   :  0.00   Min.   :  0.00
##  1st Qu.: 1.000   1st Qu.: 56.00   1st Qu.: 34.00   1st Qu.: 26.00
##  Median : 2.000   Median : 73.00   Median : 44.00   Median : 33.00
##  Mean   : 2.734   Mean   : 78.13   Mean   : 47.66   Mean   : 35.93
##  3rd Qu.: 4.000   3rd Qu.: 94.00   3rd Qu.: 58.00   3rd Qu.: 43.00
##  Max.   :26.000   Max.   :491.00   Max.   :361.00   Max.   :292.00
##  NA's   :10207    NA's   :10207    NA's   :10207    NA's   :10207
##     w_2ndWon        w_SvGms        w_bpSaved        w_bpFaced
##  Min.   : 0.00   Min.   : 0.00   Min.   : 0.000   Min.   : 0.000
##  1st Qu.:12.00   1st Qu.: 9.00   1st Qu.: 1.000   1st Qu.: 2.000
##  Median :16.00   Median :11.00   Median : 3.000   Median : 4.000
##  Mean   :16.73   Mean   :12.41   Mean   : 3.526   Mean   : 5.164
##  3rd Qu.:21.00   3rd Qu.:15.00   3rd Qu.: 5.000   3rd Qu.: 7.000
##  Max.   :82.00   Max.   :90.00   Max.   :24.000   Max.   :34.000
##  NA's   :10207   NA's   :10206   NA's   :10207    NA's   :10207
##      l_ace             l_df            l_svpt          l_1stIn
##  Min.   :  0.000   Min.   : 0.000   Min.   :  0.00   Min.   :  0.00
##  1st Qu.:  2.000   1st Qu.: 2.000   1st Qu.: 59.00   1st Qu.: 34.00
##  Median :  4.000   Median : 3.000   Median : 76.00   Median : 45.00
##  Mean   :  4.841   Mean   : 3.485   Mean   : 80.97   Mean   : 48.09
##  3rd Qu.:  7.000   3rd Qu.: 5.000   3rd Qu.: 97.00   3rd Qu.: 58.00
##  Max.   :103.000   Max.   :26.000   Max.   :489.00   Max.   :328.00
##  NA's   :10207     NA's   :10207    NA's   :10207    NA's   :10207
##     l_1stWon         l_2ndWon         l_SvGms        l_bpSaved
##  Min.   :  0.00   Min.   :  0.00   Min.   : 0.00   Min.   :-6.000
##  1st Qu.: 22.00   1st Qu.: 10.00   1st Qu.: 9.00   1st Qu.: 2.000
##  Median : 30.00   Median : 14.00   Median :11.00   Median : 4.000
##  Mean   : 31.95   Mean   : 14.98   Mean   :12.21   Mean   : 4.813
##  3rd Qu.: 40.00   3rd Qu.: 19.00   3rd Qu.:15.00   3rd Qu.: 7.000
##  Max.   :284.00   Max.   :101.00   Max.   :91.00   Max.   :28.000
##  NA's   :10207    NA's   :10207    NA's   :10206   NA's   :10207
##    l_bpFaced      winner_rank      winner_rank_points   loser_rank
##  Min.   : 0.00   Min.   :   1.00   Min.   :    1      Min.   :   1.0
##  1st Qu.: 6.00   1st Qu.:  18.00   1st Qu.:  529      1st Qu.:  37.0
##  Median : 8.00   Median :  46.00   Median :  880      Median :  70.0
##  Mean   : 8.74   Mean   :  80.66   Mean   : 1429      Mean   : 119.1
##  3rd Qu.:11.00   3rd Qu.:  89.00   3rd Qu.: 1598      3rd Qu.: 119.0
##  Max.   :38.00   Max.   :2101.00   Max.   :16950      Max.   :2159.0
##  NA's   :10207   NA's   :1189      NA's   :2177       NA's   :2536
##  loser_rank_points
```

```
##  Min.   :    1.0
##  1st Qu.:  395.0
##  Median :  658.0
##  Mean   :  895.6
##  3rd Qu.: 1040.0
##  Max.   :16950.0
##  NA's   :3519
```

TODO Opis ispisa, možda uzet summary samo za neke značajke

Zadatak 1. Kakva je distribucija mečeva na specifičnim podlogama u različitim godišnjim dobima?

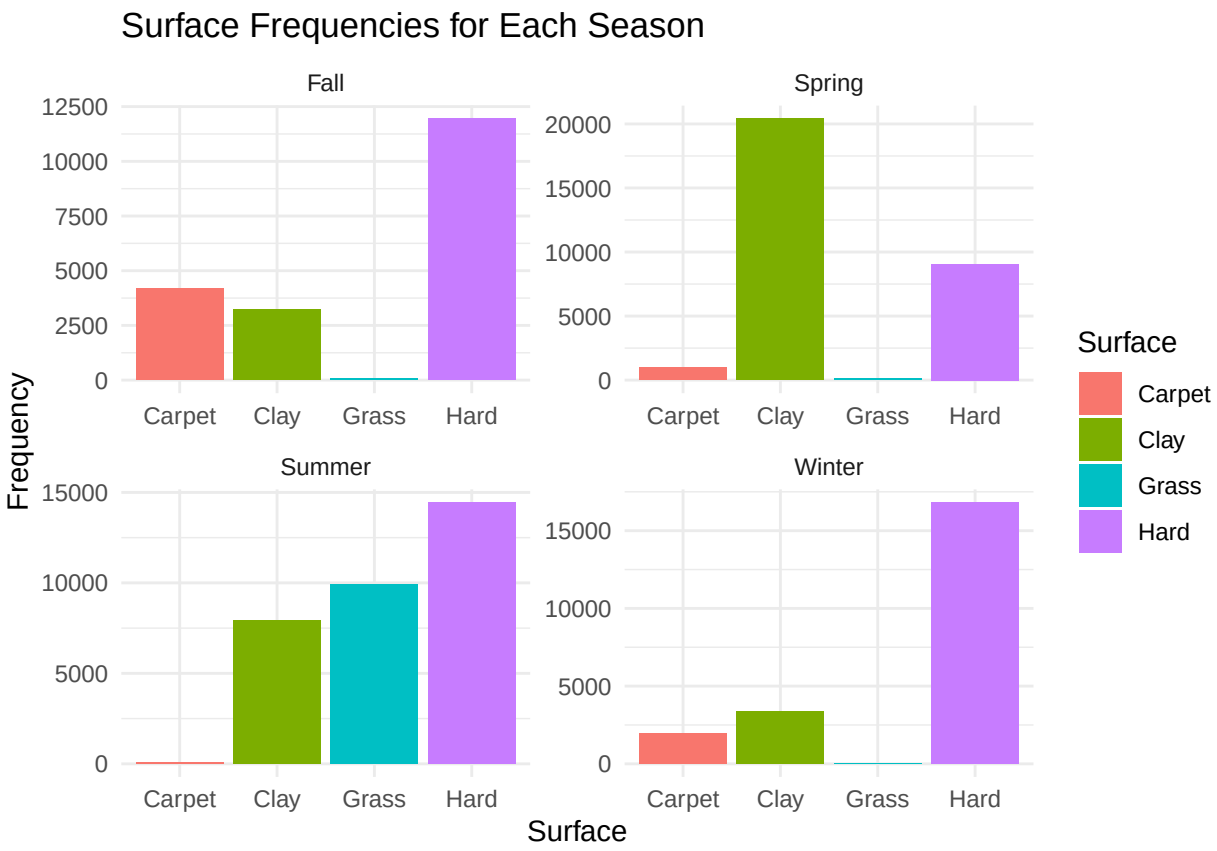


Prvi histogram prikazuje raspodjelu mečeva prema podlogama u jesen. Uvjerljivo najviše mečeva u jesen održava se na tvrdoj podlozi. Dosta manje mečeva igra se na podlozi od tepiha, a nešto malo manje na zemlji. Najmanje mečeva u jesenskom dijelu sezone igra se na travi.

Idući histogram prikazuje raspodjelu mečeva prema podlogama u proljeće. U proljetnom dijelu sezone uvjerljivo najviše teniskih mečeva igra se na podlozi od zemlje. Više od dvostruko manje mečeva održava se na tvrdoj podlozi. Jako malo mečeva održava se na podlozi od tepiha, a još manje na travi.

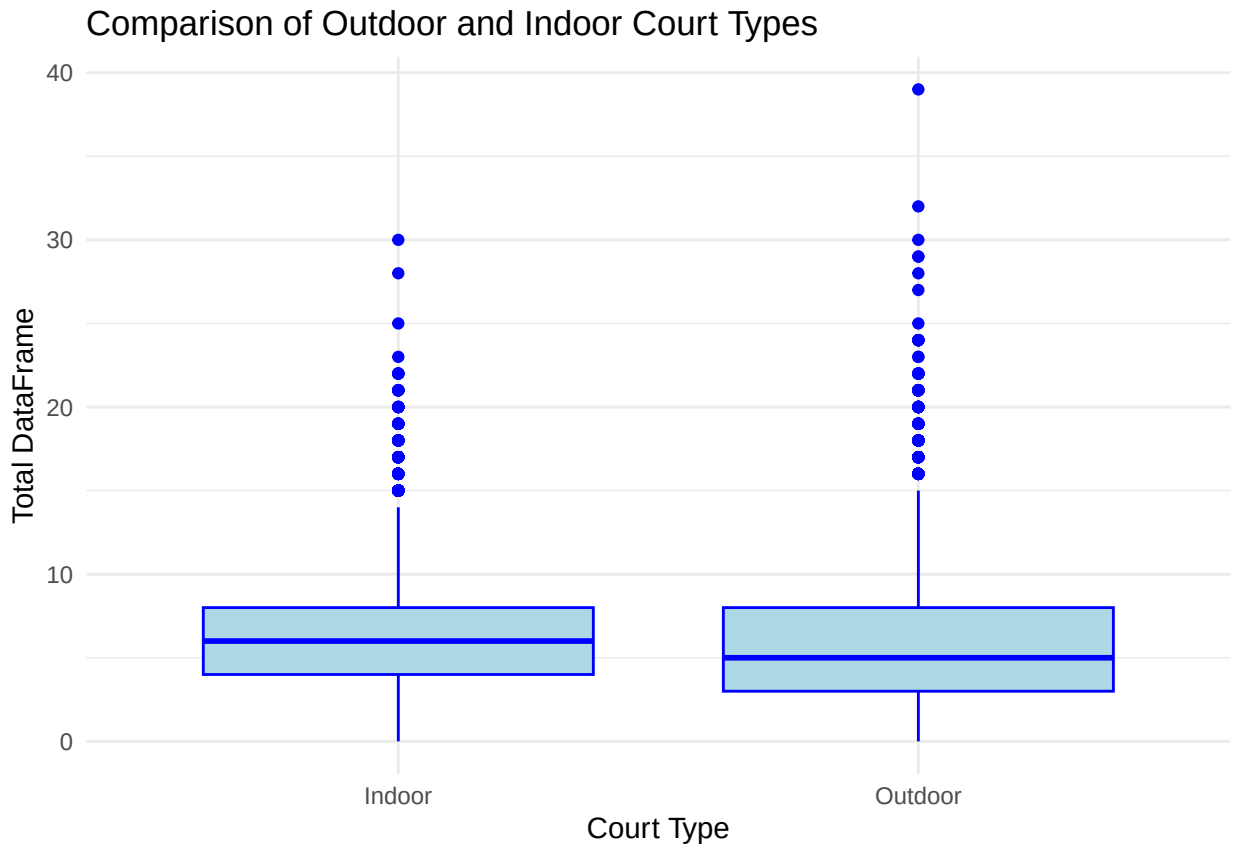
U trećem histogramu promatramo raspodjelu mečeva prema podlogama tijekom ljeta. Najviše mečeva održava se na tvrdoj podlozi, zatim na travi pa na podlozi od zemlje. Svega nekoliko mečeva igra se na podlozi od tepiha.

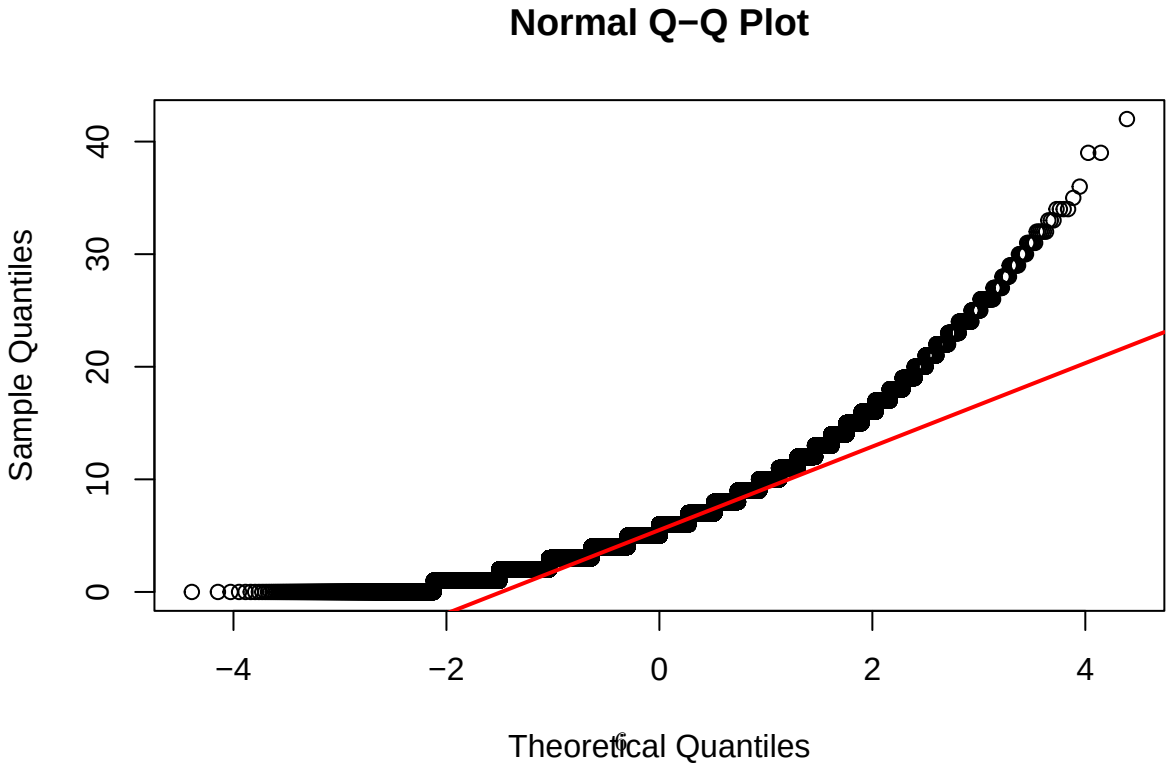
Zadnji histogram opisuje raspodjelu mečeva prema podlogama zimi. Tijekom zime prednjače mečevi na tvrdoj podlozi. Dosta manje mečeva igra se na zemlji, zatim na podlozi od tepiha te najmanje na travi.

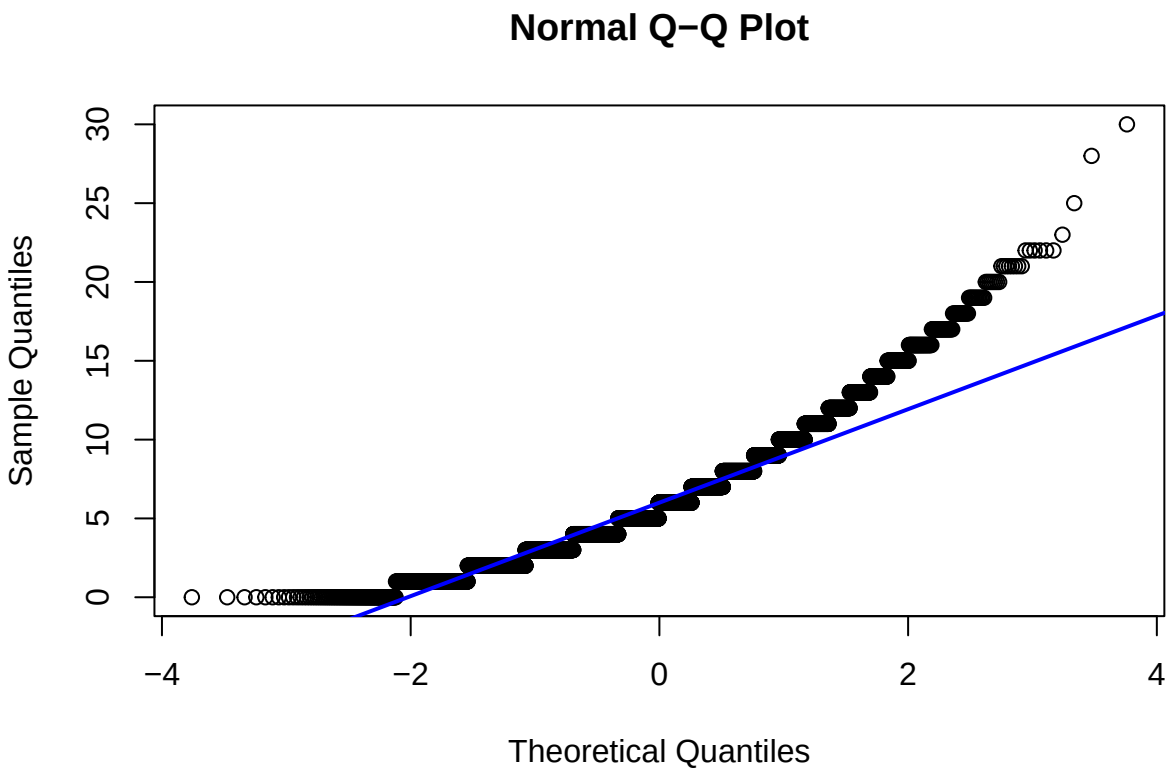


TODO Opisat histogram, šta prikazuje

Zadatak 2. Postoji li značajna razlika u prosječnom broju dvostrukih pogrešaka između mečeva odigranih na otvorenom u odnosu na mečeve odigrane na zatvorenom terenu?








```
##
##  Lilliefors (Kolmogorov-Smirnov) normality test
##
## data:  open_surface_data
## D = 0.12974, p-value < 2.2e-16

##
##  Lilliefors (Kolmogorov-Smirnov) normality test
##
## data:  closed_surface_data
## D = 0.12216, p-value < 2.2e-16

##
##  F test to compare two variances
##
## data:  open_surface_data and closed_surface_data
## F = 1.1441, num df = 88596, denom df = 5877, p-value = 4.316e-12
## alternative hypothesis: true ratio of variances is not equal to 1
## 95 percent confidence interval:
##  1.101871 1.187308
## sample estimates:
## ratio of variances
##           1.144146

##
```

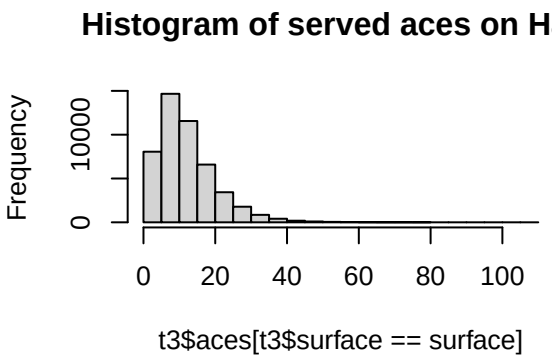
```
##  Wilcoxon rank sum test with continuity correction
##
## data:  open_surface_data and closed_surface_data
## W = 258377269, p-value = 0.3191
## alternative hypothesis: true location shift is not equal to 0
```

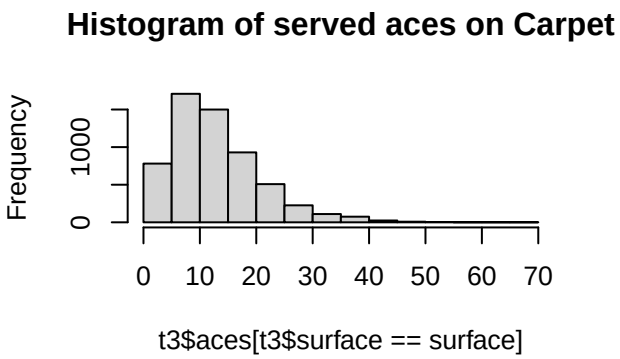
```
##
##  Two Sample t-test
##
## data:  open_surface_data and closed_surface_data
## t = 0.8201, df = 94473, p-value = 0.4122
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.06059204  0.14777857
## sample estimates:
## mean of x mean of y
##  6.221035  6.177441
```

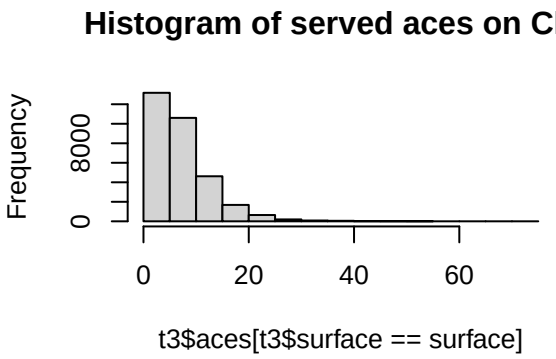
TODO Opis ispisa

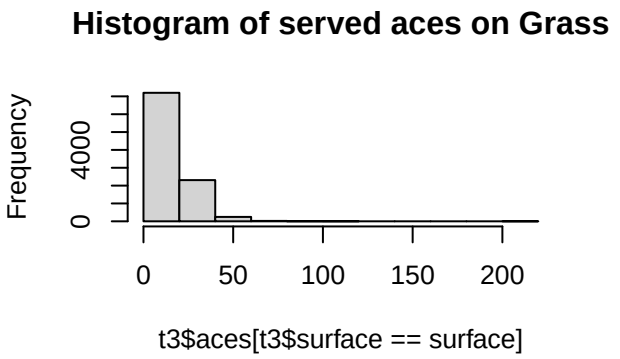
Zadatak 3. Ima li razlike u broju serviranih asova na različitim podlogama?

```
# Provjera homogenosti i normalnosti (Bartletov test)
# Vizualizacija po grupama Lili
# Kruskal Wallis

t3 <- all_matches %>%
  filter(!is.na(w_ace) & !is.na(l_ace) & !is.na(surface) & w_ace != "" & l_ace != "" & surface != "")
t3 <- select(t3, surface, w_ace, l_ace)
t3 <- t3 %>%
  mutate(aces = w_ace + l_ace)

par(mfrow = c(2, 2))
for (surface in unique(t3$surface)){
hist(t3$aces[t3$surface==surface],
main = paste("Histogram of served aces on" , surface))
}
```










```
require(nortest)
print(lillie.test(t3$aces[t3$surface=='Hard']))
```

```
##
##  Lilliefors (Kolmogorov-Smirnov) normality test
##
## data:  t3$aces[t3$surface == "Hard"]
## D = 0.11436, p-value < 2.2e-16
```

```
print(lillie.test(t3$aces[t3$surface=='Carpet']))
```

```
##
##  Lilliefors (Kolmogorov-Smirnov) normality test
##
## data:  t3$aces[t3$surface == "Carpet"]
## D = 0.10864, p-value < 2.2e-16
```

```
print(lillie.test(t3$aces[t3$surface=='Clay']))
```

```
##
##  Lilliefors (Kolmogorov-Smirnov) normality test
##
## data:  t3$aces[t3$surface == "Clay"]
## D = 0.13505, p-value < 2.2e-16
```

```r
print(lillie.test(t3$aces[t3$surface=='Grass']))
```

```
##
##  Lilliefors (Kolmogorov-Smirnov) normality test
##
## data:  t3$aces[t3$surface == "Grass"]
## D = 0.10802, p-value < 2.2e-16
```

```r
bartlett.test(t3$aces ~ t3$surface)
```

```
##
##  Bartlett test of homogeneity of variances
##
## data:  t3$aces by t3$surface
## Bartlett's K-squared = 7049.2, df = 3, p-value < 2.2e-16
```

```r
var((t3$aces[t3$surface=='Hard']))
```

```
## [1] 65.28138
```

```r
var((t3$aces[t3$surface=='Carpet']))
```

```
## [1] 63.26659
```

```r
var((t3$aces[t3$surface=='Clay']))
```

```
## [1] 31.9019
```

```r
var((t3$aces[t3$surface=='Grass']))
```

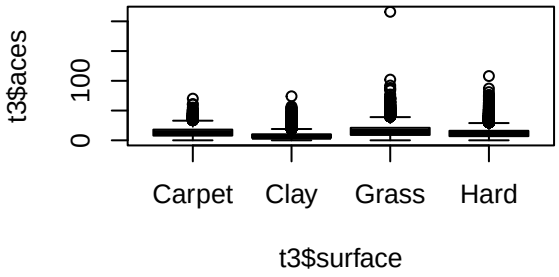
```
## [1] 104.5289
```

```r
boxplot(t3$aces ~ t3$surface)

aov_res <- aov(aces~surface, data=t3)
print(summary(aov_res))
```

```
##                Df  Sum Sq Mean Sq F value Pr(>F)
## surface         3  754563  251521    4319 <2e-16 ***
## Residuals   94471 5501707      58
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
kruskal.test(aces~surface, data=t3)
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  aces by surface
## Kruskal-Wallis chi-squared = 13657, df = 3, p-value < 2.2e-16
```



TODO Opis ispisa

Zadatak 4. Kakva je veza između vrste terena i vjerojatnosti da će mečevi otići u peti set?

```
##
##          FALSE TRUE
##   Carpet   700  179
##   Clay    5550 1240
##   Grass   3471  819
##   Hard    9090 2054
```

TODO Opis ispisa

Kontingencijskoj tablici dodajemo sume redaka i stupaca:

```
##
##          FALSE  TRUE   Sum
##   Carpet   700   179   879
##   Clay    5550  1240  6790
##   Grass   3471   819  4290
##   Hard    9090  2054 11144
##   Sum    18811  4292 23103
```

TODO Opis ispisa

Pretpostavka testa je da očekivana frekvencija pojedinog razreda mora biti veća ili jednaka 5 (`chisq.test()` pretpostavlja da je ovaj uvjet zadovoljen stoga je prije provođenja testa potrebno to provjeriti):

```
## Očekivane frekvencije za razred  FALSE - Carpet :  715.7022
## Očekivane frekvencije za razred  FALSE - Clay :  5528.576
## Očekivane frekvencije za razred  FALSE - Grass :  3493.018
## Očekivane frekvencije za razred  FALSE - Hard :  9073.704
## Očekivane frekvencije za razred  TRUE - Carpet :  163.2978
## Očekivane frekvencije za razred  TRUE - Clay :  1261.424
## Očekivane frekvencije za razred  TRUE - Grass :  796.9822
## Očekivane frekvencije za razred  TRUE - Hard :  2070.296
```

Sve očekivane frekvencije su veće od 5, nastavljamo sa χ^2 testom.

```
##
##  Pearson's Chi-squared test
##
## data:  contingency_table
## X-squared = 3.2059, df = 3, p-value = 0.361
```

TODO Opis ispisa

Zadatak 5. Možemo li procijeniti broj asova koje će igrač odservirati u tekućoj godini (zadnjoj dostupnoj sezoni) na temelju njegovih rezultata iz prethodnih sezona?

```
## Warning: Using an external vector in selections was deprecated in tidyselect 1.1.0.
## i Please use ‘all_of()‘ or ‘any_of()‘ instead.
##   # Was:
##   data %>% select(features)
##
##   # Now:
##   data %>% select(all_of(features))
##
## See <https://tidyselect.r-lib.org/reference/faq-external-vector.html>.
## This warning is displayed once every 8 hours.
## Call ‘lifecycle::last_lifecycle_warnings()‘ to see where this warning was
## generated.
```

```
## ‘summarise()‘ has grouped output by ’player_id’, ’year’, ’winner_ht’. You can
## override using the ‘.groups‘ argument.
## ‘summarise()‘ has grouped output by ’player_id’, ’year’, ’loser_ht’. You can
## override using the ‘.groups‘ argument.
```

```
## # A tibble: 7,417 x 9
## # Groups:   player_id, year, height [7,417]
##    player_id  year height hand  total_aces avg_1stIn avg_1stWon  svpt    df
##        <int> <dbl>  <int> <fct>      <int>     <dbl>      <dbl> <dbl> <int>
##  1    100284  1991    178 L             45      60.3       40.5  90.4    38
##  2    100284  1992    178 L             37      53.6       36.1  80.3    31
##  3    100284  1993    178 L              4      57         40    92.3    11
```

```
##  4    100284  1994    178 L              2      61         36    89       5
##  5    100284  1995    178 L              7      43         31.5  78.5    10
##  6    100529  1991    185 R            168      45.3       36.2  81.2    43
##  7    100529  1992    185 R             87      38.3       30.5  78.3    47
##  8    100532  1991    175 R             17      33         26.3  66       8
##  9    100581  1991    180 L            205      39.0       30.8  69.9   123
## 10    100581  1992    180 L            175      50.6       40.3  86.3   126
## # i 7,407 more rows
```

```
## # A tibble: 10,396 x 9
## # Groups:   player_id, year, height [10,396]
##    player_id  year height hand  total_aces avg_1stIn avg_1stWon  svpt    df
##        <int> <dbl>  <int> <fct>      <int>     <dbl>      <dbl> <dbl> <int>
##  1    100282  1992    180 L              0      67.5       40.5  96       5
##  2    100284  1991    178 L              9      49.2       27.1  75.6    34
##  3    100284  1992    178 L             25      57.9       33.4  90.6    46
##  4    100284  1993    178 L              4      37.4       22.2  60.4    14
##  5    100284  1994    178 L              1      56         34    87.3     3
##  6    100284  1995    178 L              3      48         29    67       2
##  7    100284  1996    178 L              3      55         30    93       2
##  8    100286  1991    168 R              0      32         18    60       2
##  9    100321  1993    193 R              0      34         14    48       0
## 10    100431  1992    178 R              8      46.5       30.5  76       4
## # i 10,386 more rows
```

```
## # A tibble: 40 x 9
## # Groups:   player_id, year, height [20]
##    player_id  year height hand  total_aces avg_1stIn avg_1stWon  svpt    df
##        <int> <dbl>  <int> <fct>      <int>     <dbl>      <dbl> <dbl> <int>
##  1    104925  2004    188 R              4      60         39    91       2
##  2    104925  2005    188 R             43      62.1       45.4  96.4    26
##  3    104925  2006    188 R            216      49.3       37    79.3    92
##  4    104925  2007    188 R            420      54.2       40.0  83.5   147
##  5    104925  2008    188 R            413      47.3       35.6  72.3   113
##  6    104925  2009    188 R            420      46.2       34.3  73.0   212
##  7    104925  2010    188 R            232      49.2       35.9  77.5   198
##  8    104925  2011    188 R            320      47.0       35.2  71.9   131
##  9    104925  2012    188 R            456      47.4       36.0  73.6   117
## 10    104925  2013    188 R            424      47.5       36.6  72.4    94
## 11    104925  2014    188 R            371      50.8       38.5  75.9    91
## 12    104925  2015    188 R            441      48.5       36.4  72.9   124
## 13    104925  2016    188 R            263      48.6       36.2  74.5   168
## 14    104925  2017    188 R            138      51.0       37.8  76.6    56
## 15    104925  2018    188 R            286      50.2       38.2  75.7   117
## 16    104925  2019    188 R            332      46.2       36.4  70.4   136
## 17    104925  2020    188 R            257      50.5       38.5  78.4   125
## 18    104925  2021    188 R            416      55.7       43.1  85.4   130
## 19    104925  2022    188 R            244      46.0       36.7  70.1    66
## 20    104925  2023    188 R            295      53.8       42.2  84.9   128
## 21    104925  2004    188 R             22      57.3       34    93.7    19
## 22    104925  2005    188 R             45      57         37.6  91.3    32
## 23    104925  2006    188 R             63      52.3       34.2  82.2    59
## 24    104925  2007    188 R             98      49         32.2  79.9    48
## 25    104925  2008    188 R             73      53.8       36.6  84.6    40
```

```
## 26    104925  2009    188 R             82      53.9       35.9  86.8    51
## 27    104925  2010    188 R             72      61.1       39.9  93.1    84
## 28    104925  2011    188 R             23      57.2       36.6  88.4    12
## 29    104925  2012    188 R             46      54         37.2  87.4    30
## 30    104925  2013    188 R             52      73.1       47.2 110.     24
## 31    104925  2014    188 R             57      60         41.5  91.4    14
## 32    104925  2015    188 R             30      60.2       39.8  91.8    11
## 33    104925  2016    188 R             38      51.8       35    82.1    20
## 34    104925  2017    188 R             31      57.8       38.6  90.1    23
## 35    104925  2018    188 R             56      57.4       38.8  87.1    35
## 36    104925  2019    188 R             60      61.4       40.3  91.3    32
## 37    104925  2020    188 R             21      45.6       31.2  72      12
## 38    104925  2021    188 R             31      56.4       39.6  92      18
## 39    104925  2022    188 R             38      69         45.2 106      22
## 40    104925  2023    188 R             15      66         41   100.     15
```

```
## `summarise()` has grouped output by 'player_id', 'year', 'height'. You can
## override using the `.groups` argument.
```

```
## # A tibble: 20 x 9
## # Groups:   player_id, year, height [20]
##    player_id  year height hand  total_aces avg_1stIn avg_1stWon  svpt    df
##        <int> <dbl>  <int> <fct>      <int>     <dbl>      <dbl> <dbl> <int>
##  1    104925  2004    188 R             26      58.7       36.5  92.3    21
##  2    104925  2005    188 R             88      59.6       41.5  93.9    58
##  3    104925  2006    188 R            279      50.8       35.6  80.8   151
##  4    104925  2007    188 R            518      51.6       36.1  81.7   195
##  5    104925  2008    188 R            486      50.5       36.1  78.4   153
##  6    104925  2009    188 R            502      50.0       35.1  79.9   263
##  7    104925  2010    188 R            304      55.1       37.9  85.3   282
##  8    104925  2011    188 R            343      52.1       35.9  80.2   143
##  9    104925  2012    188 R            502      50.7       36.6  80.5   147
## 10    104925  2013    188 R            476      60.3       41.9  91.0   118
## 11    104925  2014    188 R            428      55.4       40.0  83.6   105
## 12    104925  2015    188 R            471      54.3       38.1  82.4   135
## 13    104925  2016    188 R            301      50.2       35.6  78.3   188
## 14    104925  2017    188 R            169      54.4       38.2  83.4    79
## 15    104925  2018    188 R            342      53.8       38.5  81.4   152
## 16    104925  2019    188 R            392      53.8       38.3  80.8   168
## 17    104925  2020    188 R            278      48.1       34.8  75.2   137
## 18    104925  2021    188 R            447      56.0       41.4  88.7   148
## 19    104925  2022    188 R            282      57.5       40.9  88.1    88
## 20    104925  2023    188 R            310      59.9       41.6  92.6   143
```

```
## # A tibble: 20 x 10
## # Groups:   player_id, year, height [20]
##    player_id  year height hand  total_aces avg_1stIn avg_1stWon  svpt    df
##        <int> <dbl>  <int> <fct>      <int>     <dbl>      <dbl> <dbl> <int>
##  1    104925  2004    188 R             26      58.7       36.5  92.3    21
##  2    104925  2005    188 R             88      59.6       41.5  93.9    58
##  3    104925  2006    188 R            279      50.8       35.6  80.8   151
##  4    104925  2007    188 R            518      51.6       36.1  81.7   195
##  5    104925  2008    188 R            486      50.5       36.1  78.4   153
```

```
##  6    104925  2009    188 R           502      50.0       35.1  79.9   263
##  7    104925  2010    188 R           304      55.1       37.9  85.3   282
##  8    104925  2011    188 R           343      52.1       35.9  80.2   143
##  9    104925  2012    188 R           502      50.7       36.6  80.5   147
## 10    104925  2013    188 R           476      60.3       41.9  91.0   118
## 11    104925  2014    188 R           428      55.4       40.0  83.6   105
## 12    104925  2015    188 R           471      54.3       38.1  82.4   135
## 13    104925  2016    188 R           301      50.2       35.6  78.3   188
## 14    104925  2017    188 R           169      54.4       38.2  83.4    79
## 15    104925  2018    188 R           342      53.8       38.5  81.4   152
## 16    104925  2019    188 R           392      53.8       38.3  80.8   168
## 17    104925  2020    188 R           278      48.1       34.8  75.2   137
## 18    104925  2021    188 R           447      56.0       41.4  88.7   148
## 19    104925  2022    188 R           282      57.5       40.9  88.1    88
## 20    104925  2023    188 R           310      59.9       41.6  92.6   143
## # i 1 more variable: aces_in_following_year <int>
```

```
##        1        2        3        4
## 415.2551 508.1003 382.2384 331.1461
```