

Exploratory Data Analysis

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1.1: Load data

```
load("../analysis/data/.RData")
#load("../analysis/data/RData.dms")
QBCrossSectional$Week <- as.factor(QBCrossSectional$Week)
attach(QBCrossSectional)
```

```
## The following object is masked from package:ggplot2:
##
##      Position
```

1.2: Structures QBCrossSectional and QBPanels

1.2.1 QB (Quarterback)

```
head(QBCrossSectional)
```

```
## # A tibble: 6 x 21
##   PlayerID Week Position Opponent TeamIsHome GameDate PassingCompleti~
##   <dbl> <fct> <chr> <chr> <lgl> <date> <dbl>
## 1 6739 13 QB NYJ FALSE 2017-12-03 19
## 2 4314 3 QB HOU TRUE 2017-09-24 25
## 3 13320 10 QB MIA TRUE 2017-11-13 21
## 4 18857 5 QB KC TRUE 2017-10-08 16
## 5 14536 8 QB HOU TRUE 2017-10-29 26
## 6 18857 4 QB TEN TRUE 2017-10-01 25
## # ... with 14 more variables: PassingAttempts <dbl>,
## # PassingCompletionPercentage <dbl>, PassingYards <dbl>,
## # PassingYardsPerAttempt <dbl>, PassingTouchdowns <dbl>,
## # PassingInterceptions <dbl>, PassingRating <dbl>,
## # RushingAttempts <dbl>, RushingYards <dbl>,
## # RushingYardsPerAttempt <dbl>, RushingTouchdowns <dbl>,
## # FumblesLost <dbl>, FantasyPoints <dbl>, Team <chr>
```

```
summary(QBCrossSectional)
```

```
##      PlayerID      Week      Position      Opponent
## Min.   : 611    2      : 30 Length:453      Length:453
## 1st Qu.: 7242   13      : 29 Class :character Class :character
## Median :13723   14      : 29 Mode  :character Mode  :character
## Mean   :11932   3       : 28
## 3rd Qu.:16763   4       : 28
## Max.   :19029   12      : 28
##      (Other):281
## TeamIsHome      GameDate      PassingCompletions PassingAttempts
## Mode :logical   Min.   :2017-09-07 Min.   : 5.00 Min.   :10.00
## FALSE:226      1st Qu.:2017-10-08 1st Qu.:18.00 1st Qu.:29.00
## TRUE :227      Median :2017-11-05 Median :21.00 Median :33.00
```

```
##           Mean   :2017-11-05   Mean   :21.24   Mean   :33.62
##           3rd Qu.:2017-12-03   3rd Qu.:25.00   3rd Qu.:38.00
##           Max.   :2017-12-31   Max.   :44.00   Max.   :66.00
##
## PassingCompletionPercentage PassingYards PassingYardsPerAttempt
## Min.   :38.70           Min.   : 57.0   Min.   : 3.100
## 1st Qu.:57.10           1st Qu.:199.0   1st Qu.: 6.200
## Median :63.20           Median :241.0   Median : 7.200
## Mean   :63.48           Mean   :244.6   Mean   : 7.378
## 3rd Qu.:69.40           3rd Qu.:291.0   3rd Qu.: 8.400
## Max.   :87.00           Max.   :506.0   Max.   :14.100
##
## PassingTouchdowns PassingInterceptions PassingRating RushingAttempts
## Min.   :0.000   Min.   :0.00   Min.   : 31.14   Min.   : 0.000
## 1st Qu.:1.000   1st Qu.:0.00   1st Qu.: 77.92   1st Qu.: 1.000
## Median :1.000   Median :0.00   Median : 92.94   Median : 3.000
## Mean   :1.587   Mean   :0.66   Mean   : 93.88   Mean   : 3.185
## 3rd Qu.:2.000   3rd Qu.:1.00   3rd Qu.:109.84   3rd Qu.: 5.000
## Max.   :5.000   Max.   :4.00   Max.   :150.69   Max.   :14.000
##
## RushingYards RushingYardsPerAttempt RushingTouchdowns FumblesLost
## Min.   : -8.00   Min.   : -2.700   Min.   :0.0000   Min.   :0.0000
## 1st Qu.: 0.00   1st Qu.: 0.000   1st Qu.:0.0000   1st Qu.:0.0000
## Median : 8.00   Median : 3.000   Median :0.0000   Median :0.0000
## Mean   :14.38   Mean   : 3.839   Mean   :0.1457   Mean   :0.1766
## 3rd Qu.:23.00   3rd Qu.: 6.000   3rd Qu.:0.0000   3rd Qu.:0.0000
## Max.   :95.00   Max.   :70.000   Max.   :2.0000   Max.   :3.0000
##
## FantasyPoints      Team
## Min.   : 7.12   Length:453
## 1st Qu.:11.86   Class :character
## Median :15.86   Mode  :character
## Mean   :16.89
## 3rd Qu.:20.68
## Max.   :37.64
##
```

1.2.2 QB (Panel Data)

```
str(QBPanels)
```

```
## List of 17
## $ Opponent           :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1       : chr [1:56] NA "CHI" "DET" "SEA" ...
## ..$ 2       : chr [1:56] "CLE" "GB" "IND" "ATL" ...
## ..$ 3       : chr [1:56] NA "DET" "DAL" "CIN" ...
## ..$ 4       : chr [1:56] "PIT" "BUF" "SF" "CHI" ...
## ..$ 5       : chr [1:56] "OAK" NA "PHI" "DAL" ...
## ..$ 6       : chr [1:56] NA "MIA" "TB" NA ...
## ..$ 7       : chr [1:56] "MIN" "NE" NA NA ...
## ..$ 8       : chr [1:56] "MIA" "NYJ" NA NA ...
## ..$ 9       : chr [1:56] "TEN" "CAR" NA NA ...
## ..$ 10      : chr [1:56] NA "DAL" NA NA ...
```

```

## ..$ 11      : chr [1:56] "GB" "SEA" NA NA ...
## ..$ 12      : chr [1:56] "HOU" "TB" NA NA ...
## ..$ 13      : chr [1:56] "DET" NA NA NA ...
## ..$ 14      : chr [1:56] "PIT" NA NA NA ...
## ..$ 15      : chr [1:56] "CLE" "TB" NA "CAR" ...
## ..$ 16      : chr [1:56] "IND" "NO" NA NA ...
## ..$ 17      : chr [1:56] "CIN" "CAR" NA NA ...
## $ TeamIsHome      :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1      : logi [1:56] NA FALSE FALSE TRUE FALSE TRUE ...
## ..$ 2      : logi [1:56] TRUE TRUE FALSE FALSE TRUE FALSE ...
## ..$ 3      : logi [1:56] NA FALSE TRUE TRUE FALSE TRUE ...
## ..$ 4      : logi [1:56] TRUE TRUE TRUE TRUE FALSE TRUE ...
## ..$ 5      : logi [1:56] FALSE NA FALSE FALSE NA FALSE ...
## ..$ 6      : logi [1:56] NA TRUE TRUE NA FALSE FALSE ...
## ..$ 7      : logi [1:56] FALSE FALSE NA NA TRUE TRUE ...
## ..$ 8      : logi [1:56] TRUE FALSE NA NA FALSE TRUE ...
## ..$ 9      : logi [1:56] FALSE FALSE NA NA NA NA ...
## ..$ 10     : logi [1:56] NA TRUE NA NA FALSE FALSE ...
## ..$ 11     : logi [1:56] FALSE FALSE NA NA TRUE FALSE ...
## ..$ 12     : logi [1:56] TRUE TRUE NA NA TRUE TRUE ...
## ..$ 13     : logi [1:56] TRUE NA NA NA FALSE FALSE ...
## ..$ 14     : logi [1:56] FALSE NA NA NA TRUE FALSE ...
## ..$ 15     : logi [1:56] FALSE FALSE NA FALSE TRUE FALSE ...
## ..$ 16     : logi [1:56] TRUE FALSE NA NA FALSE TRUE ...
## ..$ 17     : logi [1:56] TRUE TRUE NA NA NA TRUE ...
## $ PassingCompletions :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1      : num [1:56] NA 21 27 28 24 16 NA NA 26 NA ...
## ..$ 2      : num [1:56] 25 19 19 33 23 30 NA 22 16 NA ...
## ..$ 3      : num [1:56] NA 24 29 28 22 25 NA 35 18 NA ...
## ..$ 4      : num [1:56] 31 24 33 18 18 32 NA 30 NA NA ...
## ..$ 5      : num [1:56] 19 NA 28 19 NA 30 NA 21 23 NA ...
## ..$ 6      : num [1:56] NA 24 18 NA 17 20 NA 11 31 NA ...
## ..$ 7      : num [1:56] 27 23 NA NA 14 21 NA 19 17 13 ...
## ..$ 8      : num [1:56] 10 18 NA NA 17 32 NA NA 26 NA ...
## ..$ 9      : num [1:56] 34 24 NA NA NA NA 15 20 14 NA ...
## ..$ 10     : num [1:56] NA 22 NA NA 19 25 24 28 23 NA ...
## ..$ 11     : num [1:56] 22 19 NA NA 30 30 NA 19 NA 17 ...
## ..$ 12     : num [1:56] 20 26 NA NA 33 18 NA NA 19 23 ...
## ..$ 13     : num [1:56] 23 NA NA NA 24 21 NA NA 26 NA ...
## ..$ 14     : num [1:56] 20 NA NA NA 44 24 NA 31 NA NA ...
## ..$ 15     : num [1:56] 26 17 NA 26 22 22 NA 37 NA NA ...
## ..$ 16     : num [1:56] 29 22 NA NA 20 21 20 NA NA NA ...
## ..$ 17     : num [1:56] 25 28 NA NA NA 18 15 NA NA NA ...
## $ PassingAttempts   :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1      : num [1:56] NA 30 48 42 36 36 NA NA 39 NA ...
## ..$ 2      : num [1:56] 34 28 36 50 35 39 NA 32 24 NA ...
## ..$ 3      : num [1:56] NA 35 48 42 39 35 NA 47 23 NA ...
## ..$ 4      : num [1:56] 49 42 51 26 30 45 NA 49 NA NA ...
## ..$ 5      : num [1:56] 26 NA 44 29 NA 40 NA 36 30 NA ...
## ..$ 6      : num [1:56] NA 35 22 NA 25 38 NA 19 47 NA ...
## ..$ 7      : num [1:56] 39 33 NA NA 24 29 NA 39 27 21 ...

```

```

## ..$ 8      : num [1:56] 15 29 NA NA 31 47 NA NA 33 NA ...
## ..$ 9      : num [1:56] 52 38 NA NA NA NA 30 36 20 NA ...
## ..$ 10     : num [1:56] NA 29 NA NA 31 34 47 37 39 NA ...
## ..$ 11     : num [1:56] 28 27 NA NA 45 37 NA 35 NA 28 ...
## ..$ 12     : num [1:56] 32 35 NA NA 45 28 NA NA 36 34 ...
## ..$ 13     : num [1:56] 36 NA NA NA 40 30 NA NA 36 NA ...
## ..$ 14     : num [1:56] 35 NA NA NA 66 43 NA 46 NA NA ...
## ..$ 15     : num [1:56] 42 31 NA 45 30 35 NA 57 NA NA ...
## ..$ 16     : num [1:56] 38 36 NA NA 29 28 34 NA NA NA ...
## ..$ 17     : num [1:56] 47 45 NA NA NA 37 34 NA NA NA ...
## $ PassingCompletionPercentage:Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1      : num [1:56] NA 70 56.2 66.7 66.7 44.4 NA NA 66.7 NA ...
## ..$ 2      : num [1:56] 73.5 67.9 52.8 66 65.7 76.9 NA 68.8 66.7 NA ...
## ..$ 3      : num [1:56] NA 68.6 60.4 66.7 56.4 71.4 NA 74.5 78.3 NA ...
## ..$ 4      : num [1:56] 63.3 57.1 64.7 69.2 60 71.1 NA 61.2 NA NA ...
## ..$ 5      : num [1:56] 73.1 NA 63.6 65.5 NA 75 NA 58.3 76.7 NA ...
## ..$ 6      : num [1:56] NA 68.6 81.8 NA 68 52.6 NA 57.9 66 NA ...
## ..$ 7      : num [1:56] 69.2 69.7 NA NA 58.3 72.4 NA 48.7 63 61.9 ...
## ..$ 8      : num [1:56] 66.7 62.1 NA NA 54.8 68.1 NA NA 78.8 NA ...
## ..$ 9      : num [1:56] 65.4 63.2 NA NA NA NA 50 55.6 70 NA ...
## ..$ 10     : num [1:56] NA 75.9 NA NA 61.3 73.5 51.1 75.7 59 NA ...
## ..$ 11     : num [1:56] 78.6 70.4 NA NA 66.7 81.1 NA 54.3 NA 60.7 ...
## ..$ 12     : num [1:56] 62.5 74.3 NA NA 73.3 64.3 NA NA 52.8 67.6 ...
## ..$ 13     : num [1:56] 63.9 NA NA NA 60 70 NA NA 72.2 NA ...
## ..$ 14     : num [1:56] 57.1 NA NA NA 66.7 55.8 NA 67.4 NA NA ...
## ..$ 15     : num [1:56] 61.9 54.8 NA 57.8 73.3 62.9 NA 64.9 NA NA ...
## ..$ 16     : num [1:56] 76.3 61.1 NA NA 69 75 58.8 NA NA NA ...
## ..$ 17     : num [1:56] 53.2 62.2 NA NA NA 48.6 44.1 NA NA NA ...
## $ PassingYards      :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1      : num [1:56] NA 321 268 311 263 267 NA NA 187 NA ...
## ..$ 2      : num [1:56] 217 252 332 343 243 447 NA 239 166 NA ...
## ..$ 3      : num [1:56] NA 294 325 313 235 378 NA 366 249 NA ...
## ..$ 4      : num [1:56] 235 242 357 179 216 307 NA 288 NA NA ...
## ..$ 5      : num [1:56] 222 NA 291 221 NA 303 NA 225 194 NA ...
## ..$ 6      : num [1:56] NA 248 283 NA 252 257 NA 128 354 NA ...
## ..$ 7      : num [1:56] 186 233 NA NA 224 249 NA 134 209 188 ...
## ..$ 8      : num [1:56] 101 254 NA NA 317 333 NA NA 257 NA ...
## ..$ 9      : num [1:56] 261 313 NA NA NA NA 201 220 140 NA ...
## ..$ 10     : num [1:56] NA 215 NA NA 236 266 273 273 262 NA ...
## ..$ 11     : num [1:56] 183 195 NA NA 299 340 NA 205 NA 282 ...
## ..$ 12     : num [1:56] 141 317 NA NA 351 227 NA NA 307 215 ...
## ..$ 13     : num [1:56] 269 NA NA NA 290 258 NA NA 331 NA ...
## ..$ 14     : num [1:56] 269 NA NA NA 506 233 NA 228 NA NA ...
## ..$ 15     : num [1:56] 288 212 NA 290 281 298 NA 434 NA NA ...
## ..$ 16     : num [1:56] 237 288 NA NA 226 224 209 NA NA NA ...
## ..$ 17     : num [1:56] 203 317 NA NA NA 190 145 NA NA NA ...
## $ PassingYardsPerAttempt :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1      : num [1:56] NA 10.7 5.6 7.4 7.3 7.4 NA NA 4.8 NA ...
## ..$ 2      : num [1:56] 6.4 9 9.2 6.9 6.9 11.5 NA 7.5 6.9 NA ...
## ..$ 3      : num [1:56] NA 8.4 6.8 7.5 6 10.8 NA 7.8 10.8 NA ...
## ..$ 4      : num [1:56] 4.8 5.8 7 6.9 7.2 6.8 NA 5.9 NA NA ...

```

```

## ..$ 5      : num [1:56] 8.5 NA 6.6 7.6 NA 7.6 NA 6.2 6.5 NA ...
## ..$ 6      : num [1:56] NA 7.1 12.9 NA 10.1 6.8 NA 6.7 7.5 NA ...
## ..$ 7      : num [1:56] 4.8 7.1 NA NA 9.3 8.6 NA 3.4 7.7 9 ...
## ..$ 8      : num [1:56] 6.7 8.8 NA NA 10.2 7.1 NA NA 7.8 NA ...
## ..$ 9      : num [1:56] 5 8.2 NA NA NA NA 6.7 6.1 7 NA ...
## ..$ 10     : num [1:56] NA 7.4 NA NA 7.6 7.8 5.8 7.4 6.7 NA ...
## ..$ 11     : num [1:56] 6.5 7.2 NA NA 6.6 9.2 NA 5.9 NA 10.1 ...
## ..$ 12     : num [1:56] 4.4 9.1 NA NA 7.8 8.1 NA NA 8.5 6.3 ...
## ..$ 13     : num [1:56] 7.5 NA NA NA 7.2 8.6 NA NA 9.2 NA ...
## ..$ 14     : num [1:56] 7.7 NA NA NA 7.7 5.4 NA 5 NA NA ...
## ..$ 15     : num [1:56] 6.9 6.8 NA 6.4 9.4 8.5 NA 7.6 NA NA ...
## ..$ 16     : num [1:56] 6.2 8 NA NA 7.8 8 6.1 NA NA NA ...
## ..$ 17     : num [1:56] 4.3 7 NA NA NA 5.1 4.3 NA NA NA ...
## $ PassingTouchdowns      :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1        : num [1:56] NA 1 1 1 2 0 NA NA 0 NA ...
## ..$ 2        : num [1:56] 2 1 1 2 2 3 NA 1 2 NA ...
## ..$ 3        : num [1:56] NA 2 2 3 1 5 NA 3 1 NA ...
## ..$ 4        : num [1:56] 1 1 1 4 1 2 NA 2 NA NA ...
## ..$ 5        : num [1:56] 0 NA 1 3 NA 1 NA 2 2 NA ...
## ..$ 6        : num [1:56] NA 1 3 NA 1 2 NA 1 2 NA ...
## ..$ 7        : num [1:56] 1 1 NA NA 2 2 NA 1 3 2 ...
## ..$ 8        : num [1:56] 1 2 NA NA 1 1 NA NA 2 NA ...
## ..$ 9        : num [1:56] 2 2 NA NA NA NA 2 2 1 NA ...
## ..$ 10       : num [1:56] NA 2 NA NA 2 3 1 2 1 NA ...
## ..$ 11       : num [1:56] 1 2 NA NA 4 3 NA 0 NA 1 ...
## ..$ 12       : num [1:56] 0 1 NA NA 4 4 NA NA 3 1 ...
## ..$ 13       : num [1:56] 2 NA NA NA 2 0 NA NA 1 NA ...
## ..$ 14       : num [1:56] 2 NA NA NA 2 1 NA 1 NA NA ...
## ..$ 15       : num [1:56] 1 1 NA 3 2 1 NA 3 NA NA ...
## ..$ 16       : num [1:56] 2 1 NA NA 2 2 2 NA NA NA ...
## ..$ 17       : num [1:56] 2 1 NA NA NA 2 1 NA NA NA ...
## $ PassingInterceptions    :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1        : num [1:56] NA 0 3 1 1 0 NA NA 2 NA ...
## ..$ 2        : num [1:56] 1 0 1 1 0 0 NA 1 0 NA ...
## ..$ 3        : num [1:56] NA 3 0 1 0 0 NA 2 0 NA ...
## ..$ 4        : num [1:56] 2 2 1 0 1 0 NA 0 NA NA ...
## ..$ 5        : num [1:56] 0 NA 0 0 NA 1 NA 1 1 NA ...
## ..$ 6        : num [1:56] NA 1 1 NA 1 1 NA 0 2 NA ...
## ..$ 7        : num [1:56] 0 0 NA NA 0 0 NA 0 1 1 ...
## ..$ 8        : num [1:56] 0 0 NA NA 1 0 NA NA 0 NA ...
## ..$ 9        : num [1:56] 2 1 NA NA NA NA 1 1 0 NA ...
## ..$ 10       : num [1:56] NA 1 NA NA 1 0 0 0 1 NA ...
## ..$ 11       : num [1:56] 1 0 NA NA 0 0 NA 0 NA 0 ...
## ..$ 12       : num [1:56] 0 0 NA NA 2 1 NA NA 0 2 ...
## ..$ 13       : num [1:56] 0 NA NA NA 1 1 NA NA 0 NA ...
## ..$ 14       : num [1:56] 1 NA NA NA 0 2 NA 2 NA NA ...
## ..$ 15       : num [1:56] 0 0 NA 3 1 1 NA 1 NA NA ...
## ..$ 16       : num [1:56] 0 1 NA NA 0 1 2 NA NA NA ...
## ..$ 17       : num [1:56] 1 0 NA NA NA 0 1 NA NA NA ...
## $ PassingRating           :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1        : num [1:56] NA 116.1 53.1 86.5 95 ...

```

```

## ..$ 2      : num [1:56] 97.3 108 82.2 90.7 104.8 ...
## ..$ 3      : num [1:56] NA 77.6 94.5 102.6 82.8 ...
## ..$ 4      : num [1:56] 64.6 61.8 83.5 128 79.3 ...
## ..$ 5      : num [1:56] 98.6 NA 90.2 122.9 NA ...
## ..$ 6      : num [1:56] NA 86.4 139.4 NA 97.4 ...
## ..$ 7      : num [1:56] 88.2 99.7 NA NA 117.4 ...
## ..$ 8      : num [1:56] 107.9 113.3 NA NA 87.7 ...
## ..$ 9      : num [1:56] 74.3 95.6 NA NA NA ...
## ..$ 10     : num [1:56] NA 104.8 NA NA 92.9 ...
## ..$ 11     : num [1:56] 90.9 115.5 NA NA 115 ...
## ..$ 12     : num [1:56] 72.5 111.2 NA NA 106.8 ...
## ..$ 13     : num [1:56] 105 NA NA NA 88.5 ...
## ..$ 14     : num [1:56] 88.9 NA NA NA 99.7 ...
## ..$ 15     : num [1:56] 90.2 87 NA 71.5 110.6 ...
## ..$ 16     : num [1:56] 109 84 NA NA 115 ...
## ..$ 17     : num [1:56] 69.7 90.7 NA NA NA ...
## $ RushingAttempts      :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1      : num [1:56] NA 3 1 7 3 2 NA NA 2 NA ...
## ..$ 2      : num [1:56] 1 1 3 2 2 2 NA 0 4 NA ...
## ..$ 3      : num [1:56] NA 1 3 4 1 1 NA 0 4 NA ...
## ..$ 4      : num [1:56] 0 1 2 1 1 1 NA 3 NA NA ...
## ..$ 5      : num [1:56] 3 NA 0 4 NA 2 NA 0 3 NA ...
## ..$ 6      : num [1:56] NA 0 5 NA 2 1 NA 1 3 NA ...
## ..$ 7      : num [1:56] 1 3 NA NA 3 5 NA 0 3 0 ...
## ..$ 8      : num [1:56] 1 6 NA NA 3 1 NA NA 1 NA ...
## ..$ 9      : num [1:56] 1 1 NA NA NA NA 4 0 5 NA ...
## ..$ 10     : num [1:56] NA 0 NA NA 2 1 1 0 0 NA ...
## ..$ 11     : num [1:56] 2 3 NA NA 1 0 NA 2 NA 1 ...
## ..$ 12     : num [1:56] 6 1 NA NA 3 5 NA NA 2 2 ...
## ..$ 13     : num [1:56] 1 NA NA NA 1 0 NA NA 7 NA ...
## ..$ 14     : num [1:56] 0 NA NA NA 1 0 NA 0 NA NA ...
## ..$ 15     : num [1:56] 4 3 NA 6 3 2 NA 0 NA NA ...
## ..$ 16     : num [1:56] 4 2 NA NA 1 2 2 NA NA NA ...
## ..$ 17     : num [1:56] 0 3 NA NA NA 0 1 NA NA NA ...
## $ RushingYards      :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1      : num [1:56] NA 11 2 21 -8 0 NA NA 0 NA ...
## ..$ 2      : num [1:56] -1 8 6 8 -2 9 NA 0 31 NA ...
## ..$ 3      : num [1:56] NA -1 7 23 6 6 NA 0 7 NA ...
## ..$ 4      : num [1:56] 0 8 1 -1 -1 2 NA 22 NA NA ...
## ..$ 5      : num [1:56] -4 NA 0 32 NA 5 NA 0 -3 NA ...
## ..$ 6      : num [1:56] NA 0 -4 NA -2 -1 NA 0 21 NA ...
## ..$ 7      : num [1:56] 0 37 NA NA -3 5 NA 0 1 0 ...
## ..$ 8      : num [1:56] 9 17 NA NA -2 2 NA NA 0 NA ...
## ..$ 9      : num [1:56] 7 -1 NA NA NA NA 2 0 13 NA ...
## ..$ 10     : num [1:56] NA 0 NA NA 5 0 1 0 0 NA ...
## ..$ 11     : num [1:56] -1 12 NA NA 10 0 NA 5 NA 0 ...
## ..$ 12     : num [1:56] 42 1 NA NA 25 -4 NA NA 28 9 ...
## ..$ 13     : num [1:56] -1 NA NA NA 4 0 NA NA 19 NA ...
## ..$ 14     : num [1:56] 0 NA NA NA 5 0 NA 0 NA NA ...
## ..$ 15     : num [1:56] 3 29 NA 43 10 -2 NA 0 NA NA ...
## ..$ 16     : num [1:56] -2 7 NA NA -1 6 1 NA NA NA ...
## ..$ 17     : num [1:56] 0 14 NA NA NA 0 -1 NA NA NA ...

```

```

## $ RushingYardsPerAttempt      :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1       : num [1:56] NA 3.7 2 3 -2.7 0 NA NA 0 NA ...
## ..$ 2       : num [1:56] -1 8 2 4 -1 4.5 NA 0 7.8 NA ...
## ..$ 3       : num [1:56] NA -1 2.3 5.8 6 6 NA 0 1.8 NA ...
## ..$ 4       : num [1:56] 0 8 0.5 -1 -1 2 NA 7.3 NA NA ...
## ..$ 5       : num [1:56] -1.3 NA 0 8 NA 2.5 NA 0 -1 NA ...
## ..$ 6       : num [1:56] NA 0 -0.8 NA -1 -1 NA 0 7 NA ...
## ..$ 7       : num [1:56] 0 12.3 NA NA -1 1 NA 0 0.3 0 ...
## ..$ 8       : num [1:56] 9 2.8 NA NA -0.7 2 NA NA 0 NA ...
## ..$ 9       : num [1:56] 7 -1 NA NA NA NA 0.5 0 2.6 NA ...
## ..$ 10      : num [1:56] NA 0 NA NA 2.5 0 1 0 0 NA ...
## ..$ 11      : num [1:56] -0.5 4 NA NA 10 0 NA 2.5 NA 0 ...
## ..$ 12      : num [1:56] 7 1 NA NA 8.3 -0.8 NA NA 14 4.5 ...
## ..$ 13      : num [1:56] -1 NA NA NA 4 0 NA NA 2.7 NA ...
## ..$ 14      : num [1:56] 0 NA NA NA 5 0 NA 0 NA NA ...
## ..$ 15      : num [1:56] 0.8 9.7 NA 7.2 3.3 -1 NA 0 NA NA ...
## ..$ 16      : num [1:56] -0.5 3.5 NA NA -1 3 0.5 NA NA NA ...
## ..$ 17      : num [1:56] 0 4.7 NA NA NA 0 -1 NA NA NA ...
## $ RushingTouchdowns          :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1       : num [1:56] NA 0 0 0 0 0 NA NA 1 NA ...
## ..$ 2       : num [1:56] 0 0 0 0 0 0 NA 0 0 NA ...
## ..$ 3       : num [1:56] NA 0 0 0 0 0 NA 0 0 NA ...
## ..$ 4       : num [1:56] 0 0 0 0 0 0 NA 1 NA NA ...
## ..$ 5       : num [1:56] 0 NA 0 0 NA 0 NA 0 0 NA ...
## ..$ 6       : num [1:56] NA 0 0 NA 0 0 NA 0 0 NA ...
## ..$ 7       : num [1:56] 0 0 NA NA 0 0 NA 0 1 0 ...
## ..$ 8       : num [1:56] 0 0 NA NA 0 0 NA NA 0 NA ...
## ..$ 9       : num [1:56] 0 0 NA NA NA NA 0 0 1 NA ...
## ..$ 10      : num [1:56] NA 0 NA NA 0 0 0 0 0 NA ...
## ..$ 11      : num [1:56] 0 0 NA NA 0 0 NA 0 NA 0 ...
## ..$ 12      : num [1:56] 0 0 NA NA 0 0 NA NA 0 0 ...
## ..$ 13      : num [1:56] 0 NA NA NA 0 0 NA NA 2 NA ...
## ..$ 14      : num [1:56] 0 NA NA NA 0 0 NA 0 NA NA ...
## ..$ 15      : num [1:56] 1 0 NA 0 0 0 NA 0 NA NA ...
## ..$ 16      : num [1:56] 0 0 NA NA 0 0 0 NA NA NA ...
## ..$ 17      : num [1:56] 0 0 NA NA NA 0 0 NA NA NA ...
## $ FumblesLost                 :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1       : num [1:56] NA 0 0 0 0 0 NA NA 0 NA ...
## ..$ 2       : num [1:56] 0 0 0 1 0 0 NA 0 1 NA ...
## ..$ 3       : num [1:56] NA 0 0 0 1 1 NA 0 0 NA ...
## ..$ 4       : num [1:56] 0 1 0 0 0 0 NA 0 NA NA ...
## ..$ 5       : num [1:56] 0 NA 0 0 NA 1 NA 1 0 NA ...
## ..$ 6       : num [1:56] NA 0 0 NA 0 0 NA 0 0 NA ...
## ..$ 7       : num [1:56] 0 0 NA NA 0 0 NA 1 0 0 ...
## ..$ 8       : num [1:56] 0 2 NA NA 0 0 NA NA 0 NA ...
## ..$ 9       : num [1:56] 0 0 NA NA NA NA 0 1 0 NA ...
## ..$ 10      : num [1:56] NA 0 NA NA 0 0 0 1 0 NA ...
## ..$ 11      : num [1:56] 0 0 NA NA 0 0 NA 0 NA 0 ...
## ..$ 12      : num [1:56] 0 0 NA NA 0 1 NA NA 1 0 ...
## ..$ 13      : num [1:56] 0 NA NA NA 0 0 NA NA 0 NA ...
## ..$ 14      : num [1:56] 0 NA NA NA 0 0 NA 0 NA NA ...

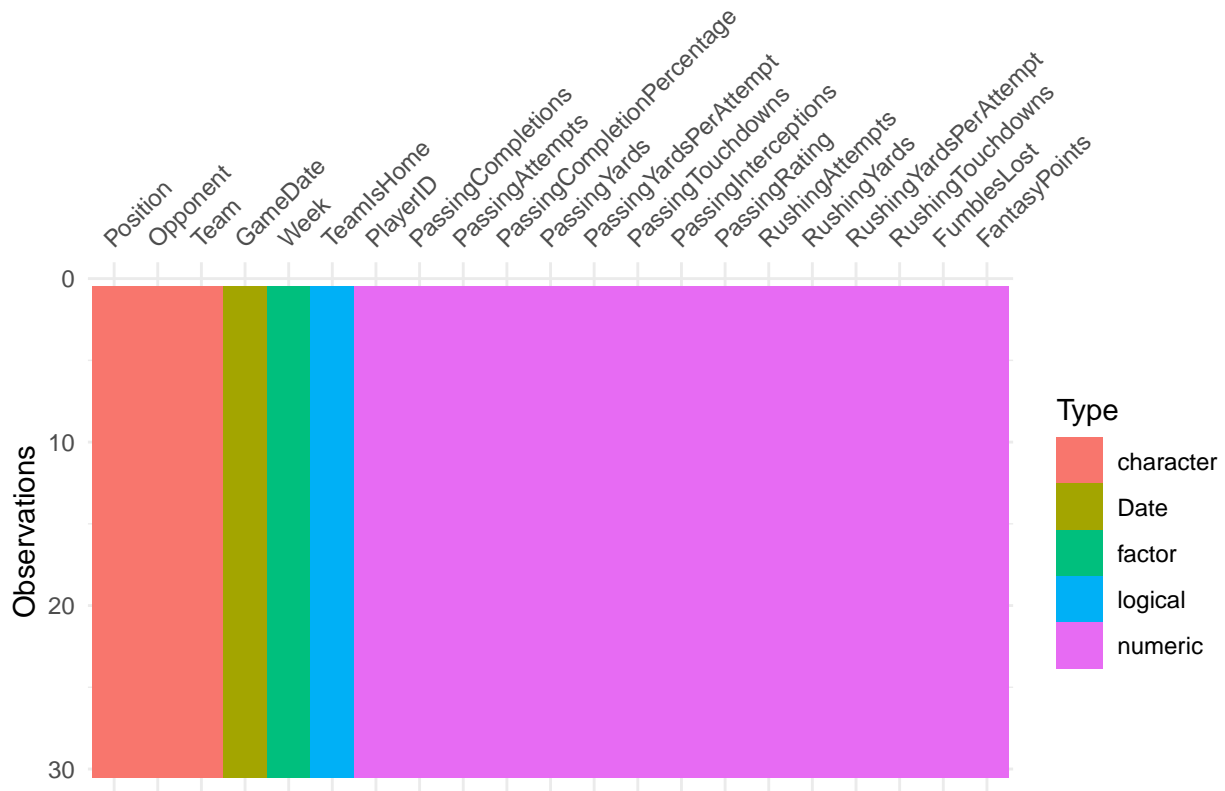
```

```
## ..$ 15      : num [1:56] 0 0 NA 0 0 0 NA 0 NA NA ...
## ..$ 16      : num [1:56] 0 0 NA NA 0 0 0 NA NA NA ...
## ..$ 17      : num [1:56] 0 0 NA NA NA 0 0 NA NA NA ...
## $ FantasyPoints      :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1       : num [1:56] NA 17.94 8.92 16.54 15.72 ...
## ..$ 2       : num [1:56] 14.6 14.9 15.9 18.5 17.5 ...
## ..$ 3       : num [1:56] NA 13.7 21.7 24.8 12 ...
## ..$ 4       : num [1:56] 9.4 8.48 16.38 23.06 10.54 ...
## ..$ 5       : num [1:56] 8.48 NA 15.64 24.04 NA ...
## ..$ 6       : num [1:56] NA 11.9 20.9 NA 11.9 ...
## ..$ 7       : num [1:56] 11.4 17 NA NA 16.7 ...
## ..$ 8       : num [1:56] 8.94 15.86 NA NA 14.48 ...
## ..$ 9       : num [1:56] 15.1 18.4 NA NA NA ...
## ..$ 10      : num [1:56] NA 14.6 NA NA 17.9 ...
## ..$ 11      : num [1:56] 9.22 17 NA NA 28.96 ...
## ..$ 12      : num [1:56] 9.84 16.78 NA NA 30.54 ...
## ..$ 13      : num [1:56] 18.7 NA NA NA 18 ...
## ..$ 14      : num [1:56] 16.8 NA NA NA 28.7 ...
## ..$ 15      : num [1:56] 21.8 15.4 NA 21.9 18.2 ...
## ..$ 16      : num [1:56] 17.3 14.2 NA NA 16.9 ...
## ..$ 17      : num [1:56] 14.1 18.1 NA NA NA ...
## $ Team      :Classes 'tbl_df', 'tbl' and 'data.frame': 56 obs. of  18 variables:
## ..$ PlayerID: num [1:56] 611 732 2428 2593 3807 ...
## ..$ 1       : chr [1:56] NA "ATL" "ARI" "GB" ...
## ..$ 2       : chr [1:56] "BAL" "ATL" "ARI" "GB" ...
## ..$ 3       : chr [1:56] NA "ATL" "ARI" "GB" ...
## ..$ 4       : chr [1:56] "BAL" "ATL" "ARI" "GB" ...
## ..$ 5       : chr [1:56] "BAL" NA "ARI" "GB" ...
## ..$ 6       : chr [1:56] NA "ATL" "ARI" NA ...
## ..$ 7       : chr [1:56] "BAL" "ATL" NA NA ...
## ..$ 8       : chr [1:56] "BAL" "ATL" NA NA ...
## ..$ 9       : chr [1:56] "BAL" "ATL" NA NA ...
## ..$ 10      : chr [1:56] NA "ATL" NA NA ...
## ..$ 11      : chr [1:56] "BAL" "ATL" NA NA ...
## ..$ 12      : chr [1:56] "BAL" "ATL" NA NA ...
## ..$ 13      : chr [1:56] "BAL" NA NA NA ...
## ..$ 14      : chr [1:56] "BAL" NA NA NA ...
## ..$ 15      : chr [1:56] "BAL" "ATL" NA "GB" ...
## ..$ 16      : chr [1:56] "BAL" "ATL" NA NA ...
## ..$ 17      : chr [1:56] "BAL" "ATL" NA NA ...
```

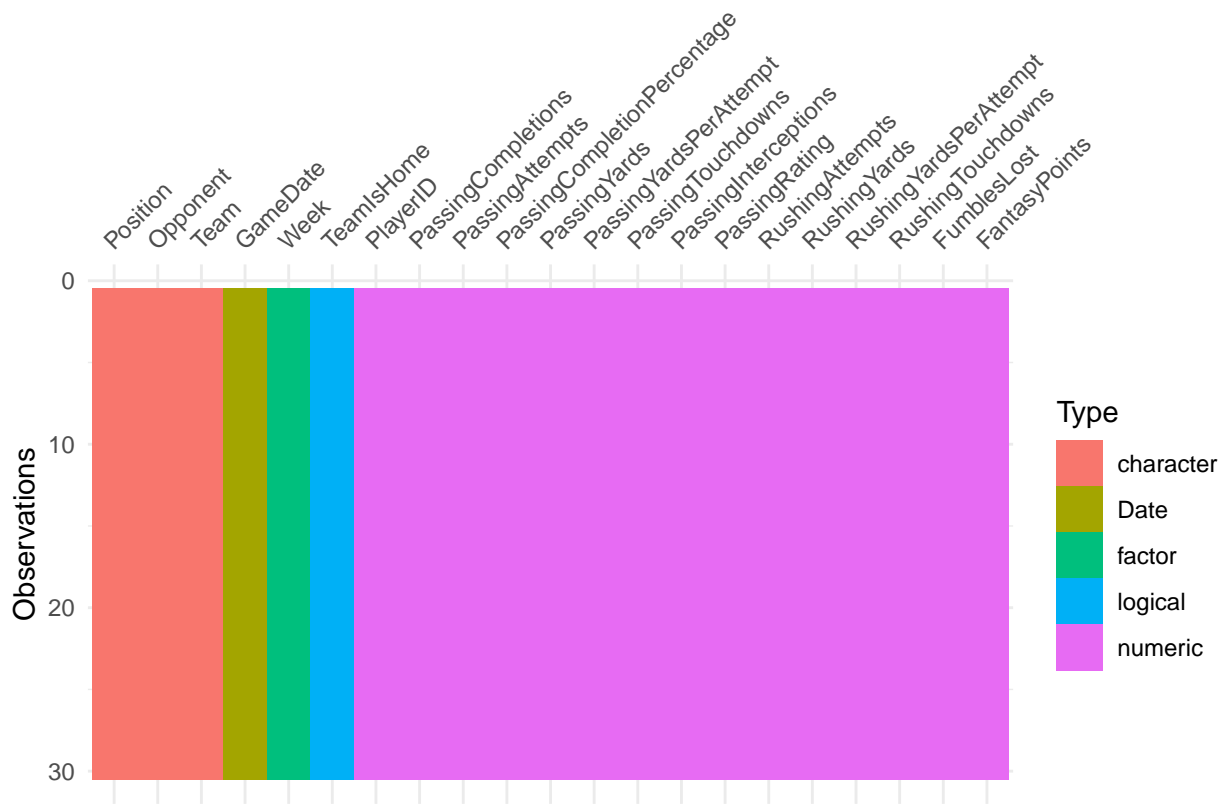
1.3: Missing Data

1.3.1 Quarterbacks (Old Data QBdata dataset)

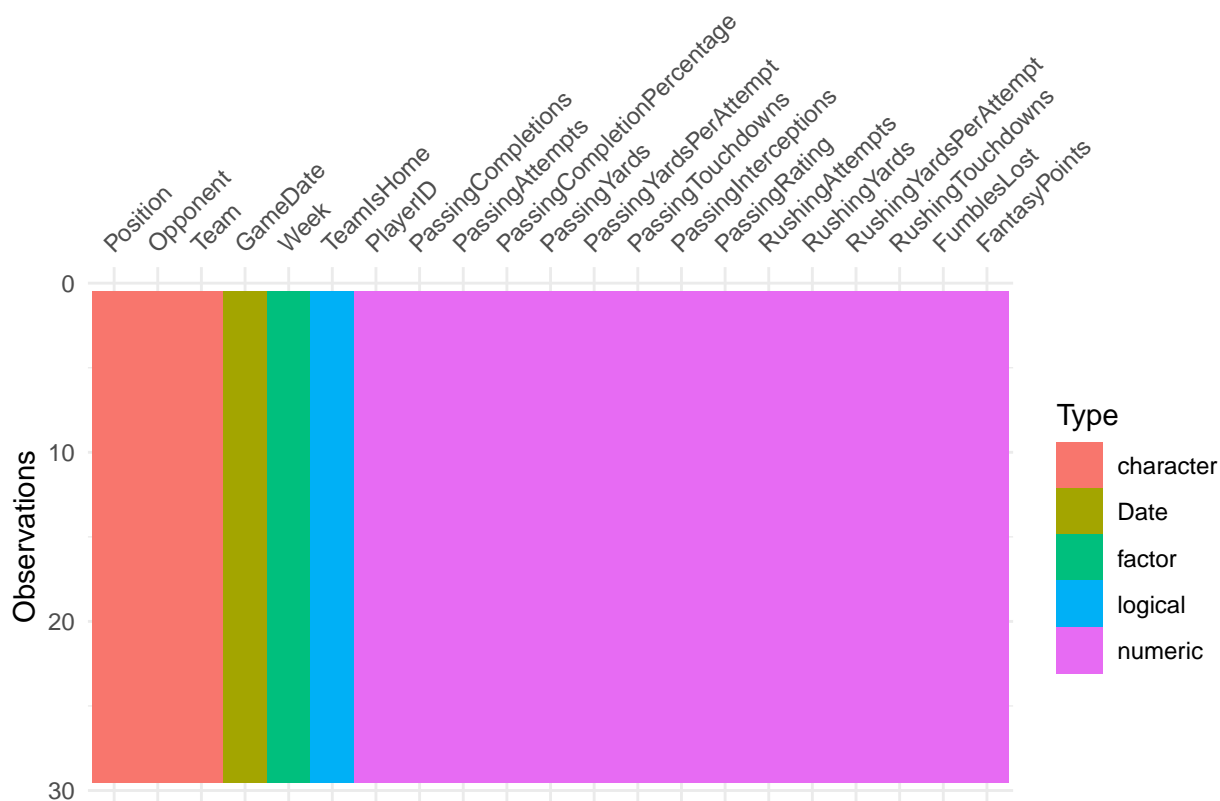
```
vis_dat(QBCrossSectional[1:30,])
```

```
vis_dat(QBCrossSectional[31:60, ])
```

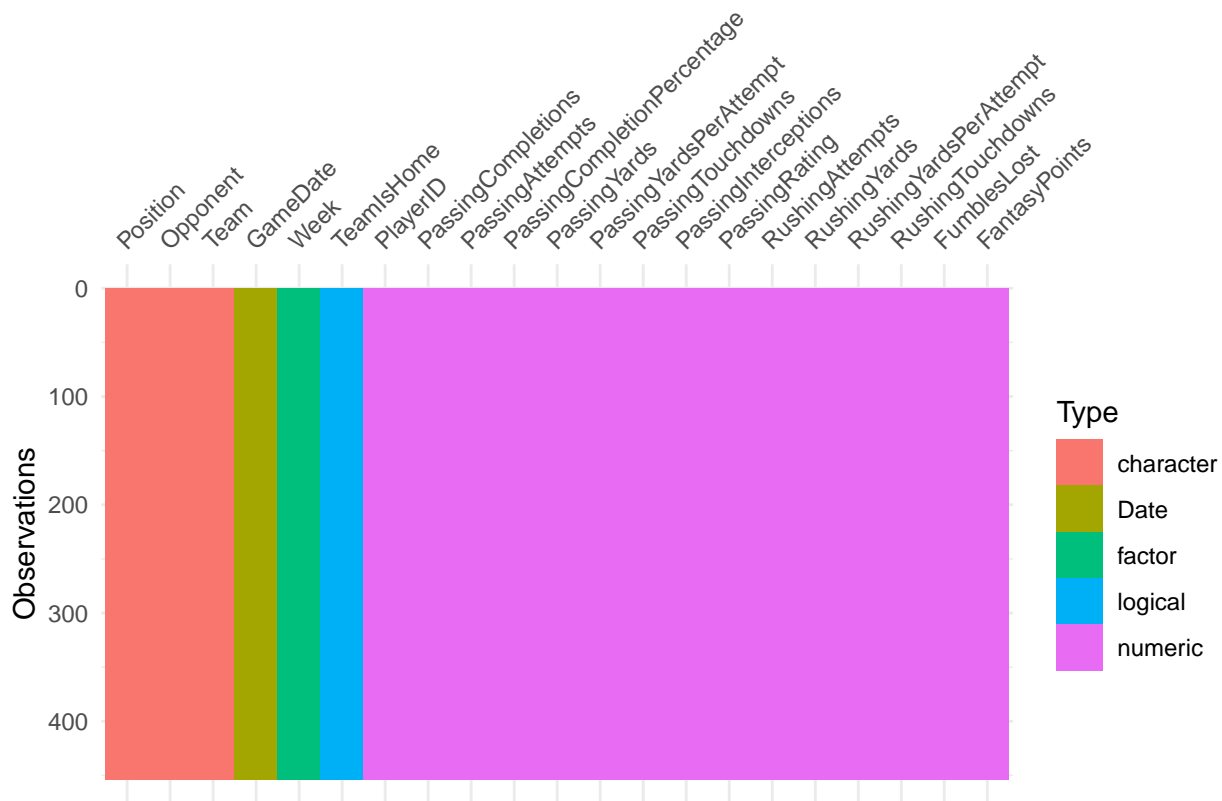


```
vis_dat(QBCrossSectional[61:89, ])
```



1.3.2 QBCrossSectional dataset (New dataset)

```
vis_dat(QBCrossSectional)
```



```
print(QBCrossSectional)
```

```
## # A tibble: 453 x 21
##   PlayerID Week  Position Opponent TeamIsHome GameDate  PassingCompleti~
##   <dbl> <fct> <chr>    <chr>    <lgl>    <date>      <dbl>
## 1     6739 13    QB      NYJ      FALSE    2017-12-03    19
## 2     4314 3     QB      HOU      TRUE     2017-09-24    25
## 3    13320 10    QB      MIA      TRUE     2017-11-13    21
## 4    18857 5     QB      KC       TRUE     2017-10-08    16
## 5    14536 8     QB      HOU      TRUE     2017-10-29    26
## 6    18857 4     QB      TEN      TRUE     2017-10-01    25
## 7    14536 3     QB      TEN      FALSE    2017-09-24    29
## 8    13320 4     QB      NE       FALSE    2017-10-01    22
## 9    18857 8     QB      SEA      FALSE    2017-10-29    19
## 10   13320 15    QB      GB       TRUE     2017-12-17    20
## # ... with 443 more rows, and 14 more variables: PassingAttempts <dbl>,
## #   PassingCompletionPercentage <dbl>, PassingYards <dbl>,
## #   PassingYardsPerAttempt <dbl>, PassingTouchdowns <dbl>,
## #   PassingInterceptions <dbl>, PassingRating <dbl>,
## #   RushingAttempts <dbl>, RushingYards <dbl>,
## #   RushingYardsPerAttempt <dbl>, RushingTouchdowns <dbl>,
## #   FumblesLost <dbl>, FantasyPoints <dbl>, Team <chr>
```

1.3.3 QBPanels dataset (New dataset)

```
print(QBPanels)
```

```
## $Opponent
## # A tibble: 56 x 18
```

```

##      PlayerID `1`  `2`  `3`  `4`  `5`  `6`  `7`  `8`  `9`  `10`
##      <dbl> <chr> <chr> <chr> <chr> <chr> <chr> <chr> <chr> <chr>
## 1      611 <NA> CLE  <NA> PIT  OAK  <NA> MIN  MIA  TEN  <NA>
## 2      732 CHI  GB   DET  BUF  <NA> MIA  NE   NYJ  CAR  DAL
## 3     2428 DET  IND  DAL  SF   PHI  TB   <NA> <NA> <NA> <NA>
## 4     2593 SEA  ATL  CIN  CHI  DAL  <NA> <NA> <NA> <NA> <NA>
## 5     3807 CLE  MIN  CHI  BAL  <NA> KC   CIN  DET  <NA> IND
## 6     4314 KC   NO   HOU  CAR  TB   NYJ  ATL  LAC  <NA> DEN
## 7     4737 <NA> <NA> <NA> <NA> <NA> <NA> <NA> <NA> SF   SEA
## 8     4932 <NA> DET  PHI  TB   LAC  DEN  SEA  <NA> LAR  SF
## 9     5282 BUF  OAK  MIA  <NA> CLE  NE   MIA  ATL  BUF  TB
## 10    5834 <NA> <NA> <NA> <NA> <NA> <NA> NYJ  <NA> <NA> <NA>
## # ... with 46 more rows, and 7 more variables: `11` <chr>, `12` <chr>,
## #   `13` <chr>, `14` <chr>, `15` <chr>, `16` <chr>, `17` <chr>
##
## $TeamIsHome
## # A tibble: 56 x 18
##      PlayerID `1`  `2`  `3`  `4`  `5`  `6`  `7`  `8`  `9`  `10`
##      <dbl> <lgl> <lgl> <lgl> <lgl> <lgl> <lgl> <lgl> <lgl> <lgl> <lgl>
## 1      611 NA    TRUE NA    TRUE FALSE NA    FALSE TRUE  FALSE NA
## 2      732 FALSE TRUE FALSE TRUE  NA    TRUE FALSE FALSE FALSE TRUE
## 3     2428 FALSE FALSE TRUE TRUE  FALSE TRUE  NA    NA    NA    NA
## 4     2593 TRUE  FALSE TRUE TRUE  FALSE NA    NA    NA    NA    NA
## 5     3807 FALSE TRUE FALSE FALSE NA    FALSE TRUE FALSE NA    FALSE
## 6     4314 TRUE  FALSE TRUE TRUE  FALSE FALSE TRUE TRUE  NA    FALSE
## 7     4737 NA    NA    NA    NA    NA    NA    NA    NA    FALSE TRUE
## 8     4932 NA    TRUE FALSE FALSE TRUE  FALSE TRUE  NA    TRUE FALSE
## 9     5282 FALSE FALSE TRUE NA    FALSE TRUE  FALSE TRUE  TRUE FALSE
## 10    5834 NA    NA    NA    NA    NA    NA    TRUE NA    NA    NA
## # ... with 46 more rows, and 7 more variables: `11` <lgl>, `12` <lgl>,
## #   `13` <lgl>, `14` <lgl>, `15` <lgl>, `16` <lgl>, `17` <lgl>
##
## $PassingCompletions
## # A tibble: 56 x 18
##      PlayerID `1`  `2`  `3`  `4`  `5`  `6`  `7`  `8`  `9`  `10`
##      <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611 NA    25  NA   31   19  NA   27   10   34  NA
## 2      732 21   19  24  24  NA   24   23   18   24  22
## 3     2428 27   19  29  33  28   18   NA   NA   NA   NA
## 4     2593 28   33  28  18  19   NA   NA   NA   NA   NA
## 5     3807 24   23  22  18  NA   17   14   17   NA  19
## 6     4314 16   30  25  32  30   20   21   32   NA  25
## 7     4737 NA    NA  NA  NA  NA   NA   NA   NA   15  24
## 8     4932 NA    22  35  30  21   11   19   NA   20  28
## 9     5282 26   16  18  NA  23   31   17   26   14  23
## 10    5834 NA    NA  NA  NA  NA   NA   13   NA   NA   NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $PassingAttempts
## # A tibble: 56 x 18
##      PlayerID `1`  `2`  `3`  `4`  `5`  `6`  `7`  `8`  `9`  `10`
##      <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611 NA    34  NA   49  26  NA   39   15   52  NA

```

```

## 2      732    30    28    35    42    NA    35    33    29    38    29
## 3     2428    48    36    48    51    44    22    NA    NA    NA    NA
## 4     2593    42    50    42    26    29    NA    NA    NA    NA    NA
## 5     3807    36    35    39    30    NA    25    24    31    NA    31
## 6     4314    36    39    35    45    40    38    29    47    NA    34
## 7     4737    NA    NA    NA    NA    NA    NA    NA    NA    NA    30
## 8     4932    NA    32    47    49    36    19    39    NA    36    37
## 9     5282    39    24    23    NA    30    47    27    33    20    39
## 10    5834    NA    NA    NA    NA    NA    NA    21    NA    NA    NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $PassingCompletionPercentage
## # A tibble: 56 x 18
##   PlayerID `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611  NA   73.5  NA   63.3  73.1  NA   69.2  66.7  65.4  NA
## 2      732   70   67.9  68.6  57.1  NA   68.6  69.7  62.1  63.2  75.9
## 3     2428  56.2  52.8  60.4  64.7  63.6  81.8  NA    NA    NA    NA
## 4     2593  66.7  66    66.7  69.2  65.5  NA    NA    NA    NA    NA
## 5     3807  66.7  65.7  56.4  60    NA    68    58.3  54.8  NA    61.3
## 6     4314  44.4  76.9  71.4  71.1  75    52.6  72.4  68.1  NA    73.5
## 7     4737  NA    NA    NA    NA    NA    NA    NA    NA    50    51.1
## 8     4932  NA    68.8  74.5  61.2  58.3  57.9  48.7  NA    55.6  75.7
## 9     5282  66.7  66.7  78.3  NA    76.7  66    63    78.8  70    59
## 10    5834  NA    NA    NA    NA    NA    NA    61.9  NA    NA    NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $PassingYards
## # A tibble: 56 x 18
##   PlayerID `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611   NA  217   NA  235  222   NA  186  101  261   NA
## 2      732  321  252  294  242   NA  248  233  254  313  215
## 3     2428  268  332  325  357  291  283   NA   NA   NA   NA
## 4     2593  311  343  313  179  221   NA   NA   NA   NA   NA
## 5     3807  263  243  235  216   NA  252  224  317   NA  236
## 6     4314  267  447  378  307  303  257  249  333   NA  266
## 7     4737   NA   NA   NA   NA   NA   NA   NA   NA  201  273
## 8     4932   NA  239  366  288  225  128  134   NA  220  273
## 9     5282  187  166  249   NA  194  354  209  257  140  262
## 10    5834   NA   NA   NA   NA   NA   NA  188   NA   NA   NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $PassingYardsPerAttempt
## # A tibble: 56 x 18
##   PlayerID `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611   NA   6.4   NA   4.8   8.5   NA   4.8   6.7   5    NA
## 2      732 10.7   9    8.4   5.8   NA    7.1   7.1   8.8   8.2   7.4
## 3     2428   5.6   9.2   6.8   7    6.6  12.9   NA    NA    NA    NA
## 4     2593   7.4   6.9   7.5   6.9   7.6   NA    NA    NA    NA    NA

```

```

## 5      3807    7.3    6.9    6      7.2 NA      10.1    9.3    10.2 NA      7.6
## 6      4314    7.4   11.5   10.8    6.8    7.6    6.8    8.6    7.1 NA      7.8
## 7      4737    NA     NA     NA     NA     NA     NA     NA     NA     6.7    5.8
## 8      4932    NA     7.5    7.8    5.9    6.2    6.7    3.4    NA     6.1    7.4
## 9      5282    4.8    6.9   10.8    NA     6.5    7.5    7.7    7.8    7     6.7
## 10     5834    NA     NA     NA     NA     NA     NA     9     NA     NA     NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $PassingTouchdowns
## # A tibble: 56 x 18
##   PlayerID `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611    NA     2    NA     1     0    NA     1     1     2    NA
## 2      732     1     1     2     1    NA     1     1     2     2     2
## 3     2428     1     1     2     1     1     3    NA    NA    NA    NA
## 4     2593     1     2     3     4     3    NA    NA    NA    NA    NA
## 5     3807     2     2     1     1    NA     1     2     1    NA     2
## 6     4314     0     3     5     2     1     2     2     1    NA     3
## 7     4737    NA    NA    NA    NA    NA    NA    NA    NA     2     1
## 8     4932    NA     1     3     2     2     1     1    NA     2     2
## 9     5282     0     2     1    NA     2     2     3     2     1     1
## 10    5834    NA    NA    NA    NA    NA    NA     2    NA    NA    NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $PassingInterceptions
## # A tibble: 56 x 18
##   PlayerID `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611    NA     1    NA     2     0    NA     0     0     2    NA
## 2      732     0     0     3     2    NA     1     0     0     1     1
## 3     2428     3     1     0     1     0     1    NA    NA    NA    NA
## 4     2593     1     1     1     0     0    NA    NA    NA    NA    NA
## 5     3807     1     0     0     1    NA     1     0     1    NA     1
## 6     4314     0     0     0     0     1     1     0     0    NA     0
## 7     4737    NA    NA    NA    NA    NA    NA    NA    NA     1     0
## 8     4932    NA     1     2     0     1     0     0    NA     1     0
## 9     5282     2     0     0    NA     1     2     1     0     0     1
## 10    5834    NA    NA    NA    NA    NA    NA     1    NA    NA    NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $PassingRating
## # A tibble: 56 x 18
##   PlayerID `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611    NA   97.3    NA   64.6   98.6    NA   88.2  108.   74.3    NA
## 2      732  116.  108.   77.6   61.8    NA   86.4  99.7  113.   95.6  105.
## 3     2428  53.1  82.2   94.5   83.5   90.2  139.    NA    NA    NA    NA
## 4     2593  86.5  90.7  103.  128.  123.    NA    NA    NA    NA    NA
## 5     3807  95.0  105.   82.8   79.3    NA   97.4  117.   87.7    NA   92.9
## 6     4314  70.0  140.  146.  105.   94.1  80.7  121.   95.4    NA  125.
## 7     4737    NA    NA    NA    NA    NA    NA    NA    NA    80   75.9

```

```

## 8      4932 NA      87.9 100.    91.2 83.7 95.9 65.5 NA      80.8 114.
## 9      5282 56.2 114.  126.    NA  101.  84.9 108. 119.  106.  77.1
## 10     5834 NA      NA      NA      NA      NA      NA  103.  NA      NA      NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $RushingAttempts
## # A tibble: 56 x 18
##   PlayerID `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611 NA      1 NA      0      3 NA      1      1      1 NA
## 2      732 3      1      1      1 NA      0      3      6      1      0
## 3     2428 1      3      3      2      0      5 NA      NA      NA      NA
## 4     2593 7      2      4      1      4 NA      NA      NA      NA      NA
## 5     3807 3      2      1      1 NA      2      3      3      NA      2
## 6     4314 2      2      1      1      2      1      5      1      NA      1
## 7     4737 NA      NA      NA      NA      NA      NA      NA      NA      4      1
## 8     4932 NA      0      0      3      0      1      0      NA      0      0
## 9     5282 2      4      4      NA      3      3      3      1      5      0
## 10    5834 NA      NA      NA      NA      NA      NA      0      NA      NA      NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $RushingYards
## # A tibble: 56 x 18
##   PlayerID `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611 NA     -1 NA      0     -4 NA      0      9      7 NA
## 2      732 11      8     -1      8 NA      0     37     17     -1      0
## 3     2428 2       6      7      1      0     -4 NA      NA      NA      NA
## 4     2593 21      8     23     -1     32 NA      NA      NA      NA      NA
## 5     3807 -8      -2      6     -1 NA      -2     -3     -2      NA      5
## 6     4314 0       9      6      2      5     -1      5      2      NA      0
## 7     4737 NA      NA      NA      NA      NA      NA      NA      NA      2      1
## 8     4932 NA      0      0     22      0      0      0      NA      0      0
## 9     5282 0      31      7      NA     -3     21      1      0     13      0
## 10    5834 NA      NA      NA      NA      NA      NA      0      NA      NA      NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $RushingYardsPerAttempt
## # A tibble: 56 x 18
##   PlayerID `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611 NA     -1 NA      0    -1.3 NA      0      9      7 NA
## 2      732 3.7      8     -1      8 NA      0     12.3     2.8     -1      0
## 3     2428 2       2     2.3     0.5      0    -0.8 NA      NA      NA      NA
## 4     2593 3       4     5.8     -1      8 NA      NA      NA      NA      NA
## 5     3807 -2.7     -1      6     -1 NA      -1     -1    -0.7      NA     2.5
## 6     4314 0       4.5      6      2     2.5    -1      1      2      NA      0
## 7     4737 NA      NA      NA      NA      NA      NA      NA      NA     0.5      1
## 8     4932 NA      0      0     7.3      0      0      0      NA      0      0
## 9     5282 0       7.8     1.8      NA     -1      7     0.3      0     2.6      0
## 10    5834 NA      NA      NA      NA      NA      NA      0      NA      NA      NA

```

```

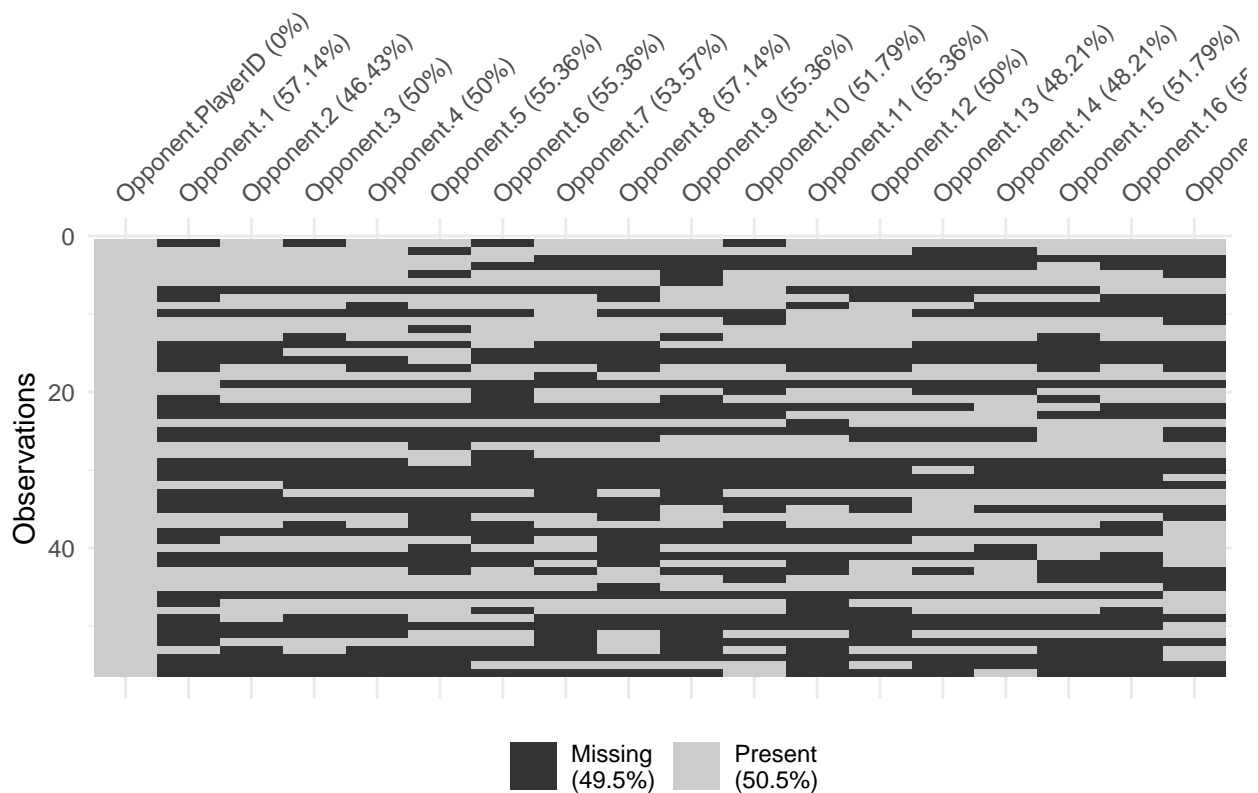
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $RushingTouchdowns
## # A tibble: 56 x 18
##   PlayerID `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611  NA    0  NA    0    0  NA    0    0    0    NA
## 2      732    0    0    0    0  NA    0    0    0    0    0
## 3     2428    0    0    0    0    0    0    NA  NA  NA  NA
## 4     2593    0    0    0    0    0  NA  NA  NA  NA  NA
## 5     3807    0    0    0    0  NA    0    0    0  NA    0
## 6     4314    0    0    0    0    0    0    0    0  NA    0
## 7     4737  NA  NA  NA  NA  NA  NA  NA  NA  NA    0    0
## 8     4932  NA    0    0    1    0    0    0  NA    0    0
## 9     5282    1    0    0  NA    0    0    1    0    1    0
## 10    5834  NA  NA  NA  NA  NA  NA    0  NA  NA  NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $FumblesLost
## # A tibble: 56 x 18
##   PlayerID `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611  NA    0  NA    0    0  NA    0    0    0    NA
## 2      732    0    0    0    1  NA    0    0    2    0    0
## 3     2428    0    0    0    0    0    0    NA  NA  NA  NA
## 4     2593    0    1    0    0    0  NA  NA  NA  NA  NA
## 5     3807    0    0    1    0  NA    0    0    0  NA    0
## 6     4314    0    0    1    0    1    0    0    0  NA    0
## 7     4737  NA  NA  NA  NA  NA  NA  NA  NA  NA    0    0
## 8     4932  NA    0    0    0    1    0    1  NA    1    1
## 9     5282    0    1    0  NA    0    0    0    0    0    0
## 10    5834  NA  NA  NA  NA  NA  NA    0  NA  NA  NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##
## $FantasyPoints
## # A tibble: 56 x 18
##   PlayerID `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      611  NA   14.6  NA   9.4  8.48  NA   11.4  8.94  15.1  NA
## 2      732 17.9   14.9 13.7  8.48  NA   11.9 17.0  15.9  18.4 14.6
## 3     2428  8.92  15.9 21.7 16.4  15.6 20.9  NA   NA   NA  NA
## 4     2593 16.5   18.5 24.8 23.1 24.0  NA   NA   NA   NA  NA
## 5     3807 15.7   17.5 12   10.5  NA   11.9 16.7  14.5  NA  17.9
## 6     4314 10.7   30.8 35.7 20.5 12.6 16.2 18.5  17.5  NA  22.6
## 7     4737  NA   NA   NA  NA  NA  NA  NA  NA   14.2 15.0
## 8     4932  NA   11.6 22.6 27.7 13   9.12 7.36  NA   12.8 16.9
## 9     5282  9.48  15.7 14.7  NA  13.5 20.3 24.5  18.3  16.9 12.5
## 10    5834  NA   NA   NA  NA  NA  NA  13.5  NA   NA  NA
## # ... with 46 more rows, and 7 more variables: `11` <dbl>, `12` <dbl>,
## #   `13` <dbl>, `14` <dbl>, `15` <dbl>, `16` <dbl>, `17` <dbl>
##

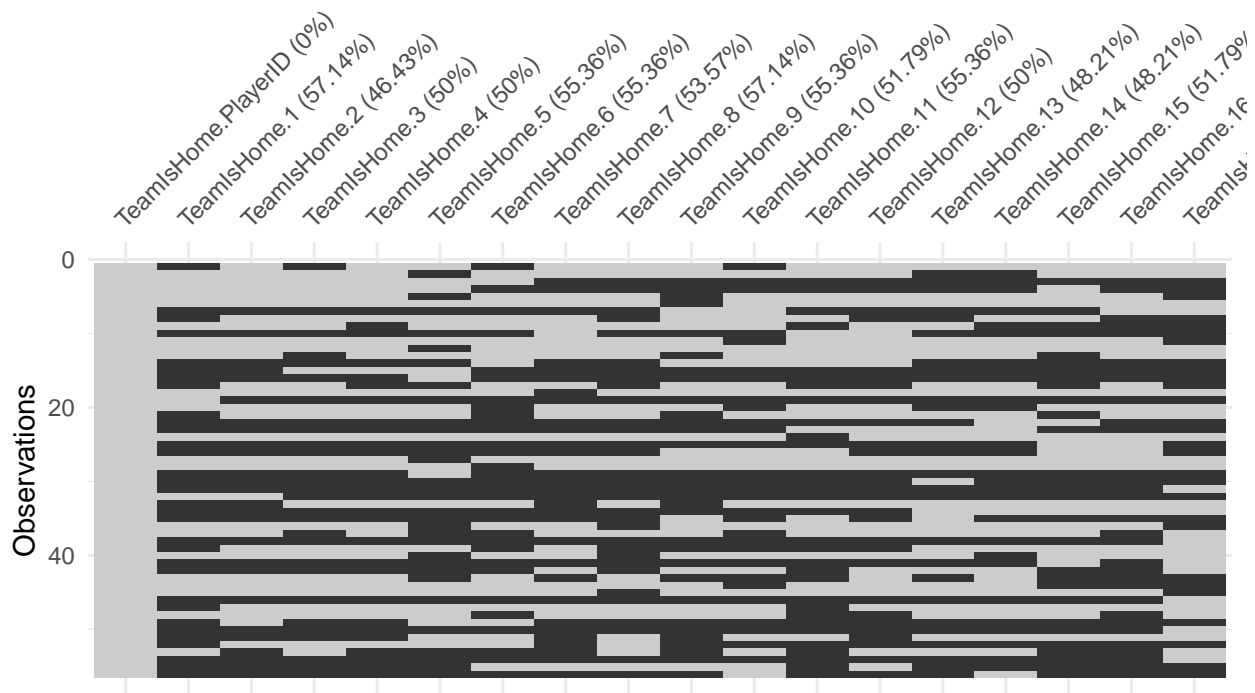
```



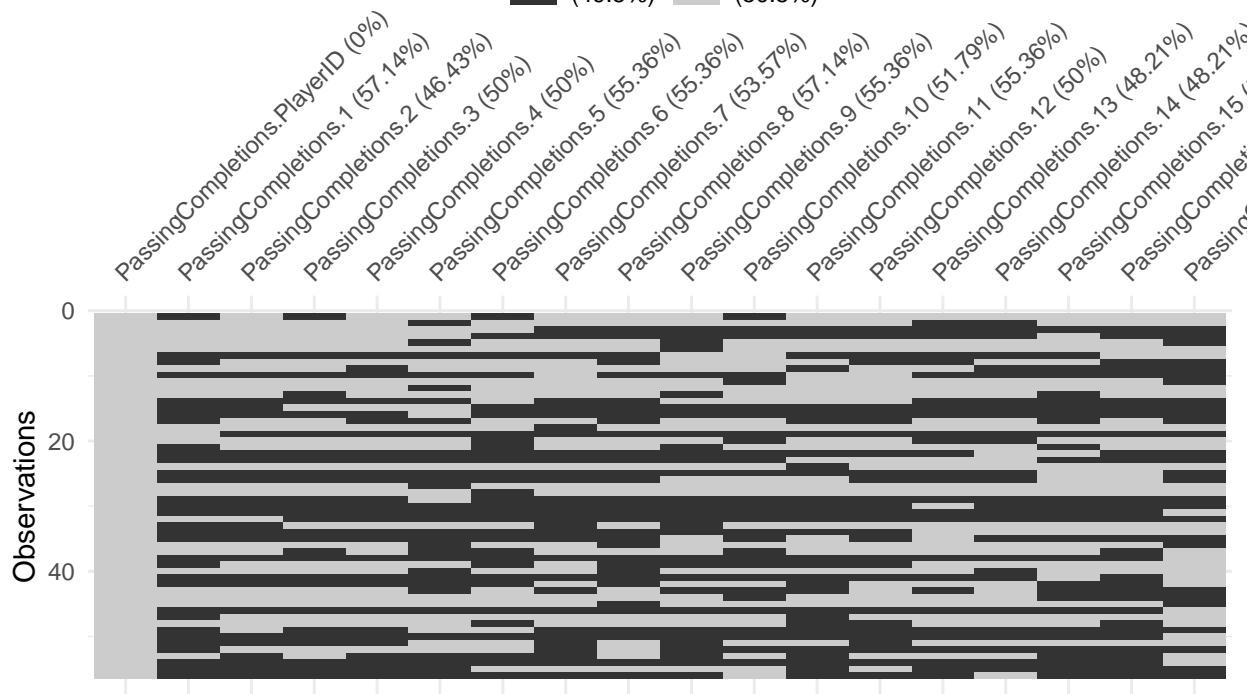
```
## $Team
## # A tibble: 56 x 18
##   PlayerID `1`  `2`  `3`  `4`  `5`  `6`  `7`  `8`  `9`  `10`
##   <dbl> <chr> <chr> <chr> <chr> <chr> <chr> <chr> <chr> <chr> <chr>
## 1     611 <NA> BAL  <NA> BAL  BAL  <NA> BAL  BAL  BAL  <NA>
## 2     732 ATL  ATL  ATL  ATL  <NA> ATL  ATL  ATL  ATL  ATL
## 3    2428 ARI  ARI  ARI  ARI  ARI  ARI  <NA> <NA> <NA> <NA>
## 4    2593 GB   GB   GB   GB   GB   <NA> <NA> <NA> <NA> <NA>
## 5    3807 PIT  PIT  PIT  PIT  <NA> PIT  PIT  PIT  <NA> PIT
## 6    4314 NE   NE   NE   NE   NE   NE   NE   NE   <NA> NE
## 7    4737 <NA> <NA> <NA> <NA> <NA> <NA> <NA> <NA> ARI  ARI
## 8    4932 <NA> NYG  NYG  NYG  NYG  NYG  NYG  <NA> NYG  NYG
## 9    5282 NYJ  NYJ  NYJ  <NA> NYJ  NYJ  NYJ  NYJ  NYJ  NYJ
## 10   5834 <NA> <NA> <NA> <NA> <NA> <NA> MIA  <NA> <NA> <NA>
## # ... with 46 more rows, and 7 more variables: `11` <chr>, `12` <chr>,
## #   `13` <chr>, `14` <chr>, `15` <chr>, `16` <chr>, `17` <chr>
```

```
for (panel in 1:length(QBPanels)) {
  missing_plot <- vis_miss(as.data.frame(QBPanels[panel]))
  print(missing_plot)
}
```

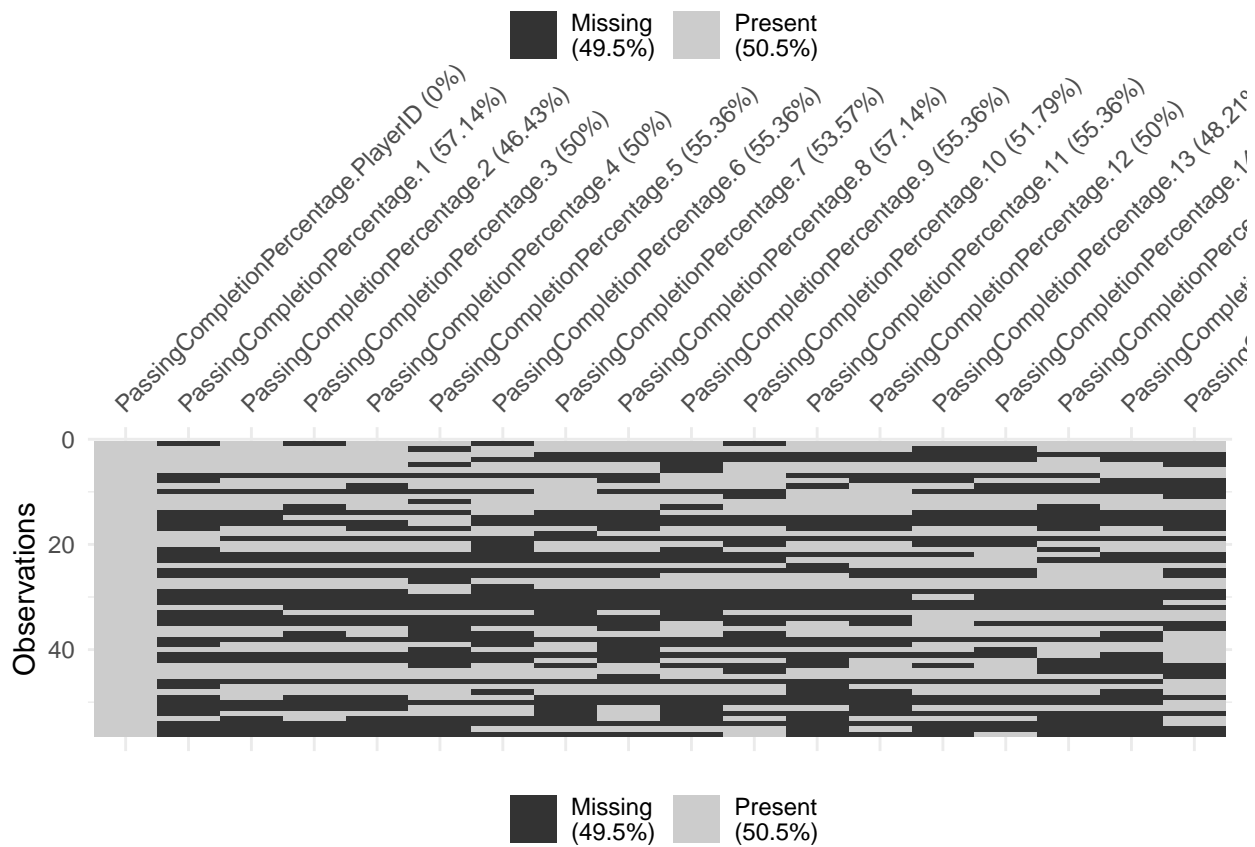
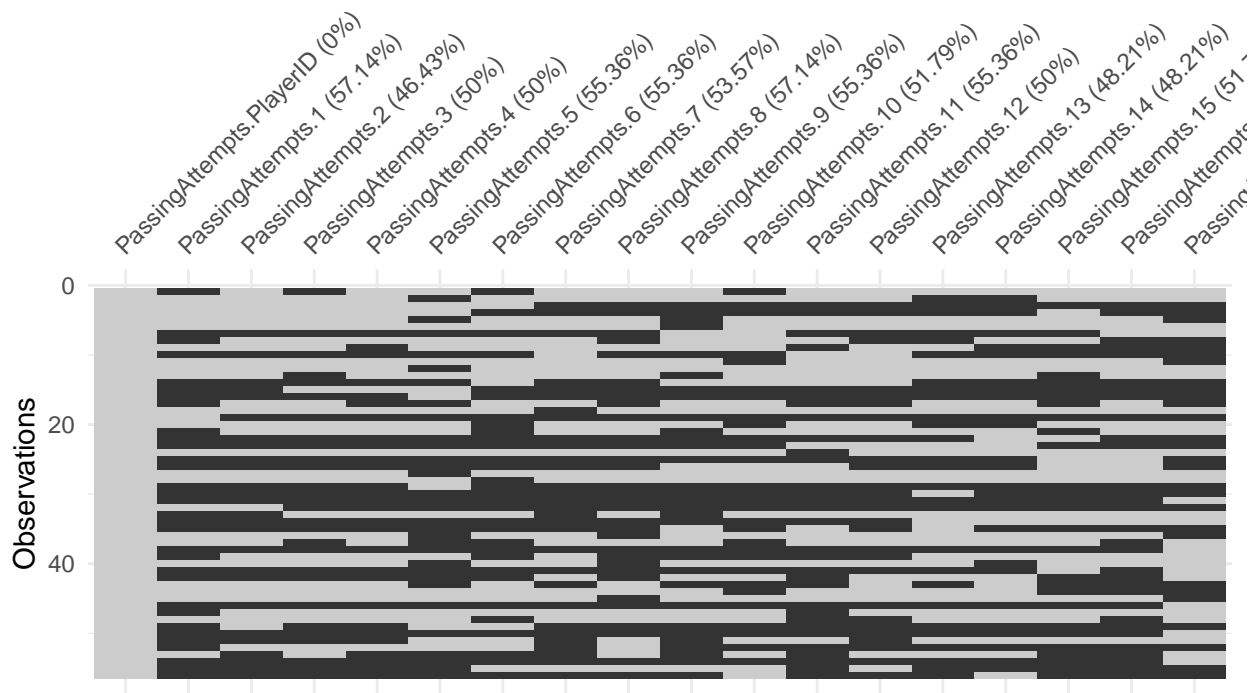


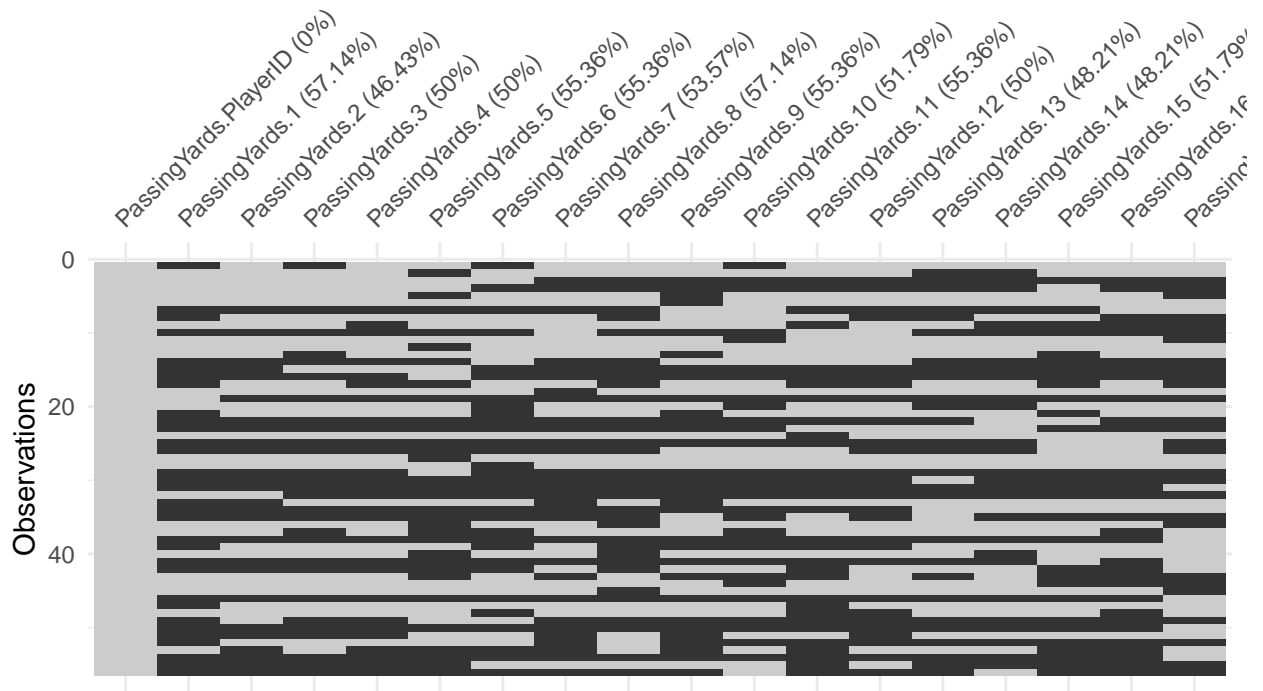


Missing (49.5%) Present (50.5%)

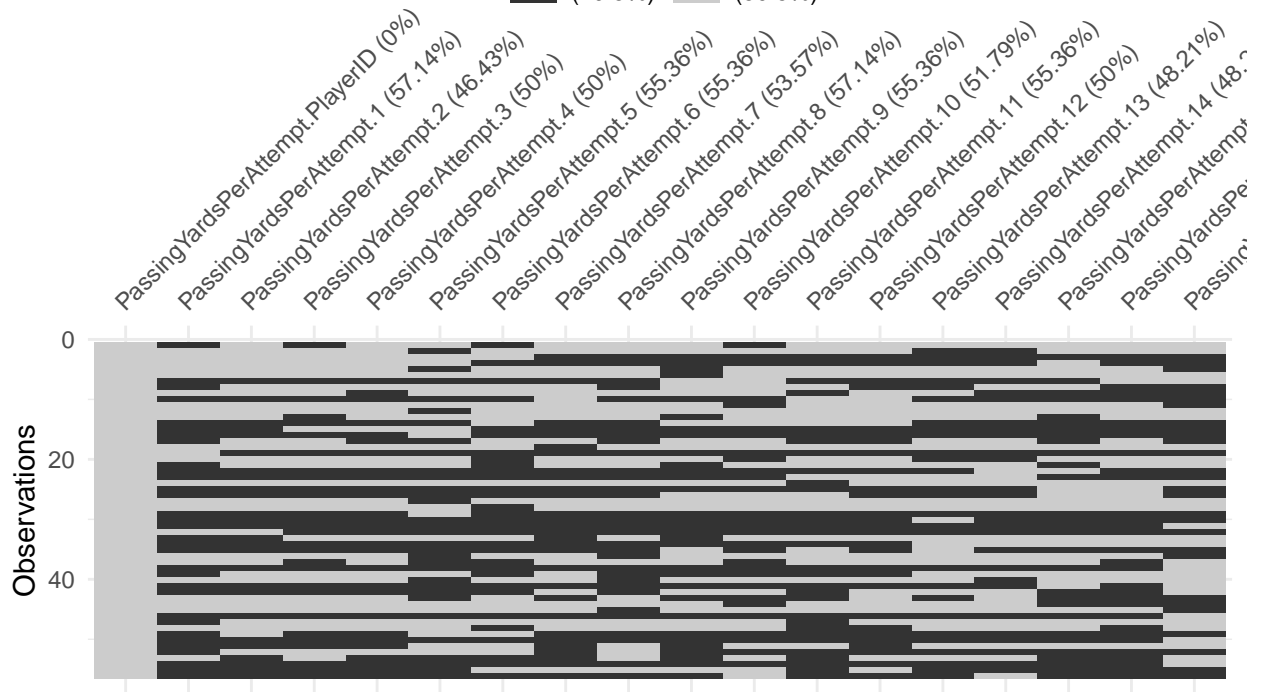


Missing (49.5%) Present (50.5%)

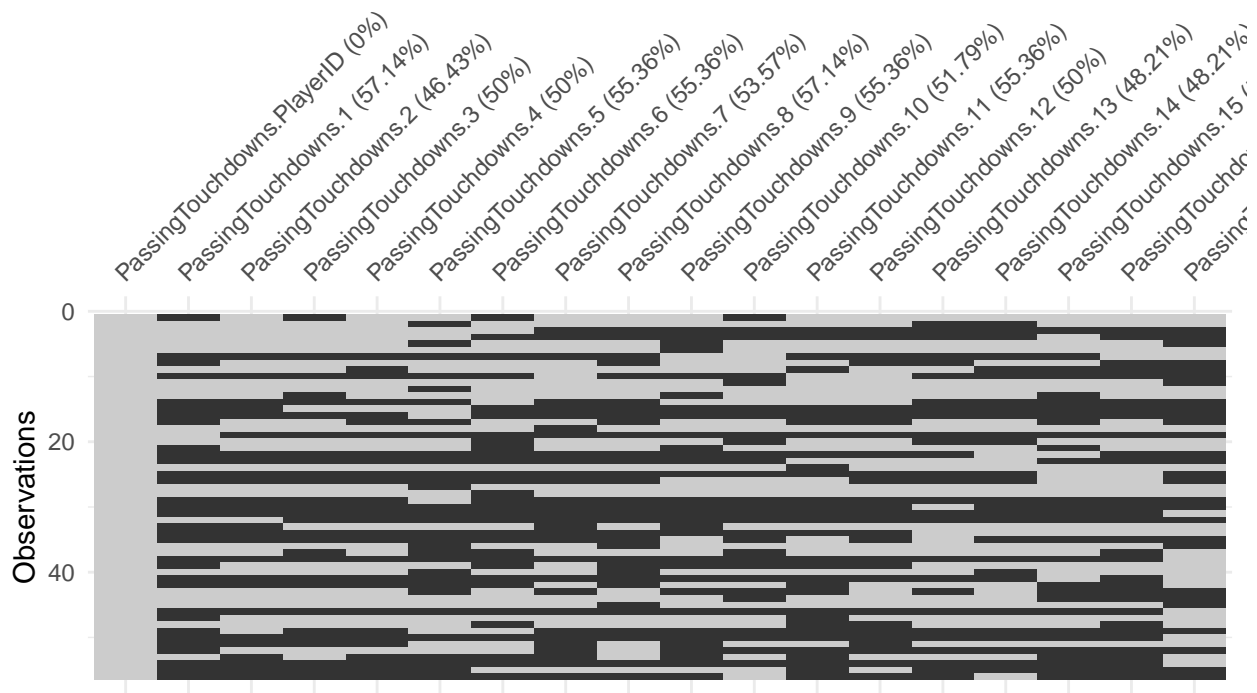




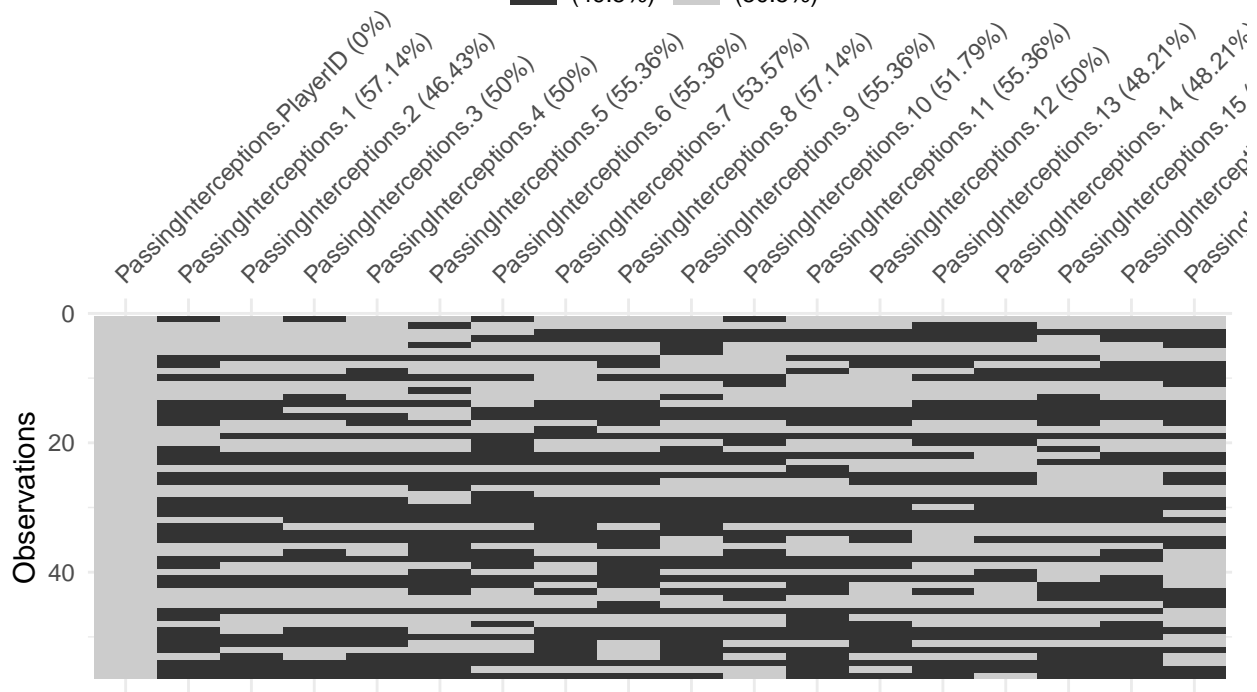
Missing (49.5%) Present (50.5%)



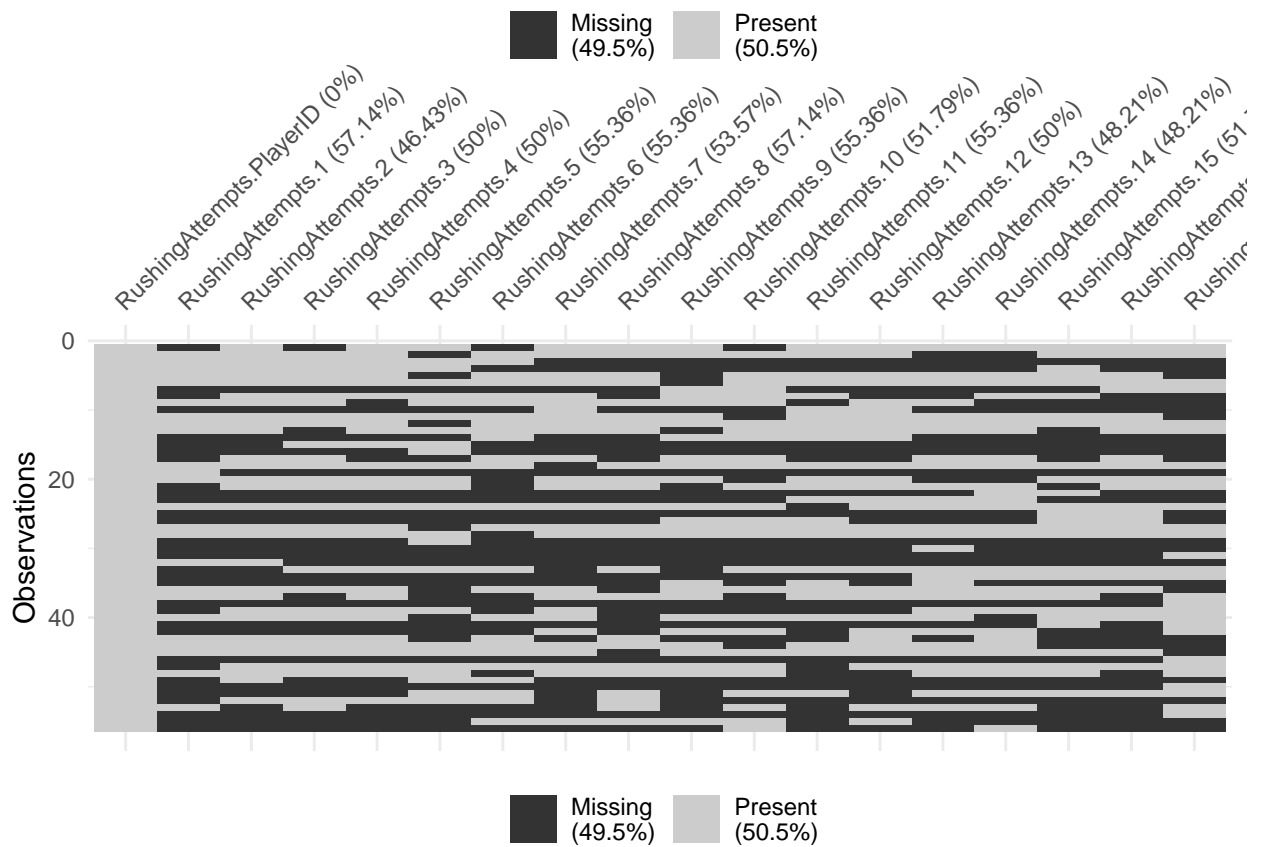
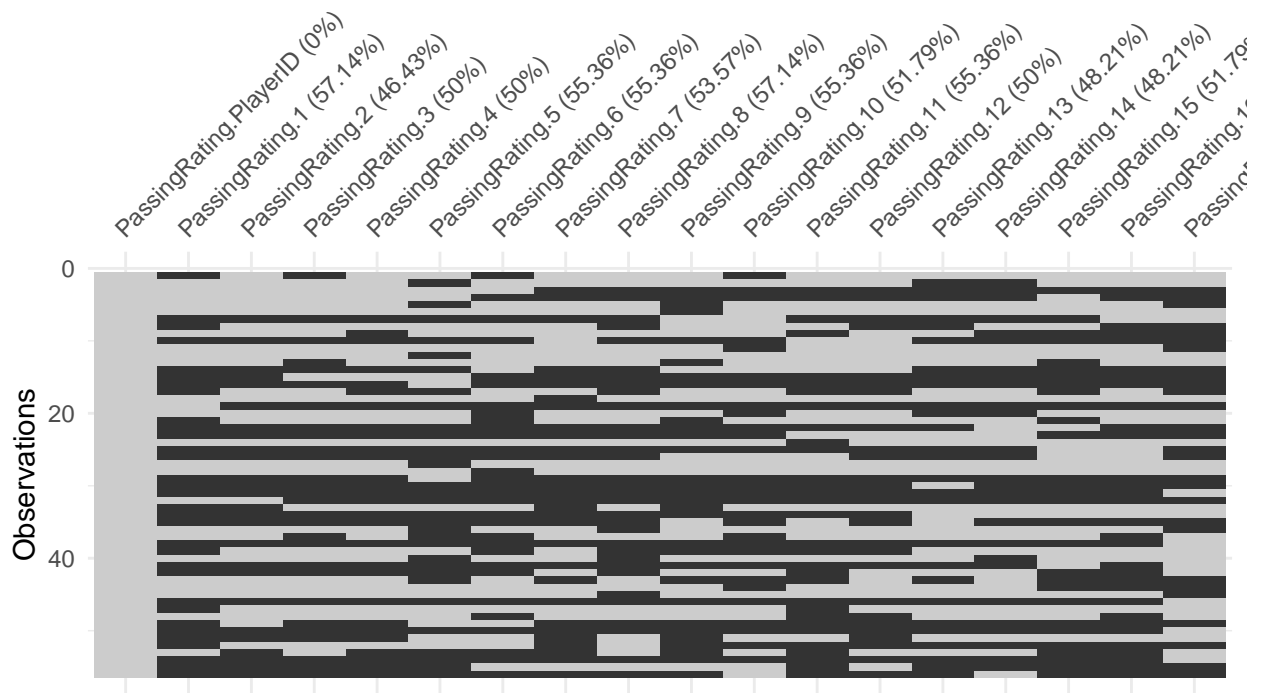
Missing (49.5%) Present (50.5%)

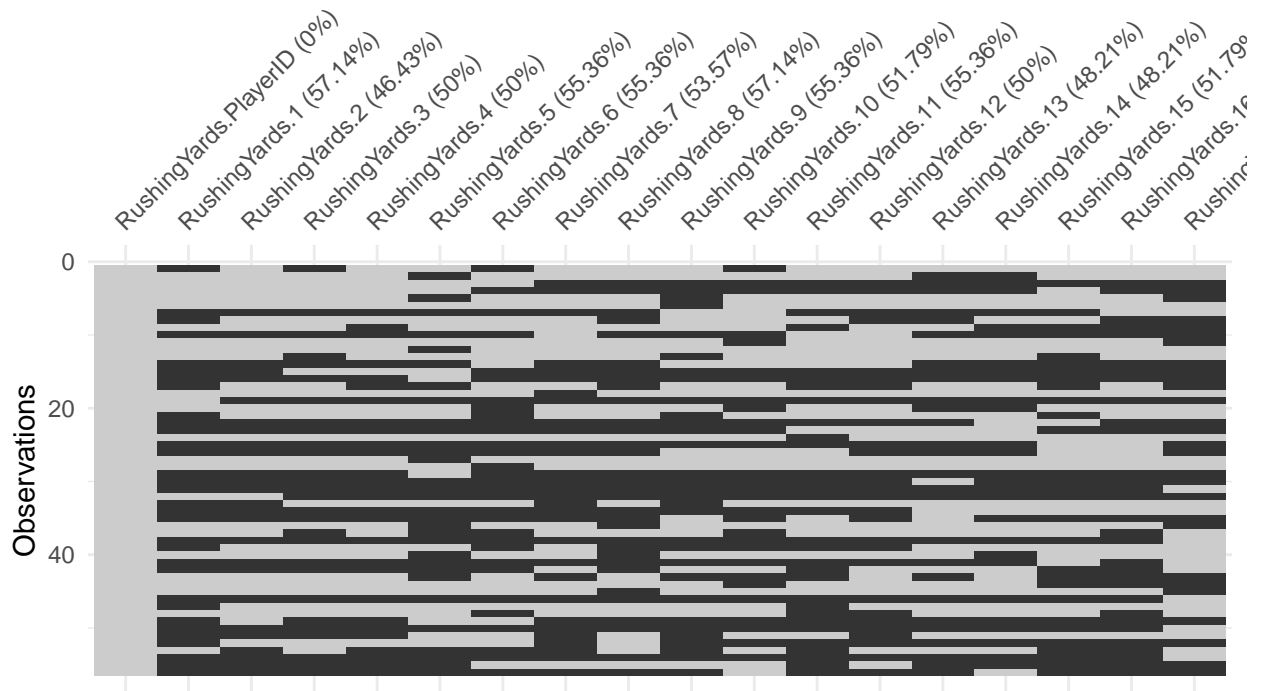


Missing (49.5%) Present (50.5%)

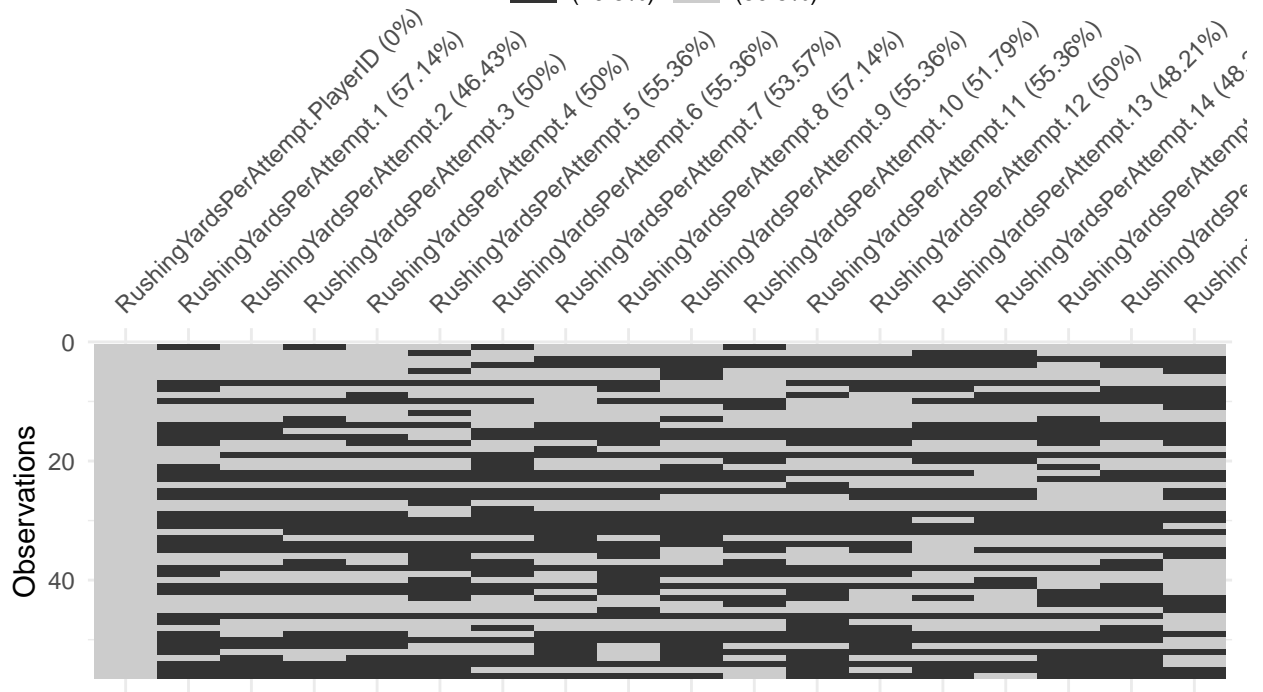


Missing (49.5%) Present (50.5%)

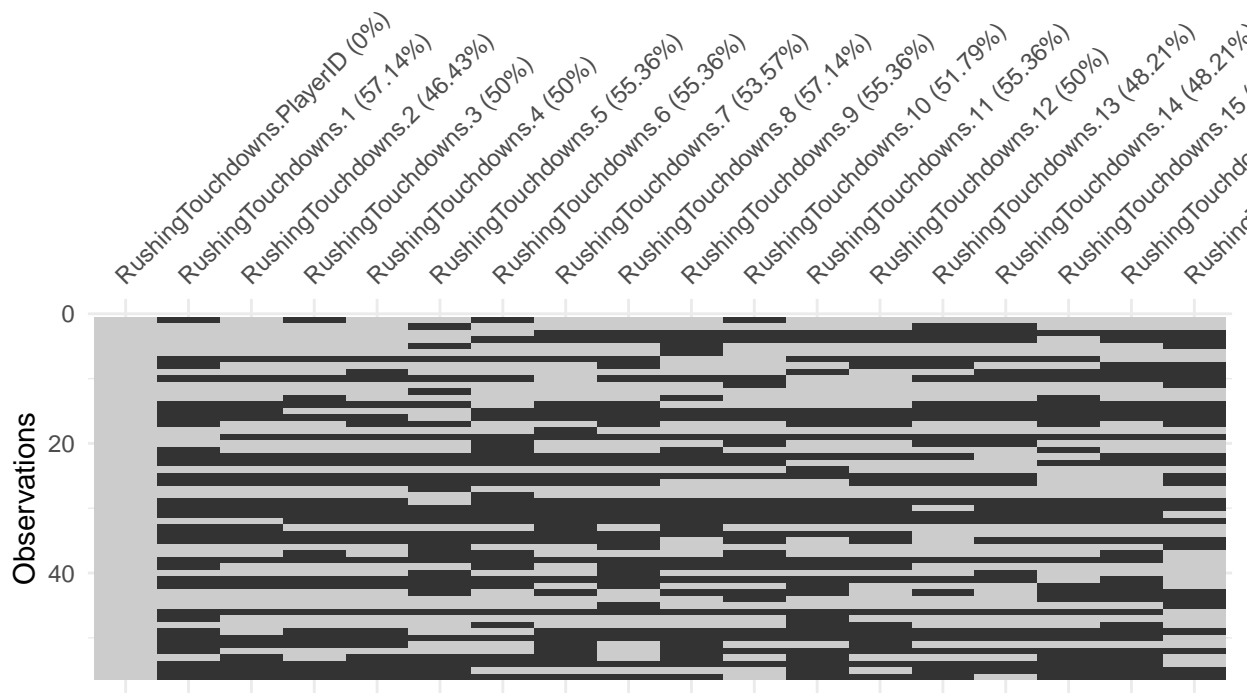




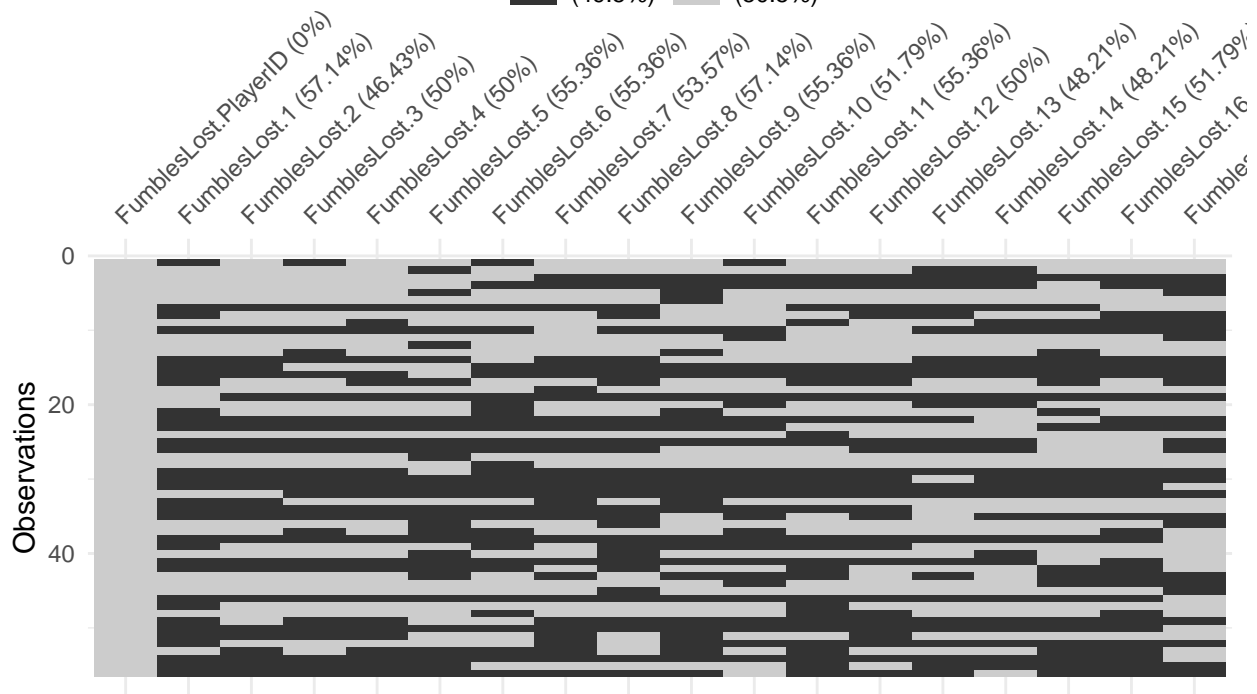
Missing (49.5%)
 Present (50.5%)



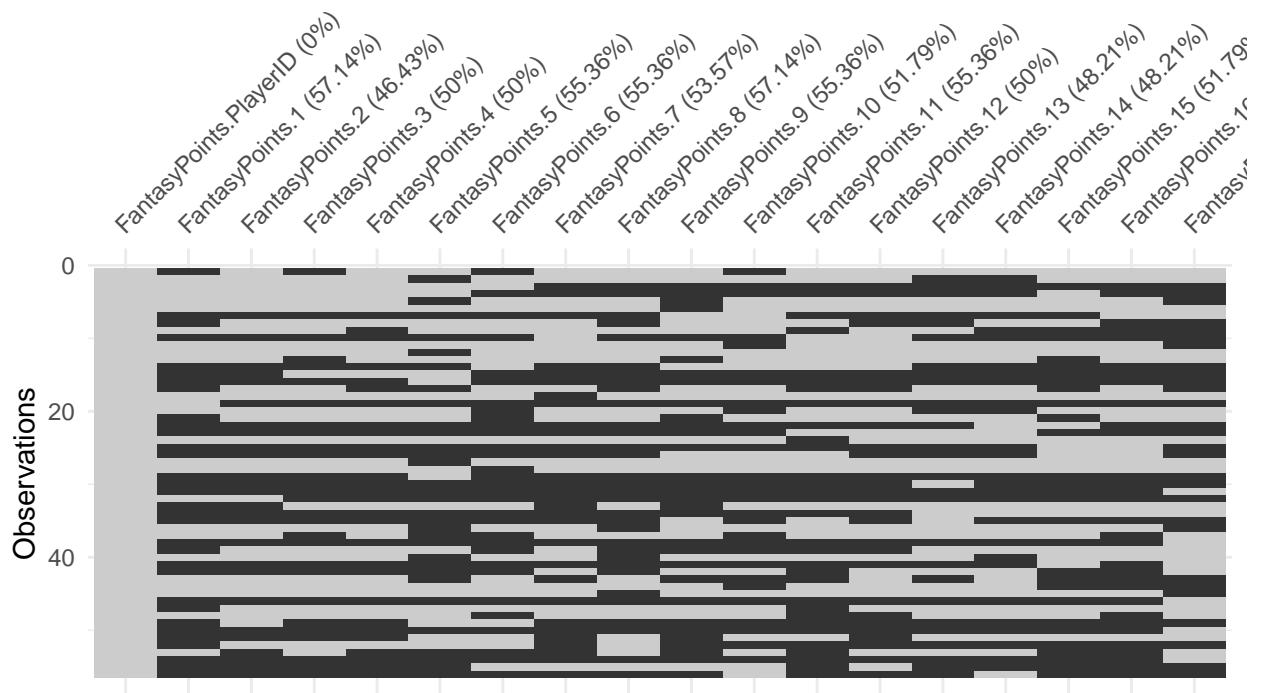
Missing (49.5%)
 Present (50.5%)



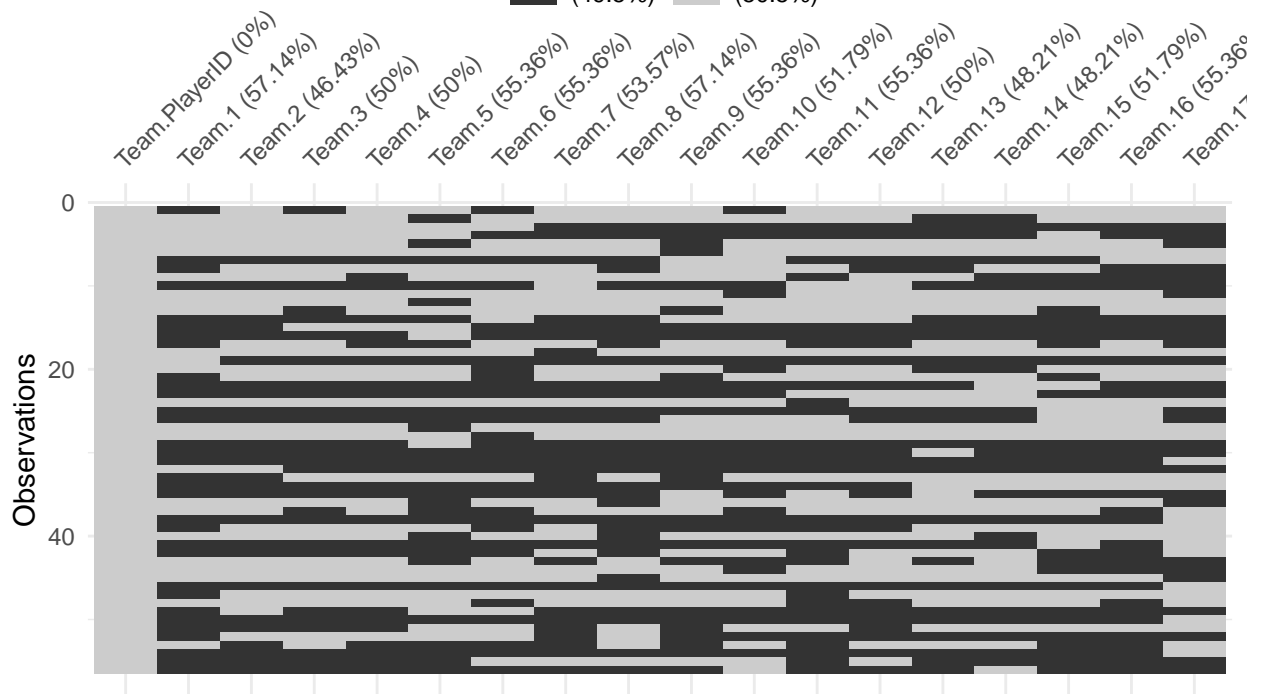
Missing (49.5%) Present (50.5%)



Missing (49.5%) Present (50.5%)



Missing (49.5%)
 Present (50.5%)



Missing (49.5%)
 Present (50.5%)

1.4: Corrrelogram

1.4.1 Corrrrelogram Style1 QBData (Old dataset)

```
#QBdata_num <- QBCrossSectional[-c(1:3,5:16,29:36,39:52,55:56,74:89)]
#corr <- round(cor(QBdata_num), 1)

#ggcorrplot(corr, hc.order = TRUE,
#           type = "full",
#           lab = TRUE,
#           lab_size = 1.5,
#           method="square",
#           colors = c("tomato2", "white", "springgreen3"),
#           title="Correlogram of Quarterbacks", tl.cex = 7,pch=2,pch.col =3,show.diag = T,
#           ggtheme=theme_classic)
```

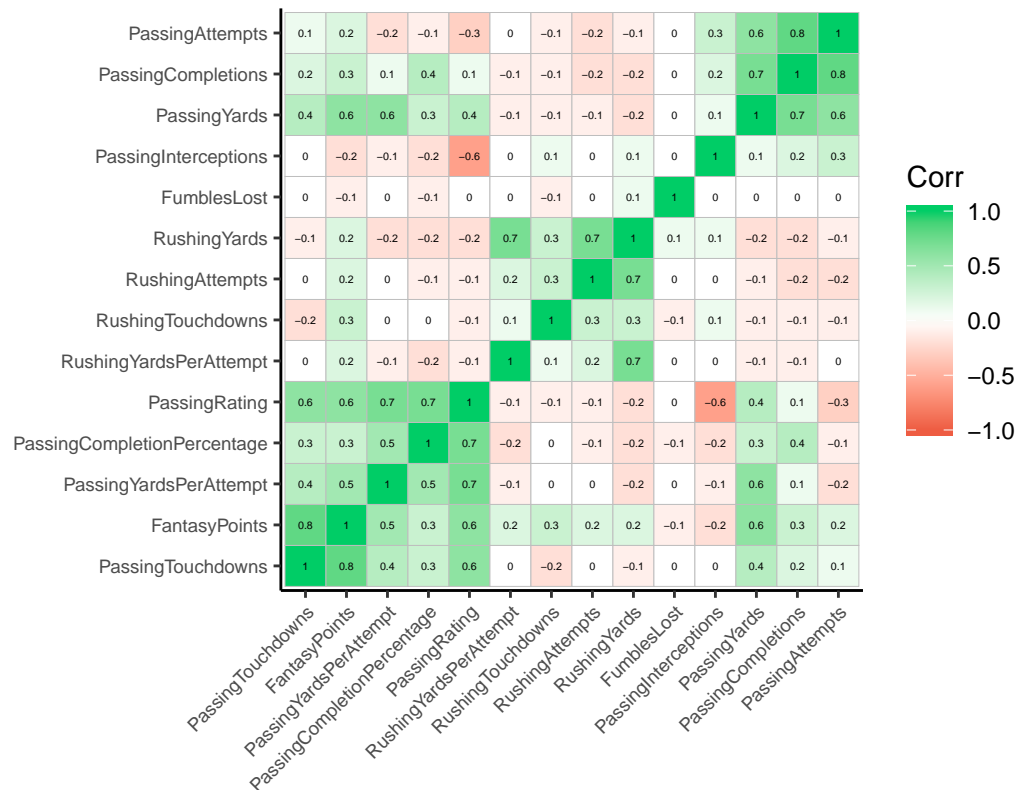
1.4.2 Corrrrelogram Style2 QBData (Old dataset)

```
#corrplot(corr, method="circle",tl.cex = 0.55,tl.col = "#1C1C1C")
```

1.4.3 Corrrrelogram of Crosssectional data (New dataset)

```
QBX_ds <- QBCrossSectional[-c(1:6,21)]
corr <- round(cor(QBX_ds), 1)
ggcorrplot(corr, hc.order = TRUE,
           type = "full",
           lab = TRUE,
           lab_size = 1.5,
           method="square",
           colors = c("tomato2", "white", "springgreen3"),
           title="Correlogram of Quarterbacks", tl.cex = 7,pch=2,pch.col =3,show.diag = T,
           ggtheme=theme_classic)
```

Correlogram of Quarterbacks

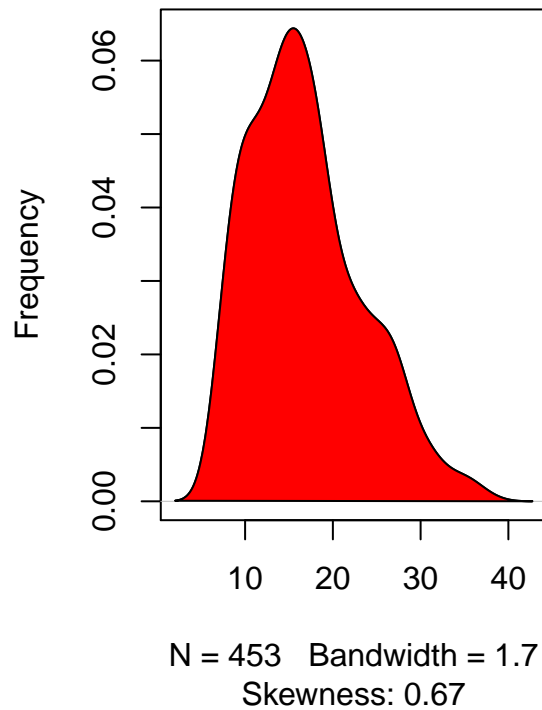


1.5: Distributions

1.5.1 Density plot for FantasyPoints is approximately Normal (Old QBData)

```
library(e1071)
par(mfrow=c(1, 2)) # divide graph area in 2 columns
target <- QBCrossSectional$FantasyPoints
plot(density(target), main="QBdata: FantasyPoints", ylab="Frequency", sub=paste("Skewness:", round(e1071::skewness(target), 2)))
polygon(density(target), col="red", asp=1.2 )
```

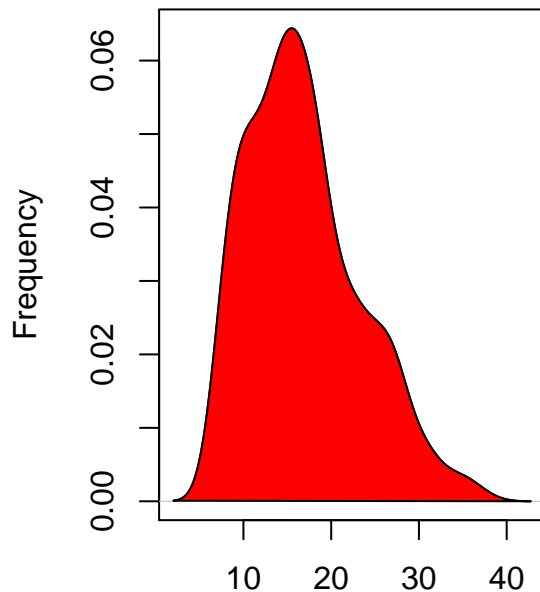
QBdata: FantasyPoints



1.5.2 Density plot for Fantasypoints is approxmiately Normal (New QBCrossSectional)

```
par(mfrow=c(1, 2)) # divide graph area in 2 columns
target <- QBCrossSectional$FantasyPoints
plot(density(target), main="CrossSectional Dataset: FantasyPoints", ylab="Frequency", sub=paste("Skewness: 0.67"))
polygon(density(target), col="red")
```

CrossSectional Dataset: FantasyPo

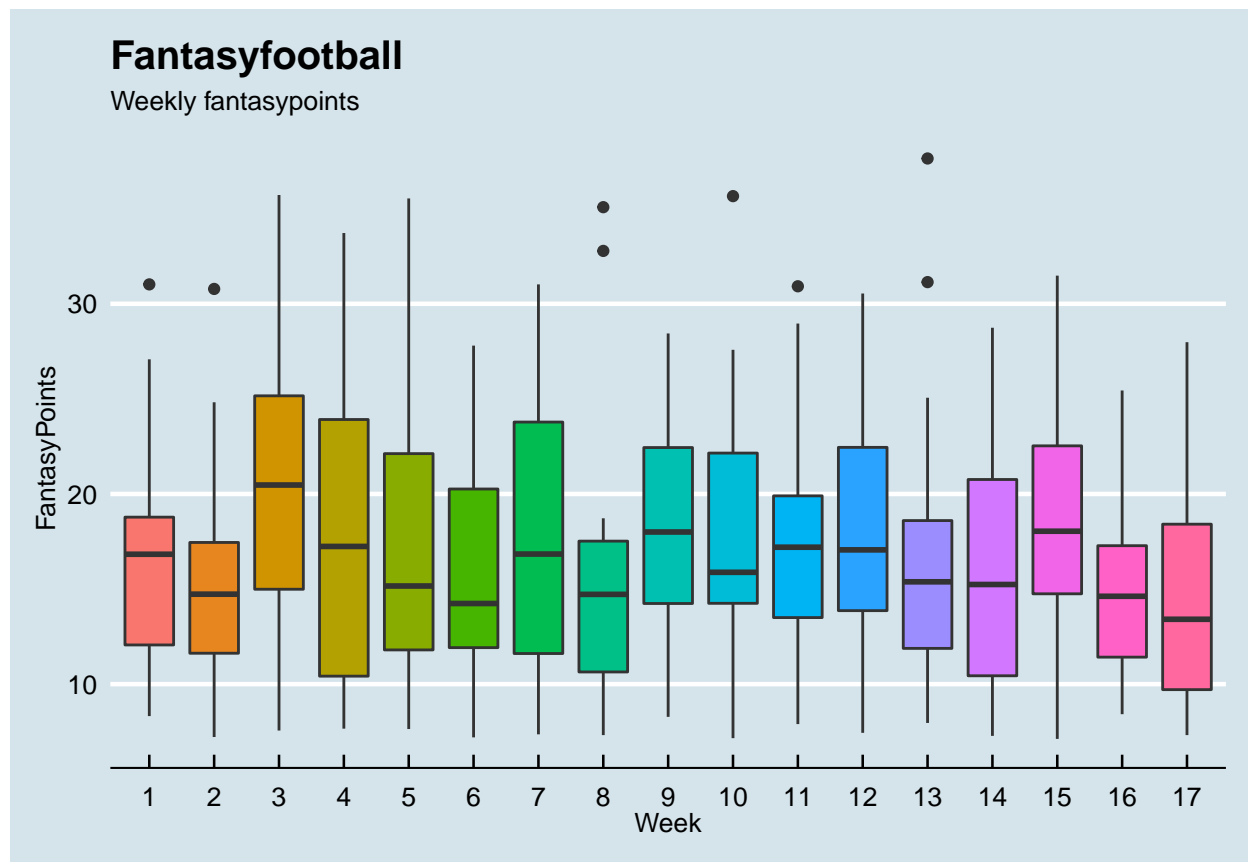


N = 453 Bandwidth = 1.7
Skewness: 0.67

1.5.3 Boxplots - Target and Individual Predictor Behavior for per Team

I think we should do these by week - not team - we want to look at variance of the time series across observations

```
QBCrossSectional %>% ggplot(aes(y=FantasyPoints,x=Week,fill=Week,group=Week))+  
  geom_boxplot(show.legend = FALSE)+  
  xlab("Week")+ylab("FantasyPoints")+  
  labs(title="Fantasyfootball",  
        subtitle="Weekly fantasypoints",  
        aption="Source: Fantasyfootball")+theme_economist()
```



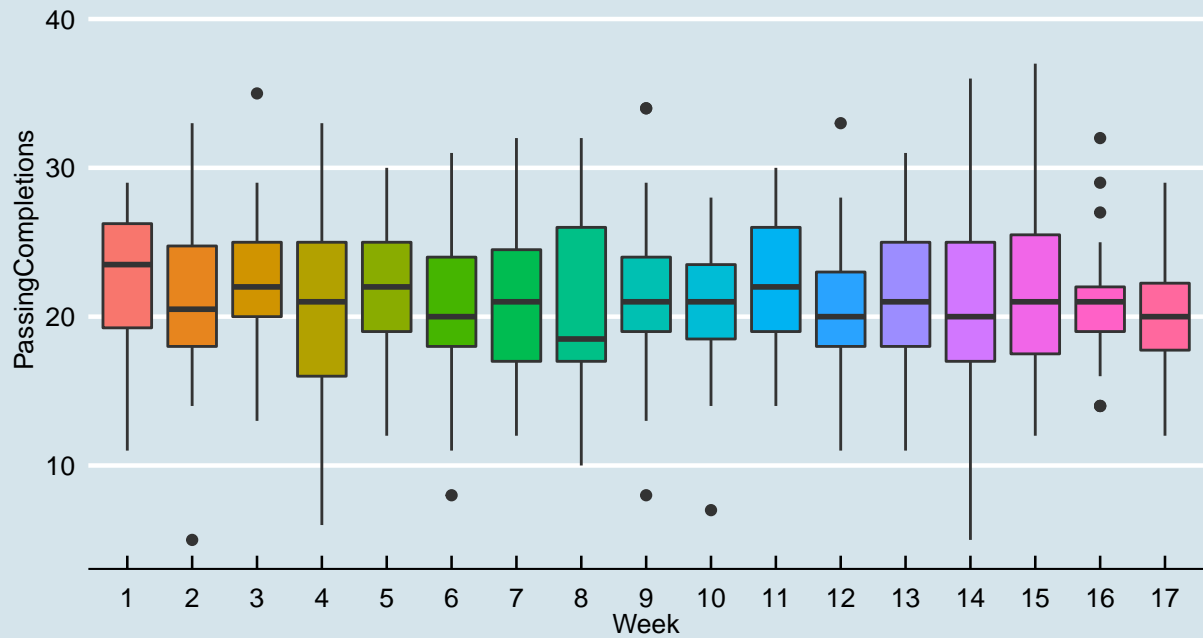
```
for (i in 7:19) {

ggplotp <- QBCrossSectional %>% ggplot(aes_string(y=names(QBCrossSectional[i]),x=Week,fill=Week,group=W
      geom_boxplot(show.legend = FALSE)+
      xlab("Week")+ylab(names(QBCrossSectional[i]))+
      labs(title="Fantasyfootball",
            subtitle="Weekly fantasypoints",
            caption="Source: Fantasyfootball")+theme_economist()

      print(ggplotp)
}
```

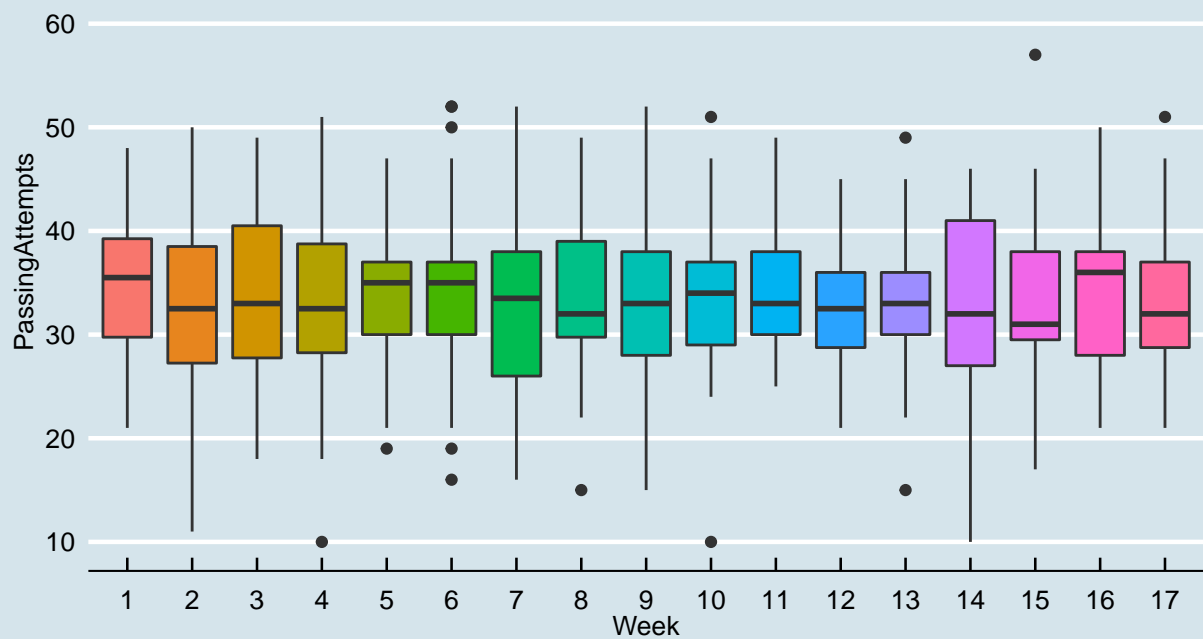
Fantasyfootball

Weekly fantasypoints



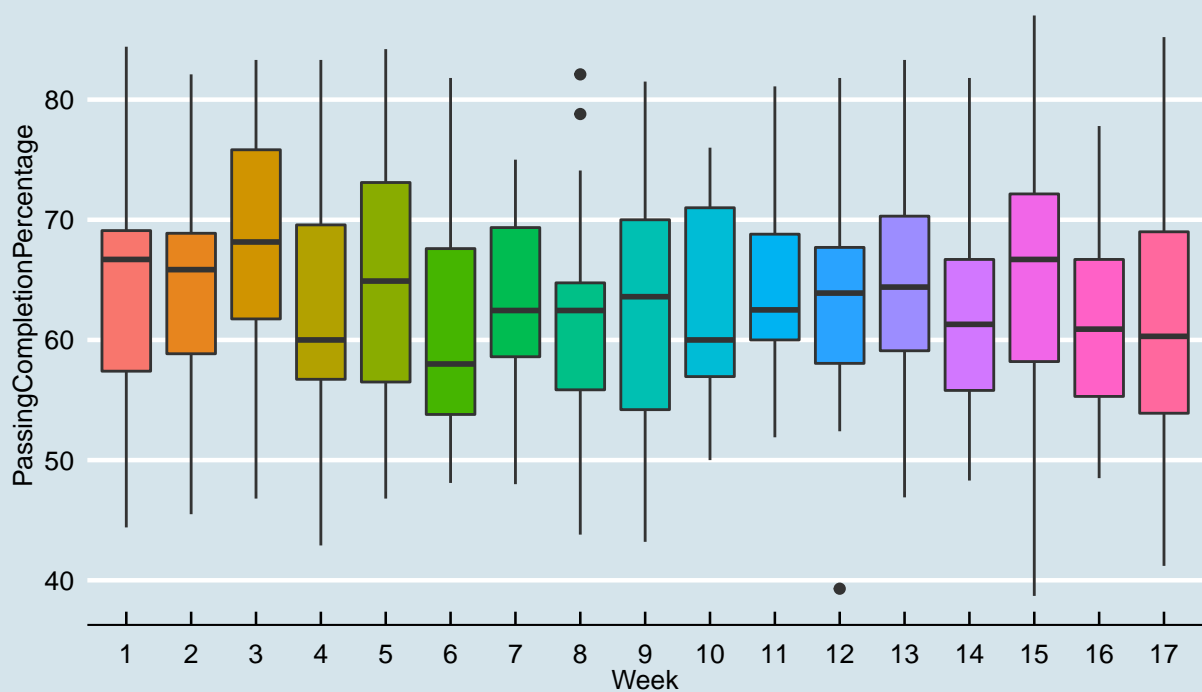
Fantasyfootball

Weekly fantasypoints



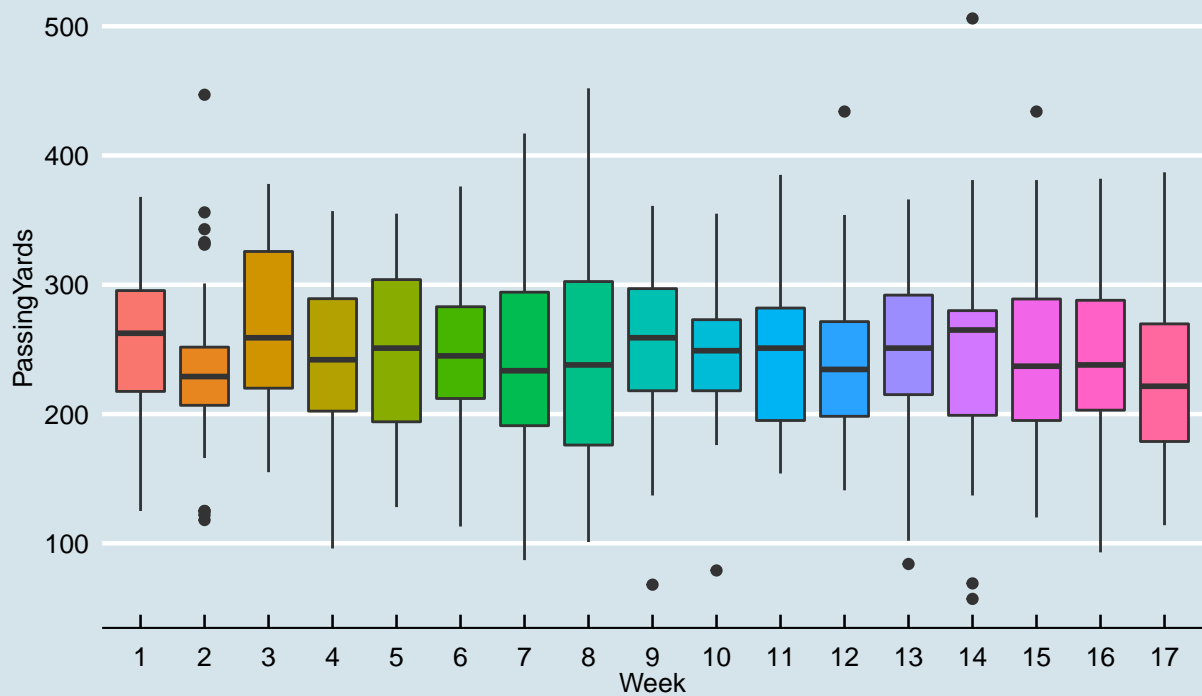
Fantasyfootball

Weekly fantasypoints



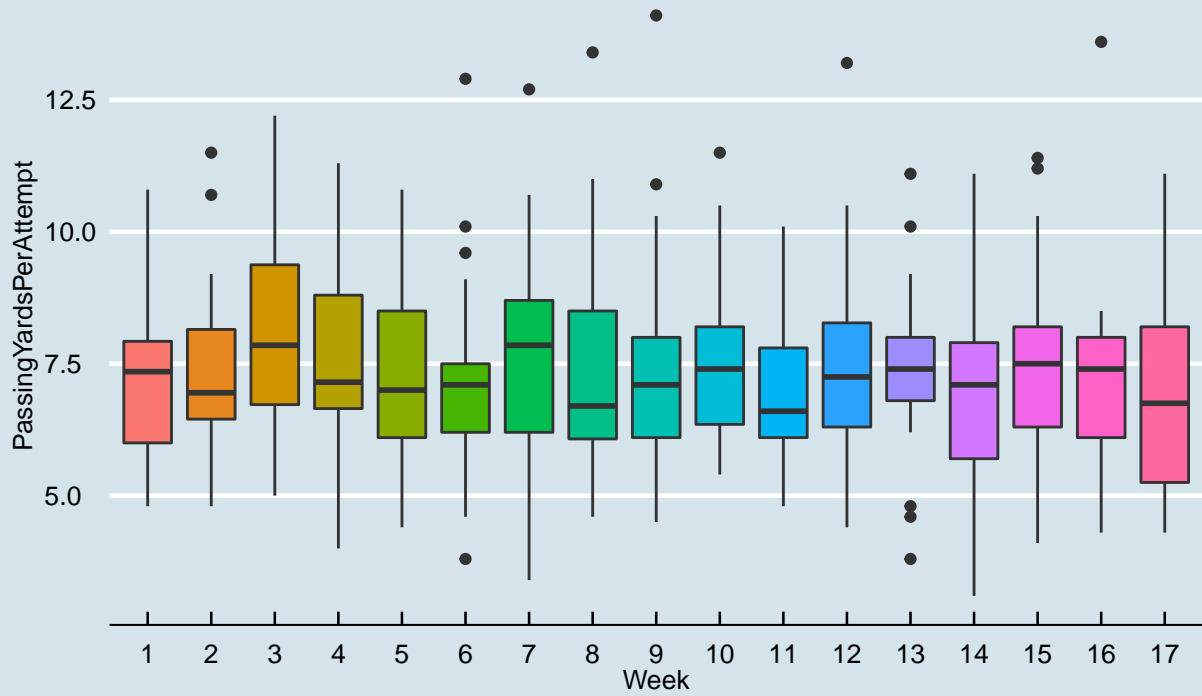
Fantasyfootball

Weekly fantasypoints



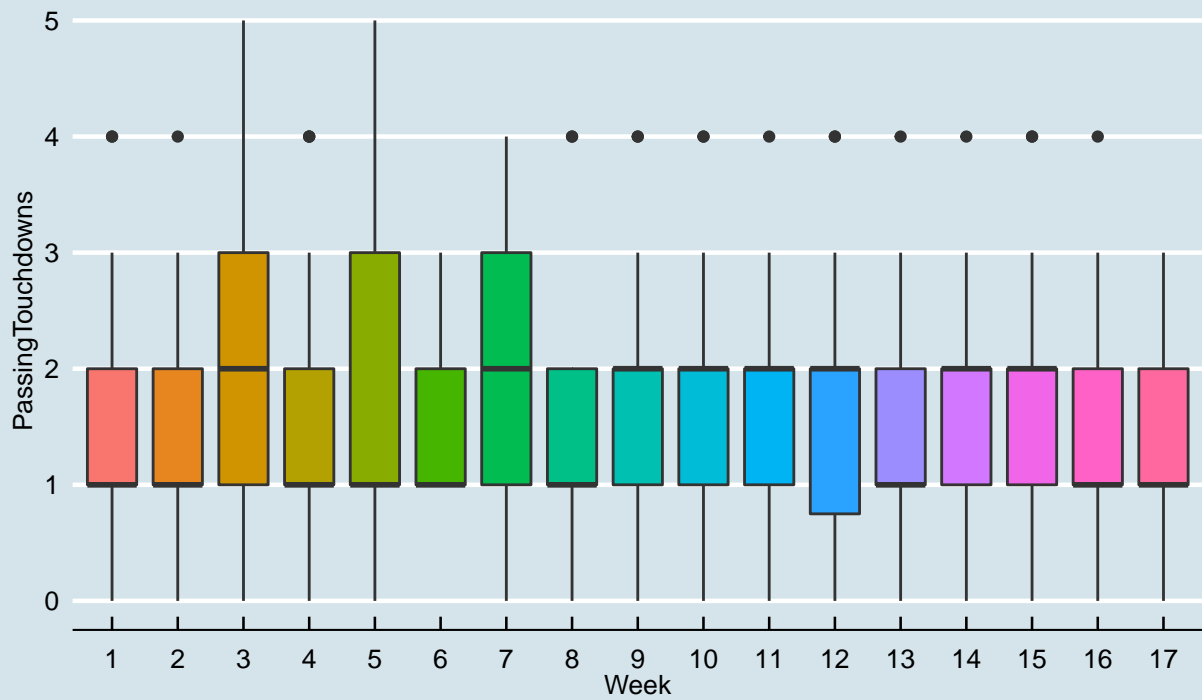
Fantasyfootball

Weekly fantasypoints



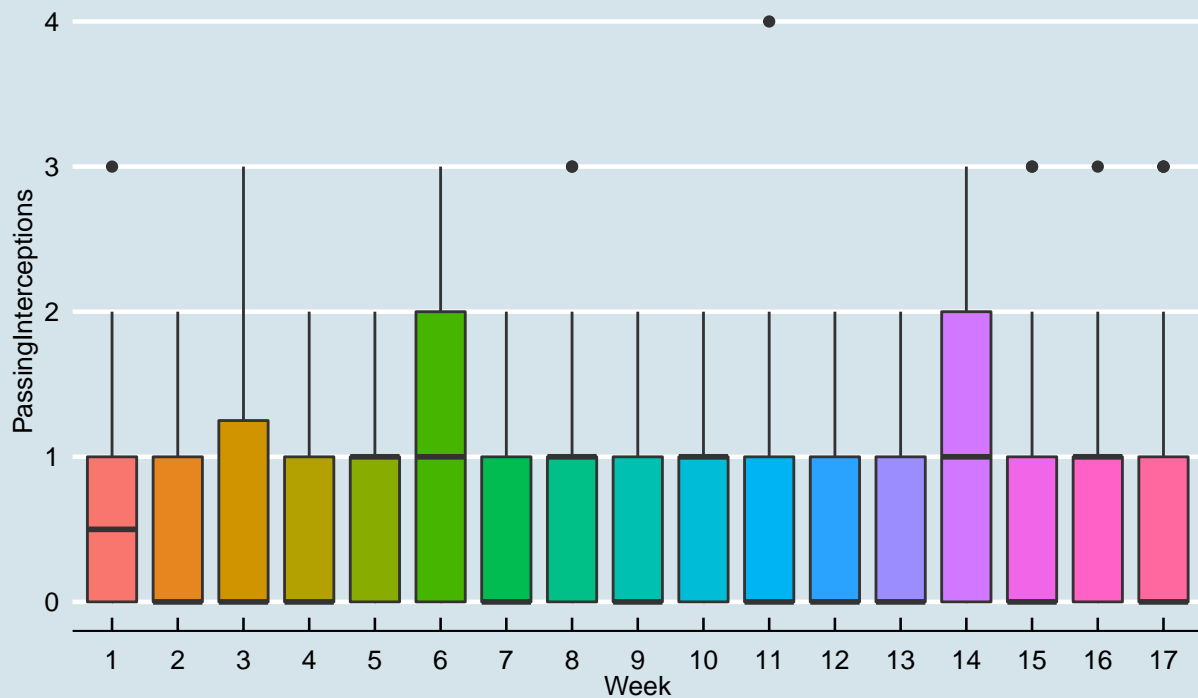
Fantasyfootball

Weekly fantasypoints



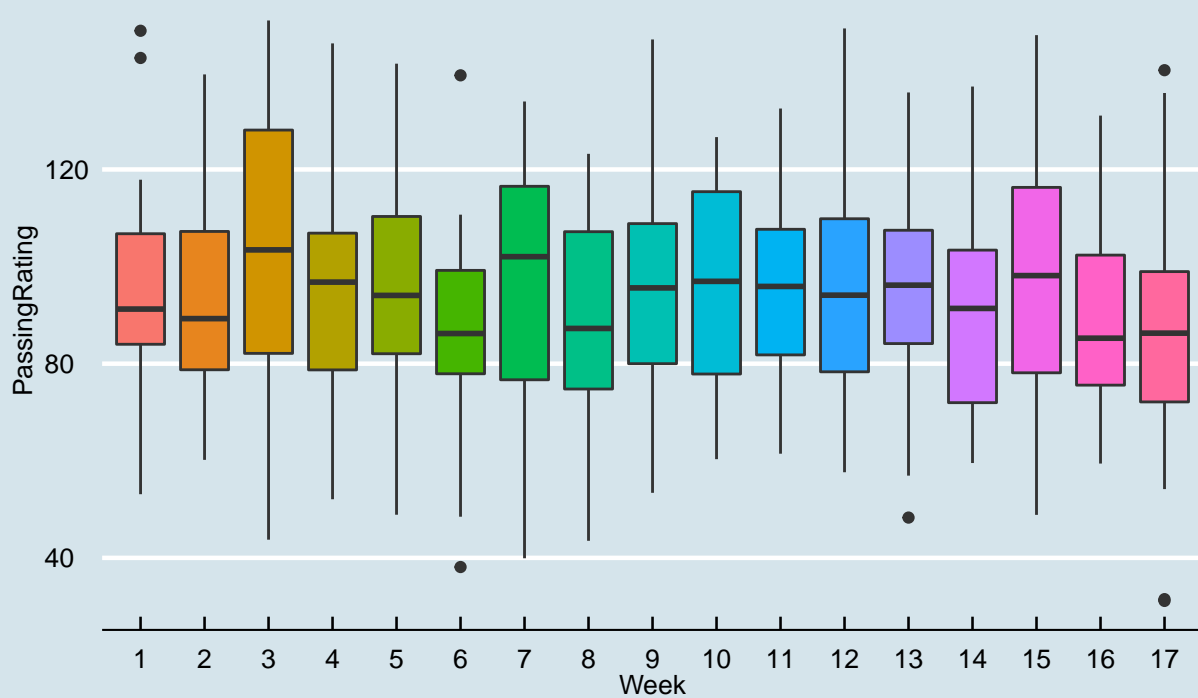
Fantasyfootball

Weekly fantasypoints



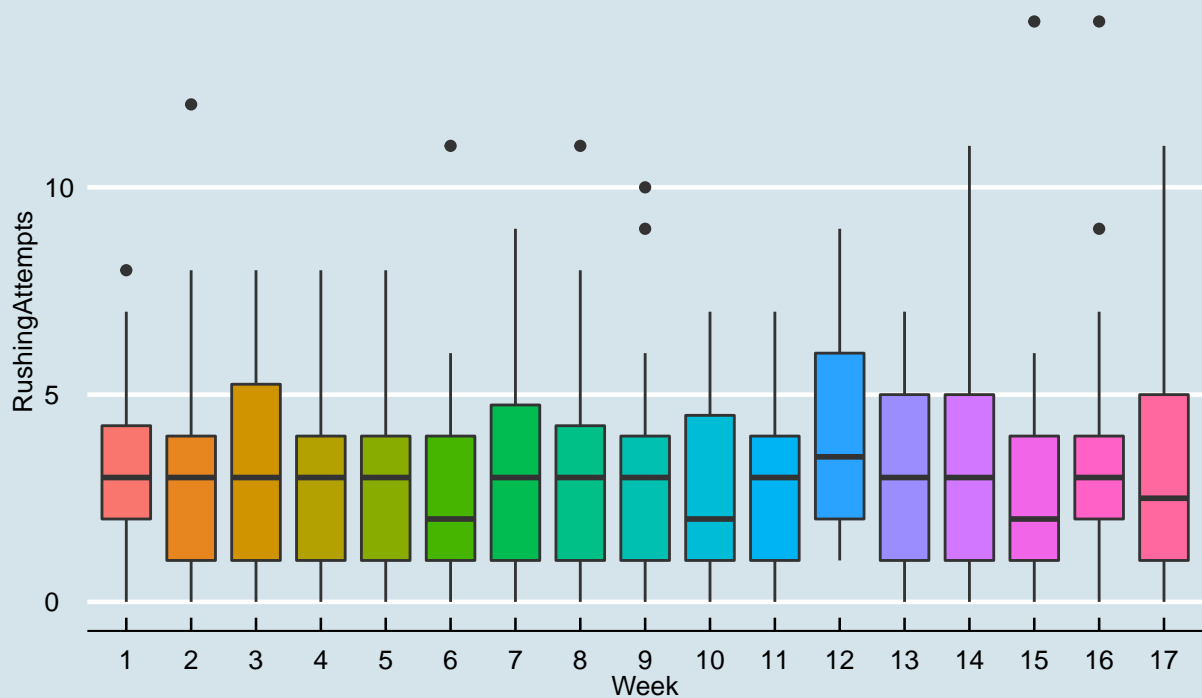
Fantasyfootball

Weekly fantasypoints



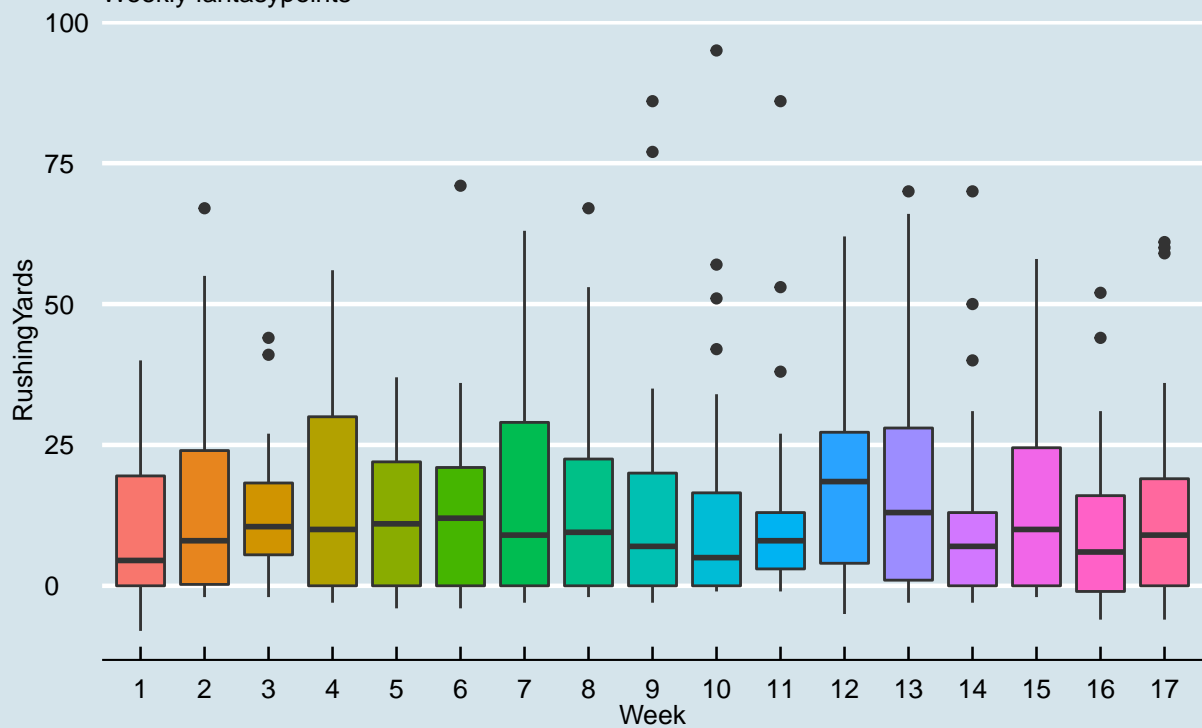
Fantasyfootball

Weekly fantasypoints



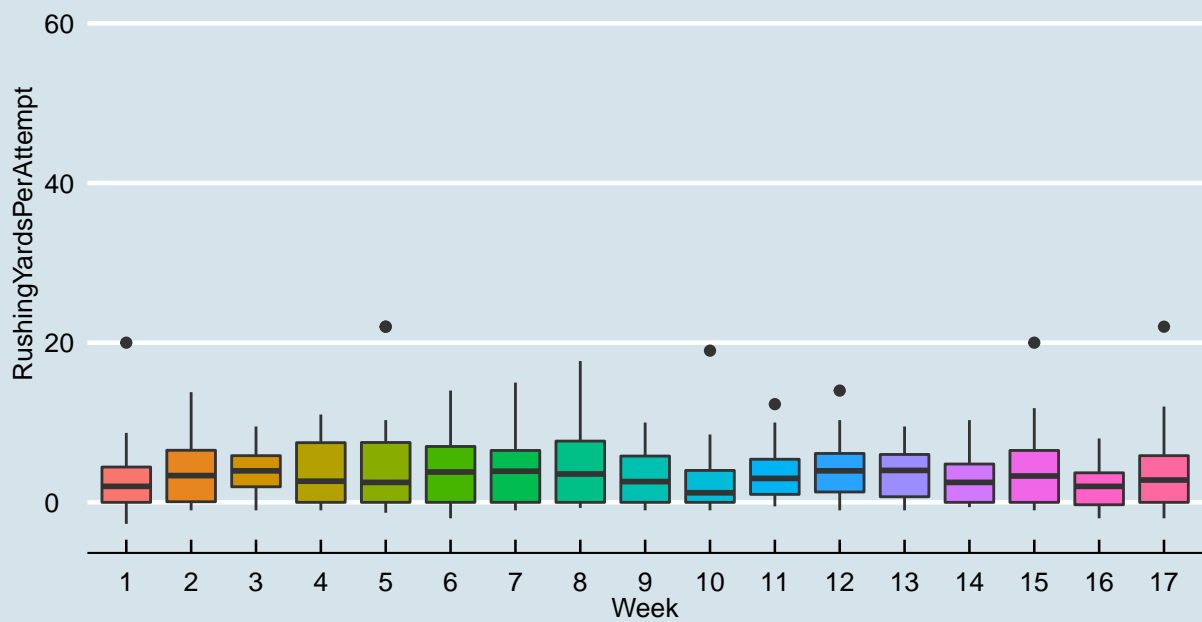
Fantasyfootball

Weekly fantasypoints



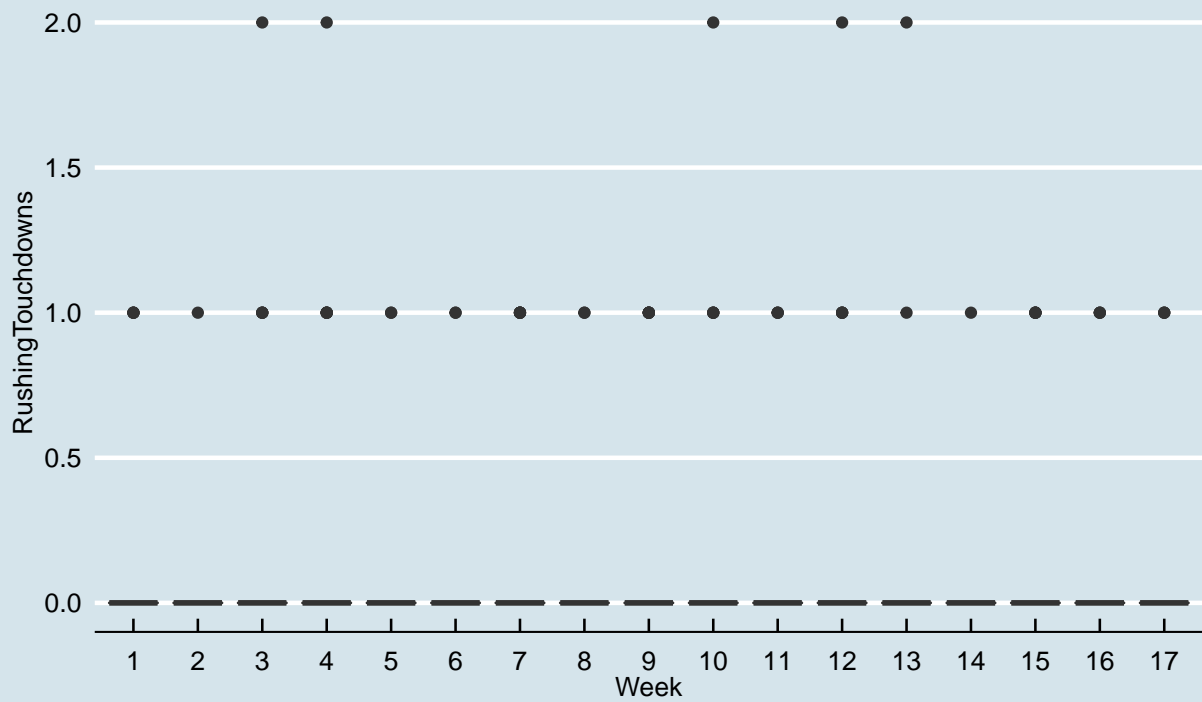
Fantasyfootball

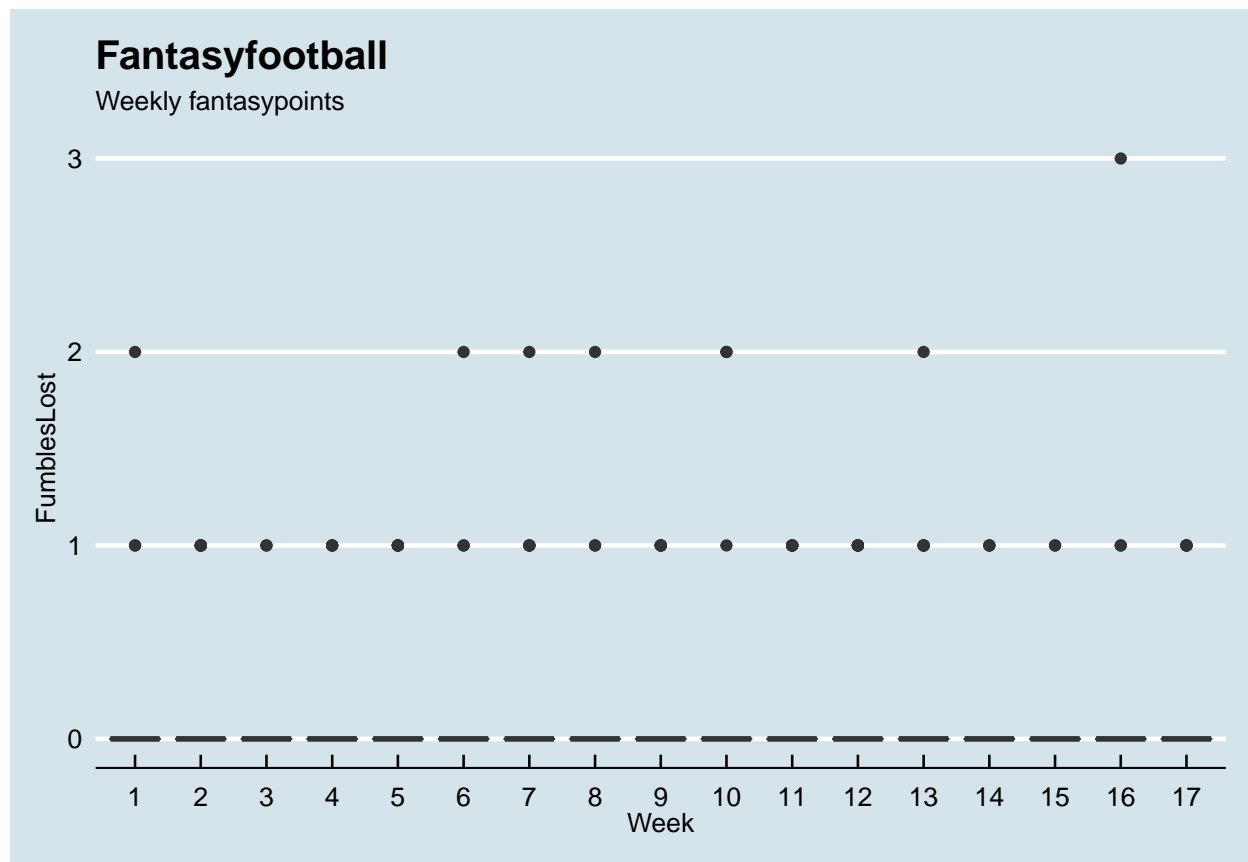
Weekly fantasypoints



Fantasyfootball

Weekly fantasypoints



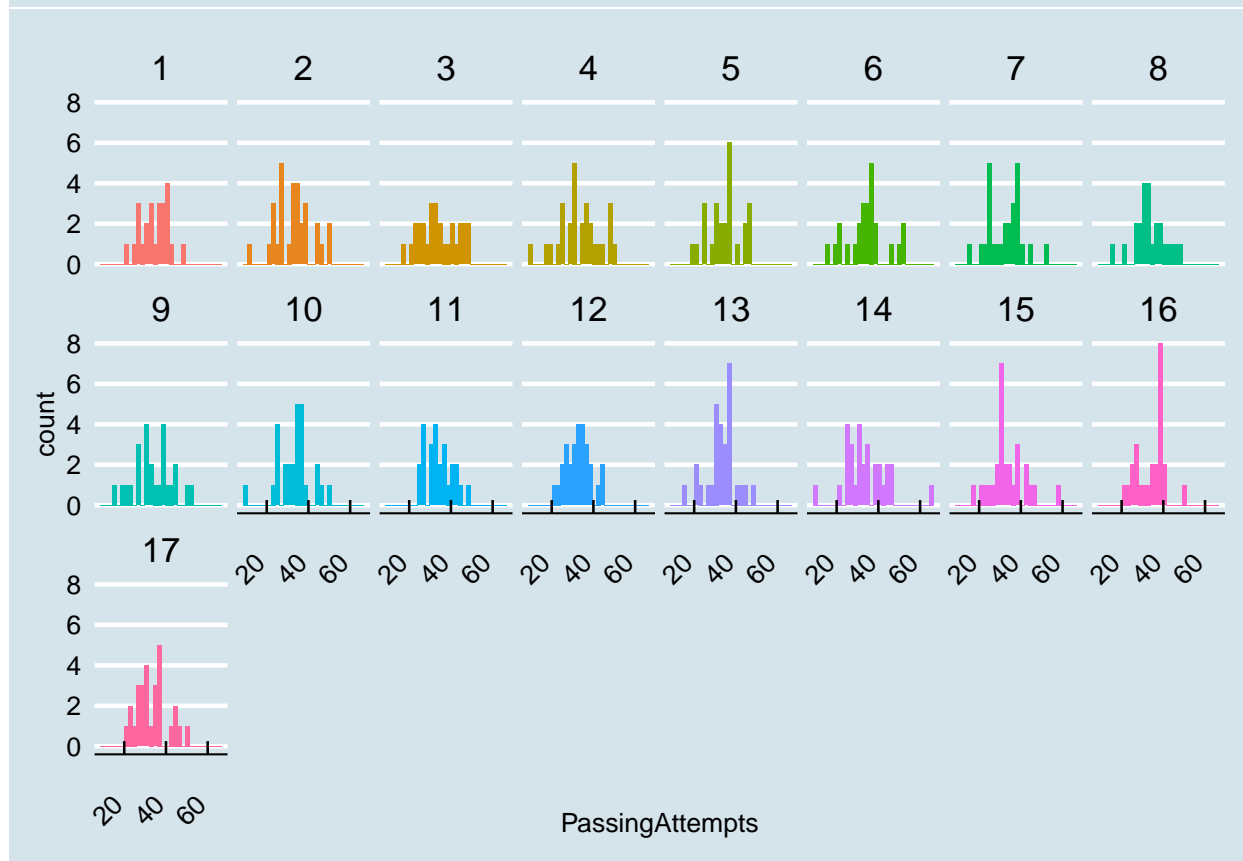
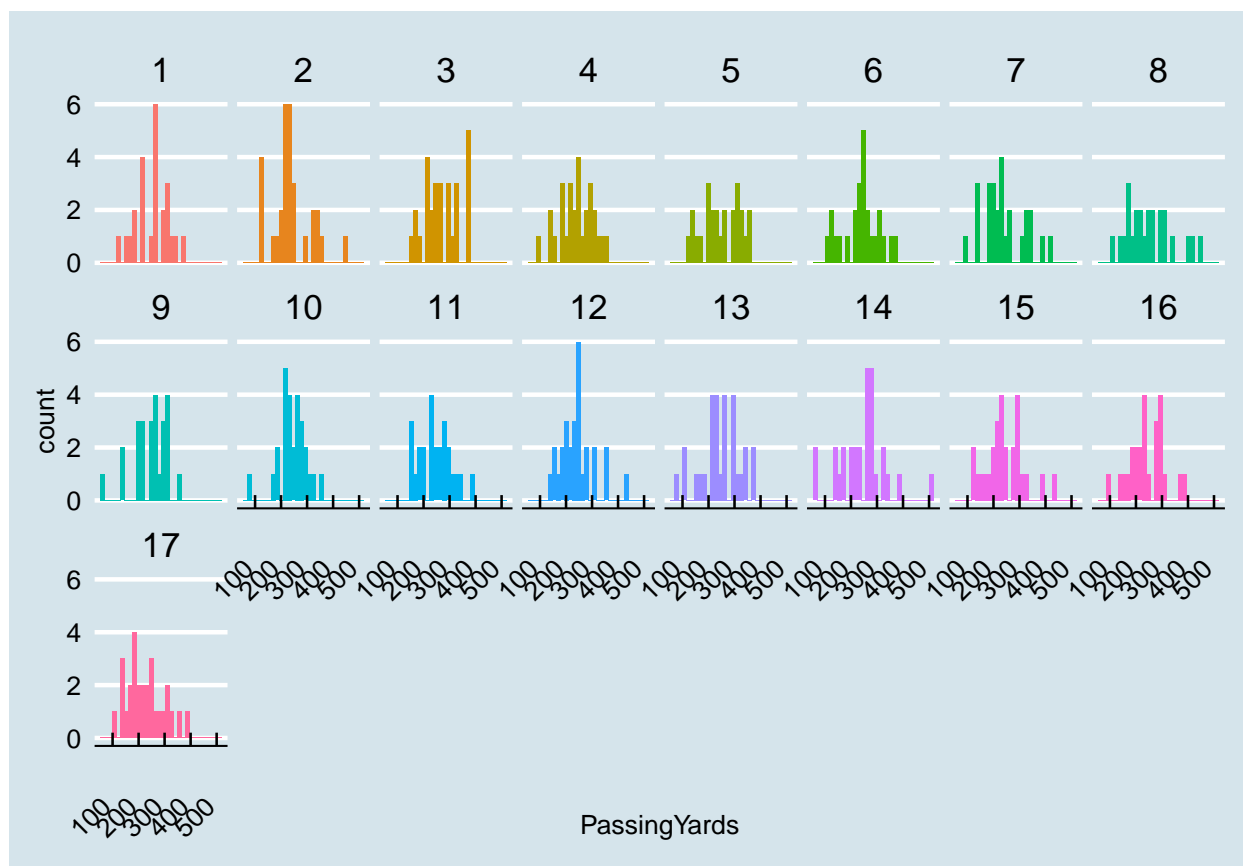


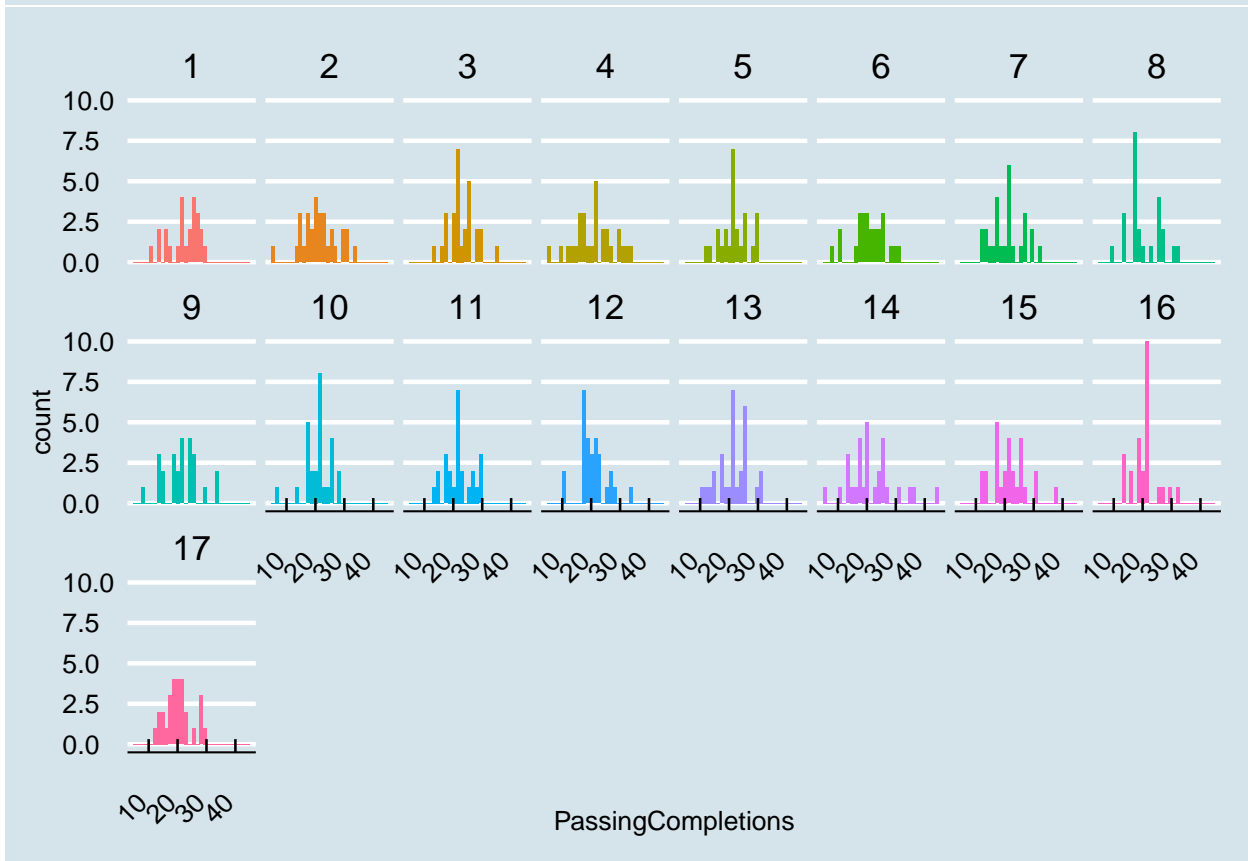
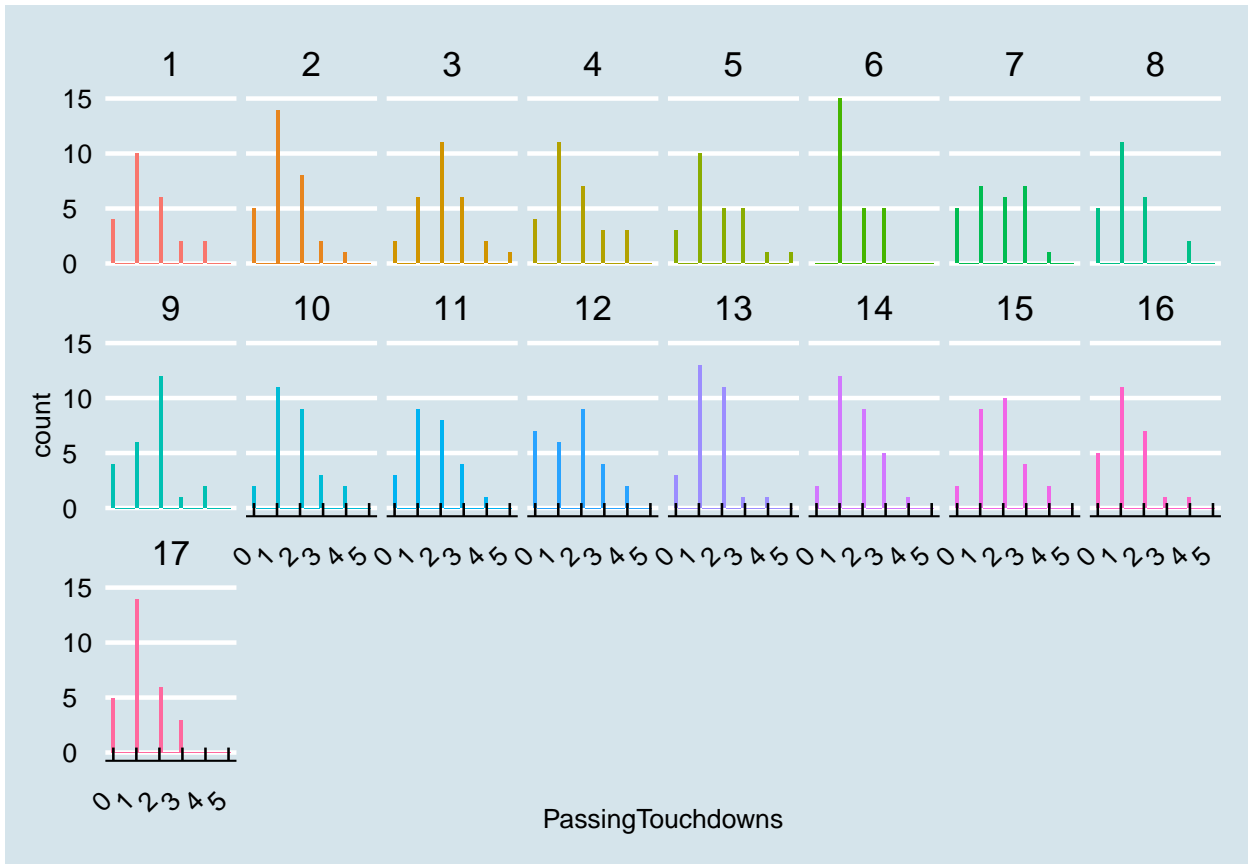
Check for skewed predictors

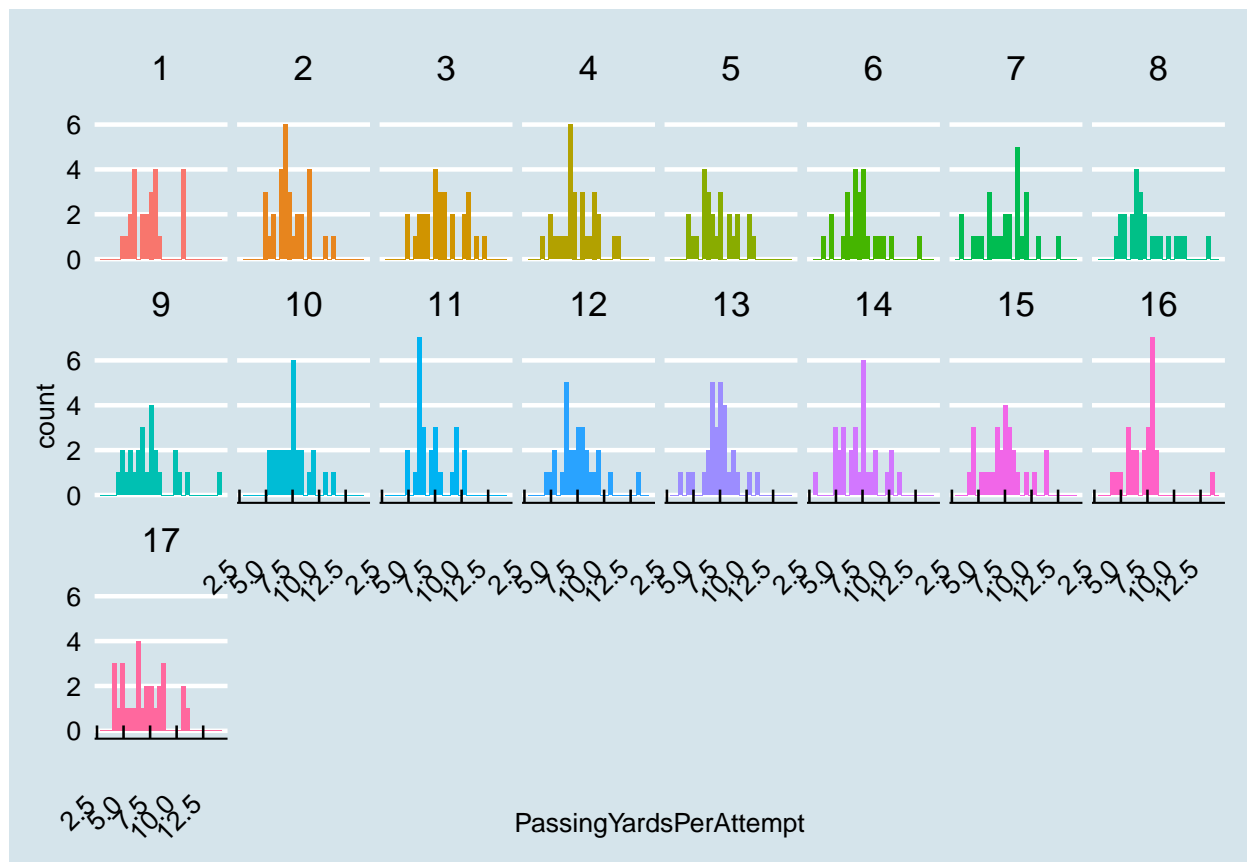
1.5.4 Histograms - Normality by Week

```
features_to_keep = c('PassingYards', 'PassingAttempts', 'PassingTouchdowns', 'PassingCompletions', 'PassingInterceptions')
for(f in features_to_keep){
  hist = QBCrossSectional %>% ggplot(aes_string(x=f))+
    geom_histogram(bins=30,aes(fill=Week),show.legend = FALSE)+
    facet_wrap(~Week,ncol=8)+theme_economist()+theme(axis.text.x = element_text(angle=45))

  print(hist)
}
```







1.6: Relationships

1.6.1 Relationship between FantasyPoints with all predictors and taking Opponent into consideration

Not sure that combining these is useful

```
attach(QBCrossSectional)
```

```
## The following objects are masked from QBCrossSectional (pos = 4):
```

```
##
```

```
## FantasyPoints, FumblesLost, GameDate, Opponent,
## PassingAttempts, PassingCompletionPercentage,
## PassingCompletions, PassingInterceptions, PassingRating,
## PassingTouchdowns, PassingYards, PassingYardsPerAttempt,
## PlayerID, Position, RushingAttempts, RushingTouchdowns,
## RushingYards, RushingYardsPerAttempt, Team, TeamIsHome, Week
```

```
## The following object is masked from package:ggplot2:
```

```
##
```

```
## Position
```

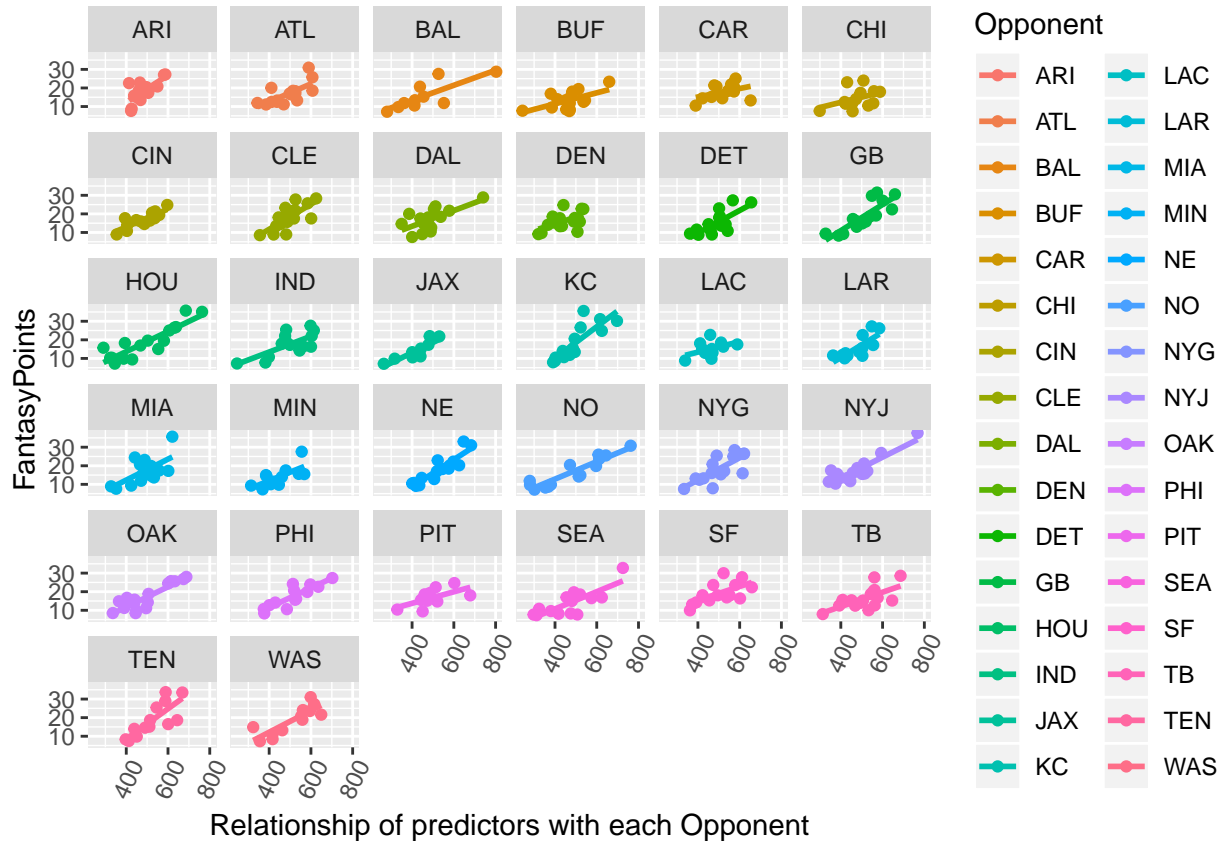
```
QBCrossSectional %>% ggplot(aes(y=FantasyPoints,x=PassingCompletions+PassingAttempts+
PassingCompletionPercentage+
PassingYards+PassingYardsPerAttempt+
PassingTouchdowns+PassingInterceptions+
PassingRating+RushingAttempts+RushingYards+
RushingYardsPerAttempt+RushingTouchdowns+FumblesLost,
```



```

color=Opponent))+
xlab("Relationship of predictors with each Opponent")+
geom_point()+
geom_smooth(method="lm",se=F)+
theme(axis.text.x = element_text(angle=65, vjust=0.6))+facet_wrap(~Opponent)

```



1.6.2 Relationship between FanatasyPoints with all predictors and taking Home turf into consideration

Same here....

```
attach(QBCrossSectional)
```

```

## The following objects are masked from QBCrossSectional (pos = 3):
##
## FantasyPoints, FumblesLost, GameDate, Opponent,
## PassingAttempts, PassingCompletionPercentage,
## PassingCompletions, PassingInterceptions, PassingRating,
## PassingTouchdowns, PassingYards, PassingYardsPerAttempt,
## PlayerID, Position, RushingAttempts, RushingTouchdowns,
## RushingYards, RushingYardsPerAttempt, Team, TeamIsHome, Week
## The following objects are masked from QBCrossSectional (pos = 5):
##
## FantasyPoints, FumblesLost, GameDate, Opponent,
## PassingAttempts, PassingCompletionPercentage,
## PassingCompletions, PassingInterceptions, PassingRating,
## PassingTouchdowns, PassingYards, PassingYardsPerAttempt,

```

```
## PlayerID, Position, RushingAttempts, RushingTouchdowns,
## RushingYards, RushingYardsPerAttempt, Team, TeamIsHome, Week

## The following object is masked from package:ggplot2:
##
## Position

QBCrossSectional %>% ggplot(aes(y=FantasyPoints,x=PassingCompletions+PassingAttempts+
                                PassingCompletionPercentage+
                                PassingYards+PassingYardsPerAttempt+
                                PassingTouchdowns+PassingInterceptions+
                                PassingRating+RushingAttempts+RushingYards+
                                RushingYardsPerAttempt+RushingTouchdowns+FumblesLost,
                                color=TeamIsHome))+

  geom_point()+
  geom_smooth(method="lm",se=F)+
  theme(axis.text.x = element_text(angle=65, vjust=0.6))+facet_wrap(~TeamIsHome)
```



1.6.3 Relationship between FanatasyPoints with all predictors per team

and here.....

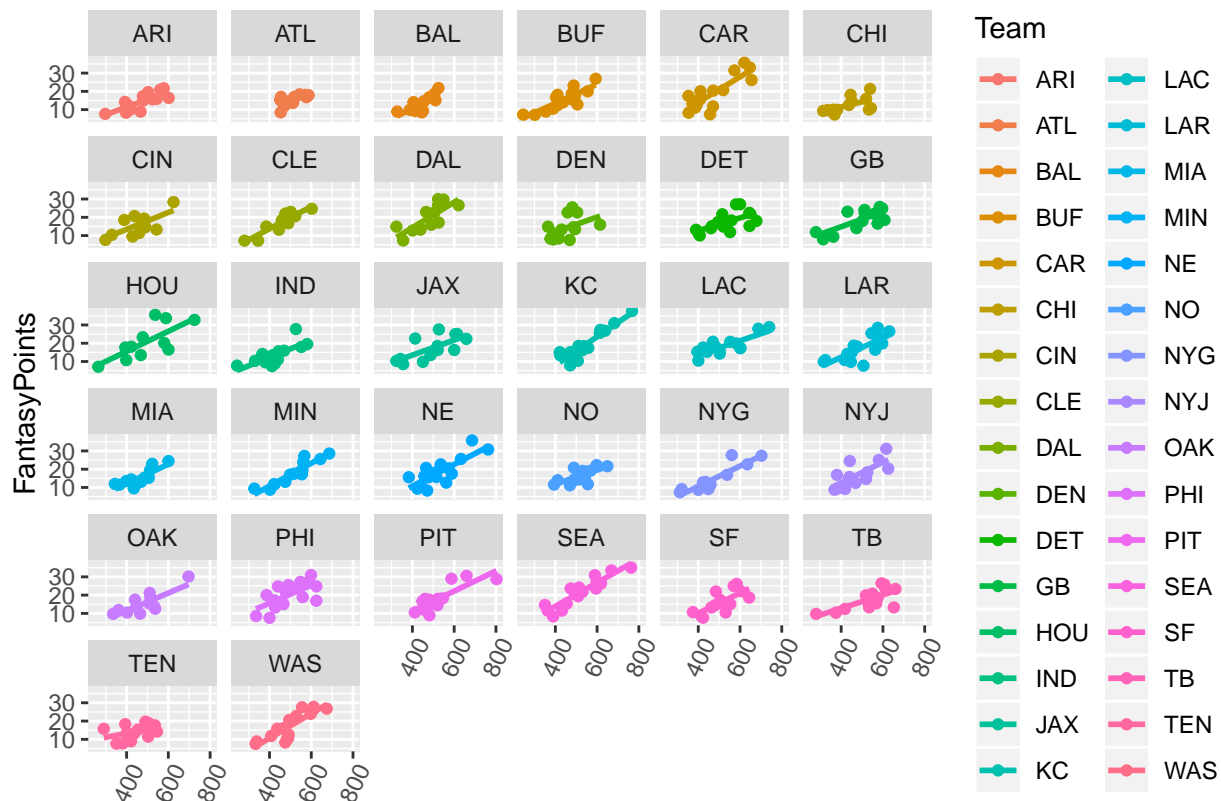
```
attach(QBCrossSectional)
```

```
## The following objects are masked from QBCrossSectional (pos = 3):
##
## FantasyPoints, FumblesLost, GameDate, Opponent,
## PassingAttempts, PassingCompletionPercentage,
## PassingCompletions, PassingInterceptions, PassingRating,
```

```

##      PassingTouchdowns, PassingYards, PassingYardsPerAttempt,
##      PlayerID, Position, RushingAttempts, RushingTouchdowns,
##      RushingYards, RushingYardsPerAttempt, Team, TeamIsHome, Week
## The following objects are masked from QBCrossSectional (pos = 4):
##
##      FantasyPoints, FumblesLost, GameDate, Opponent,
##      PassingAttempts, PassingCompletionPercentage,
##      PassingCompletions, PassingInterceptions, PassingRating,
##      PassingTouchdowns, PassingYards, PassingYardsPerAttempt,
##      PlayerID, Position, RushingAttempts, RushingTouchdowns,
##      RushingYards, RushingYardsPerAttempt, Team, TeamIsHome, Week
## The following objects are masked from QBCrossSectional (pos = 6):
##
##      FantasyPoints, FumblesLost, GameDate, Opponent,
##      PassingAttempts, PassingCompletionPercentage,
##      PassingCompletions, PassingInterceptions, PassingRating,
##      PassingTouchdowns, PassingYards, PassingYardsPerAttempt,
##      PlayerID, Position, RushingAttempts, RushingTouchdowns,
##      RushingYards, RushingYardsPerAttempt, Team, TeamIsHome, Week
## The following object is masked from package:ggplot2:
##
##      Position
QBCrossSectional %>% ggplot(aes(y=FantasyPoints,x=PassingCompletions+PassingAttempts+
                                PassingCompletionPercentage+
                                PassingYards+PassingYardsPerAttempt+
                                PassingTouchdowns+PassingInterceptions+
                                PassingRating+RushingAttempts+
                                RushingYards+RushingYardsPerAttempt+
                                RushingTouchdowns+FumblesLost,color=Team)) +
  geom_point()+
  geom_smooth(method="lm",se=F)+
  theme(axis.text.x = element_text(angle=65, vjust=0.6))+facet_wrap(~Team)

```

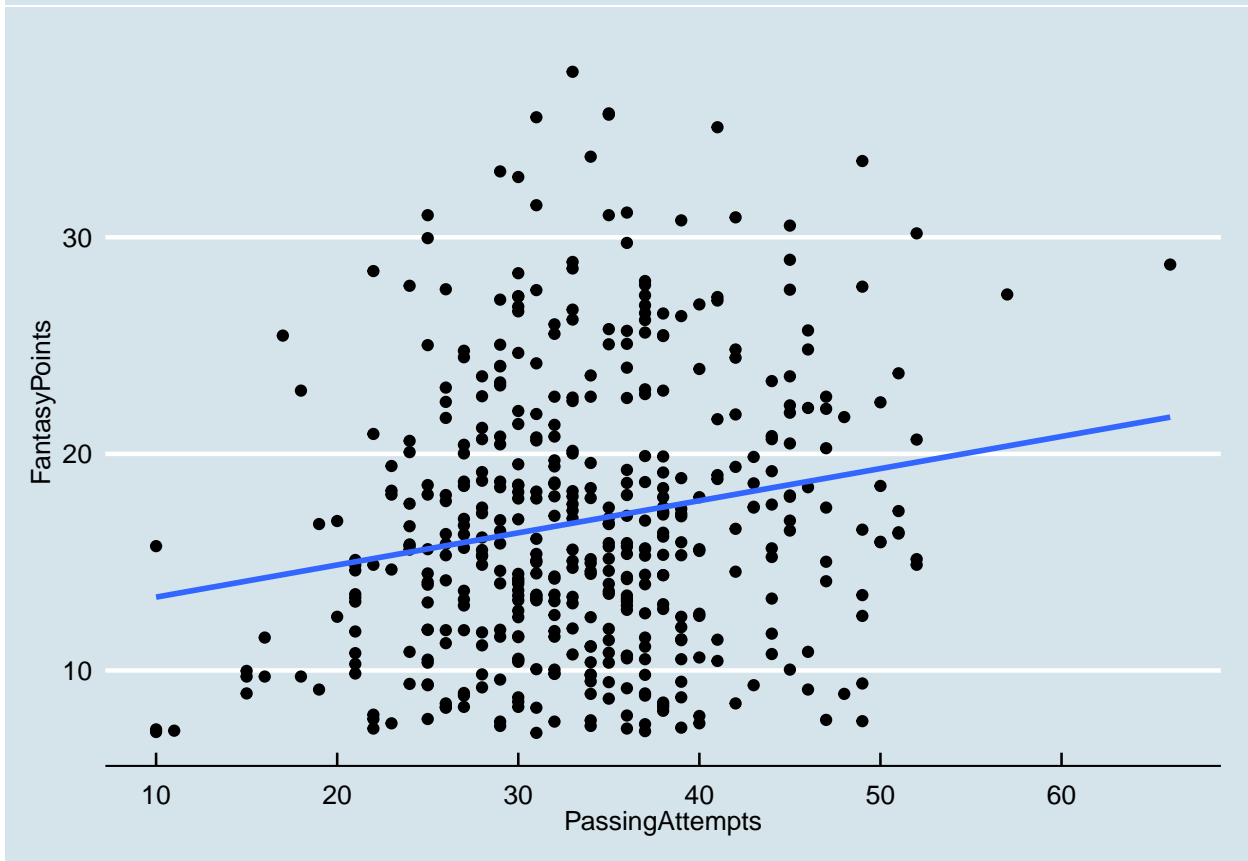
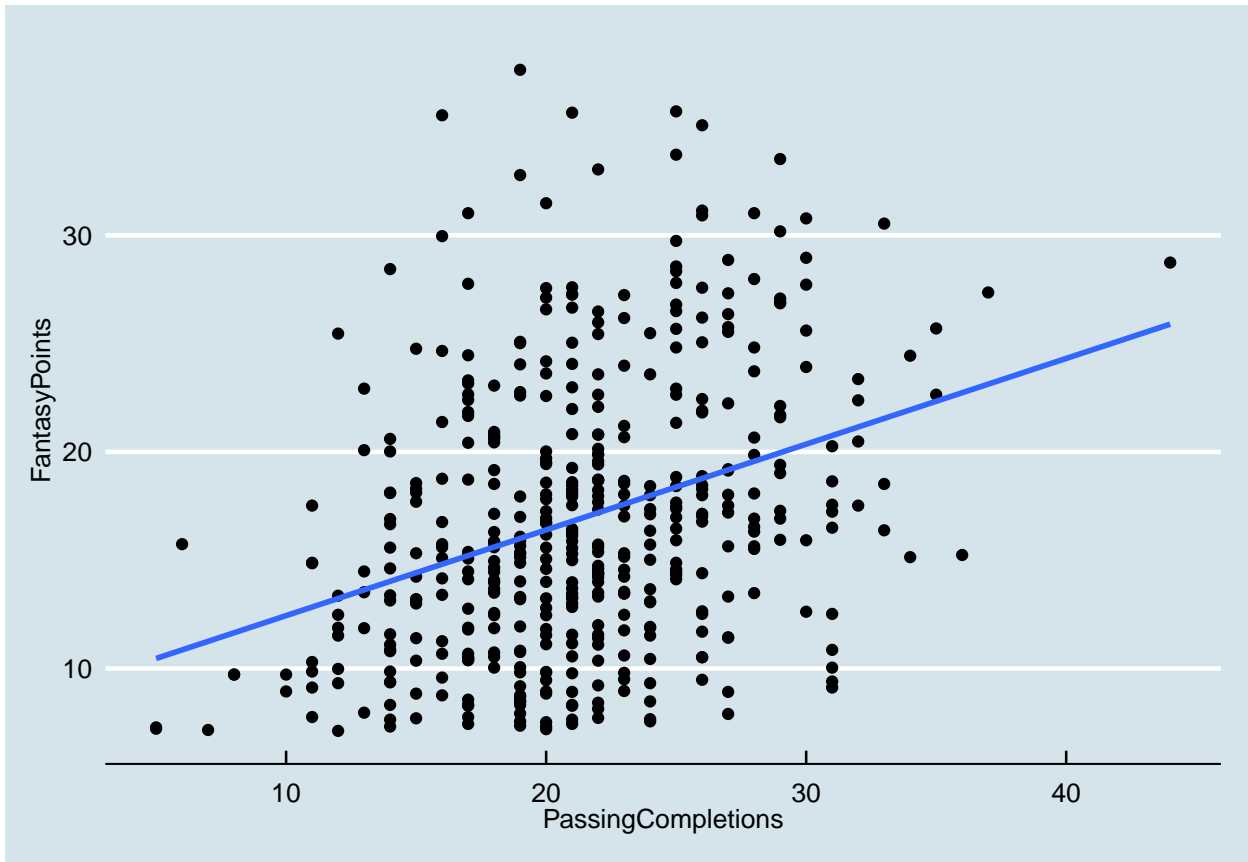


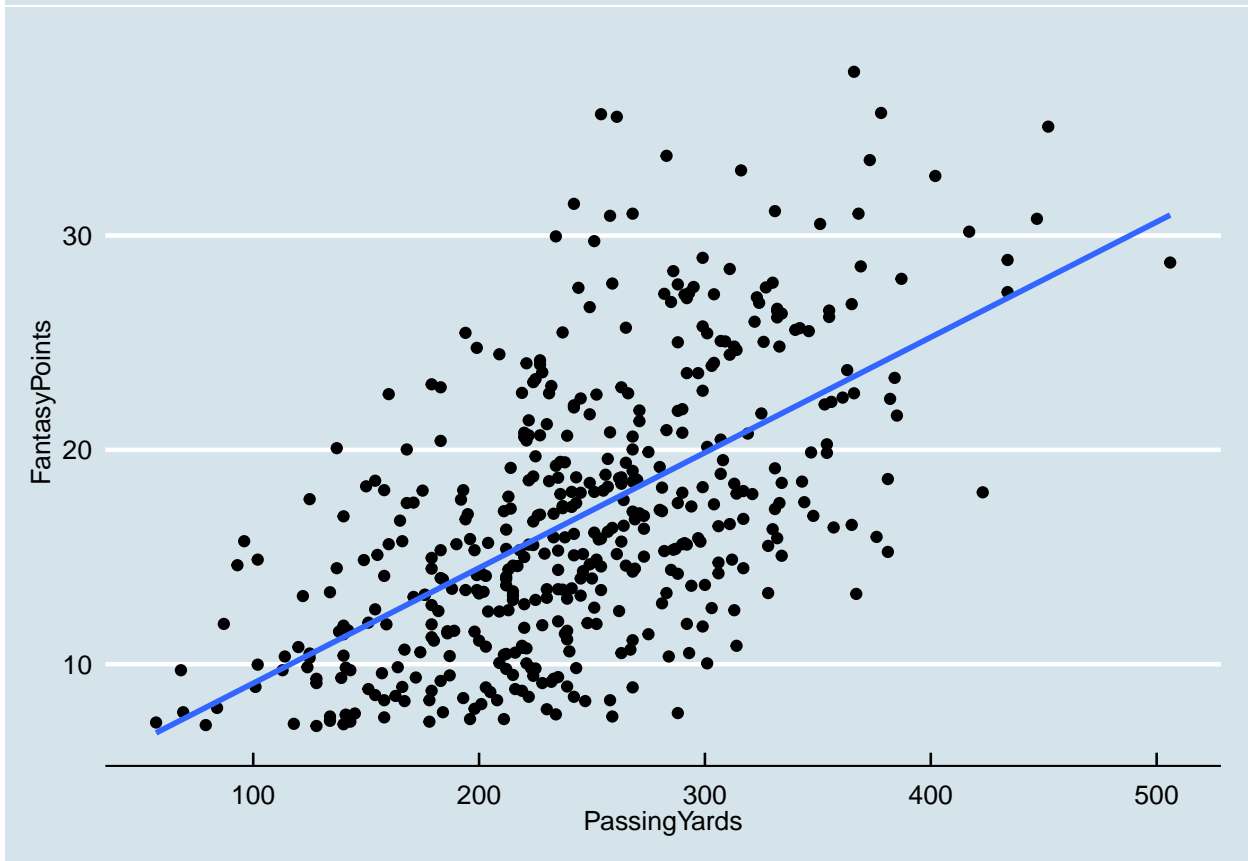
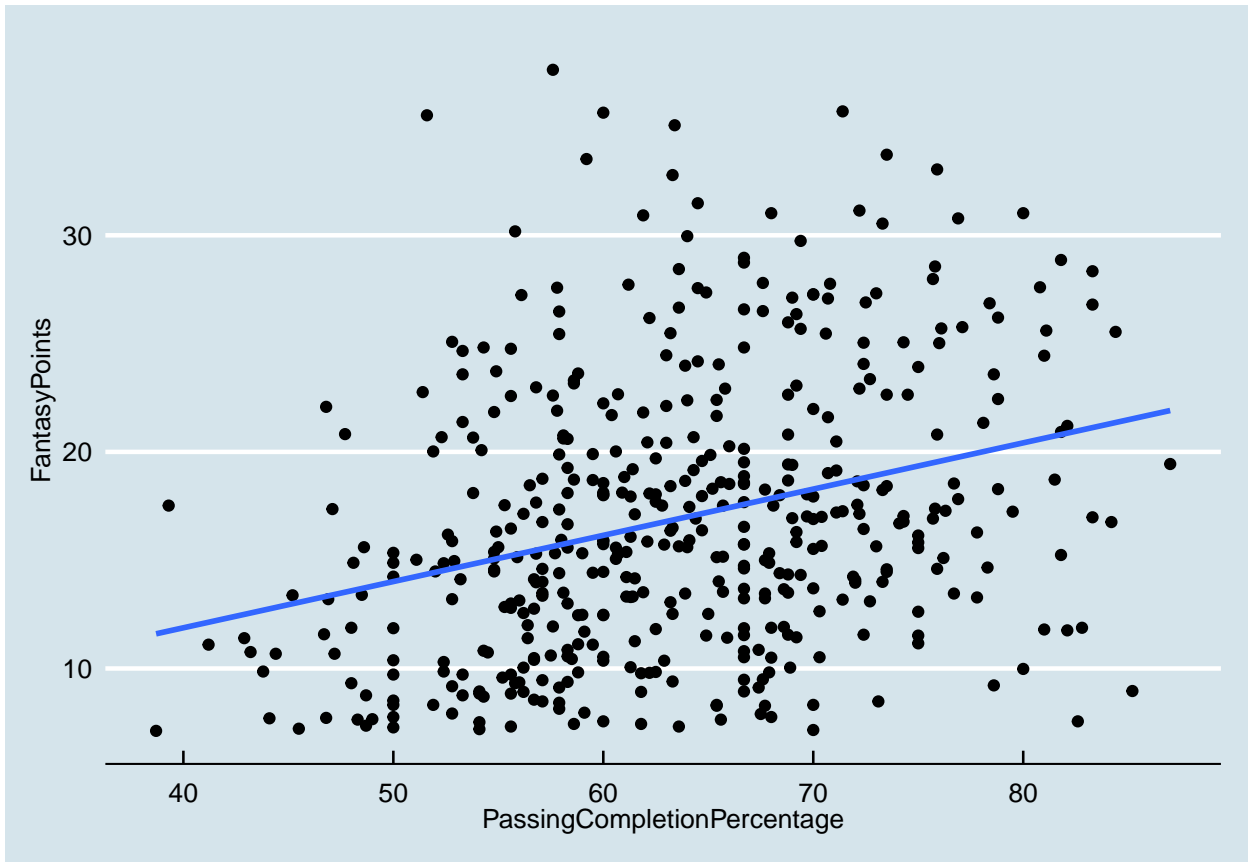
PassingCompletions + PassingAttempts + PassingCompletionPercentage + ...

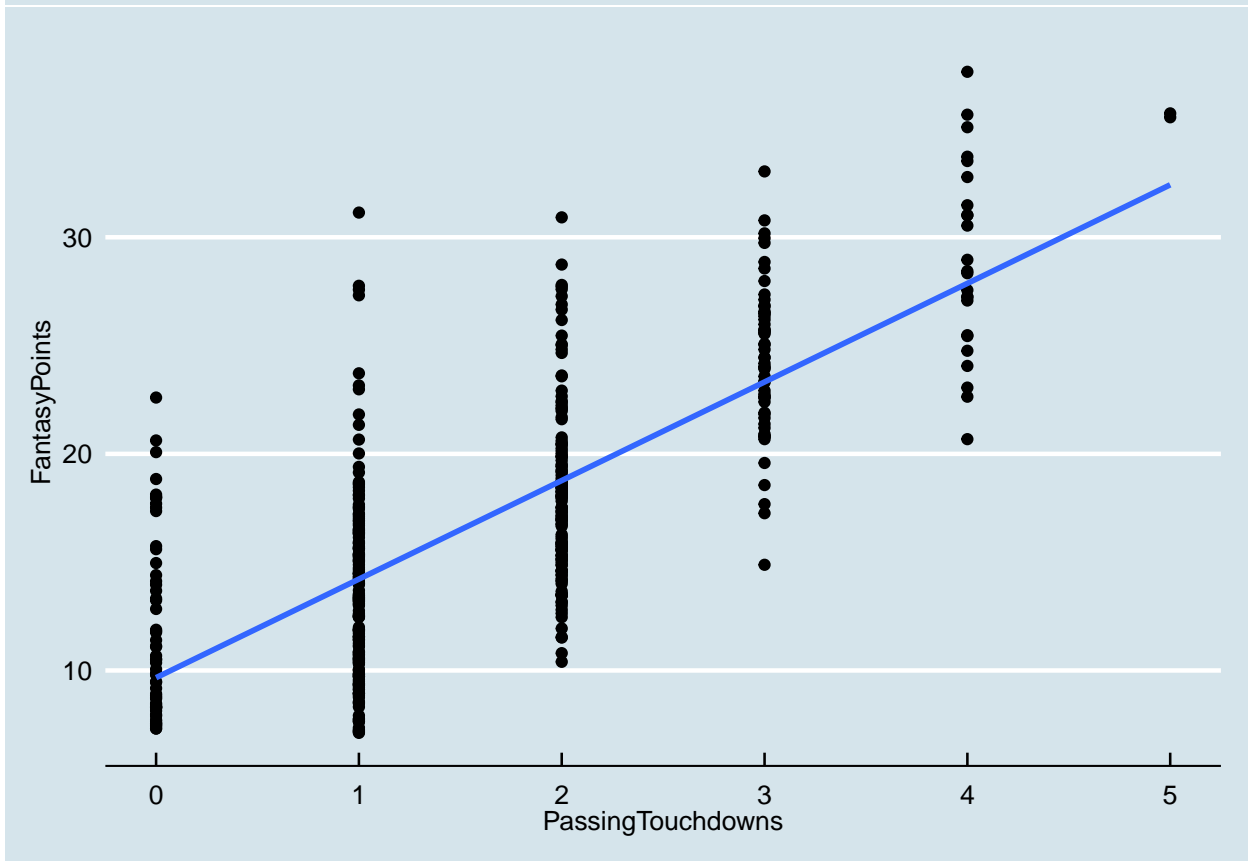
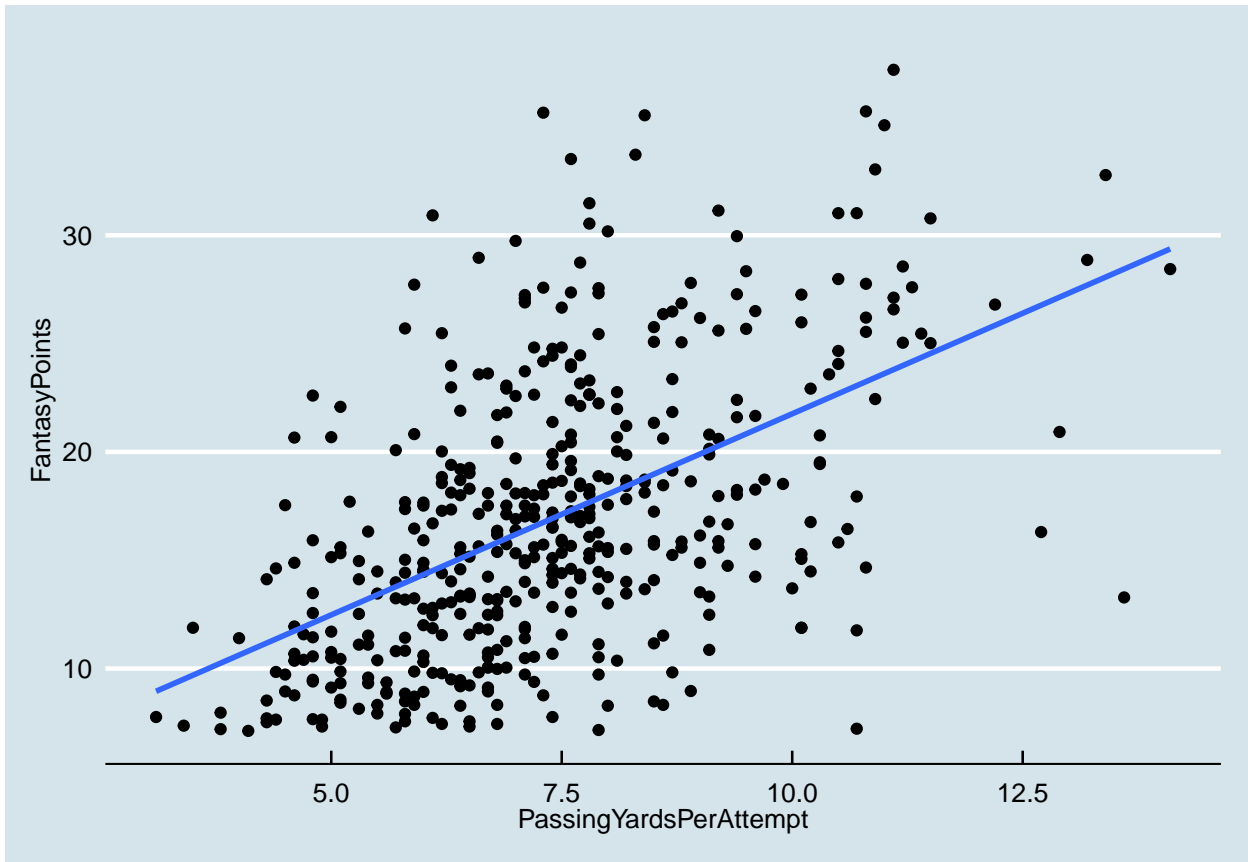
1.6.4 Relationship between FantasyPoints and Individual predictors

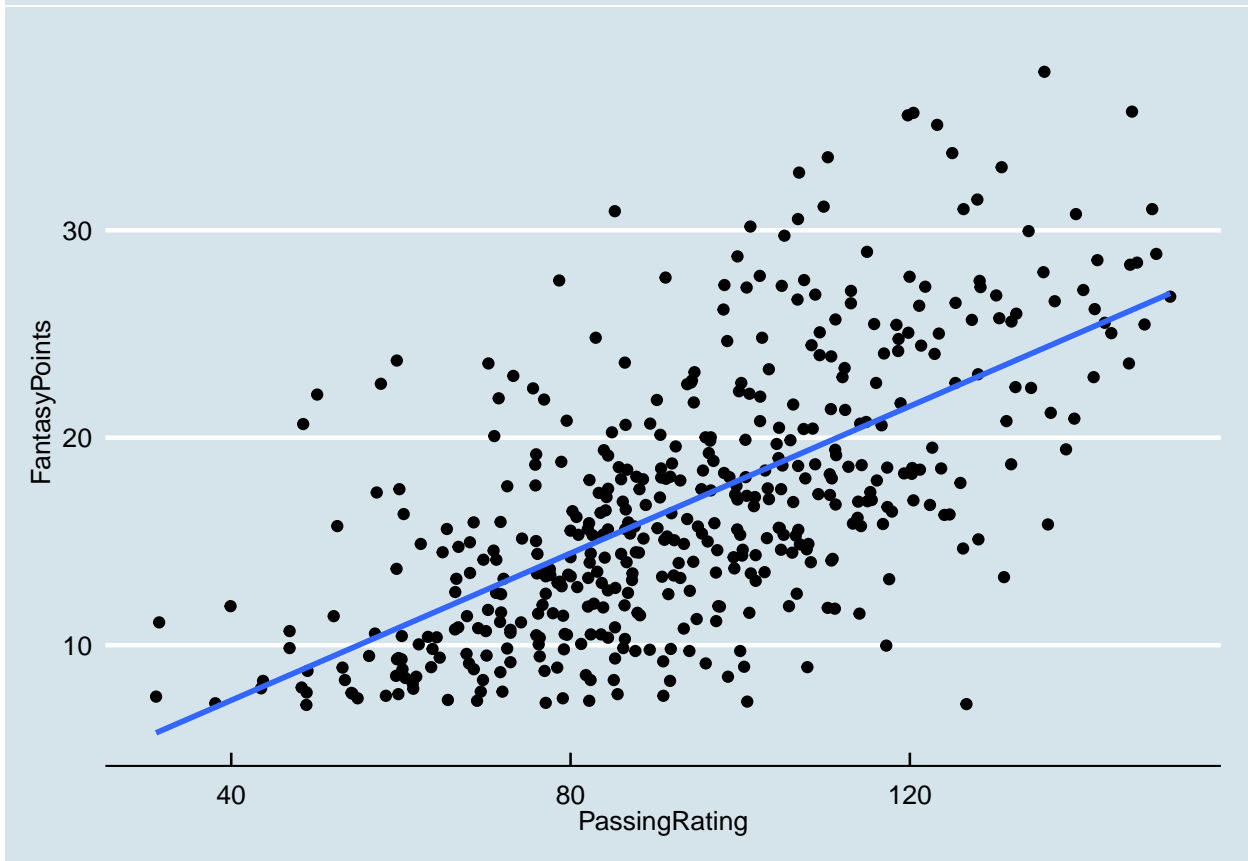
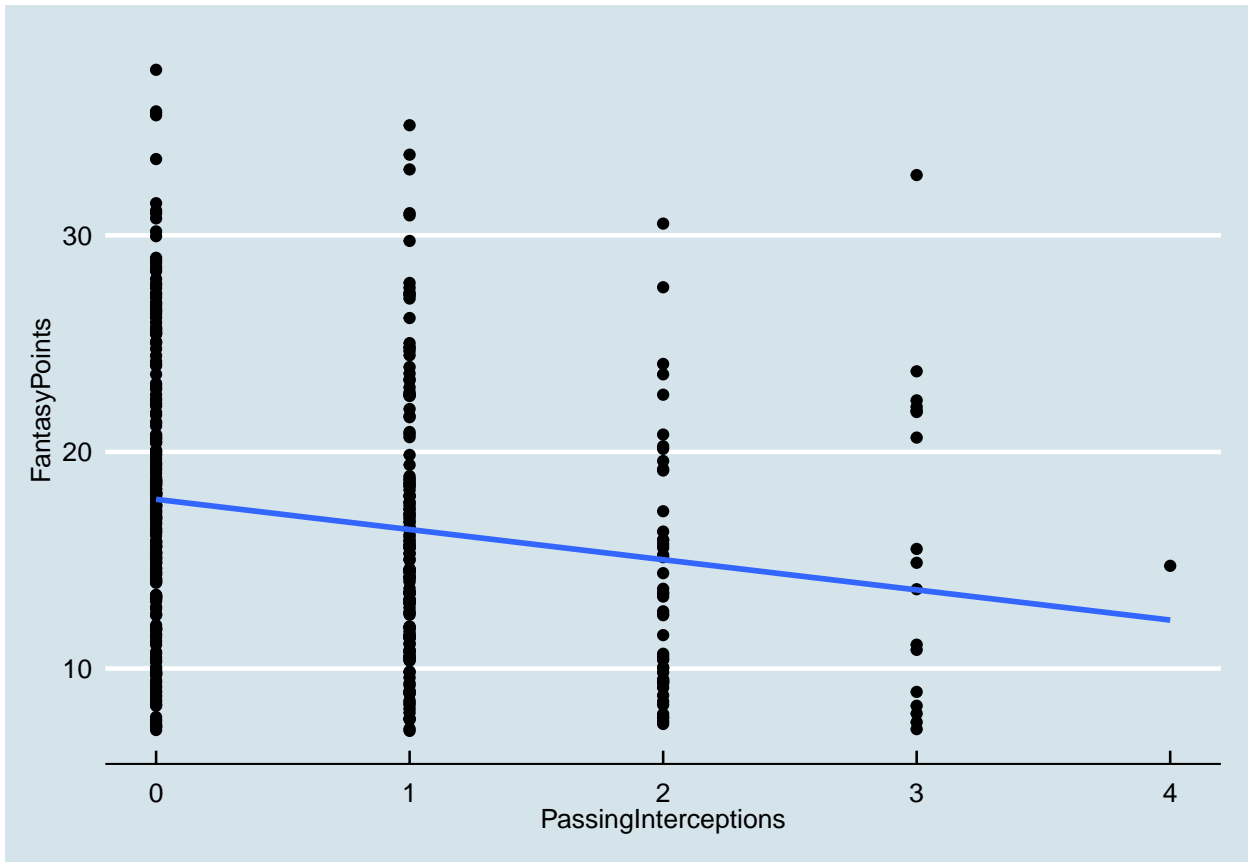
This makes sense - but we are actually trying to capture what the NEXT value for fantasy points is like. week since the fantasy score is a linear combination of the predictors for any given week. We need to sl

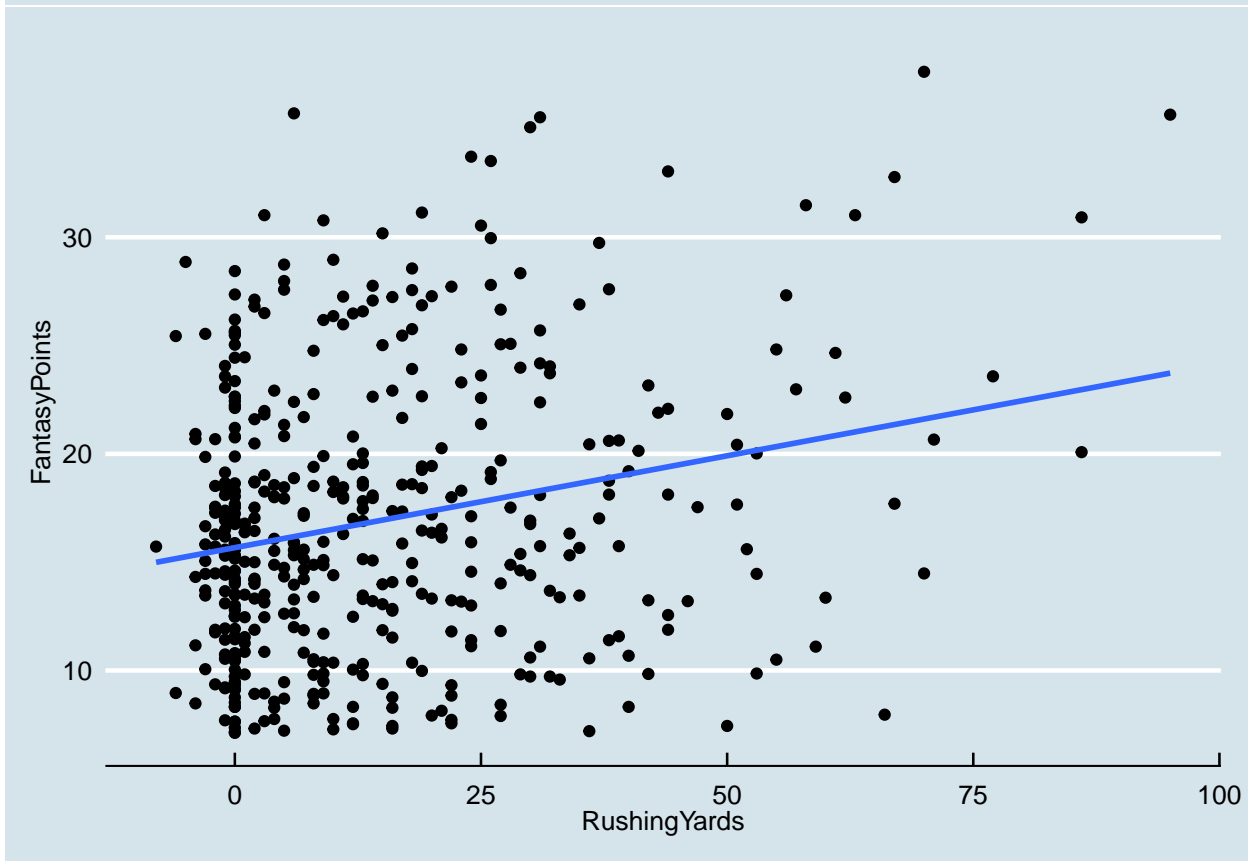
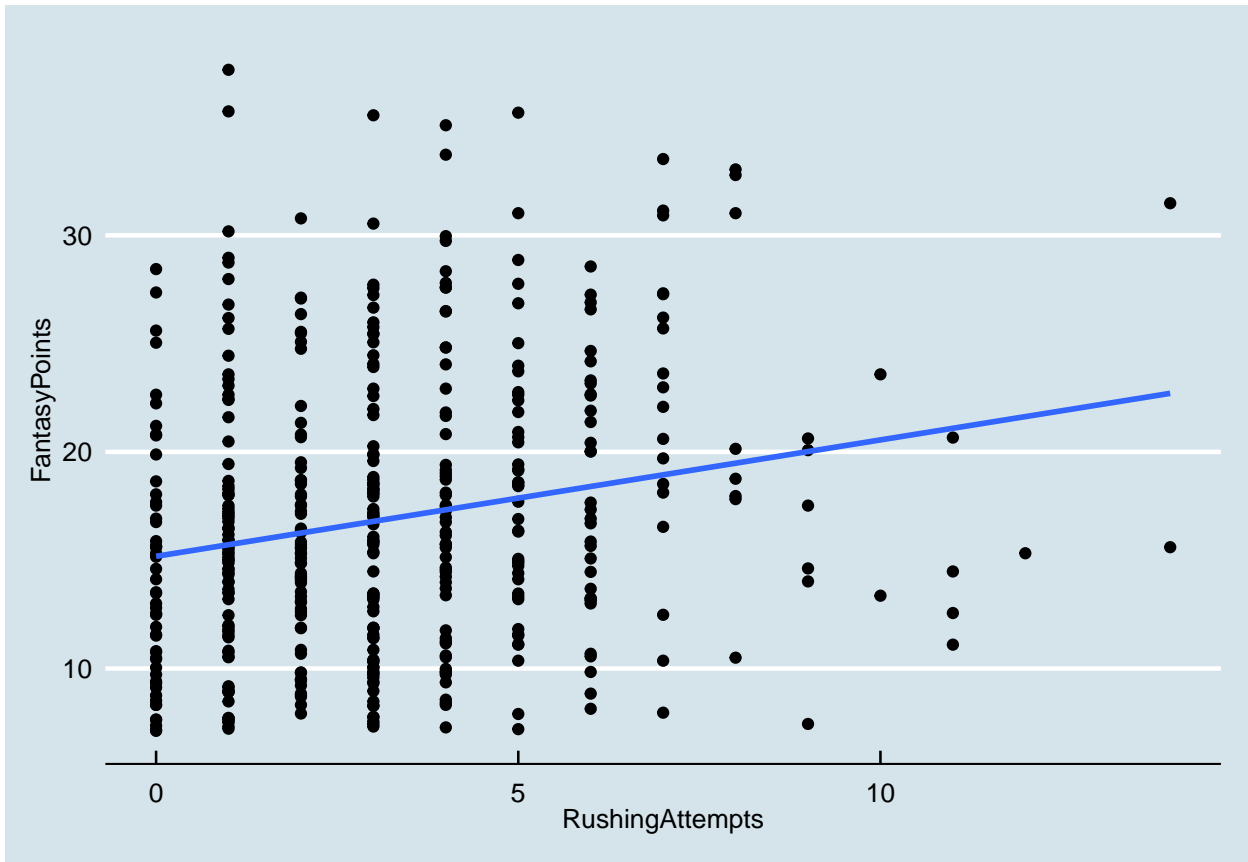
```
for (i in 7:19) {
  linear_plot <- QBCrossSectional %>%
    ggplot(aes_string(y="FantasyPoints",x=names(QBCrossSectional[i]))) +
    geom_point()+geom_smooth(method="lm",se=F)+
    theme(axis.text.x = element_text(angle=65, vjust=0.6))+
    theme_economist()
  print(linear_plot)
}
```

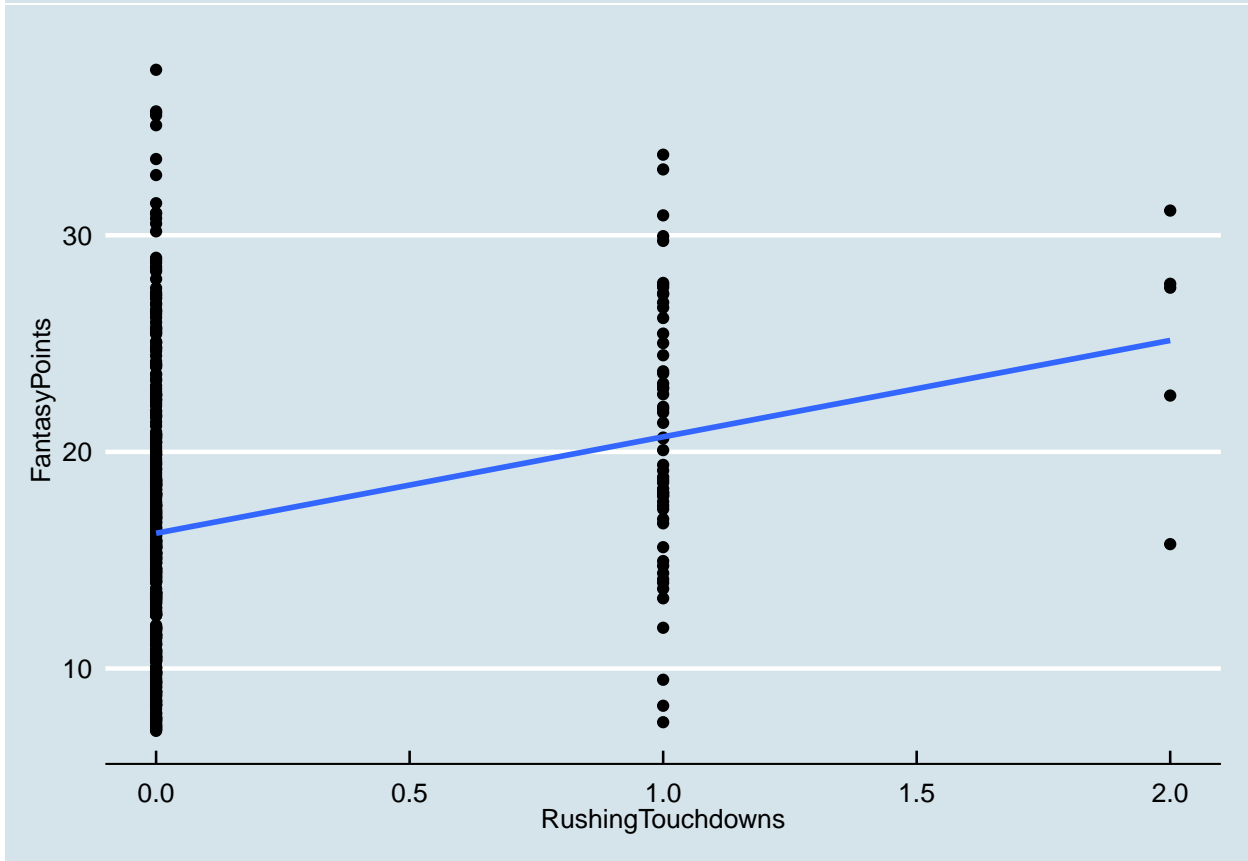
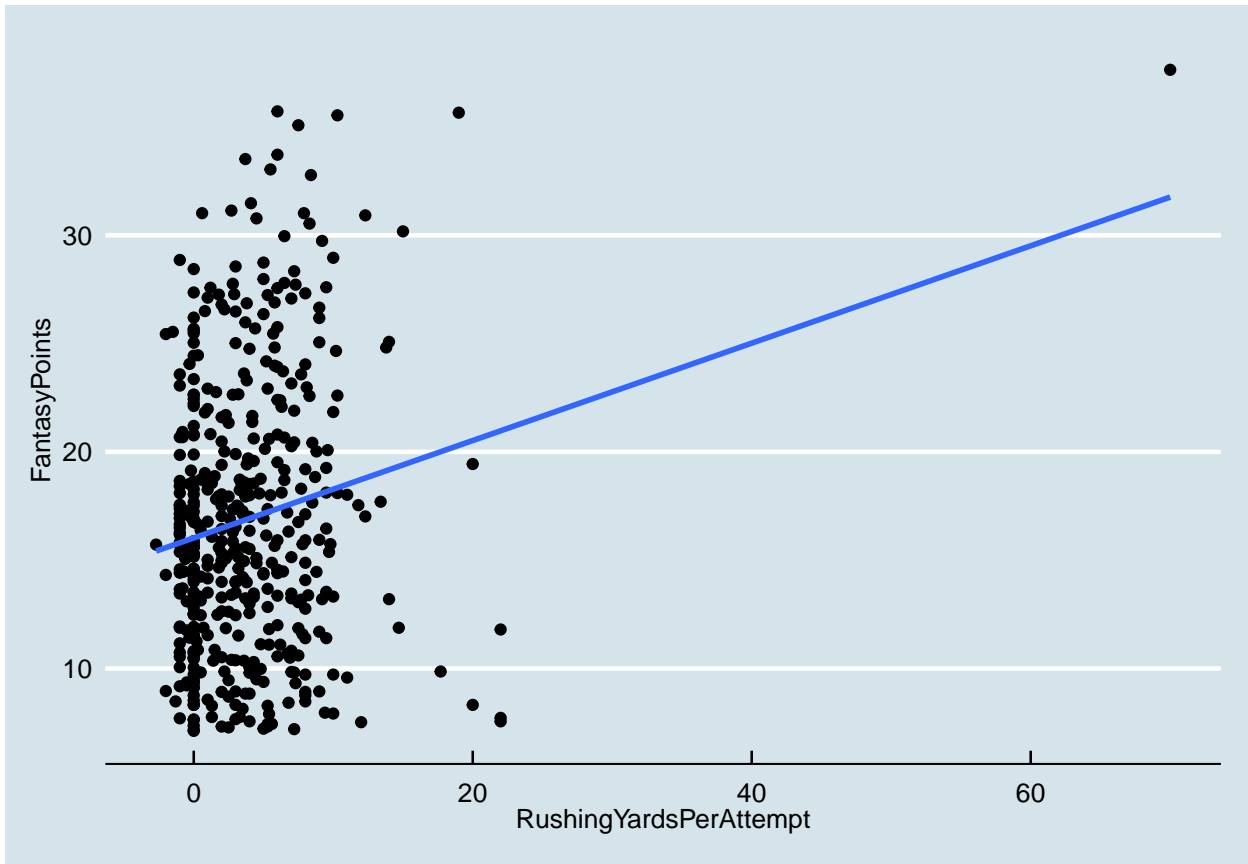


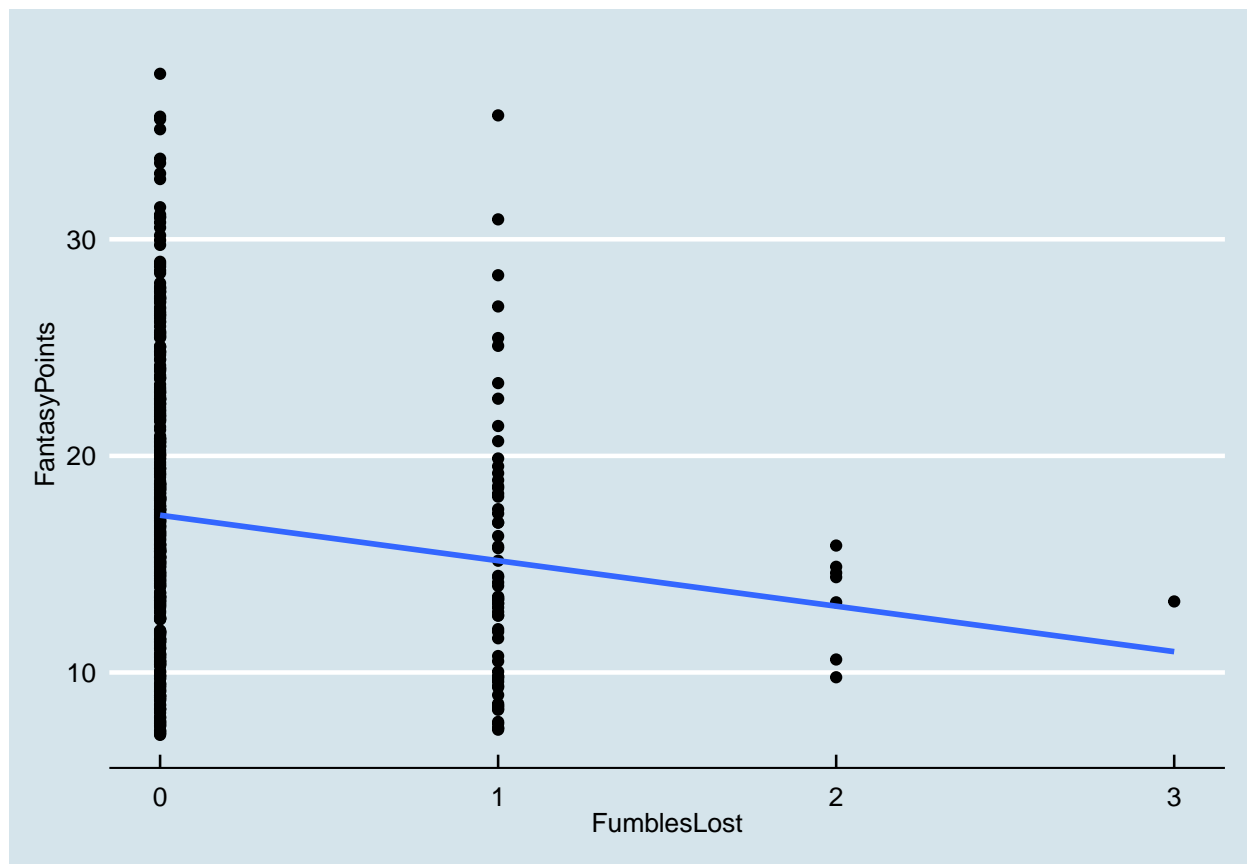












Drop rushing yards per attempt

1.7 Defensive stats

1.7.1 Player Defensive Stats

```
defensive_positions = getFootballData("https://fantasydata.com/FantasyStatsNFL/FantasyStats_Read?sort=F")
defensive_positions$StatSummary = c(NULL)
```

1.7.2 Team Defensive Stats

```
team_defense = getFootballData("https://fantasydata.com/FantasyStatsNFL/FantasyStats_Read?sort=FantasyP")
team_defense$StatSummary = c(NULL)
```

Defensive Players and team defense by week

```
defensive_players_by_week = sqldf("SELECT
    Week,
    FantasyPosition,
    Count(*)
FROM defensive_positions
GROUP BY Week, FantasyPosition")

team_defense_by_week = sqldf("SELECT
```

```

        Week,
        FantasyPosition,
        Count(*)
FROM team_defense
GROUP BY Week, FantasyPosition")

# this looks good some teams are on bye in certain weeks

```

Do some averages for Defense before stitching on to QB data

```

defensive_columns = c('Team', 'Week', 'TacklesForLoss', 'Sacks', 'QuarterbackHits', 'Interceptions', 'FantasyPoints')

team_defense = team_defense %>% select(defensive_columns) %>% rename('DefensiveFantasyPoints'='FantasyPoints')
mutate(WeeklyRank = dense_rank(DefensiveFantasyPoints))
# mutate(PlayerName = paste(FirstName, " ", LastName))
attach(team_defense)

```

```
## The following objects are masked from QBCrossSectional (pos = 3):
```

```
##
```

```
## Team, Week
```

```
## The following objects are masked from QBCrossSectional (pos = 4):
```

```
##
```

```
## Team, Week
```

```
## The following objects are masked from QBCrossSectional (pos = 5):
```

```
##
```

```
## Team, Week
```

```
## The following objects are masked from QBCrossSectional (pos = 7):
```

```
##
```

```
## Team, Week
```

```
team_defense$Week = as.factor(team_defense$Week)
```

```
sqldf("SELECT Week, Team, WeeklyRank FROM team_defense WHERE Week IN(1, 2) ORDER BY Team, Week")
```

```

##      Week Team WeeklyRank
## 1      1  ARI           8
## 2      2  ARI          12
## 3      1  ATL           6
## 4      2  ATL          14
## 5      1  BAL          14
## 6      2  BAL          15
## 7      1  BUF           9
## 8      2  BUF          12
## 9      1  CAR          11
## 10     2  CAR          12
## 11     1  CHI           3
## 12     2  CHI           6
## 13     1  CIN           5
## 14     2  CIN           9
## 15     1  CLE           4
## 16     2  CLE           8
## 17     1  DAL          10

```

## 18	2	DAL	4
## 19	1	DEN	4
## 20	2	DEN	14
## 21	1	DET	12
## 22	2	DET	15
## 23	1	GB	9
## 24	2	GB	4
## 25	1	HOU	1
## 26	2	HOU	11
## 27	1	IND	3
## 28	2	IND	9
## 29	1	JAX	15
## 30	2	JAX	3
## 31	1	KC	4
## 32	2	KC	13
## 33	1	LAC	8
## 34	2	LAC	5
## 35	1	LAR	15
## 36	2	LAR	4
## 37	2	MIA	4
## 38	1	MIN	3
## 39	2	MIN	4
## 40	1	NE	2
## 41	2	NE	4
## 42	1	NO	1
## 43	2	NO	2
## 44	1	NYG	3
## 45	2	NYG	7
## 46	1	NYJ	5
## 47	2	NYJ	1
## 48	1	OAK	3
## 49	2	OAK	11
## 50	1	PHI	13
## 51	2	PHI	6
## 52	1	PIT	12
## 53	2	PIT	10
## 54	1	SEA	7
## 55	2	SEA	10
## 56	1	SF	5
## 57	2	SF	9
## 58	2	TB	16
## 59	1	TEN	3
## 60	2	TEN	11
## 61	1	WAS	10
## 62	2	WAS	9

Add defensive matchups

```
QBCrossSectionalDefensiveOverlay = QBCrossSectional %>% left_join(team_defense, by = c('Week'='Week', 'U
```

1.7.3 Add some lag data for QB

CumulativeVariables (these should definitely be combined into a weekly ranking)

```
#Should we just train on second half of 2017?
QBCrossSectionalDefensiveOverlayCumulativePassYards = QBCrossSectionalDefensiveOverlay %>% group_by(Play
  , CumulativeAveragePassingTouchdowns=cummean(PassingTouchdowns)
  , CumulativeAverageCompletions = cummean(PassingCompletions) # not sure that completions matter
  , CumulativeMaxPassingTouchdowns = cummax(PassingTouchdowns)
  , CumulativeMaxPassingYards = cummax(PassingYards)
  , CumulativeMaxPassingAttempts = cummax(PassingAttempts)
  , CumulativeMaxPassingRating = cummax(PassingRating)
  , CumulativeMaxCompletions = cummax(PassingCompletions)
  , CumulativeMaxPassYardsPerAttempt = cummax(PassingYardsPerAttempt)
  , CumulativeMinPassingTouchdowns = cummin(PassingTouchdowns)
  , CumulativeMinPassingYards = cummin(PassingYards) #Let's get mins to capture downside risk
  , CumulativeMinPassingAttempts = cummin(PassingAttempts)
  , CumulativeMinPassingRating = cummin(PassingRating)
  , CumulativeMinCompletions = cummin(PassingCompletions)
  , CumulativeMinPassYardsPerAttempt = cummin(PassingYardsPerAttempt)
  , LastWeekQuarterBackRating = lag(PassingRating)
  , LastWeekQuarterPassingYards = lag(PassingYards)
  , LastWeekQuarterPassingTouchdowns = lag(PassingTouchdowns)
  , NextWeekFantasyPoints = lead(FantasyPoints) #Target Variable
)

QBCrossSectionalDefensiveOverlayCumulativePassYards %>% filter(PlayerID == 6739) %>% write.csv('alex_sm
final_ds <- QBCrossSectionalDefensiveOverlayCumulativePassYards
attach(QBCrossSectionalDefensiveOverlayCumulativePassYards)

## The following objects are masked from team_defense:
##
##   AssistedTackles, DefensiveFantasyPoints, DefensiveTouchdowns,
##   FumblesForced, FumblesRecovered, Interceptions,
##   PassesDefended, PointsAllowedByDefenseSpecialTeams,
##   QuarterbackHits, Sacks, SackYards, Safeties, SoloTackles,
##   TacklesForLoss, Team, Week, WeeklyRank

## The following objects are masked from QBCrossSectional (pos = 4):
##
##   FantasyPoints, FumblesLost, GameDate, Opponent,
##   PassingAttempts, PassingCompletionPercentage,
##   PassingCompletions, PassingInterceptions, PassingRating,
##   PassingTouchdowns, PassingYards, PassingYardsPerAttempt,
##   PlayerID, Position, RushingAttempts, RushingTouchdowns,
##   RushingYards, RushingYardsPerAttempt, Team, TeamIsHome, Week

## The following objects are masked from QBCrossSectional (pos = 5):
##
##   FantasyPoints, FumblesLost, GameDate, Opponent,
##   PassingAttempts, PassingCompletionPercentage,
##   PassingCompletions, PassingInterceptions, PassingRating,
##   PassingTouchdowns, PassingYards, PassingYardsPerAttempt,
##   PlayerID, Position, RushingAttempts, RushingTouchdowns,
##   RushingYards, RushingYardsPerAttempt, Team, TeamIsHome, Week
```

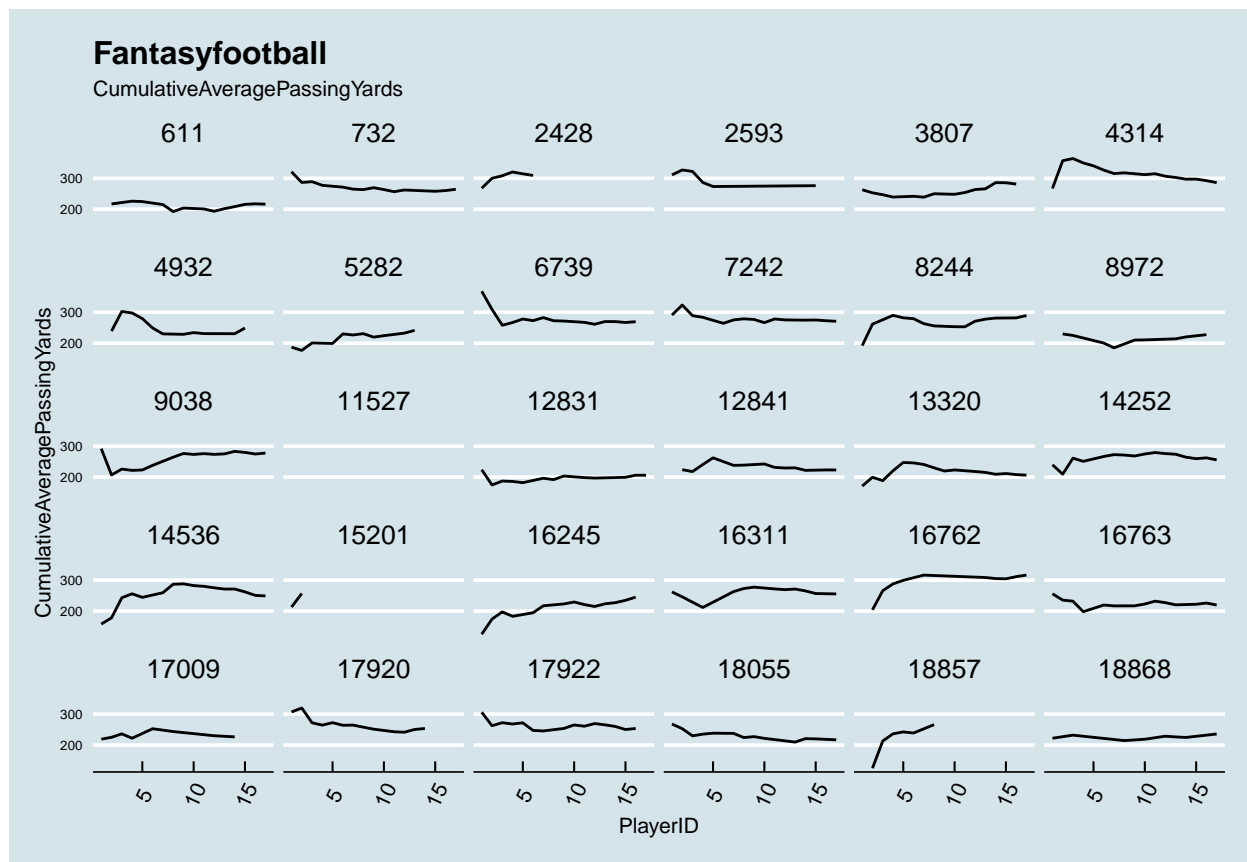
```
## The following objects are masked from QBCrossSectional (pos = 6):
##
##   FantasyPoints, FumblesLost, GameDate, Opponent,
##   PassingAttempts, PassingCompletionPercentage,
##   PassingCompletions, PassingInterceptions, PassingRating,
##   PassingTouchdowns, PassingYards, PassingYardsPerAttempt,
##   PlayerID, Position, RushingAttempts, RushingTouchdowns,
##   RushingYards, RushingYardsPerAttempt, Team, TeamIsHome, Week
## The following objects are masked from QBCrossSectional (pos = 8):
##
##   FantasyPoints, FumblesLost, GameDate, Opponent,
##   PassingAttempts, PassingCompletionPercentage,
##   PassingCompletions, PassingInterceptions, PassingRating,
##   PassingTouchdowns, PassingYards, PassingYardsPerAttempt,
##   PlayerID, Position, RushingAttempts, RushingTouchdowns,
##   RushingYards, RushingYardsPerAttempt, Team, TeamIsHome, Week
## The following object is masked from package:ggplot2:
##
##   Position
```

1.7.4 Individuals Line plots for cumulative averages by week

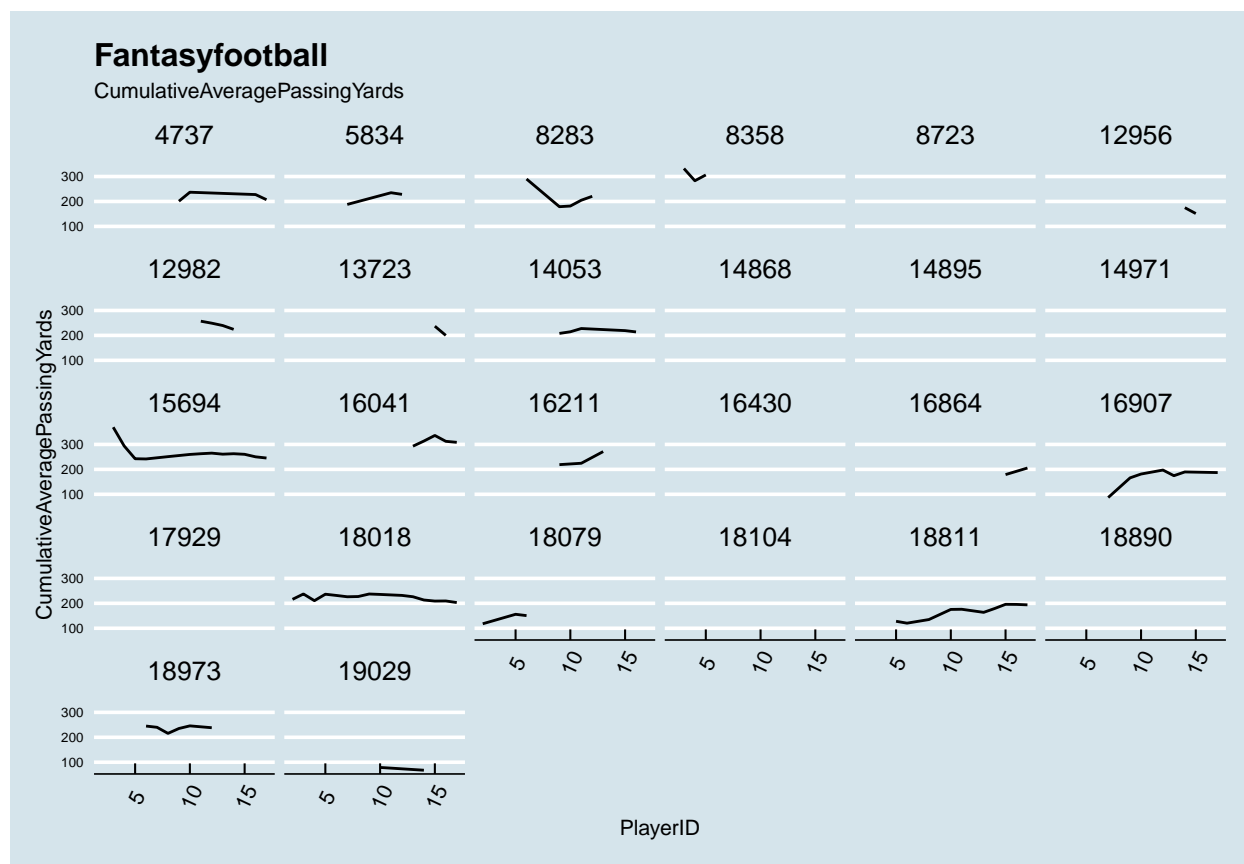
```
for(p in 37:51){
  #print(paste("violin plots for ",names(players_ds[p])))
  for (player in seq(1,length(unique(final_ds$PlayerID)),by=30)){
    a_size <- player + 29
    players_ds <- final_ds %>% filter(PlayerID %in% unique(final_ds$PlayerID)[player:a_size])

    line_plot <- players_ds %>%
      ggplot(aes_string(x="as.numeric(Week)",y=names(players_ds[p])))+
      ggtitle(names(players_ds[p]))+
      geom_line(show.legend = FALSE)+
        xlab("PlayerID")+
        ylab(names(players_ds[p]))+
        labs(title="Fantasyfootball",
             subtitle=names(players_ds[p]),
             caption="Source: Fantasyfootball")+
      theme_economist(base_size=8)+theme(axis.text.y = element_text(size=5))+
      theme(axis.text.x = element_text(angle=65, vjust=0.6))+facet_wrap(~PlayerID)
    suppressWarnings(print(line_plot))
  }
}
```

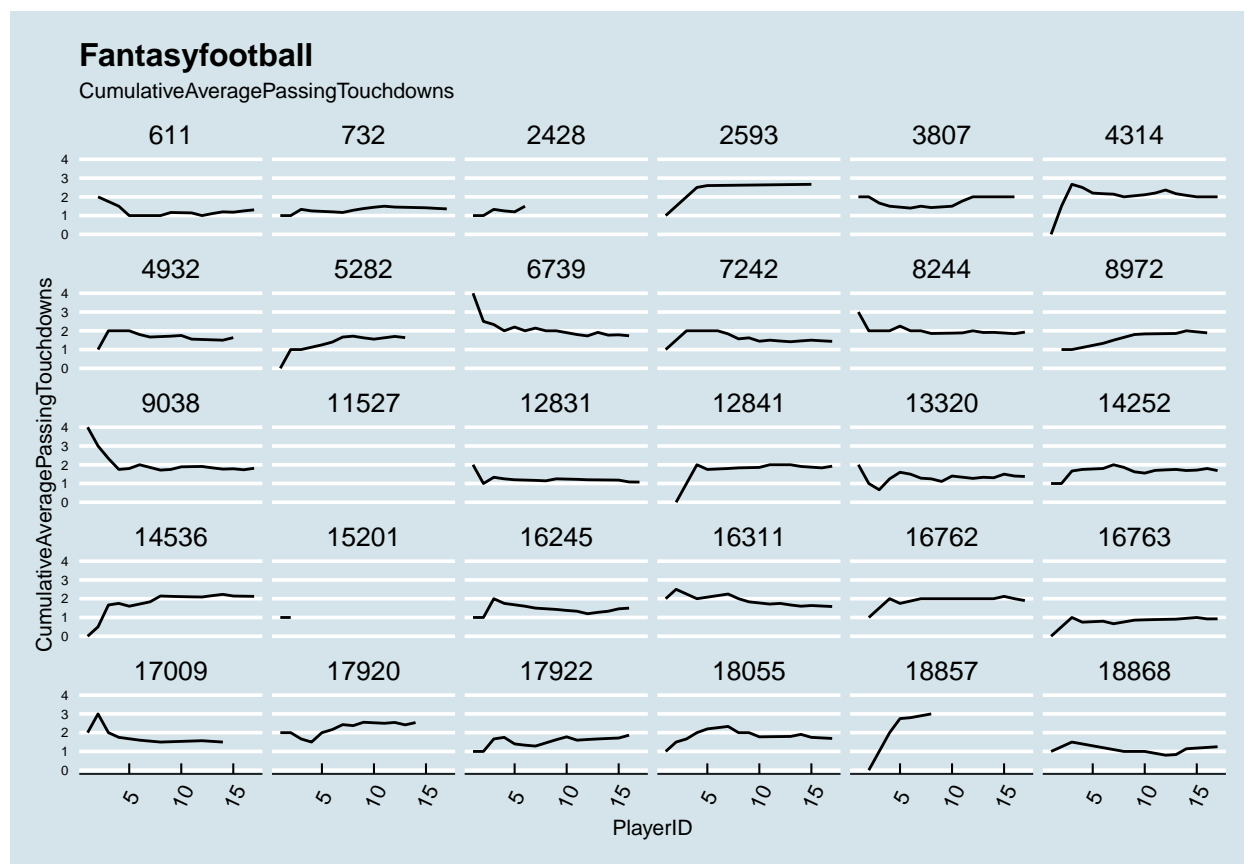
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



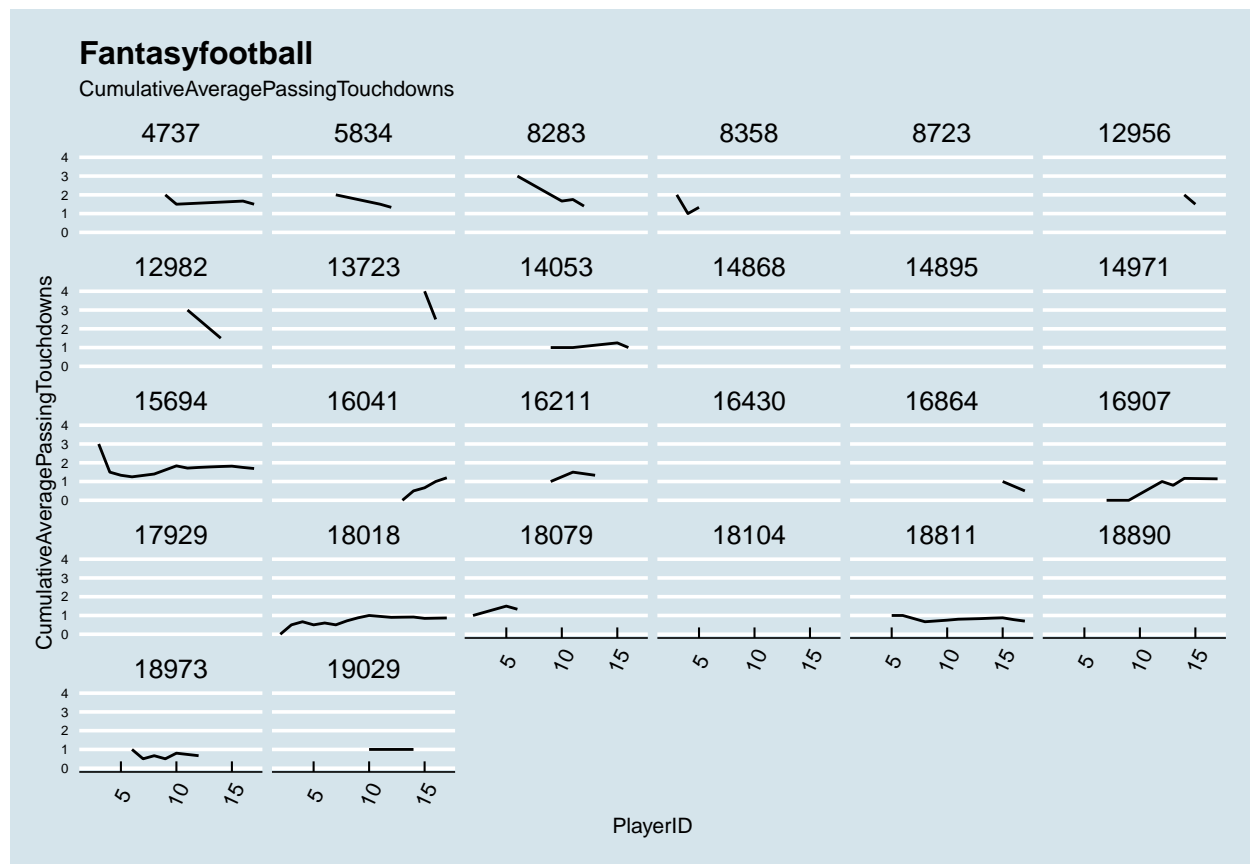
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```

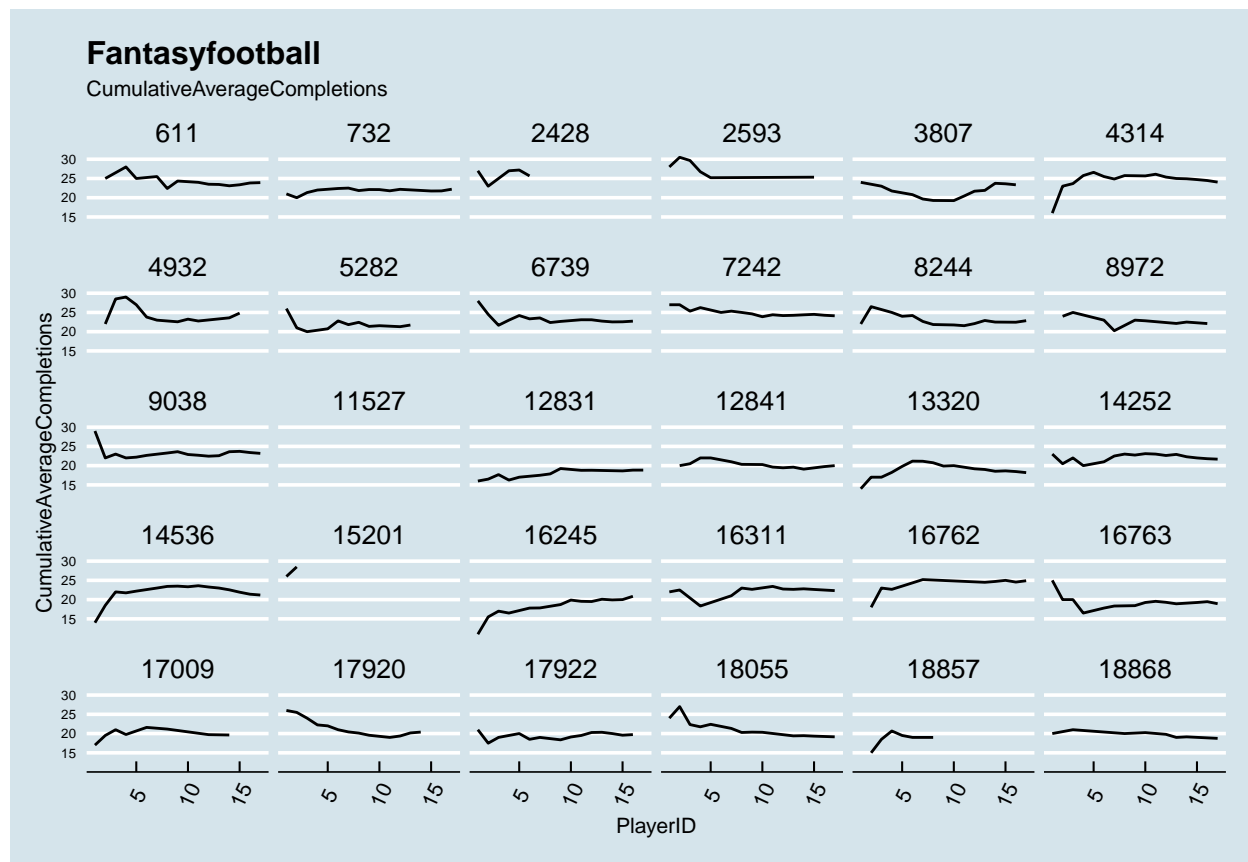
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



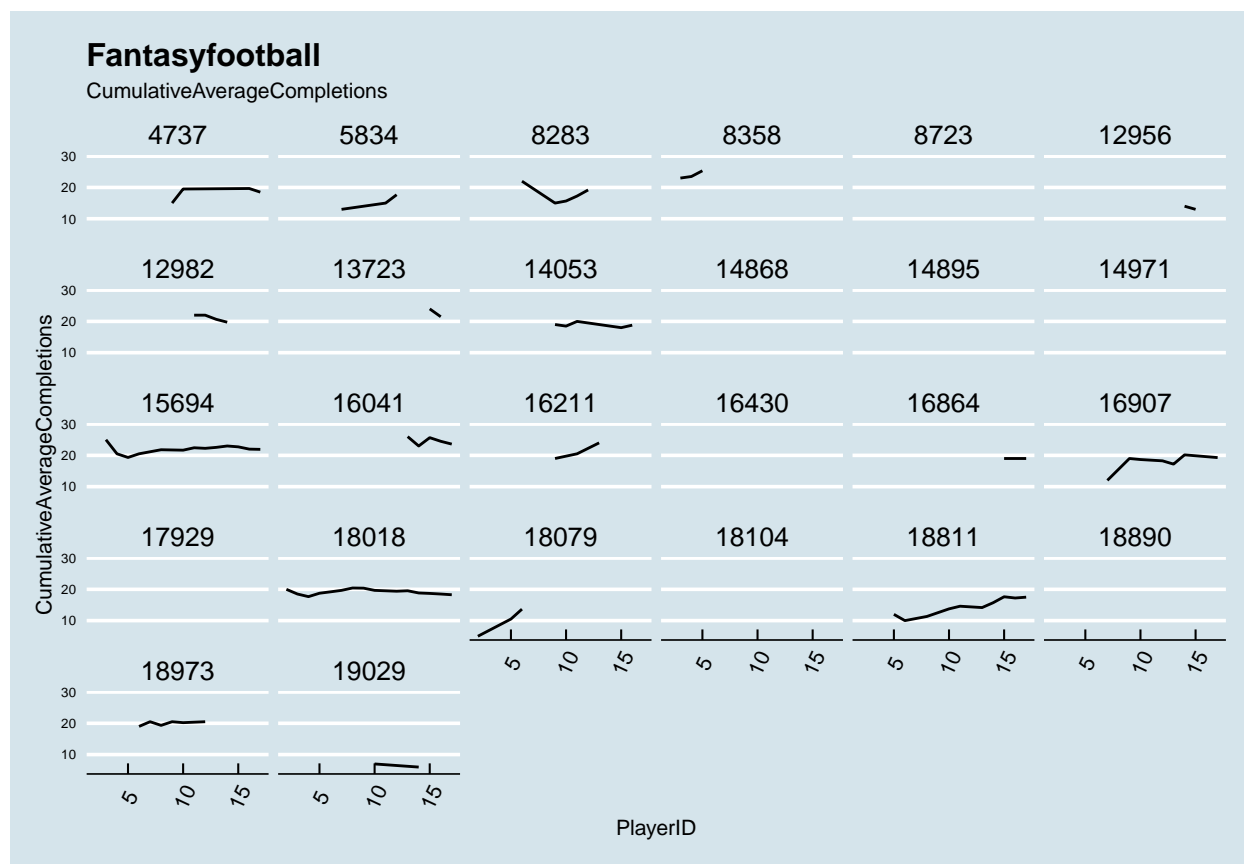
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



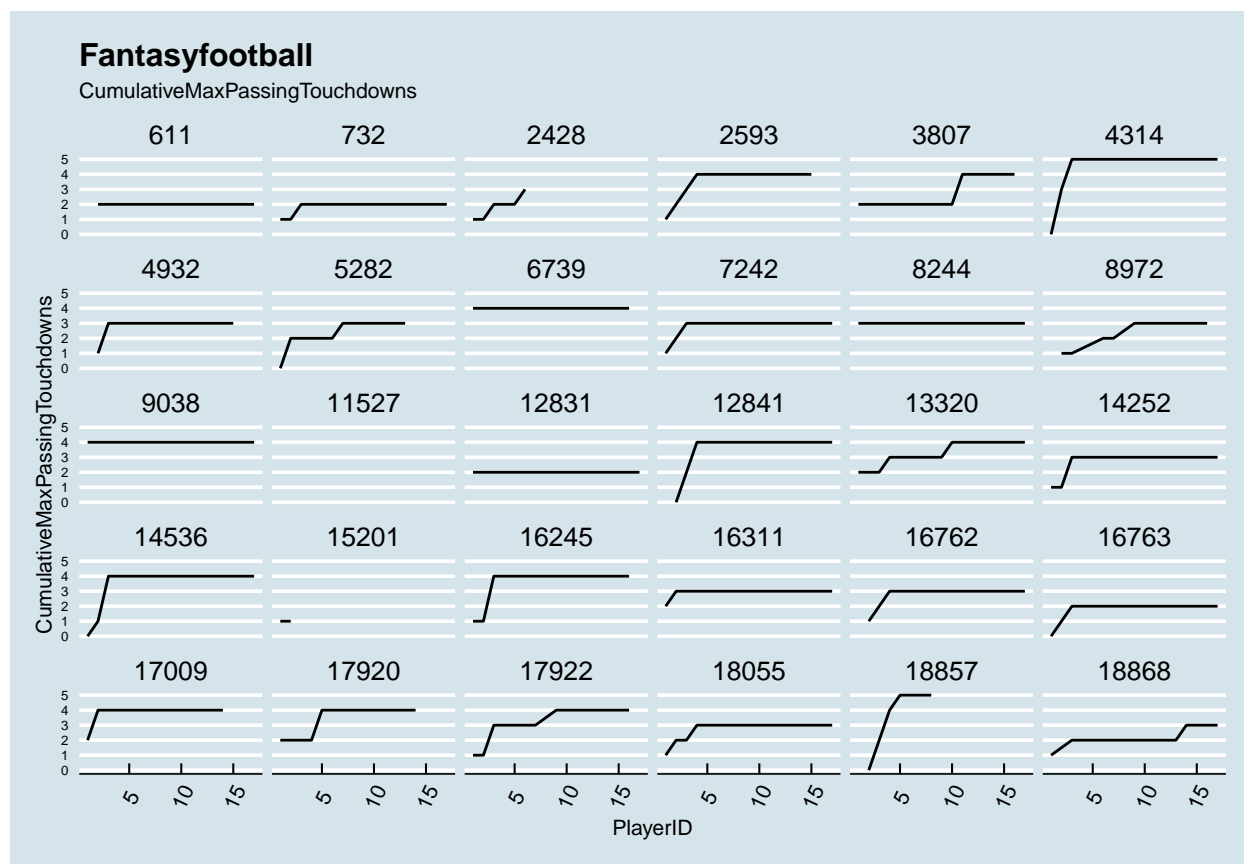
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



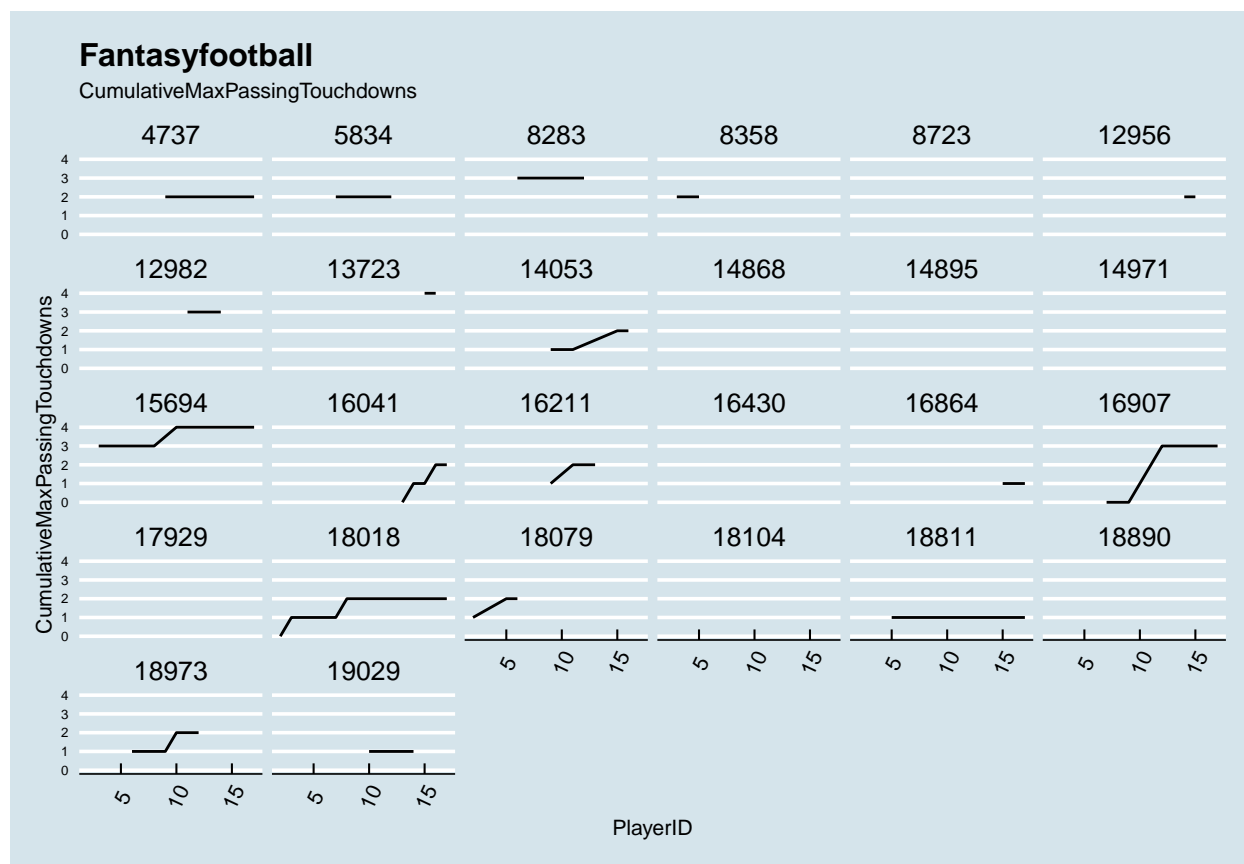
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



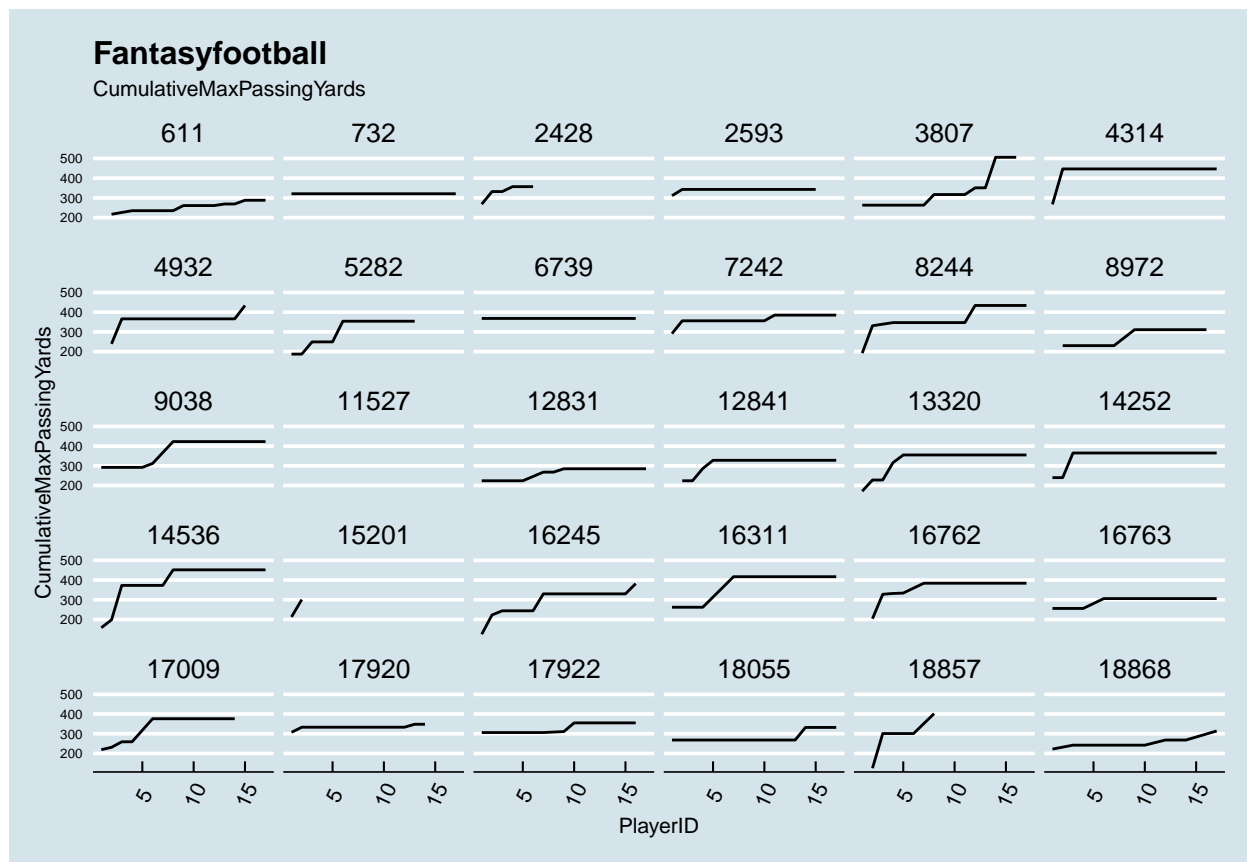
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



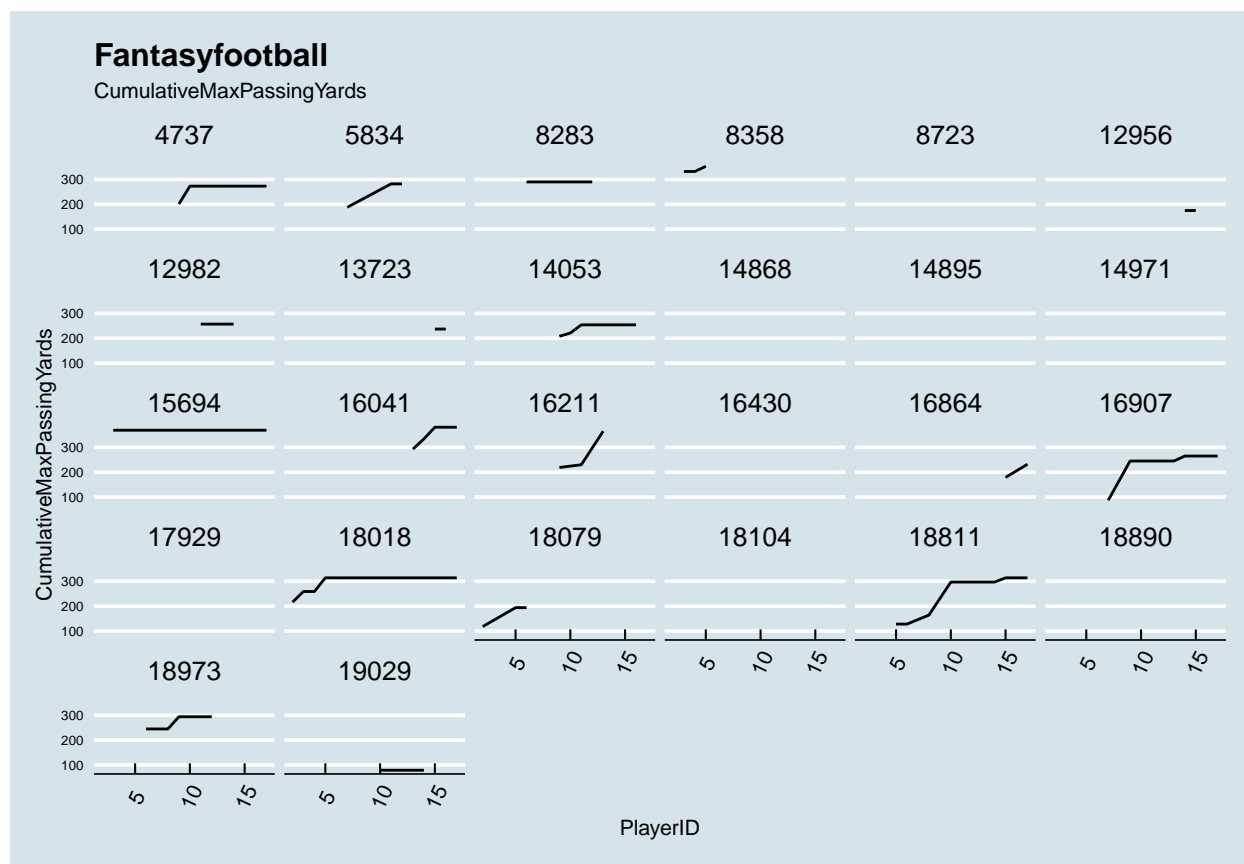
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



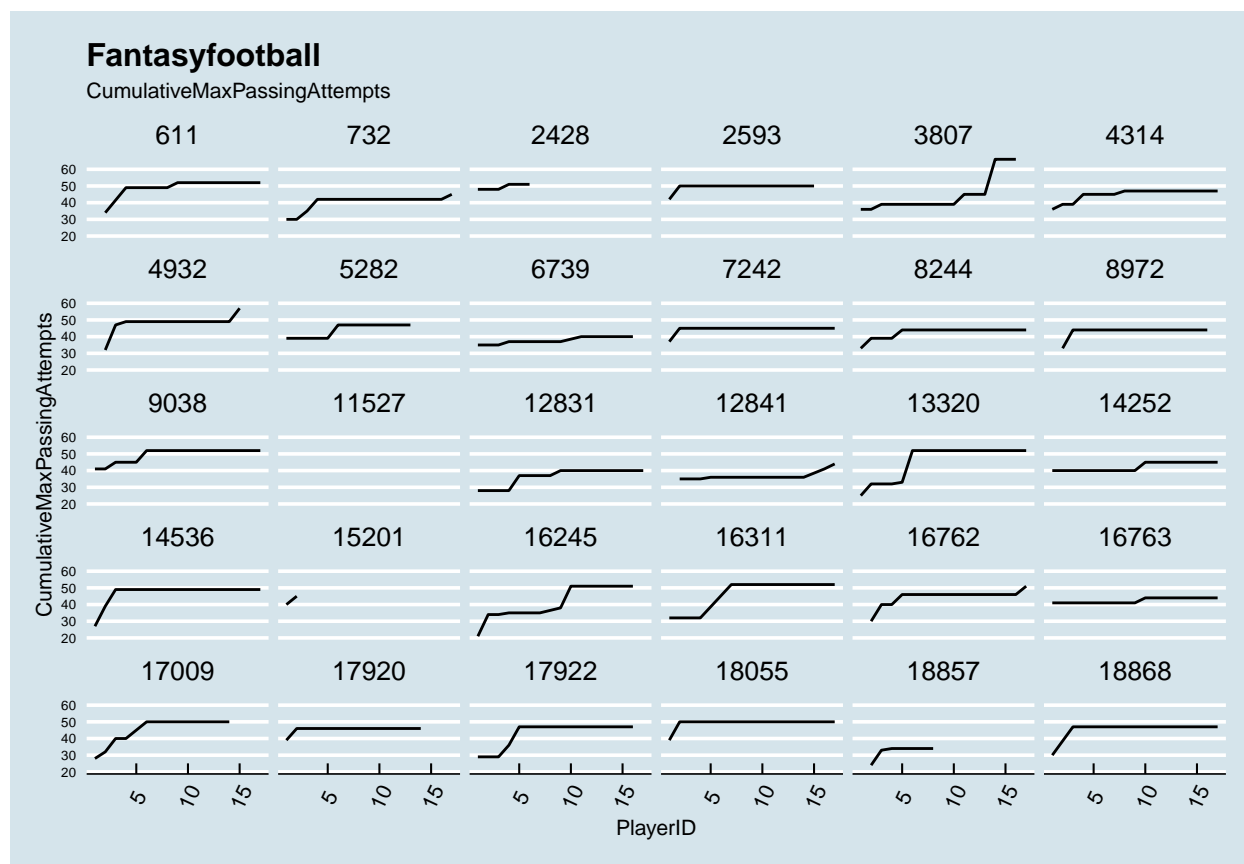
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



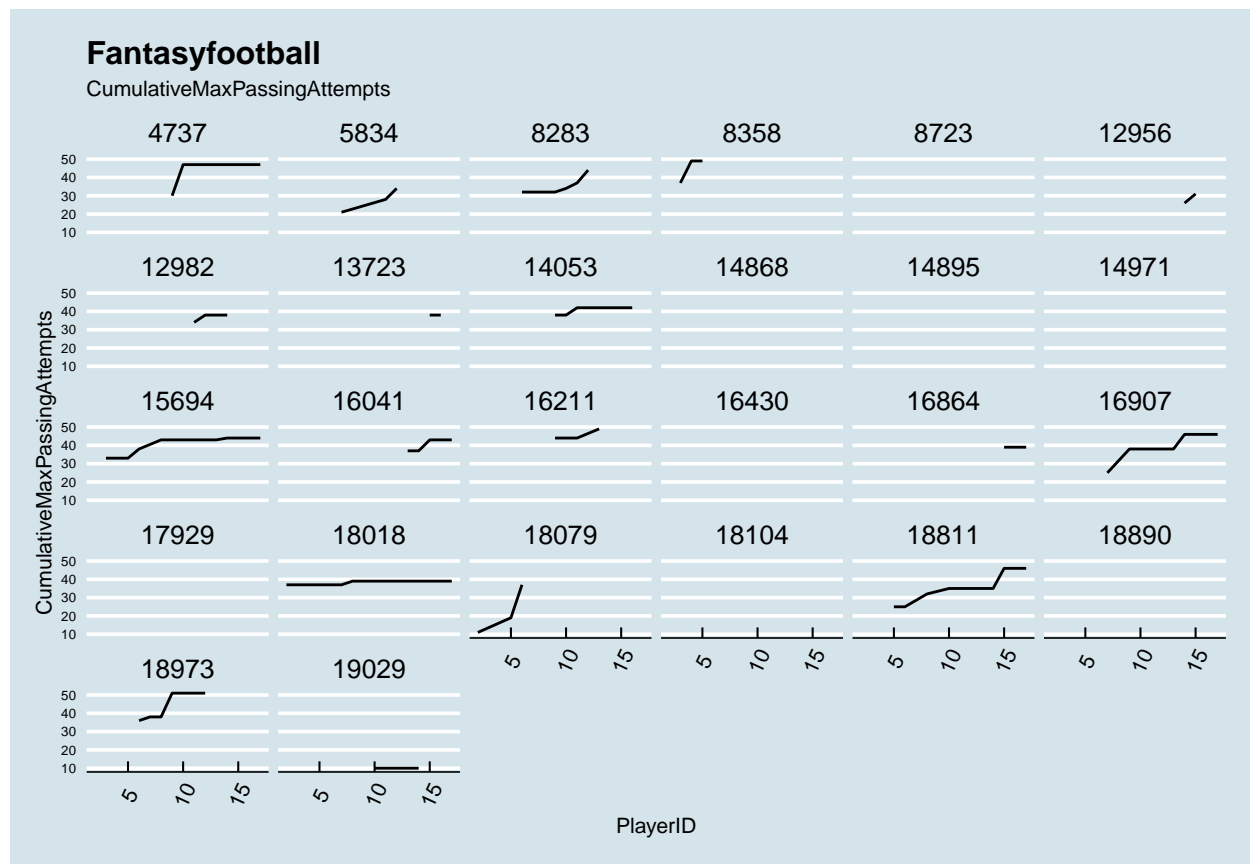
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```

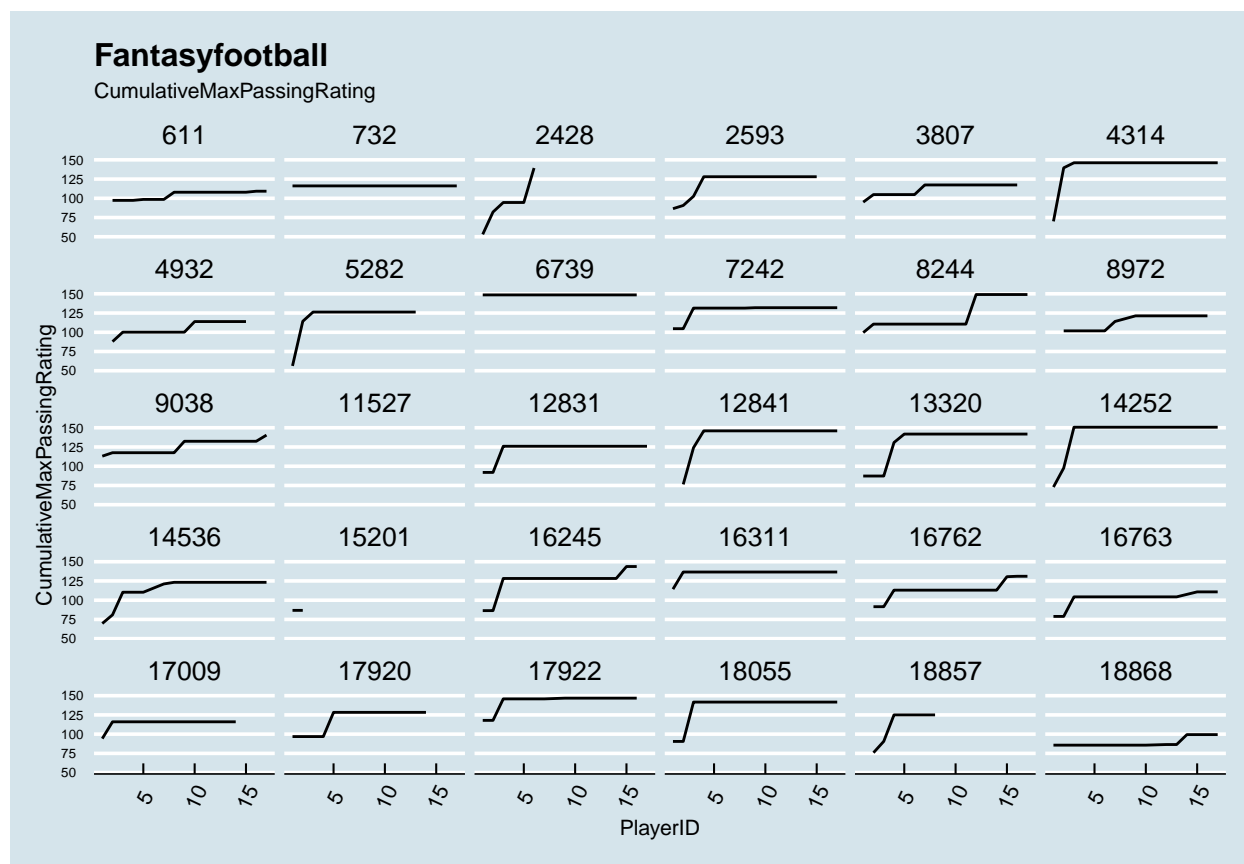
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



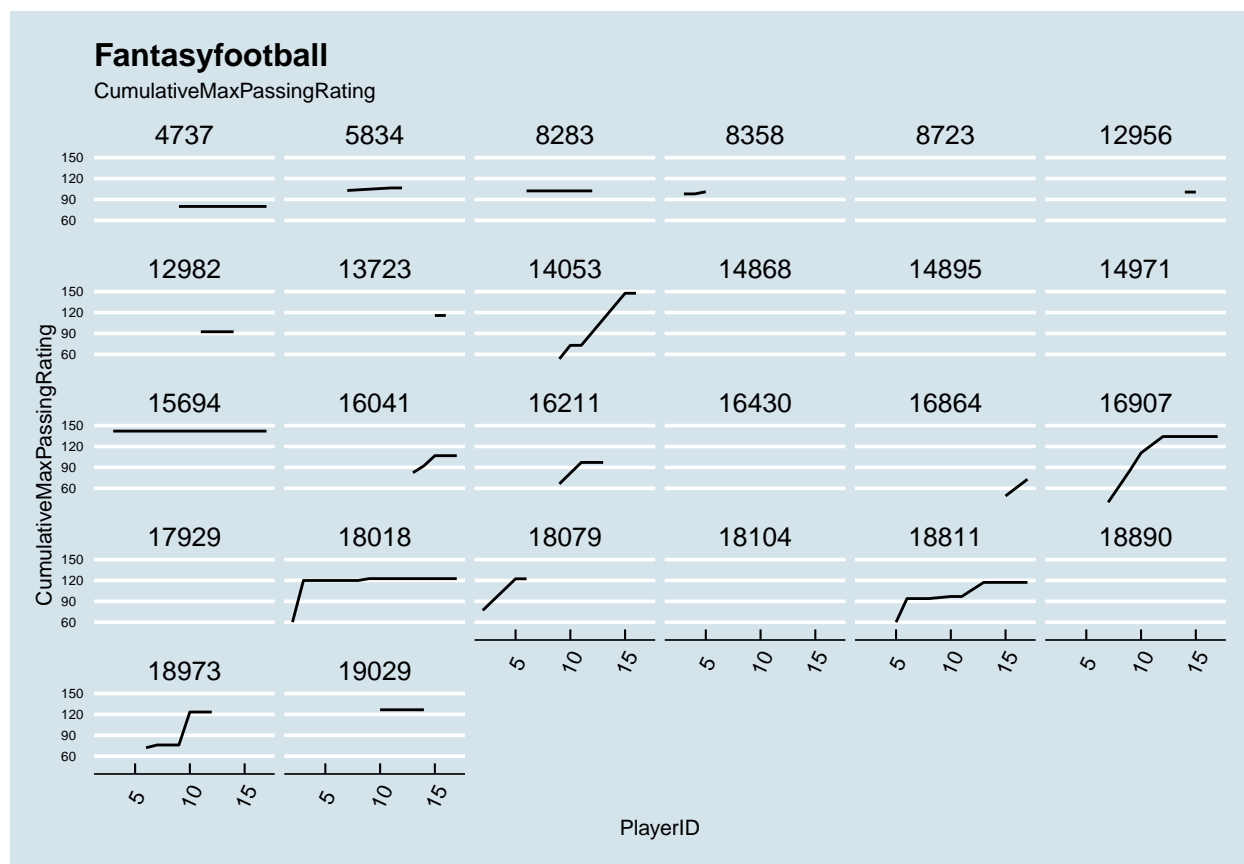
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
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## adjust the group aesthetic?
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## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



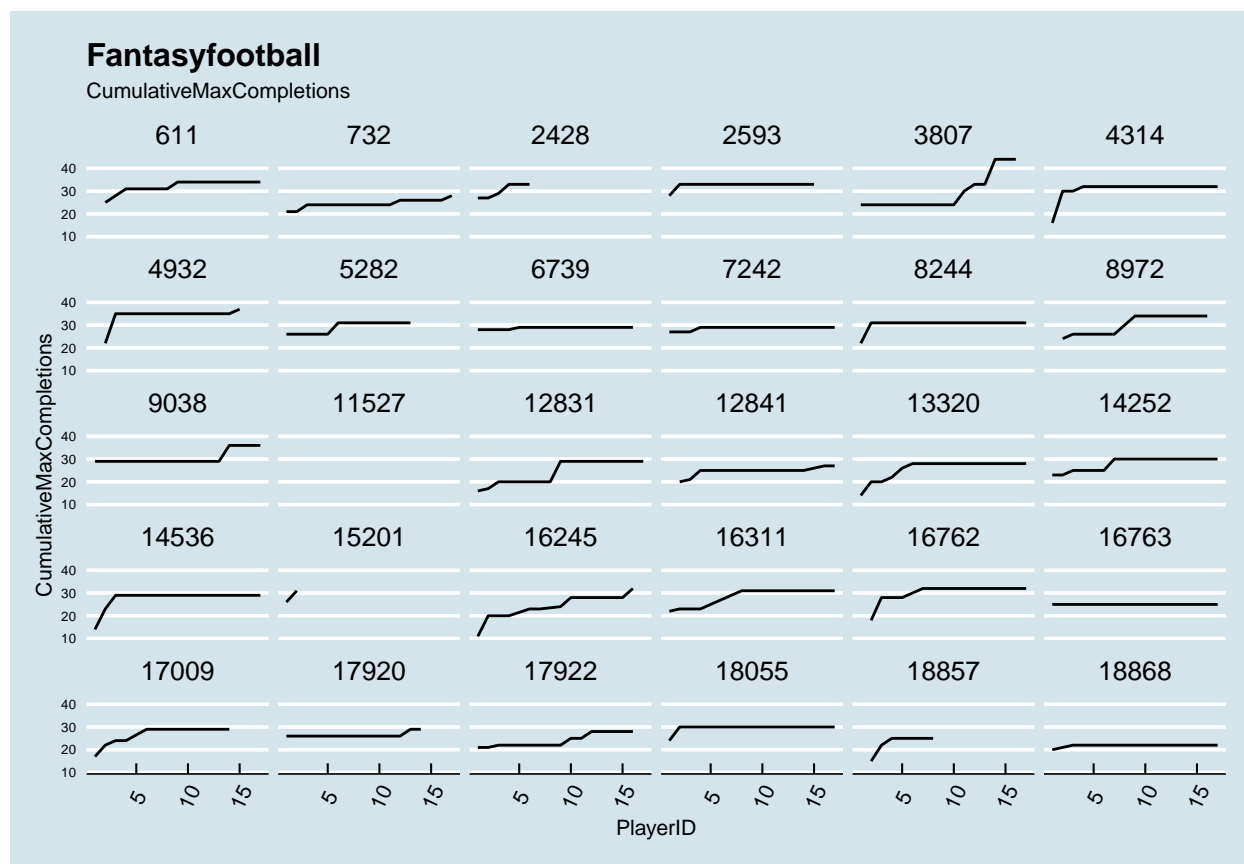
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



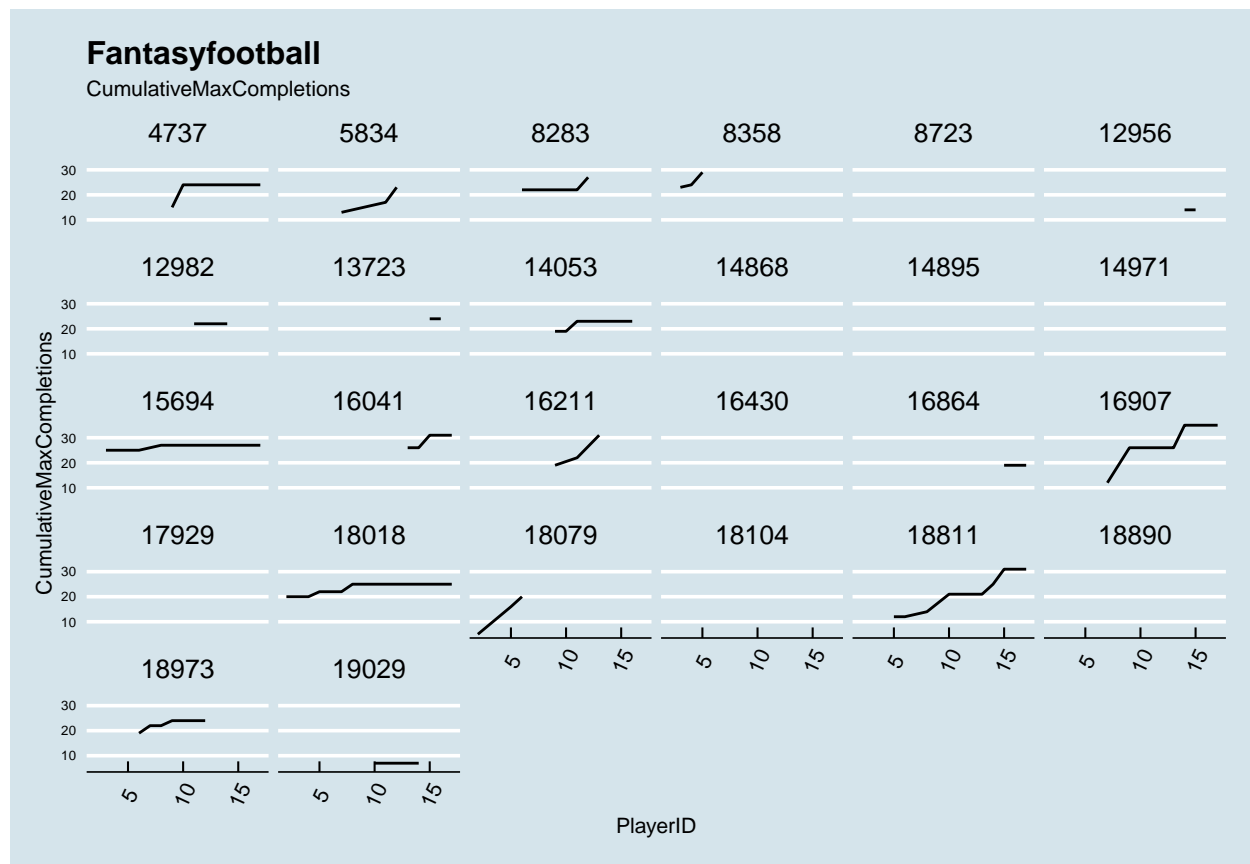
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
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## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



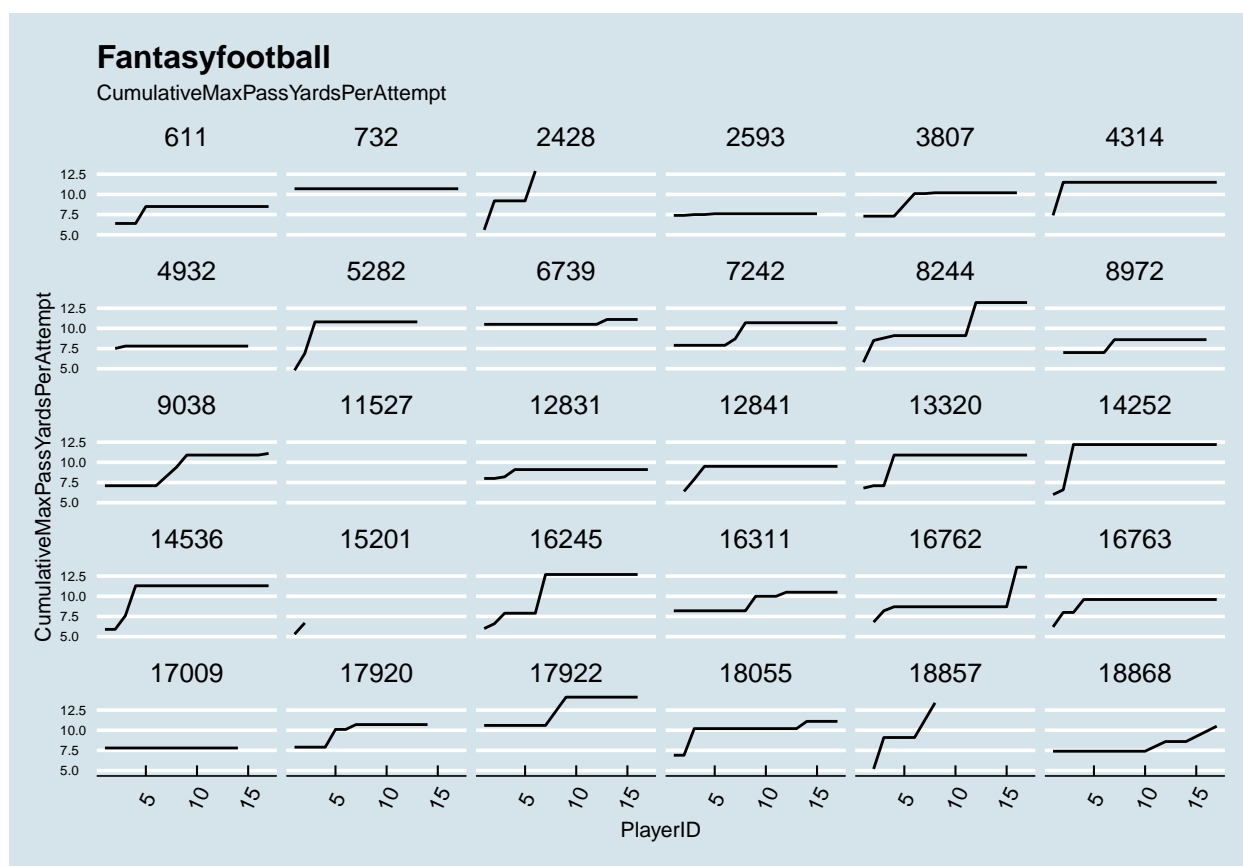
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



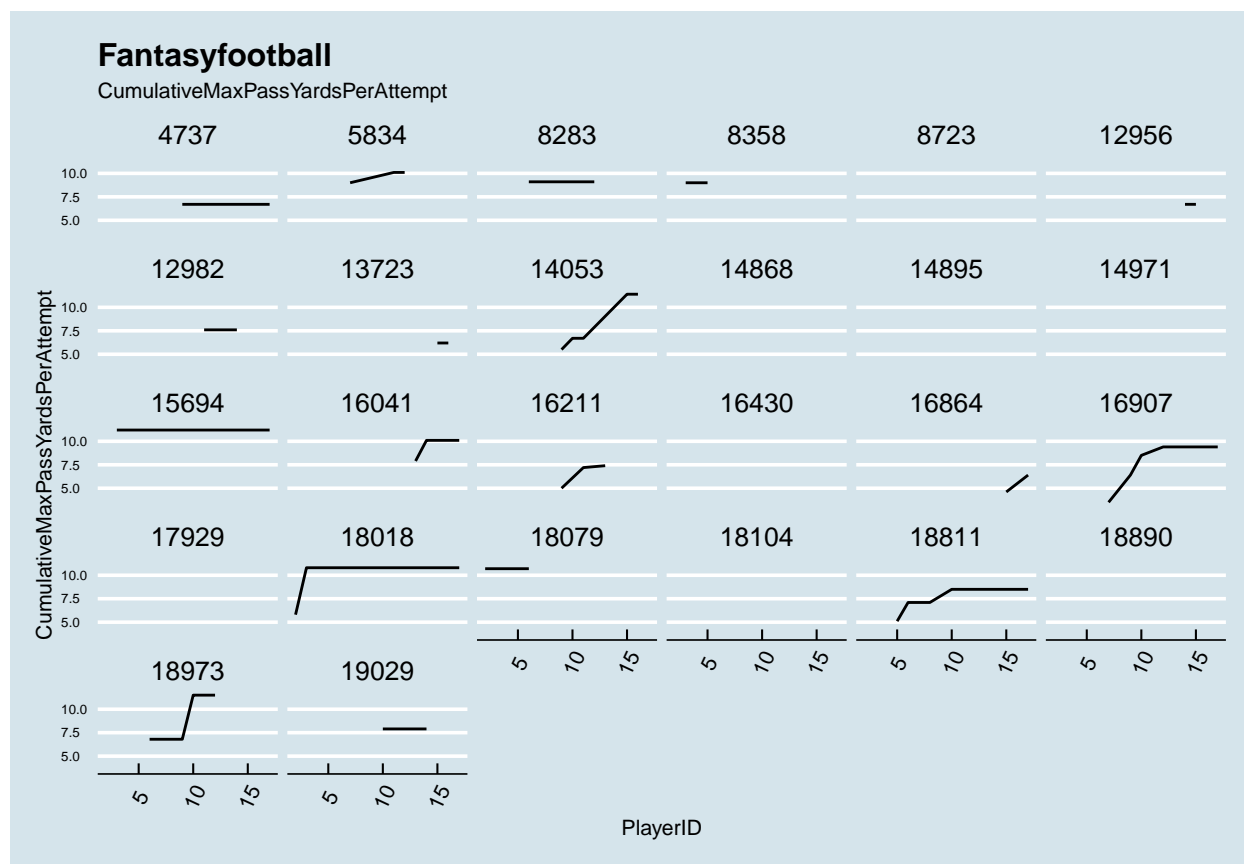
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
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## adjust the group aesthetic?
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## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



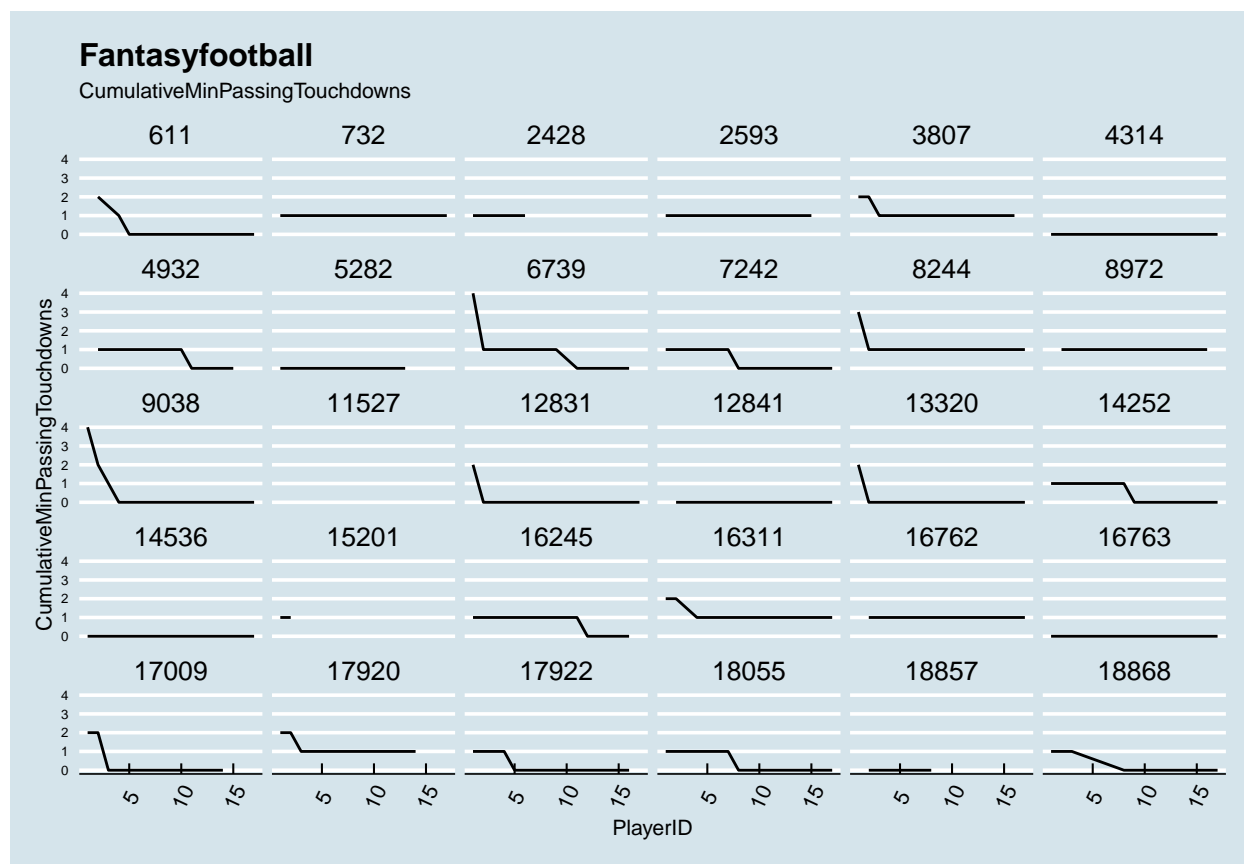
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



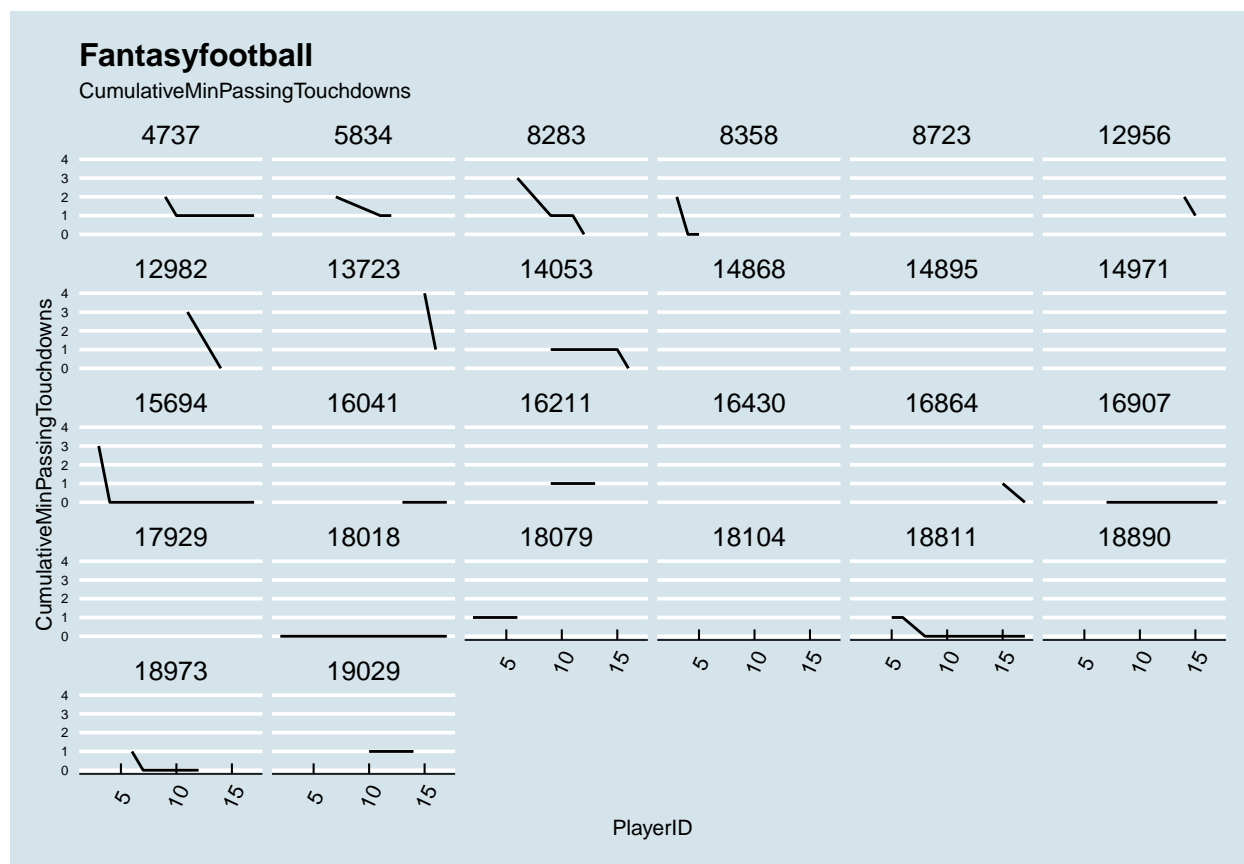
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
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## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```

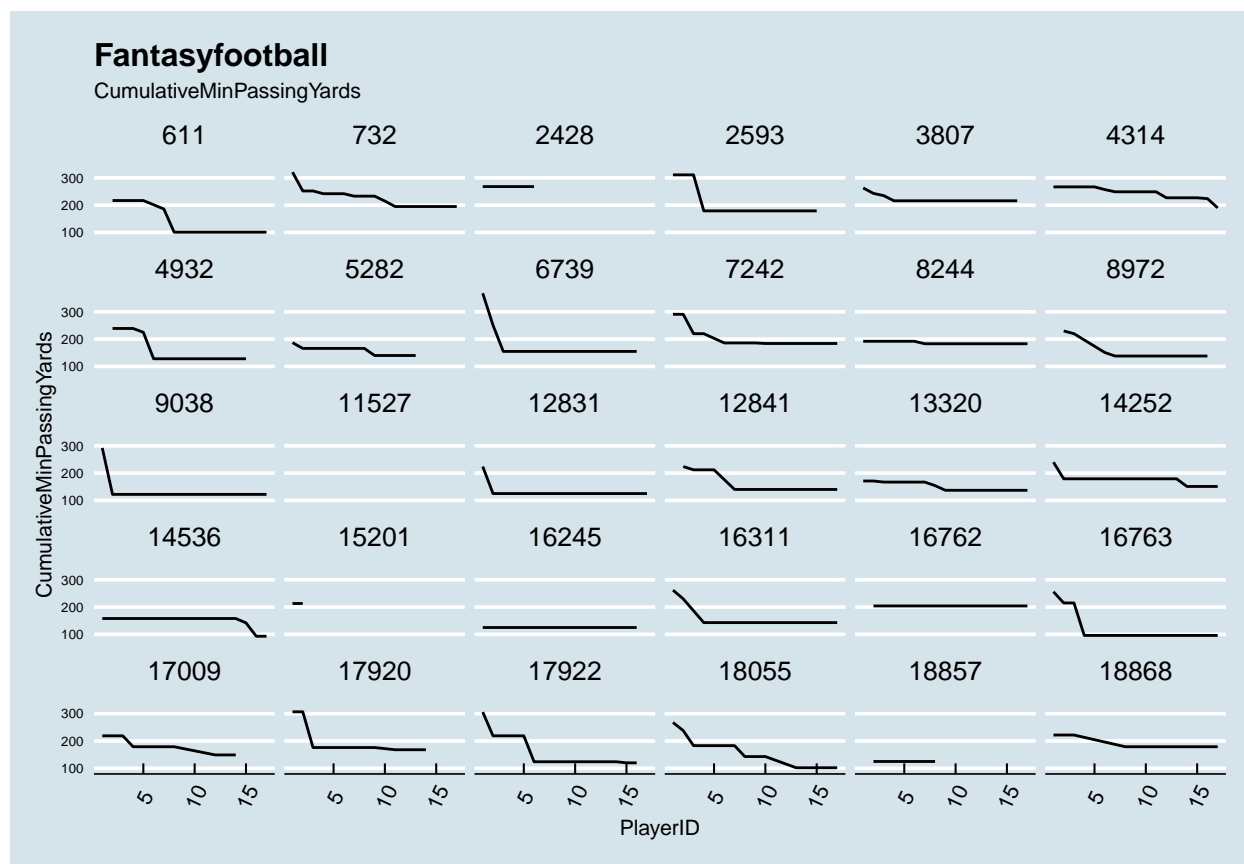
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



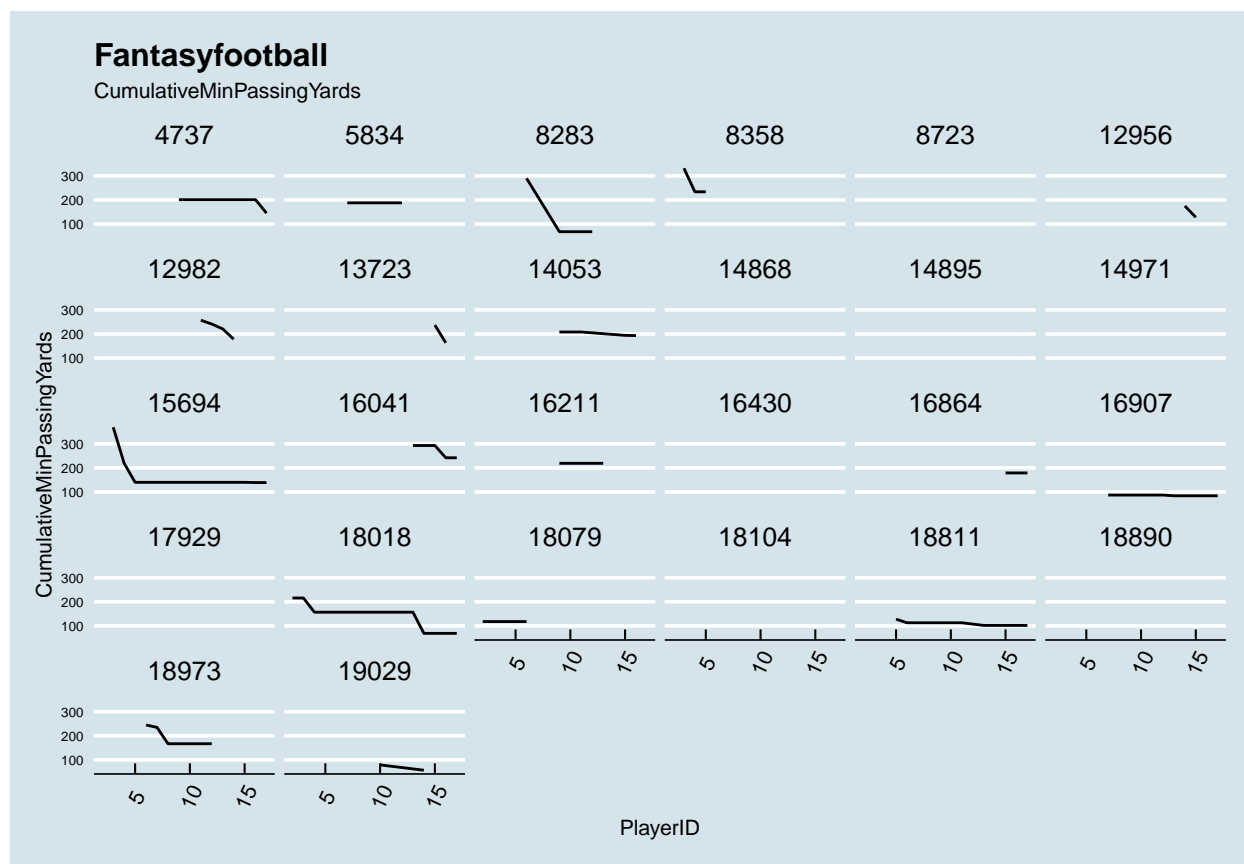
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
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## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



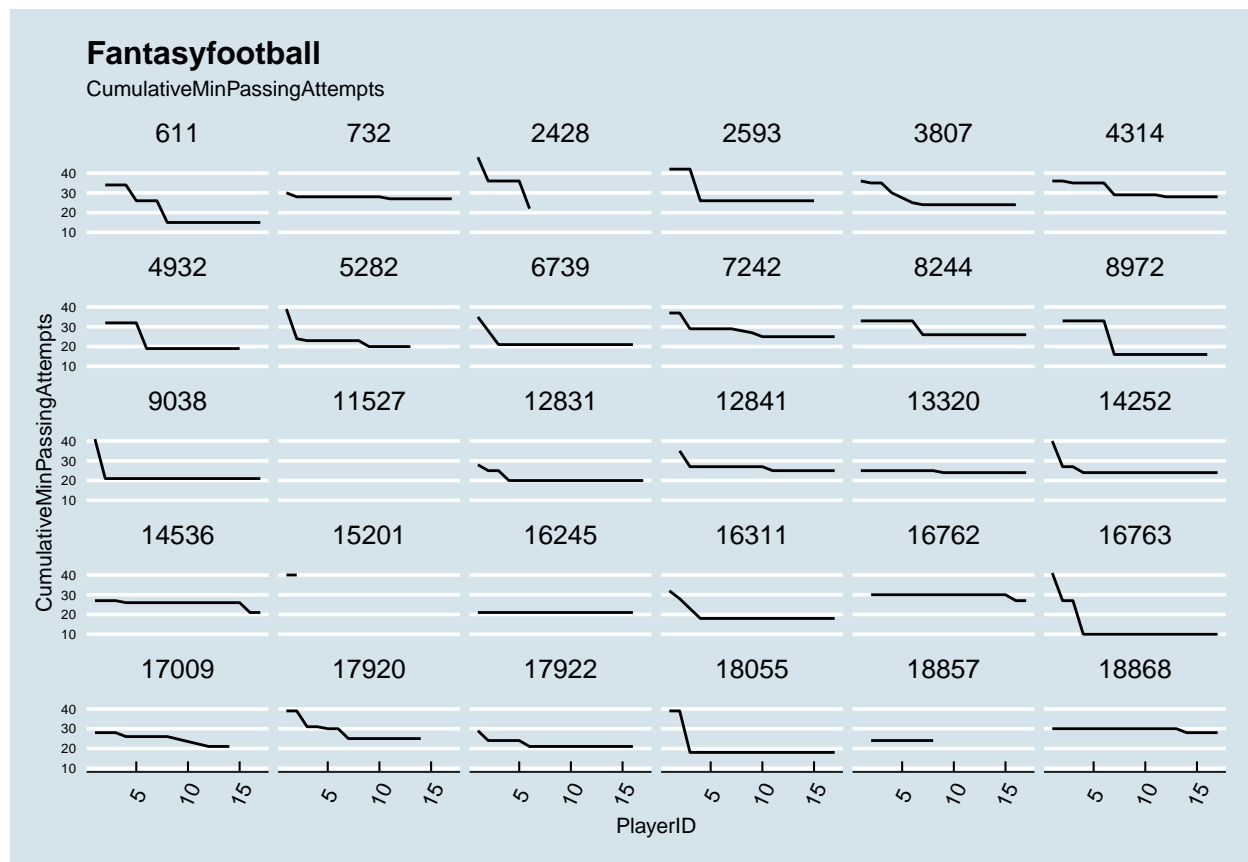
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



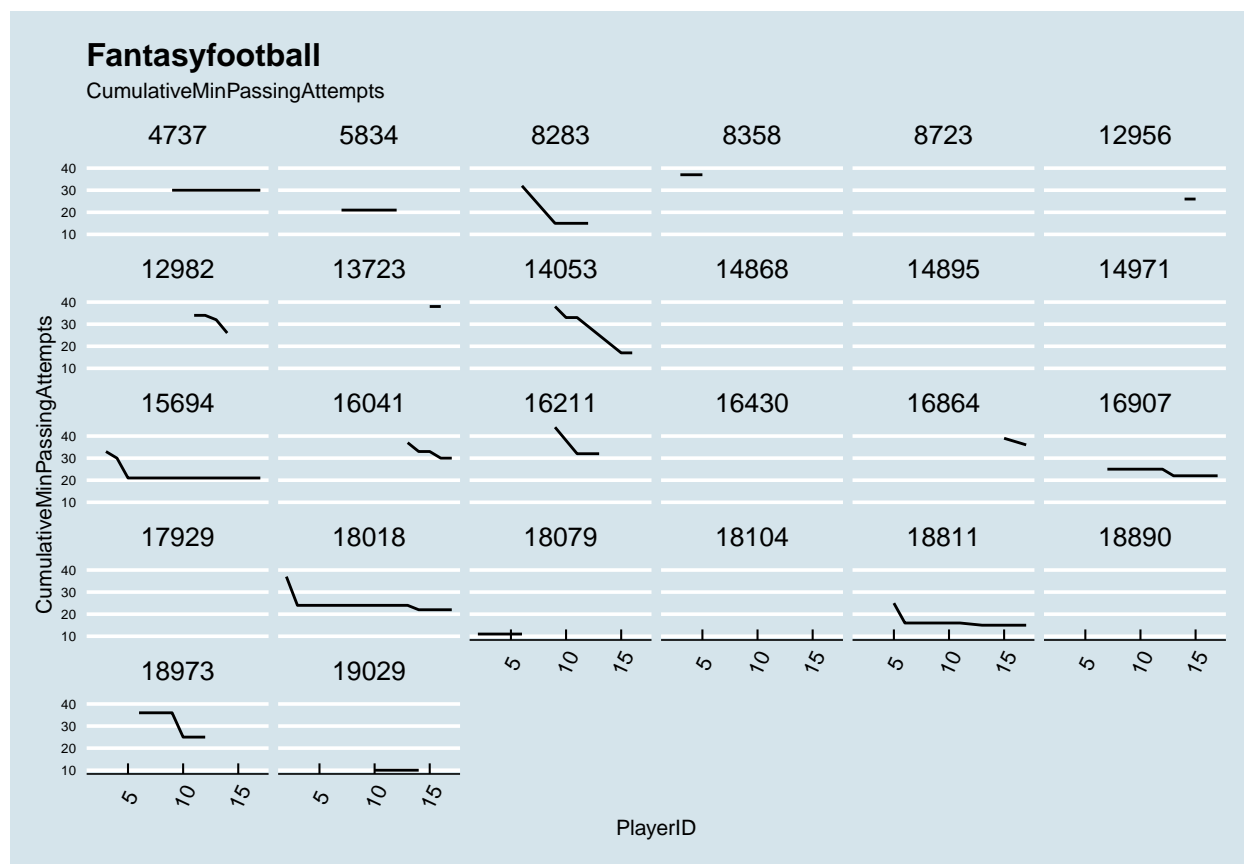
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
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## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



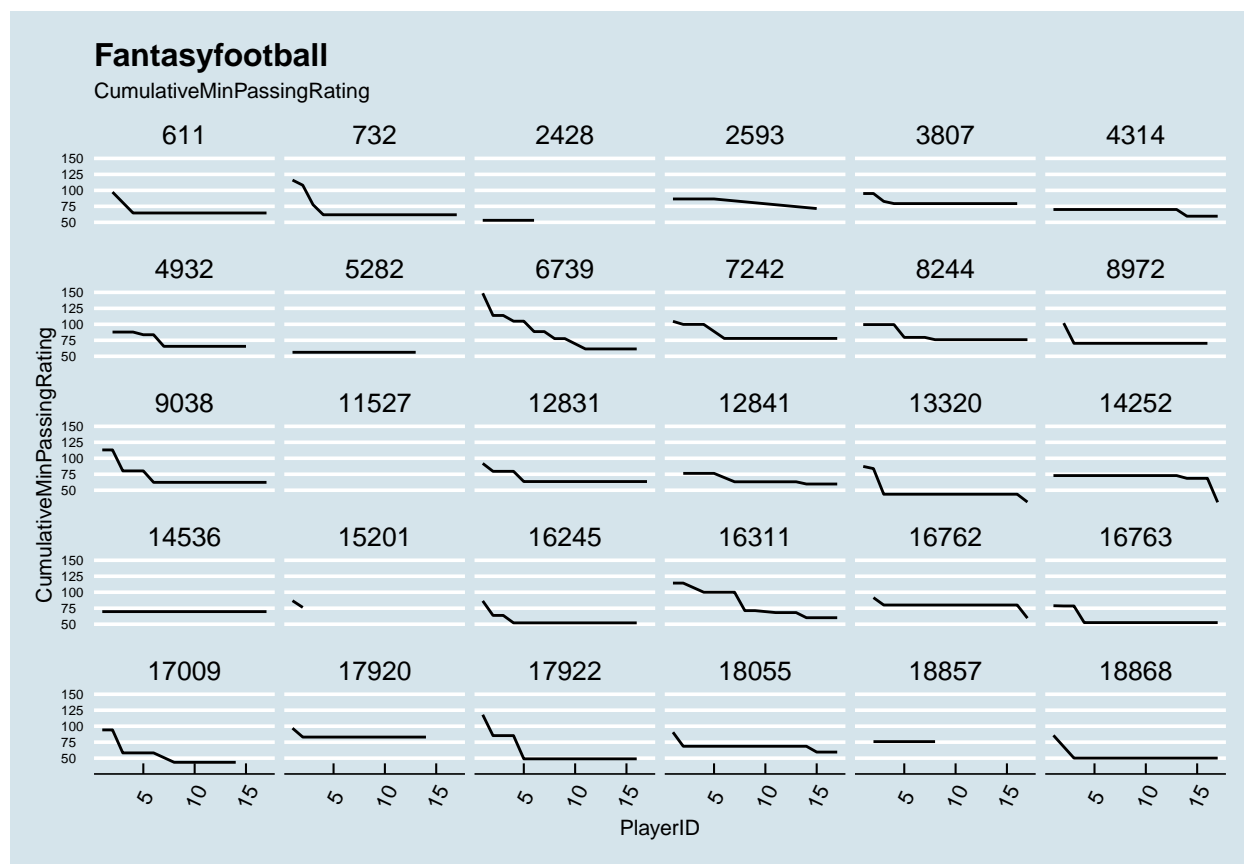
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



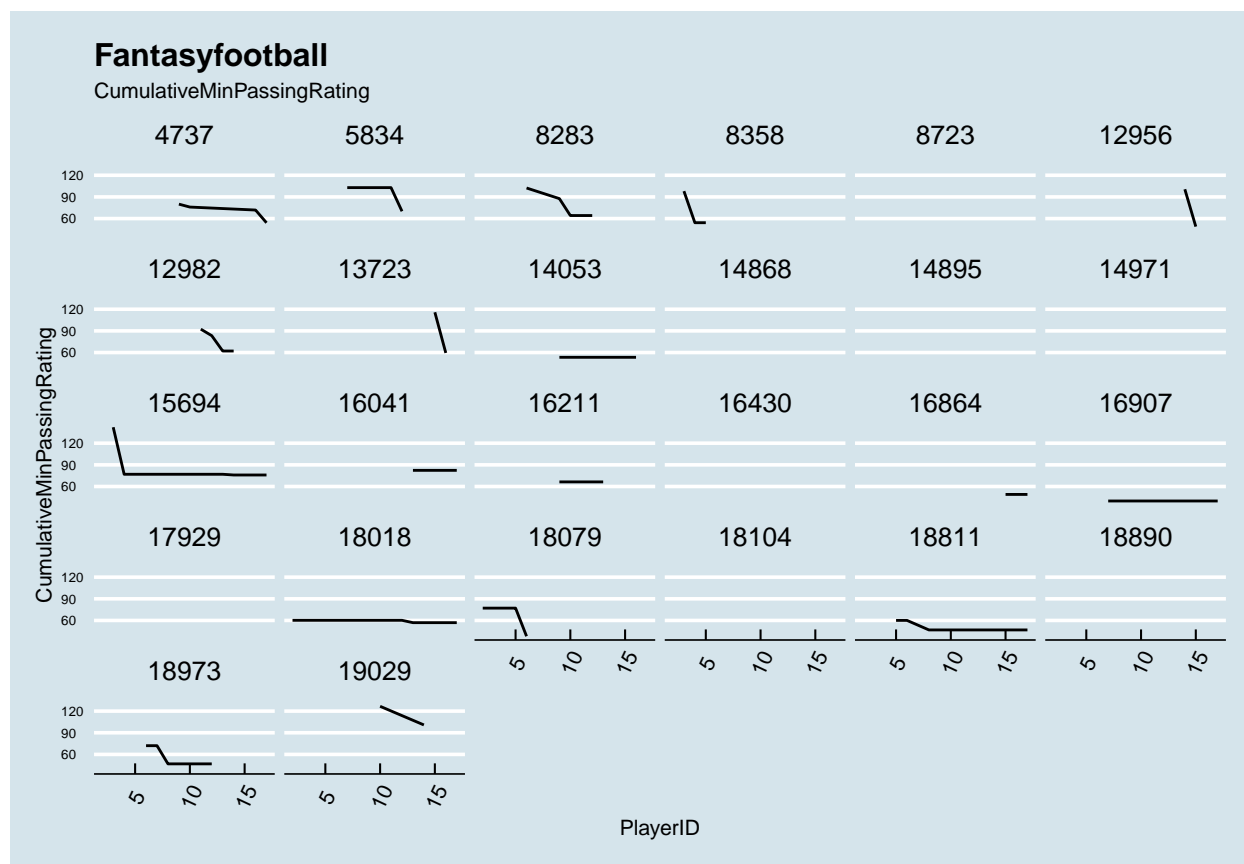
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
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## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



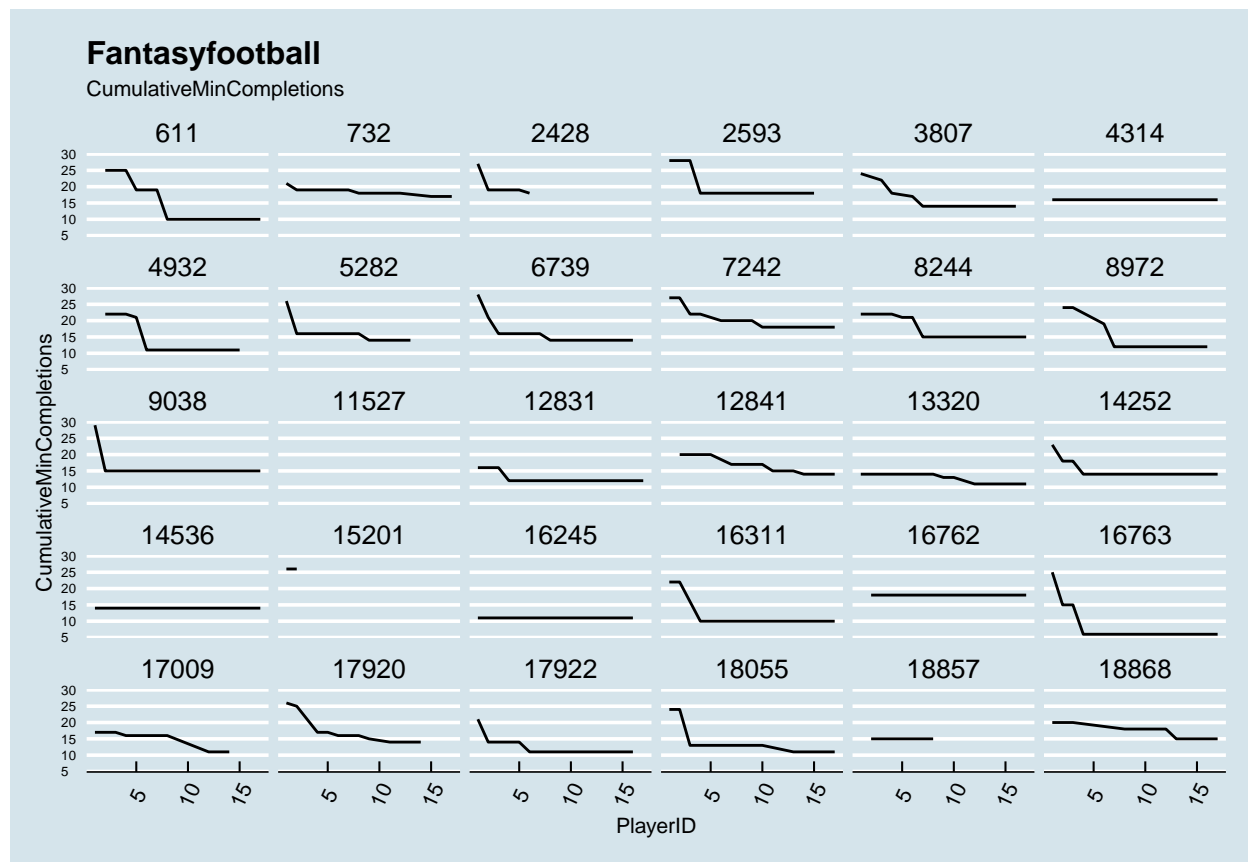
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



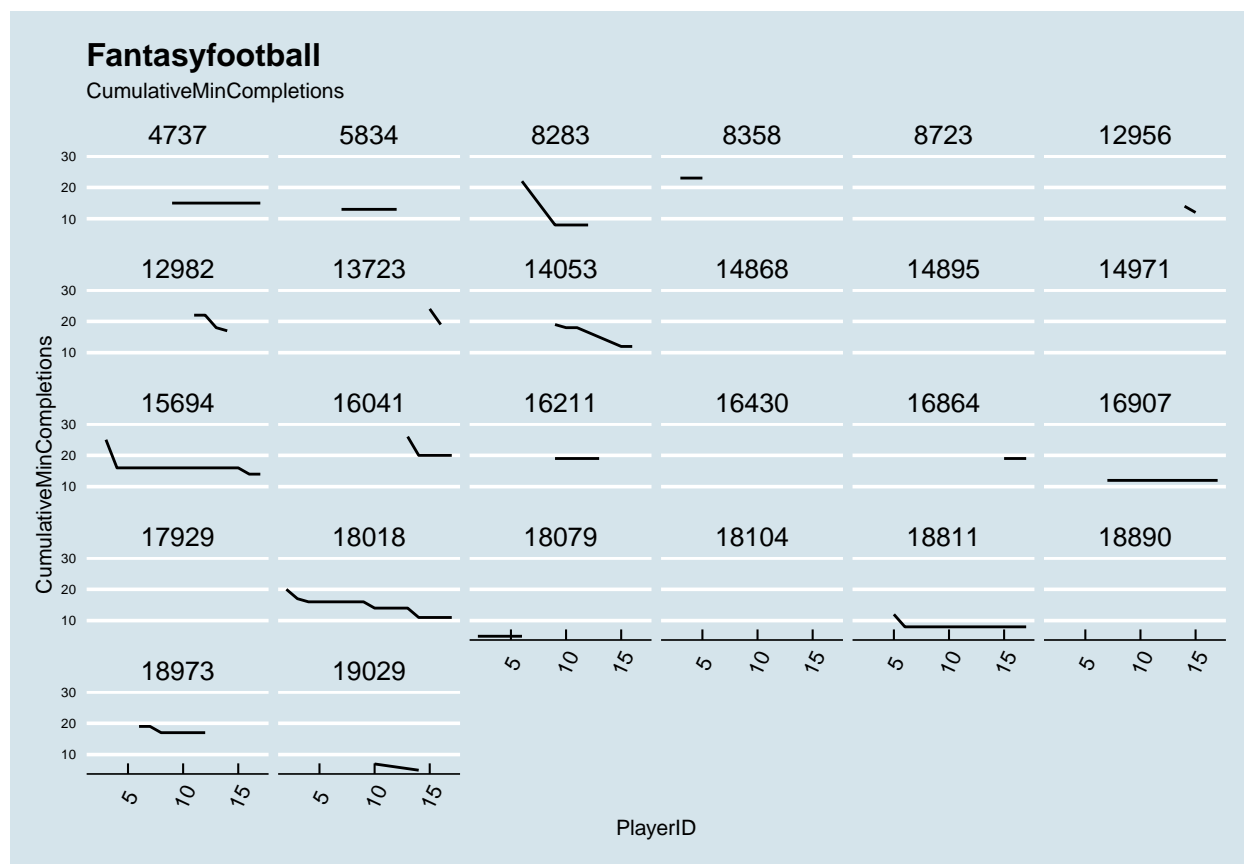
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
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## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```

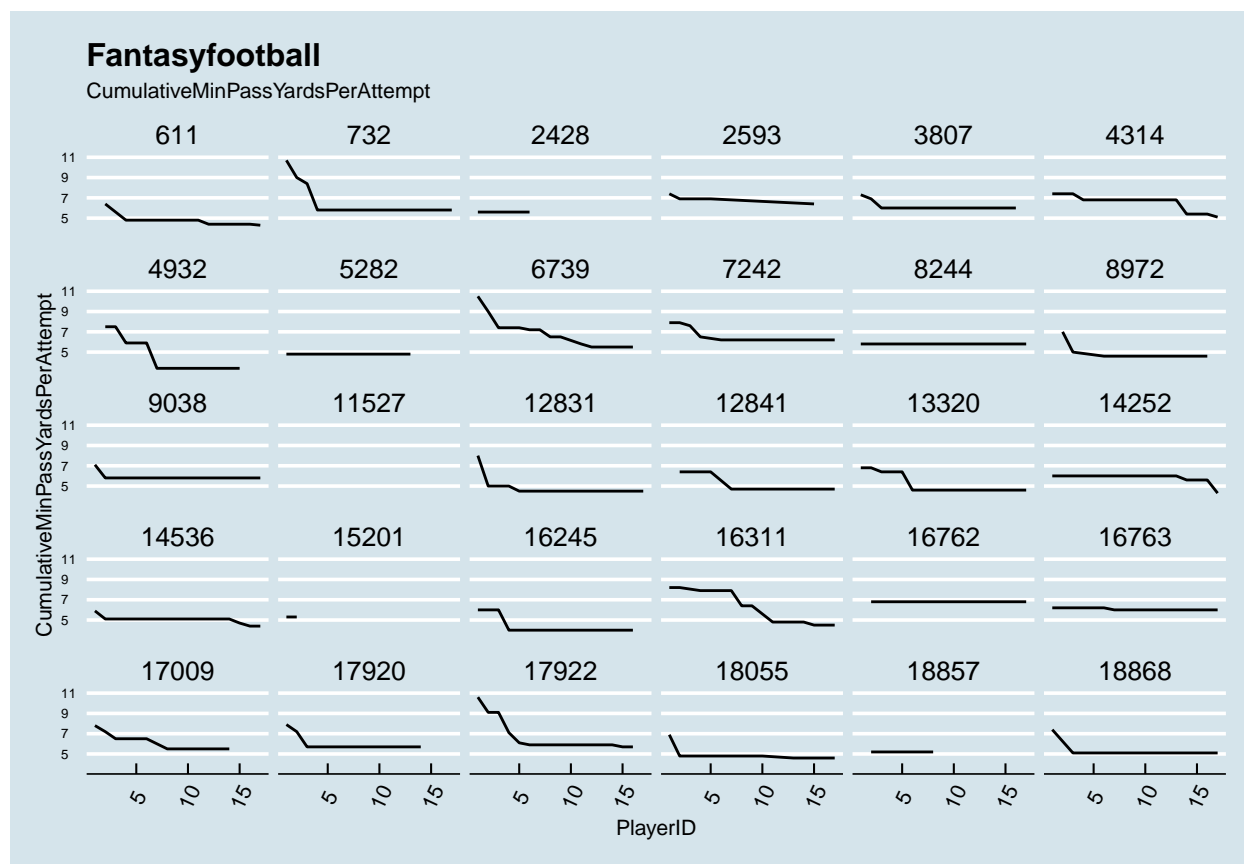
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



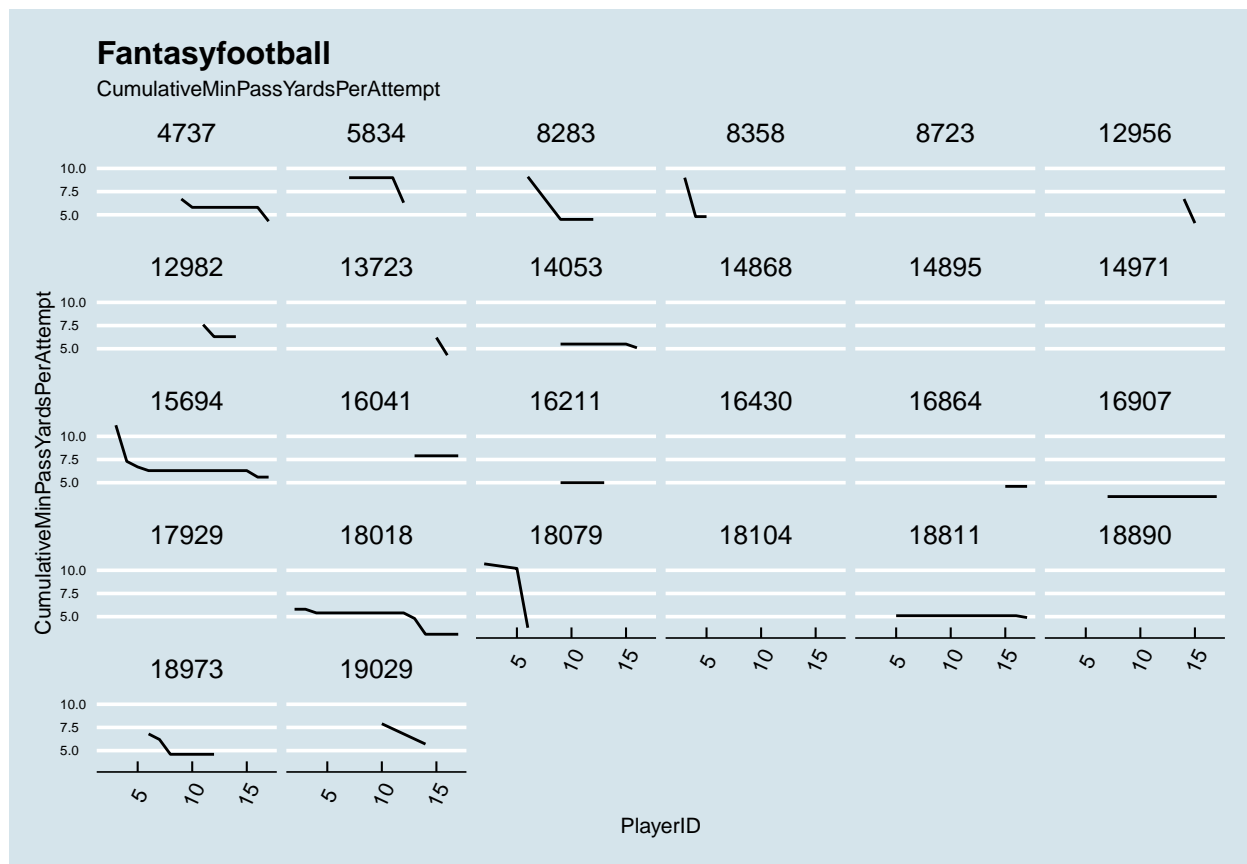
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
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```



```
## geom_path: Each group consists of only one observation. Do you need to
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```



```
## geom_path: Each group consists of only one observation. Do you need to
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## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



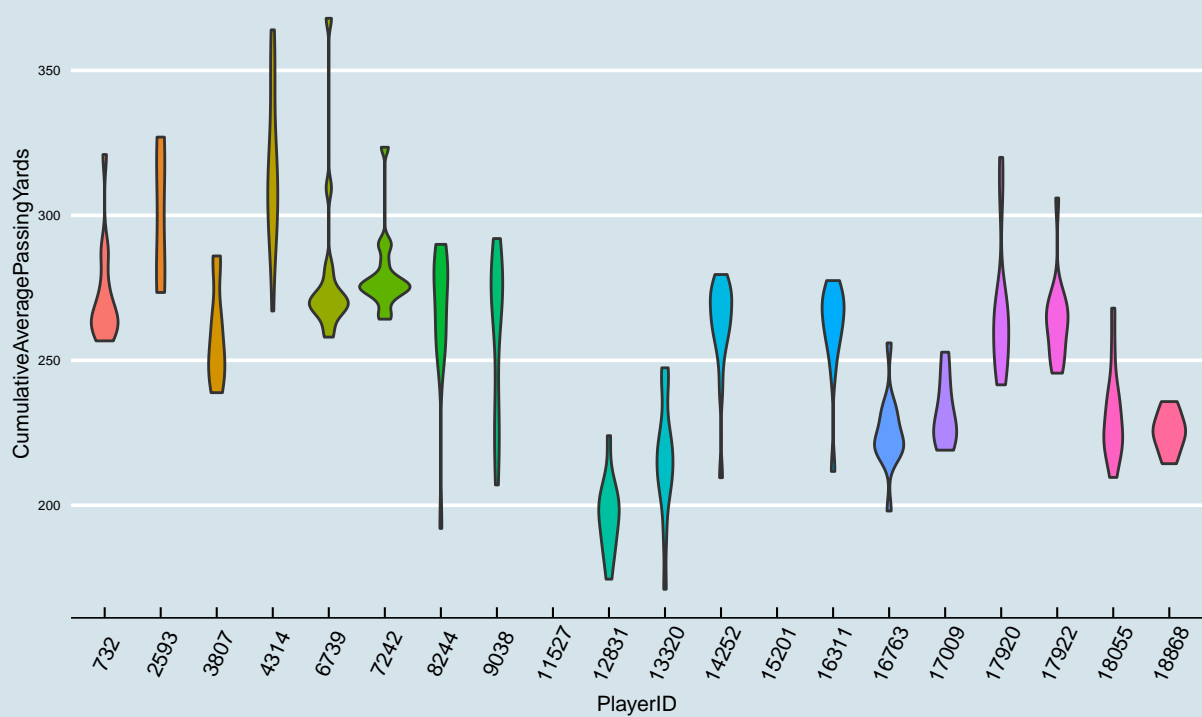
1.7.5 Individuals Violin plots for cumulative averages

```
for(p in 37:51){
  #print(paste("violin plots for ",names(players_ds[p])))
  for (player in seq(1,length(unique(final_ds$PlayerID)),by=20)){
    a_size <- player + 19
    players_ds <- final_ds %>% filter(PlayerID %in% unique(final_ds$PlayerID)[player:a_size])

    v_plot <- players_ds %>%
      ggplot(aes_string(x="as.factor(PlayerID)",y=names(players_ds[p]),fill="as.factor(Play
      ggtitle(names(players_ds[p]))+
      geom_violin(show.legend = FALSE)+
        xlab("PlayerID")+
        ylab(names(players_ds[p]))+
        labs(title="Fantasyfootball",
        subtitle=names(players_ds[p]),
        aption="Source: Fantasyfootball")+
        theme_economist(base_size=8)+theme(axis.text.y = element_text(size=5))+
        theme(axis.text.x = element_text(angle=65, vjust=0.6))
    print(v_plot)
  }
}
```

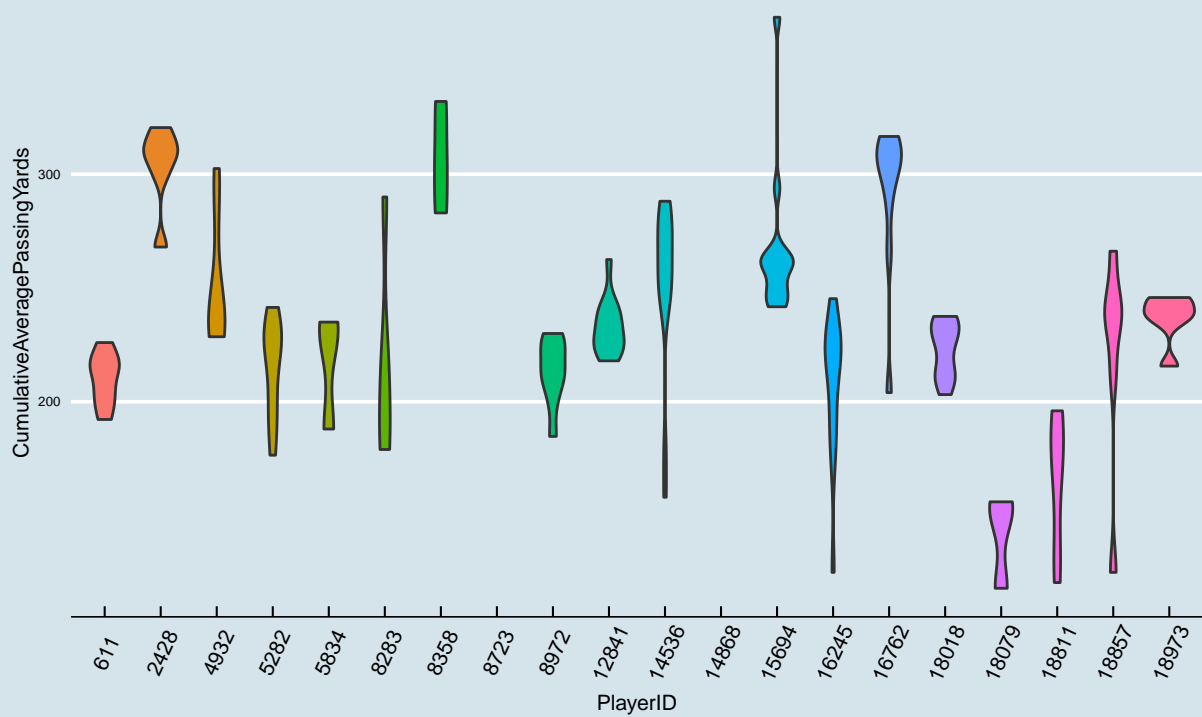
Fantasyfootball

CumulativeAveragePassingYards



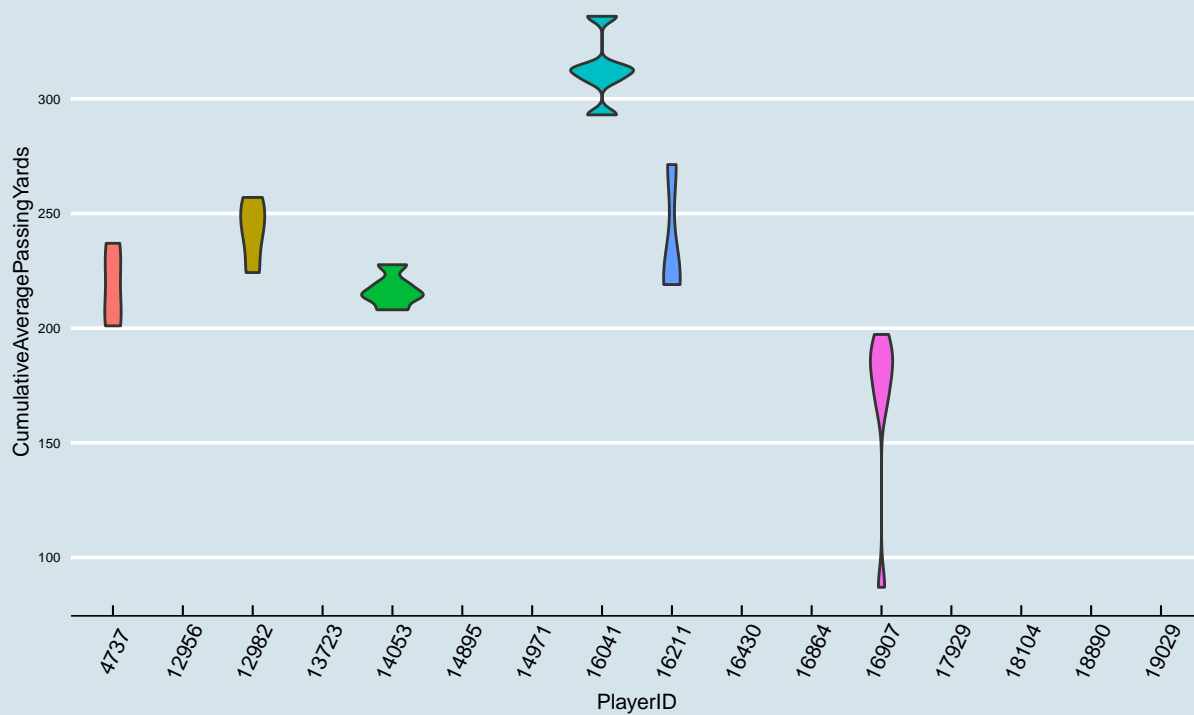
Fantasyfootball

CumulativeAveragePassingYards



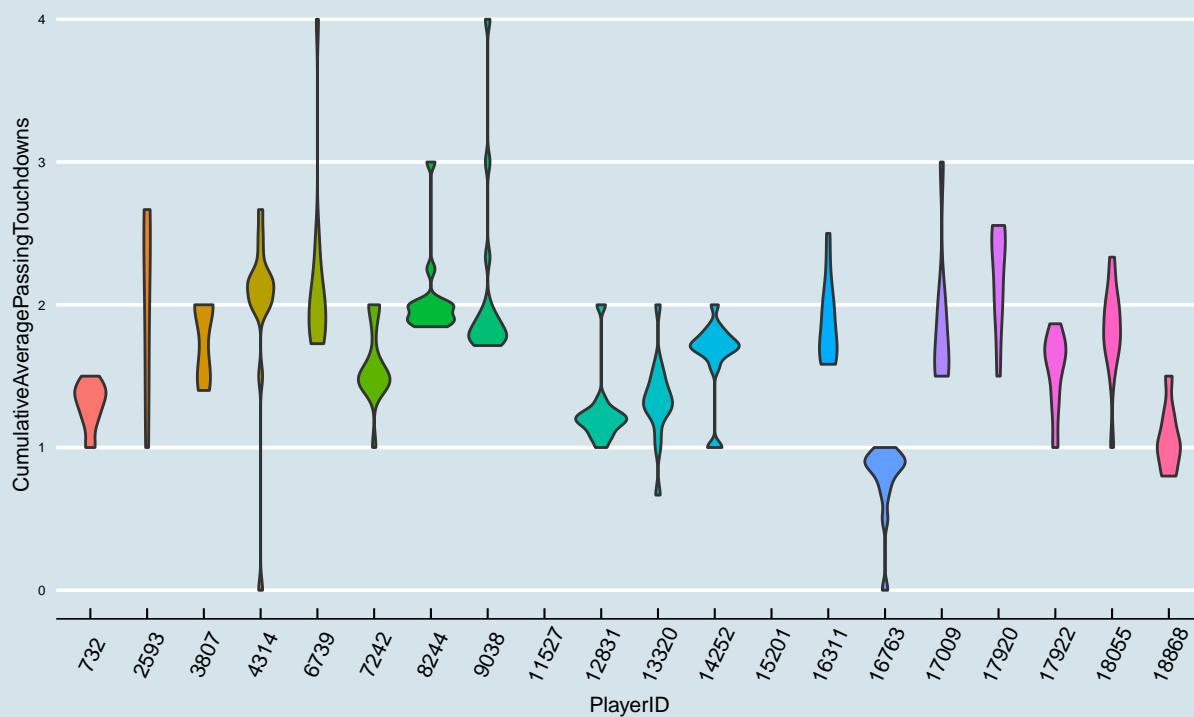
Fantasyfootball

CumulativeAveragePassingYards



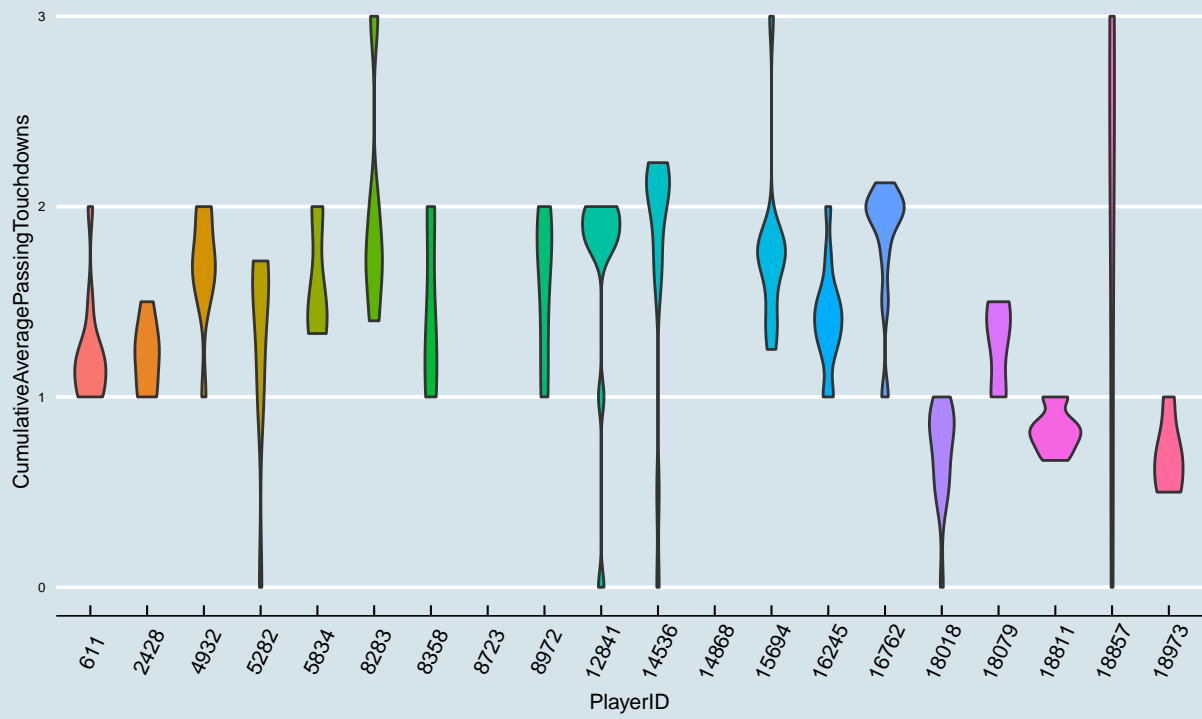
Fantasyfootball

CumulativeAveragePassingTouchdowns



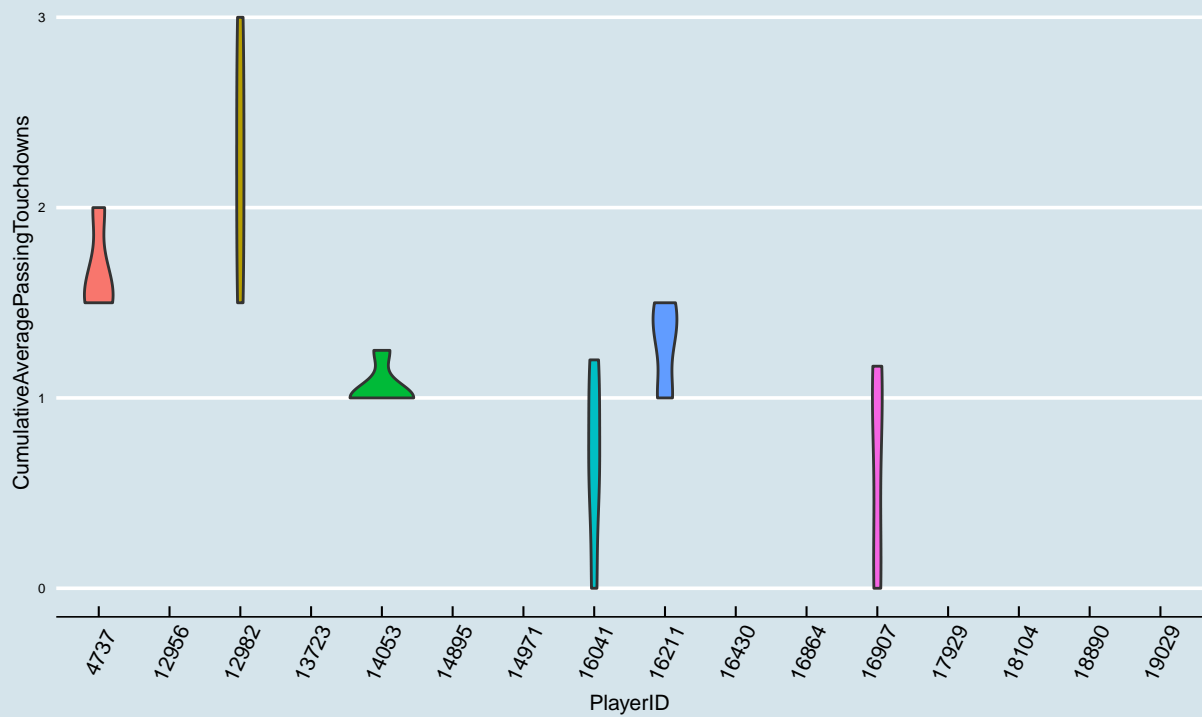
Fantasyfootball

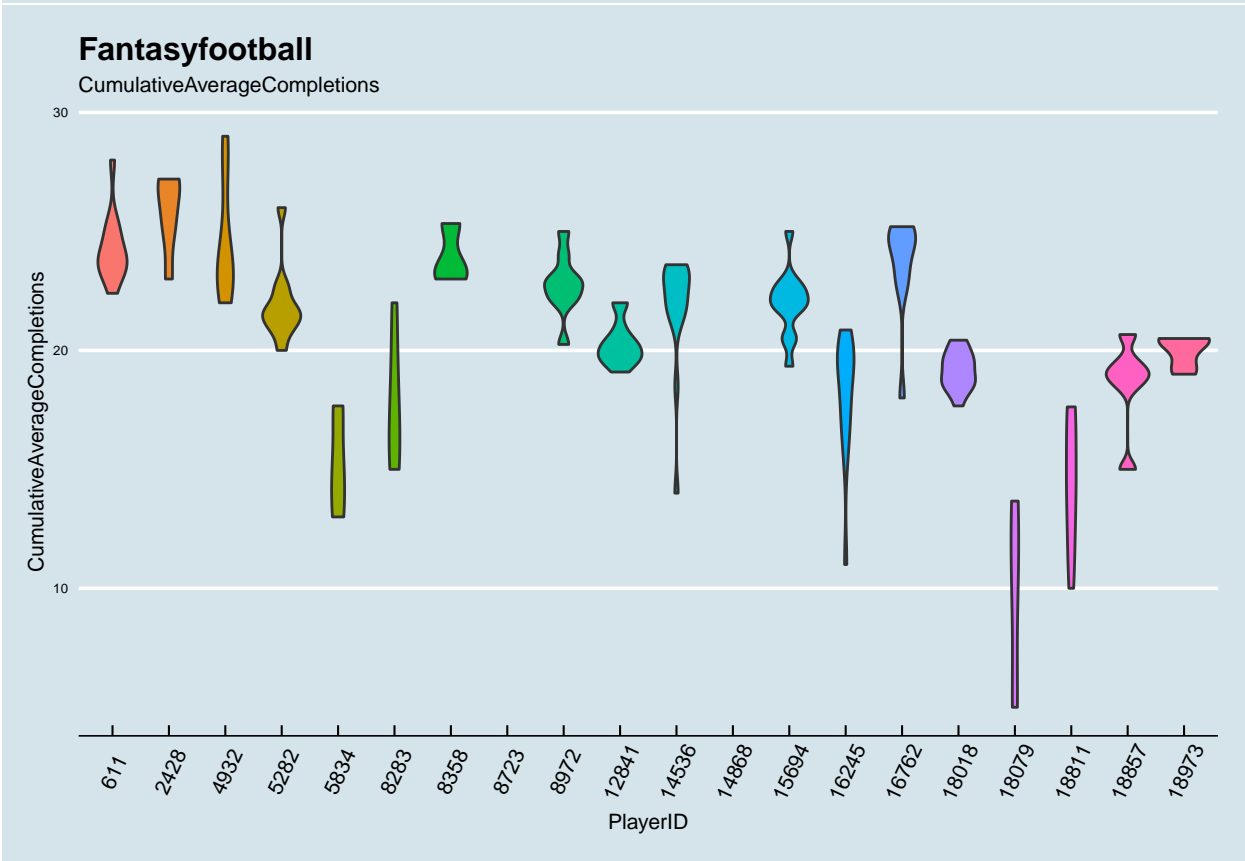
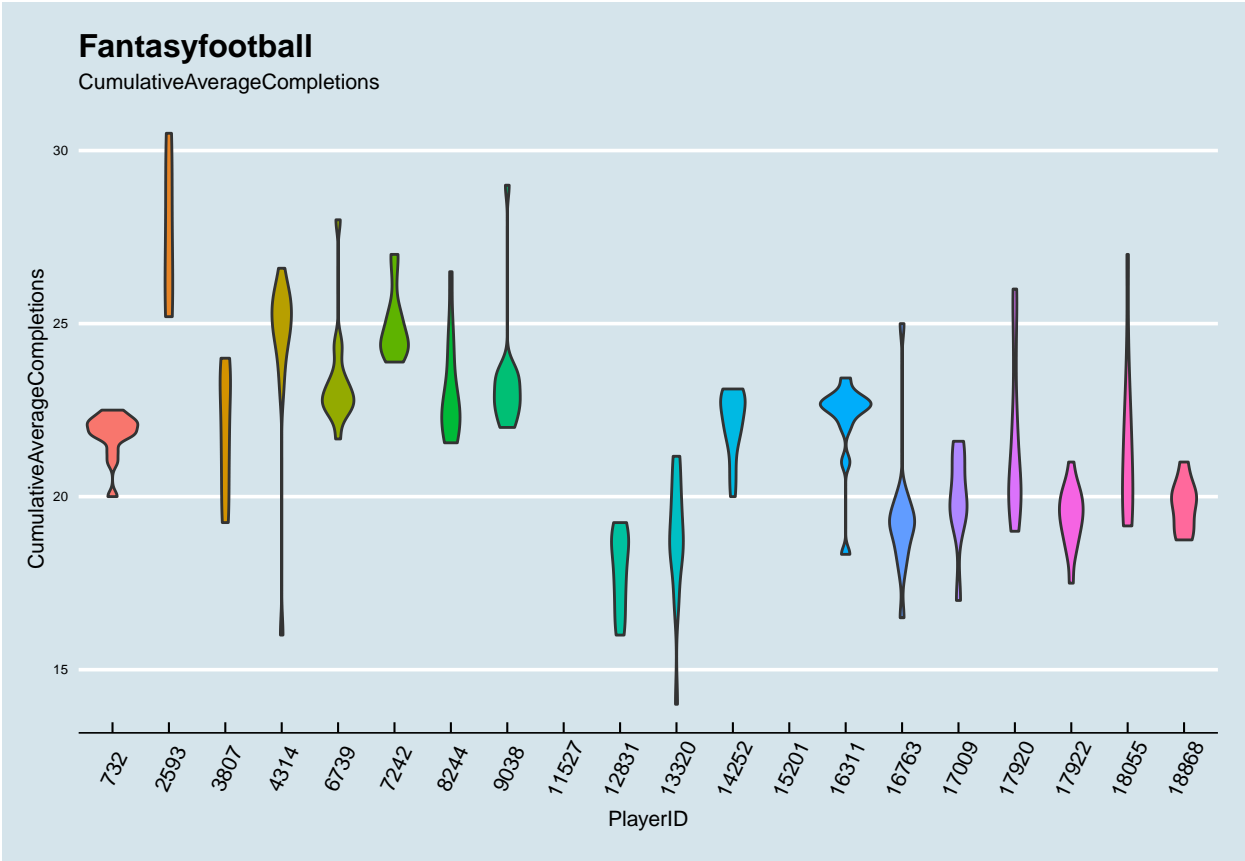
CumulativeAveragePassingTouchdowns



Fantasyfootball

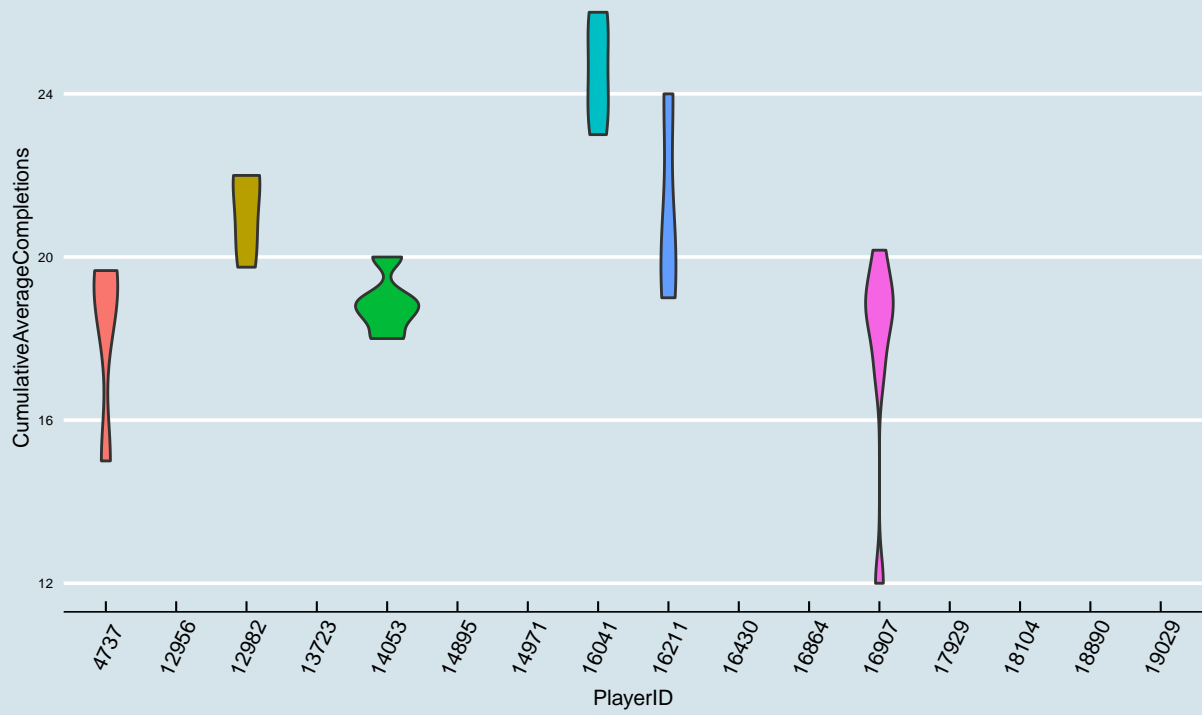
CumulativeAveragePassingTouchdowns





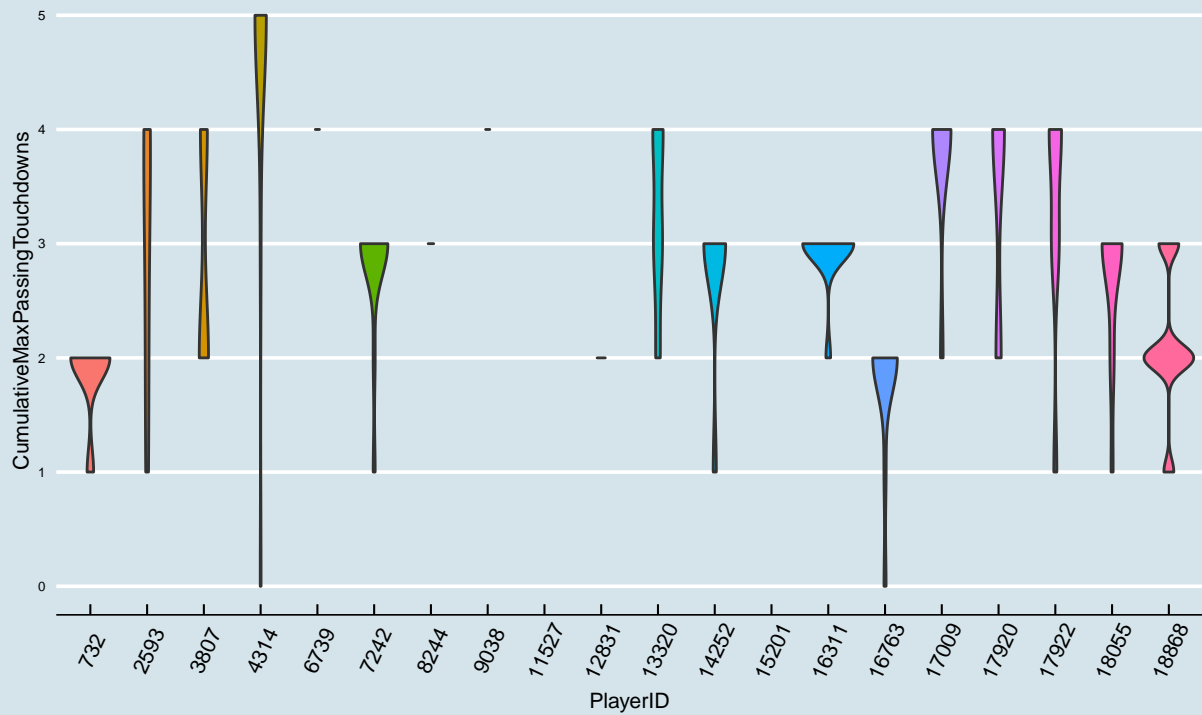
Fantasyfootball

CumulativeAverageCompletions



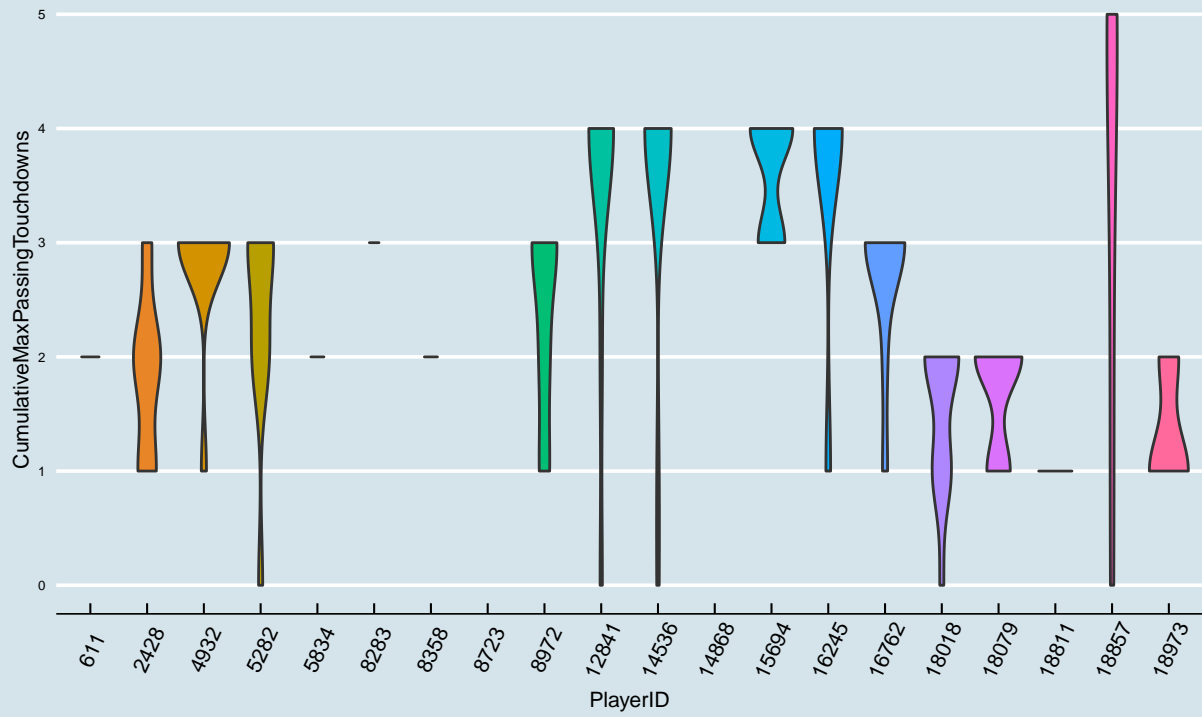
Fantasyfootball

CumulativeMaxPassingTouchdowns



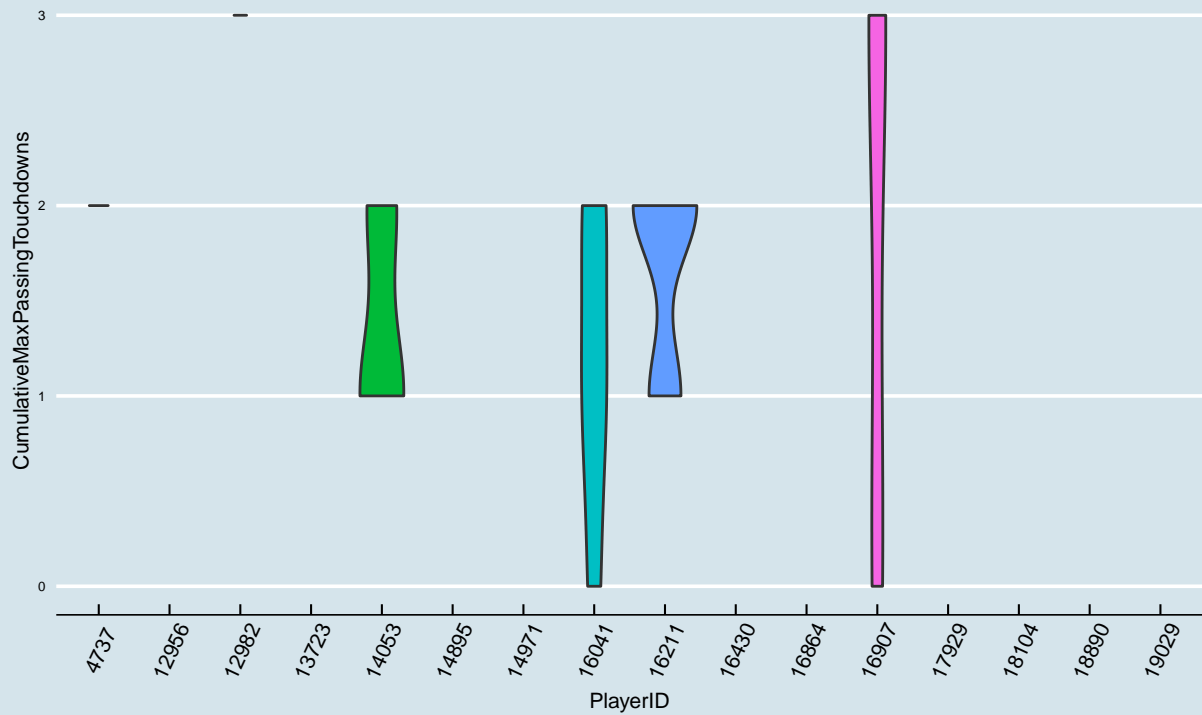
Fantasyfootball

CumulativeMaxPassingTouchdowns



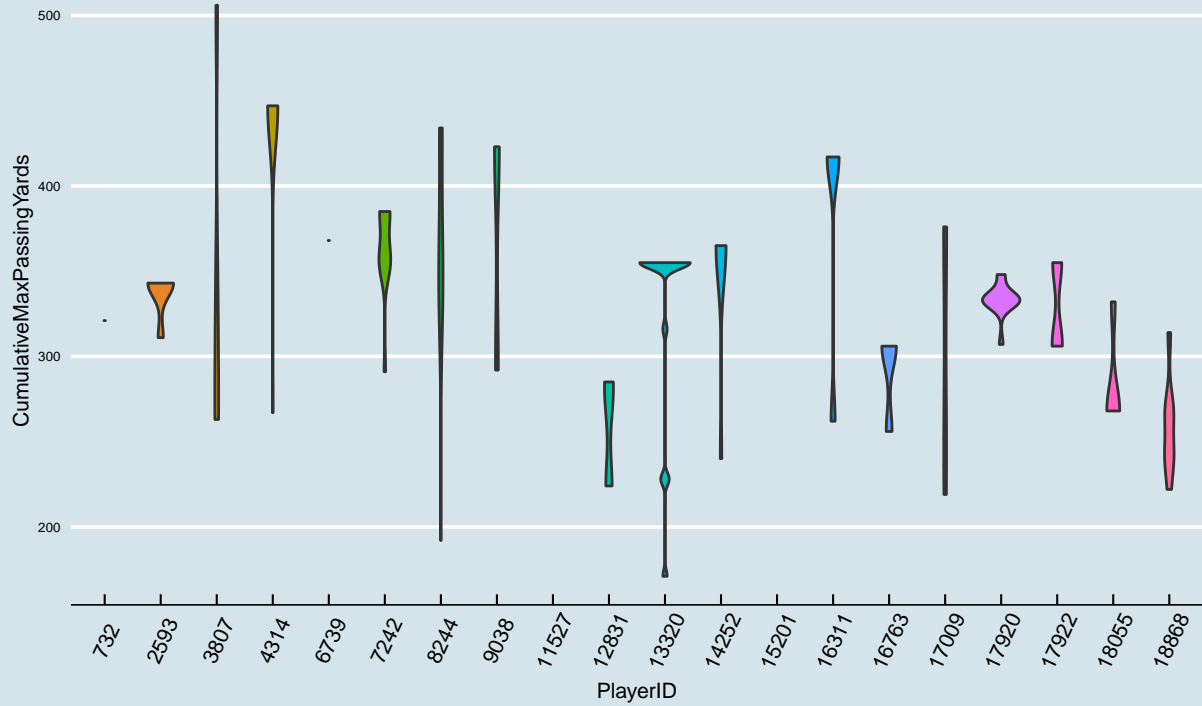
Fantasyfootball

CumulativeMaxPassingTouchdowns



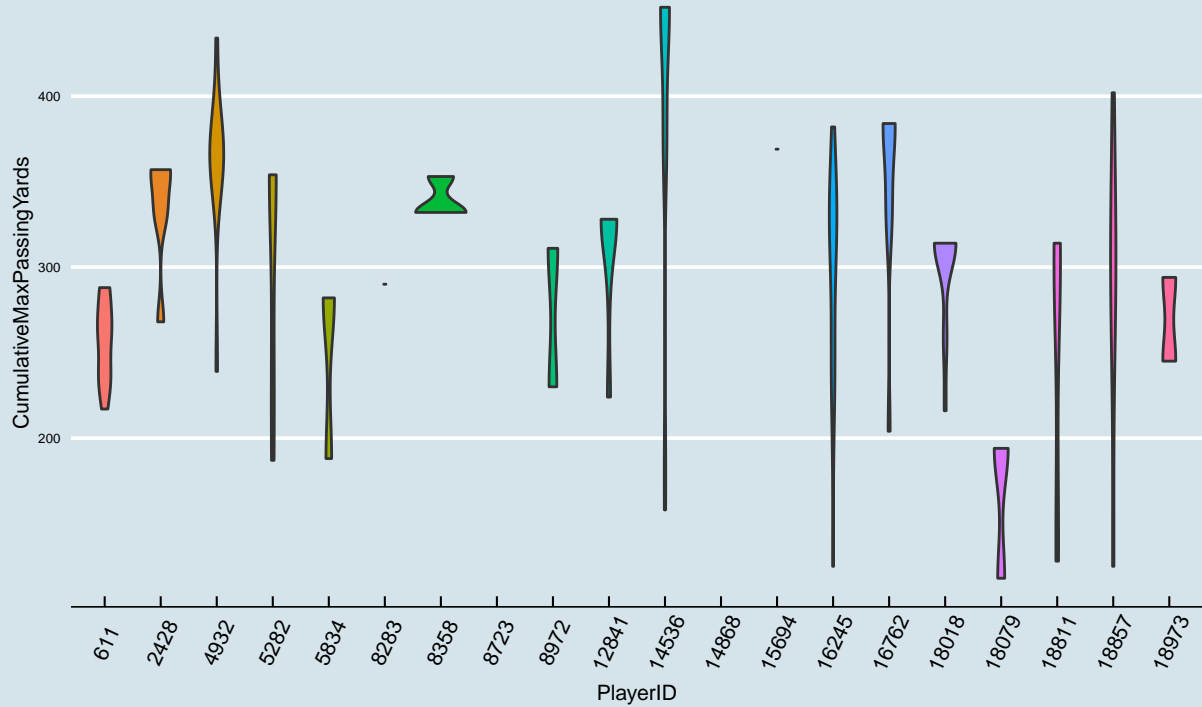
Fantasyfootball

CumulativeMaxPassingYards



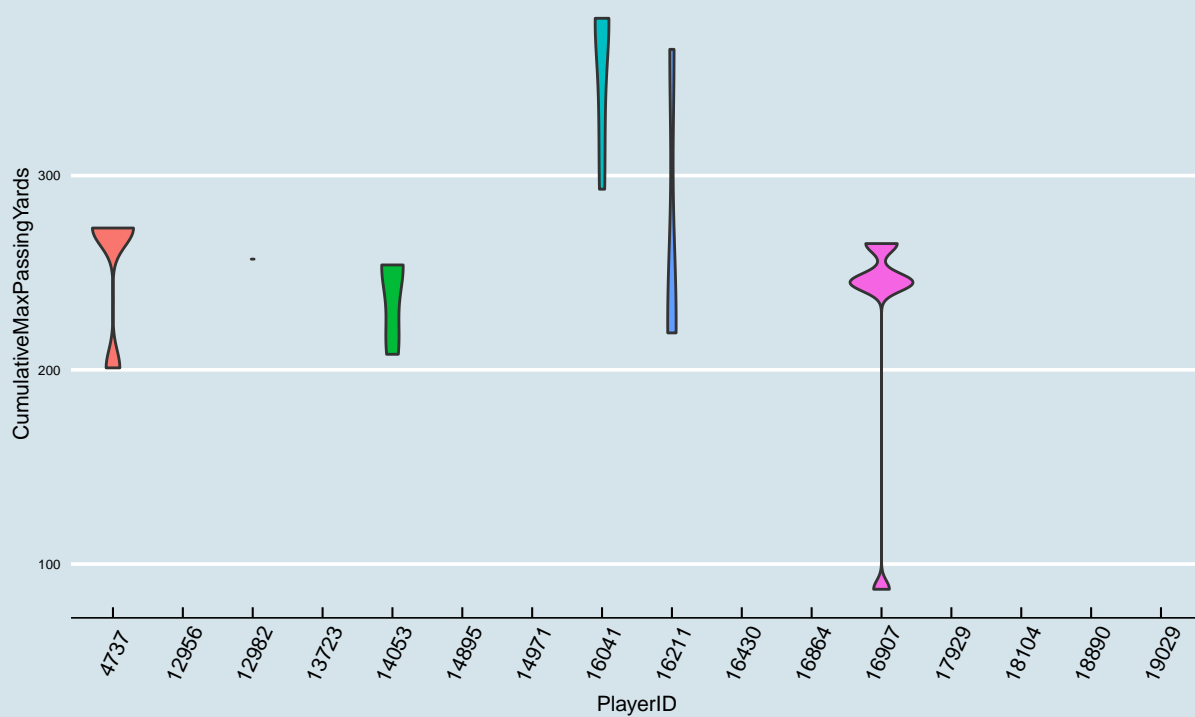
Fantasyfootball

CumulativeMaxPassingYards



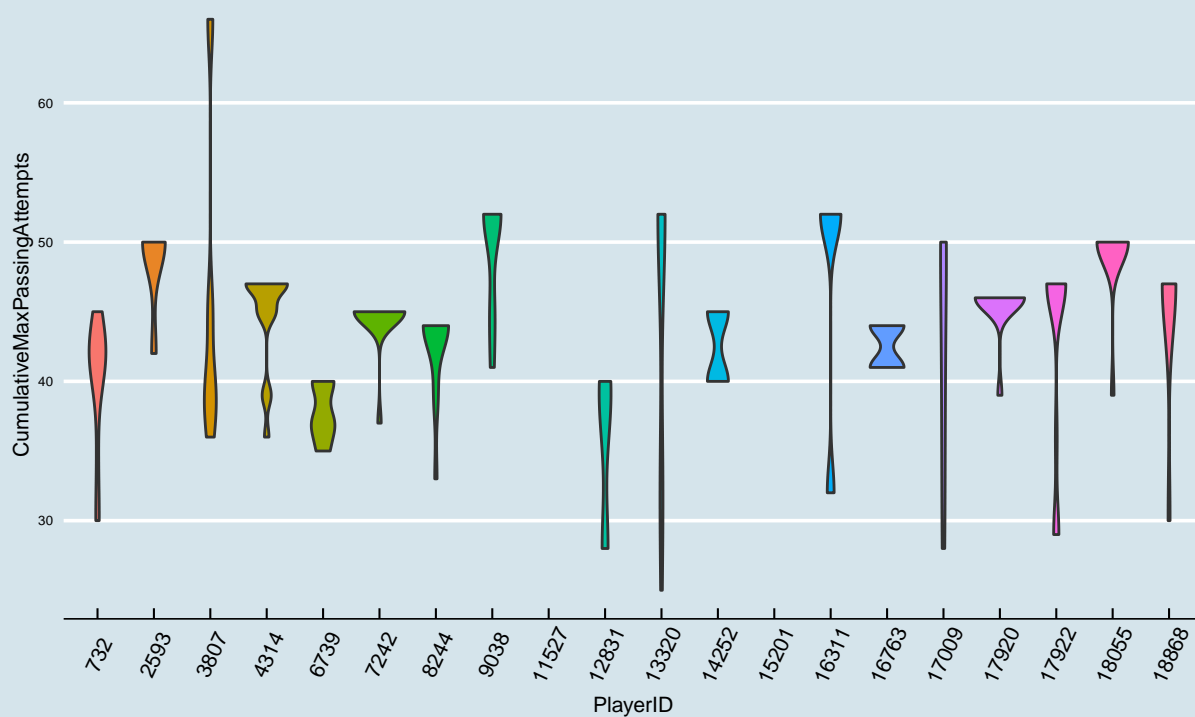
Fantasyfootball

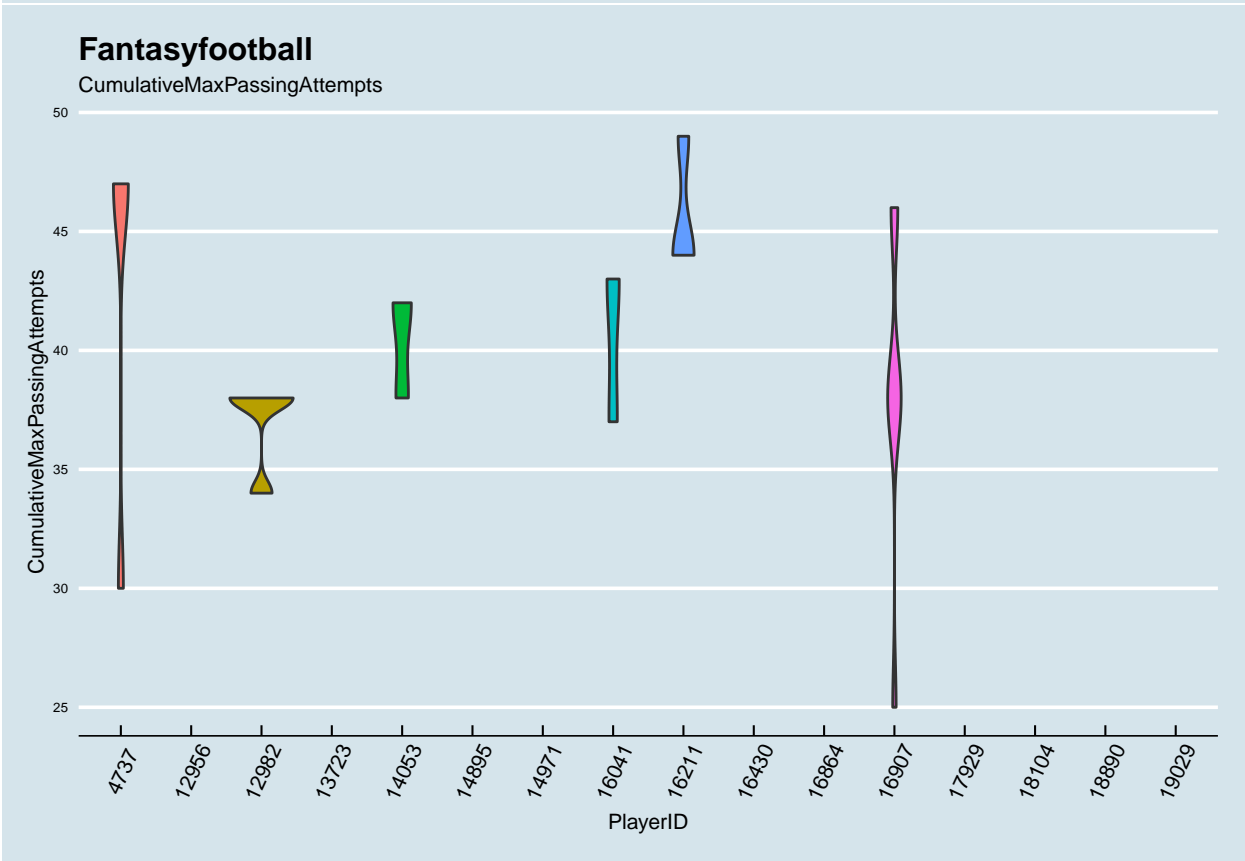
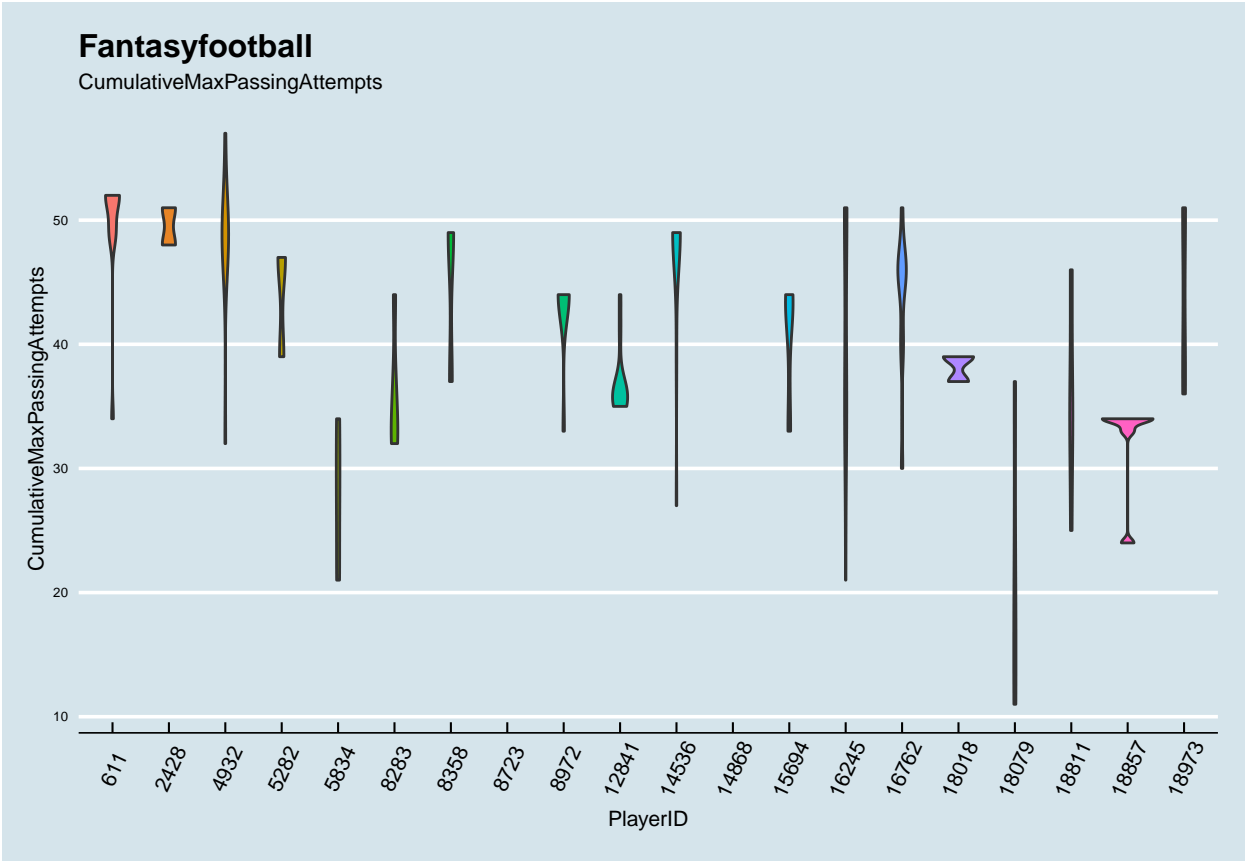
CumulativeMaxPassingYards



Fantasyfootball

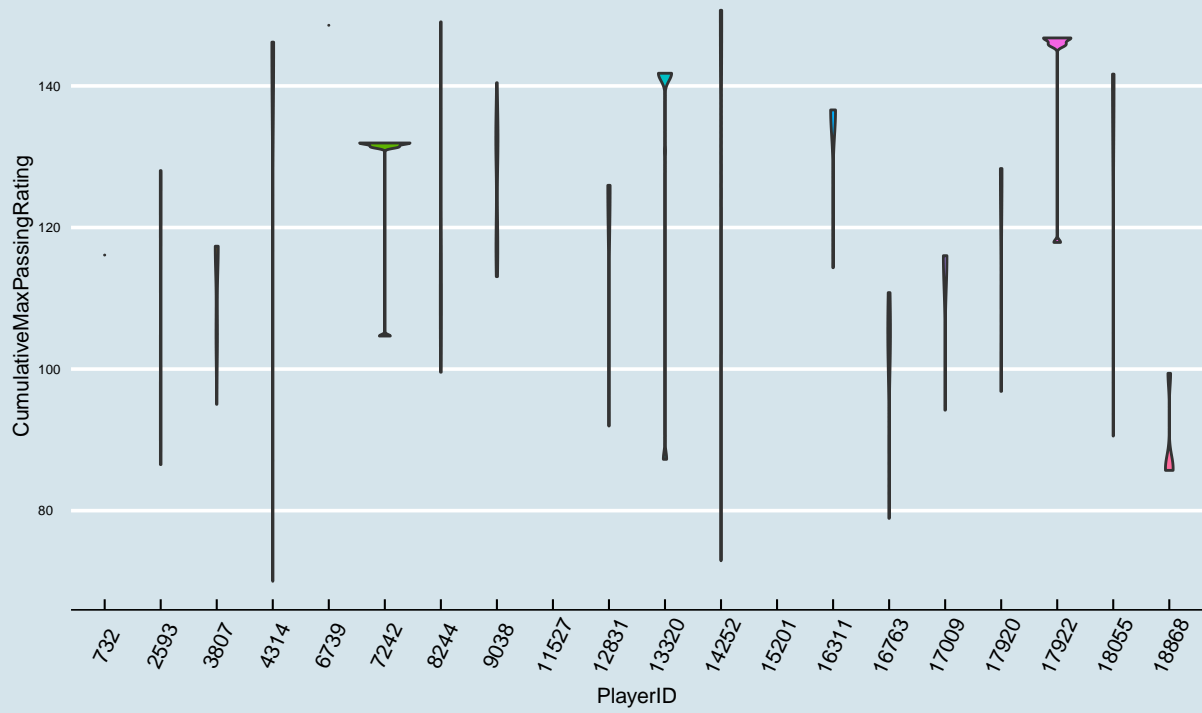
CumulativeMaxPassingAttempts





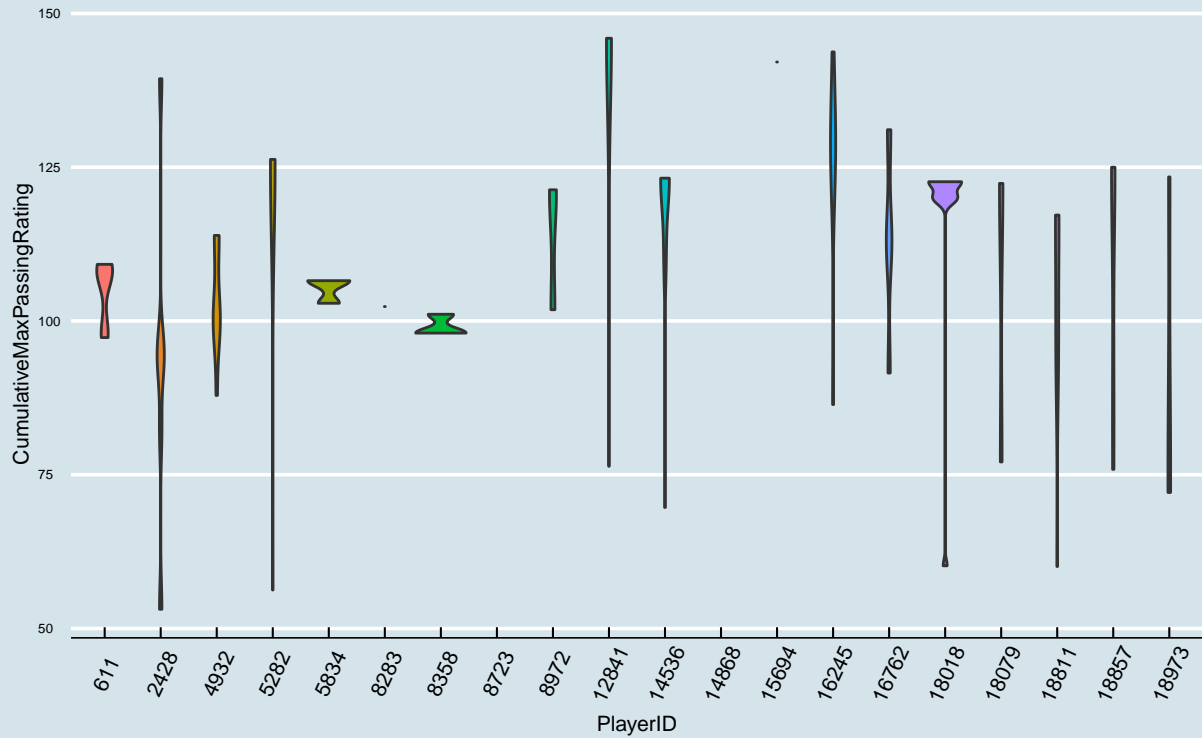
Fantasyfootball

CumulativeMaxPassingRating



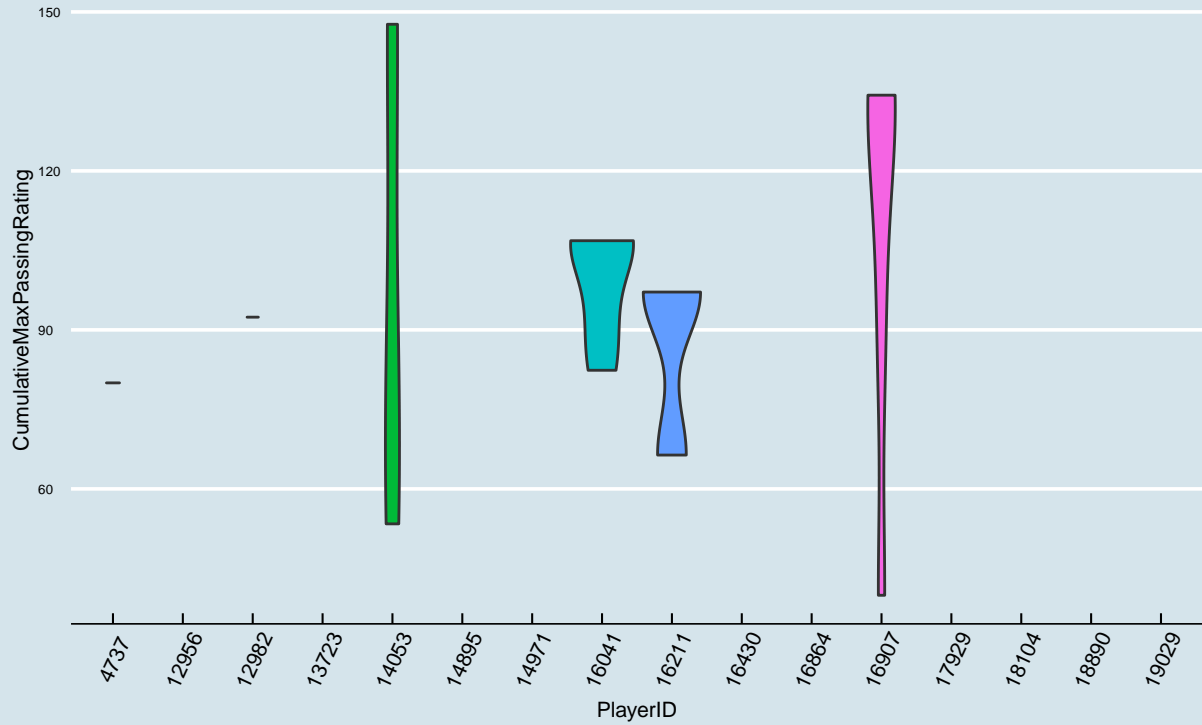
Fantasyfootball

CumulativeMaxPassingRating



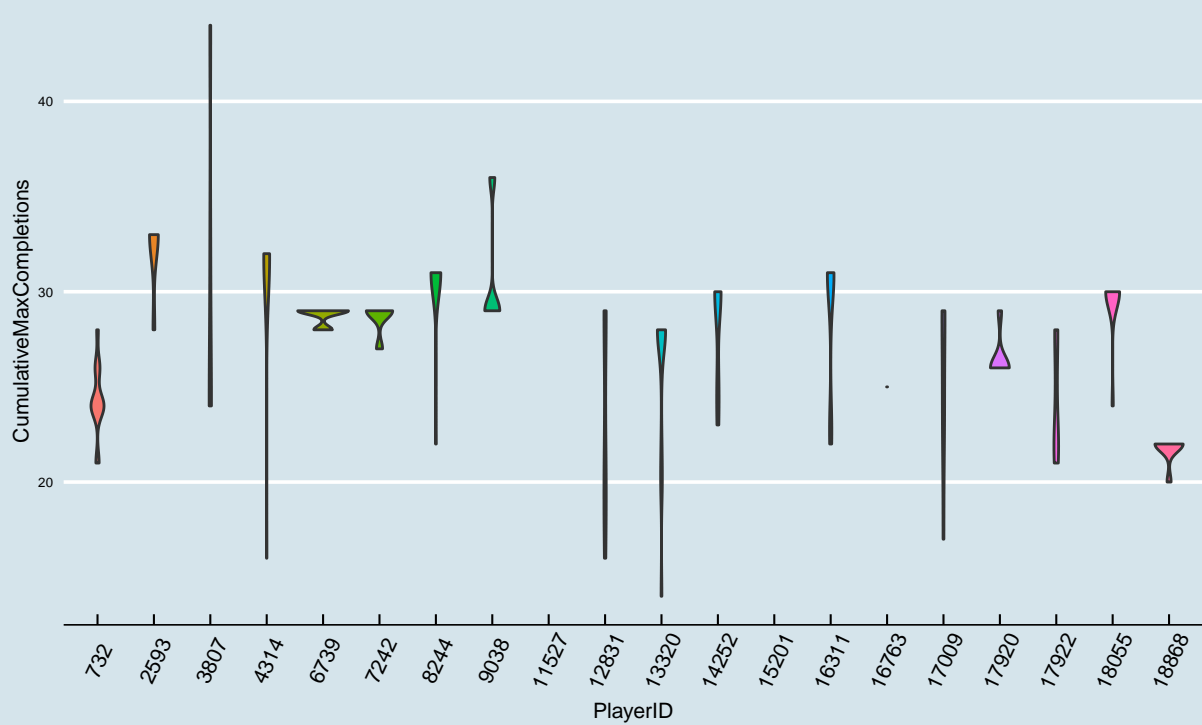
Fantasyfootball

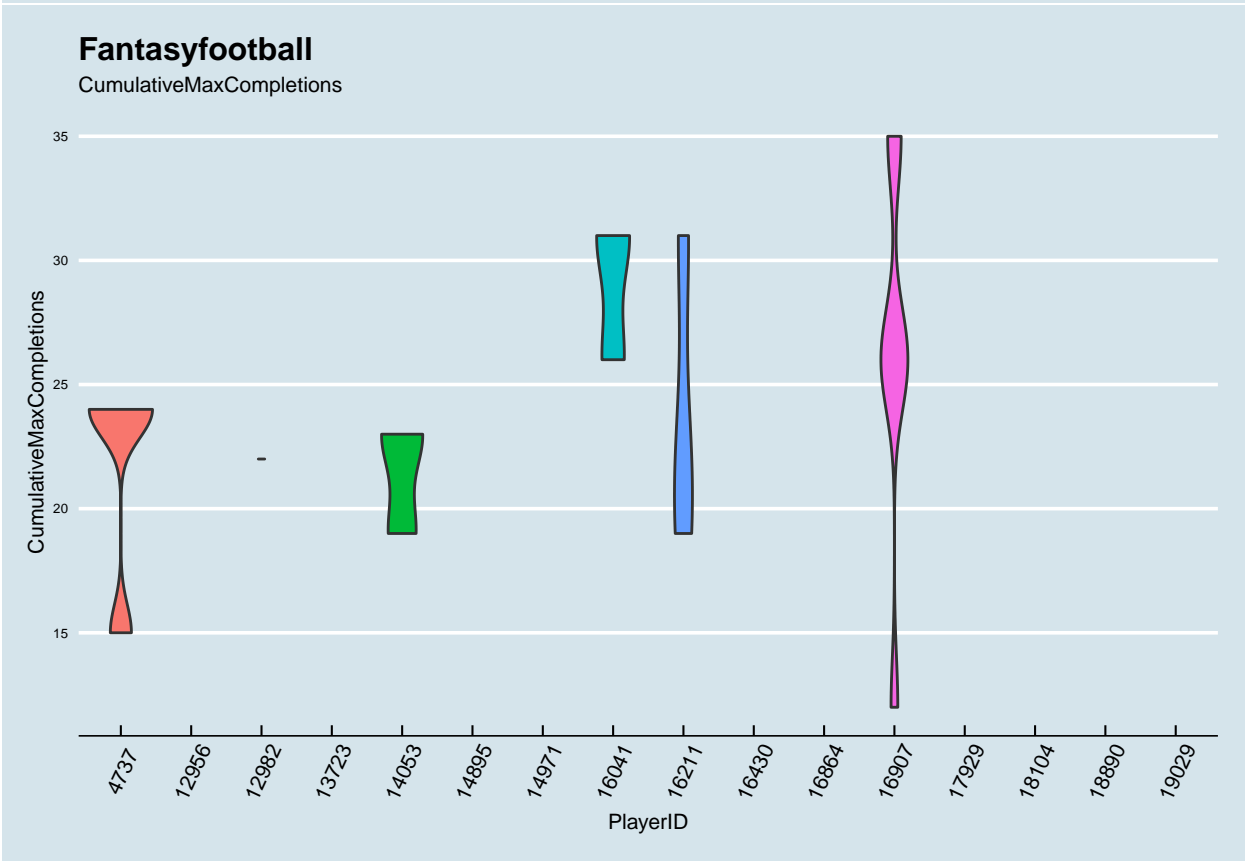
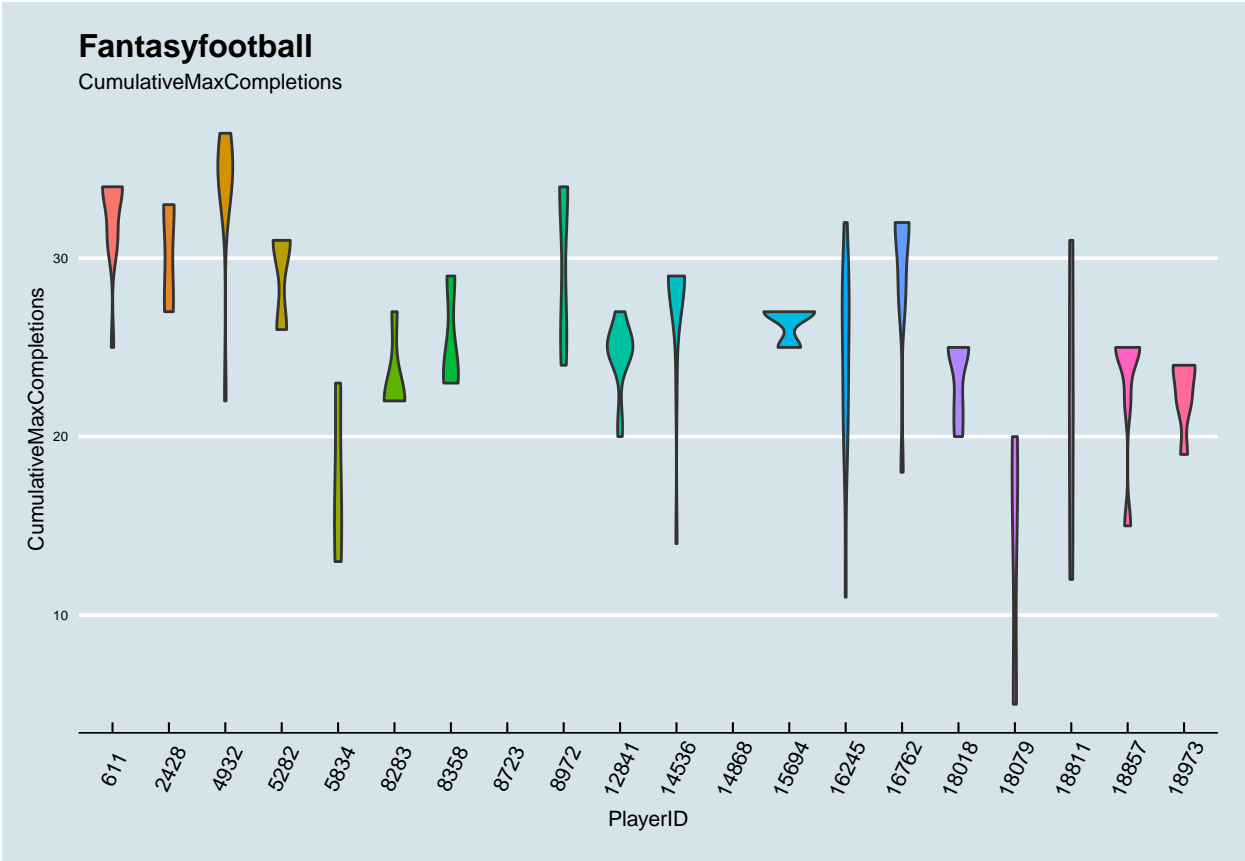
CumulativeMaxPassingRating



Fantasyfootball

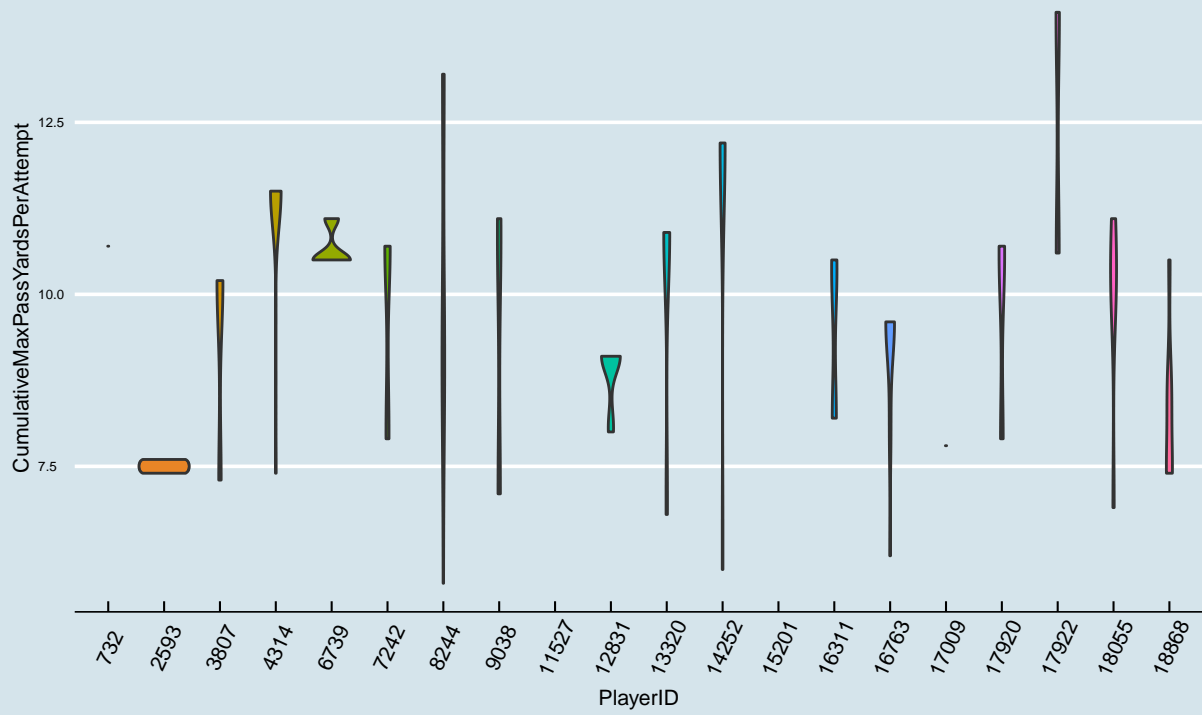
CumulativeMaxCompletions





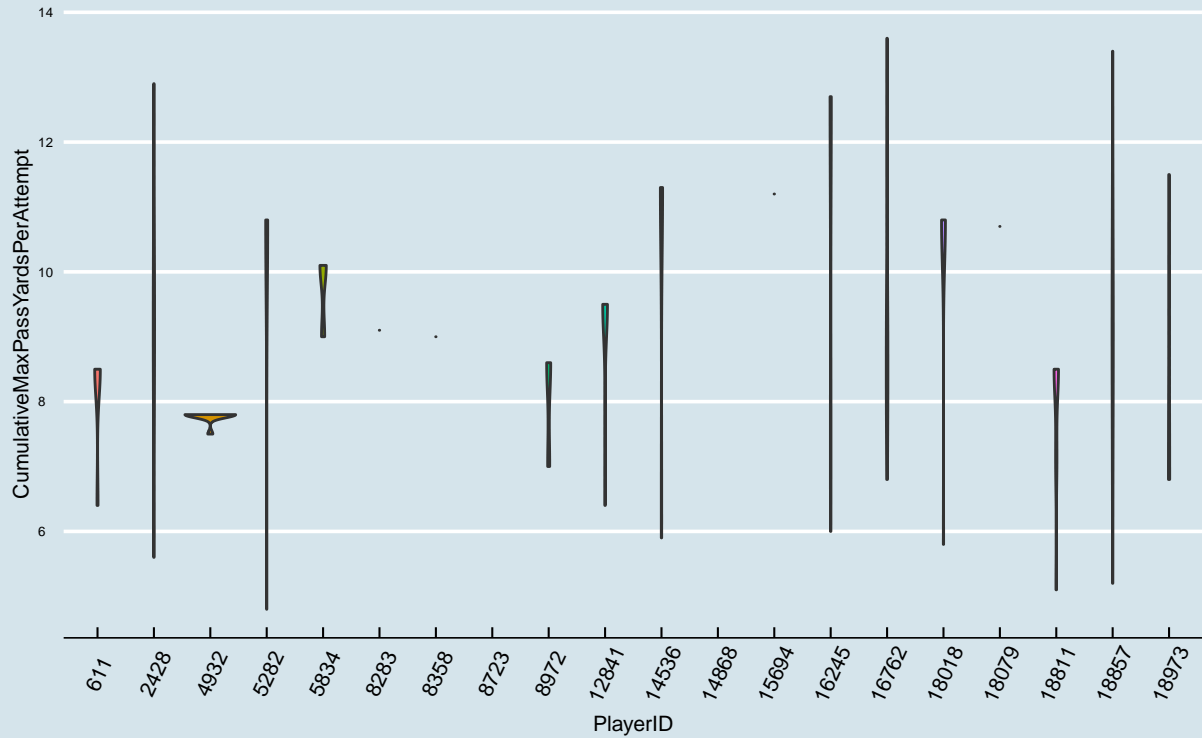
Fantasyfootball

CumulativeMaxPassYardsPerAttempt



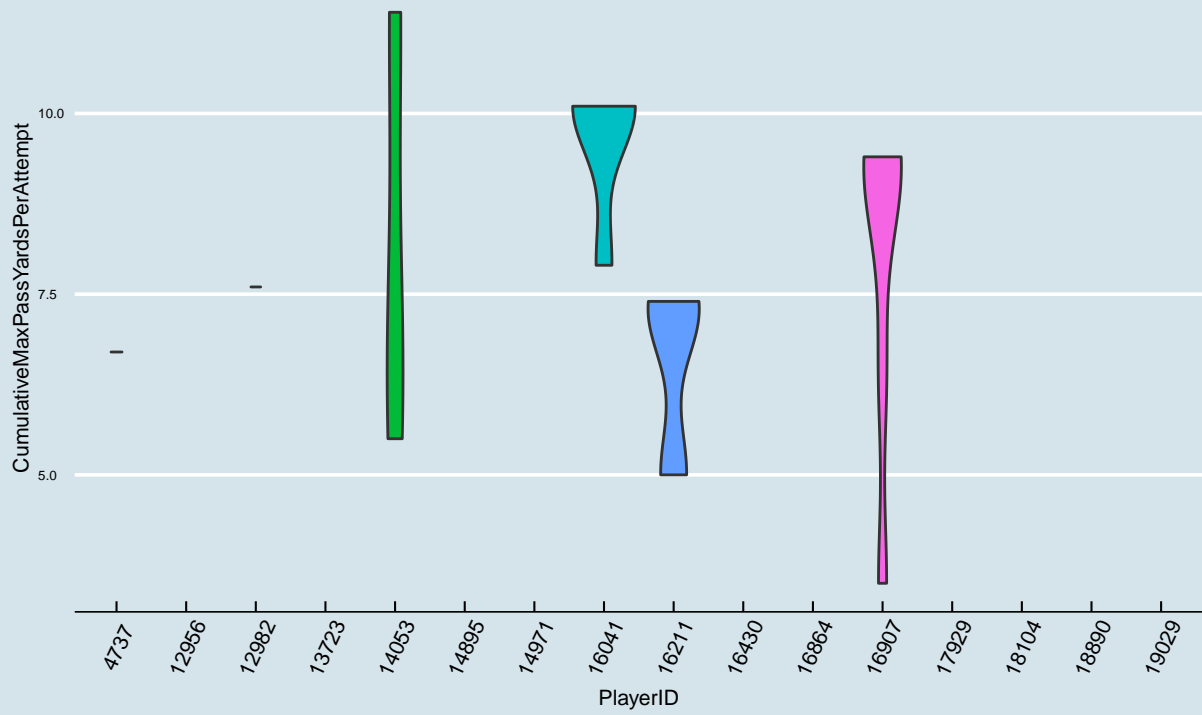
Fantasyfootball

CumulativeMaxPassYardsPerAttempt



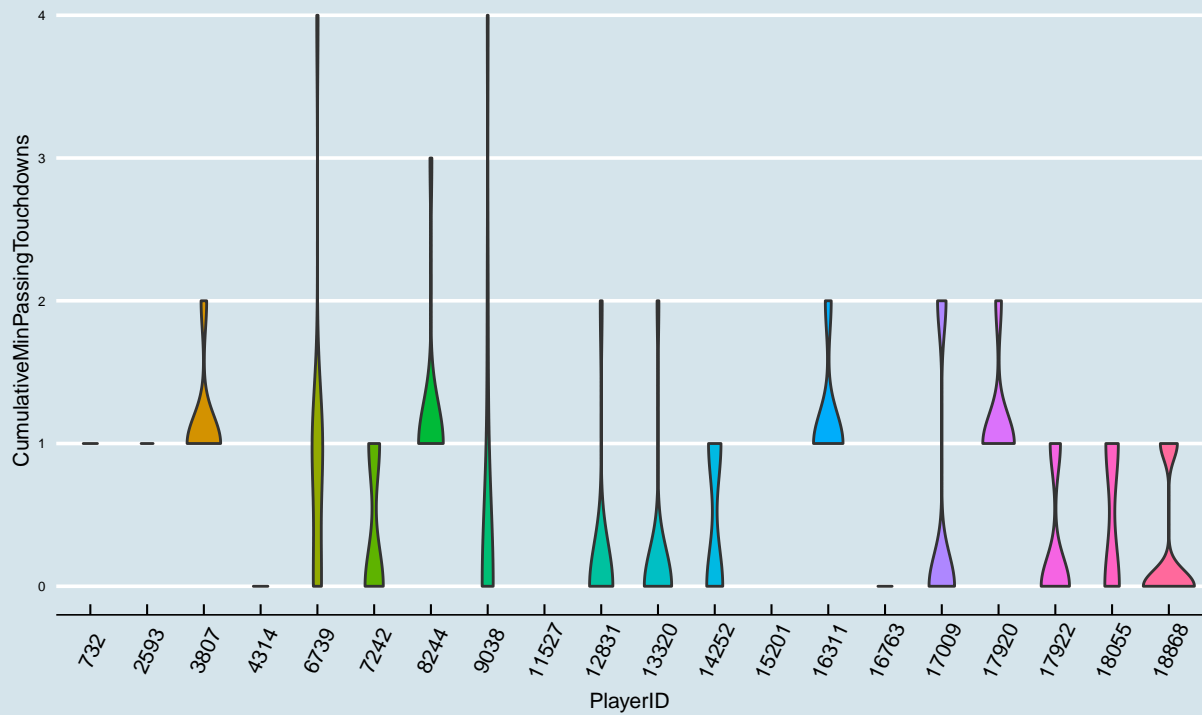
Fantasyfootball

CumulativeMaxPassYardsPerAttempt



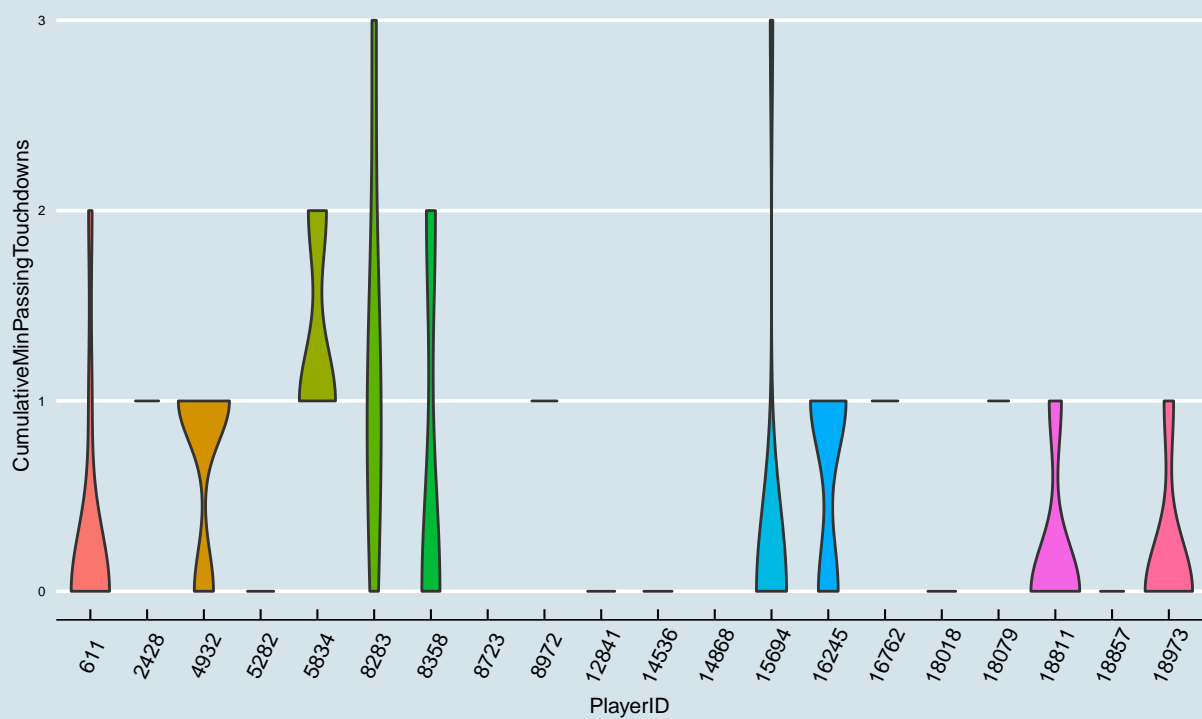
Fantasyfootball

CumulativeMinPassingTouchdowns



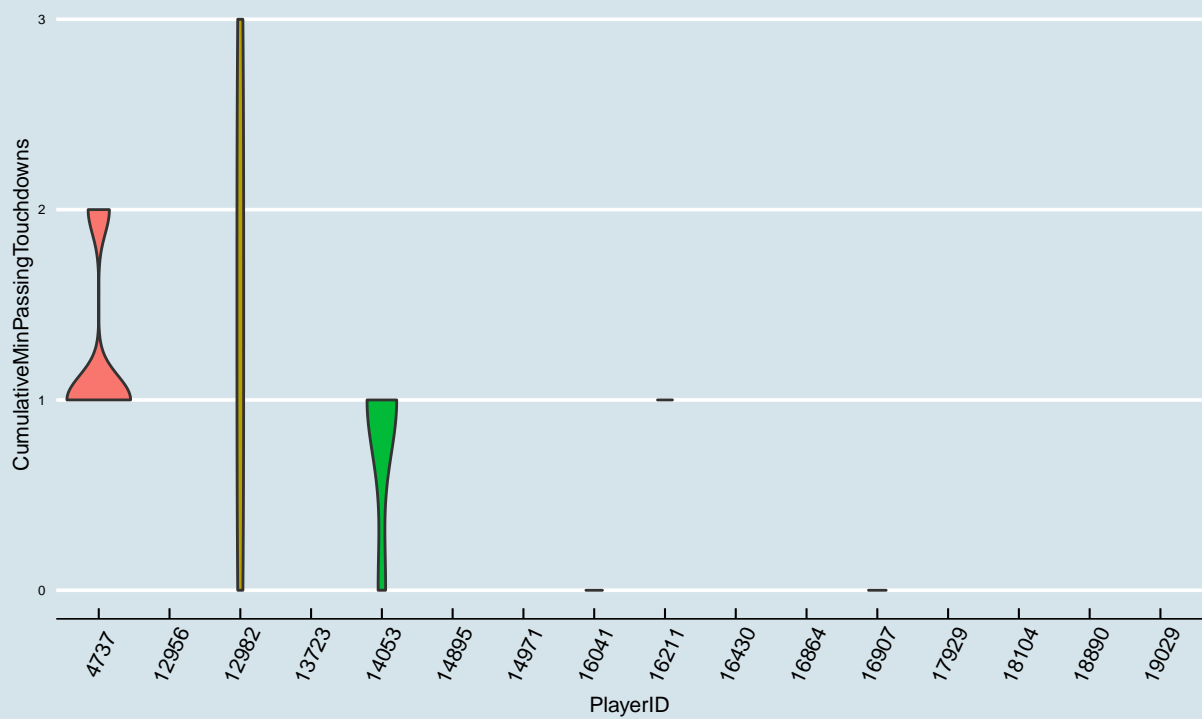
Fantasyfootball

CumulativeMinPassingTouchdowns



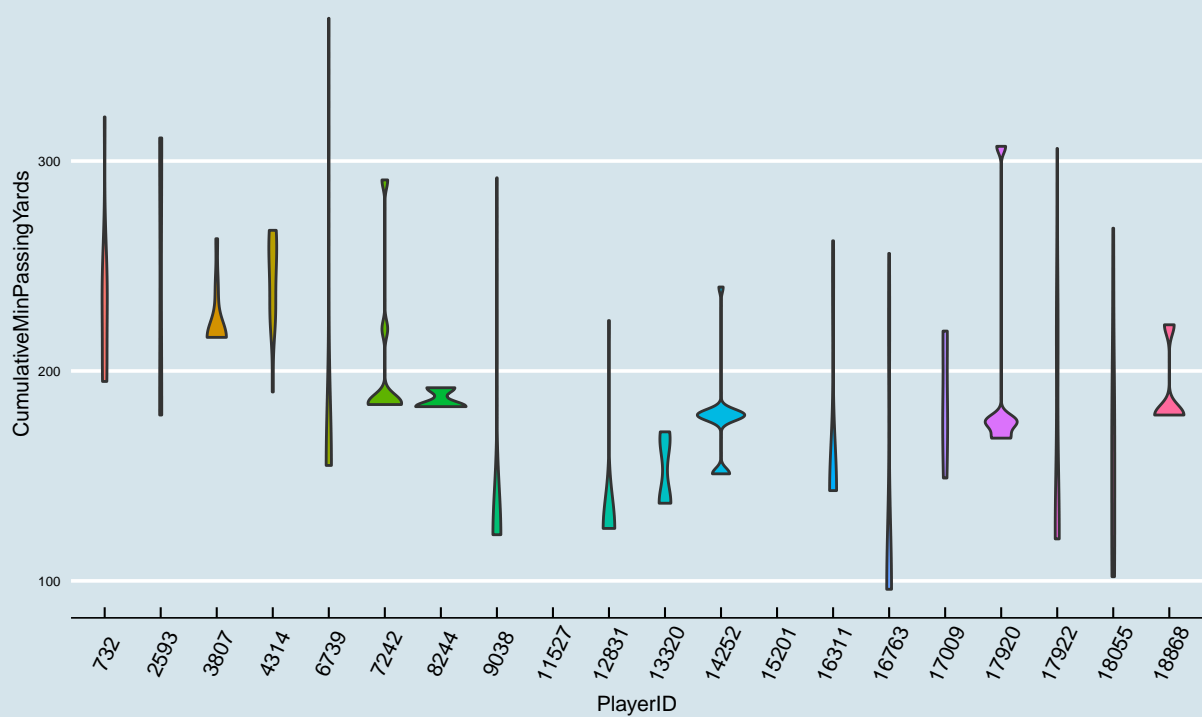
Fantasyfootball

CumulativeMinPassingTouchdowns



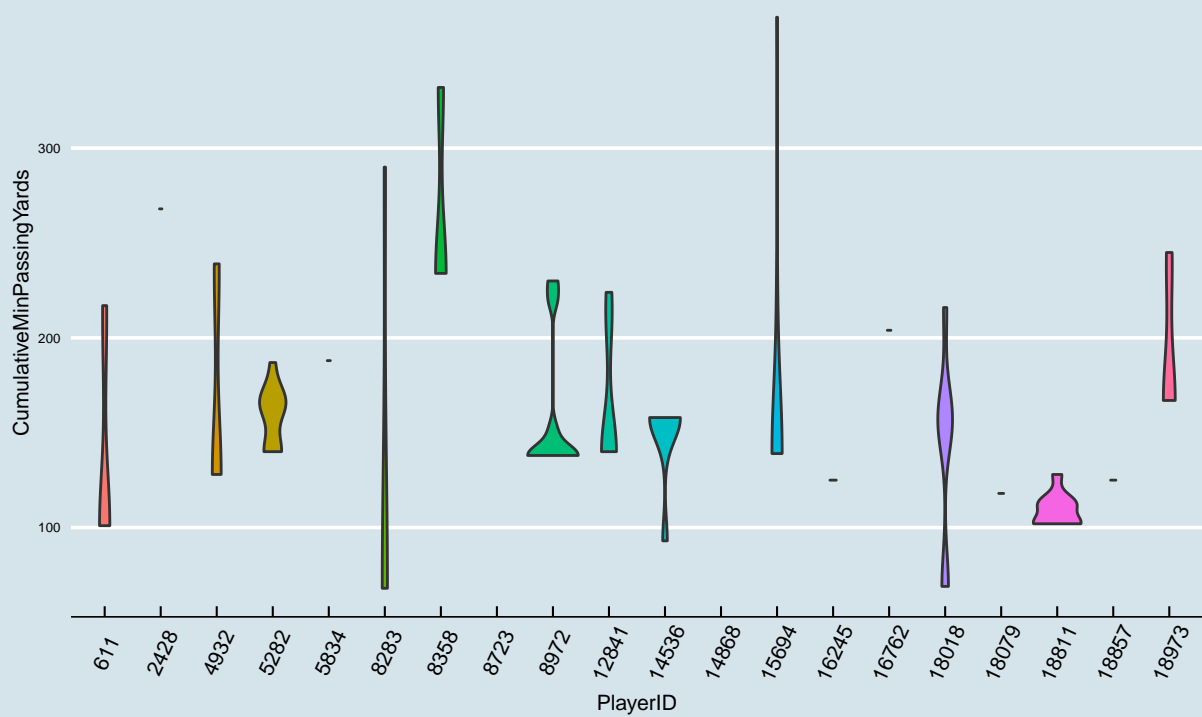
Fantasyfootball

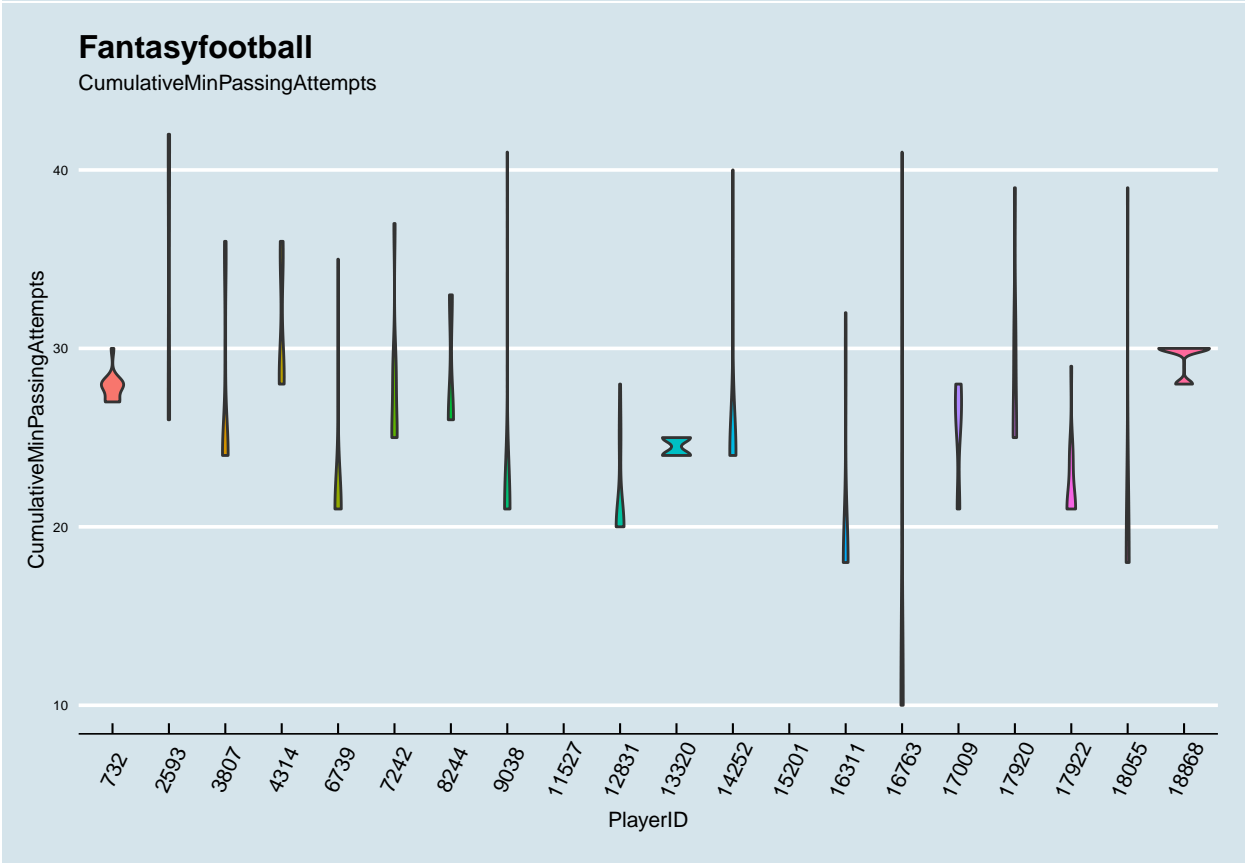
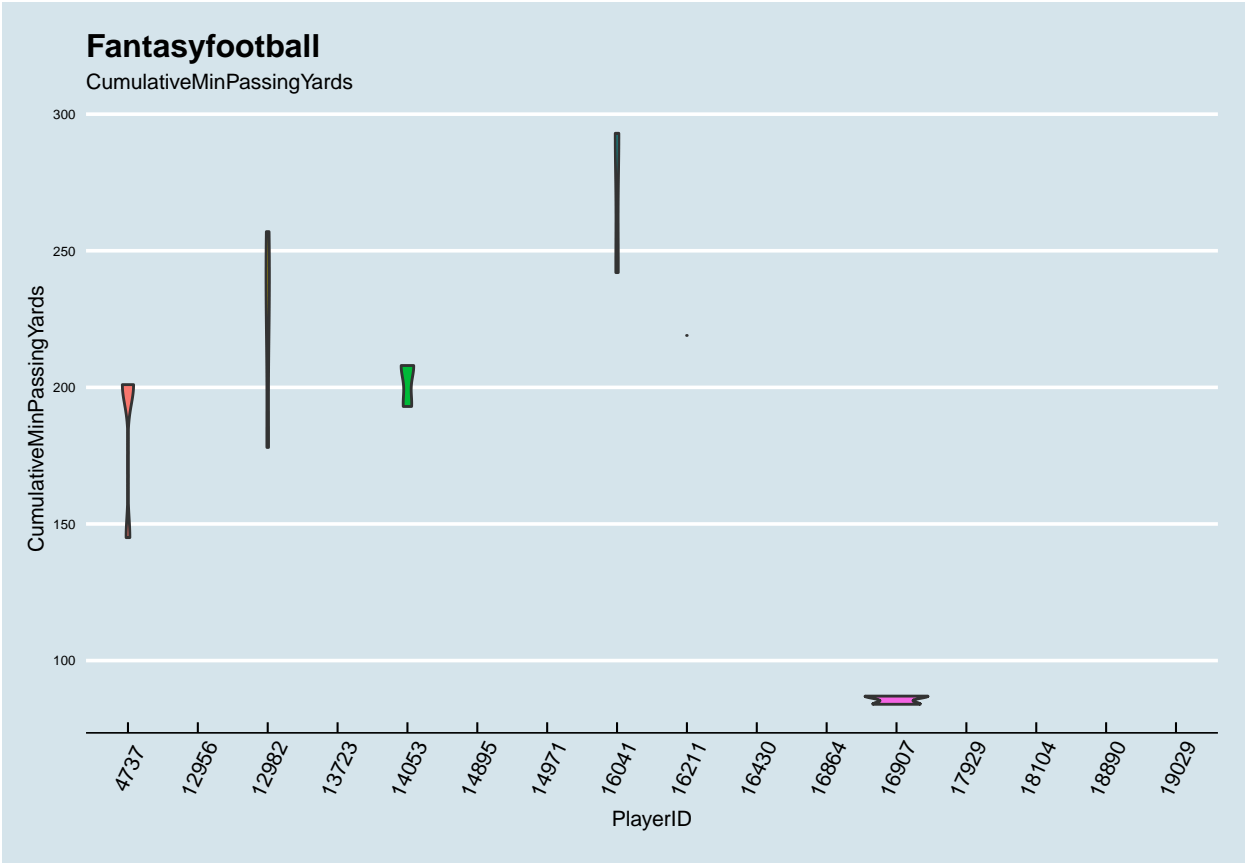
CumulativeMinPassingYards

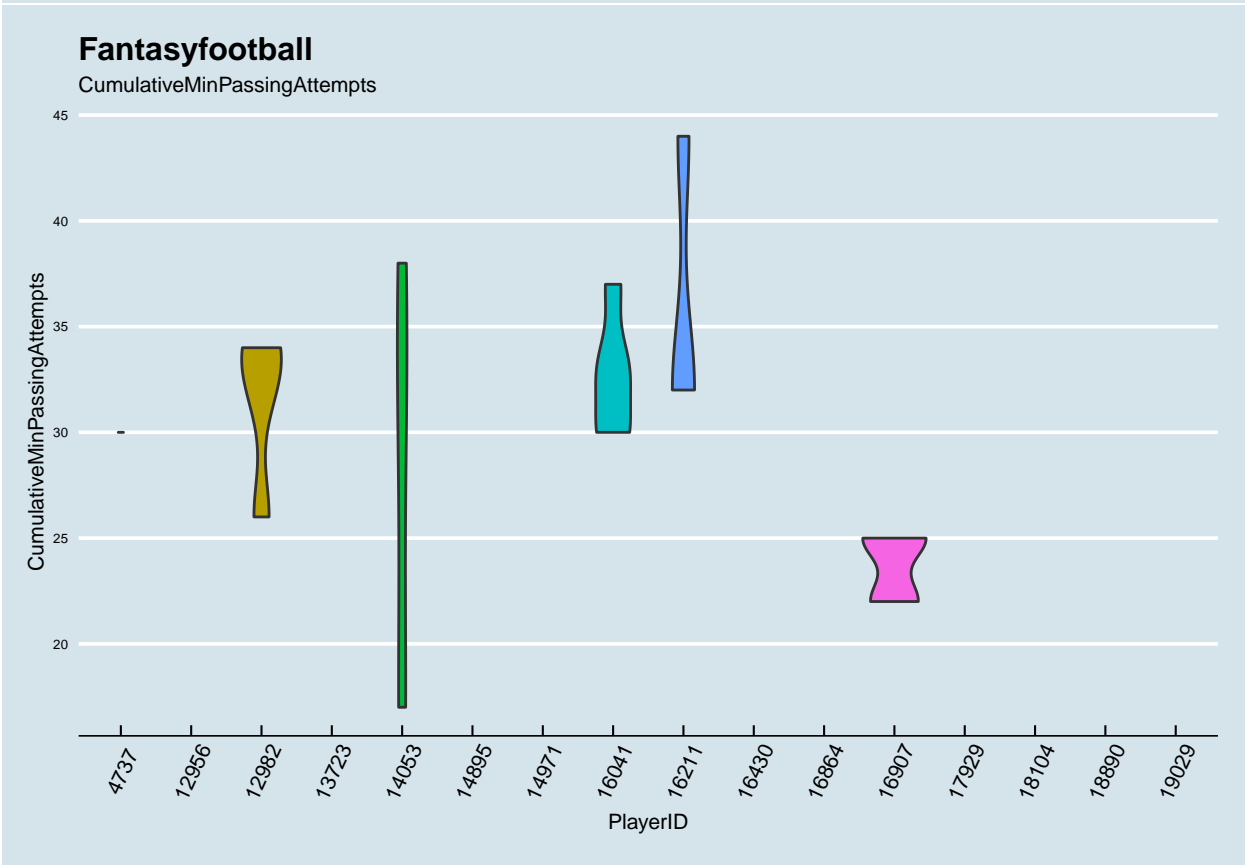
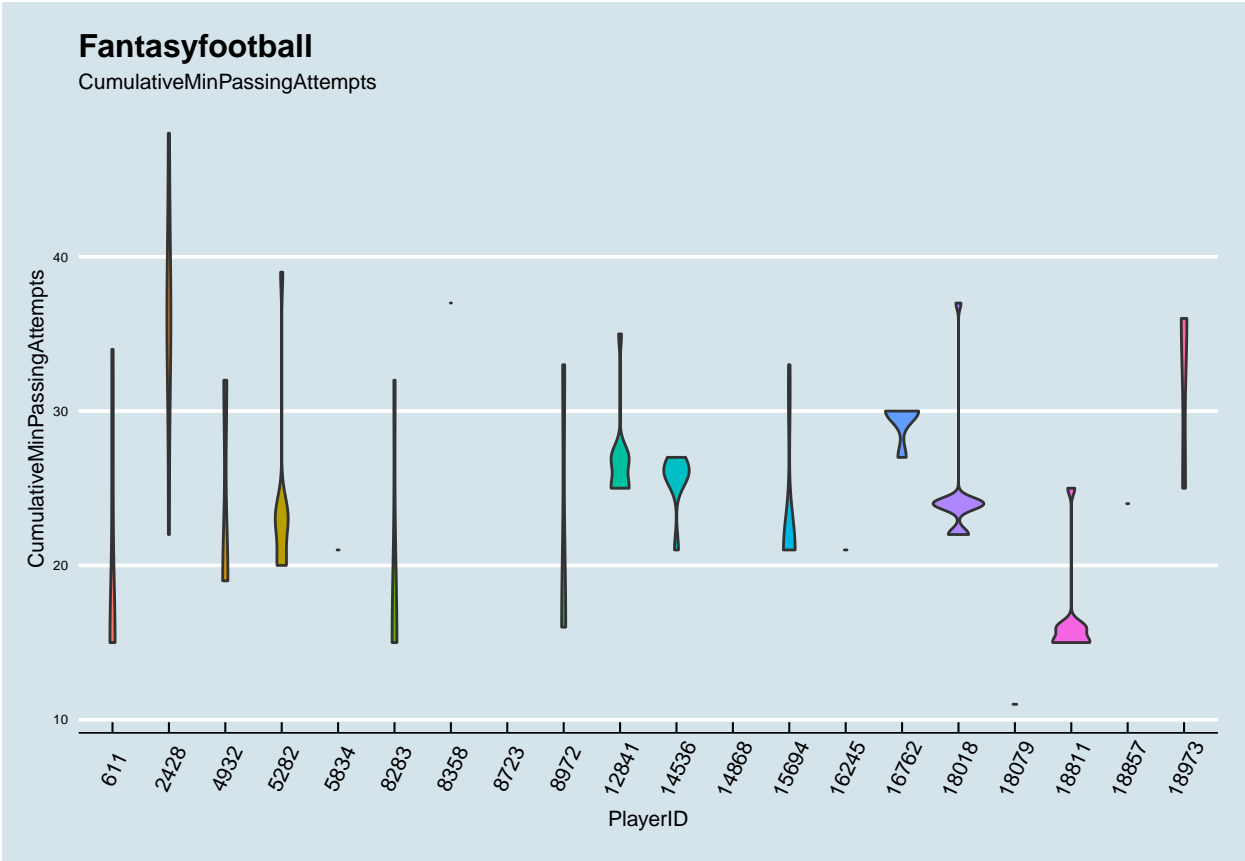


Fantasyfootball

CumulativeMinPassingYards

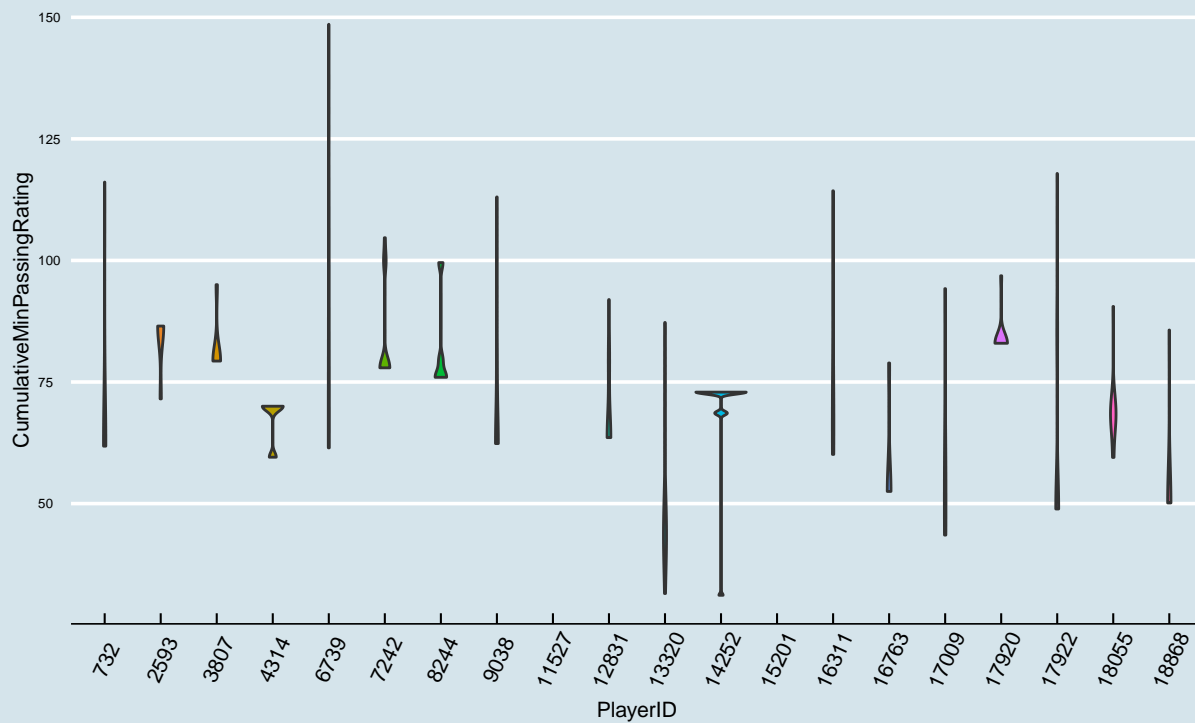






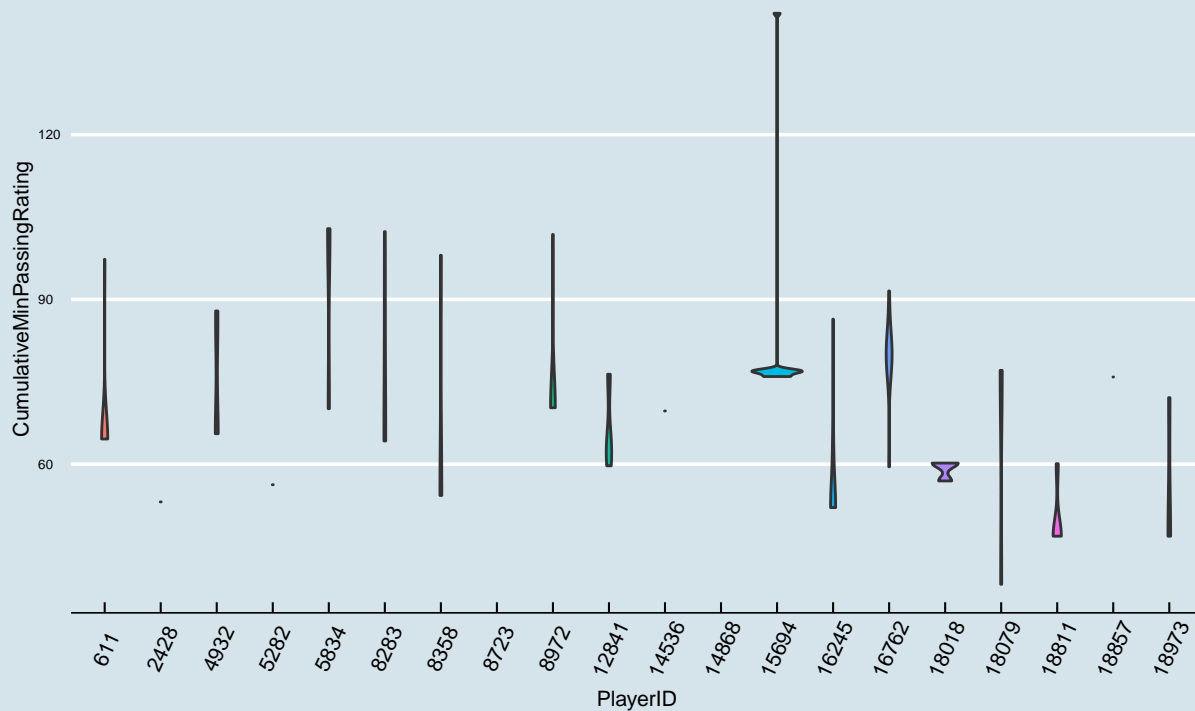
Fantasyfootball

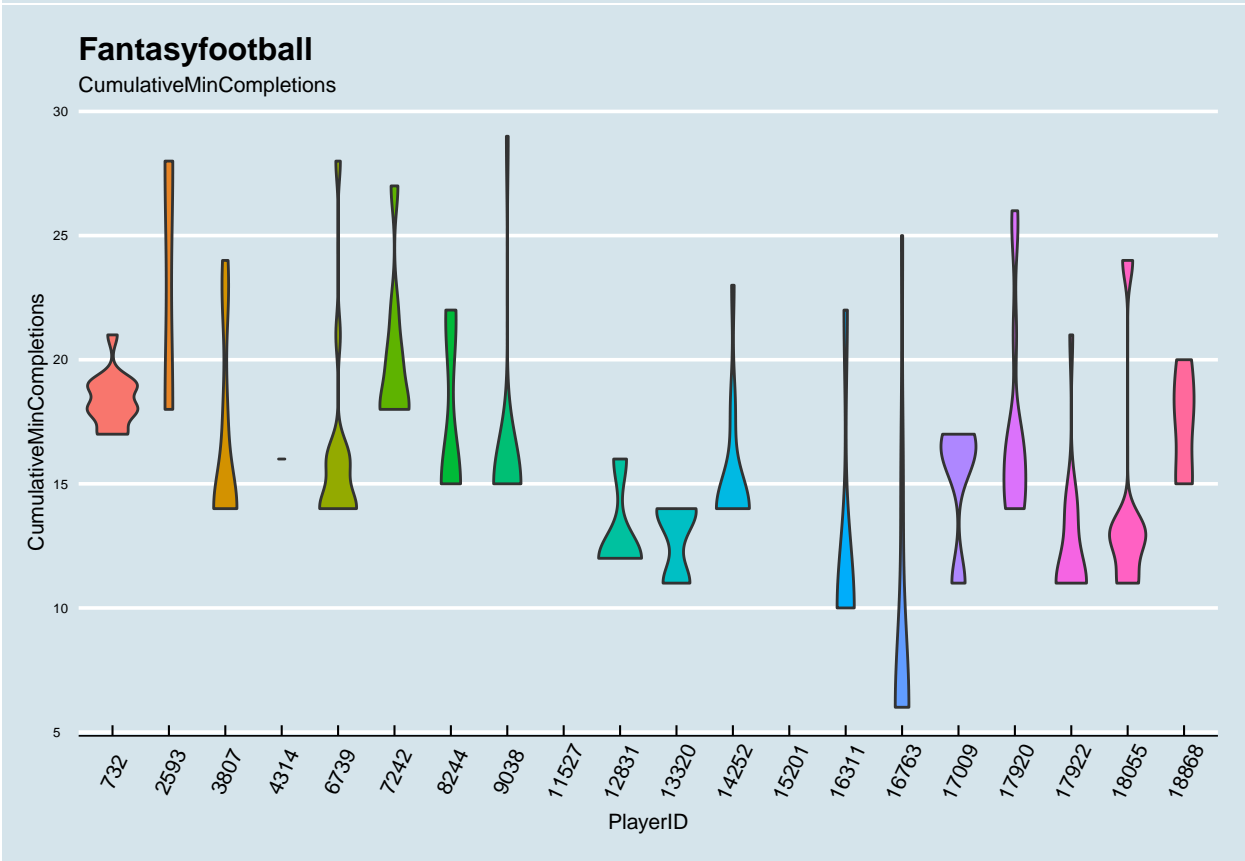
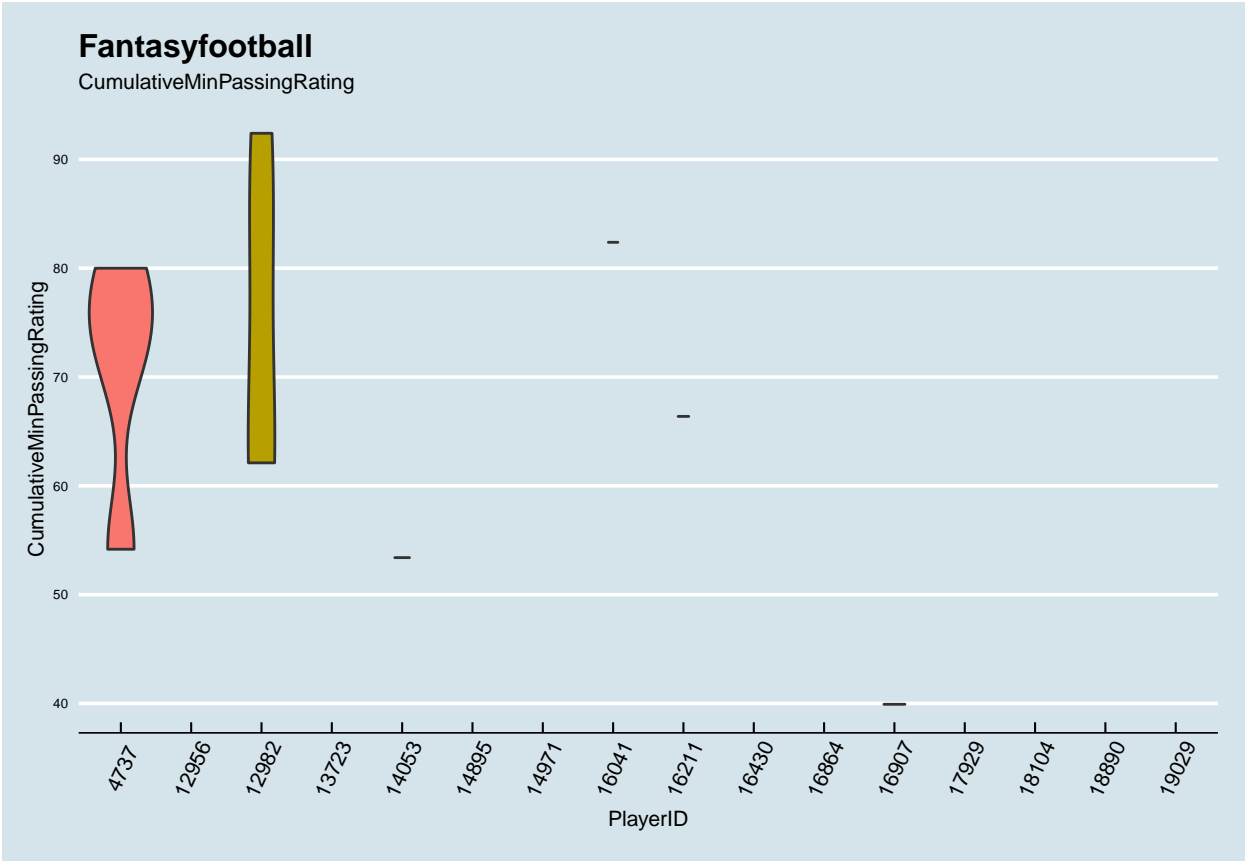
CumulativeMinPassingRating

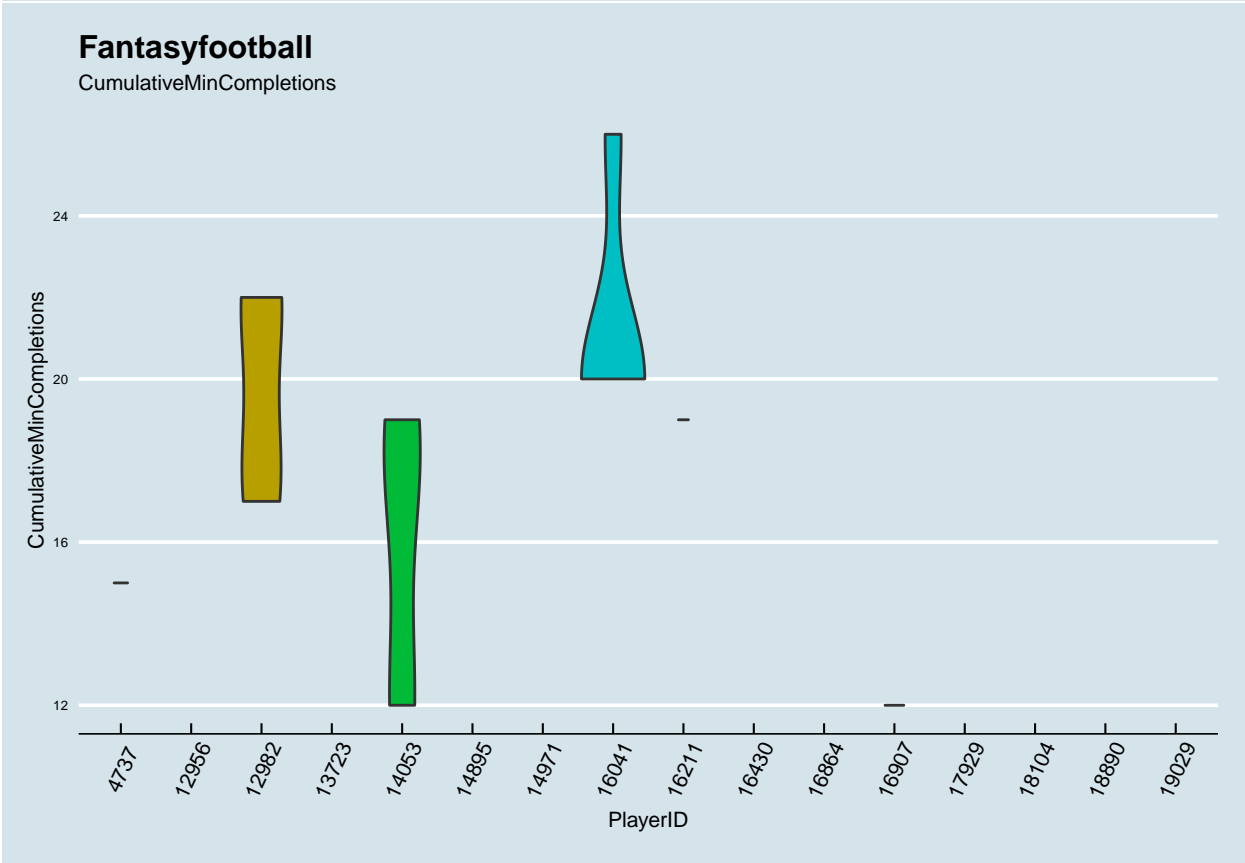
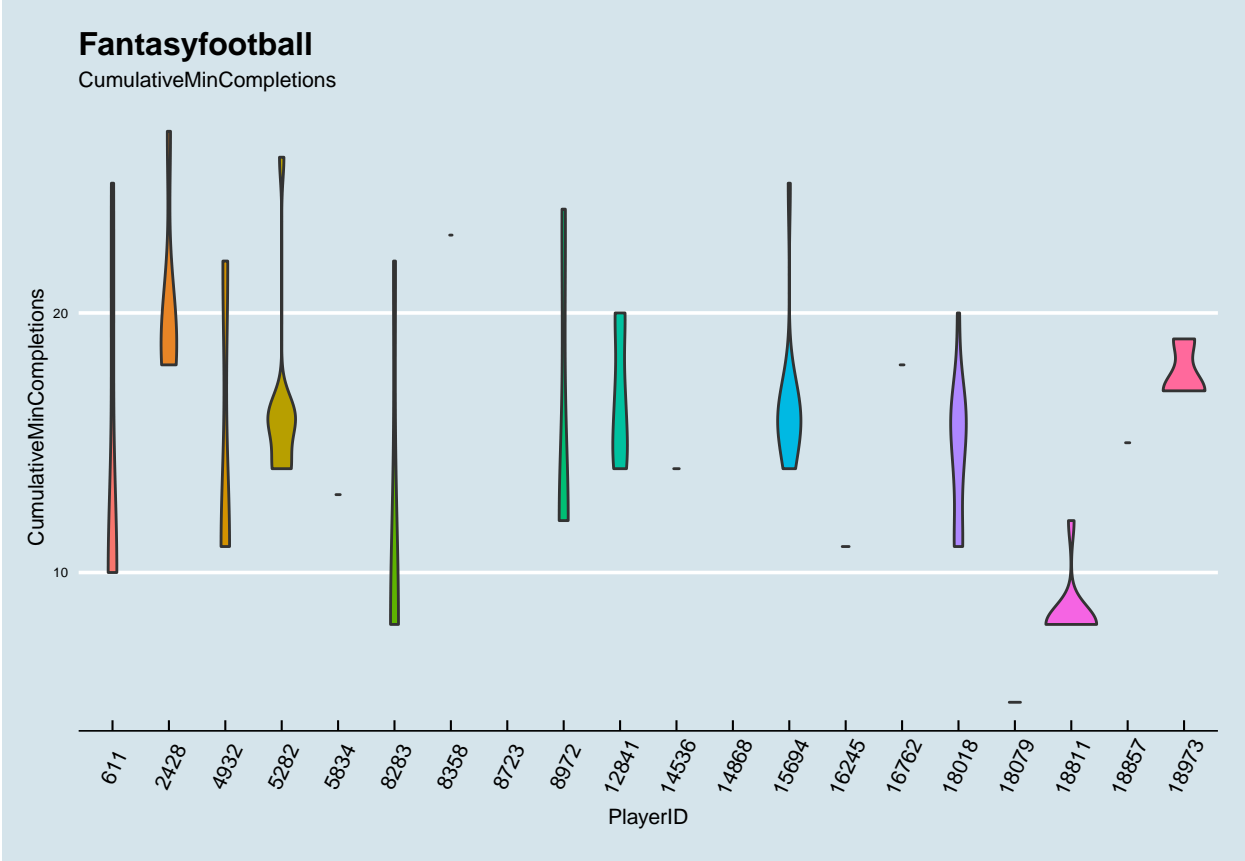


Fantasyfootball

CumulativeMinPassingRating

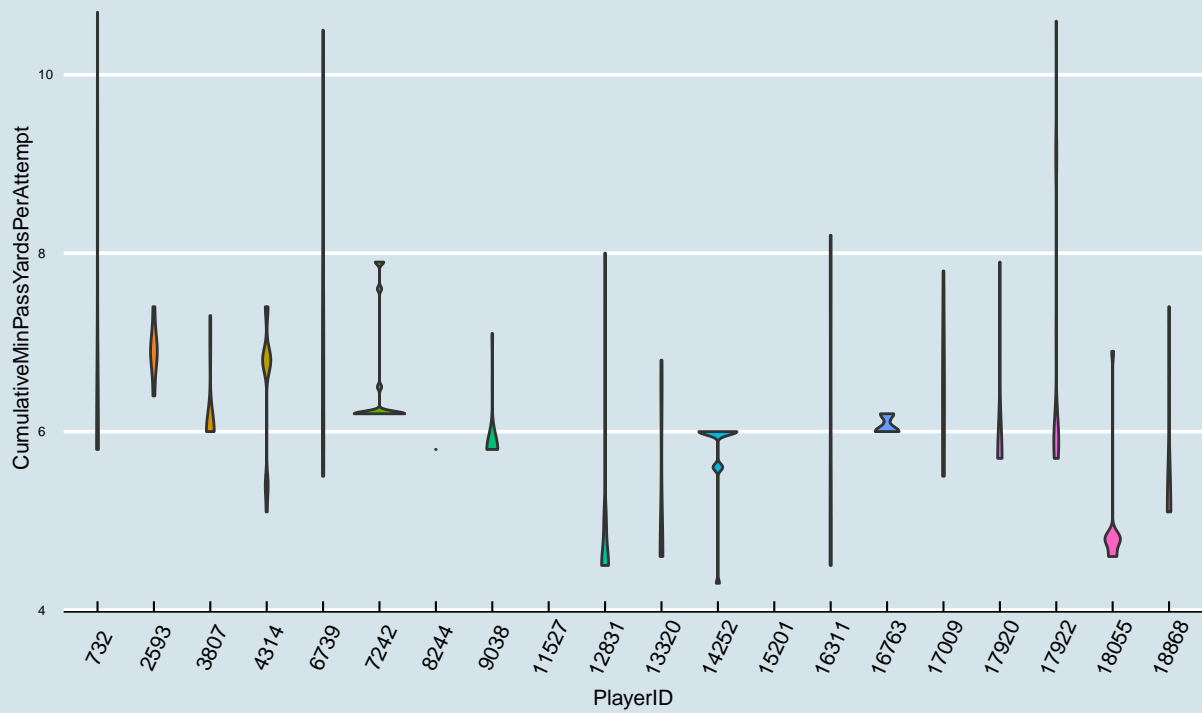






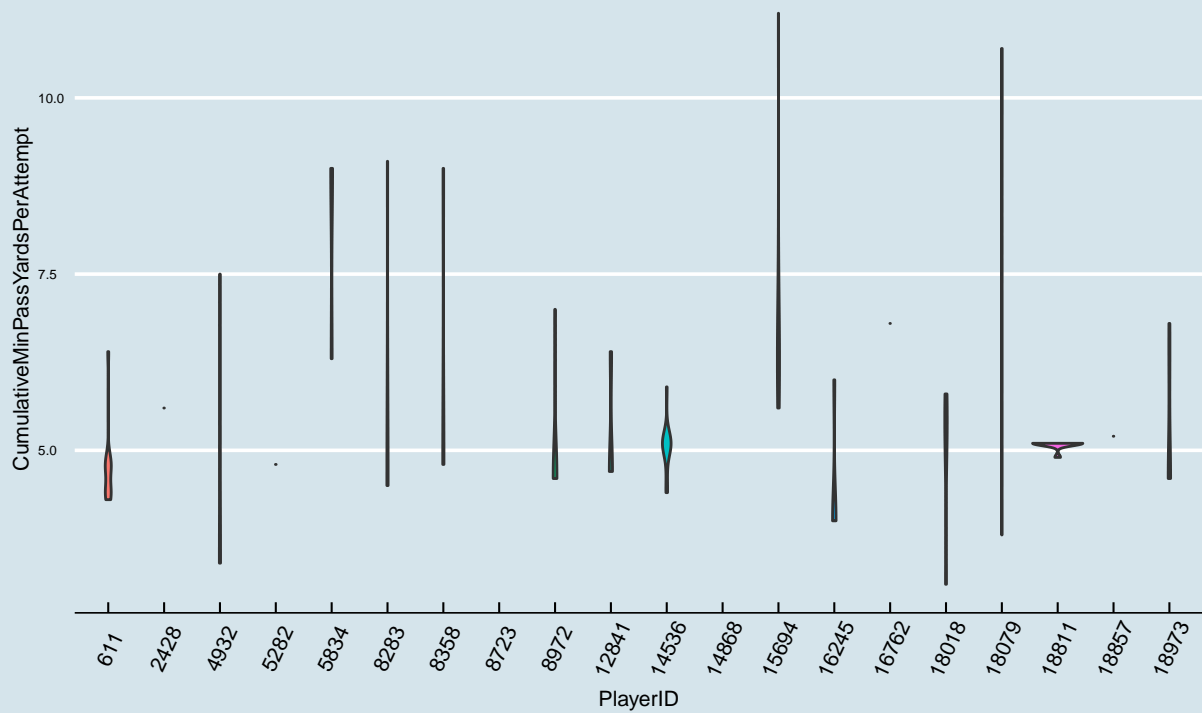
Fantasyfootball

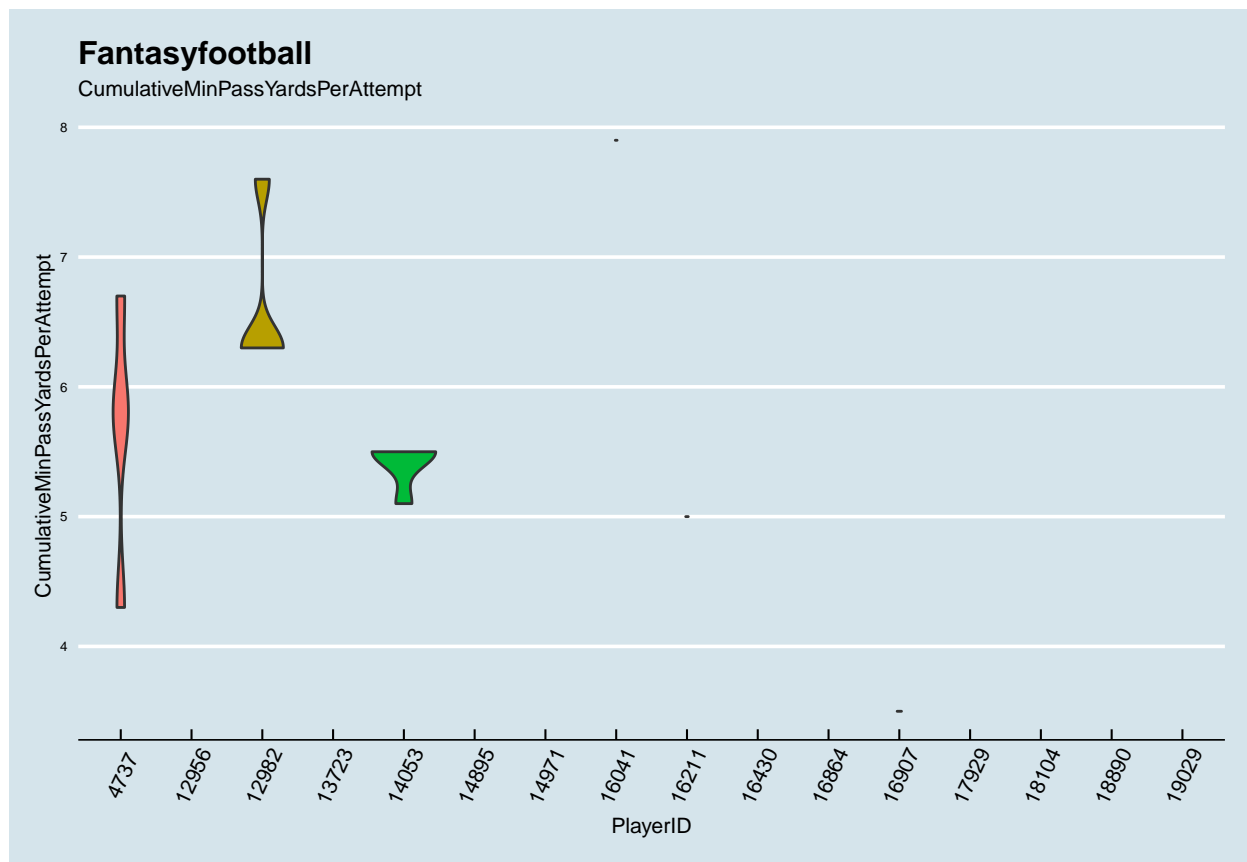
CumulativeMinPassYardsPerAttempt



Fantasyfootball

CumulativeMinPassYardsPerAttempt

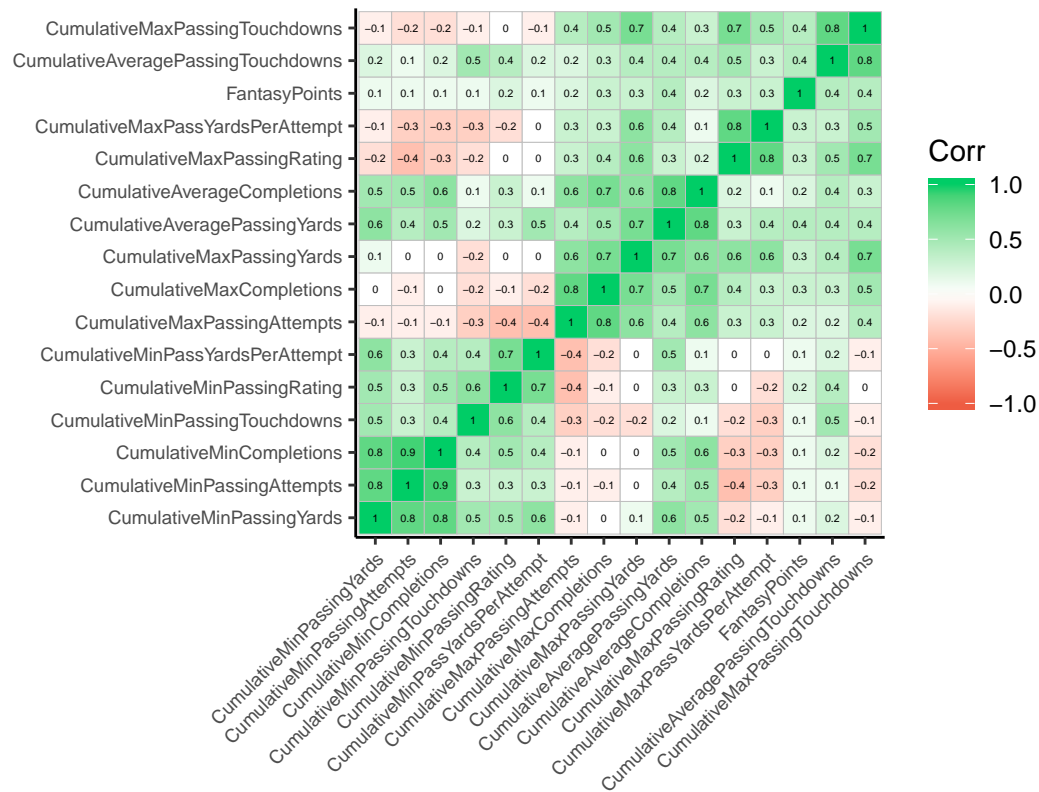




1.7.6 Correlogram for Cumulative Averages

```
final_cor_ds <- final_ds %>% select(PlayerID,FantasyPoints,names(final_ds[37:51]))
corr <- round(cor(final_cor_ds[-1]), 1)
ggcorrplot(corr, hc.order = TRUE,
            type = "full",
            lab = TRUE,
            lab_size = 1.5,
            method="square",
            colors = c("tomato2", "white", "springgreen3"),
            title="Correlogram of Cumulative Averages", tl.cex = 7,pch=2,pch.col =3,show.diag = T,
            ggtheme=theme_classic)
```

Correlogram of Cumulative Averages



Do we want to convert any of these to factors?