UFC Analysis

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Abstract

Introduction

Methods

Data Preprocessing

Model Fitting and Evaluation

Results

```
# loading all the libraries
library(dplyr)
```

```
Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag

The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```r
library(car)          # For VIF
```

```
Loading required package: carData
```

```
Attaching package: 'car'
```

```
The following object is masked from 'package:dplyr':

    recode
```

```r
library(ggplot2)      # For residual plots
library(broom)
library(knitr)
```

```r
# reading the data
ufc <- read.csv("ufc-master.csv")
```

```r
# DATA CLEANING CELL
# removing the data which has way too many missing values

ufc = subset(ufc, select = -c(BMatchWCRank, RMatchWCRank, RWFlyweightRank,
                              RWFeatherweightRank, RWStrawweightRank, RWBantamweightRank,
                              RHeavyweightRank, RLightHeavyweightRank, RMiddleweightRank,
                              RWelterweightRank, RLightweightRank, RFeatherweightRank,
                              RBantamweightRank, RFlyweightRank, RPFPRank, BWFlyweightRank,
                              BWFeatherweightRank, BWStrawweightRank, BWBantamweightRank,
                              BHeavyweightRank, BLightHeavyweightRank, BMiddleweightRank,
                              BWelterweightRank, BLightweightRank, BFeatherweightRank,
                              BBantamweightRank, BFlyweightRank, BPFPRank))

# removing all missing value rows from the columns of interest
ufc_clean <- ufc %>%
  filter(
    !is.na(RedAvgSubAtt),
    !is.na(BlueAvgSubAtt),
    !is.na(BlueReachCms),
    !is.na(RedReachCms),
    !is.na(BlueAvgSigStrLanded),
    !is.na(RedAvgSigStrLanded),
```

```
    !is.na(TotalFightTimeSecs),
    !is.na(WeightClass)
  )
nrow(ufc_clean)
```

```
[1] 4895
```

Research Question 1: Fighter Reach vs Total Strikes Landed

```
filtered_ufc_blue <- ufc_clean[c("BlueReachCms","BlueAvgSigStrLanded","WeightClass", "BlueHe
colnames(filtered_ufc_blue) <- c("ReachCms", "AvgSigStrLanded", "WeightClass", "Height", "Wi
filtered_ufc_red <- ufc_clean[c("RedReachCms","RedAvgSigStrLanded","WeightClass", "RedHeight
colnames(filtered_ufc_red) <- c("ReachCms", "AvgSigStrLanded", "WeightClass", "Height", "Win

# appending the two data sets
ufc_q1 <- rbind(filtered_ufc_blue, filtered_ufc_red)

# exclude outlier(one observation with 0 cm reach)
ufc_q1 <- ufc_q1[ufc_q1$ReachCms > 0,]
ufc_q1 <- ufc_q1[ufc_q1$AvgSigStrLanded > 0, ]
```

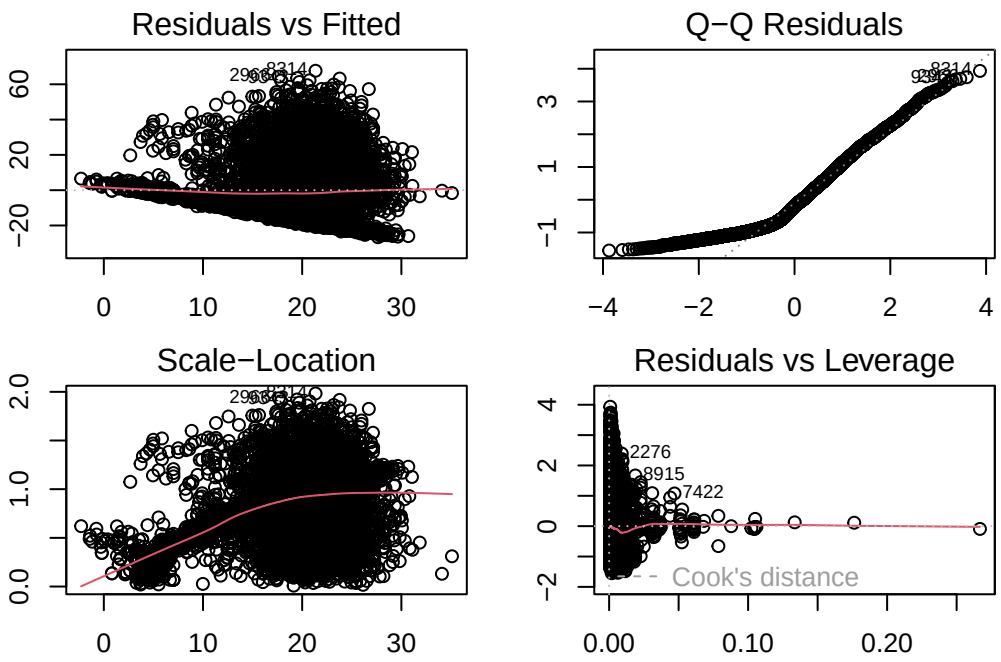
```
model_q1 <- lm(AvgSigStrLanded ~ ReachCms + WeightClass*WinStreak + Height,
               data = ufc_q1)

cooks_d <- cooks.distance(model_q1)
influential <- which(cooks_d > (4 / nrow(ufc_q1)))
ufc_q1_clean <- ufc_q1[-influential, ]

model_q1_clean <- lm(AvgSigStrLanded ~ log(ReachCms) + WinStreak * WeightClass + log(Height)
summary(model_q1_clean)
```

```
Call:
lm(formula = AvgSigStrLanded ~ log(ReachCms) + WinStreak * WeightClass +
    log(Height), data = ufc_q1_clean)

Residuals:
    Min      1Q  Median      3Q     Max
-26.646 -14.706  -3.488  11.234  67.651
```

```
Coefficients:
                                          Estimate Std. Error t value
(Intercept)                              370.84260   36.25877  10.228
log(ReachCms)                            -52.68014    7.20203  -7.315
WinStreak                                  0.88969    0.44797   1.986
WeightClassCatch Weight                  -11.98423    3.11742  -3.844
WeightClassFeatherweight                   3.15345    0.99510   3.169
WeightClassFlyweight                      -5.12434    1.27743  -4.011
WeightClassHeavyweight                     5.67378    1.35218   4.196
WeightClassLight Heavyweight               8.21926    1.26942   6.475
WeightClassLightweight                     5.88441    0.93235   6.311
WeightClassMiddleweight                    5.28211    1.09455   4.826
WeightClassWelterweight                    7.67438    1.01547   7.557
WeightClassWomen's Bantamweight           -8.38313    1.52870  -5.484
WeightClassWomen's Featherweight         -15.29454    4.30357  -3.554
WeightClassWomen's Flyweight             -14.94543    1.39726 -10.696
WeightClassWomen's Strawweight           -13.58684    1.45493  -9.339
log(Height)                              -15.59306    9.11990  -1.710
WinStreak:WeightClassCatch Weight         -0.23074    1.87824  -0.123
WinStreak:WeightClassFeatherweight         0.07549    0.61197   0.123
WinStreak:WeightClassFlyweight             1.09982    0.85105   1.292
WinStreak:WeightClassHeavyweight          -0.08639    0.65154  -0.133
WinStreak:WeightClassLight Heavyweight    -0.29595    0.63414  -0.467
WinStreak:WeightClassLightweight           0.08217    0.54268   0.151
WinStreak:WeightClassMiddleweight         -0.24912    0.53973  -0.462
WinStreak:WeightClassWelterweight          0.11901    0.55113   0.216
WinStreak:WeightClassWomen's Bantamweight  1.70091    1.02098   1.666
WinStreak:WeightClassWomen's Featherweight -1.01963   3.74947  -0.272
WinStreak:WeightClassWomen's Flyweight    -1.23959    0.77629  -1.597
WinStreak:WeightClassWomen's Strawweight   3.87668    1.15362   3.360
                                         Pr(>|t|)
(Intercept)                               < 2e-16 ***
log(ReachCms)                            2.80e-13 ***
WinStreak                                0.047055 *
WeightClassCatch Weight                  0.000122 ***
WeightClassFeatherweight                 0.001535 **
WeightClassFlyweight                     6.08e-05 ***
WeightClassHeavyweight                   2.74e-05 ***
WeightClassLight Heavyweight             9.98e-11 ***
WeightClassLightweight                   2.89e-10 ***
WeightClassMiddleweight                  1.42e-06 ***
WeightClassWelterweight                  4.50e-14 ***
WeightClassWomen's Bantamweight          4.27e-08 ***
```

```
WeightClassWomen's Featherweight           0.000381 ***
WeightClassWomen's Flyweight                < 2e-16 ***
WeightClassWomen's Strawweight              < 2e-16 ***
log(Height)                                0.087339 .
WinStreak:WeightClassCatch Weight          0.902230
WinStreak:WeightClassFeatherweight         0.901824
WinStreak:WeightClassFlyweight             0.196284
WinStreak:WeightClassHeavyweight           0.894523
WinStreak:WeightClassLight Heavyweight     0.640726
WinStreak:WeightClassLightweight           0.879649
WinStreak:WeightClassMiddleweight          0.644412
WinStreak:WeightClassWelterweight          0.829044
WinStreak:WeightClassWomen's Bantamweight  0.095757 .
WinStreak:WeightClassWomen's Featherweight 0.785675
WinStreak:WeightClassWomen's Flyweight     0.110345
WinStreak:WeightClassWomen's Strawweight   0.000781 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 17.21 on 9241 degrees of freedom
Multiple R-squared:  0.07087,   Adjusted R-squared:  0.06816
F-statistic: 26.11 on 27 and 9241 DF,  p-value: < 2.2e-16
```

```r
par(mfrow = c(2, 2), mar = c(2,2,2,2))
plot(model_q1_clean)
```




```
vif(model_q1_clean)
```

```
there are higher-order terms (interactions) in this model
consider setting type = 'predictor'; see ?vif
```

```
                              GVIF Df GVIF^(1/(2*Df))
log(ReachCms)             5.706517  1        2.388832
WinStreak                11.784558  1        3.432864
WeightClass            1301.454686 12        1.348242
log(Height)               6.579795  1        2.565111
WinStreak:WeightClass  3430.026689 12        1.403796
```

Research Question 2: Is the fight outcome associated with the number of submission attempts made by a fighter?

```
ufc_q2 <- ufc_clean %>%
  mutate(
    Outcome = ifelse(Winner == "Red", 1, 0),  # Binary outcome: 1 for Red win, 0 for Blue wi
    WeightClass = as.factor(WeightClass),
    TotalRedSubAttempts = RedAvgSubAtt,        # Red's submission attempts
    TotalBlueSubAttempts = BlueAvgSubAtt
```

```
  ) %>%
  mutate(
    LogRedSubAttempts = log1p(TotalRedSubAttempts),
    LogBlueSubAttempts = log1p(TotalBlueSubAttempts),
    LogBlueReach = log1p(BlueReachCms),
    LogRedReach = log1p(RedReachCms),
    LogBlueSigStr = log1p(BlueAvgSigStrLanded),
    LogRedSigStr = log1p(RedAvgSigStrLanded),
    LogFightTime = log1p(TotalFightTimeSecs)
  )

# Check dimensions of the cleaned dataset
dim(ufc_q2)
```

```
[1] 4895  100
```

```
sim_logistic_model <- glm(
  Outcome ~
    LogRedSubAttempts +
    LogBlueSubAttempts +
    LogBlueReach +
    LogRedReach +
    LogBlueSigStr +
    LogRedSigStr +
    LogFightTime +
    WeightClass,
  data = ufc_q2,
  family = binomial
)


step_model <- step(sim_logistic_model, direction = "both")
```

```
Start:  AIC=6606.31
Outcome ~ LogRedSubAttempts + LogBlueSubAttempts + LogBlueReach +
    LogRedReach + LogBlueSigStr + LogRedSigStr + LogFightTime +
    WeightClass

                   Df Deviance    AIC
- WeightClass      12   6576.9 6592.9
- LogFightTime      1   6567.5 6605.5
```

```
<none>                     6566.3 6606.3
- LogBlueReach         1   6569.7 6607.7
- LogRedReach          1   6573.9 6611.9
- LogBlueSubAttempts   1   6578.2 6616.2
- LogRedSubAttempts    1   6587.2 6625.2
- LogRedSigStr         1   6624.5 6662.5
- LogBlueSigStr        1   6625.8 6663.8

Step:  AIC=6592.94
Outcome ~ LogRedSubAttempts + LogBlueSubAttempts + LogBlueReach +
    LogRedReach + LogBlueSigStr + LogRedSigStr + LogFightTime

                     Df Deviance    AIC
- LogFightTime        1   6577.8 6591.8
<none>                    6576.9 6592.9
- LogRedReach         1   6584.6 6598.6
- LogBlueReach        1   6584.8 6598.8
- LogBlueSubAttempts  1   6589.3 6603.3
+ WeightClass        12   6566.3 6606.3
- LogRedSubAttempts   1   6597.5 6611.5
- LogRedSigStr        1   6634.1 6648.1
- LogBlueSigStr       1   6637.7 6651.7

Step:  AIC=6591.77
Outcome ~ LogRedSubAttempts + LogBlueSubAttempts + LogBlueReach +
    LogRedReach + LogBlueSigStr + LogRedSigStr

                     Df Deviance    AIC
<none>                    6577.8 6591.8
+ LogFightTime        1   6576.9 6592.9
- LogRedReach         1   6585.2 6597.2
- LogBlueReach        1   6586.0 6598.0
- LogBlueSubAttempts  1   6590.4 6602.4
+ WeightClass        12   6567.5 6605.5
- LogRedSubAttempts   1   6597.9 6609.9
- LogRedSigStr        1   6635.0 6647.0
- LogBlueSigStr       1   6638.4 6650.4
```

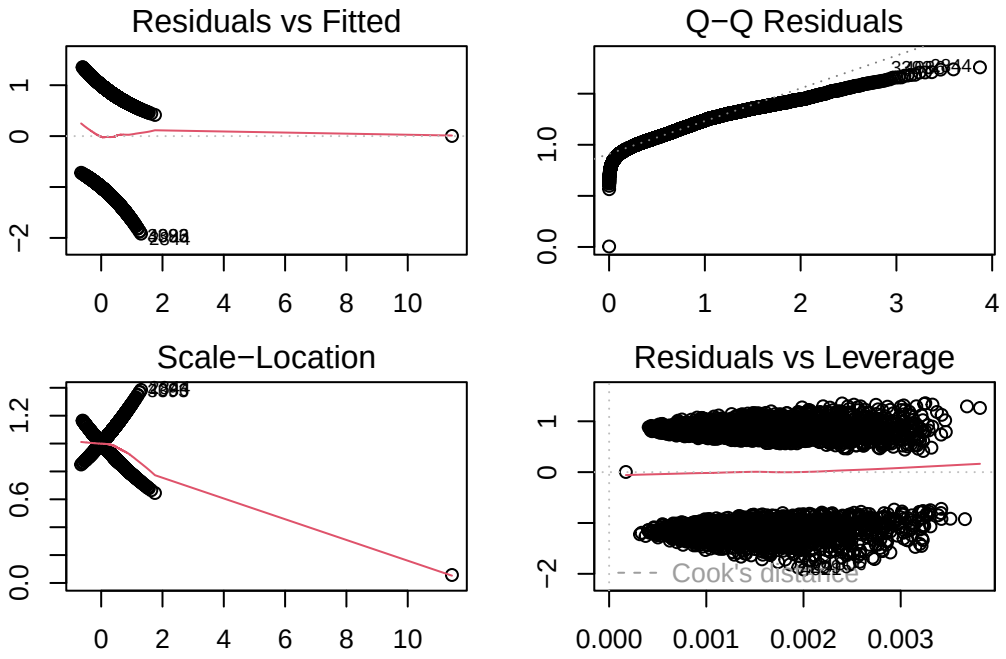
```r
# Calculate Cook's distance and leverage
cooks_distance <- cooks.distance(step_model)
hat_values <- hatvalues(step_model)
residuals <- residuals(step_model, type = "deviance")
```

```r
# Thresholds
n <- nrow(ufc_q2)
p <- length(coef(step_model)) - 1
cooks_threshold <- 4 / n
leverage_threshold <- 2 * (p + 1) / n

# Identify influential points
influential_points <- which(cooks_distance > cooks_threshold |
                            hat_values > leverage_threshold |
                            abs(residuals) > 2)

# Remove influential points
ufc_q2_filtered <- ufc_q2[-influential_points, ]

# Refit the model
final_model <- glm(formula = Outcome ~ LogRedSubAttempts + LogBlueSubAttempts +
    LogBlueReach + LogRedReach + LogBlueSigStr + LogRedSigStr,
    family = binomial, data = ufc_q2_filtered)

# Model summary
summary(final_model)
```

```
Call:
glm(formula = Outcome ~ LogRedSubAttempts + LogBlueSubAttempts +
    LogBlueReach + LogRedReach + LogBlueSigStr + LogRedSigStr,
    family = binomial, data = ufc_q2_filtered)

Coefficients:
                   Estimate Std. Error z value Pr(>|z|)
(Intercept)         0.68061    2.87556   0.237 0.812897
LogRedSubAttempts   0.43736    0.09732   4.494 6.98e-06 ***
LogBlueSubAttempts -0.34346    0.09384  -3.660 0.000252 ***
LogBlueReach       -2.10785    0.76588  -2.752 0.005920 **
LogRedReach         2.03037    0.74314   2.732 0.006292 **
LogBlueSigStr      -0.46782    0.05704  -8.201 2.37e-16 ***
LogRedSigStr        0.46156    0.05861   7.876 3.39e-15 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)
```

```
    Null deviance: 6324.0  on 4643  degrees of freedom
Residual deviance: 6221.7  on 4637  degrees of freedom
AIC: 6235.7

Number of Fisher Scoring iterations: 4
```

```
par(mfrow=c(2,2), mar = c(2,2,2,2))

plot(final_model)
```



Appendix

1. Research Question 1

```
summary(model_q1)
```

```
Call:
lm(formula = AvgSigStrLanded ~ ReachCms + WeightClass * WinStreak +
    Height, data = ufc_q1)
```

```
Residuals:
    Min      1Q  Median      3Q     Max
-40.690 -16.289  -5.282  12.193 130.324

Coefficients:
                                             Estimate Std. Error t value
(Intercept)                                 70.464514   7.601471   9.270
ReachCms                                    -0.291116   0.044133  -6.596
WeightClassCatch Weight                     -9.095782   3.143148  -2.894
WeightClassFeatherweight                     1.876641   1.086578   1.727
WeightClassFlyweight                        -4.529124   1.338491  -3.384
WeightClassHeavyweight                       3.178827   1.502231   2.116
WeightClassLight Heavyweight                 6.209295   1.391018   4.464
WeightClassLightweight                       4.596201   1.021647   4.499
WeightClassMiddleweight                      2.927605   1.219982   2.400
WeightClassWelterweight                      6.033458   1.113355   5.419
WeightClassWomen's Bantamweight             -0.802552   1.602920  -0.501
WeightClassWomen's Featherweight           -12.811029   3.967100  -3.229
WeightClassWomen's Flyweight                -9.880458   1.540134  -6.415
WeightClassWomen's Strawweight              -4.992836   1.487524  -3.356
WinStreak                                    0.870168   0.412687   2.109
Height                                       0.003184   0.057040   0.056
WeightClassCatch Weight:WinStreak           -1.423668   1.632883  -0.872
WeightClassFeatherweight:WinStreak           0.554692   0.544312   1.019
WeightClassFlyweight:WinStreak               1.981276   0.668963   2.962
WeightClassHeavyweight:WinStreak             0.396386   0.606659   0.653
WeightClassLight Heavyweight:WinStreak      -0.306468   0.565002  -0.542
WeightClassLightweight:WinStreak            -0.348661   0.499440  -0.698
WeightClassMiddleweight:WinStreak           -0.051047   0.525470  -0.097
WeightClassWelterweight:WinStreak           -0.279404   0.510292  -0.548
WeightClassWomen's Bantamweight:WinStreak   -0.246415   0.878204  -0.281
WeightClassWomen's Featherweight:WinStreak  -1.308624   1.961281  -0.667
WeightClassWomen's Flyweight:WinStreak      -1.583140   0.826751  -1.915
WeightClassWomen's Strawweight:WinStreak     3.041336   0.843915   3.604
                                            Pr(>|t|)
(Intercept)                                 < 2e-16 ***
ReachCms                                   4.43e-11 ***
WeightClassCatch Weight                    0.003814 **
WeightClassFeatherweight                   0.084179 .
WeightClassFlyweight                       0.000718 ***
WeightClassHeavyweight                     0.034364 *
WeightClassLight Heavyweight               8.14e-06 ***
```

```
WeightClassLightweight                       6.91e-06 ***
WeightClassMiddleweight                      0.016427 *
WeightClassWelterweight                      6.13e-08 ***
WeightClassWomen's Bantamweight              0.616607
WeightClassWomen's Featherweight             0.001245 **
WeightClassWomen's Flyweight                 1.47e-10 ***
WeightClassWomen's Strawweight               0.000792 ***
WinStreak                                    0.035010 *
Height                                       0.955490
WeightClassCatch Weight:WinStreak            0.383299
WeightClassFeatherweight:WinStreak           0.308195
WeightClassFlyweight:WinStreak               0.003067 **
WeightClassHeavyweight:WinStreak             0.513519
WeightClassLight Heavyweight:WinStreak       0.587541
WeightClassLightweight:WinStreak             0.485130
WeightClassMiddleweight:WinStreak            0.922613
WeightClassWelterweight:WinStreak            0.584022
WeightClassWomen's Bantamweight:WinStreak    0.779031
WeightClassWomen's Featherweight:WinStreak   0.504642
WeightClassWomen's Flyweight:WinStreak       0.055535 .
WeightClassWomen's Strawweight:WinStreak     0.000315 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 19.83 on 9707 degrees of freedom
Multiple R-squared:  0.03763,   Adjusted R-squared:  0.03495
F-statistic: 14.06 on 27 and 9707 DF,  p-value: < 2.2e-16
```

```
# 1. Check Variance Inflation Factor (VIF) for collinearity
vif_values <- vif(model_q1)
```

```
there are higher-order terms (interactions) in this model
consider setting type = 'predictor'; see ?vif
```

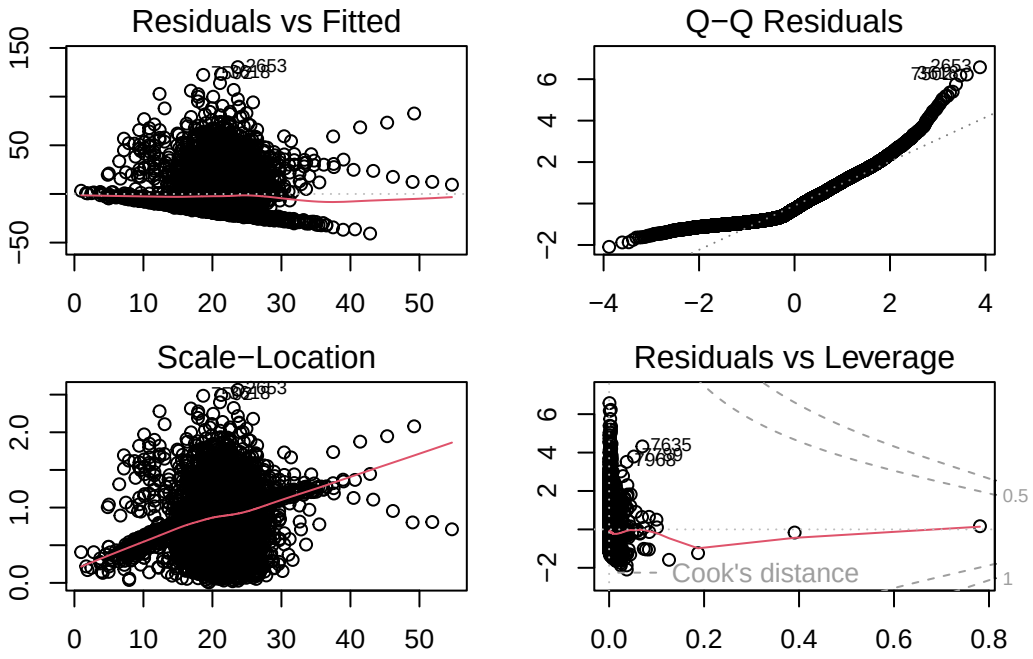
```
print("Variance Inflation Factor (VIF):")
```

```
[1] "Variance Inflation Factor (VIF):"
```

```
print(vif_values)
```

```
                              GVIF Df GVIF^(1/(2*Df))
ReachCms                  5.823552  1        2.413204
WeightClass             476.978854 12        1.293017
WinStreak                11.703017  1        3.420967
Height                    6.653360  1        2.579411
WeightClass:WinStreak  1247.323837 12        1.345858
```

```
# 2. Residuals vs Fitted Plot for Linearity
par(mfrow = c(2, 2), mar = c(2, 2, 2, 2))  # Set plotting layout
plot(model_q1)
```



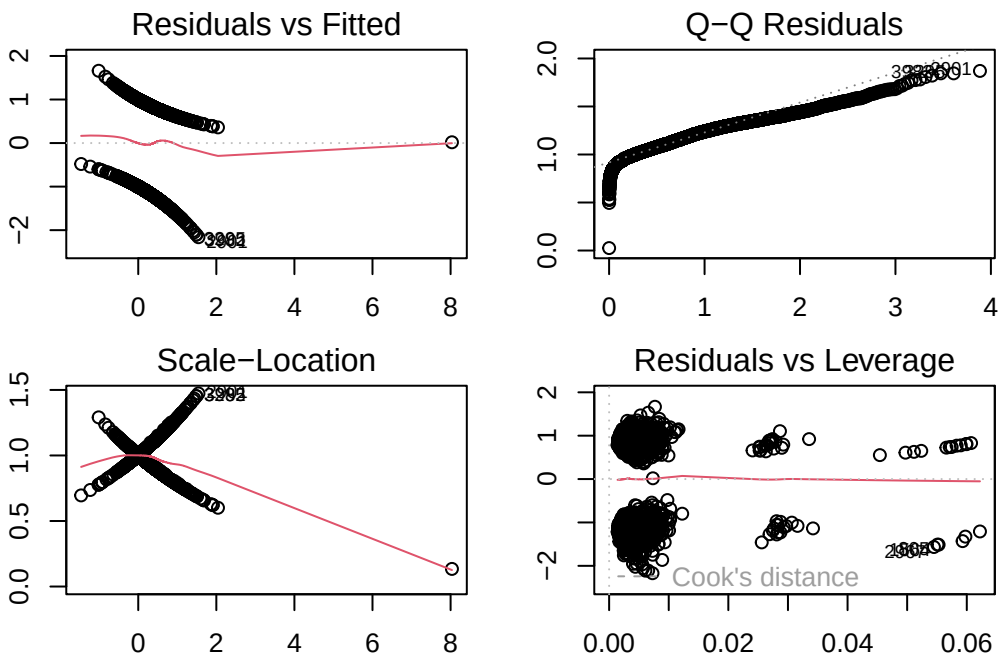
2. Research Question 2

```
# Model summary of the initial simple logistic model
summary(sim_logistic_model)
```

```
Call:
glm(formula = Outcome ~ LogRedSubAttempts + LogBlueSubAttempts +
    LogBlueReach + LogRedReach + LogBlueSigStr + LogRedSigStr +
    LogFightTime + WeightClass, family = binomial, data = ufc_q2)
```

```
Coefficients:
                                Estimate Std. Error z value Pr(>|z|)
(Intercept)                    -5.351057   6.459545  -0.828 0.407447
LogRedSubAttempts               0.405680   0.089319   4.542 5.57e-06 ***
LogBlueSubAttempts             -0.292197   0.084704  -3.450 0.000561 ***
LogBlueReach                   -1.439347   0.907894  -1.585 0.112883
LogRedReach                     2.491817   0.903558   2.758 0.005819 **
LogBlueSigStr                  -0.365003   0.048374  -7.545 4.51e-14 ***
LogRedSigStr                    0.373853   0.050081   7.465 8.33e-14 ***
LogFightTime                    0.035227   0.032697   1.077 0.281313
WeightClassCatch Weight        -0.057436   0.343726  -0.167 0.867293
WeightClassFeatherweight       -0.027917   0.131144  -0.213 0.831425
WeightClassFlyweight           -0.003566   0.159466  -0.022 0.982161
WeightClassHeavyweight         -0.045397   0.208875  -0.217 0.827942
WeightClassLight Heavyweight   -0.176252   0.192860  -0.914 0.360776
WeightClassLightweight         -0.136914   0.126242  -1.085 0.278128
WeightClassMiddleweight        -0.276099   0.164307  -1.680 0.092883 .
WeightClassWelterweight        -0.281531   0.145431  -1.936 0.052888 .
WeightClassWomen's Bantamweight -0.177841   0.191071  -0.931 0.351979
WeightClassWomen's Featherweight  0.230400   0.512452   0.450 0.652996
WeightClassWomen's Flyweight   -0.122585   0.184749  -0.664 0.506998
WeightClassWomen's Strawweight  0.011955   0.187268   0.064 0.949100
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 6674.5  on 4894  degrees of freedom
Residual deviance: 6566.3  on 4875  degrees of freedom
AIC: 6606.3

Number of Fisher Scoring iterations: 4
```

```r
par(mfrow=c(2,2), mar = c(2,2,2,2))

plot(sim_logistic_model)
```




```
# Model summary of the step model
summary(step_model)
```

```
Call:
glm(formula = Outcome ~ LogRedSubAttempts + LogBlueSubAttempts +
    LogBlueReach + LogRedReach + LogBlueSigStr + LogRedSigStr,
    family = binomial, data = ufc_q2)

Coefficients:
                   Estimate Std. Error z value Pr(>|z|)
(Intercept)         0.36477    2.73096   0.134 0.893744
LogRedSubAttempts   0.39057    0.08768   4.454 8.41e-06 ***
LogBlueSubAttempts -0.29815    0.08385  -3.556 0.000377 ***
LogBlueReach       -1.90853    0.71404  -2.673 0.007521 **
LogRedReach         1.88597    0.69892   2.698 0.006967 **
LogBlueSigStr      -0.36729    0.04821  -7.618 2.57e-14 ***
LogRedSigStr        0.36873    0.04979   7.405 1.31e-13 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)
```

```
    Null deviance: 6674.5  on 4894  degrees of freedom
Residual deviance: 6577.8  on 4888  degrees of freedom
AIC: 6591.8

Number of Fisher Scoring iterations: 4
```

```r
par(mfrow=c(2,2), mar = c(2,2,2,2))

plot(step_model)
```