**Exploratory Analysis of NFL Receiving Statistics and NFL Arrests Statistics**

**Team Members:**

**Josh Janda (joshlj2), Jack Massey (jmassey4), Ashley Arroyo (aarroy30), Isaias Lopez (ielopez2)**

**Introduction**

For our project, we have chosen two NFL datasets which relate to statistics for receiving players from 2000 to 2016 by week and arrests statistics 2000 to 2017. Our interest in these datasets is to analyze how statistics differ between teams as well as years. These statistics include both playing statistics as well as arrest statistics. Some background information for the [first dataset](https://data.world/chrishayles/nfl-data/workspace/file?filename=receiving.csv)’s source is that it is from the website *Kaggle* which is a website that provides numerous datasets for data science competitions as well as data analysis. The [second dataset](https://www.kaggle.com/patrickmurphy/nfl-arrests) is gathered from the website *data.world*, which similarly to *Kaggle,* provides real world datasets for data analysis/data science competitions.

Overall, our main goal for this project is to analyze these datasets to answer questions regarding the most successful teams and players and if data on passing yards is in line with this belief, how risky a team is determined by number of arrests, what positions and side of the ball are arrested more frequently, and are better teams more likely to have more frequent arrests.

**Methods**

Our first dataset, mentioned above, includes the receiving statistics from 2000 until 2016 and has 67,761 observations of 14 variables. The variables and descriptions are:

* name = "Last, First Name of Player"
* team = "Team of Player"
* rec = "Total Number of Receives"
* yds = "Total Number of Yards"
* tgt = "Total Number of Targets"
* avg = "Average Yards per Receive"
* td = "Number of Touchdowns"
* fstdn = "Number of First Downs"
* pct = "Percentage of First Downs for each Receive"
* lng = "Longest Gain/Receive for Week"
* fum = "Number of Fumbles"
* fuml = "Number of Fumbles Lost"
* season = "Season Year"
* wk = "Week of Season"

Our second dataset, mentioned above, includes the arrests statistics of players from 2000 until 2017 and includes 850 observations of 8 variables. The variables and descriptions are:

* date = "Date of Incident"
* team = "Team of Player"
* name = "Name of Player"
* position = "Player's Position"
* case = "Incident Type"
* category = " Incident Crime Categories"
* description = "Description of Crime"
* outcome = "Incident outcome description"

For validating and cleaning the data, we are using guidelines that are of our knowledge of NFL statistics. Such as what the correct number of unique teams should be equal to, whether the statistics make sense or not, and analyzing for misspellings and mistyped values. We will be validating and cleaning the data through the use of multiple techniques, such as frequency tables, checking variable uniqueness, single variable analysis for missing/extreme values, and adding labels and appropriate formats to variables.

For starting, we first utilized the *nlevels* frequency table for both the arrests and receiving datasets to check for missing values and incorrect number of unique levels (**Table 1 and** 2). For our first issue, we noticed that the number of teams in our receiving dataset was not equal to the total current number of NFL teams (**Figure 1)**. This is due to the Saint Louis Rams moving to Los Angeles. This will be left as is due to it being a valid observation. Our second issue is that the names of the teams for the arrest and receiving dataset were not all the same throughout **(Figure 2 compared to Figure 1)**. This will be fixed by renaming the incorrectly abbreviated teams in the receiving dataset to avoid complications when merging later on. Our third issue was noticed when checking whether there were any players where receptions was greater than targets. This should not be possible, and we found one observation where this is the case (**Figure 3**). This was remedied by setting the target variable to the appropriate value which was obtained through Google. Our fourth issue was discovered when looking at the number of arrests per positions (**Figure 4**), in which the “DE” position had a “/” attached to the end. We know there is no “DE/” position, so this was remedied by setting the position to “DE”.

For cleaning, we have created labels for each variable in both datasets which the labels are included in the above descriptions of the data. We have also created a format for the “wk” variable in the receiving dataset, which changed the weeks from 101-117 to 1-17 to make the week numbers clearer as well as creating a separate arrests dataset which indicates whether a player is offense or defense.

Some additional data preparation we have performed is the use of subsetting, conditioning, and merging the datasets. For merging, we have merged the datasets based on team and included relevant statistics by team which are total yards and total number of arrests for all wide receivers (**Figure 5**). For subsetting, we have grouped the arrests data by offense or defense and then analyzed the total number of arrests by side of the ball (**Figure 6**). We have also grouped the arrests data by team to look at the frequency of arrests per team, and then lastly grouped by position to look at the frequency of arrests per position (**Figure 7 and 8**). Regarding the best players, we have grouped the players by year and found the player with the max number of yards (**Figure 9**). For the best teams, we have grouped the data by team and look at the total yardage for each team over all years (**Figure 10**). To confirm our belief that more yardage equates to a better team, we have looked at one team over one season (New England Patriots) and looked at the total yardage for this team for each game (**Figure 11**).

For analyzing variables, we have chosen to analyze them by group and through frequency tables. These tables can all be seen, and are mentioned, above.

Overall, we have read in and validated/cleaned the data and then utilized numerous summary/grouping/frequency techniques to answer our research questions.

**Results**

In Table 1, we see that there are three missing values from “Average Yards per Receiver”, “Percentage of First Downs for each Receiver”, and “caught/targets”. We also note that while there are 33 teams, there are only 32 since one team changed city.

In Table 2, we see a missing value for “Incident outcome description”.

In Figure 1, we see the distribution of players who are receiving among the teams. There should only be 32 teams, but the dataset includes STL which is now LA because the team changed cities.

In Figure 2, we are using the arrested dataset. There are is a 35 total of “Team Identifier at time of incident”. Thirty-five are listed because the data covers the time between January 2000 to March 2017 and we discovered that some teams moved cities. This figure also includes distribution of arrested players by team.

In the “Incident Type” table, we see the frequency and percentage specific degrees of sentences and consequences due to player’s crime for “case 1”. The category with the most frequency is “arrested” (731), with players being “charged” as second. Players detained, or have died, or were summoned is only has a frequency of 1.

In Figure 3, we set our target to 1 after finding that it had a 0, an error.

In Figure 7, group by processing through a query was used to sort teams by the number of player arrests. The team with the highest player arrests is MIN with 49 arrests. The lowest is LAC with 1. We thought that there might be some connection between the arrest statistics of the teams and the actual cities where they played but there didn’t seem to be a connection.

In Figure 4 and 8, the number of arrests were grouped by position. The position with highest number of arrests is WR with 136 arrests. The position with the lowest is OL with 1 arrest. The O-line is regarded as a position that requires more leadership and decision making than WR. This might be why the arrest numbers are so different.

In Figure 6, we use broader categories of positions either on Offense or Defense. Positions on defense have more player arrests than positions on offense with 450. Positions on offense have 400 player arrests. This is a pretty large sample size and discrepancy and would be an interesting research question as to why defenders are arrested more often.

In Figure 9, players with the most yards in a game per season is displayed. Calvin Johnson ran 329 yards in one game in the 2013 season, the most yards receiving in a game per season. He is universally agreed upon to be one of the best receivers of all-time so this statistic would be a good way to get an idea of who the best players are.

In Figure 10, total yards per team over the course of the time period is displayed on a table. The team with the highest total number of yards is NO with 76701 yards. It turns out the number of receiving yards is a good indicator of success because the top five teams in total yards also had the most playoff appearances over the time period . LA has the lowest yards of any team, with 3313 yards receiving. This could be because recently they were once STL in St. Louis.

In Figure 11, looking at the total number of yards per week by the New England Patriots in season 2016, we find that the week with their highest recorded yards receiving is weeks 5 and 14 with 406. New England Patriots currently has a high attendance in the Super Bowl. NE has a high 71081 total yards run, which supports that teams with more yards receiving tend to be better.

We also looked at actual game results for each of their games during the 2016 season and noted that in each game they had more receiving word they won the game. So, while we saw that receiving yards are an indicator of long term sustained success they are also an indicator of single game success.

In Figure 5, the player arrests and receiving player datasets were inner joined. The table displayed shows total yards and total arrests grouped by teams. Teams that have more yards such as NE (71081 yards) have a low number of arrests (4 arrests). The team with the highest arrests number of arrests is TEN (12 arrests) a total of 60299 yards. While TEN has a lower number of total yards run then NE, the number can be considered large, suggesting that TEN is a “good” team. Looking at the lowest total yards, HOU has a total of 55171 yards, but has one the lowest counts of arrests (3). There is no reasonable evidence to suggest that better teams have more arrests. Our stated belief was incorrect.

After analyzing the receiving and arrests dataset, we were able to answer the questions regarding the most successful teams and players. Initially, we believed that better teams (teams with more passing yards) had more arrests. However, after reviewing figure five, we were able to conclude that better teams do not necessarily have more arrests.

**Table 1**

**The FREQ Procedure**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of Variable Levels** | | | | |
| **Variable** | **Label** | **Levels** | **Missing Levels** | **Nonmissing Levels** |
| **name** | Last, First Name of Player | 2353 | 0 | 2353 |
| **team** | Team of Player | 33 | 0 | 33 |
| **rec** | Total Number of Receives | 21 | 0 | 21 |
| **yds** | Total Number of Yards | 259 | 0 | 259 |
| **tgt** | Total Number of Targets | 26 | 0 | 26 |
| **avg** | Average Yards per Receive | 445 | 1 | 444 |
| **td** | Number of Touchdowns | 5 | 0 | 5 |
| **fstdn** | Number of First Downs | 15 | 0 | 15 |
| **pct** | Percentage of First Downs for each Receive | 67 | 1 | 66 |
| **lng** | Longest Gain/Receive for Week | 116 | 0 | 116 |
| **fum** | Number of Fumbles | 4 | 0 | 4 |
| **fuml** | Number of Fumbles Lost | 3 | 0 | 3 |
| **season** | Season Year | 17 | 0 | 17 |
| **wk** | Week of Season | 17 | 0 | 17 |
| **catch\_pct** | caught/targets | 79 | 1 | 78 |
| **preformance** | how well the player did that week | 3 | 0 | 3 |

**Table 2**

**The FREQ Procedure**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Label** | **Levels** | **Missing Levels** | **Nonmissing Levels** |
| **date** | Date of Incident | 783 | 0 | 783 |
| **team** | Team of Player | 35 | 0 | 35 |
| **name** | Name of Player | 640 | 0 | 640 |
| **position** | Player's Position | 18 | 0 | 18 |
| **case1** | Incident Type | 10 | 0 | 10 |
| **category** | Incident Crime Categories | 107 | 0 | 107 |
| **description** | Description of Crime | 842 | 0 | 842 |
| **outcome** | Incident outcome description | 50 | 1 | 49 |

**Number of Variable Levels**

**Figure 1**

**The FREQ Procedure**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Team of Player** | | | | |
| **team** | **Frequency** | **Percent** | **Cumulative Frequency** | **Cumulative**  **Percent** |
| **ARZ** | 2207 | 3.26 | 2207 | 3.26 |
| **ATL** | 2095 | 3.09 | 4302 | 6.35 |
| **BAL** | 2141 | 3.16 | 6443 | 9.51 |
| **BUF** | 2019 | 2.98 | 8462 | 12.49 |
| **CAR** | 2062 | 3.04 | 10524 | 15.53 |
| **CHI** | 2049 | 3.02 | 12573 | 18.55 |
| **CIN** | 2119 | 3.13 | 14692 | 21.68 |
| **CLE** | 2173 | 3.21 | 16865 | 24.89 |
| **DAL** | 2069 | 3.05 | 18934 | 27.94 |
| **DEN** | 2101 | 3.10 | 21035 | 31.04 |
| **DET** | 2201 | 3.25 | 23236 | 34.29 |
| **GB** | 2255 | 3.33 | 25491 | 37.62 |
| **HOU** | 1802 | 2.66 | 27293 | 40.28 |
| **IND** | 1967 | 2.90 | 29260 | 43.18 |
| **JAX** | 2186 | 3.23 | 31446 | 46.41 |
| **KC** | 2087 | 3.08 | 33533 | 49.49 |
| **LA** | 123 | 0.18 | 33656 | 49.67 |
| **MIA** | 2117 | 3.12 | 35773 | 52.79 |
| **MIN** | 2171 | 3.20 | 37944 | 56.00 |
| **NE** | 2121 | 3.13 | 40065 | 59.13 |
| **NO** | 2247 | 3.32 | 42312 | 62.44 |
| **NYG** | 2071 | 3.06 | 44383 | 65.50 |
| **NYJ** | 2042 | 3.01 | 46425 | 68.51 |
| **OAK** | 2236 | 3.30 | 48661 | 71.81 |
| **PHI** | 2205 | 3.25 | 50866 | 75.07 |
| **PIT** | 2063 | 3.04 | 52929 | 78.11 |
| **SD** | 2004 | 2.96 | 54933 | 81.07 |
| **SEA** | 2188 | 3.23 | 57121 | 84.30 |
| **SF** | 2088 | 3.08 | 59209 | 87.38 |
| **STL** | 2051 | 3.03 | 61260 | 90.41 |
| **TB** | 2156 | 3.18 | 63416 | 93.59 |
| **TEN** | 2156 | 3.18 | 65572 | 96.77 |
| **WSH** | 2189 | 3.23 | 67761 | 100.00 |

**Figure 2**

**The FREQ Procedure**

|  |  |  |
| --- | --- | --- |
| **Number of Variable Levels** | | |
| **Variable** | **Label** | **Levels** |
| **team** | Team of Player | 35 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Team of Player** | | | | |
| **team** | **Frequency** | **Percent** | **Cumulative Frequency** | **Cumulative**  **Percent** |
| **ARI** | 21 | 2.47 | 21 | 2.47 |
| **ATL** | 20 | 2.35 | 41 | 4.82 |
| **BAL** | 27 | 3.18 | 68 | 8.00 |
| **BUF** | 19 | 2.24 | 87 | 10.24 |
| **CAR** | 21 | 2.47 | 108 | 12.71 |
| **CHI** | 32 | 3.76 | 140 | 16.47 |
| **CIN** | 44 | 5.18 | 184 | 21.65 |
| **CLE** | 33 | 3.88 | 217 | 25.53 |
| **DAL** | 17 | 2.00 | 234 | 27.53 |
| **DEN** | 47 | 5.53 | 281 | 33.06 |
| **DET** | 18 | 2.12 | 299 | 35.18 |
| **Fre** | 3 | 0.35 | 302 | 35.53 |
| **GB** | 23 | 2.71 | 325 | 38.24 |
| **HOU** | 13 | 1.53 | 338 | 39.76 |
| **IND** | 35 | 4.12 | 373 | 43.88 |
| **JAC** | 34 | 4.00 | 407 | 47.88 |
| **KC** | 32 | 3.76 | 439 | 51.65 |
| **LAC** | 1 | 0.12 | 440 | 51.76 |
| **LAR** | 5 | 0.59 | 445 | 52.35 |
| **MIA** | 31 | 3.65 | 476 | 56.00 |
| **MIN** | 49 | 5.76 | 525 | 61.76 |
| **NE** | 20 | 2.35 | 545 | 64.12 |
| **NO** | 25 | 2.94 | 570 | 67.06 |
| **NYG** | 16 | 1.88 | 586 | 68.94 |
| **NYJ** | 20 | 2.35 | 606 | 71.29 |
| **OAK** | 21 | 2.47 | 627 | 73.76 |
| **PHI** | 18 | 2.12 | 645 | 75.88 |
| **PIT** | 24 | 2.82 | 669 | 78.71 |
| **SD** | 26 | 3.06 | 695 | 81.76 |
| **SEA** | 26 | 3.06 | 721 | 84.82 |
| **SF** | 24 | 2.82 | 745 | 87.65 |
| **STL** | 12 | 1.41 | 757 | 89.06 |
| **TB** | 36 | 4.24 | 793 | 93.29 |
| **TEN** | 36 | 4.24 | 829 | 97.53 |
| **WAS** | 21 | 2.47 | 850 | 100.00 |

**Figure 3**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Obs** | **team** | **name** | **rec** | **tgt** |
| **51808** | PHI | Peters, Jason | 1 | 0 |

**Figure 4**

|  |  |
| --- | --- |
| **Player's Position** | **count** |
| C | 5 |
| CB | 112 |
| DB | 4 |
| DE | 68 |
| DE/ | 1 |
| DT | 77 |
| FB | 15 |
| K | 12 |
| LB | 118 |
| OG | 25 |
| OL | 1 |
| OT | 49 |
| P | 3 |
| QB | 18 |
| RB | 97 |
| S | 70 |
| TE | 39 |
| WR | 136 |

**Figure 5**

|  |  |  |
| --- | --- | --- |
| **Team of Player** | **sumarrests** | **totalyds** |
| NO | 4 | 76701 |
| IND | 2 | 73155 |
| GB | 1 | 71558 |
| NE | 4 | 71081 |
| PHI | 2 | 68355 |
| DEN | 8 | 67733 |
| SD | 5 | 67114 |
| DET | 1 | 66436 |
| NYG | 2 | 65997 |
| PIT | 7 | 65791 |
| DAL | 5 | 65058 |
| ATL | 2 | 63537 |
| MIN | 7 | 62271 |
| KC | 5 | 61961 |
| CIN | 10 | 61780 |
| SEA | 2 | 61665 |
| OAK | 2 | 61139 |
| TB | 5 | 61047 |
| TEN | 12 | 60299 |
| BAL | 3 | 59780 |
| MIA | 4 | 59607 |
| CAR | 5 | 58988 |
| CHI | 6 | 57725 |
| BUF | 4 | 57559 |
| NYJ | 3 | 57501 |
| CLE | 6 | 57232 |
| SF | 3 | 57124 |
| HOU | 3 | 55171 |

**Figure 6**

|  |  |
| --- | --- |
| **off\_def** | **count** |
| D | 450 |
| O | 400 |

**Figure 7**

|  |  |
| --- | --- |
| **Team of Player** | **NumCases** |
| MIN | 49 |
| DEN | 47 |
| CIN | 44 |
| TB | 36 |
| TEN | 36 |
| IND | 35 |
| JAC | 34 |
| CLE | 33 |
| CHI | 32 |
| KC | 32 |
| MIA | 31 |
| BAL | 27 |
| SD | 26 |
| SEA | 26 |
| NO | 25 |
| SF | 24 |
| PIT | 24 |
| GB | 23 |
| OAK | 21 |
| CAR | 21 |
| ARI | 21 |
| WAS | 21 |
| NYJ | 20 |
| NE | 20 |
| ATL | 20 |
| BUF | 19 |
| PHI | 18 |
| DET | 18 |
| DAL | 17 |
| NYG | 16 |
| HOU | 13 |
| STL | 12 |
| LAR | 5 |
| Fre | 3 |
| LAC | 1 |

**Figure 8**

|  |  |  |  |
| --- | --- | --- | --- |
| **Player's Position** | | **count** | |
| C | | 5 | |
| CB | | 112 | |
| DB | | 4 | |
| DE | | 69 | |
| DT | | 77 | |
| FB | | 15 | |
| K | | 12 | |
| LB | | 118 | |
| OG | | 25 | |
| OL | | 1 | |
| OT | | 49 | |
| P | | 3 | |
| QB | | 18 | |
| RB | | 97 | |
| S | | 70 | |
| TE | | 39 | |
| WR | | 136 | |

**Figure 9**

|  |  |  |
| --- | --- | --- |
| **Last, First Name of Player** | **Season Year** | **MaxYds** |
| Smith, Jimmy | 2000 | 291 |
| Gardner, Rod | 2001 | 208 |
| Burress, Plaxico | 2002 | 253 |
| Boldin, Anquan | 2003 | 217 |
| Bennett, Drew | 2004 | 233 |
| Chambers, Chris | 2005 | 238 |
| Evans, Lee | 2006 | 265 |
| Curtis, Kevin | 2007 | 221 |
| Owens, Terrell | 2008 | 213 |
| Austin, Miles | 2009 | 250 |
| Britt, Kenny | 2010 | 225 |
| Johnson, Calvin | 2011 | 244 |
| Johnson, Andre | 2012 | 273 |
| Johnson, Calvin | 2013 | 329 |
| Jones, Julio | 2014 | 259 |
| Brown, Antonio | 2015 | 284 |
| Jones, Julio | 2016 | 300 |

**Figure 10**

|  |  |
| --- | --- |
| **Team of Player** | **TotYds** |
| NO | 76701 |
| IND | 73155 |
| GB | 71558 |
| NE | 71081 |
| PHI | 68355 |
| DEN | 67733 |
| SD | 67114 |
| ARZ | 66647 |
| DET | 66436 |
| NYG | 65997 |
| PIT | 65791 |
| DAL | 65058 |
| ATL | 63537 |
| WSH | 62957 |
| STL | 62815 |
| MIN | 62271 |
| KC | 61961 |
| CIN | 61780 |
| SEA | 61665 |
| OAK | 61139 |
| TB | 61047 |
| TEN | 60299 |
| BAL | 59780 |
| JAX | 59665 |
| MIA | 59607 |
| CAR | 58988 |
| CHI | 57725 |
| BUF | 57559 |
| NYJ | 57501 |
| CLE | 57232 |
| SF | 57124 |
| HOU | 55171 |
| LA | 3313 |

**Figure 11**

|  |  |  |
| --- | --- | --- |
| **Obs** | **wk** | **total\_yds** |
| **1** | 1 | 264 |
| **2** | 2 | 324 |
| **3** | 3 | 103 |
| **4** | 4 | 205 |
| **5** | 5 | 406 |
| **6** | 6 | 376 |
| **7** | 7 | 222 |
| **8** | 8 | 315 |
| **9** | 10 | 316 |
| **10** | 11 | 280 |
| **11** | 12 | 286 |
| **12** | 13 | 269 |
| **13** | 14 | 406 |
| **14** | 15 | 188 |
| **15** | 16 | 220 |
| **16** | 17 | 276 |