

# NFL\_Data\_Analysis

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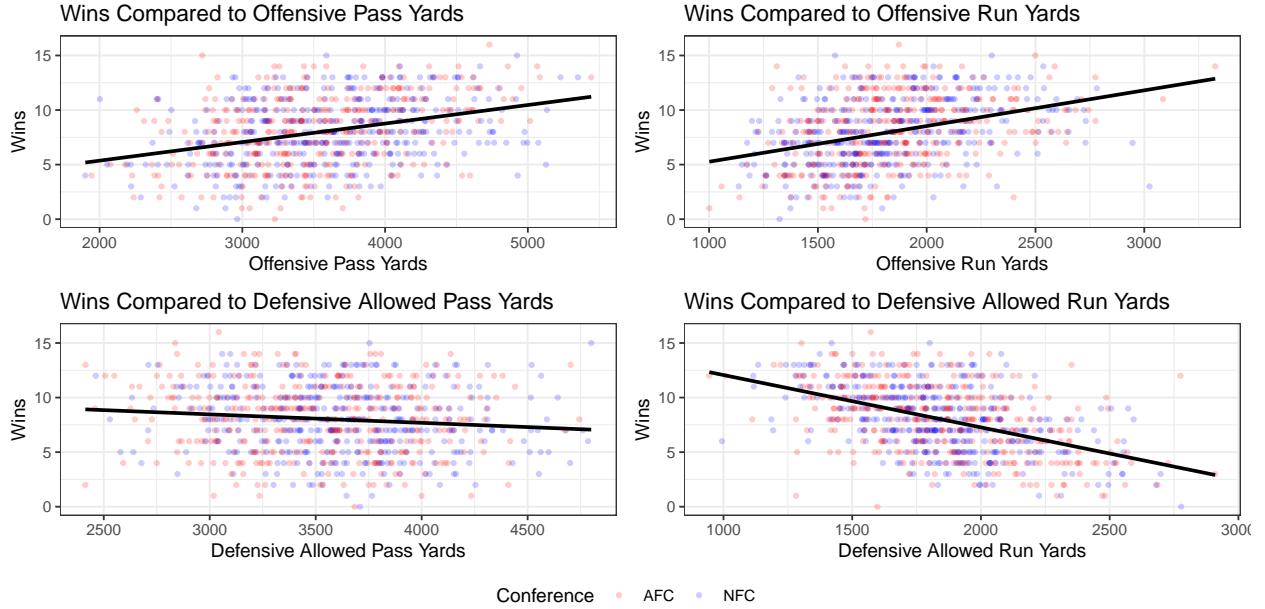
## Data Overview

### Offensive and Defensive Association with Wins

#### Scatterplot of Win associations

In Figure 1 the y-axis has the wins that range from 0 to 16 and a linear regression line that wins with four different variables. In Wins Compared to Offensive Pass Yards the x-axis is the Offensive Pass Yards that range from 1000 to 6000. There is a positive linear association between wins and offensive pass yards which shows that as teams pass for more yards in a season they tend to win more games. In Wins Compared to Offensive Run Yards the x-axis is offensive run yards that range from 1000 to 4000 yards. There is a slightly stronger positive linear association between offensive run yards per seasons and offensive pass yards. This leads us to believe that it is slightly more important for teams to focus on good run offense then pass offense. Wins Compared to Defensive Allowed Pass Yards has defensive allowed pass yards as the x-axis with a range of 2000 to 5000 yards. There is a slightly negative linear association between defensive allowed pass yards and team wins. In Wins Compared to Defensive Allowed Run Yards the x-axis is defensive allowed run yards with a range from 500 to 3000 yards. There is a relatively strong negative linear association between defensive run yards allowed and team wins in a season. This leads us to believe that it is much more important to focus on run defense than pass defense as that would lead to more wins. In Figure 1 the colors are sorted by AFC and NFC teams for all of the graphs. In Figure 1 it seems to be more important to focus on both run offense and run defense to lead to more wins. It is definitely more important to focus on run defense then it is to focus on pass defense. This could be because a strong game allows a team to control the clock and have more possession time then the other team as every run play uses the clock.

Figure 1: Win Association of Offensive and Defensive Pass Yards



### Average Wins and Offensive and Defensive Yards Table

Table 1 includes the average team wins, the 32 NFL teams, average Offensive pass yards, average offensive rush yards, average defensive rush yards, and average defensive pass yards. The defensive statistics is the average amount of yards that the defense allowed so the lower the number the better the team is in that particular stat. The team with the most average wins in the patriots which makes sense as they had one of the biggest dynasties in NFL history. What is interesting about this is that they had the highest wins, but in every other category there was at least one team that performed better then them. The highest average offensive pass yards belonged to New Orleans which is 9th in the average wins statistic. The highest average rush yards belongs and lowest allowed rush yards belongs to Baltimore which is 5th in average wins. Buffalo has the lowest allowed pass yards and they are 17th in average wins. This shows that the best team is not the best in each category so it must be a combination of these things that lead to winning football. Cleveland does have the lowest average wins and lowest average allowed rush yards so there could be a stronger correlation with losing and have a bad rush defense which is also supported in Figure 1

Table 1: NFL Offensive and Defensive Statistics

Teams	Average Wins	Mean Offensive Pass Yards	Mean Offense Run Yards	Mean Defensive Pass Yards	Mean Defensive Run Yards
NE	11.250000	3931.292	1864.833	3585.875	1756.208
PIT	10.041667	3672.917	1864.958	3295.708	1582.000
GB	9.958333	3960.792	1817.250	3531.542	1847.375
IND	9.750000	3988.958	1735.125	3528.333	1957.333
BAL	9.458333	3247.500	2084.083	3407.500	1501.792
PHI	9.250000	3701.000	1990.417	3531.208	1801.333
SEA	9.125000	3446.958	1981.708	3632.792	1834.292

Table 1: NFL Offensive and Defensive Statistics

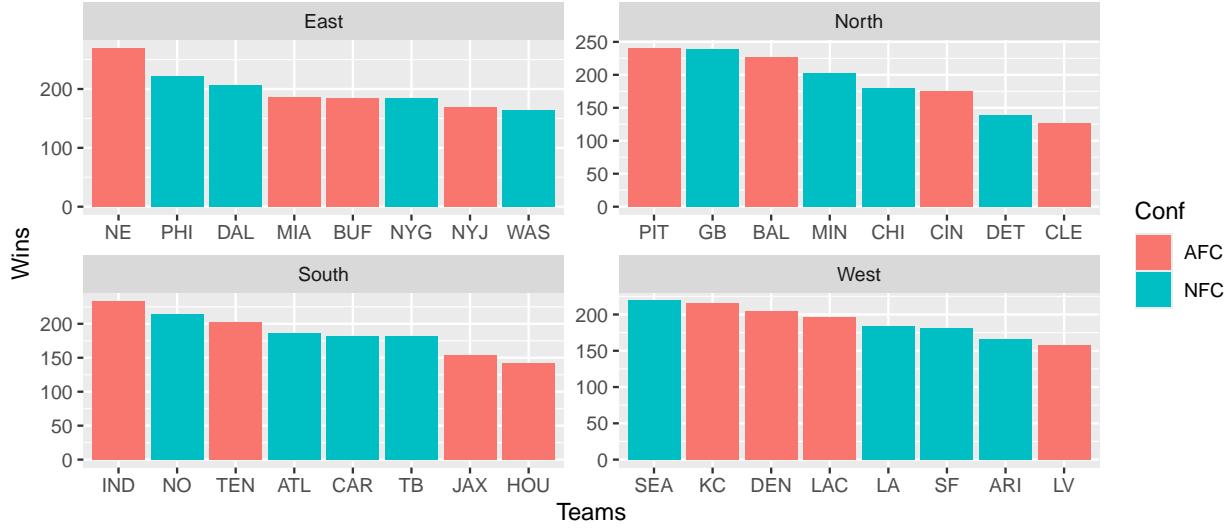
Teams	Average Wins	Mean Offensive Pass Yards	Mean Offense Run Yards	Mean Defensive Pass Yards	Mean Defensive Run Yards
KC	8.958333	3721.917	1979.125	3667.083	1998.042
NO	8.916667	4153.792	1813.708	3656.417	1868.917
DAL	8.583333	3679.125	1950.875	3536.792	1782.583
DEN	8.541667	3689.208	2003.583	3432.250	1781.417
MIN	8.458333	3578.417	2011.667	3768.750	1733.958
TEN	8.458333	3333.250	1964.042	3754.167	1703.875
LAC	8.166667	3892.083	1742.625	3569.333	1764.667
ATL	7.791667	3623.417	1858.667	3792.958	1916.625
MIA	7.750000	3363.583	1718.250	3510.583	1857.417
BUF	7.708333	3255.375	1941.000	3221.000	1968.667
LA	7.666667	3733.750	1728.917	3533.833	1890.708
NYG	7.666667	3622.708	1832.167	3676.292	1820.167
CAR	7.583333	3308.417	1915.333	3519.833	1830.167
SF	7.541667	3326.375	1969.667	3618.833	1747.417
TB	7.541667	3679.042	1662.875	3486.292	1787.375
CHI	7.500000	3182.750	1775.917	3548.667	1835.250
CIN	7.291667	3482.042	1766.792	3616.208	1887.458
NYJ	7.041667	3168.583	1853.833	3468.083	1837.750
ARI	6.916667	3598.417	1559.417	3589.958	1932.250
WAS	6.833333	3450.458	1857.292	3537.042	1858.875
HOU	6.761905	3501.048	1803.762	3648.286	1947.190
LV	6.541667	3541.250	1797.792	3629.833	1995.250
JAX	6.416667	3342.375	1890.958	3528.833	1854.958
DET	5.791667	3728.750	1527.250	3817.000	1940.750
CLE	5.291667	3175.083	1711.042	3457.750	2170.792

## Team Wins from 1999-2022

When people think of the best football team of all time, to many, the first thing to come to mind is wins. In this section we will look at a visualization and some statistics to build an understanding of team wins in the 21st century.

First we have simple box plots Figure 2 showing every NFL team's total wins since from 1999-2022. The box plots are separated and colored so one can more easily compare within divisions and across the conferences. Note the thin white lines, which show how the wins are summed up by season. An interesting observation is that it seems as though teams with more wins were also more consistent across seasons as the distance between white lines does not vary as much as those in teams with less overall wins. This is a observed trend which can be made by looking at the figure, but it will not be shown to be statistically significant in this section, whether or not it truly is.

Figure 2: Boxplots of Team Wins



Now it would be appropriate to provide a table showing statistics for wins by season. The following table Table 2 gives seasons played from 1999-2022, minimum wins in a season, first quartile, median wins, third quartile, maximum wins in a season, simple arithmetic mean of wins, and standard deviation for each team. One thing to note is that Houston has played three seasons less than the other teams, as they joined the NFL in the 2002 season. Standard deviation represented by SD is the how much a team's amount of wins usually varies from season to season.

Table 2: Team Wins Statistics

Team	Seasons	Minimum	Quartile 1	Median	Quartile 3	Max	Mean	SD
ARI	24	3	5.00	6.5	8.25	13	6.92	2.72
ATL	24	4	5.75	7.0	10.00	13	7.79	2.78
BAL	24	5	8.00	10.0	11.00	14	9.46	2.34
BUF	24	3	6.00	7.0	9.00	13	7.71	2.56
CAR	24	1	6.00	7.0	8.75	15	7.58	3.17
CHI	24	3	5.00	7.0	9.25	13	7.50	2.95
CIN	24	2	4.00	7.5	10.00	12	7.29	3.10
CLE	24	0	4.00	5.0	7.00	11	5.29	2.68
DAL	24	4	6.00	8.5	10.25	13	8.58	2.69
DEN	24	4	6.75	8.0	10.25	13	8.54	2.75
DET	24	0	3.00	6.0	8.25	11	5.79	2.90
GB	24	4	8.00	10.0	12.00	15	9.96	2.71
HOU	21	2	4.00	7.0	9.00	12	6.76	3.03
IND	24	2	8.00	10.5	12.00	14	9.75	3.22
JAX	24	1	4.75	6.0	8.25	14	6.42	3.24
KC	24	2	7.00	9.5	12.00	14	8.96	3.51
LA	24	1	5.75	7.0	10.25	14	7.67	3.71
LAC	24	1	6.50	8.5	9.25	14	8.17	3.10
LV	24	2	4.00	6.0	8.00	12	6.54	2.89

Table 2: Team Wins Statistics

Team	Seasons	Minimum	Quartile 1	Median	Quartile 3	Max	Mean	SD
MIA	24	1	6.00	8.0	9.25	11	7.75	2.44
MIN	24	3	6.75	8.0	10.00	13	8.46	2.59
NE	24	5	10.00	12.0	13.00	16	11.25	2.56
NO	24	3	7.00	8.5	11.00	13	8.92	2.87
NYG	24	3	6.00	7.5	10.00	12	7.67	2.66
NYJ	24	2	4.75	7.5	9.00	11	7.04	2.56
PHI	24	4	7.75	9.5	11.00	14	9.25	2.75
PIT	24	6	8.75	10.0	12.00	15	10.04	2.24
SEA	24	4	7.00	9.0	10.25	13	9.12	2.36
SF	24	2	5.00	7.0	10.25	13	7.54	3.46
TB	24	2	5.00	7.5	10.00	13	7.54	3.08
TEN	24	2	6.75	9.0	11.00	13	8.46	3.13
WAS	24	3	5.00	7.0	8.00	10	6.83	2.12

## Team Efficiency

Figure 3: NFL Team Efficiency Scatter Plot

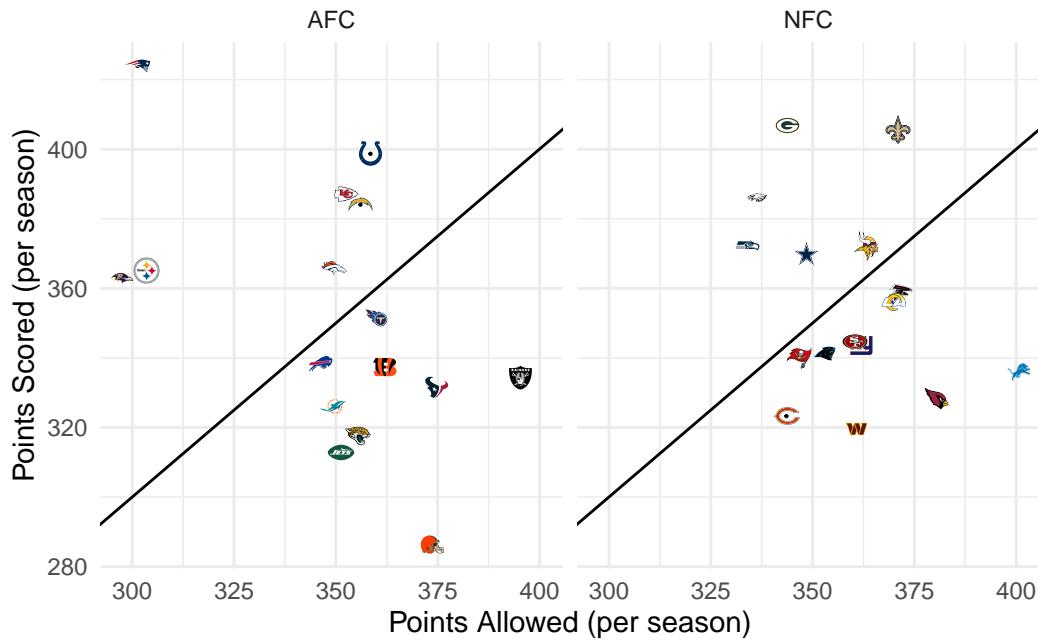


Figure 3 shows a scatter plot of each NFL team's efficiency by showing the relationship between a team's average points allowed per season (x-axis) vs average points scored per season (y-axis) from the 1999 NFL regular season to the 2022 NFL regular season. Each point on the graph represents an individual team average and differentiates the teams by team logo. The top left corner of the plot shows the most efficient teams. The bottom right corner of the plot shows the least efficient

teams. The diagonal line in the middle of both plots demonstrates a efficiency threshold. If a team is above the line they are considered efficient. If a team is below the line they are considered inefficient. If a team is on the line they are neutral. The plot is broken up into two sides, one representing the AFC teams and the other representing the NFC teams.

Table 3: AFC Efficiency Table

Team	image	Average Point Differential	Win Rate	Loss Rate
NE		122.5833	11.2500	4.8333
PIT		61.7500	10.0417	5.9167
IND		40.1667	9.7500	6.2917
BAL		65.3750	9.4583	6.6250
KC		34.5417	8.9583	7.1250
DEN		16.2083	8.5417	7.5417
TEN		-8.2917	8.4583	7.6250
LAC		28.0000	8.1667	7.9167
MIA		-23.2917	7.7500	8.3333
BUF		-8.0000	7.7083	8.3333
CIN		-24.5833	7.2917	8.5833
NYJ		-38.5417	7.0417	9.0417
HOU		-43.1905	6.7619	9.2857
LV		-61.0417	6.5417	9.5417
JAX		-37.8333	6.4167	9.6667
CLE		-87.4583	5.2917	10.7500

Table 4: NFC Efficiency Table

Team	image	Average Point Differential	Win Rate	Loss Rate
GB		62.9167	9.9583	6.0417
PHI		49.7083	9.2500	6.7500
SEA		38.2083	9.1250	6.9167
NO		34.7083	8.9167	7.1667
DAL		21.4583	8.5833	7.5000
MIN		9.2083	8.4583	7.5417
ATL		-13.5417	7.7917	8.2500
LA		-13.8333	7.6667	8.3750
NYG		-18.1250	7.6667	8.3750
CAR		-11.9167	7.5833	8.4583
SF		-15.7083	7.5417	8.5000
TB		-6.5417	7.5417	8.5417
CHI		-20.3333	7.5000	8.5833
ARI		-52.2083	6.9167	9.0833
WAS		-41.2500	6.8333	9.1667
DET		-64.5417	5.7917	10.2083

## #Code Appendix

```
#Tidyverse Coding Styling
```

```
library(tidyverse)
library(ggimage)
library(kableExtra)
library(patchwork)
library(ggpubr)

NFL_raw <- read.csv("nfl-team-statistics (1).csv")

NFC_East_data <- NFL_raw %>%
  filter(team %in% c("DAL", "NYG", "PHI", "WAS")) %>%
  mutate(Conf = 'NFC_East')

NFC_West_data <- NFL_raw %>%
  filter(team %in% c("LA", "SEA", "SF", "ARI")) %>%
  mutate(Conf = 'NFC_West')

NFC_North_data <- NFL_raw %>%
  filter(team %in% c("CHI", "GB", "DET", "MIN")) %>%
  mutate(Conf = 'NFC_North')

NFC_South_data <- NFL_raw %>%
  filter(team %in% c("TB", "CAR", "ATL", "NO")) %>%
  mutate(Conf = 'NFC_South')

AFC_East_data <- NFL_raw %>%
  filter(team %in% c("NE", "BUF", "MIA", "NYJ")) %>%
  mutate(Conf = 'AFC_East')

AFC_West_data <- NFL_raw %>%
  filter(team %in% c("DEN", "LAC", "KC", "LV")) %>%
  mutate(Conf = 'AFC_West')

AFC_North_data <- NFL_raw %>%
  filter(team %in% c("BAL", "PIT", "CIN", "CLE")) %>%
  mutate(Conf = 'AFC_North')

AFC_South_data <- NFL_raw %>%
  filter(team %in% c("JAX", "IND", "HOU", "TEN")) %>%
  mutate(Conf = 'AFC_South')

NFL_Clean <- bind_rows(NFC_East_data, NFC_North_data, NFC_South_data, NFC_West_data, AFC_East_data,
  arrange(season, team)) %>%
  separate_wider_delim(
```

```

    cols = 'Conf',
    delim = '_',
    names = c('Conf', 'Div')
  )

#author: Timothy Smith
#reviewed: Isaac Swope

plot1<-NFL_Clean%>%
  group_by(Div)%>%
  ggplot(# Step 1: Create the first graph using ggplot and geom point with x as offense pass yard
  mapping = aes(
    x = offense_total_yards_gained_pass,
    y = wins,
    color = Conf
  )#Step 2: Make the points size 1 and the transparency to be .2 ----
) +
  geom_point(size = 1, alpha=0.2) +
  labs(#Step 3: add labels and title to the data visualization and create the colors for the plot
  x = "Offensive Pass Yards",
  y = "Wins",
  color = "Conference",
  title = "Wins Compared to Offensive Pass Yards"
) +
  scale_color_manual(
  values = c("red", "blue")
) +
  theme_bw() +
  theme(
    legend.position = "bottom"
) +
  geom_smooth(method = "lm", se = FALSE, color = "black")
# Step 4: Create the regression line ----
plot2<-NFL_Clean%>%
  group_by(Div)%>%
  ggplot(# Step 5: Repeat Step 1 but x is the total rush yards----)
  mapping = aes(
    x = offense_total_yards_gained_run,
    y = wins,
    color = Conf
  )#Step 6: repeat step 2 for the second plot ----
) +
  geom_point(size=1, alpha=0.2) +
  labs(#Step 7: repeat step 3 for the second plot----
  x = "Offensive Run Yards",
  y = "Wins",
  color = "Conference",

```

```

    shape = "team",
    title = "Wins Compared to Offensive Run Yards"
) +
scale_color_manual(
  values = c("red", "blue")
)+ 
theme_bw() +
theme(
  legend.position = "bottom"
)+ 
geom_smooth(method = "lm", se = FALSE, color = "black")
#Step 8: Repeat step 4 for second plot----
plot3<-NFL_Clean%>%
  group_by(Div)%>%
ggplot(#Step 9: Repeat step 1 but with x as the defensive allowed pass yards ----
  mapping = aes(
    x = defense_total_yards_gained_pass,
    y = wins,
    color = Conf
  )#Step 10: Repeat step 2 but for third plot----
) +
geom_point(size=1, alpha=0.2) +
labs(#Step 11: repeat step 3 but for third plot----
  x = "Defensive Allowed Pass Yards",
  y = "Wins",
  color = "Conference",
  title = "Wins Compared to Defensive Allowed Pass Yards"
) +
scale_color_manual(
  values = c("red", "blue")
)+ 
theme_bw() +
theme(
  legend.position = "bottom"
)+ 
geom_smooth(method = "lm", se = FALSE, color = "black")
#Step 12: repeat step 4 but for third plot----

plot4<-NFL_Clean%>%
  group_by(Div)%>%
ggplot(#Step 13: repeat step 1 but x is the allowed rush yards----
  mapping = aes(
    x = defense_total_yards_gained_run,
    y = wins,
    color = Conf
  )# Step 14: repeat step 2 but for fourth plot----
) +

```

```

geom_point(size=1, alpha=0.2) +
  labs(#Step 15: repeat step 3 but for fourth plot----
    x = "Defensive Allowed Run Yards",
    y = "Wins",
    color = "Conference",
    title = "Wins Compared to Defensive Allowed Run Yards"
  ) +
  scale_color_manual(
    values = c("red", "blue")
  ) +
  theme_bw() +
  theme(
    legend.position = "bottom"
  ) +
  geom_smooth(method = "lm", se = FALSE, color = "black")
#Step 16: repeat step 4 but for fourth plot----

ggarrange(plot1, plot2, plot3, plot4, nrow = 2, ncol = 2, common.legend = TRUE, legend = "bot")

#Step 17: create a grid with all of the plots together----


#author: Timothy Smith
#reviewed: Isaac Swope

NFL_O_D <- NFL_Clean %>%
  group_by(team)%>%
  summarize(#Step 1: Determine the average values of the 5 main statistics that I want to work
    Mean_Wins = mean(wins, na.rm = TRUE),
    Mean_O_pass_yards = mean(offense_total_yards_gained_pass, na.rm = TRUE),
    Mean_O_run_yards = mean(offense_total_yards_gained_run, na.rm = TRUE),
    Mean_D_pass_yards = mean(defense_total_yards_gained_pass, na.rm = TRUE),
    Mean_D_run_yards = mean(defense_total_yards_gained_run, na.rm = TRUE)
  ) %>%
  arrange(desc(Mean_Wins))

  names(NFL_O_D) <- c(#Step 2: replace the Names of the columns----
  "Teams",
  "Average Wins",
  "Mean Offensive Pass Yards",
  "Mean Offense Run Yards",
  "Mean Defensive Pass Yards",
  "Mean Defensive Run Yards"
  )

NFL_O_D %>%
  kable(#Step 3: Create the table using the kable function----
```

```

booktabs = TRUE,
align = c("l", rep("c",10)))

#author: Isaac Swope
#reviewed: Kyle Barber

#we need to sum and order by wins so we use fct_reorder and then .desc=TRUE to force descending
ggplot(NFL_Clean) +
  aes(x = fct_reorder(team, wins, .fun=sum, .desc=TRUE), y = wins, fill = Conf) +
  geom_col(color = NA) +
  facet_wrap("Div", scales = "free") + #eliminate spacing between columns due to scale
  labs(y = "Wins",
       x = "Teams",
       )

#author: Isaac Swope
#reviewed: Timothy Smith

winsTable <- NFL_Clean %>%
  group_by(team)%>% #we want to group by team
  summarize( # calculating the selected statistics
    Count=n(),
    Min = min(wins, na.rm = TRUE),
    Quartile_1 = quantile(wins, probs = 0.25, na.rm = TRUE),
    Median = median(wins, na.rm = TRUE),
    Quintile_3 = quantile(wins, probs = 0.75, na.rm = TRUE),
    Max = max(wins, na.rm = TRUE),
    Mean = mean(wins, na.rm = TRUE),
    SD = sd(wins, na.rm = TRUE),
    )%>%
  mutate(
    across(
      .cols = where(is.numeric),
      .fns = ~round(.x, digits = 2) #rounding to 2 decimal places
    )
  )

names(winsTable) <- c( #renaming columns
  "Team",
  "Seasons",
  "Minimum",
  "Quartile 1",
  "Median",
  "Quartile 3",
  "Max",
  "Mean",
  "SD"
)

```

```

)

winsTable %>%
  kable(
    booktabs = TRUE,
    align = c("l", rep("c",10))
  )

#Author: Kyle Barber
#reviewer

NFL_Clean_3 <- NFL_Clean %>% ## Wrangle data
  select(team, Conf, score_differential, points_scored,
         points_allowed, wins, losses) %>% ### Choose necessary columns
  group_by(team, Conf) %>%
  summarise(
    points_scored = mean(points_scored),
    points_allowed = mean(points_allowed),
    wins = mean(wins),
    losses = mean(losses),
    point_differential = mean(score_differential),
    .groups = "drop"
  ) ### Get the mean for each variable
NFL_Clean_3$logo <- paste0("Logos/", NFL_Clean_3$team, ".png") ### Add logo column

ggplot(NFL_Clean_3) + ## Make plot
  aes(x = points_allowed, y = points_scored) + ### Set aesthetic
  geom_point(size = 0.1) + ### Make scatter plot
  geom_image(aes(image = logo)) + ### add in images
  labs(
    x = "Points Allowed (per season)",
    y = "Points Scored (per season)"
  ) + ### Set x and y axis labels
  geom_abline(slope = 1, intercept = 0) + ### Add efficiency line
  theme_minimal() +
  facet_wrap(vars(Conf)) ### Separate plots by conference

#Author: Kyle Barber
#Reviewer

AFC_table <- NFL_Clean_3%>% ## Clean data
  filter(Conf == 'AFC')%>% ### Choose necessary conference
  select(team, point_differential, wins, losses, logo)%>% ### Choose necessary variables
  mutate(
    point_differential = round(point_differential, digits = 4),
    wins = round(wins, digits = 4),
    losses = round(losses, digits = 4),

```

```

image = ""
) %>% ### Round all numeric variables
arrange(desc(wins)) %>% ### Arrange by descending win rate
rename( ### Rename variables
  Team = team,
  `Average Point Differential` = point_differential,
  `Win Rate` = wins,
  `Loss Rate` = losses
)

AFC_table %>% ## Make table
  select(Team, image, `Average Point Differential`, `Win Rate`, `Loss Rate`) %>%### Choose nec
  kable( ### Set format
    booktabs = TRUE,
    align = c("l", rep("c", 10)),
    format = "latex"
  ) %>%
  kable_paper() %>%
  column_spec(2, image = spec_image(path = AFC_table$logo, 50, 50)) ### Add images

#Author: Kyle Barber
#Reviewer:

NFC_table <- NFL_Clean_3 %>% ## Clean data
  filter(Conf == 'NFC') %>% ### Choose necessary conference
  select(team, point_differential, wins, losses, logo) %>% ### Choose necessary variables
  mutate( ### round each numeric variable
    point_differential = round(point_differential, digits = 4),
    wins = round(wins, digits = 4),
    losses = round(losses, digits = 4),
    image = ""
  ) %>%
  arrange(desc(wins)) %>% ### Arrange by win rate descending
  rename( ### Rename variables
    Team = team,
    `Average Point Differential` = point_differential,
    `Win Rate` = wins,
    `Loss Rate` = losses
  )

NFC_table %>% ## Make table
  select(Team, image, `Average Point Differential`, `Win Rate`, `Loss Rate`) %>% ### select ne
  kable( ### Set format
    booktabs = TRUE,
    align = c("l", rep("c", 10)),
    format = "latex"
  ) %>%

```

```
kable_paper() %>%
  column_spec(2, image = spec_image(path = NFC_table$logo, 50, 50)) ### Add images
```