Final Project

Investigating the Importance of Third Downs in College Football

Introduction

In the game of football, third downs are often pivotal moments that can significantly influence the outcome of a game. These critical plays present teams with a high-pressure opportunity to either sustain their drives or force a turnover. The importance of third-down scenarios is magnified in college football, where the dynamics of offensive and defensive strategies can vary widely. This project investigates the hypothesis that third downs are the most critical down in college football, shaping team success both offensively and defensively. By analyzing data from the 2023 college football season, we aim to uncover the relationships between third-down efficiency and overall team performance, providing insights into the strategic importance of these moments.

Research Focus

The central question guiding this analysis is whether third downs can be considered the most critical down in college football. To address this, we investigate several aspects of third-down performance. First, we explore how offensive third-down conversion rates correlate with overall offensive rankings. Next, we examine the relationship between defensive third-down stop rates and overall defensive rankings. Finally, we compare the third-down conversion efficiency of top-performing teams with those ranked lower, aiming to highlight how third-down scenarios differentiate successful teams from their peers. Through these analyses, we hope to demonstrate the strategic value of excelling in third-down situations.

Methodology

Data Collection and Preparation

The dataset used in this project consists of comprehensive statistics from the 2023 college football season. Key metrics include overall offensive and defensive ranks, third-down offensive conversion rates, and third-down defensive stop rates. These data were sourced from Kaggle, a reputable aggregator of official league statistics. The dataset was cleaned and prepared for analysis. Missing values were addressed using appropriate imputation techniques, and rankings were standardized to ensure consistent comparisons across teams. Additional

variables, such as third-down efficiency ratios, were computed to provide deeper insights into team performance.

Analytical Approach

The analysis was conducted using the R programming language, leveraging powerful tools for data manipulation and visualization. The **dplyr** package facilitated efficient data wrangling, while **ggplot2** was employed to create detailed and informative visualizations. The project focuses on exploring relationships through scatter plots, bar charts, and descriptive statistics. These methods allow us to identify patterns, trends, and outliers in the data, offering a comprehensive view of third-down performance across college football teams.

Results and Analysis

Third-Down Offensive Conversion Rate and Overall Offensive Rank

Here we can see a clear trend of teams ability to convert on third down translates to their offensive rank. The outliers in this chart could describe teams that are very powerful on offense that do not often get to third down (convert on first and second downs).

Third-Down Defensive Stop Rate and Overall Defensive Rank

Here we see a much similar chart to the previous but this one seems to have less outliers. We decided to include a line of best fit that could show the variance of the results. We can explain this having less outliers by the fact that when a team is on defense they have to get to third down to consider it a "stop". Where as when you are on offense a "conversion" can be on first second or third down.

Third-Down Conversion Rates of Top-Performing Teams

This chart takes the top ten defenses for 2023 and plots their third down conversion rates. Here we see some variance in our results. This variance could be explained by some of these top defenses excelling in turnovers, which would not affect the third down stat.

Discussion

The findings of this analysis highlight the crucial role third-down performance plays in college football, shaping the game's overall flow and determining team success. Teams that excel in third-down situations, both offensively and defensively, are typically in a better position to control the pace of the game. On offense, converting third downs allows teams to maintain possession, prolong drives, and create additional opportunities to score. Each successful conversion not only provides a fresh set of downs but also exhausts the opposing defense, often leading to more favorable conditions for subsequent plays. Teams that struggle to convert on third down risk stalling their offense, potentially giving the opposing team more opportunities

to regain possession and seize control of the game. On the defensive side, preventing third-down conversions disrupts the opposing team's rhythm and momentum. A strong defense that can consistently stop third-down plays forces the offense to either punt or attempt risky plays, leading to turnovers or lost opportunities. These stops can also generate emotional momentum for the defense, shifting the psychological advantage in favor of the defending team. The ability to stop third downs also reflects a defense's discipline and preparedness, as third-down stops often require precise execution and an understanding of the offensive team's tendencies. These findings align with the broader understanding of football strategy, where situational success—such as converting on third down or stopping an opponent on third down—often determines the outcome of a game. When a team is able to consistently succeed in these high-pressure situations, they are more likely to control the game's tempo, manage the clock effectively, and dictate the flow of play, all of which contribute to a higher chance of winning. However, while third-down performance appears to be a strong predictor of team success, it is not the only factor. Football is a multifaceted sport where a team's overall performance is shaped by a variety of elements, including individual talent, coaching decisions, and execution in other critical phases of the game, such as special teams or red zone efficiency. A team that is highly effective on third down but struggles in the red zone or has a high turnover rate may still underperform relative to expectations. Additionally, factors like offensive play calling, defensive schemes, and even the ability to adapt to in-game circumstances can influence how well a team performs on third down. Coaching strategies, such as deciding whether to go for it on fourth down or opting for conservative play calling to manage the clock, can impact a team's overall efficiency and success in third-down situations

Conclusion

This project demonstrates that third downs are a critical component of college football strategy. Teams that dominate third-down scenarios often find themselves among the top performers, highlighting the importance of situational excellence in achieving success. By focusing on third-down efficiency, both offensively and defensively, teams can improve their competitive edge and increase their chances of success in high-stakes games. These findings contribute to a deeper understanding of the dynamics of college football and provide valuable insights for coaches, analysts, and fans alike.

Appendix

```
# Import Dataset
cfb23 <- read.csv("~/Desktop/archive-4/cfb23.csv", header=FALSE)
  View(cfb23)

# Import necessary libraries
```

```r
library(ggplot2)
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
# Clean data
cfb23$`V20` <- as.numeric(cfb23$`V20`)
```

```
Warning: NAs introduced by coercion
```

```r
cfb23$`V7` <- as.numeric(cfb23$`V7`)
```

```
Warning: NAs introduced by coercion
```

```r
# Clean Data
summary(cfb23)
```

```
       V1              V2                 V3                 V4
 Min.   :  0.00   Length:135         Length:135         Length:135
 1st Qu.: 33.25   Class :character   Class :character   Class :character
 Median : 66.50   Mode  :character   Mode  :character   Mode  :character
 Mean   : 66.50
 3rd Qu.: 99.75
 Max.   :133.00
 NA's   :1
      V5                 V6                  V7            V8
 Length:135         Length:135         Min.   :3245   Length:135
 Class :character   Class :character   1st Qu.:4241   Class :character
 Mode  :character   Mode  :character   Median :4909   Mode  :character
                                       Mean   :4936
```

```
                                3rd Qu.:5622
                                Max.   :7440
                                NA's   :2
     V9                 V10                V11                V12
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

    V13                V14                V15                V16
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

    V17                V18                V19                 V20
Length:135         Length:135         Length:135         Min.   : 40.00
Class :character   Class :character   Class :character   1st Qu.: 60.00
Mode  :character   Mode  :character   Mode  :character   Median : 68.00
                                                         Mean   : 68.29
                                                         3rd Qu.: 78.00
                                                         Max.   :101.00
                                                         NA's   :2
    V21                V22                V23                V24
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

    V25                V26                V27                V28
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
     V29                V30                V31                V32
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

     V33                V34                V35                V36
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

     V37                V38                V39                V40
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

     V41                V42                V43                V44
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

     V45                V46                V47                V48
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

     V49                V50                V51                V52
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
```

```
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
    V53                V54                V55                V56
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
    V57                V58                V59                V60
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
    V61                V62                V63                V64
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
    V65                V66                V67                V68
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
    V69                V70                V71                V72
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
    V73                V74                V75                V76
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

    V77                V78                V79                V80
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

    V81                V82                V83                V84
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

    V85                V86                V87                V88
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

    V89                V90                V91                V92
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

    V93                V94                V95                V96
```

```
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
    V97                V98                V99                V100
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
    V101               V102               V103               V104
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
    V105               V106               V107               V108
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
    V109               V110               V111               V112
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
    V113               V114               V115               V116
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
    V117               V118               V119               V120
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

    V121               V122               V123               V124
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

    V125               V126               V127               V128
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

    V129               V130               V131               V132
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character

    V133               V134               V135               V136
Length:135         Length:135         Length:135         Length:135
Class :character   Class :character   Class :character   Class :character
Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
     V137               V138               V139               V140
 Length:135         Length:135         Length:135         Length:135
 Class :character   Class :character   Class :character   Class :character
 Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
     V141               V142               V143               V144
 Length:135         Length:135         Length:135         Length:135
 Class :character   Class :character   Class :character   Class :character
 Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```
     V145               V146               V147               V148
 Length:135         Length:135         Length:135         Length:135
 Class :character   Class :character   Class :character   Class :character
 Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

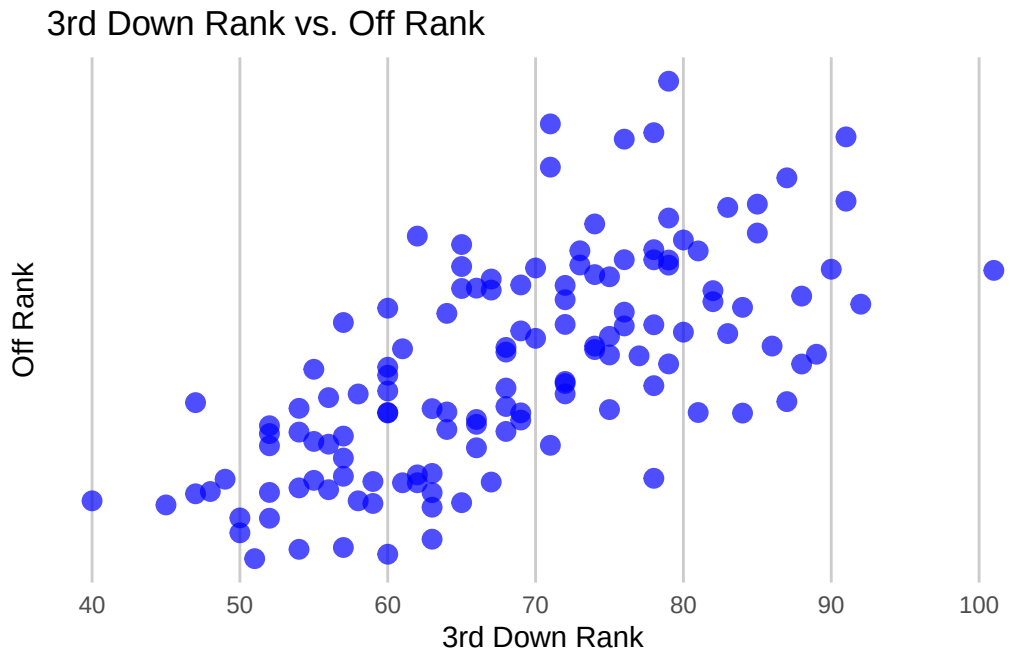
```
     V149               V150               V151               V152
 Length:135         Length:135         Length:135         Length:135
 Class :character   Class :character   Class :character   Class :character
 Mode  :character   Mode  :character   Mode  :character   Mode  :character
```

```r
cfb23_clean <- cfb23 %>%
  filter(!is.na(`V20`) & !is.na(`V7`))

# Data Visualization 1
ggplot(cfb23_clean, aes(x = `V20`, y = `V7`)) +
  geom_point(color = "blue", size = 3, alpha = 0.7) +
  labs(
    title = "3rd Down Rank vs. Off Rank",
```

```
    x = "3rd Down Rank",
    y = "Off Rank"
  ) +
  scale_x_continuous(breaks = seq(0, 100, 10)) +
  scale_y_continuous(breaks = seq(0, 100, 10)) +
  theme_minimal() +
  theme(
    axis.text.x = element_text(angle = 0, hjust = 0.5),
    axis.text.y = element_text(angle = 0, vjust = 0.5),
    panel.grid.major = element_line(color = "gray80", size = 0.5),
    panel.grid.minor = element_blank()
  )
```

```
Warning: The `size` argument of `element_line()` is deprecated as of ggplot2 3.4.0.
i Please use the `linewidth` argument instead.
```



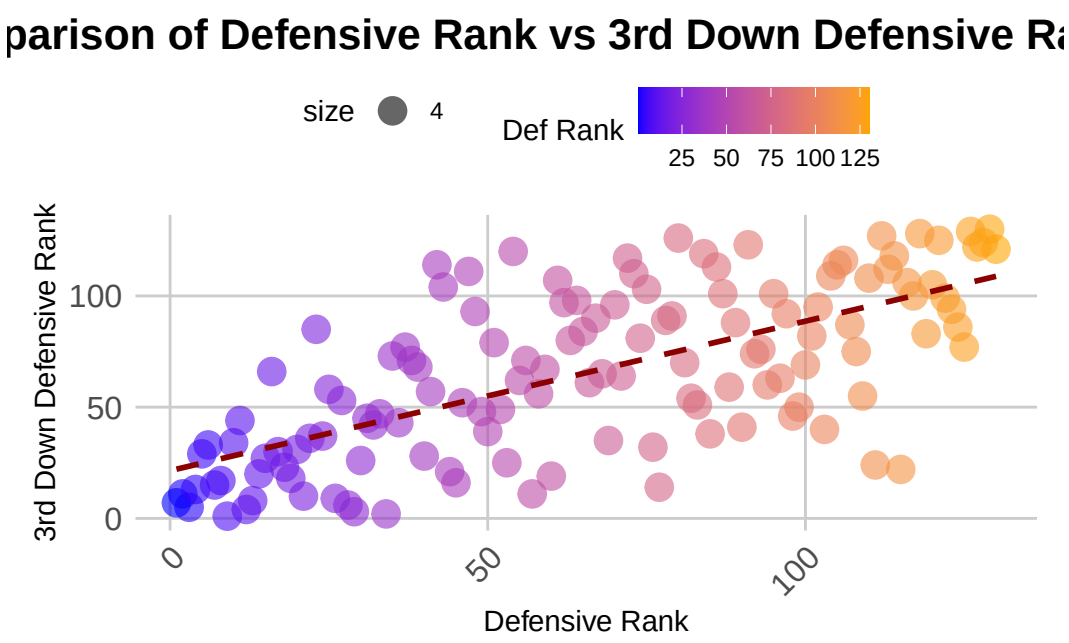

```
# Clean Data
cfb23_clean <- cfb23 %>%
  mutate(
    `V11` = as.numeric(`V11`),
    `V22` = as.numeric(`V22`)
```

```
  ) %>%
  filter(!is.na(`V11`) & !is.na(`V22`))
```

```
Warning: There were 2 warnings in `mutate()`.
The first warning was:
i In argument: `V11 = as.numeric(V11)`.
Caused by warning:
! NAs introduced by coercion
i Run `dplyr::last_dplyr_warnings()` to see the 1 remaining warning.
```

```
# Data Visualization 2
ggplot(cfb23_clean, aes(x = `V11`, y = `V22`)) +
  geom_point(aes(color = `V11`, size = 4), alpha = 0.6) +
  geom_smooth(method = "lm", se = FALSE, color = "darkred", linetype = "dashed") +
  scale_color_gradient(low = "blue", high = "orange") +
  labs(
    title = "Comparison of Defensive Rank vs 3rd Down Defensive Rank (2023)",
    x = "Defensive Rank",
    y = "3rd Down Defensive Rank",
    color = "Def Rank"
  ) +
  theme_minimal() +
  theme(
    plot.title = element_text(size = 16, face = "bold", hjust = 0.5),
    axis.text.x = element_text(angle = 45, hjust = 1, size = 12),
    axis.text.y = element_text(size = 12),
    legend.position = "top",
    panel.grid.major = element_line(color = "gray80", size = 0.5),
    panel.grid.minor = element_blank(),
    plot.margin = margin(10, 10, 10, 10)
  )
```

```
`geom_smooth()` using formula = 'y ~ x'
```




```
# Clean Data
cfb23_summary <- cfb23_clean %>%
  group_by(V3) %>%
  summarise(
    mean_def_rank = mean(V11, na.rm = TRUE),
    mean_3rd_down_def_rank = mean(V22, na.rm = TRUE)
  )

# Data Visualization 3
cfb23_filtered <- cfb23_clean %>%
  filter(V11 >= 1 & V11 <= 10)
ggplot(cfb23_filtered, aes(x = reorder(V3, V11), y = V23)) +
  geom_bar(stat = "identity", fill = "lightblue") +
  labs(
    title = "Opponent 3rd Down Conversion for top 10 defences",
    x = "Team",
    y = "Opponent 3rd Down Conversion"
  ) +
  coord_flip() +
  theme_minimal() +
  theme(
    plot.title = element_text(size = 16, face = "bold", hjust = 0.5),
    axis.text.x = element_text(size = 12),
```

```
    axis.text.y = element_text(size = 10),
    plot.margin = margin(10, 10, 10, 10)
  )
```