Niners Vs Eagles Week 13 Simulation (2023)

```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.4     v readr     2.1.5
## v forcats   1.0.0     v stringr   1.5.1
## v ggplot2   3.5.1     v tibble    3.2.1
## v lubridate 1.9.3     v tidyr     1.3.1
## v purrr     1.0.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(ggthemes)
library(formatR)
knitr::opts_chunk$set(tidy.opts=list(width.cutoff = 40), tidy = TRUE)
```

Eagles Simulation Code

```
eagles_drives <- 11

set.seed(123)
eagles <- function(drives) {
    eagles_points <- 0
    # eagles_score_pct determined by
    # taking team scoring percentage
    # (45.4%; adjusted manually to
    # 40.4% after Dallas Goedert got
    # injured) Adjusted Eagle's scoring
    # percentage by comparing Average
    # Opponent's ELO (1503.18182)
    # compared to 49ers ELO (1693)
    # final calculation: 0.404 *
    # (1503.18182/1693) = 0.358703753
    eagles_score_pct <- 0.358703753
    brown_rec_td <- 0
    smith_rec_td <- 0
    swift_rec_td <- 0
    stoll_rec_td <- 0
    zacc_rec_td <- 0
    jones_rec_td <- 0
    watkins_rec_td <- 0
    hurts_rushing_td <- 0
```

```
    swift_rushing_td <- 0
    gainwell_rushing_td <- 0
    eagles_passing_td <- 0
    eagles_rushing_td <- 0
    eagles_fg_made <- 0
    while (drives > 0) {
        # determines if eagles get any
        # points
        if (runif(1) <= eagles_score_pct) {
            # determined by taking
            # total TDs/(Total TDs +
            # FG) 35/(35+19) =
            # 0.648149148
            eagles_td_pct <- 0.648149148
            # determines if eagles
            # score a TD or a FG
            if (runif(1) <= eagles_td_pct) {
                # determines whether
                # the eagles score a
                # Passing TD or a
                # Rushing TD On the
                # season, the Eagles
                # had 18 Passing TDs
                # and 17 Rushing TDs
                # 18/(18+17) =
                # 0.514285714
                eagles_passing_td_pct <- 0.514285714
                if (runif(1) <= eagles_passing_td_pct) {
                  eagles_points <- eagles_points +
                    7
                  eagles_passing_td <- eagles_passing_td +
                    1
                  # each player's
                  # Redzone target%
                  # from the season
                  # these numbers sum
                  # up to one
                  brown_td_pct <- 0.44
                  smith_td_pct <- 0.16
                  swift_td_pct <- 0.16
                  stoll_td_pct <- 0.08
                  zacc_td_pct <- 0.08
                  jones_td_pct <- 0.04
                  watkins_td_pct <- 0.04
                  u <- runif(1)
                  if (u <= brown_td_pct) {
                    brown_rec_td <- brown_rec_td +
                      1
                    # given that AJ
                    # Brown doesn't
                    # score, we assume
                    # that smith's
                    # chance to score
```

```
      # is the sum of AJ
      # Browns TD% and
      # Devonta Smith's
      # TD% this
      # assumption is
      # made for all
      # receivers
    } else if (u <= sum(brown_td_pct,
      smith_td_pct)) {
      smith_rec_td <- smith_rec_td +
        1
    } else if (u <= sum(brown_td_pct,
      smith_td_pct, swift_td_pct)) {
      swift_rec_td <- swift_rec_td +
        1
    } else if (u <= sum(brown_td_pct,
      smith_td_pct, swift_td_pct,
      stoll_td_pct)) {
      stoll_rec_td <- stoll_rec_td +
        1
    } else if (u <= sum(brown_td_pct,
      smith_td_pct, swift_td_pct,
      stoll_td_pct, zacc_td_pct)) {
      zacc_rec_td <- zacc_rec_td +
        1
    } else if (u <= sum(brown_td_pct,
      smith_td_pct, swift_td_pct,
      stoll_td_pct, zacc_td_pct,
      jones_td_pct)) {
      jones_rec_td <- jones_rec_td +
        1
    } else {
      watkins_rec_td <- watkins_rec_td +
        1
    }
  } else {
    # Rushing TD
    eagles_points <- eagles_points +
      7
    eagles_rushing_td <- eagles_rushing_td +
      1
    # numbers gotten by
    # taking the
    # proportion of
    # Rushing TDs on the
    # Season for the team
    hurts_td_pct <- (12/18)
    swift_td_pct <- (4/18)
    gainwell_td_pct <- (2/18)
    u <- runif(1)
    if (u <= hurts_td_pct) {
      hurts_rushing_td <- hurts_rushing_td +
        1
```

```
                    # follows the same
                    # logic as
                    # receivers
                  } else if (u <= sum(hurts_td_pct,
                    swift_td_pct)) {
                    swift_rushing_td <- swift_rushing_td +
                      1
                  } else {
                    gainwell_rushing_td <- gainwell_rushing_td +
                      1
                  }
                }
            } else {
                # FG
                eagles_points <- eagles_points +
                  3
                eagles_fg_made <- eagles_fg_made +
                  1
            }
        } else {
            eagles_points <- eagles_points
        }
        drives <- drives - 1
    }
    return(list(eagles_points = as.numeric(eagles_points),
        eagles_passing_td = as.numeric(eagles_passing_td),
        eagles_rushing_td = as.numeric(eagles_rushing_td),
        eagles_fg_made = as.numeric(eagles_fg_made),
        brown_rec_td = as.numeric(brown_rec_td),
        smith_rec_td = as.numeric(smith_rec_td),
        swift_rec_td = as.numeric(swift_rec_td),
        stoll_rec_td = as.numeric(stoll_rec_td),
        zacc_rec_td = as.numeric(zacc_rec_td),
        jones_rec_td = as.numeric(jones_rec_td),
        watkins_rec_td = as.numeric(watkins_rec_td),
        hurts_rushing_td = as.numeric(hurts_rushing_td),
        swift_rushing_td = as.numeric(swift_rushing_td),
        gainwell_rushing_td = as.numeric(gainwell_rushing_td)))
}

do.call(rbind, replicate(1e+05, eagles(eagles_drives),
    simplify = FALSE)) -> EaglesTotals
EaglesTotals <- as.data.frame(EaglesTotals)
EaglesTotals <- EaglesTotals %>%
    mutate(game_number = 1:n())
```

Niner Simulation Code

```
niners_drives <- 11

set.seed(234)
```

```
niners <- function(drives) {
    niners_points <- 0
    # niners_score_pct calculated the
    # same way as the eagles_score_pct
    niners_score_pct <- 0.397844506
    mccaffrey_rec_td <- 0
    kittle_rec_td <- 0
    samuel_rec_td <- 0
    aiyuk_rec_td <- 0
    juszczyk_rec_td <- 0
    bell_rec_td <- 0
    dwelley_rec_td <- 0
    jennings_rec_td <- 0
    mccloud_rec_td <- 0
    mitchell_rec_td <- 0
    mccaffrey_rushing_td <- 0
    samuel_rushing_td <- 0
    mason_rushing_td <- 0
    purdy_rushing_td <- 0
    niners_passing_td <- 0
    niners_rushing_td <- 0
    niners_fg_made <- 0
    while (drives > 0) {
        if (runif(1) <= niners_score_pct) {
            niners_td_pct <- 0.685185185
            if (runif(1) <= niners_td_pct) {
                niners_passing_td_pct <- 0.513513514
                if (runif(1) <= niners_passing_td_pct) {
                  niners_points <- niners_points +
                    7
                  niners_passing_td <- niners_passing_td +
                    1
                  mccaffrey_td_pct <- 0.2766
                  kittle_td_pct <- 0.2128
                  samuel_td_pct <- 0.1915
                  aiyuk_td_pct <- 0.1064
                  juszczyk_td_pct <- 0.0851
                  mitchell_td_pct <- 0.0426
                  bell_td_pct <- 0.0213
                  dwelley_td_pct <- 0.0213
                  jennings_td_pct <- 0.0213
                  mccloud_td_pct <- 0.0213
                  u <- runif(1)
                  if (u <= mccaffrey_td_pct) {
                    mccaffrey_rec_td <- mccaffrey_rec_td +
                      1
                  } else if (u <= sum(mccaffrey_td_pct,
                    kittle_td_pct)) {
                    kittle_rec_td <- kittle_rec_td +
                      1
                  } else if (u <= sum(mccaffrey_td_pct,
                    kittle_td_pct, samuel_td_pct)) {
                    samuel_rec_td <- samuel_rec_td +
```

```
      1
    } else if (u <= sum(mccaffrey_td_pct,
      kittle_td_pct, samuel_td_pct,
      aiyuk_td_pct)) {
      aiyuk_rec_td <- aiyuk_rec_td +
        1
    } else if (u <= sum(mccaffrey_td_pct,
      kittle_td_pct, samuel_td_pct,
      aiyuk_td_pct, juszczyk_td_pct)) {
      juszczyk_rec_td <- juszczyk_rec_td +
        1
    } else if (u <= sum(mccaffrey_td_pct,
      kittle_td_pct, samuel_td_pct,
      aiyuk_td_pct, juszczyk_td_pct,
      mitchell_td_pct)) {
      mitchell_rec_td <- mitchell_rec_td +
        1
    } else if (u <= sum(mccaffrey_td_pct,
      kittle_td_pct, samuel_td_pct,
      aiyuk_td_pct, juszczyk_td_pct,
      mitchell_td_pct, bell_td_pct)) {
      bell_rec_td <- bell_rec_td +
        1
    } else if (u <= sum(mccaffrey_td_pct,
      kittle_td_pct, samuel_td_pct,
      aiyuk_td_pct, juszczyk_td_pct,
      mitchell_td_pct, bell_td_pct,
      dwelley_td_pct)) {
      dwelley_rec_td <- dwelley_rec_td +
        1
    } else if (u <= sum(mccaffrey_td_pct,
      kittle_td_pct, samuel_td_pct,
      aiyuk_td_pct, juszczyk_td_pct,
      mitchell_td_pct, bell_td_pct,
      dwelley_td_pct, jennings_td_pct)) {
      jennings_rec_td <- jennings_rec_td +
        1
    } else {
      mccloud_rec_td <- mccloud_rec_td +
        1
    }
  } else {
    # Rushing TD
    niners_points <- niners_points +
      7
    niners_rushing_td <- niners_rushing_td +
      1
    mccaffrey_td_pct <- (12/20)
    samuel_td_pct <- (4/20)
    mason_td_pct <- (2/20)
    purdy_td_pct <- (2/20)
    u <- runif(1)
    if (u <= mccaffrey_td_pct) {
```

```
                    mccaffrey_rushing_td <- mccaffrey_rushing_td +
                      1
                  } else if (u <= sum(mccaffrey_td_pct,
                    samuel_td_pct)) {
                    samuel_rushing_td <- samuel_rushing_td +
                      1
                  } else if (u <= sum(mccaffrey_td_pct,
                    samuel_td_pct, mason_td_pct)) {
                    mason_rushing_td <- mason_rushing_td +
                      1
                  } else {
                    purdy_rushing_td <- purdy_rushing_td +
                      1
                  }
                }
            } else {
                # FG
                niners_points <- niners_points +
                  3
                niners_fg_made <- niners_fg_made +
                  1
            }
        } else {
            niners_points <- niners_points
        }
        drives <- drives - 1
    }
    return(list(niners_points = as.numeric(niners_points),
        niners_passing_td = as.numeric(niners_passing_td),
        niners_rushing_td = as.numeric(niners_rushing_td),
        niners_fg_made = as.numeric(niners_fg_made),
        mccaffrey_rec_td = as.numeric(mccaffrey_rec_td),
        kittle_rec_td = as.numeric(kittle_rec_td),
        samuel_rec_td = as.numeric(samuel_rec_td),
        aiyuk_rec_td = as.numeric(aiyuk_rec_td),
        juszczyk_rec_td = as.numeric(juszczyk_rec_td),
        bell_rec_td = as.numeric(bell_rec_td),
        dwelley_rec_td = as.numeric(dwelley_rec_td),
        jennings_rec_td = as.numeric(jennings_rec_td),
        mccloud_rec_td = mccloud_rec_td,
        mitchell_rec_td = mitchell_rec_td,
        mccaffrey_rushing_td = mccaffrey_rushing_td,
        samuel_rushing_td = samuel_rushing_td,
        mason_rushing_td = mason_rushing_td,
        purdy_rushing_td = purdy_rushing_td))
}

do.call(rbind, replicate(1e+05, niners(niners_drives),
    simplify = FALSE)) -> NinersTotals
NinersTotals <- as.data.frame(NinersTotals)
NinersTotals <- NinersTotals %>%
    mutate(game_number = 1:n())
```

Joining Both Simulations on Game Number

```
SimulationResults <- left_join(EaglesTotals,
    NinersTotals, by = "game_number")
```

Finding Which Team Won

```
SimulationResults <- SimulationResults %>%
    mutate(eagles_win = ifelse(as.numeric(eagles_points) >
        as.numeric(niners_points), 1, 0))
# dummy variable stating if the niners
# won
SimulationResults <- SimulationResults %>%
    mutate(niners_win = ifelse(as.numeric(eagles_points) <
        as.numeric(niners_points), 1, 0))
# dummy variable stating if the game
# went to overtime
SimulationResults <- SimulationResults %>%
    mutate(overtime = ifelse(as.numeric(eagles_points) ==
        as.numeric(niners_points), 1, 0))
```

Finding Win Probability for Each Team as well as the Likelihood of Overtime

```
eagles_win_prob <- mean(SimulationResults$eagles_win)
print(paste("Eagles Win Probability: ", round(eagles_win_prob,
    3) * 100, "%"))
```

```
## [1] "Eagles Win Probability:  38.7 %"
```

```
niners_win_prob <- mean(SimulationResults$niners_win)
print(paste("49ers Win Probability: ", round(niners_win_prob,
    3) * 100, "%"))
```

```
## [1] "49ers Win Probability:  56.3 %"
```

```
overtime <- mean(SimulationResults$overtime)
print(paste("Overtime Probability: ", round(overtime,
    3) * 100, "%"))
```

```
## [1] "Overtime Probability:  5 %"
```

Finding Expected Scored by Both Sides

```
eagles_expected_points <- mean(as.numeric(SimulationResults$eagles_points))
print(paste("Eagles Expected Points: ", round(eagles_expected_points,
    0)))
```

```
## [1] "Eagles Expected Points:  22"
```

```
niners_expected_points <- mean(as.numeric(SimulationResults$niners_points))
print(paste("Niners Expected Points: ", round(niners_expected_points,
    0)))
```

```
## [1] "Niners Expected Points:  25"
```

Finding Out Which Players had the Most 2 Receiving TD Games

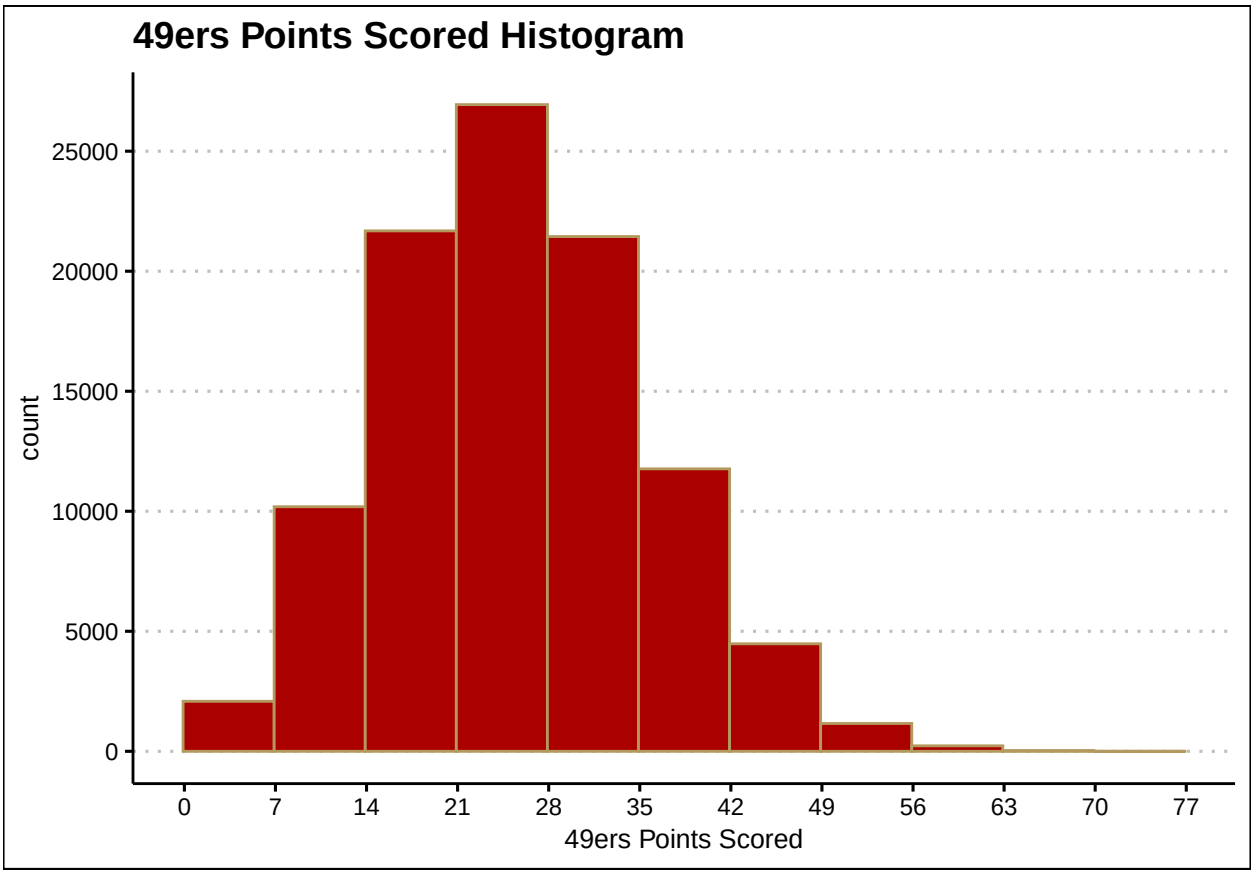
```
brown_2plus_Td <- SimulationResults %>%
    filter(brown_rec_td > 1) %>%
    summarize(aj_games = n(), aj_pct_games = round((n()/1e+05) *
        100, 2))
smith_2plus_Td <- SimulationResults %>%
    filter(smith_rec_td > 1) %>%
    summarize(smith_games = n(), smith_pct_games = round((n()/1e+05) *
        100, 2))
swift_2plus_Td <- SimulationResults %>%
    filter(swift_rec_td > 1) %>%
    summarize(swift_games = n(), swift_pct_games = round((n()/1e+05) *
        100, 2))
stoll_2plus_Td <- SimulationResults %>%
    filter(stoll_rec_td > 1) %>%
    summarize(stoll_games = n(), stoll_pct_games = round((n()/1e+05) *
        100, 2))
zacc_2plus_Td <- SimulationResults %>%
    filter(zacc_rec_td > 1) %>%
    summarize(zacc_games = n(), zacc_pct_games = round((n()/1e+05) *
        100, 2))
jones_2plus_Td <- SimulationResults %>%
    filter(jones_rec_td > 1) %>%
    summarize(jones_games = n(), jones_pct_games = round((n()/1e+05) *
        100, 2))
watkins_2plus_Td <- SimulationResults %>%
    filter(watkins_rec_td > 1) %>%
    summarize(watkins_games = n(), watkins_pct_games = round((n()/1e+05) *
        100, 2))
mccaffrey_2plus_Td <- SimulationResults %>%
    filter(mccaffrey_rec_td > 1) %>%
    summarize(mccaffrey_games = n(), mccaffrey_pct_games = round((n()/1e+05) *
        100, 2))
kittle_2plus_Td <- SimulationResults %>%
    filter(kittle_rec_td > 1) %>%
    summarize(kittle_games = n(), kittle_pct_games = round((n()/1e+05) *
        100, 2))
```

```
samuel_2plus_Td <- SimulationResults %>%
    filter(samuel_rec_td > 1) %>%
    summarize(samuel_games = n(), samuel_pct_games = round((n()/1e+05) *
        100, 2))
aiyuk_2plus_Td <- SimulationResults %>%
    filter(aiyuk_rec_td > 1) %>%
    summarize(aiyuk_games = n(), aiyuk_pct_games = round((n()/1e+05) *
        100, 2))
juszczyk_2plus_Td <- SimulationResults %>%
    filter(juszczyk_rec_td > 1) %>%
    summarize(juszczyk_games = n(), juszczyk_pct_games = round((n()/1e+05) *
        100, 2))
bell_2plus_Td <- SimulationResults %>%
    filter(bell_rec_td > 1) %>%
    summarize(bell_games = n(), bell_pct_games = round((n()/1e+05) *
        100, 2))
dwelley_2plus_Td <- SimulationResults %>%
    filter(dwelley_rec_td > 1) %>%
    summarize(dwelley_games = n(), dwelley_pct_games = round((n()/1e+05) *
        100, 2))
jennings_2plus_Td <- SimulationResults %>%
    filter(jennings_rec_td > 1) %>%
    summarize(jennings_games = n(), jennings_pct_games = round((n()/1e+05) *
        100, 2))
mccloud_2Plus_Td <- SimulationResults %>%
    filter(mccloud_rec_td > 1) %>%
    summarize(mccloud_games = n(), mccloud_pct_games = round((n()/1e+05) *
        100, 2))
mitchell_2Plus_Td <- SimulationResults %>%
    filter(mitchell_rec_td > 1) %>%
    summarize(mitchell_games = n(), mitchell_pct_games = round((n()/1e+05) *
        100, 2))

# Combining all totals into a dataframe
X2plus_TD <- bind_cols(brown_2plus_Td, smith_2plus_Td,
    swift_2plus_Td, stoll_2plus_Td, zacc_2plus_Td,
    jones_2plus_Td, watkins_2plus_Td, mccaffrey_2plus_Td,
    kittle_2plus_Td, samuel_2plus_Td, aiyuk_2plus_Td,
    juszczyk_2plus_Td, bell_2plus_Td, dwelley_2plus_Td,
    jennings_2plus_Td, mccloud_2Plus_Td,
    mitchell_2Plus_Td)
```

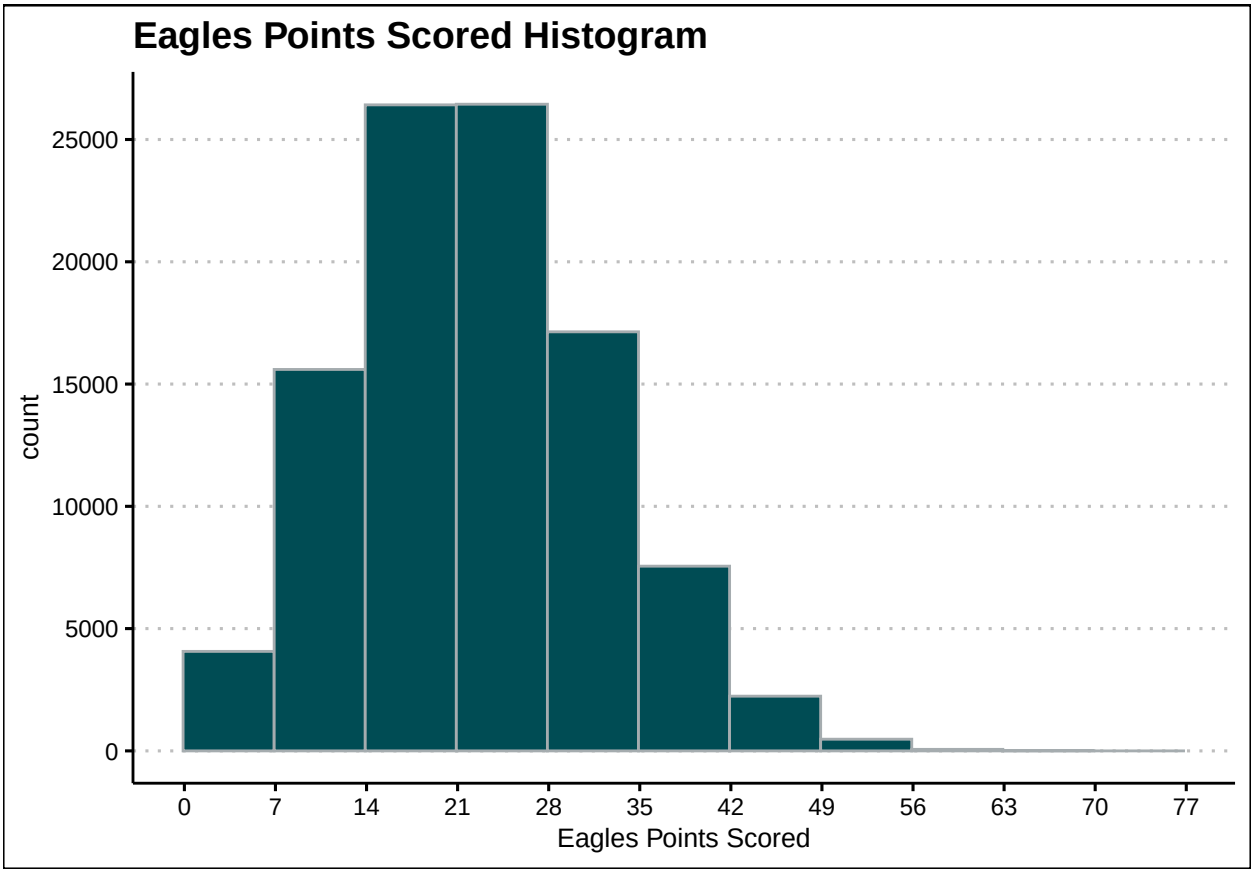
49ers Points Histogram

```
SimulationResults %>%
    ggplot(aes(as.numeric(niners_points))) +
    geom_histogram(binwidth = 7, color = "#B3995D",
        fill = "#AA0000", breaks = seq(-0.1,
            77, 7)) + scale_x_continuous(breaks = seq(0,
    77, 7)) + scale_y_continuous(breaks = seq(0,
    30000, 5000)) + ggtitle("49ers Points Scored Histogram") +
    xlab("49ers Points Scored") + theme_clean()
```



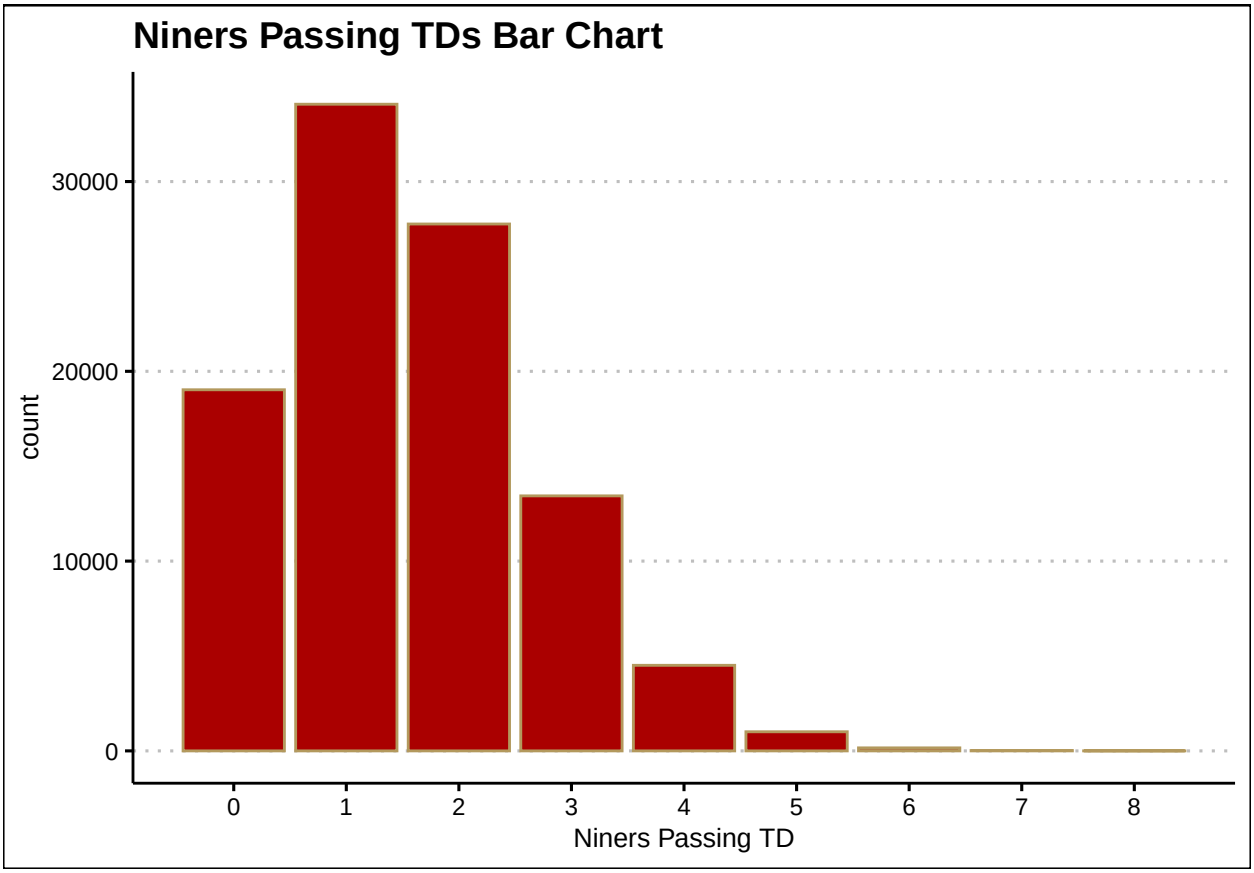
Eagles Points Histogram

```
SimulationResults %>%
    ggplot(aes(as.numeric(eagles_points))) +
    geom_histogram(binwidth = 7, color = "#A5ACAF",
        fill = "#004C54", breaks = seq(-0.1,
            77, 7)) + scale_x_continuous(breaks = seq(0,
    77, 7)) + scale_y_continuous(breaks = seq(0,
    30000, 5000)) + ggtitle("Eagles Points Scored Histogram") +
    xlab("Eagles Points Scored") + theme_clean()
```



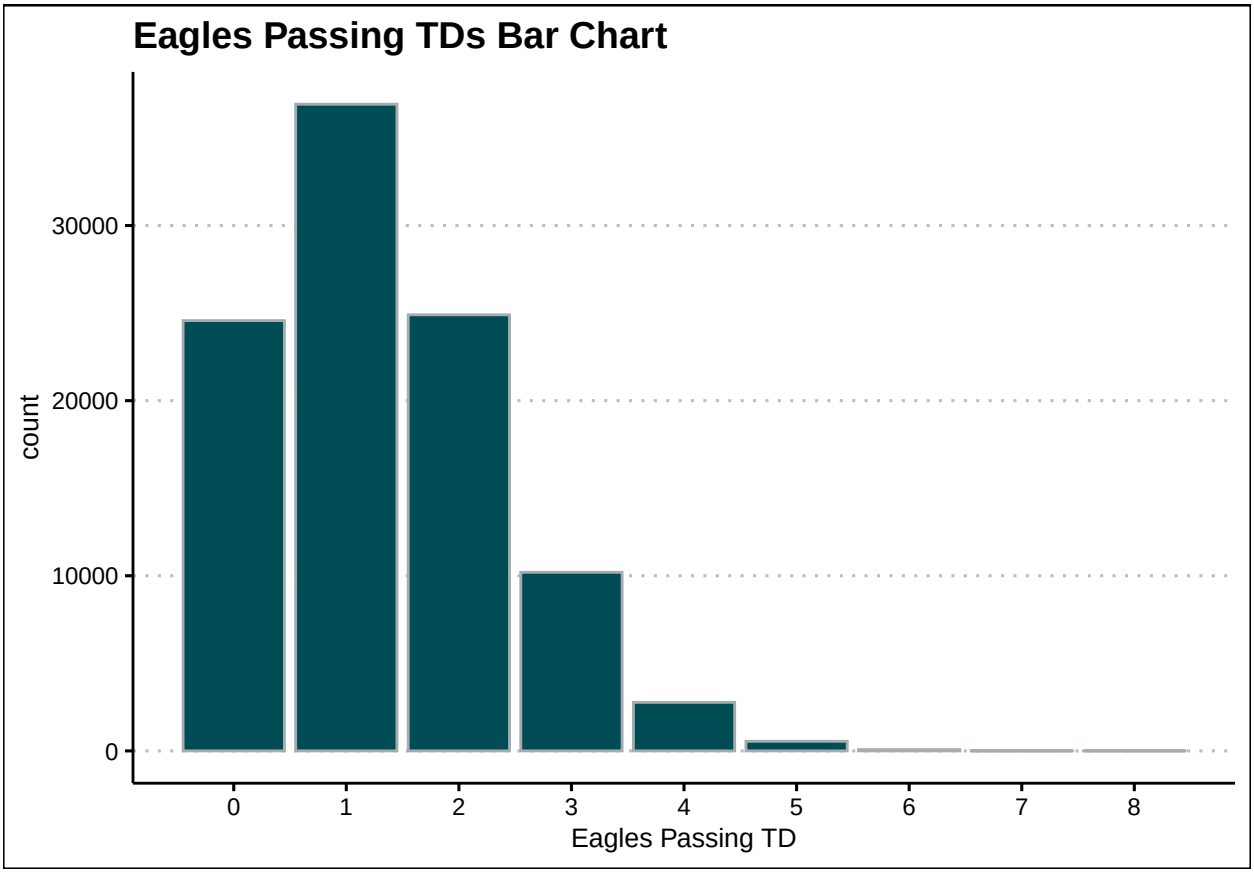
Niners Passing TDs Bar Chart

```
SimulationResults %>%
    ggplot(aes(as.numeric(niners_passing_td))) +
    geom_bar(color = "#B3995D", fill = "#AA0000") +
    scale_x_continuous(breaks = seq(0, 11,
        1)) + xlab("Niners Passing TD") +
    ggtitle("Niners Passing TDs Bar Chart") +
    theme_clean()
```



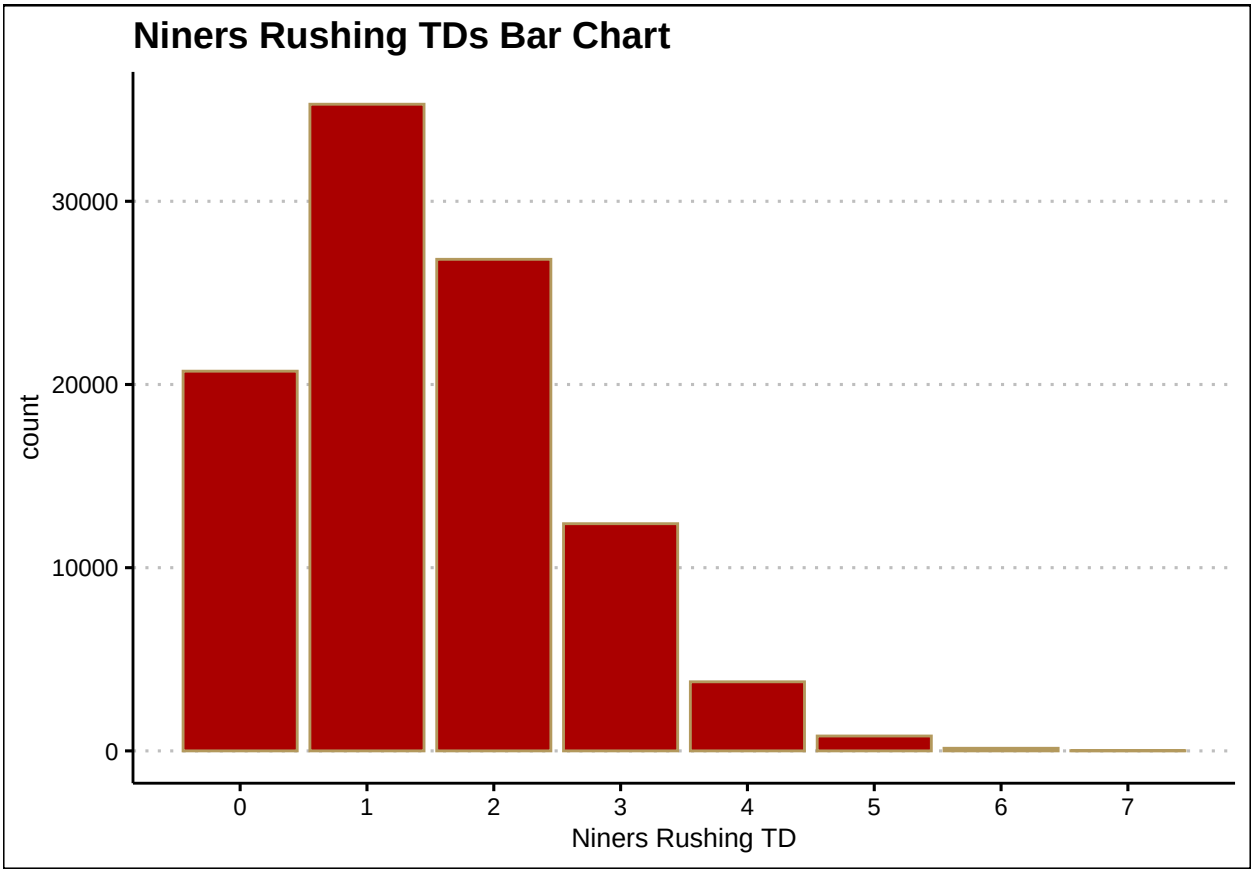
Eagles Passing TDs Bar Chart

```
SimulationResults %>%
    ggplot(aes(as.numeric(eagles_passing_td))) +
    geom_bar(color = "#A5ACAF", fill = "#004C54") +
    scale_x_continuous(breaks = seq(0, 11,
        1)) + xlab("Eagles Passing TD") +
    ggtitle("Eagles Passing TDs Bar Chart") +
    theme_clean()
```



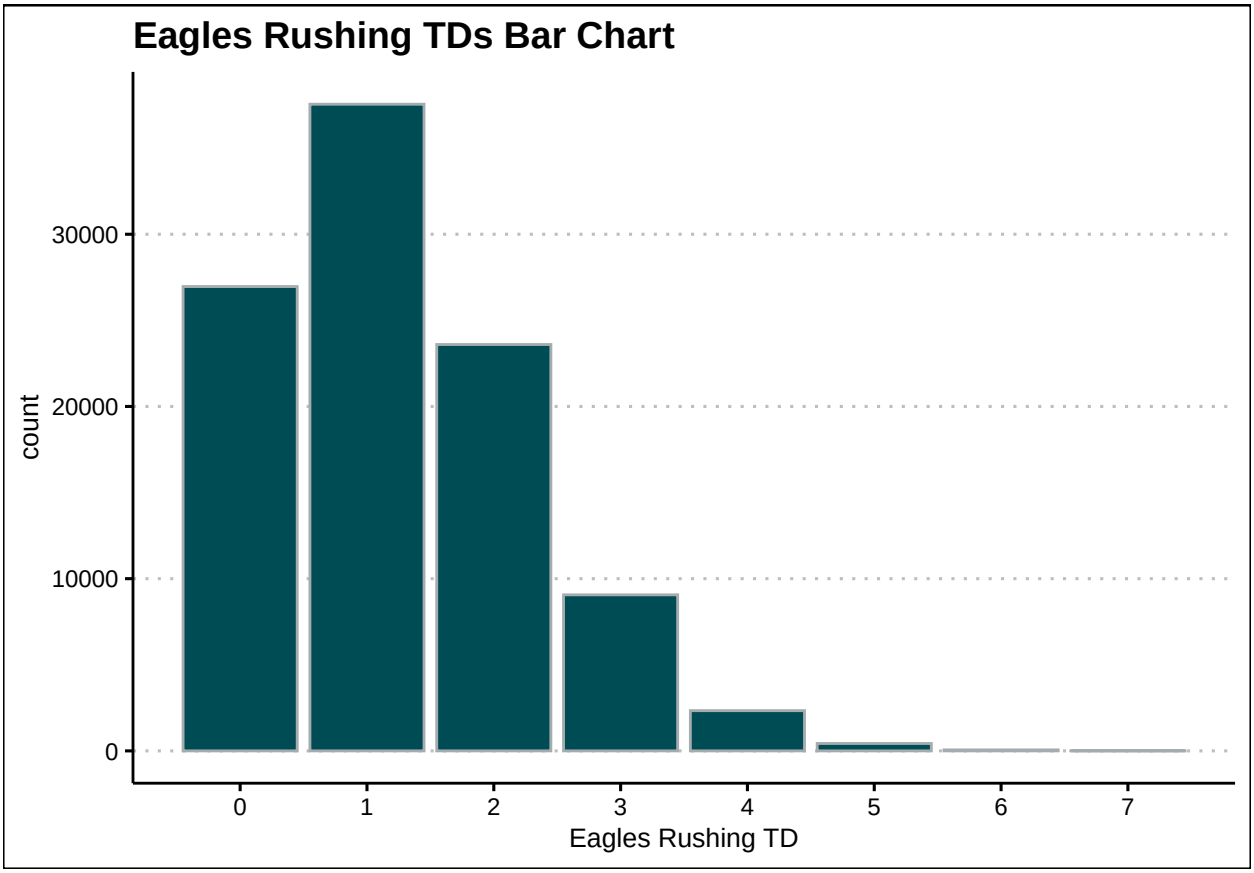
Niners Rushing TDs Chart

```
SimulationResults %>%
    ggplot(aes(as.numeric(niners_rushing_td))) +
    geom_bar(color = "#B3995D", fill = "#AA0000") +
    scale_x_continuous(breaks = seq(0, 11,
        1)) + xlab("Niners Rushing TD") +
    ggtitle("Niners Rushing TDs Bar Chart") +
    theme_clean()
```



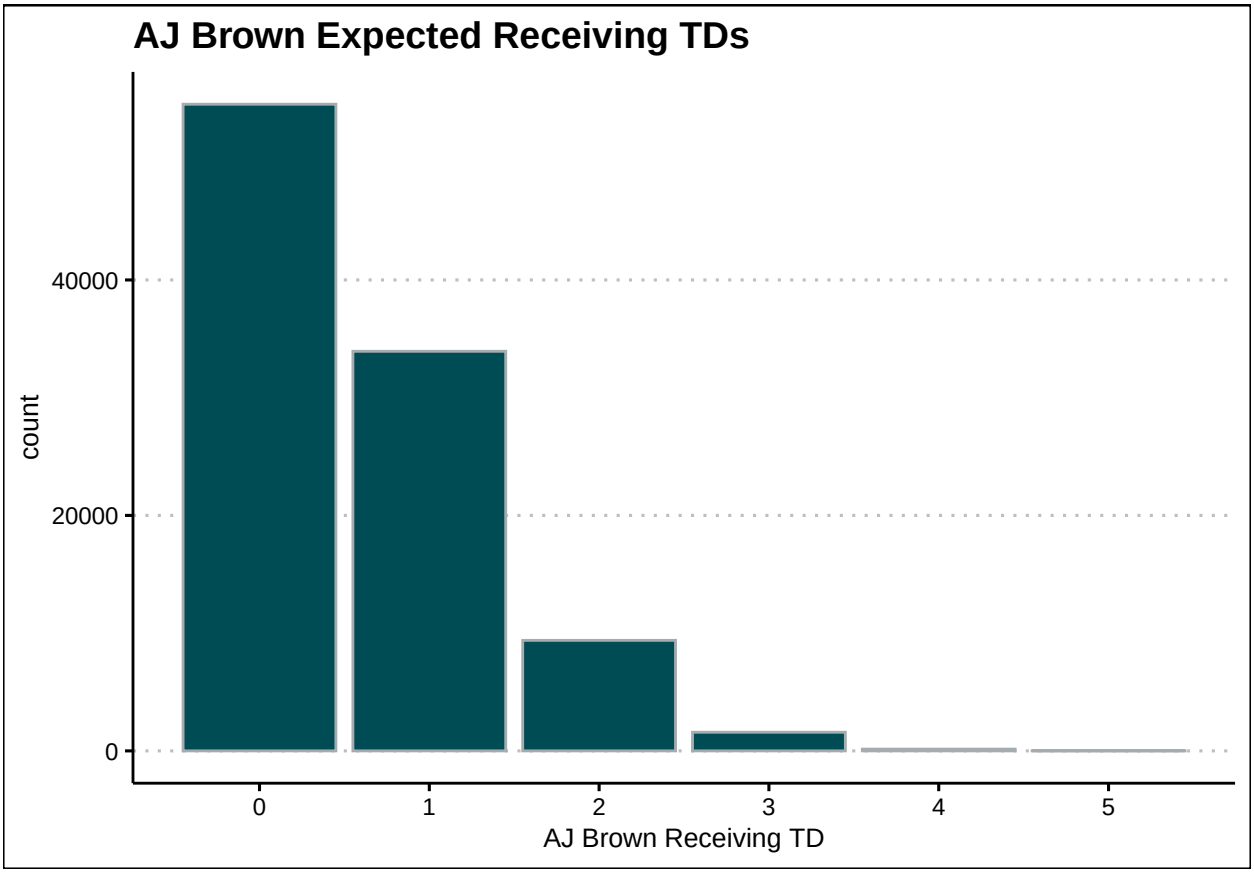
Eagles Rushing TD Bar Graph

```
SimulationResults %>%
    ggplot(aes(as.numeric(eagles_rushing_td))) +
    geom_bar(color = "#A5ACAF", fill = "#004C54") +
    scale_x_continuous(breaks = seq(0, 11,
        1)) + xlab("Eagles Rushing TD") +
    ggtitle("Eagles Rushing TDs Bar Chart") +
    theme_clean()
```



AJ Brown had the most expected 2 Rec TD Games

```
SimulationResults %>%
    ggplot(aes(as.numeric(brown_rec_td))) +
    geom_bar(color = "#A5ACAF", fill = "#004C54") +
    scale_x_continuous(breaks = seq(0, 11,
        1)) + ggtitle("AJ Brown Expected Receiving TDs") +
    xlab("AJ Brown Receiving TD") + theme_clean()
```


AJ Brown Expected Receiving TDs
40000
20000
0
count
0
1
2
3
4
5
AJ Brown Receiving TD