Duke Offensive Stats: 2022-23

Packages

```
library(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.3     v readr     2.1.4
v forcats   1.0.0     v stringr   1.5.0
v ggplot2   3.4.3     v tibble    3.2.1
v lubridate 1.9.2     v tidyr     1.3.0
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 becor
```

```
library(tidymodels)
```

```
-- Attaching packages --------------------------------------- tidymodels 1.1.1 --
v broom        1.0.5     v rsample      1.2.0
v dials        1.2.0     v tune         1.1.2
v infer        1.0.4     v workflows    1.1.3
v modeldata    1.2.0     v workflowsets 1.0.1
v parsnip      1.1.1     v yardstick    1.2.0
v recipes      1.0.8
-- Conflicts ------------------------------------------ tidymodels_conflicts() --
x scales::discard() masks purrr::discard()
x dplyr::filter()   masks stats::filter()
x recipes::fixed()  masks stringr::fixed()
x dplyr::lag()      masks stats::lag()
```

```
x yardstick::spec() masks readr::spec()
x recipes::step()   masks stats::step()
* Search for functions across packages at https://www.tidymodels.org/find/
```

Home-Game Attendance & Offensive Performance

This section explores if any relationship appears to exist between game attendance and the offensive performance of Duke during games in Wallace Wade Stadium.

Import Data

```
offense_data <- read_csv("data/Duke Stats - DukeOffense.csv")
```

```
Rows: 416 Columns: 40
-- Column specification --------------------------------------------------------
Delimiter: ","
chr  (9): OppName, Surface, Day, Site, Result, TV_Coverage, City, State, Type
dbl (25): FPI, FPI_diff, Month, Date, Year, Start_Time, DukePts, OppPts, Poi...
lgl  (6): Rain, 1stSeedQB, SchoolBreak, NatlHoliday, Bowl, UNC_Game

i Use `spec()` to retrieve the full column specification for this data.
i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
offense_data <- offense_data |>
  mutate(isHome = if_else(Site == "Home", TRUE, FALSE)) |>
  mutate(Day = as.factor(Day)) |>
  mutate(AttPct = if_else(AttNum/40004 > 1.0, 100.0, AttNum/40004*100))

home_offense_data <- offense_data |>
  filter(isHome == TRUE)

glimpse(home_offense_data)
```

```
Rows: 208
Columns: 41
$ OppName      <chr> "Clemson", "Lafayette", "Northwestern", "Notre Dame", "No~
$ FPI          <dbl> 13.8, NA, 0.8, 20.7, 6.9, -1.7, -0.5, -11.8, NA, -4.0, 6.~
$ FPI_diff     <dbl> 4.8, NA, -8.2, 11.7, -2.1, -10.7, -9.5, -17.1, -5.3, -9.3~
```

```
$ Surface      <chr> "Grass", "Grass", "Grass", "Grass", "Grass", "Grass", "Gr~
$ Month        <dbl> 9, 9, 9, 9, 10, 11, 11, 9, 9, 10, 10, 11, 11, 9, 9, 9, 9,~
$ Date         <dbl> 4, 9, 16, 30, 14, 2, 25, 2, 17, 1, 15, 12, 26, 4, 9, 16, ~
$ Year         <dbl> 2023, 2023, 2023, 2023, 2023, 2023, 2023, 2022, 2022, 202~
$ Day          <fct> Mon, Sat, Sat, Sat, Sat, Thu, Sat, Fri, Sat, Sat, Sat, Sa~
$ Start_Time   <dbl> 20.0, 18.0, 15.5, 19.5, 20.0, 19.5, 12.0, 19.5, 18.0, 19.~
$ Site         <chr> "Home", "Home", "Home", "Home", "Home", "Home", "Home", "~
$ Result       <chr> "W", "W", "W", "L", "W", "W", "W", "W", "W", "W", "L", "W~
$ DukePts      <dbl> 28, 42, 38, 14, 24, 24, 30, 30, 49, 38, 35, 24, 34, 28, 4~
$ OppPts       <dbl> 7, 7, 14, 21, 3, 21, 19, 0, 20, 17, 38, 7, 31, 7, 7, 14, ~
$ PointDiff    <dbl> 21, 35, 24, -7, 21, 3, 11, 30, 29, 21, -3, 17, 3, 21, 35,~
$ AttNum       <dbl> 31638, 17481, 18141, 40768, 31833, 18277, 17639, 20722, 3~
$ AttPct       <dbl> 79.08709, 43.69813, 45.34797, 100.00000, 79.57454, 45.687~
$ ESPN_WinPred <dbl> 0.872, 0.993, 0.698, 0.300, 0.774, 0.812, 0.788, 0.771, N~
$ Rain         <lgl> FALSE, TRUE, FALSE, FALSE, TRUE, FALSE, FALSE, FALSE, FAL~
$ `1stSeedQB`  <lgl> TRUE, TRUE, TRUE, TRUE, FALSE, FALSE, FALSE, TRUE, TRUE, ~
$ SchoolBreak  <lgl> TRUE, FALSE, FALSE, FALSE, TRUE, FALSE, TRUE, FALSE, FALS~
$ NatlHoliday  <lgl> TRUE, FALSE, FALSE, FALSE, FALSE, FALSE, FALSE, FALSE, FA~
$ TV_Coverage  <chr> "ESPN", "ACCNX", "ACCN", "ABC", "ACCN", "ESPN", "ACCN", "~
$ City         <chr> "Durham", "Durham", "Durham", "Durham", "Durham", "Durham~
$ State        <chr> "NC", "NC", "NC", "NC", "NC", "NC", "NC", "NC", "NC", "NC~
$ Bowl         <lgl> FALSE, FALSE, FALSE, FALSE, FALSE, FALSE, FALSE, FALSE, F~
$ UNC_Game     <lgl> FALSE, FALSE, FALSE, FALSE, FALSE, FALSE, FALSE, FALSE, F~
$ Type         <chr> "Rushing", "Rushing", "Rushing", "Rushing", "Rushing", "R~
$ Attempts     <dbl> 30, 45, 40, 40, 30, 41, 30, 35, 35, 48, 42, 41, 30, 34, 2~
$ Yards        <dbl> 199, 261, 268, 189, 194, 181, 69, 172, 222, 248, 297, 165~
$ AvgYd        <dbl> 6.633333, 5.800000, 6.700000, 4.725000, 6.466667, 4.41463~
$ TD_Gained    <dbl> 3, 4, 5, 1, 1, 2, 1, 1, 4, 4, 4, 1, 0, 0, 2, 0, 1, 2, 1, ~
$ Comp         <dbl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, 17, 2~
$ CompPct      <dbl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, 50.00~
$ Int          <dbl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, 0, 0,~
$ Rating       <dbl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, 93.23~
$ Touchbacks   <dbl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N~
$ TouchbackPct <dbl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N~
$ OutOfBounds  <dbl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N~
$ Onside       <dbl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N~
$ Fumbles      <dbl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N~
$ isHome       <lgl> TRUE, TRUE, TRUE, TRUE, TRUE, TRUE, TRUE, TRUE, TRUE, TRU~
```

Not all columns are used for each type of offensive statistic. For example, the "Onside" column is only relevant for rows whose *Type* column value is "Kickoffs". The *Comp* column represents completions (in terms of completed passes), successes (with Field_Goals, 3rd_Down_Conv,

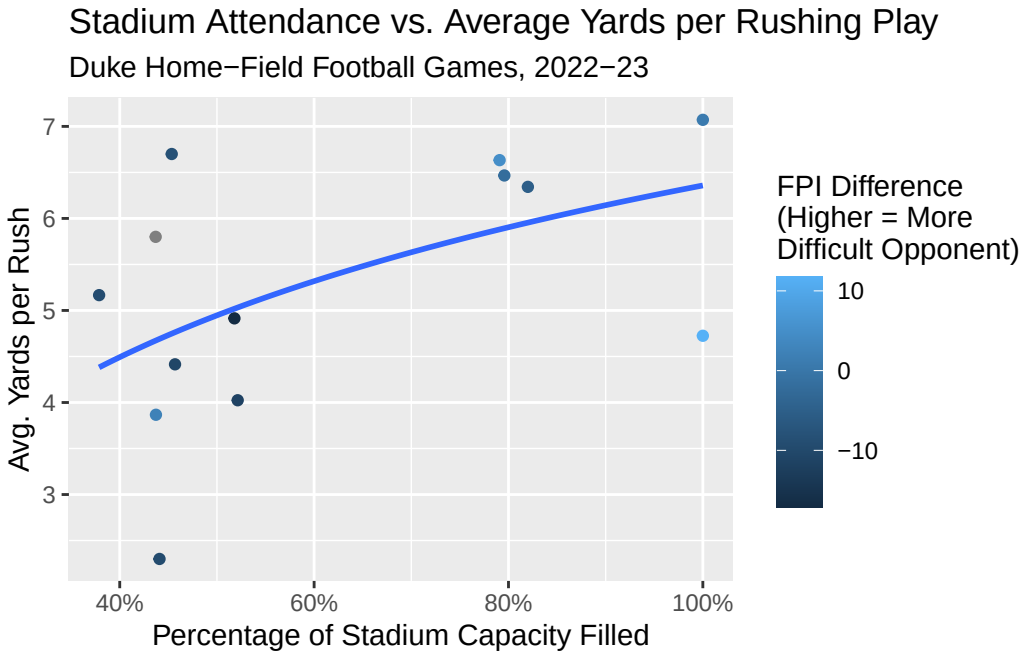
4th_Down_Conv, etc.), or a total count (with Duke_Penalties, Opp_Penalties, etc.) depending on the football context of the row's *Type*.

Rushing

Attendance as a predictor of *average yards* gained/lost per rushing play:

```
# Dataset filtering
home_off_rush_data <- home_offense_data |>
  filter(Type == "Rushing")

# Visualization
home_off_rush_data |>
  ggplot(
    aes(x = AttPct, y = AvgYd, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ log(x), se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Average Yards per Rushing Play",
       subtitle = "Duke Home-Field Football Games, 2022-23",
       x = "Percentage of Stadium Capacity Filled",
       y = "Avg. Yards per Rush",
       color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```




```
# Linear model
att_rush_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(AvgYd ~ log(AttPct), data = home_off_rush_data)

tidy(att_rush_glm)
```

```
# A tibble: 2 x 5
  term        estimate std.error statistic p.value
  <chr>          <dbl>     <dbl>     <dbl>   <dbl>
1 (Intercept)    -3.02      4.24    -0.712  0.492
2 log(AttPct)     2.04      1.04     1.96   0.0760
```

```
glance(att_rush_glm)$AIC
```

```
[1] 46.70963
```

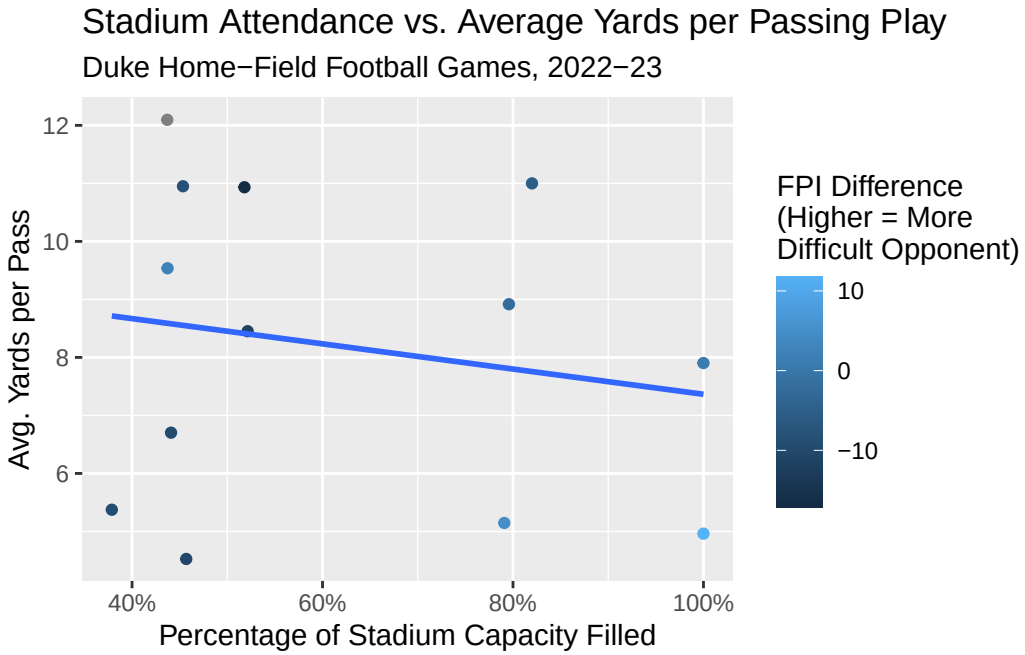
Wallace Wade attendance was *not* a strongly significant predictor of average yards gained/lost per rushing play in 2022-23.

Passing

Attendance as a predictor of *average yards* gained/lost per passing play:

```
# Dataset filtering
home_off_pass_data <- home_offense_data |>
  filter(Type == "Passing")

# Visualization
home_off_pass_data |>
  ggplot(
    aes(x = AttPct, y = AvgYd, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ x, se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Average Yards per Passing Play",
       subtitle = "Duke Home-Field Football Games, 2022-23",
       x = "Percentage of Stadium Capacity Filled",
       y = "Avg. Yards per Pass",
       color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```




```
# Linear model
att_pass_yd_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(AvgYd ~ AttPct, data = home_off_pass_data)

tidy(att_pass_yd_glm)
```

```
# A tibble: 2 x 5
  term        estimate std.error statistic p.value
  <chr>          <dbl>     <dbl>     <dbl>   <dbl>
1 (Intercept)   9.54      2.26       4.21  0.00145
2 AttPct       -0.0217    0.0345    -0.631 0.541
```

```
glance(att_pass_yd_glm)$AIC
```

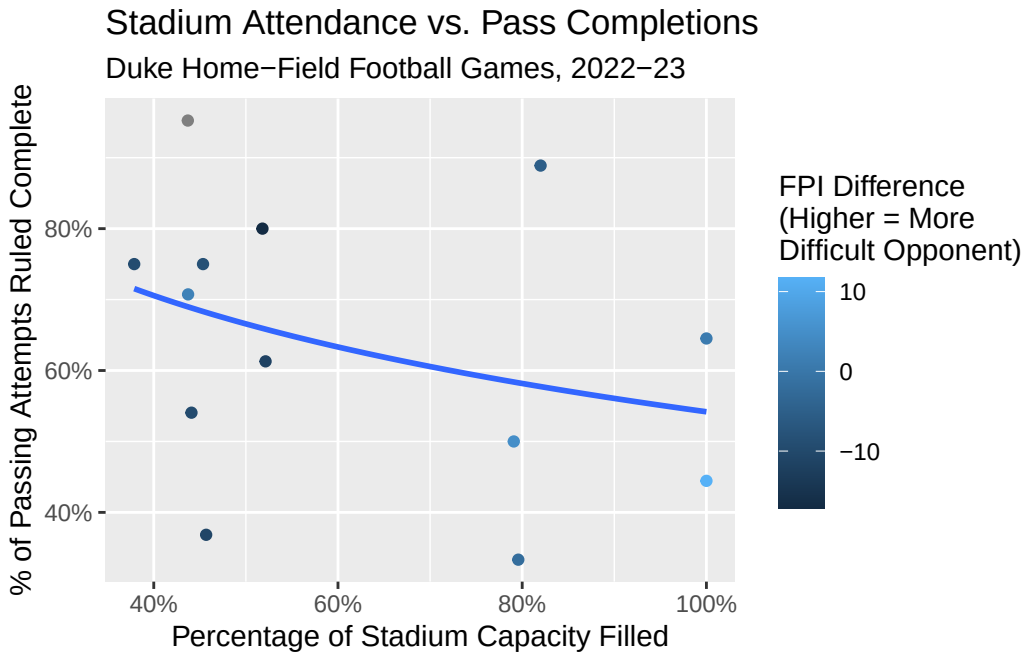
```
[1] 66.68931
```

Wallace Wade attendance was *not* a statistically significant predictor of average yards gained/lost per passing play in 2022-23.

Attendance as a predictor of passing *completions* per game:

```
# Visualization
home_off_pass_data |>
  ggplot(
    aes(x = AttPct, y = CompPct, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ log(x), se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  scale_y_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Pass Completions",
       subtitle = "Duke Home-Field Football Games, 2022-23",
       x = "Percentage of Stadium Capacity Filled",
       y = "% of Passing Attempts Ruled Complete",
       color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```



```r
# Linear model
att_pass_comp_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(CompPct ~ log(AttPct), data = home_off_pass_data)

tidy(att_pass_comp_glm)
```

```
# A tibble: 2 x 5
  term        estimate std.error statistic p.value
  <chr>          <dbl>     <dbl>     <dbl>   <dbl>
1 (Intercept)    137.       64.5      2.12  0.0580
2 log(AttPct)    -17.9      15.8     -1.13  0.282
```

```r
glance(att_pass_comp_glm)$AIC
```

```
[1] 117.4746
```

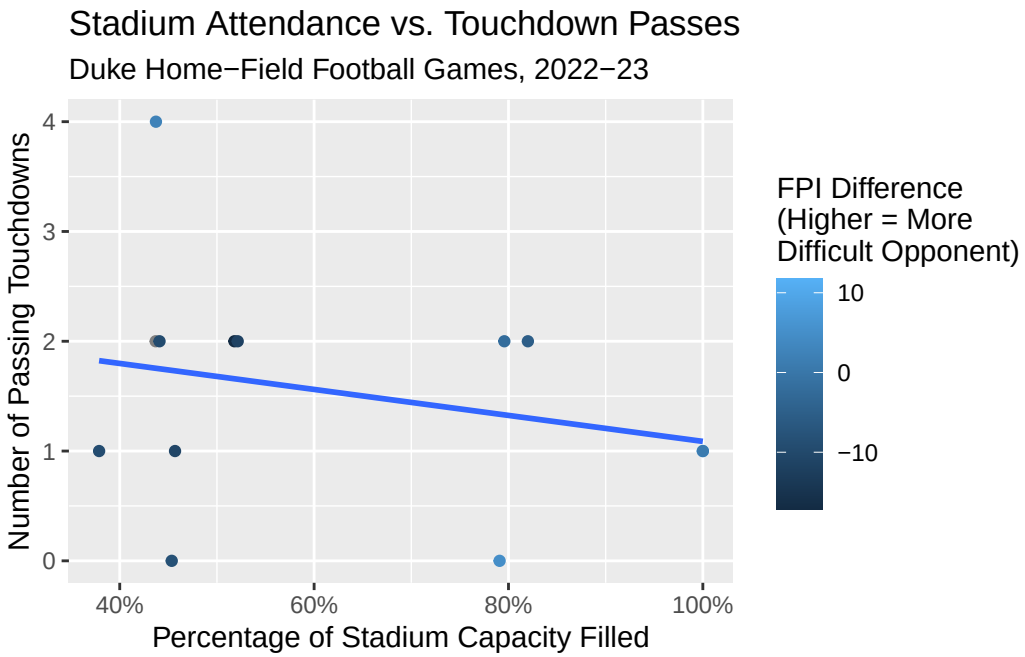
Wallace Wade attendance was *not* a statistically significant predictor of the percentage of passing plays that were completed per game in 2022-23.

Attendance as a predictor of *touchdown* passes per game:

```r
# Visualization
home_off_pass_data |>
  ggplot(
    aes(x = AttPct, y = TD_Gained, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ x, se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Touchdown Passes",
       subtitle = "Duke Home-Field Football Games, 2022-23",
       x = "Percentage of Stadium Capacity Filled",
       y = "Number of Passing Touchdowns",
       color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
```

```
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```




```
# Linear model
att_pass_td_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(TD_Gained ~ AttPct, data = home_off_pass_data)

tidy(att_pass_td_glm)
```

```
# A tibble: 2 x 5
  term        estimate std.error statistic p.value
  <chr>          <dbl>     <dbl>     <dbl>   <dbl>
1 (Intercept)   2.27      0.884      2.57   0.0260
2 AttPct       -0.0118    0.0135    -0.879  0.398
```

```
glance(att_pass_td_glm)$AIC
```

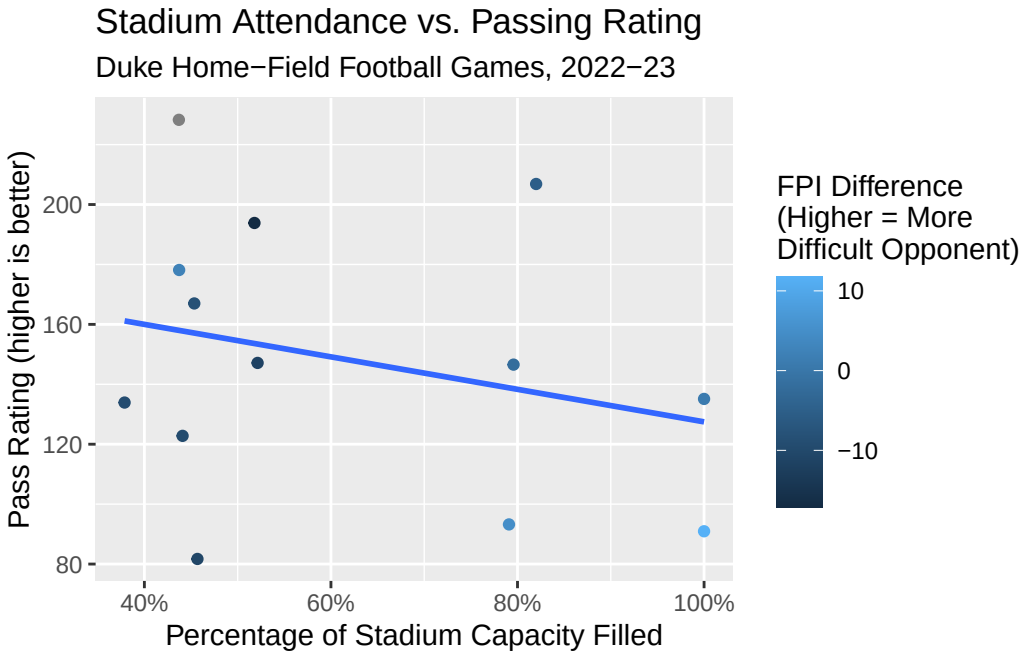
```
[1] 42.2379
```

Wallace Wade attendance was *not* a statistically significant predictor of the number of touchdown passing plays per game in 2022-23.

Attendance as a predictor of *pass rating*:

```
# Visualization
home_off_pass_data |>
  ggplot(
    aes(x = AttPct, y = Rating, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ x, se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Passing Rating",
       subtitle = "Duke Home-Field Football Games, 2022-23",
       x = "Percentage of Stadium Capacity Filled",
       y = "Pass Rating (higher is better)",
       color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```




```
# Linear model
att_pass_qb_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(Rating ~ AttPct, data = home_off_pass_data)

tidy(att_pass_qb_glm)
```

```
# A tibble: 2 x 5
  term        estimate std.error statistic  p.value
  <chr>          <dbl>     <dbl>     <dbl>    <dbl>
1 (Intercept)  182.       38.2       4.76  0.000595
2 AttPct        -0.542     0.582    -0.932 0.371
```

```
glance(att_pass_qb_glm)$AIC
```

```
[1] 140.1709
```

Wallace Wade attendance was *not* a statistically significant predictor of passing rating per game in 2022-23.

Punt Returns

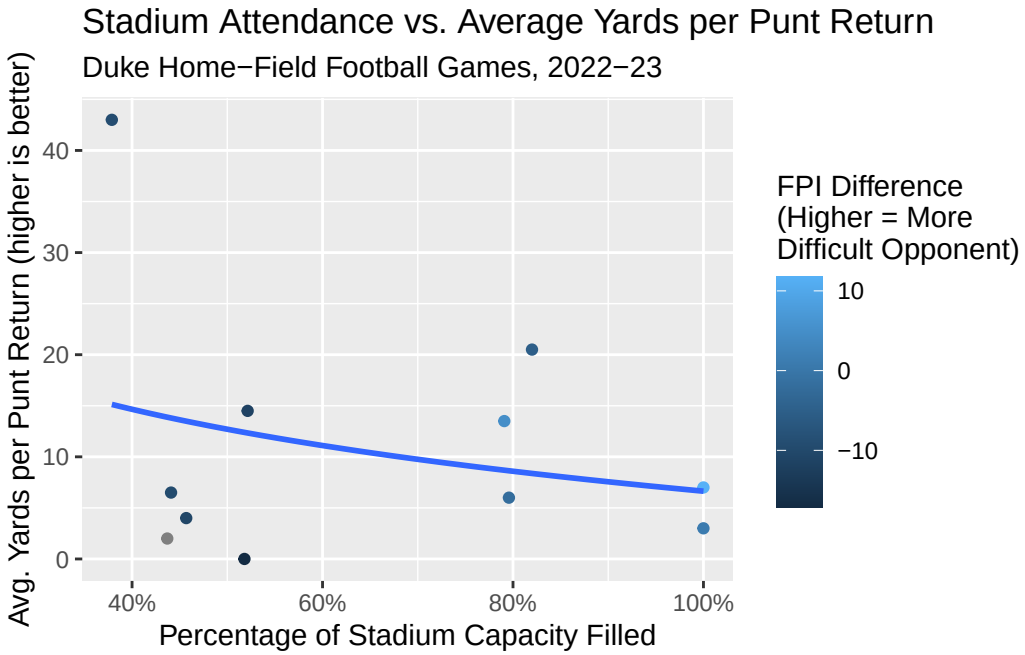
Attendance as a predictor of *average yards* returned per punt return:

```
# Dataset filtering
home_off_punt_return_data <- home_offense_data |>
  filter(Type == "Punt_Returns")

# Visualization
home_off_punt_return_data |>
  ggplot(
    aes(x = AttPct, y = AvgYd, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ log(x), se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Average Yards per Punt Return",
       subtitle = "Duke Home-Field Football Games, 2022-23",
       x = "Percentage of Stadium Capacity Filled",
       y = "Avg. Yards per Punt Return (higher is better)",
       color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: Removed 2 rows containing non-finite values (`stat_smooth()`).
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```

```
Warning: Removed 2 rows containing missing values (`geom_point()`).
```




```
# Linear model
att_punt_ret_yd_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(AvgYd ~ log(AttPct), data = home_off_punt_return_data)

tidy(att_punt_ret_yd_glm)
```

```
# A tibble: 2 x 5
  term        estimate std.error statistic p.value
  <chr>          <dbl>     <dbl>     <dbl>   <dbl>
1 (Intercept)    46.9       45.5     1.03    0.329
2 log(AttPct)    -8.75      11.0    -0.795   0.447
```

```
glance(att_punt_ret_yd_glm)$AIC
```

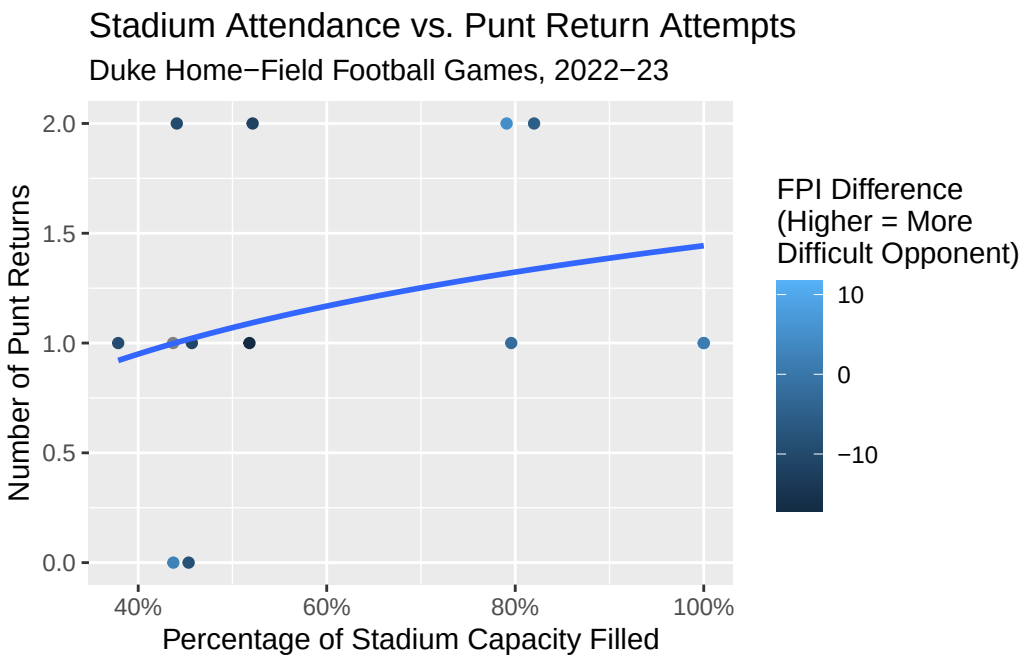
```
[1] 90.60412
```

Wallace Wade attendance was *not* a statistically significant predictor of average punt return yardage per game in 2022-23.

Attendance as a predictor of punt return *attempts* per game:

```
# Visualization
home_off_punt_return_data |>
  ggplot(
    aes(x = AttPct, y = Attempts, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ log(x), se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Punt Return Attempts",
       subtitle = "Duke Home-Field Football Games, 2022-23",
       x = "Percentage of Stadium Capacity Filled",
       y = "Number of Punt Returns",
       color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```



```r
# Linear model
att_punt_ret_attempts_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(Attempts ~ log(AttPct), data = home_off_punt_return_data)

tidy(att_punt_ret_attempts_glm)
```

```
# A tibble: 2 x 5
  term        estimate std.error statistic p.value
  <chr>          <dbl>     <dbl>     <dbl>   <dbl>
1 (Intercept)   -1.04      2.33     -0.445   0.665
2 log(AttPct)    0.539     0.571     0.943   0.366
```

```r
glance(att_punt_ret_attempts_glm)$AIC
```

```
[1] 31.14664
```

Wallace Wade attendance was *not* a statistically significant predictor of the number of punt return attempts per game in 2022-23.

Kickoff Returns

Attendance as a predictor of *average yards* returned per kickoff return:

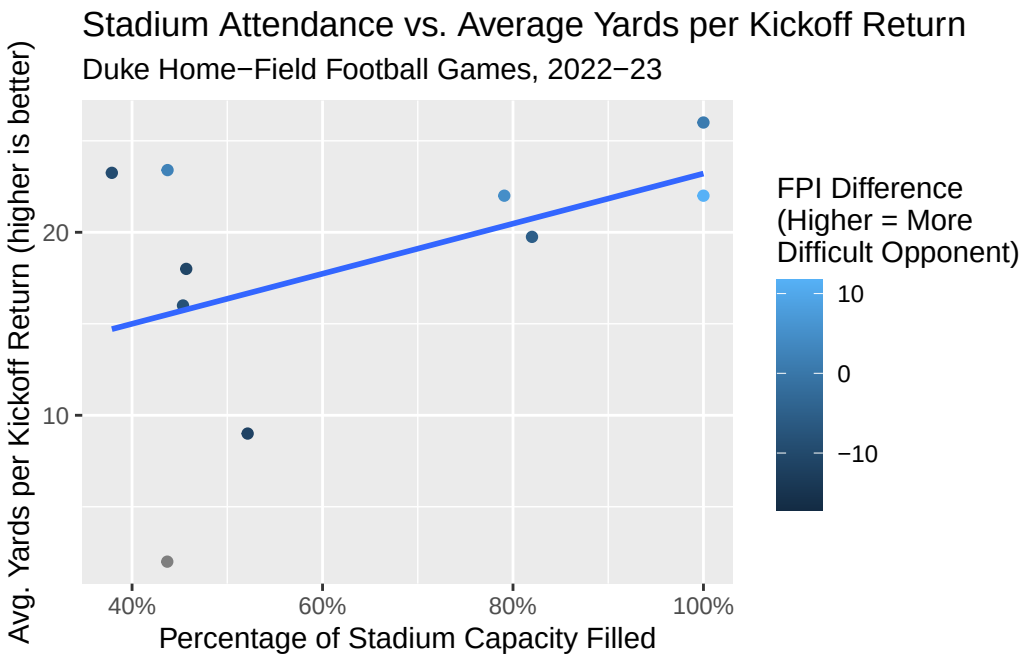
```r
# Dataset filtering
home_off_kickoff_return_data <- home_offense_data |>
  filter(Type == "Kickoff_Returns")

# Visualization
home_off_kickoff_return_data |>
  ggplot(
    aes(x = AttPct, y = AvgYd, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ x, se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Average Yards per Kickoff Return",
       subtitle = "Duke Home-Field Football Games, 2022-23",
```

```
        x = "Percentage of Stadium Capacity Filled",
        y = "Avg. Yards per Kickoff Return (higher is better)",
        color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: Removed 3 rows containing non-finite values (`stat_smooth()`).
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```

```
Warning: Removed 3 rows containing missing values (`geom_point()`).
```




```
# Linear model
att_kickoff_ret_yd_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(AvgYd ~ AttPct, data = home_off_kickoff_return_data)

tidy(att_kickoff_ret_yd_glm)
```

```
# A tibble: 2 x 5
  term        estimate std.error statistic p.value
  <chr>          <dbl>     <dbl>     <dbl>   <dbl>
1 (Intercept)    9.52      6.38       1.49   0.174
2 AttPct         0.137     0.0950     1.44   0.188
```

```
glance(att_kickoff_ret_yd_glm)$AIC
```

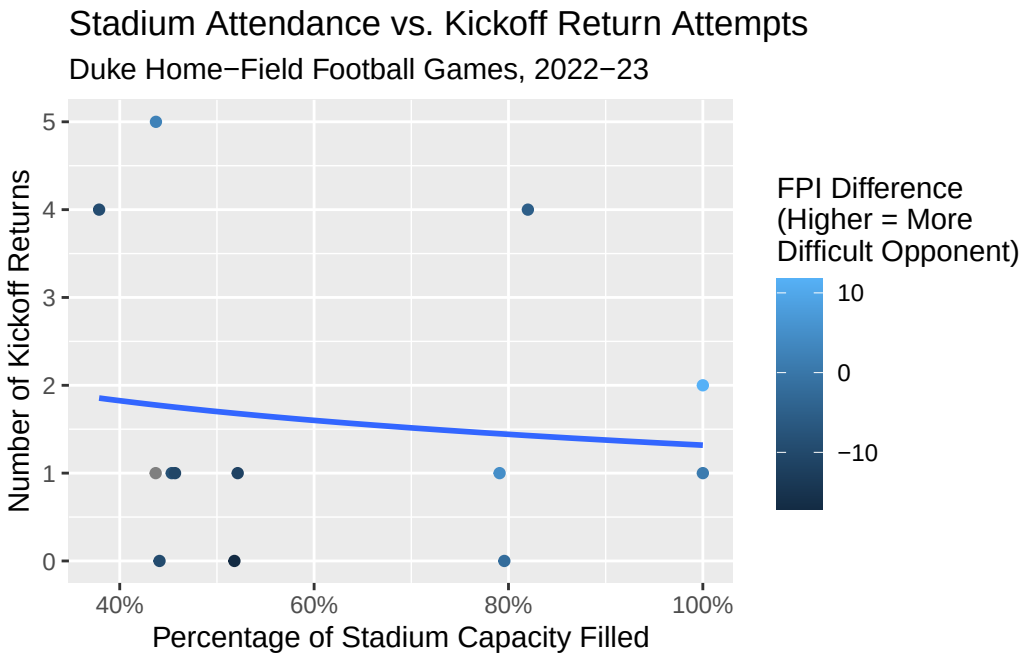
```
[1] 71.1234
```

Wallace Wade attendance was *not* a statistically significant predictor of the average yards returned per kickoff return attempt in 2022-23.

Attendance as a predictor of kickoff return *attempts* per game:

```
# Visualization
home_off_kickoff_return_data |>
  ggplot(
    aes(x = AttPct, y = Attempts, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ log(x), se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Kickoff Return Attempts",
       subtitle = "Duke Home-Field Football Games, 2022-23",
       x = "Percentage of Stadium Capacity Filled",
       y = "Number of Kickoff Returns",
       color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```




```
# Linear model
att_kickoff_ret_attempts_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(Attempts ~ log(AttPct), data = home_off_kickoff_return_data)

tidy(att_kickoff_ret_attempts_glm)
```

```
# A tibble: 2 x 5
  term        estimate std.error statistic p.value
  <chr>          <dbl>     <dbl>     <dbl>   <dbl>
1 (Intercept)    3.86       5.80     0.666   0.519
2 log(AttPct)   -0.552      1.42    -0.389   0.705
```

```
glance(att_kickoff_ret_attempts_glm)$AIC
```

```
[1] 54.85574
```

Wallace Wade attendance was *not* a statistically significant predictor of the number of kickoff return attempts per game in 2022-23.

Punts

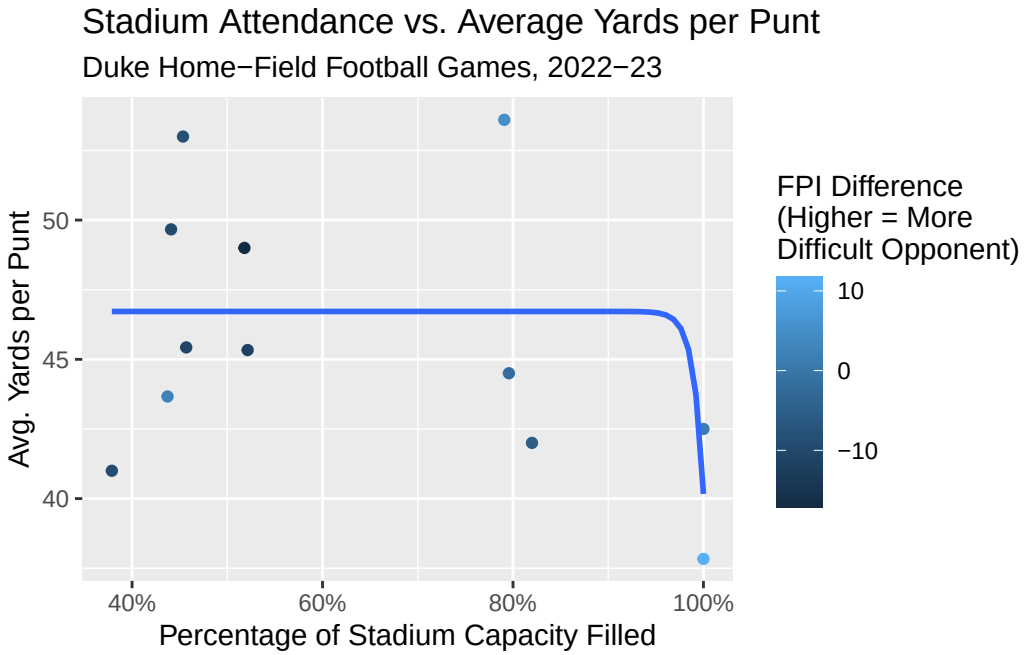
Attendance as a predictor of *average yards* per punt:

```
# Dataset filtering
home_off_punts_data <- home_offense_data |>
  filter(Type == "Punts")

# Visualization
home_off_punts_data |>
  ggplot(
    aes(x = AttPct, y = AvgYd, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ exp(x), se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Average Yards per Punt",
       subtitle = "Duke Home-Field Football Games, 2022-23",
       x = "Percentage of Stadium Capacity Filled",
       y = "Avg. Yards per Punt",
       color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: Removed 1 rows containing non-finite values (`stat_smooth()`).
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```

```
Warning: Removed 1 rows containing missing values (`geom_point()`).
```




```
# Linear model
att_punts_yd_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(AvgYd ~ exp(AttPct), data = home_off_punts_data)

tidy(att_punts_yd_glm)
```

```
# A tibble: 2 x 5
  term         estimate std.error statistic  p.value
  <chr>           <dbl>     <dbl>     <dbl>    <dbl>
1 (Intercept)  4.67e+ 1  1.36e+ 0     34.4  1.02e-11
2 exp(AttPct) -2.44e-43  1.24e-43     -1.97 7.71e- 2
```

```
glance(att_punts_yd_glm)$AIC
```

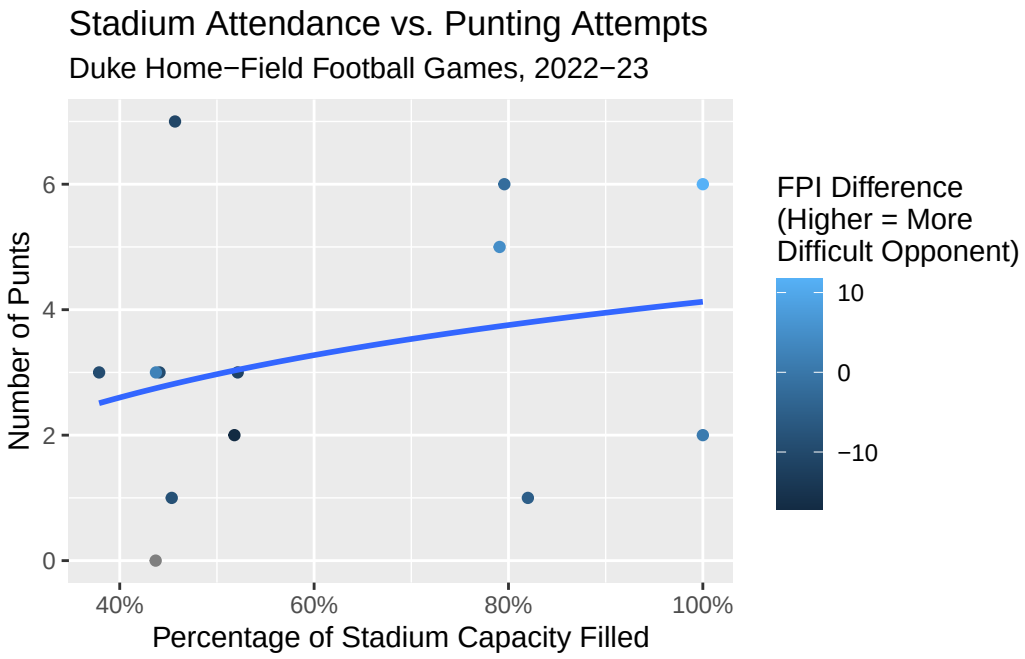
```
[1] 72.83974
```

Wallace Wade attendance was *not* a strong predictor of the average yards punted per punt attempt in 2022-23.

Attendance as a predictor of punting *attempts* per game:

```
# Visualization
home_off_punts_data |>
  ggplot(
    aes(x = AttPct, y = Attempts, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ log(x), se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Punting Attempts",
       subtitle = "Duke Home-Field Football Games, 2022-23",
       x = "Percentage of Stadium Capacity Filled",
       y = "Number of Punts",
       color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```



```r
# Linear model
att_punts_attempts_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(Attempts ~ log(AttPct), data = home_off_punts_data)

tidy(att_punts_attempts_glm)
```

```
# A tibble: 2 x 5
  term        estimate std.error statistic p.value
  <chr>          <dbl>     <dbl>     <dbl>   <dbl>
1 (Intercept)    -3.55      7.34    -0.483   0.638
2 log(AttPct)     1.67      1.80     0.926   0.374
```

```r
glance(att_punts_attempts_glm)$AIC
```

```
[1] 60.97246
```

Wallace Wade attendance was *not* a statistically significant predictor of the number of punting attempts per game in 2022-23.

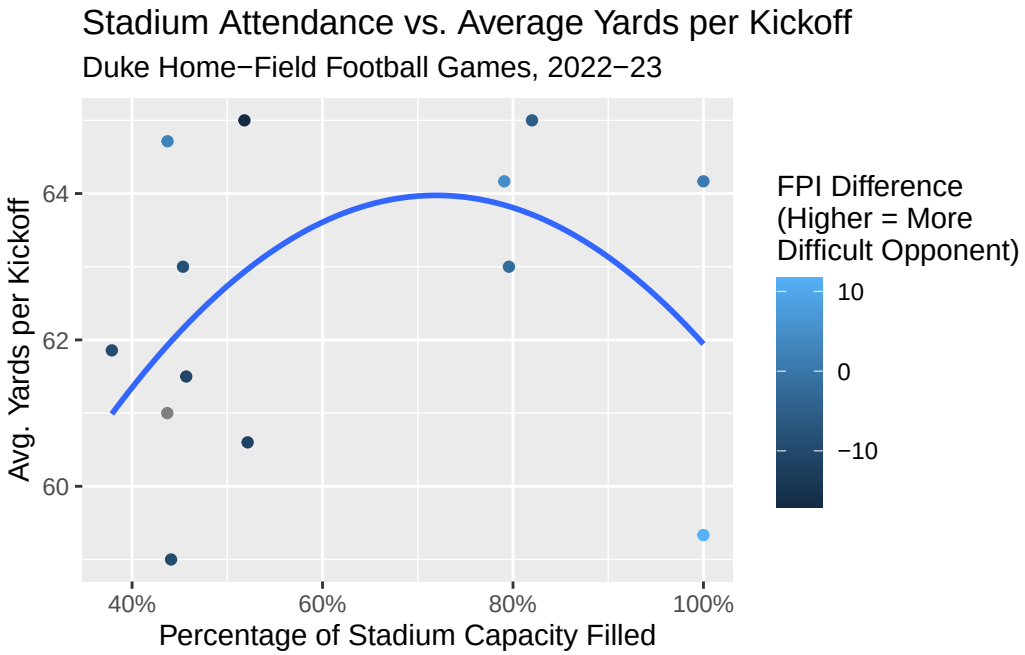
Kickoffs

Attendance as a predictor of *average yards* per kickoff:

```r
# Dataset filtering
home_off_kickoffs_data <- home_offense_data |>
  filter(Type == "Kickoffs")

# Visualization
home_off_kickoffs_data |>
  ggplot(
    aes(x = AttPct, y = AvgYd, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ poly(x,2), se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Average Yards per Kickoff",
       subtitle = "Duke Home-Field Football Games, 2022-23",
```

```
        x = "Percentage of Stadium Capacity Filled",
        y = "Avg. Yards per Kickoff",
        color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```




```
# Linear model
att_kickoffs_yd_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(AvgYd ~ poly(AttPct,2), data = home_off_kickoffs_data)

tidy(att_kickoffs_yd_glm)
```

```
# A tibble: 3 x 5
  term             estimate std.error statistic  p.value
  <chr>               <dbl>     <dbl>     <dbl>    <dbl>
```

```
1 (Intercept)         62.5      0.579   108.    1.14e-16
2 poly(AttPct, 2)1     1.23     2.09      0.588 5.70e- 1
3 poly(AttPct, 2)2    -2.82     2.09     -1.35  2.06e- 1
```

```
glance(att_kickoffs_yd_glm)$AIC
```

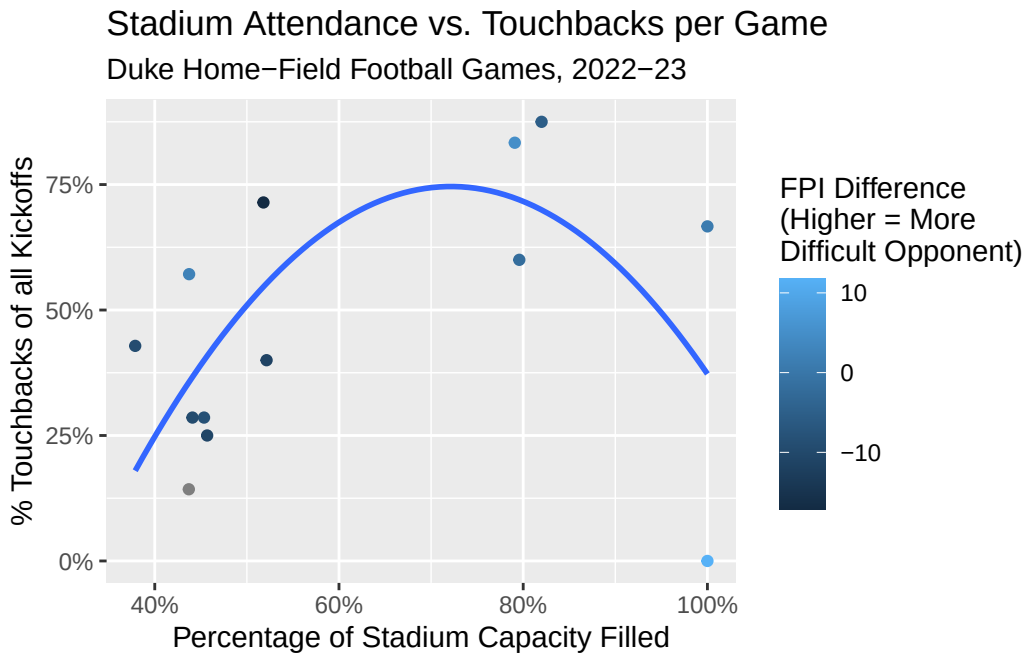
```
[1] 60.60392
```

Wallace Wade attendance was *not* a strong predictor of the average yards kicked per kickoff attempt in 2022-23.

Attendance as a predictor of *touchback percentage* per game:

```
# Visualization
home_off_kickoffs_data |>
  ggplot(
    aes(x = AttPct, y = TouchbackPct, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ poly(x,2), se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  scale_y_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Touchbacks per Game",
       subtitle = "Duke Home-Field Football Games, 2022-23",
       x = "Percentage of Stadium Capacity Filled",
       y = "% Touchbacks of all Kickoffs",
       color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

```
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```




```
# Linear model
att_kickoffs_touchback_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(TouchbackPct ~ poly(AttPct,2), data = home_off_kickoffs_data)

tidy(att_kickoffs_touchback_glm)
```

```
# A tibble: 3 x 5
  term             estimate std.error statistic   p.value
  <chr>               <dbl>     <dbl>     <dbl>     <dbl>
1 (Intercept)          46.6      6.40      7.28 0.0000267
2 poly(AttPct, 2)1     24.7     23.1       1.07 0.309
3 poly(AttPct, 2)2    -52.8     23.1      -2.29 0.0451
```

```
glance(att_kickoffs_touchback_glm)$AIC
```

```
[1] 123.0841
```

Wallace Wade attendance is a statistically ***possible*** predictor of the percent of kickoff attempts that were touchbacks in 2022-23.