

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 become
```

```
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", "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, 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", "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, NA, 17, 2~
\$ CompPct	<dbl> NA, 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, NA, 0, 0, ~
\$ Rating	<dbl> NA, 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, NA, N~
\$ TouchbackPct	<dbl> NA, 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, NA, N~
\$ Onside	<dbl> NA, 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, NA, N~
\$ isHome	<lgl> TRUE, 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:

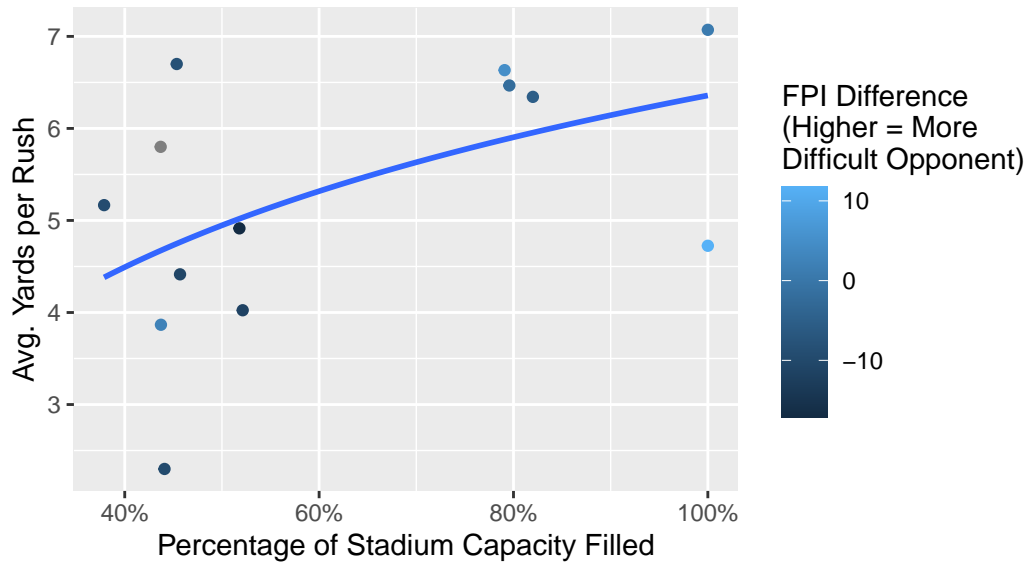
```
# Dataset filtering
home_off_rush_data <- home_offense_data |>
  filter(Type == "Rushing")

# 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?

Stadium Attendance vs. Average Yards per Rushing Play Duke Home-Field Football Games, 2022-23



```
# 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

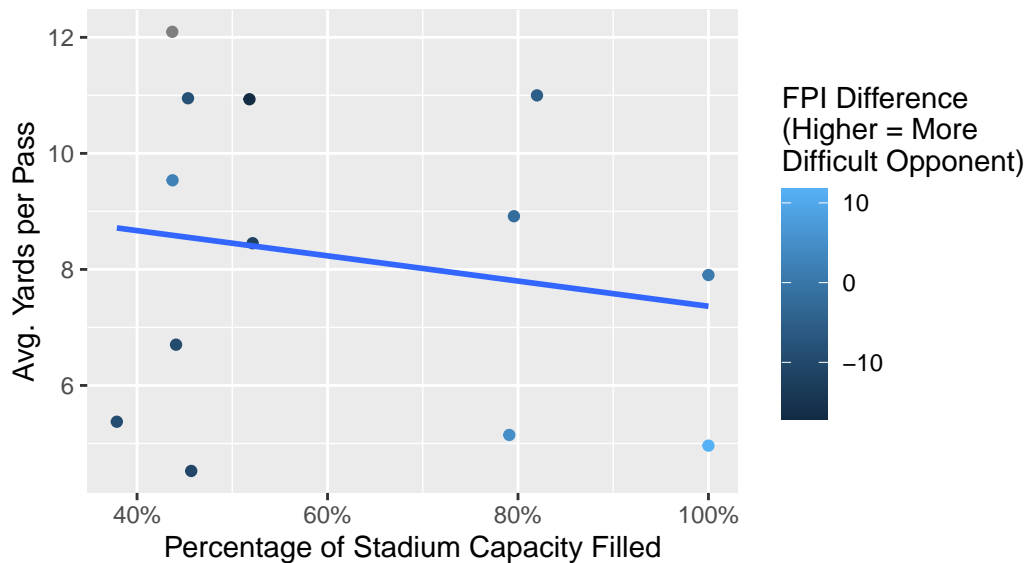
Attendance as a predictor of *average yards gained/lost* per passing play:

```
# 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?

Stadium Attendance vs. Average Yards per Passing Play Duke Home-Field Football Games, 2022-23



```
# 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
```

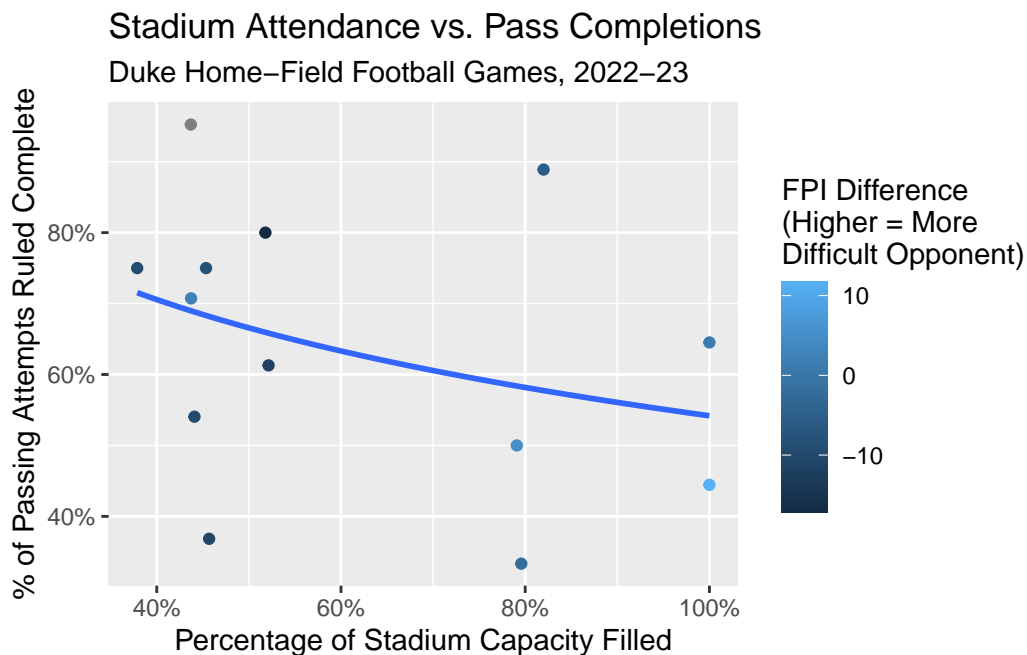
Wallace Wade attendance was *not* a statistically significant predictor of average yards gained/lost per passing play in 2022-23.

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?




```
# 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
```

```
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.

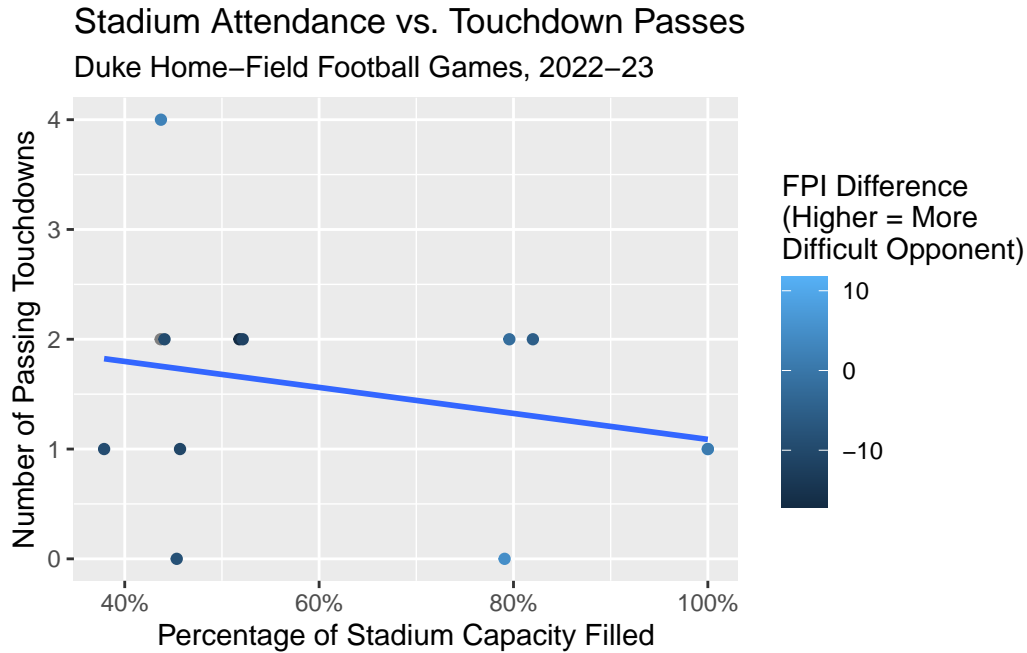
Attendance as a predictor of *touchdown* passes per game:

```
# 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 touch-down passing plays per game in 2022-23.

Attendance as a predictor of *pass rating*:

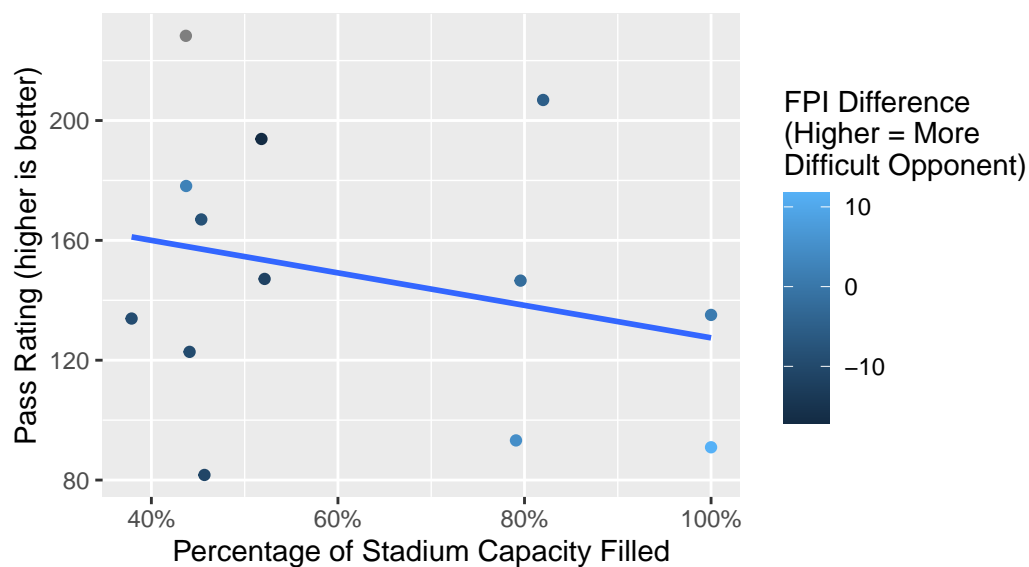
```
# Visualization
home_off_pass_data |>
  ggplot(
    aes(x = AttPct, y = Rating, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ x, se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Passing Rating",
        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?

Stadium Attendance vs. Passing Rating

Duke Home-Field Football Games, 2022-23



```
# 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()`).

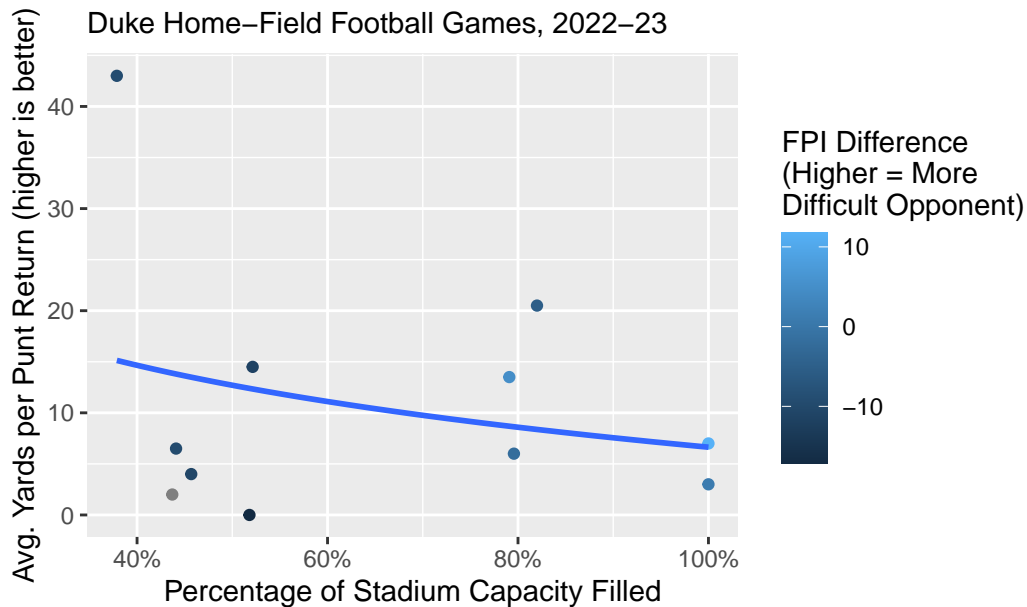
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in the data.

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()`).

Stadium Attendance vs. Average Yards per Punt Return

Duke Home-Field Football Games, 2022-23



```
# 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
```

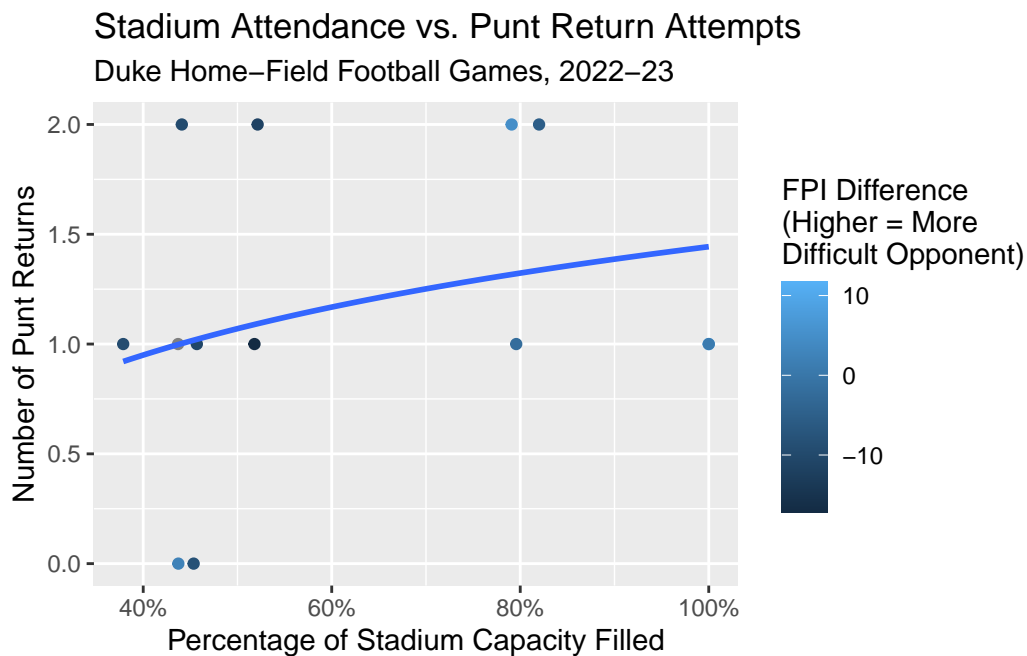
Wallace Wade attendance was *not* a statistically significant predictor of average punt return yardage per game in 2022-23.

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?



```
# 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

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:

```
# 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",
```



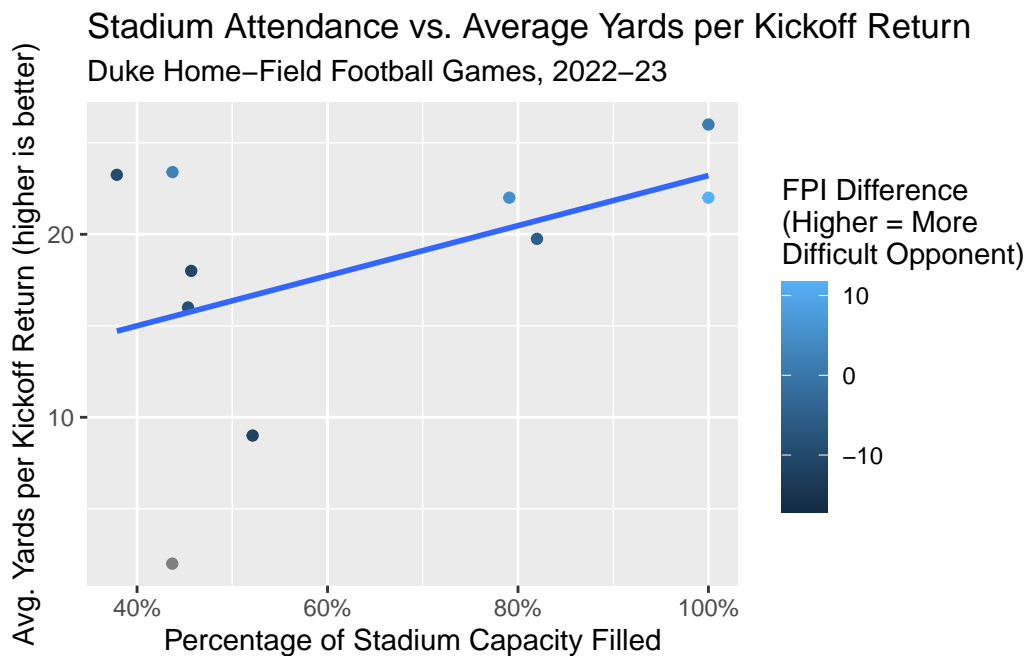
```
x = "Percentage of Stadium Capacity Filled",
y = "Avg. Yards per Kickoff Return (higher is better)",
color = "FPI Difference\n(Higher = More\nDifficult Opponent)")
```

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:

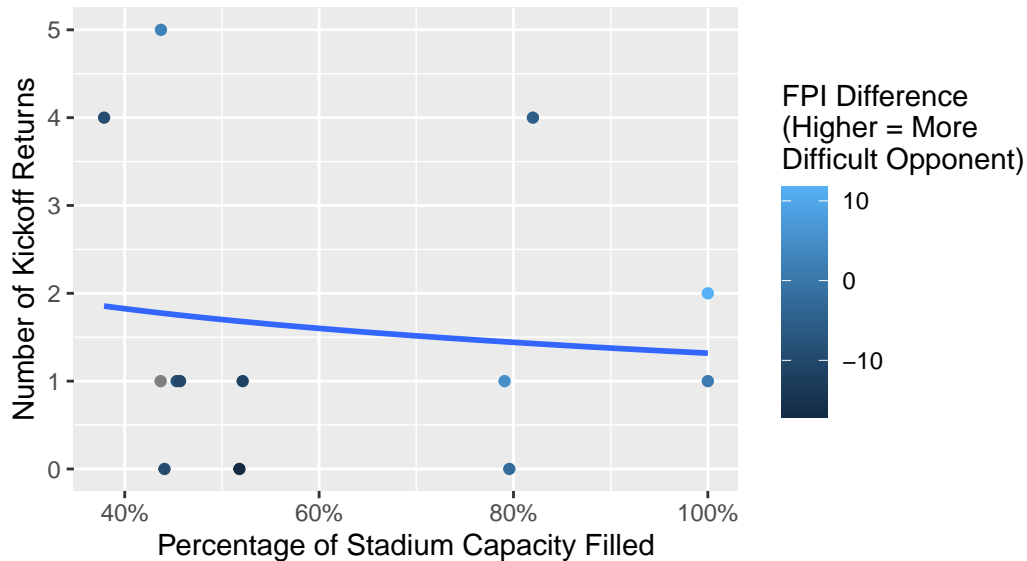
```
# Visualization
home_off_kickoff_return_data |>
  ggplot(
    aes(x = AttPct, y = Attempts, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ log(x), se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. Kickoff 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?

Stadium Attendance vs. Kickoff Return Attempts

Duke Home-Field Football Games, 2022-23



```
# 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()`).

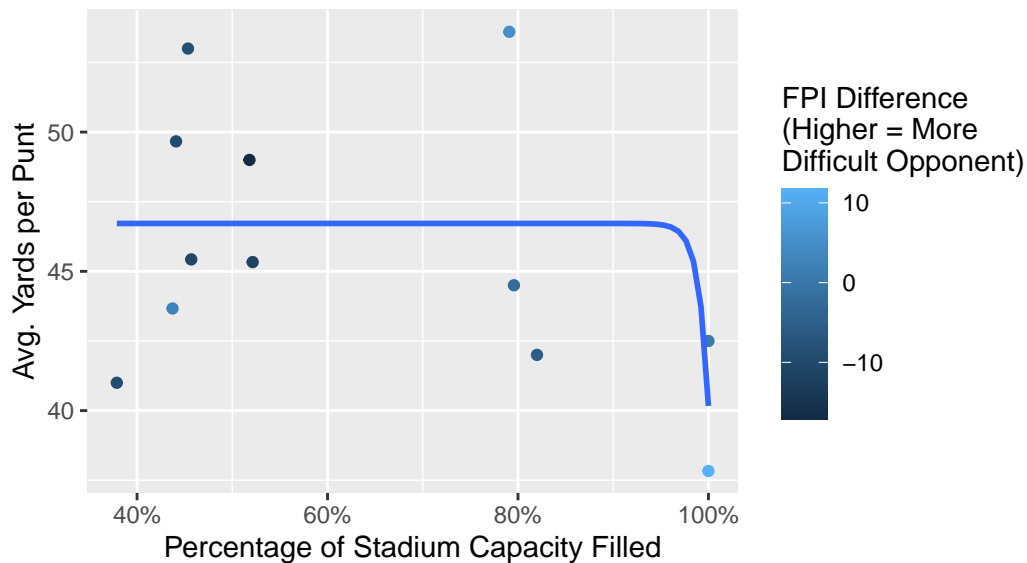
Warning: The following aesthetics were dropped during statistical transformation: colour
i This can happen when ggplot fails to infer the correct grouping structure in the data.

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()`).

Stadium Attendance vs. Average Yards per Punt

Duke Home-Field Football Games, 2022-23



```
# 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
```

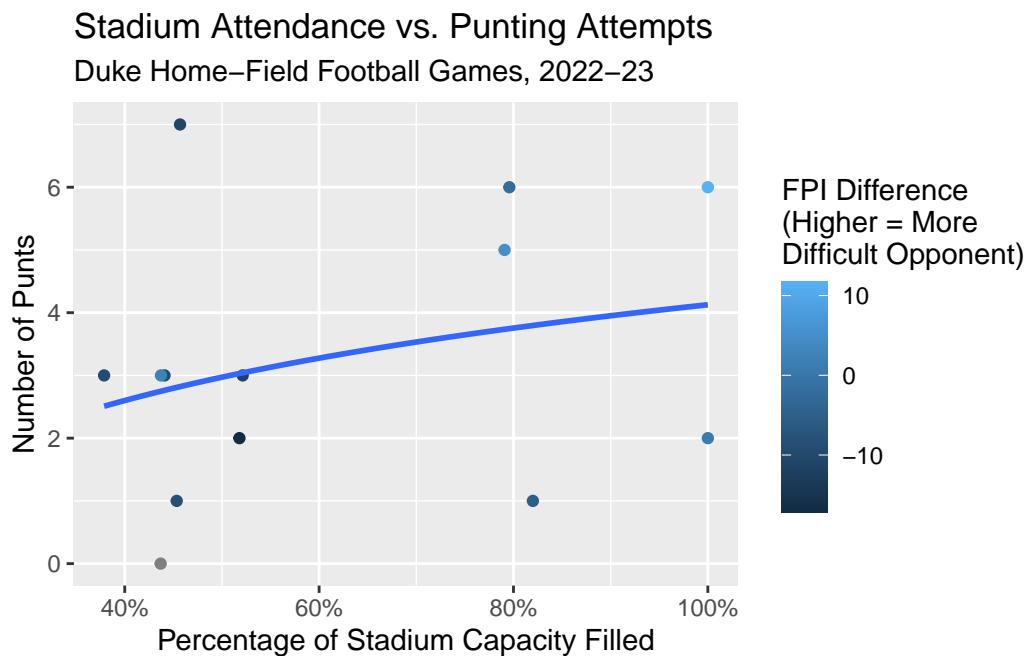
Wallace Wade attendance was *not* a strong predictor of the average yards punted per punt attempt in 2022-23.

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?



```
# 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
```

```
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:

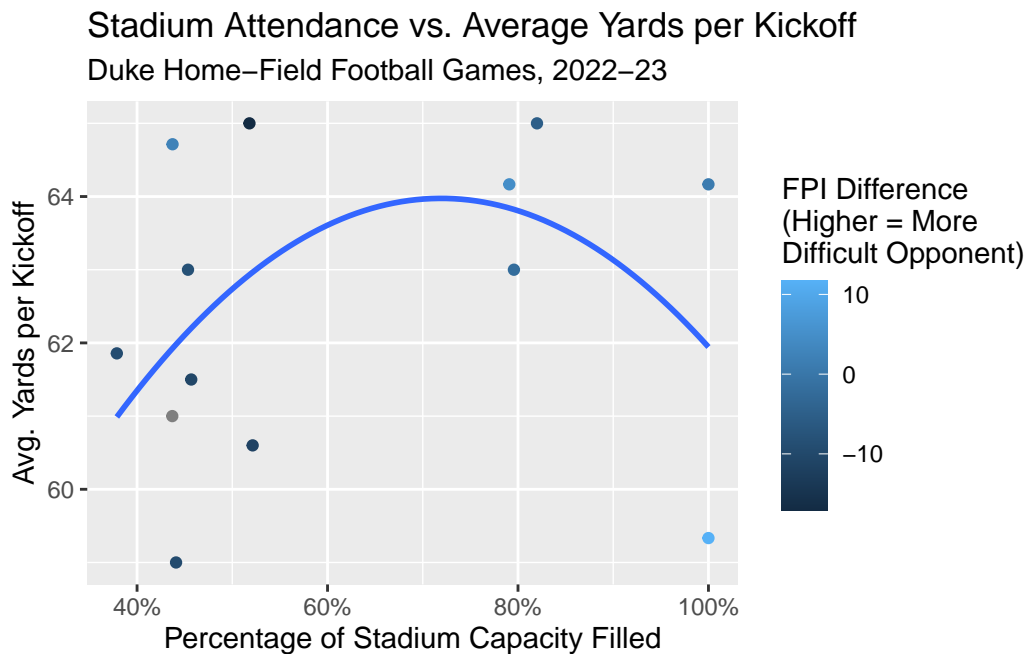
```
# Dataset filtering
home_off_kickoffs_data <- home_offense_data |>
  filter(Type == "Kickoffs")

# 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*:

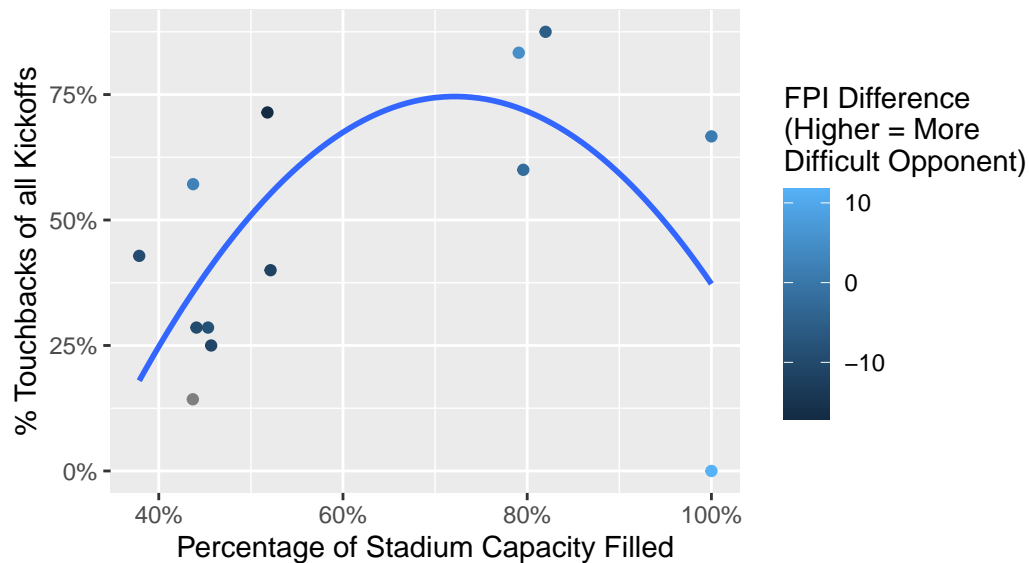
```
# Visualization
home_off_kickoffs_data |>
  ggplot(
    aes(x = AttPct, y = TouchbackPct, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ poly(x,2), se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  scale_y_continuous(labels = label_percent(scale = 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?

Stadium Attendance vs. Touchbacks per Game

Duke Home-Field Football Games, 2022-23



```
# 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.

Field Goals

Attendance as a predictor of 3-point field goal percentage per game:

```
# Dataset filtering
home_off_fg_data <- home_offense_data |>
  filter(Type == "Field_Goals")

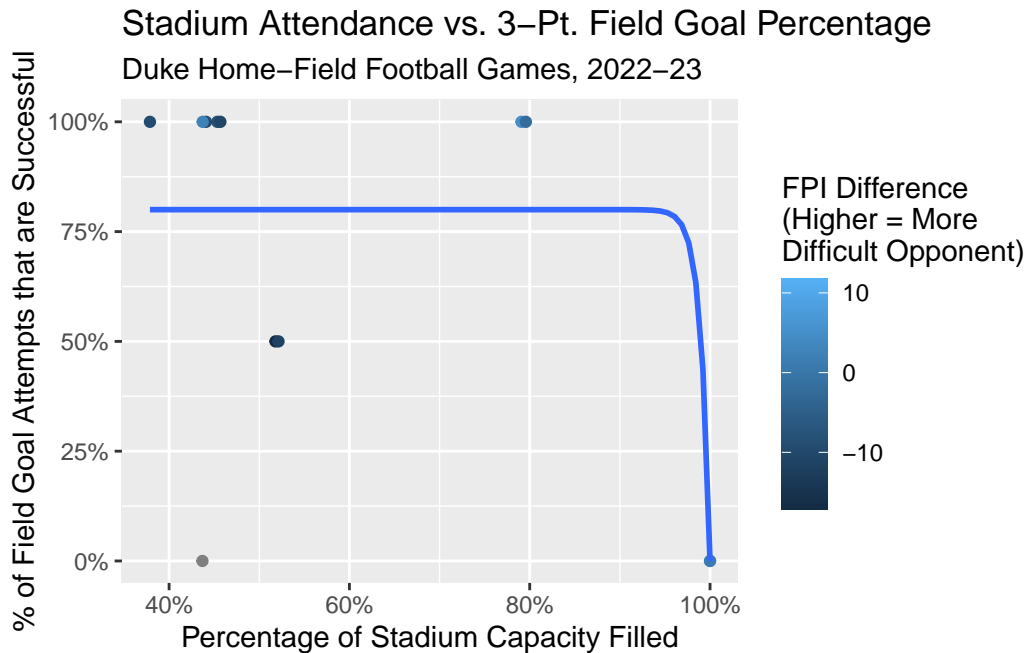
# Visualization
home_off_fg_data |>
  ggplot(
    aes(x = AttPct, y = CompPct, color = FPI_diff)
  ) +
  geom_point() +
  geom_smooth(method = "glm", formula = y ~ exp(x), se = FALSE) +
  scale_x_continuous(labels = label_percent(scale = 1)) +
  scale_y_continuous(labels = label_percent(scale = 1)) +
  labs(title = "Stadium Attendance vs. 3-Pt. Field Goal Percentage",
        subtitle = "Duke Home-Field Football Games, 2022-23",
        x = "Percentage of Stadium Capacity Filled",
        y = "% of Field Goal Attempts that are Successful",
        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_fg_comp_pct_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(CompPct ~ exp(AttPct), data = home_off_fg_data)

tidy(att_fg_comp_pct_glm)
```

```
# A tibble: 2 x 5
  term          estimate std.error statistic    p.value
<chr>         <dbl>     <dbl>     <dbl>    <dbl>
1 (Intercept)  8.00e+ 1  1.05e+ 1      7.63 0.0000178
2 exp(AttPct) -2.98e-42  9.56e-43     -3.11 0.0110
```

```
glance(att_fg_comp_pct_glm)$AIC
```

```
[1] 121.9035
```

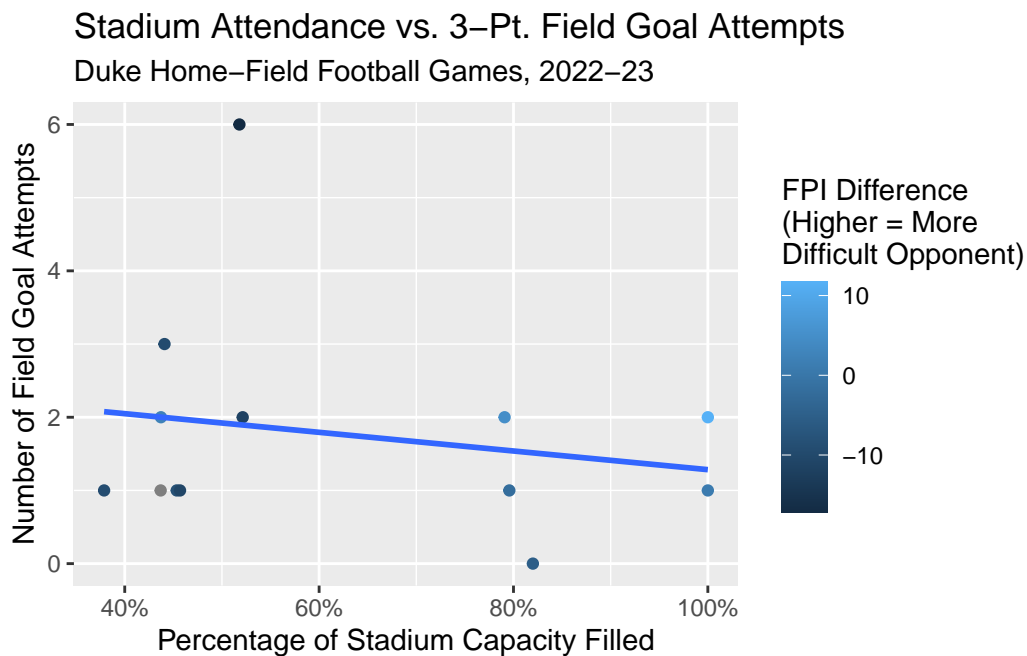
Based on Duke football games in Wallace Wade during 2022-23, there *is* significant evidence that when football attendance is 100% or very close to 100%, the predicted 3-pt. field goals percentage decreases dramatically.

Attendance as a predictor of the number of 3-pt. field goals *attempted* per game:

```
# Visualization
home_off_fg_data |>
  ggplot(
    aes(x = AttPct, y = Attempts, 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. 3-Pt. Field Goal Attempts",
        subtitle = "Duke Home-Field Football Games, 2022-23",
        x = "Percentage of Stadium Capacity Filled",
        y = "Number of Field Goal Attempts",
        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_fg_attempts_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(Attempts ~ AttPct, data = home_off_fg_data)

tidy(att_fg_attempts_glm)
```

```
# A tibble: 2 x 5
  term          estimate std.error statistic p.value
<chr>         <dbl>     <dbl>     <dbl>   <dbl>
1 (Intercept)    2.56       1.26       2.02   0.0680
2 AttPct        -0.0127    0.0193    -0.662  0.521
```

```
glance(att_fg_attempts_glm)$AIC
```

```
[1] 51.54802
```

Wallace Wade attendance was *not* a statistically significant predictor of the number of 3-point field goals attempted per game in 2022-23.

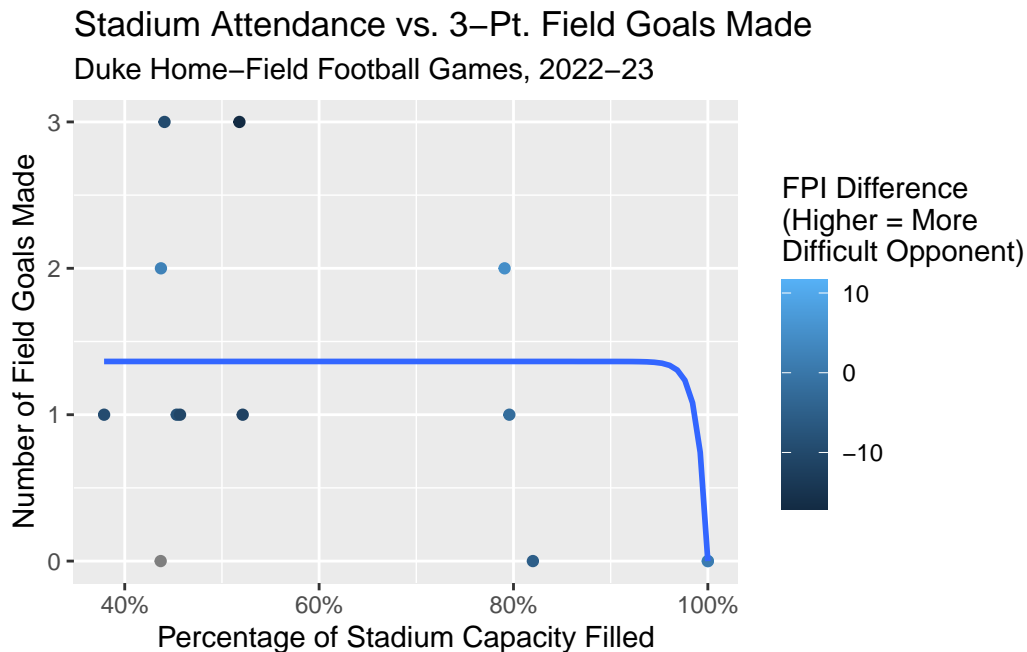
Attendance as a predictor of the number of 3-pt. field goals *made* per game:

```
# Visualization
home_off_fg_data |>
  ggplot(
    aes(x = AttPct, y = Comp, 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. 3-Pt. Field Goals Made",
       subtitle = "Duke Home-Field Football Games, 2022-23",
       x = "Percentage of Stadium Capacity Filled",
       y = "Number of Field Goals Made",
       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_fg_comp_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(Comp ~ exp(AttPct), data = home_off_fg_data)

tidy(att_fg_comp_glm)
```

```
# A tibble: 2 x 5
  term      estimate std.error statistic  p.value
<chr>      <dbl>     <dbl>     <dbl>    <dbl>
1 (Intercept) 1.36e+ 0  2.95e- 1     4.62 0.000741
2 exp(AttPct) -5.07e-44  2.80e-44    -1.81 0.0974
```

```
glance(att_fg_comp_glm)$AIC
```

```
[1] 40.17209
```

Wallace Wade attendance was *not* a *strong* predictor of the number of 3-point field goals made per game in 2022-23. (However, there may be a slightly stronger, albeit still weak, association between FGs made & stadium attendance than the association between FGs attempted & stadium attendance.)

Total Offense

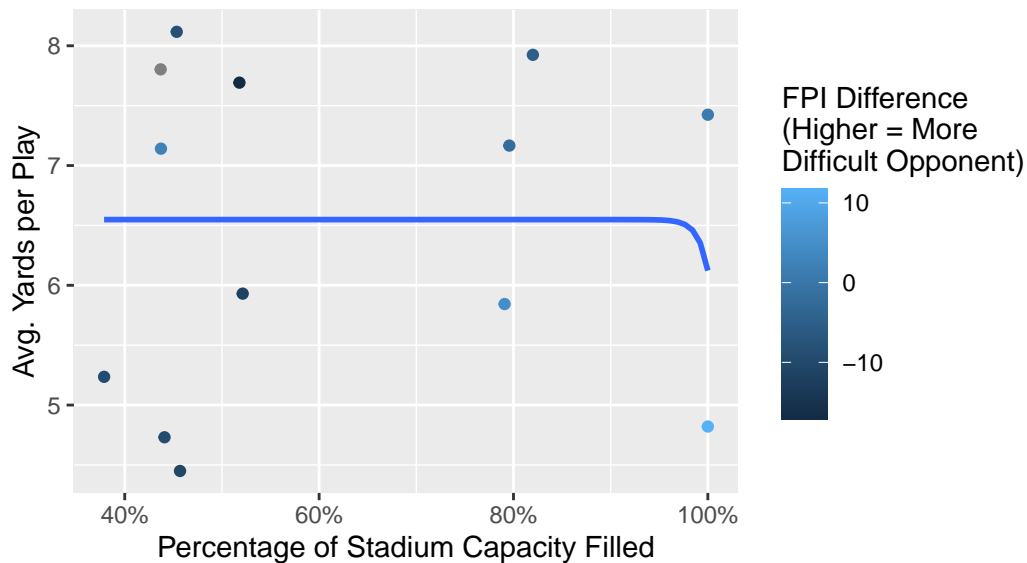
Attendance as a predictor of *average yards per offensive play*:

```
# Dataset filtering
home_off_total_data <- home_offense_data |>
  filter(Type == "Total_Offense")

# Visualization
home_off_total_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 Offensive Play",
        subtitle = "Duke Home-Field Football Games, 2022-23",
        x = "Percentage of Stadium Capacity Filled",
        y = "Avg. Yards per Play",
        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?

Stadium Attendance vs. Average Yards per Offensive Play Duke Home-Field Football Games, 2022-23



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

tidy(att_total_yd_glm)
```

```
# A tibble: 2 x 5
  term      estimate std.error statistic    p.value
<chr>      <dbl>     <dbl>     <dbl>    <dbl>
1 (Intercept) 6.55e+ 0  4.23e- 1    15.5  0.00000000820
2 exp(AttPct) -1.58e-44  4.01e-44   -0.395  0.701
```

```
glance(att_total_yd_glm)$AIC
```

```
[1] 49.53165
```

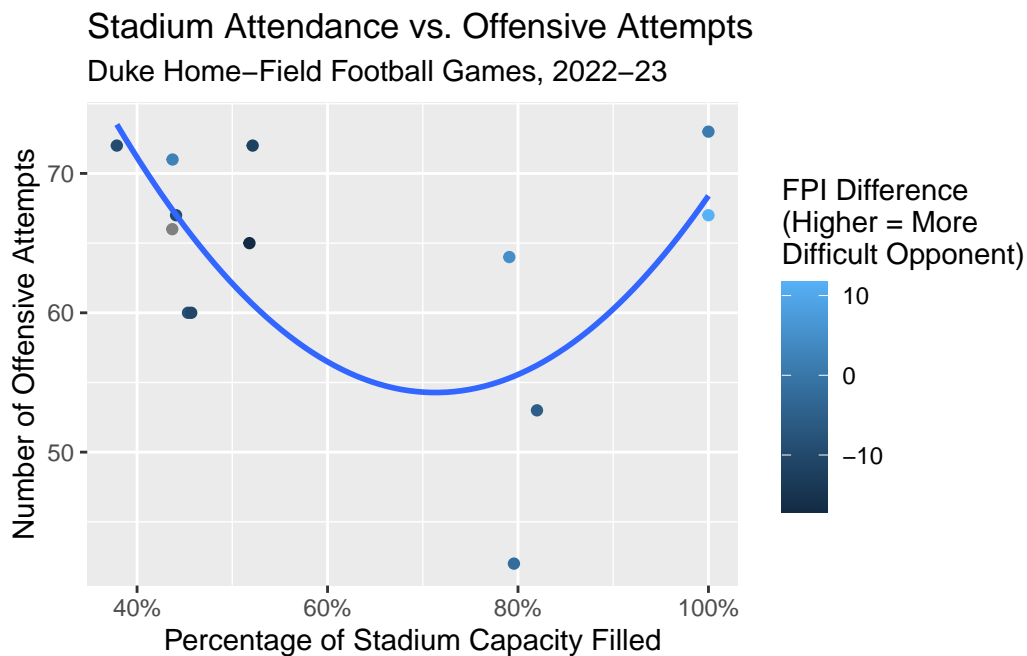
Wallace Wade attendance was *not* a statistically significant predictor of the average yards gained/lost per offensive play attempt in 2022-23.

Attendance as a predictor of total offensive *attempts* per game:

```
# Visualization
home_off_total_data |>
  ggplot(
    aes(x = AttPct, y = Attempts, 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. Offensive Attempts",
        subtitle = "Duke Home-Field Football Games, 2022-23",
        x = "Percentage of Stadium Capacity Filled",
        y = "Number of Offensive Attempts",
        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_total_attempts_glm <- linear_reg() |>
  set_engine("glm") |>
  fit(Attempts ~ poly(AttPct,2), data = home_off_total_data)

tidy(att_total_attempts_glm)

# A tibble: 3 x 5
  term                estimate std.error statistic  p.value
<chr>              <dbl>    <dbl>    <dbl>    <dbl>
1 (Intercept)         64        2.00     32.0 2.09e-11
2 poly(AttPct, 2)1    -6.59        7.21    -0.914 3.82e- 1
3 poly(AttPct, 2)2     18.8        7.21     2.61 2.60e- 2

glance(att_total_attempts_glm)$AIC
```

```
[1] 92.84864
```

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