Quarterback Heatmaps

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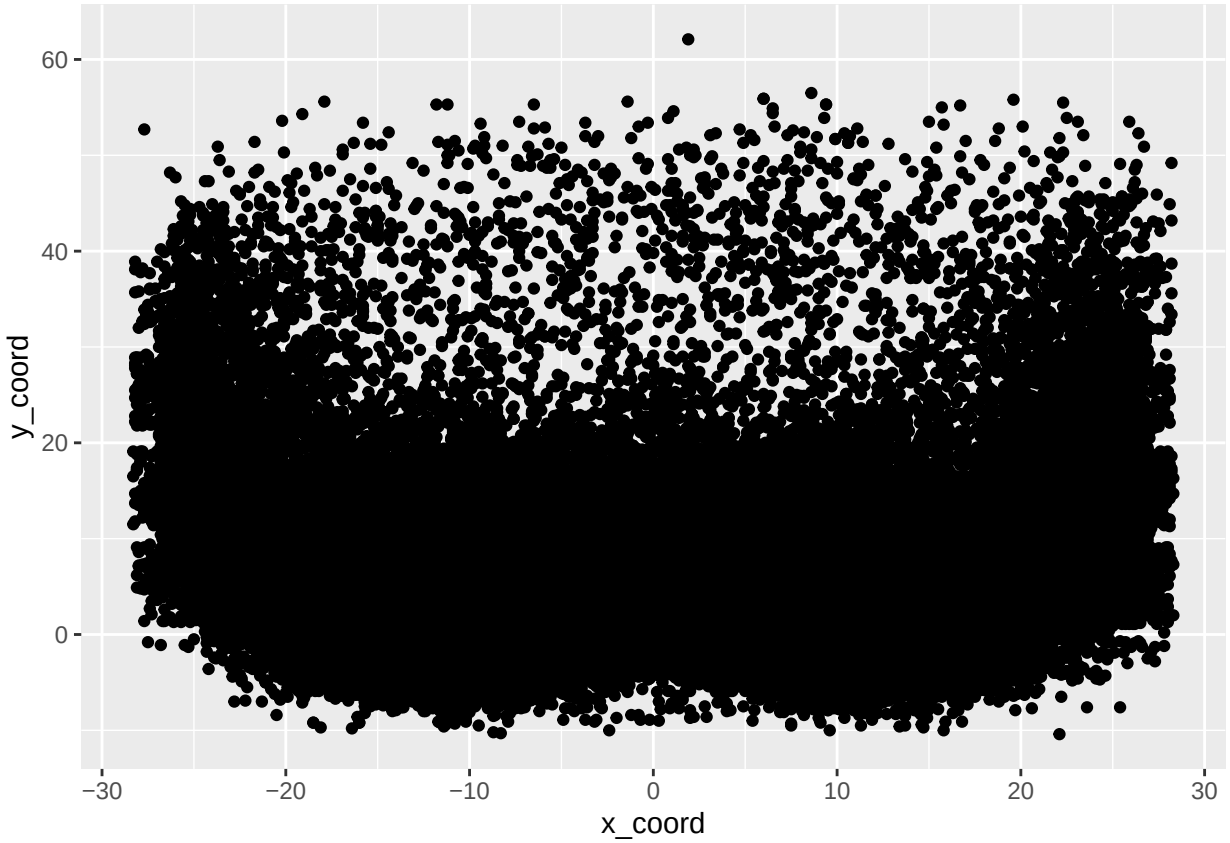
```
library(tidyverse)
library(ggtext)
library(ggExtra)
library(patchwork)
library(paletteer)
library(scales)
library(gt)
```

```
df <- read_csv('heatmapdata.csv')
```

Plot of all the points

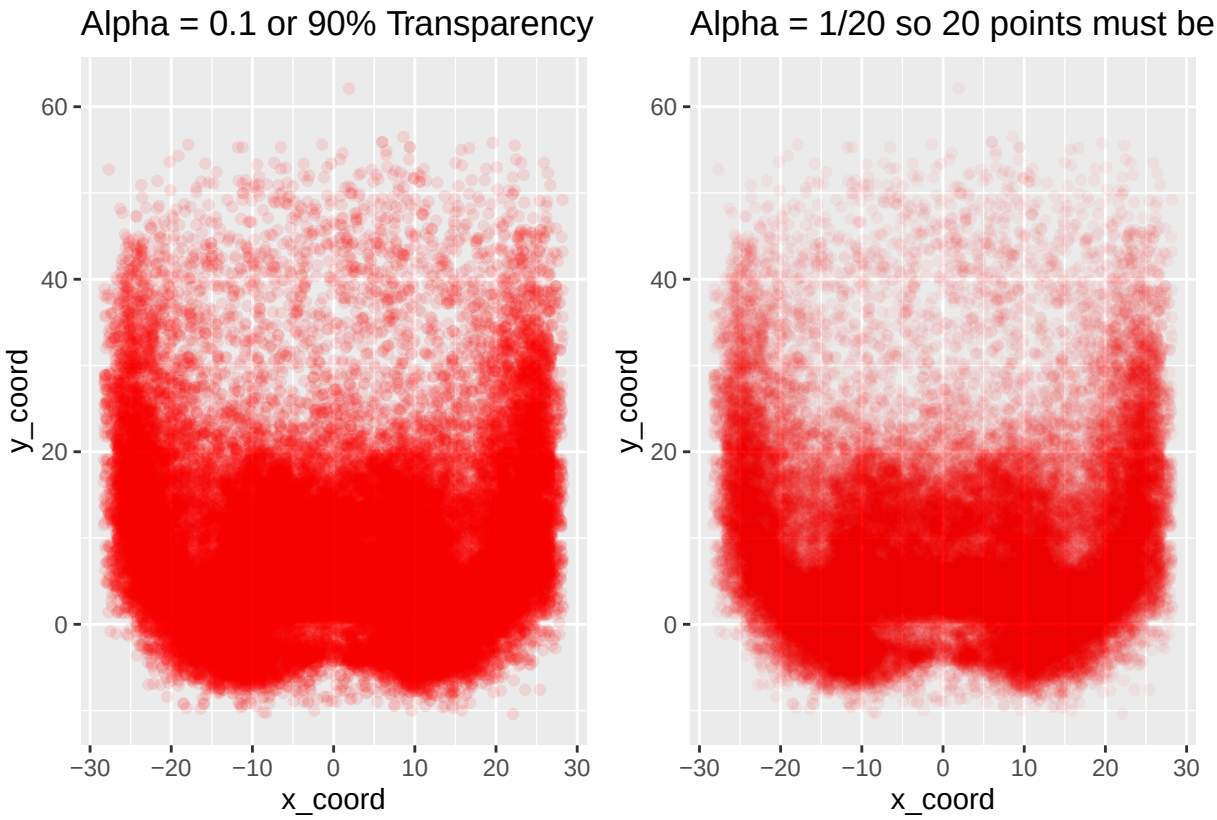
```
df %>%
  ggplot(aes(x_coord,y_coord)) +
  geom_point()
```



This plot is over plotted, impossible to see any differences between 10 ~ 20 yard DOT.

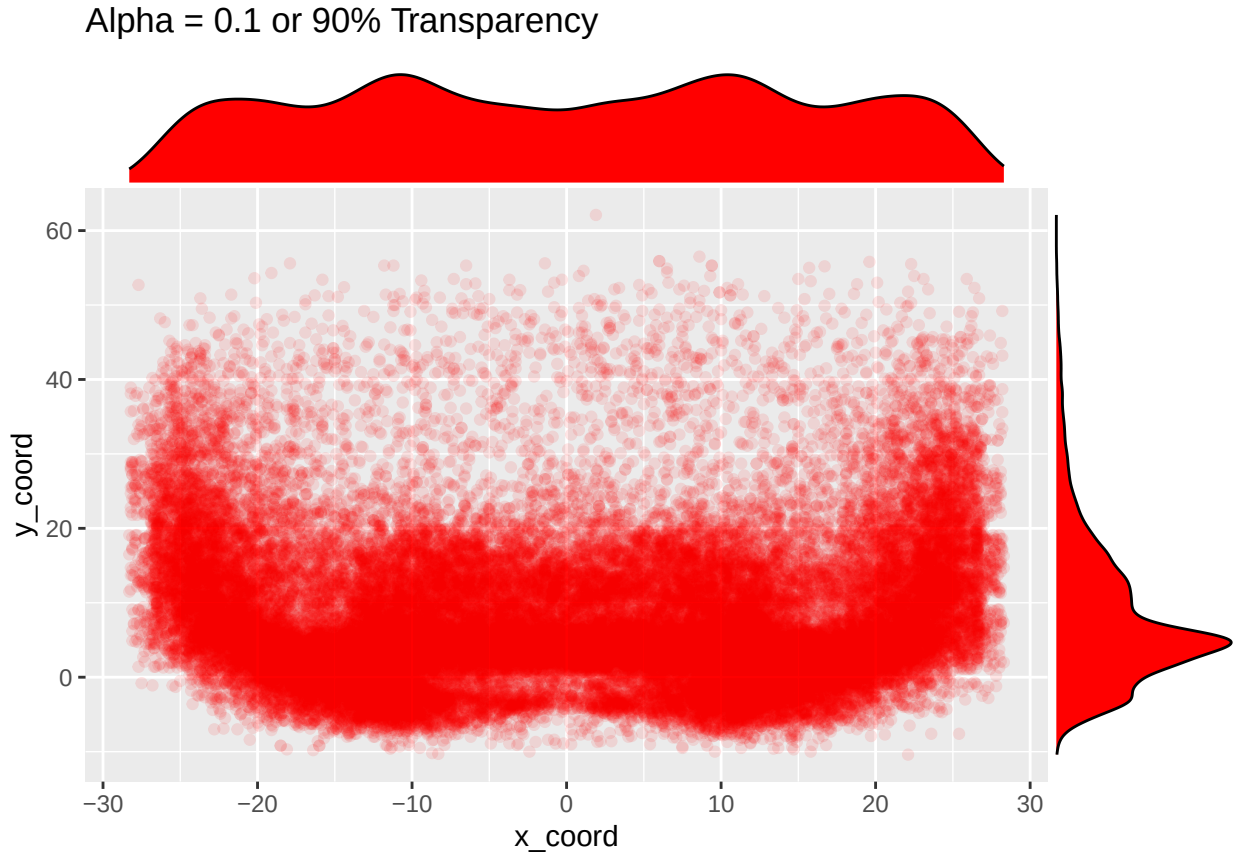
Add Transparency to try to visualize most common throws

```
red_beard <- df %>%
  ggplot(aes(x_coord,y_coord)) +
  geom_point(alpha = 0.1, color = 'red') +
  labs(title = 'Alpha = 0.1 or 90% Transparency')

red_beard_ratio <- df %>%
  ggplot(aes(x_coord,y_coord)) +
  geom_point(alpha = 1/20, color = 'red') +
  labs(title = 'Alpha = 1/20 so 20 points must be stacked')

red_beard + red_beard_ratio
```



Add Marginal Plots to further help visualize

```
ggMarginal(red_beard, type = 'density', fill = 'red')
```

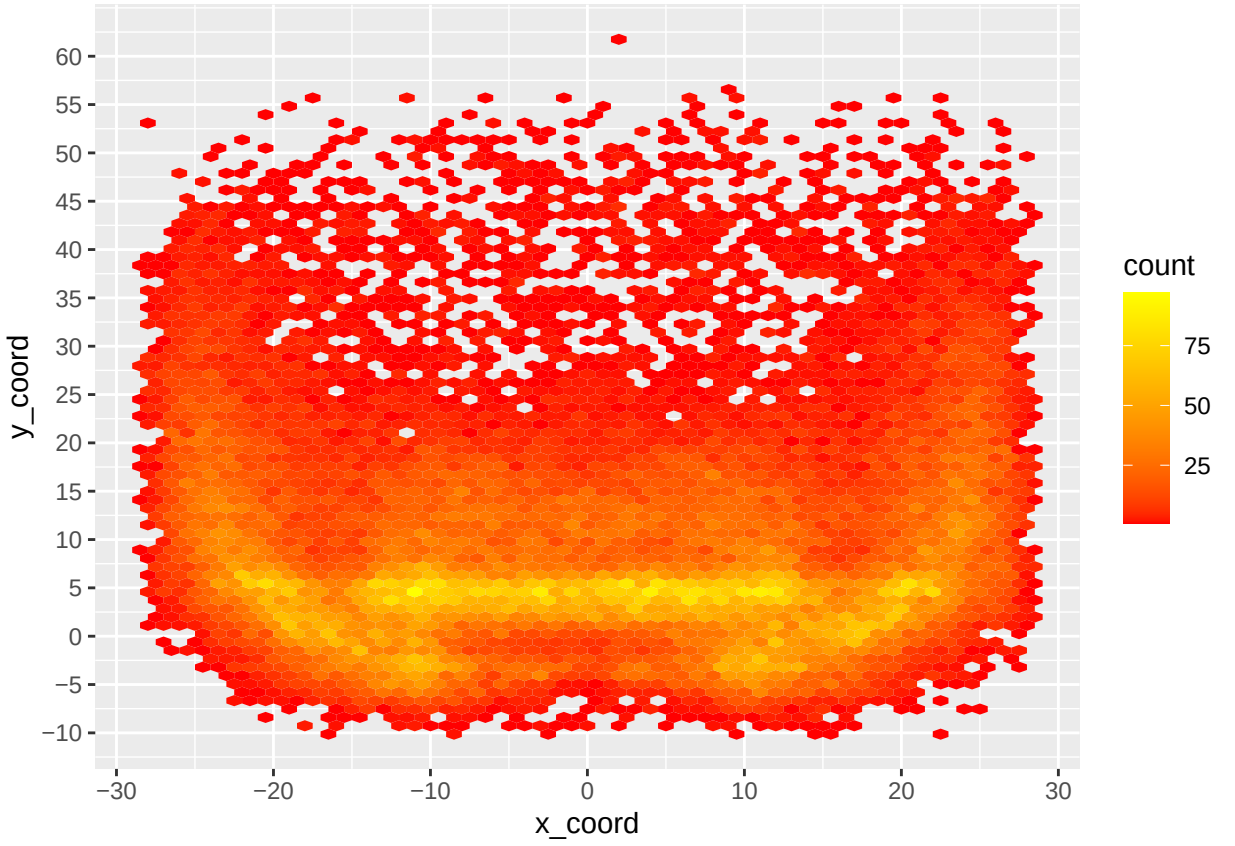



```
ggMarginal(red_beard, type = 'histogram', fill = 'red')
```

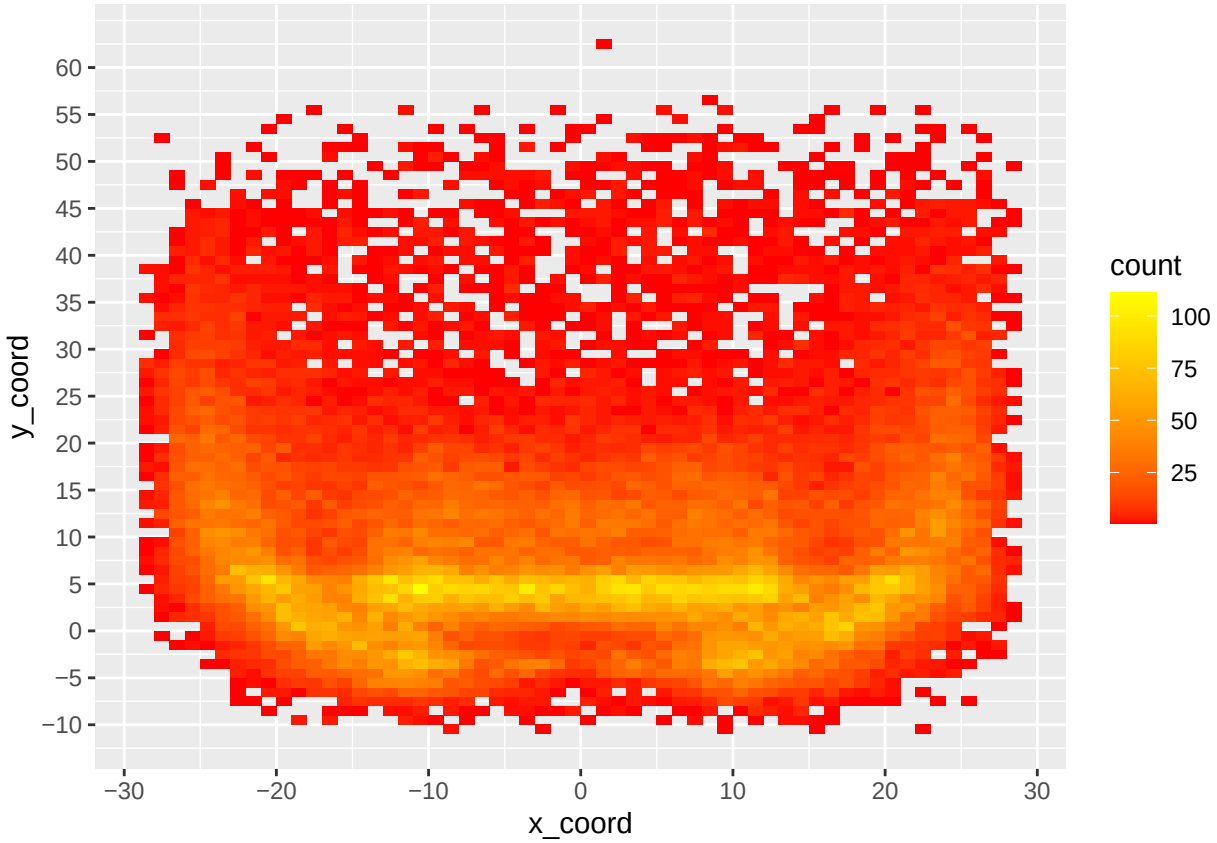
2D Density Alternatives

Since we are actually interested in the density of passes at each coordinate, it makes sense to bin each coordinate and use a hex plot or bin2d

```
hex_plot <- df %>%
  ggplot(aes(x_coord, y_coord)) +
  geom_hex(binwidth = c(1,1)) +
  scale_fill_gradient(low = 'red', high = 'yellow') +
  scale_y_continuous(breaks = seq(-10,60,5))

hex_plot
```




```
bin2d <- df %>%
  ggplot(aes(x_coord, y_coord)) +
  geom_bin2d(binwidth = c(1,1)) +
  scale_fill_gradient(low = 'red', high = 'yellow') +
  scale_y_continuous(breaks = seq(-10,60,5))

bin2d
```



We can see the majority of passes are thrown between 2-7 yards.

Examining Most Common DOTs

Histogram of just Y DOT

```
df %>%
  ggplot(aes(y_coord)) +
  geom_histogram(binwidth = 1) +
  scale_x_continuous(breaks = seq(-10,60,5))
```

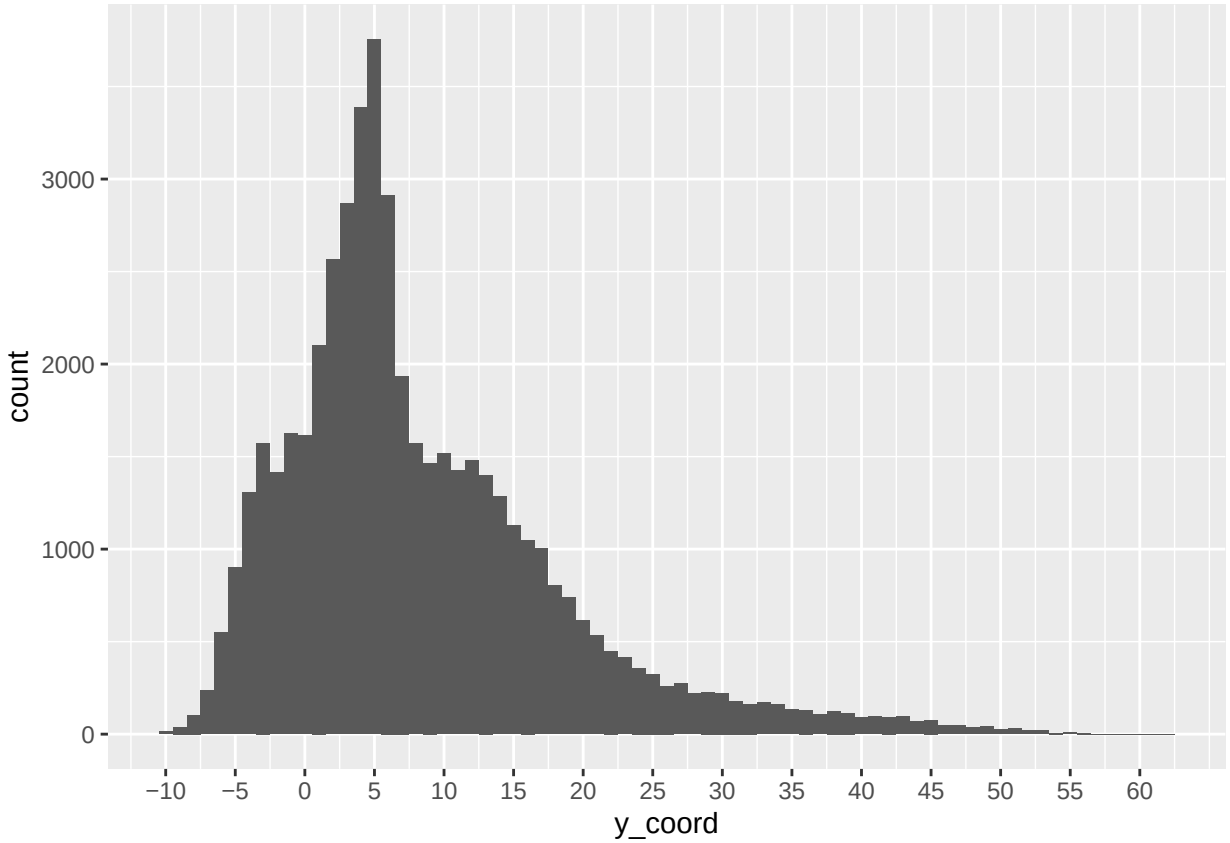


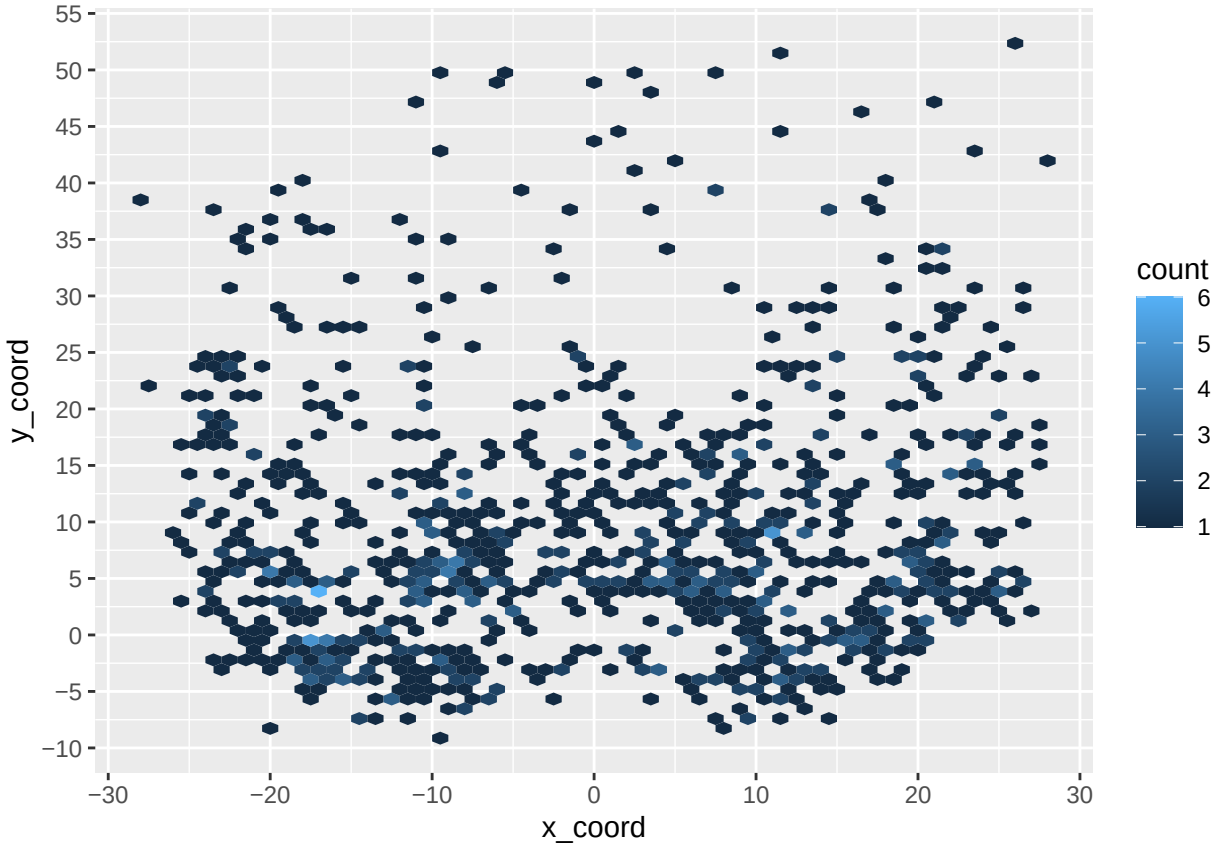
Table of most common DOT

Plotting only Mahomes

```
mahomes <- df %>%
  filter(str_detect(name, c('Mahomes')))
```

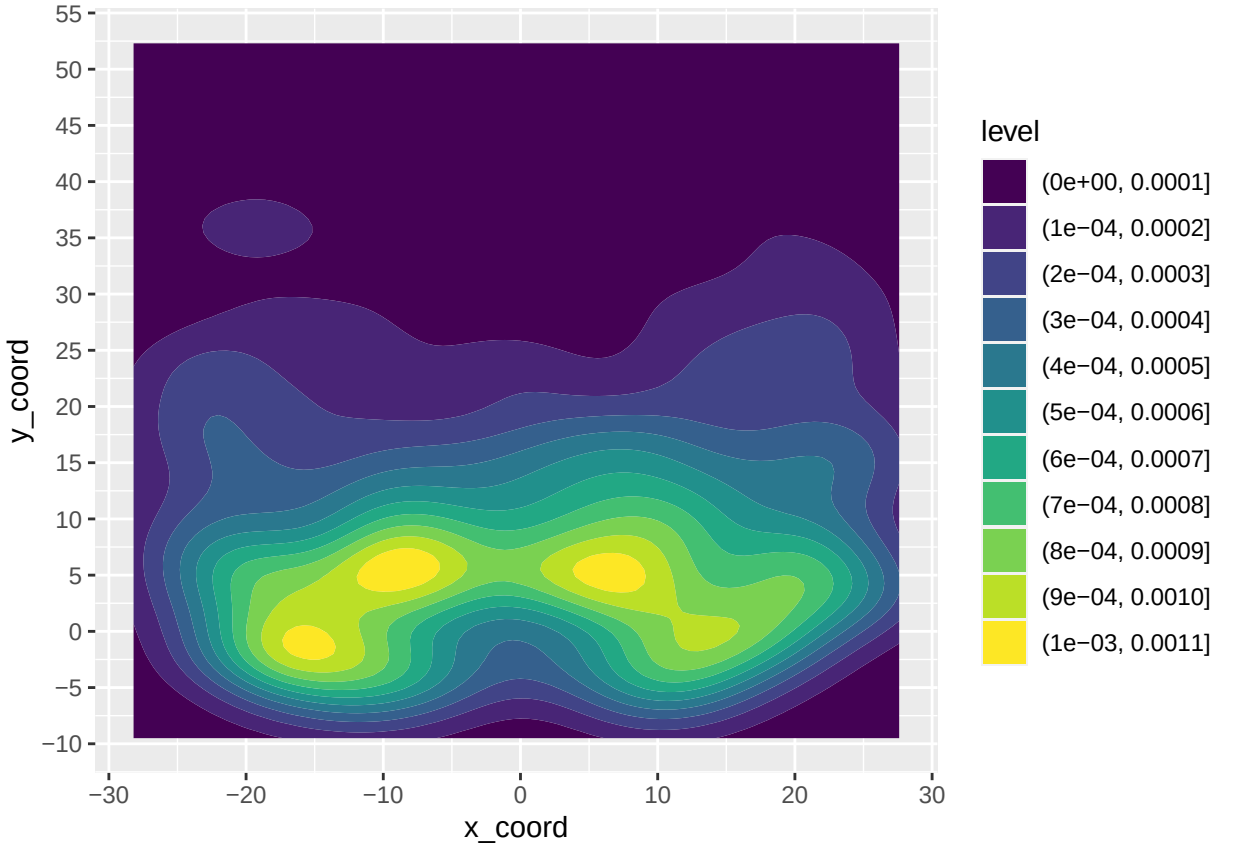
With fewer observations, harder to determine overall trend:

```
mahomes %>%
  ggplot(aes(x_coord, y_coord)) +
  geom_hex(binwidth = c(1,1)) +
  scale_y_continuous(breaks = seq(-10,60,5))
```



Solution: 2D Density Plot

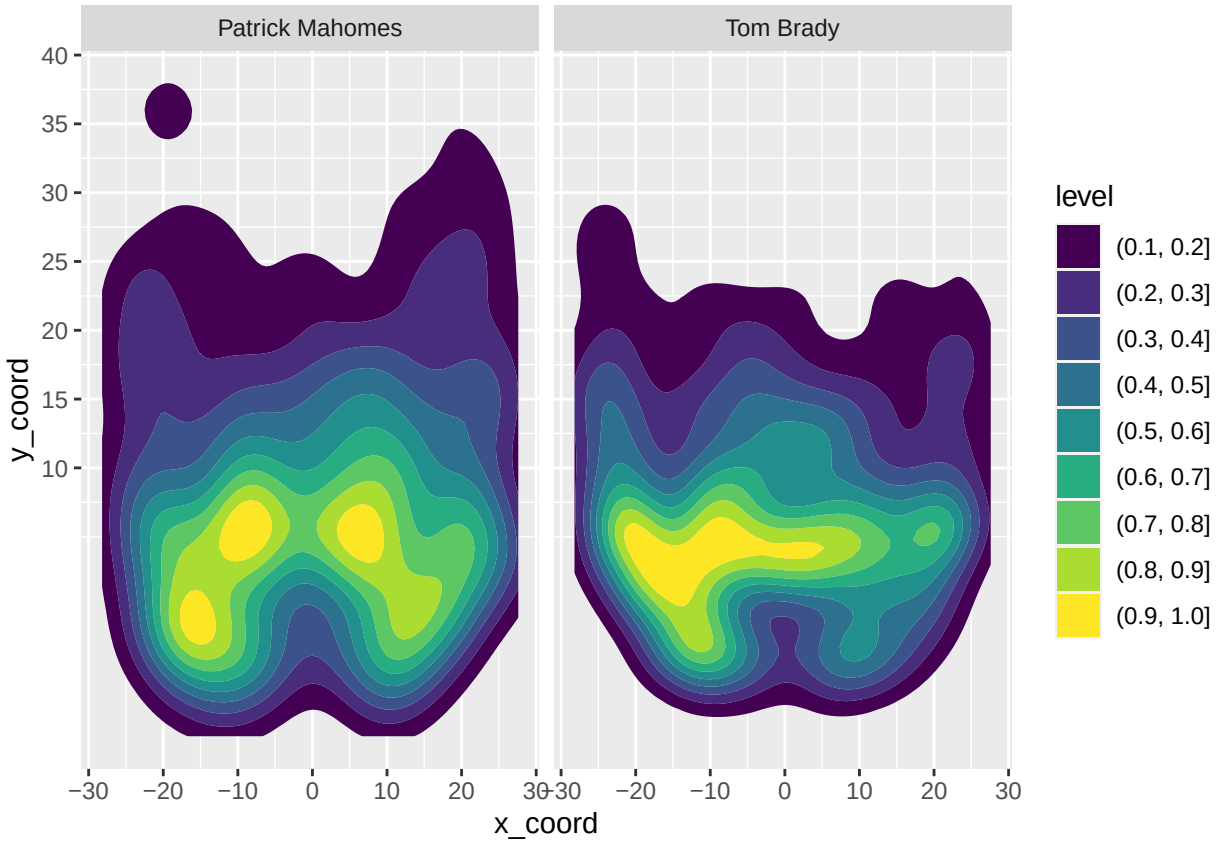
```
mahomes %>%
  ggplot(aes(x_coord,y_coord)) +
  geom_density_2d_filled() +
  scale_y_continuous(breaks = seq(-10,60,5))
```



We can use this to compare 2 different QBs. Normalize by number of throws, drop least frequent areas.

Mahomes vs. Brady

```
df %>%
  filter(str_detect(name, c('Mahomes|Brady'))) %>%
  ggplot(aes(x_coord,y_coord)) +
  geom_density_2d_filled(
    aes(fill = ..level..),
    contour_var = 'ndensity', # normalize
    breaks = seq(0.1,1, length.out = 10) # drop least frequent
  ) +
  scale_y_continuous(breaks = seq(10,60,5)) +
  facet_wrap(~name)
```



Build a Football Field

```
not_div_5 <- function(x) {
  x[x %% 5 != 0]
}

center_df <- tibble(
  x_coord = c(rep(-3.1, 60), rep(3.1, 60)),
  y_coord = seq(-14, 59, 1) %>% rep(2) %>% not_div_5(),
  text = "--"
)

# line labels
annotate_df <- tibble(
  x_coord = c(12.88, -12.88) %>% rep(each = 5),
  y_coord = seq(10, 50, 10) %>% rep(2),
  text = seq(10, 50, 10) %>% rep(2) %>% str_replace("(.)(.)", "\\1 \\2"),
  rotation = c(90, 270) %>% rep(each = 5)
)

# yardlines
yardline_df <- tibble(
  y = seq(-15, 60, 5),
```

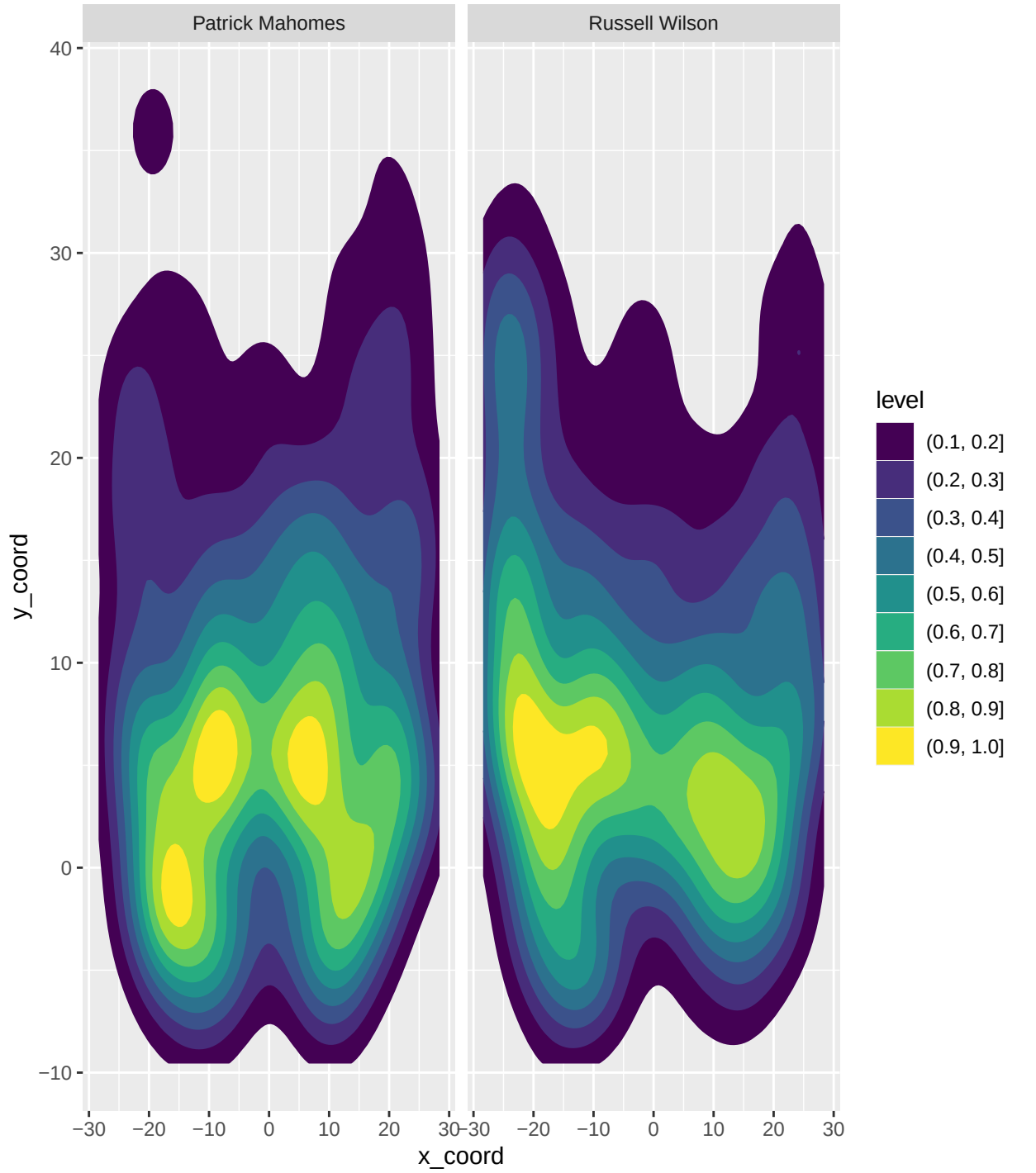
```
  yend = seq(-15, 60, 5),
  x = rep(-56 / 2, 16),
  xend = rep(56 / 2, 16)
)

# sidelines
sideline_df <- tibble(
  y = c(-15.15, -15.15),
  yend = c(60.15, 60.15),
  x = c(-56 / 2, 56 / 2),
  xend = c(-56 / 2, 56 / 2)
)



add_field <- function() {
  list(
    coord_cartesian(
      xlim = c(-53.333 / 2, 53.333 / 2),
      ylim = c(-15, 60)
    ),
    geom_text(
      data = annotate_df, aes(label = text, angle = rotation),
      color = front_col, size = 8
    ),
    geom_segment(
      data = yardline_df, color = front_col, size = 1,
      aes(x = x, y = y, xend = xend, yend = yend)
    ),
    geom_segment(
      x = -56 / 2, y = 0, xend = 56 / 2, yend = 0,
      color = "blue", size = 1, alpha = 0.5
    ),
    geom_segment(
      data = sideline_df, color = front_col, size = 2,
      aes(x = x, y = y, xend = xend, yend = yend)
    ),
    geom_text(
      data = center_df,
      aes(label = text), color = front_col, vjust = 0.32
    ),
    theme_void(),
    theme(
      strip.text = element_text(size = 20, color = front_col),
      plot.background = element_rect(fill = back_col, color = NA),
      legend.position = "none",
      plot.margin = unit(c(2, 1, 0.5, 1), unit = "cm"),
      plot.caption = element_text(color = front_col),
      plot.title = element_text(color = front_col),
      plot.subtitle = element_text(color = front_col),
      panel.background = element_rect(fill = back_col, color = NA),
      panel.border = element_blank()
    )
```

```
  )
}
```

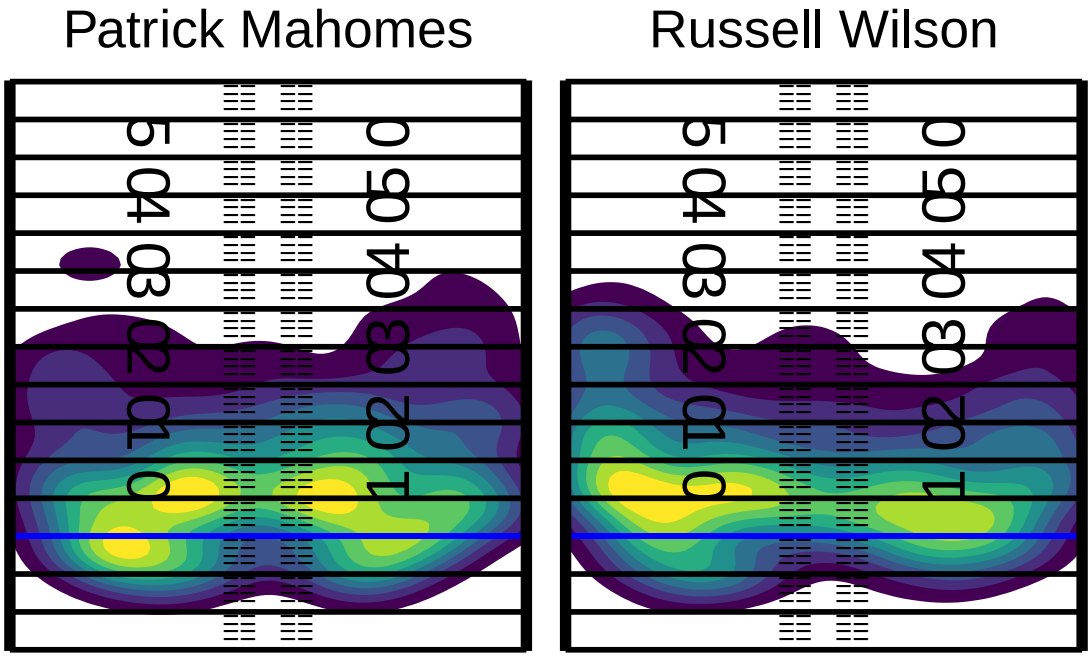
Mahomes vs Wilson

```
passer_df <- df %>%
  filter(str_detect(name, c('Mahomes|Russell'))) %>%
  mutate(name = factor(name, levels = c('Patrick Mahomes', 'Russell Wilson'))) %>%
  select(name, x_coord, y_coord)
```

```
pass_map <- passer_df %>%
  ggplot(aes(x_coord, y_coord)) +
  geom_density_2d_filled(
    aes(fill = ..level.., color = ..level..),
    contour_var = 'ndensity',
    breaks = seq(.1,1,length.out = 10)
  ) +
  facet_wrap(~name)

pass_map
```




```
back_col <- 'white'
front_col <- 'black'

pass_map +
  add_field()
```

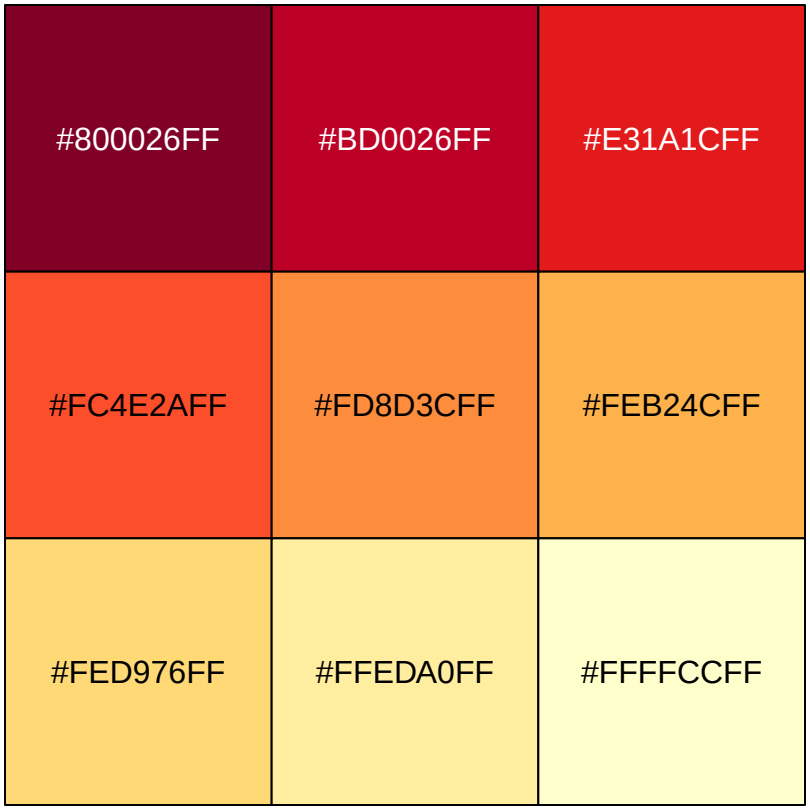


Specify Color Schemes

```
heat_colors <- grDevices::colorRampPalette(c("#800026FF", "#FC4E2AFF", "#FEB24CFF", "#FFFFCCFF"))(10)

heat_palette <- paletteer::paletteer_d("RColorBrewer::YlOrRd", n = 9, direction = -1)

heat_colors_interpolated <- colorRampPalette(paletteer::paletteer_d("RColorBrewer::YlOrRd", n = 9, dire

heat_colors %>% scales::show_col()
```

#800026	#A91A27	#D23428	#FC4E2A
#FC6F35	#FD9040	#FEB24C	#FECB76
#FEE5A1	#FFFFCC		

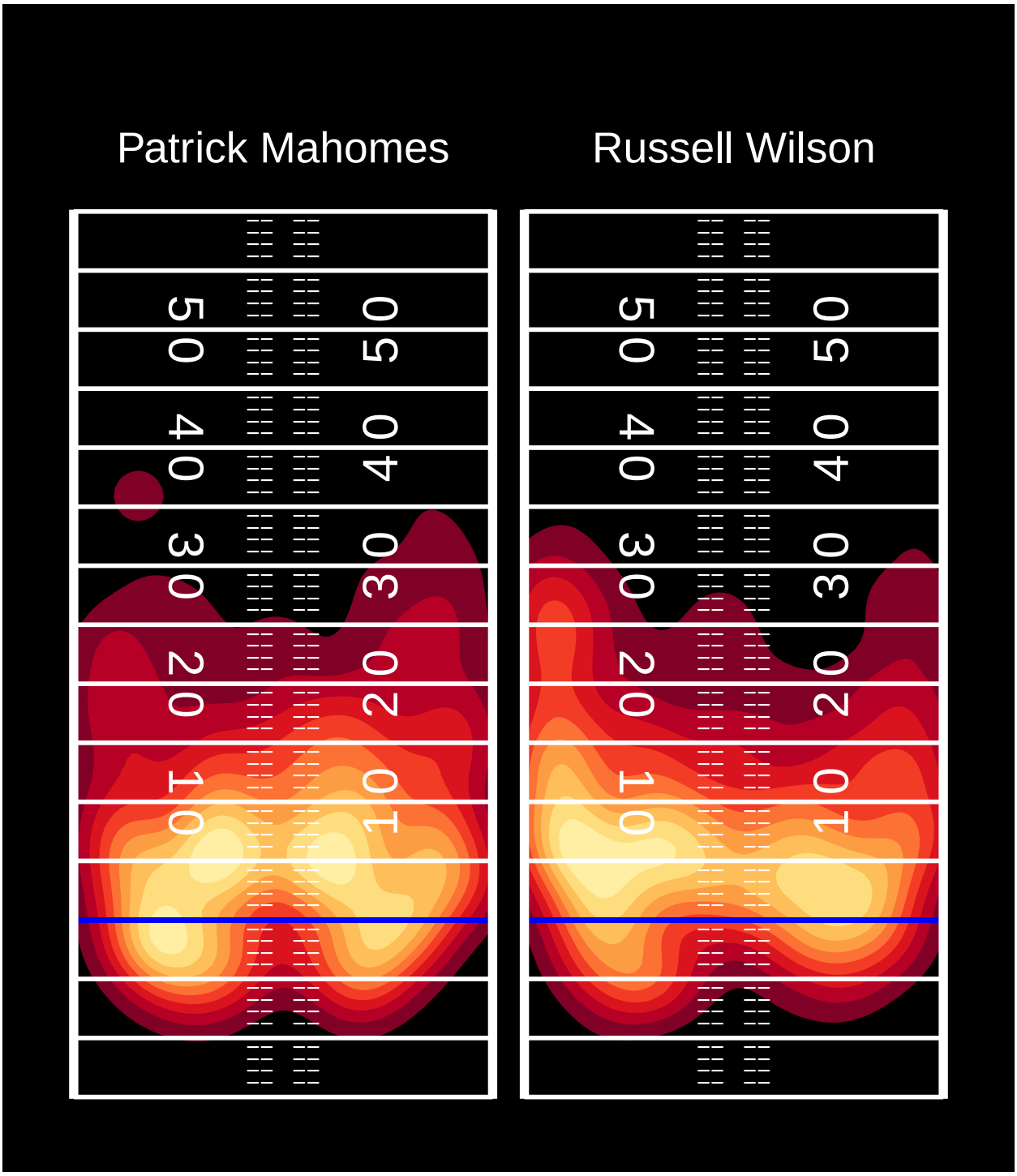
```
heat_palette %>% scales::show_col()
```




```
heat_colors_interpolated %>% scales::show_col()
```

#800026	#B60026	#DA141E	#F33C25
#FC7134	#FD9D43	#FEBE59	#FEDD7F
#FFEFA4	#FFFFCC		

```
back_col <- "black"
front_col <- "white"

pass_map +
  add_field() +
  scale_fill_manual(values = c(heat_colors_interpolated), aesthetics = c("fill", "color"))
```


Patrick Mahomes
Russell Wilson