Poise or Panic? Breaking Down QB Pressure

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Take a look at these two plays

Tom Brady

199th Overall Pick

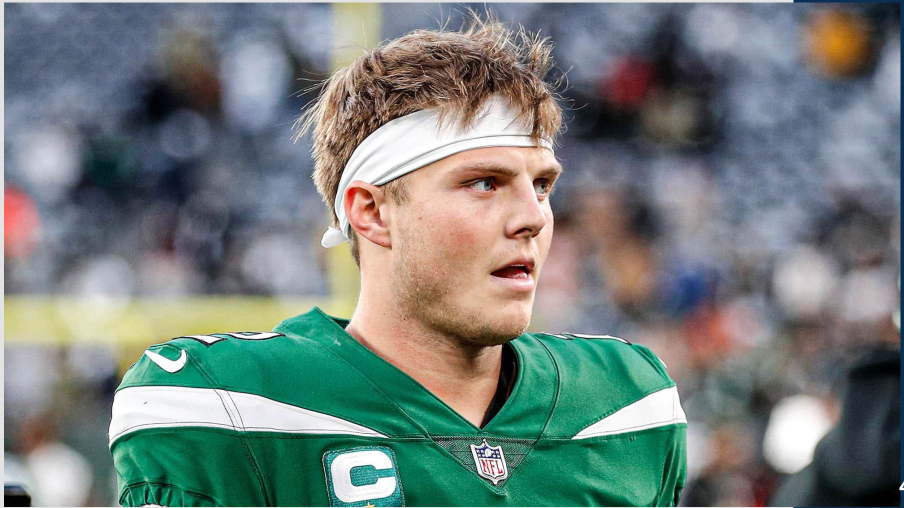
Zach Wilson

2nd Overall Pick

How do we quantify QB performance against pressure?

Importance

- QBs perform differently under pressure
- QB performance under pressure defines outcomes of games



Pressure Score Formula

- Multivariable regression model
- Bin into clean, medium, and high pressure situations

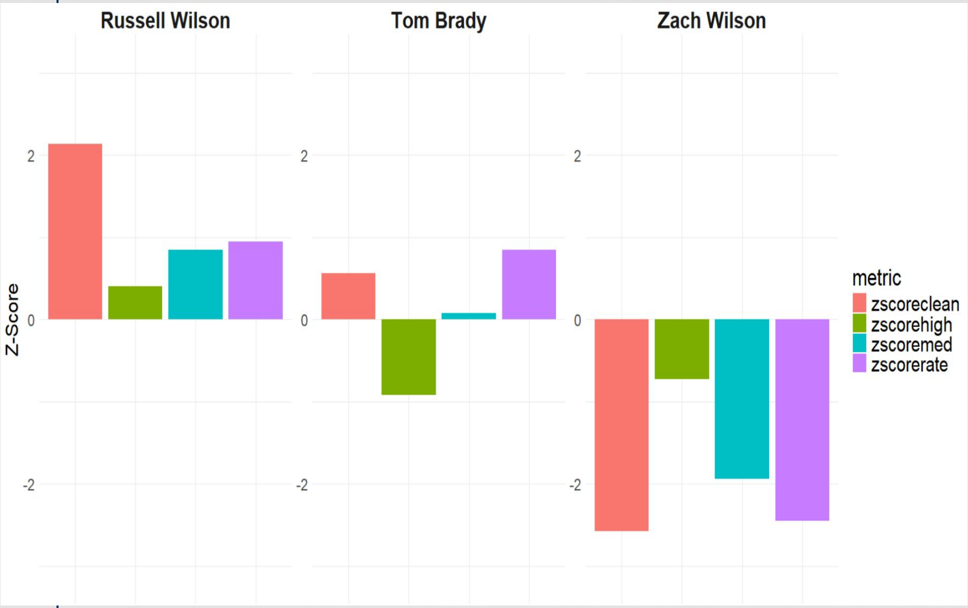
```
Call:
lm(formula = passer_rating_play ~ (hurries) + (hits) + (beatsbydef)
    data = per_play_stats)

Residuals:
    Min      1Q  Median      3Q     Max
-81.662 -40.150   7.767  32.767  71.145

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  79.7331     0.5162 154.449   <2e-16 ***
hurries      -8.0321     0.7860 -10.220   <2e-16 ***
hits        -10.8826     1.3057  -8.335   <2e-16 ***
beatsbydef    0.9643     0.8136   1.185    0.236
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 34.25 on 7126 degrees of freedom
Multiple R-squared:  0.02484,	Adjusted R-squared:  0.02443
F-statistic:  60.5 on 3 and 7126 DF,  p-value: < 2.2e-16
```

```
pressure_score = hits * 10.88 + hurries * 8.03
```

Using bins to separate levels of pressure

Pressure Score	**Pressure Level**
0	Clean Pocket
(0, 15]	Medium Pressure
(15, ∞)	High Pressure

Standardized Passer Rating

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0.02484 = R-Squared

Discrete outcomes result in model being less interpretable

We can’t see everything using hits, hurries, beats.

Past Work

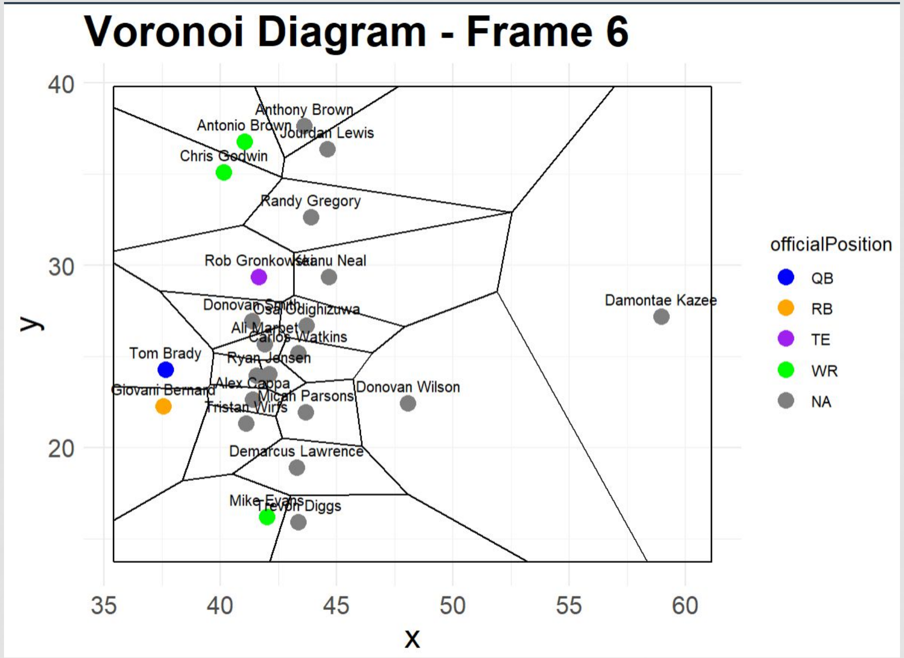
- Ibrahim (2021)
    - Offensive Line & QB Voronoi data to estimate protection levels
    - Binning system
    - Modeled duration in which space remained unchanged
- STRAIN - Nguyen, Yurko, Matthews (2023)
    - Based on strain rate in material science
    - Developed to rank pass rushers
- Our goal: combine these ideas to quantify QB performance under pressure

Voronoi Diagrams

Using Voronoi diagrams to measure rate of change in pocket area

Voronoi Overview

- Partitions based on players
- QB Region can be used to measure “pocket” space



Example Play - Cowboys vs. Buccaneers (Week 1, 2021)

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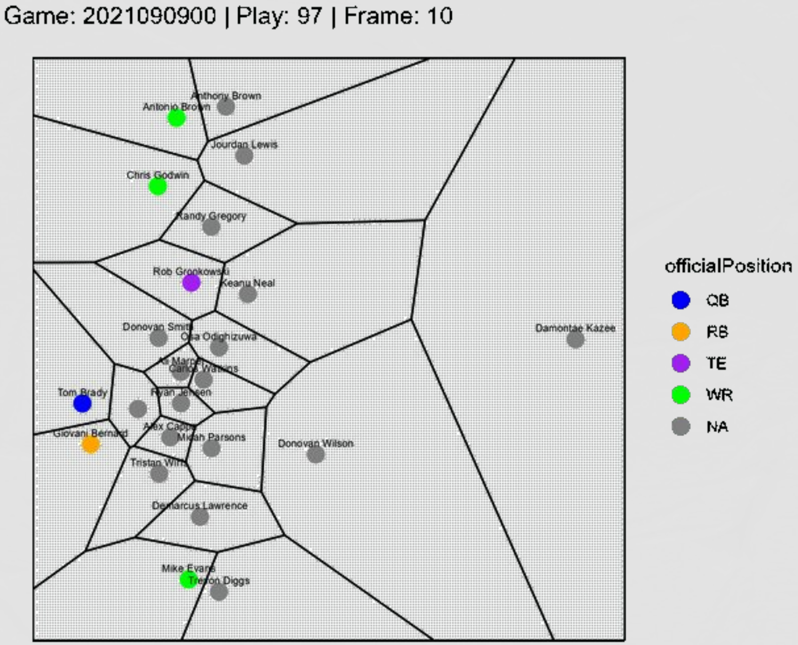
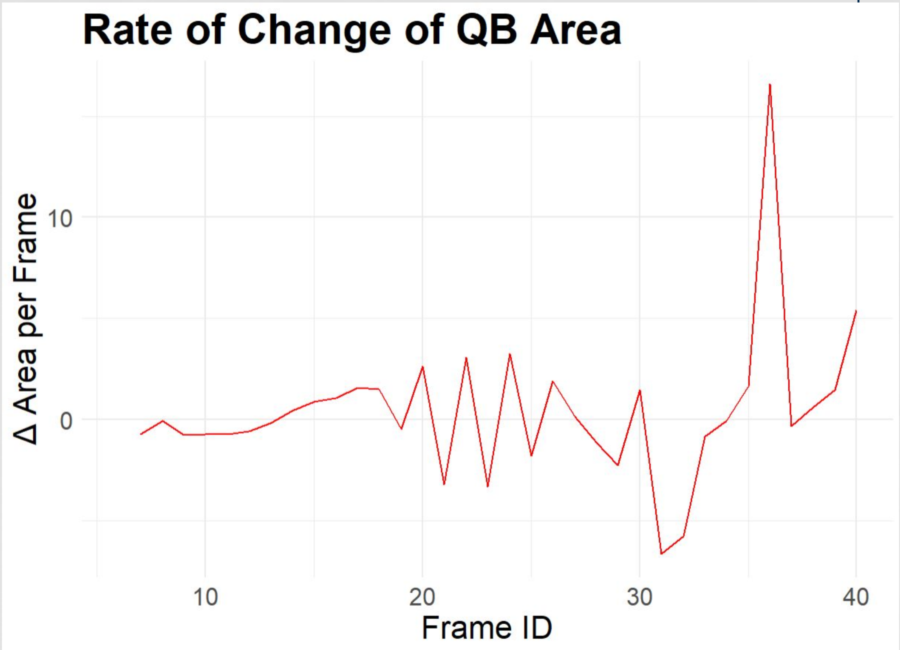
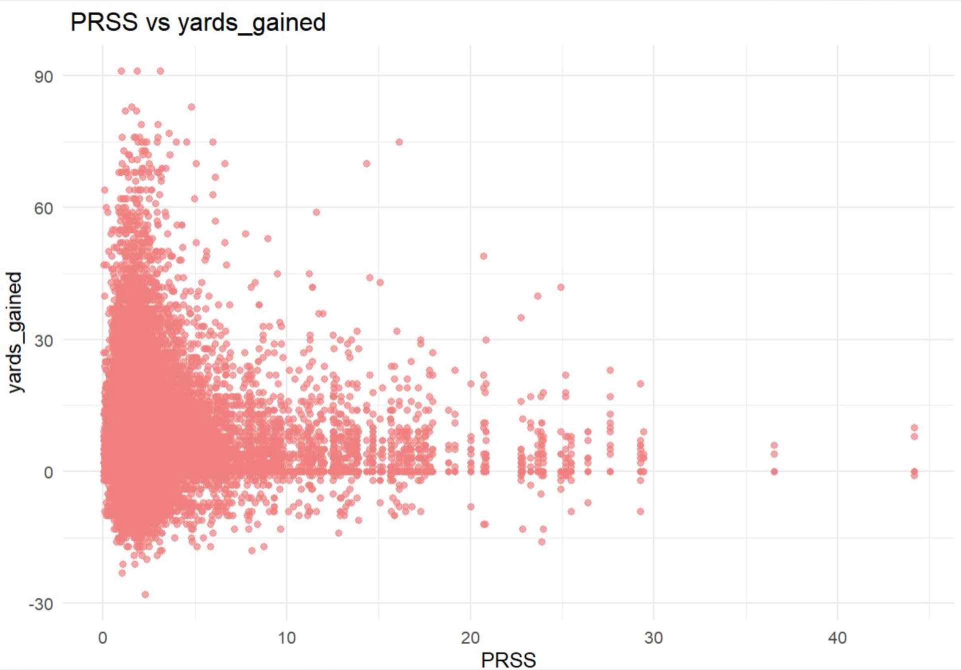




PRSS - Pocket Reduction Speed Score

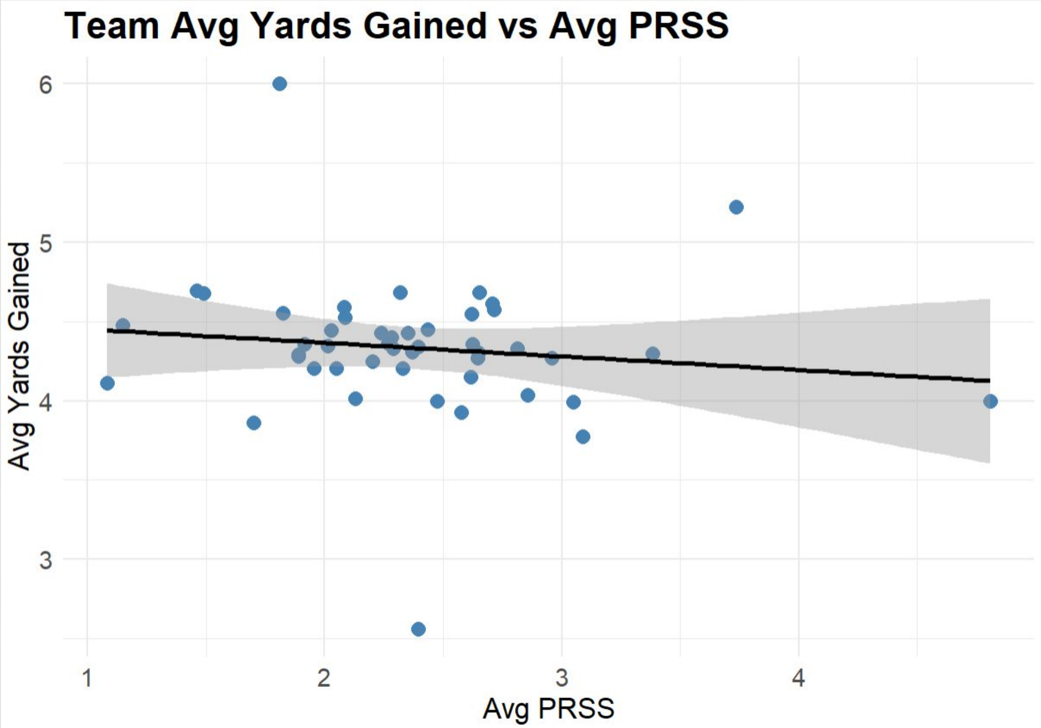
Maximum Negative Change in Pocket Area

Early Attempts



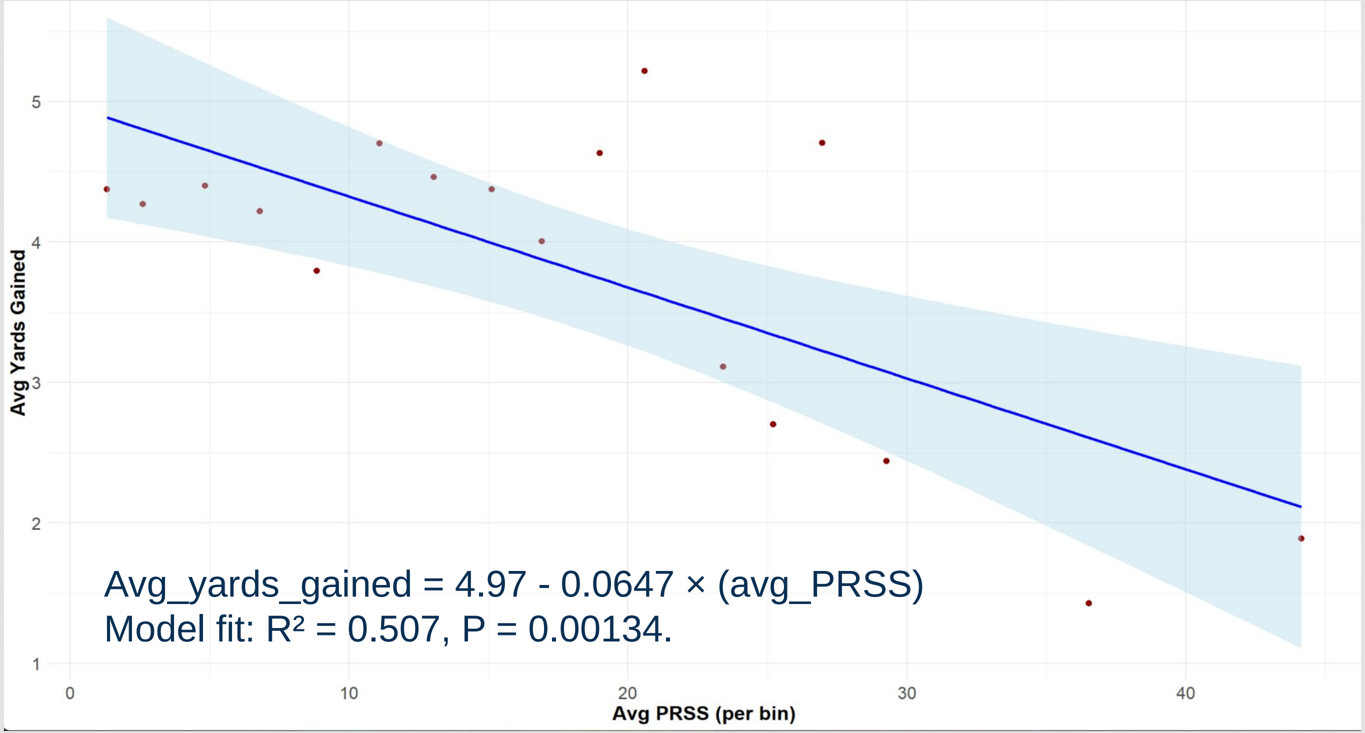
- Plotting the raw data looks a bit messy
- Lower PRSS does seem to be associated with more yards gained though

Early Attempts



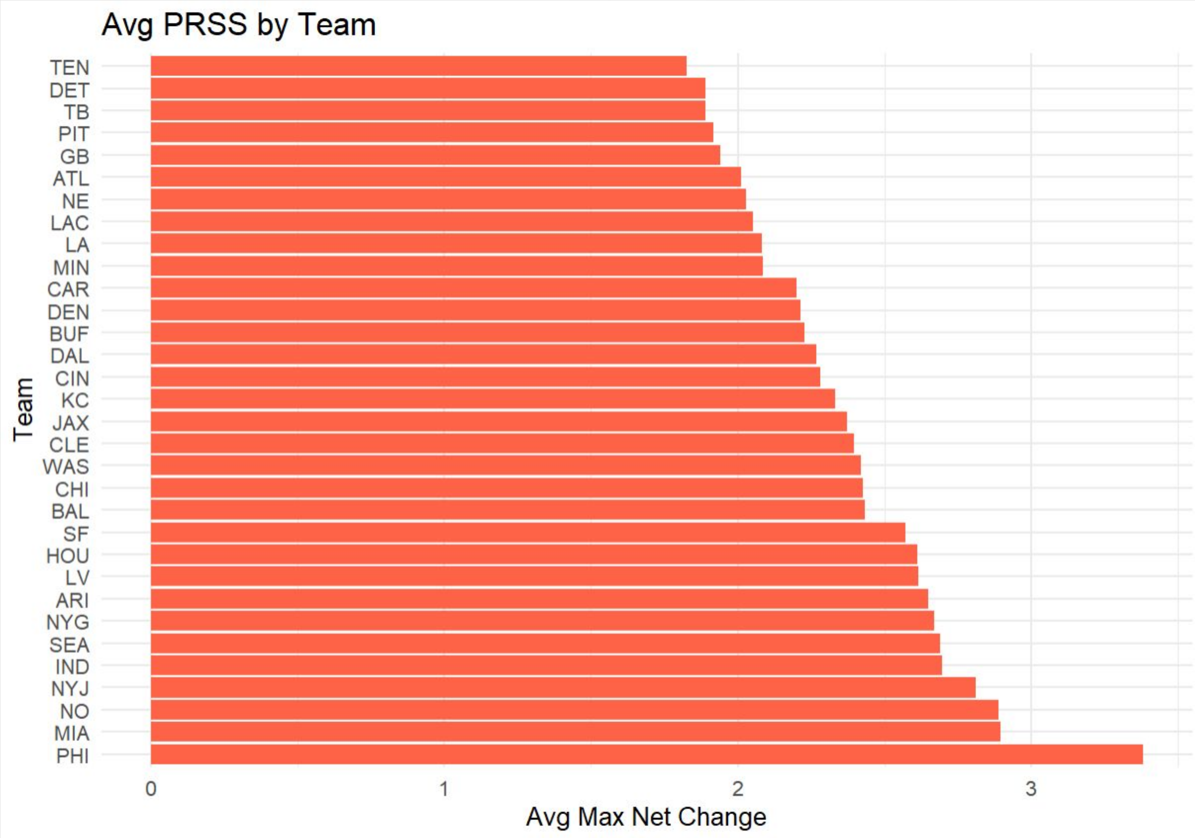
- Averaging data by QB is a bit messy but might show some trend
    - Averaging reduces granularity of how specific lower and higher PRSS values will affect avg_yards_gained

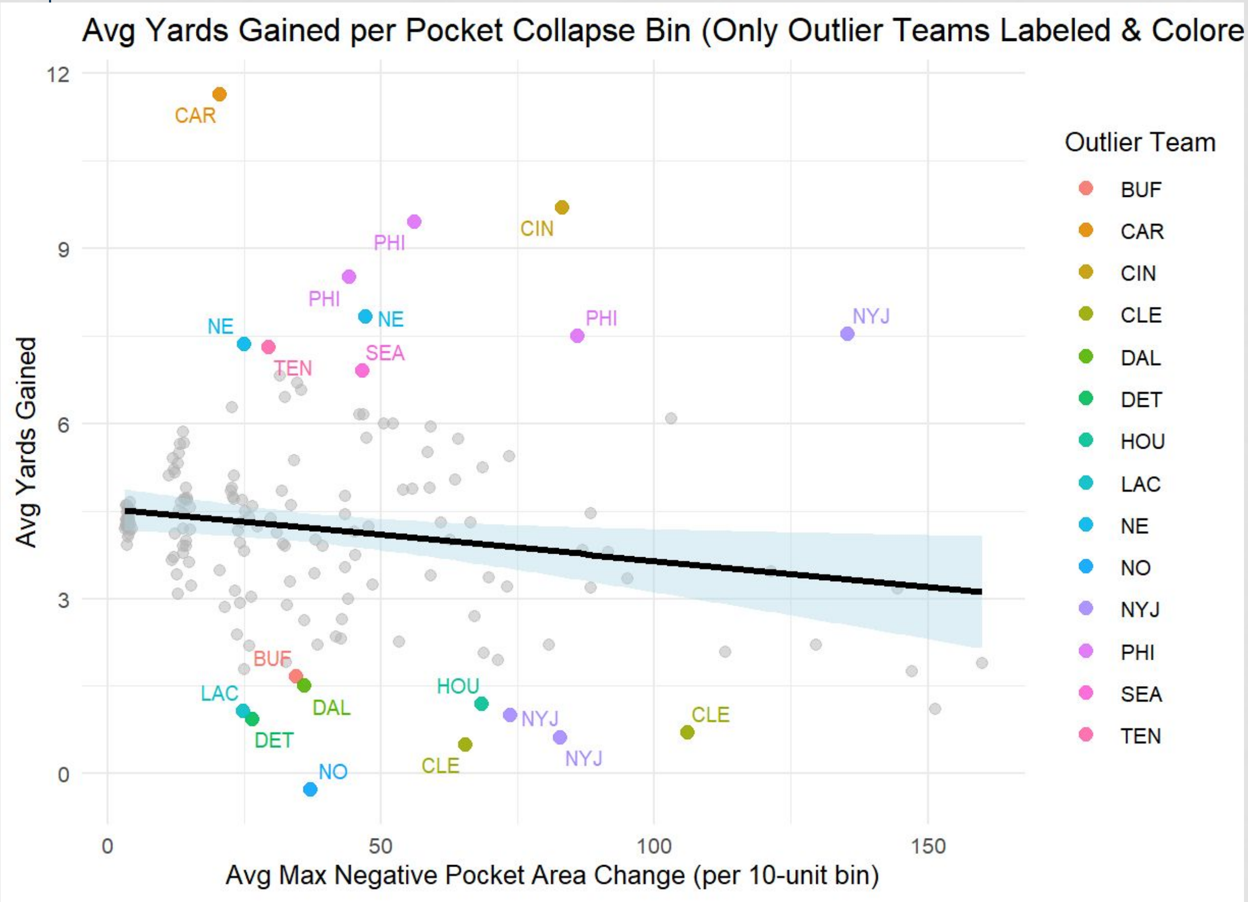
Binned Avg. PRSS (Voronoi) vs. Avg Yards Gained



- Binning increases interpretability of how PRSS affects passing
- Higher scores associated with fewer yards gained on a pass play

Avg. PRSS for Offensive Team





- Binned into increments of 10
- Calculated average yards gained within the bins
- Allows us to see which qb is outperforming / underperforming their o-line at specific PRSS levels.

PRSS Applications

- Using PRSS can determine which quarterbacks fare better under pressure
- Joe Burrow, Jalen Hurts, were high above the regression line and went on to be stars
- Using similar data can be used to judge college prospects

Analyzing College Prospects using PRSS

- Handling pressure is the hardest aspect for college athletes to transition to the NFL

Next Steps for PRSS

- Apply PRSS to Full-Season Data
- Apply to Draft Preparation and Free Agency
- Explore Correlation with More Advanced QB Stats

Thank You!

Methods

- Gather freeze frames of all players per play
- Generate Voronoi diagrams for each freeze frame until the pass using deldir package in R
- Calculate QB pocket area change and QB pocket area *rate of change* (PRSS)
- Gather conclusions for QB performance and PRSS