

A Deeper Understanding of Quarterback Pressure in Football

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Affecting quarterback play is both critical and achievable. Impact plays:

- ▶ Sack
- ▶ Knockdown
- ▶ Hits
- ▶ Hurry?
- ▶ Pressure?



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Definition of pressure:

- ▶ Affecting quarterback play by decreasing the pocket area, causing expedited decision making or a sub-optimal outcome



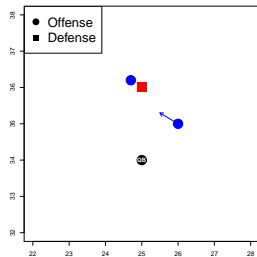
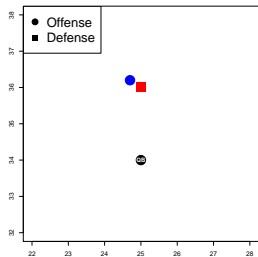
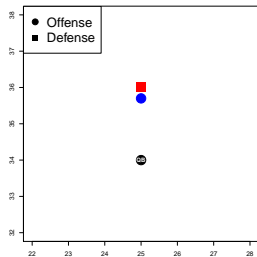
Issues with current methods:

- ▶ Binary outcomes
- ▶ Cannot differentiate based on quality of opponent
- ▶ Quarterback may not optimally use that space

Pocket Pressure:

- ▶ Expected pocket region
- ▶ Area of the expected pocket attributed to each player
- ▶ Quarterback contribution to pressure based on actual location relative to optimal location

Not all “Pressure” is created equal

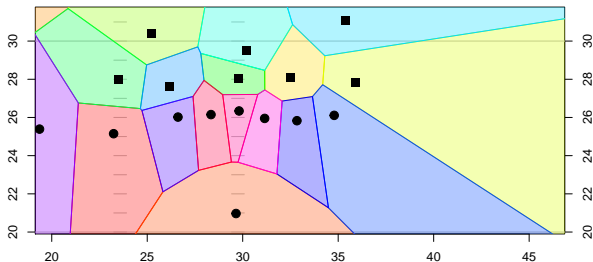


Voronoi Tessellations



Real estate around the quarterback (the “pocket”) defines the success of the offensive line.

- ▶ Voronoi tessellations = area for each player/team

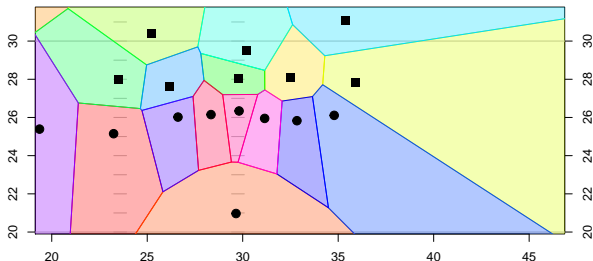


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Issue:

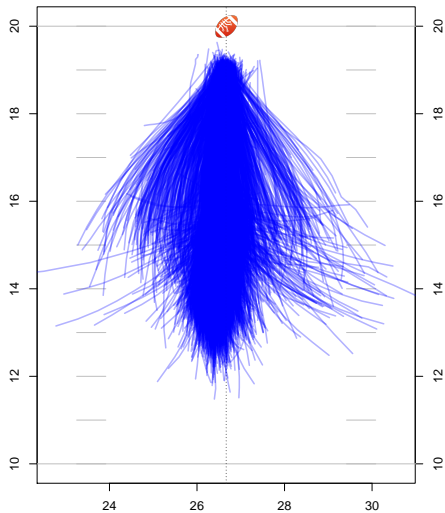
- ▶ What is the “expected” pocket?



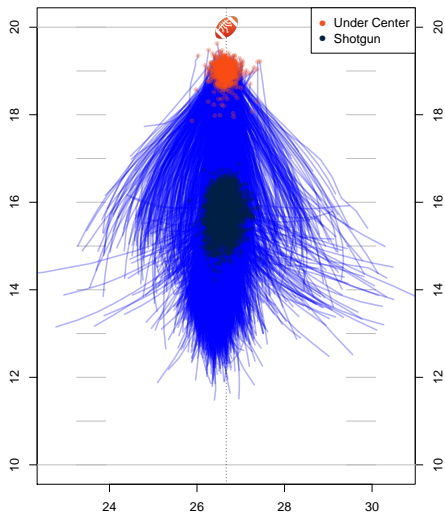
Ideal pocket location is relative to the quarterback location and the play-call.

- ▶ Does it matter if the quarterback is under center or in shotgun?
- ▶ What is the quarterback depth and how quickly is it obtained?
- ▶ What about motion and roll-outs?

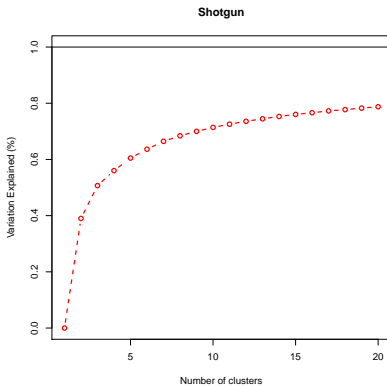
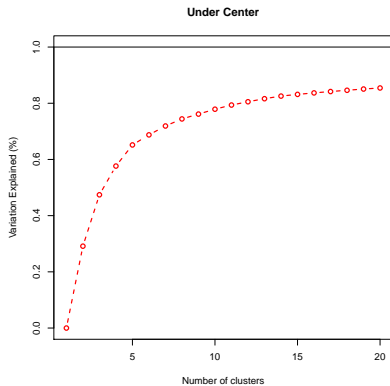
Use quarterback clusters to subset the plays used for expected pocket calculation.



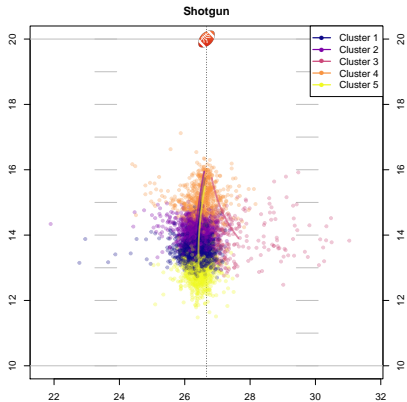
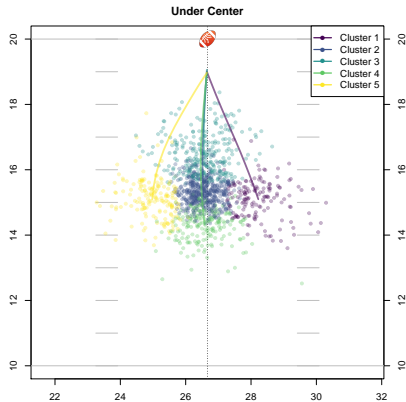
QB Path



K-means Clustering



QB Path Clusters



Shotgun - Cluster 5



Under Center - Cluster 1



Expected Pockets - Under Center



Expected Pockets - Shotgun



Pole-of-inaccessibility



Pole-of-inaccessibility:

- ▶ Location that is the most difficult to reach based on a set of criteria
- ▶ Optimization: maximize distance between a point and a polygon

Challenge:

- ▶ Doesn't account for temporal dependence in QB location

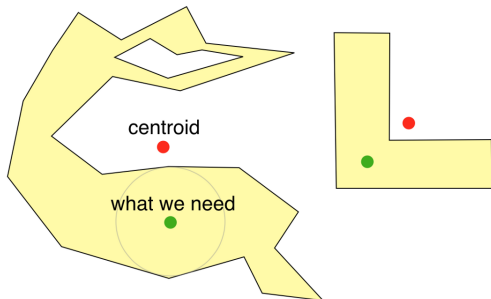


Image courtesy of blob.mapbox.com



Modified algorithm:

- ▶ Construct an extended pocket polygon (extend to OTs and beyond the QB)
- ▶ Generate uniformly distributed points that cover the offensive real estate
- ▶ Run K-Means and collect cluster centers (candidate sequences)
- ▶ For each center, compute the distance to the nearest edge of the polygon
- ▶ Use Viterbi algorithm to simultaneously maximize QB distance from defenders and minimize sequential movement

Objective Function:

- ▶ $\sum_t (\text{distance to edge of pocket})_t - \alpha * (\text{distance from previous point})_t$
 - ▶ α is a tuning parameter

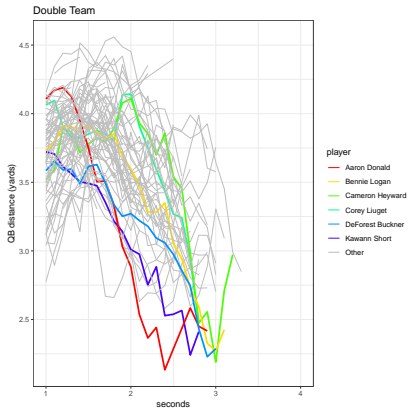
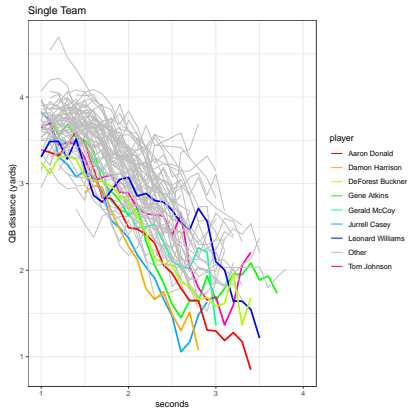
NE vs. KC



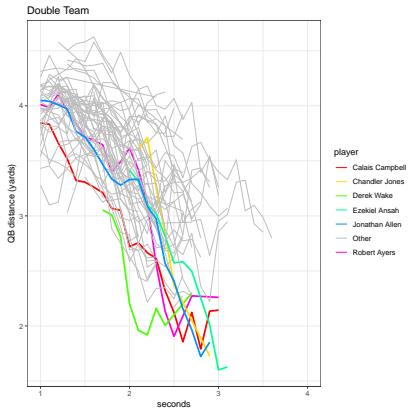
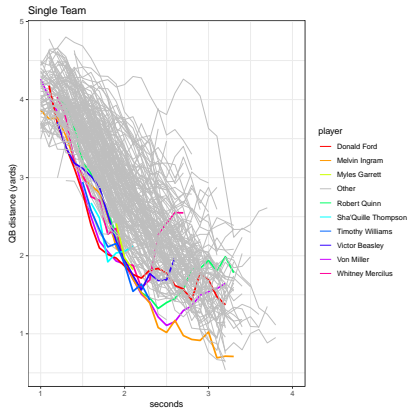
AZ vs. TB



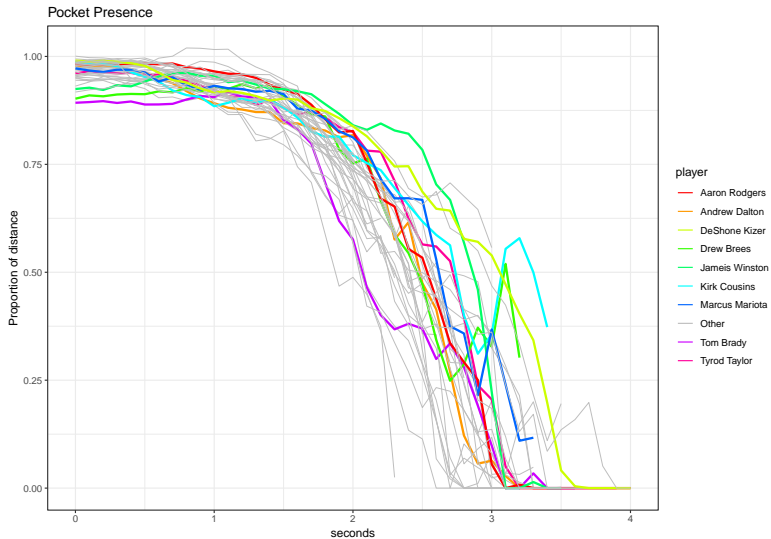
Pocket Pressure - DT



Pocket Pressure - *EDGE*



Pocket Presence





Conclusion:

- ▶ Our methodology allows us to
 - ▶ Provide a continuous, non-stationary measure of pressure
 - ▶ Scale according to the average competitor
 - ▶ Adjust for quarterback pocket presence
 - ▶ Create pressure region profiles (not shown)

Future Work

- ▶ Propagate error in expected pocket
- ▶ Scramble ability metric



For more information, visit **DeepFootball.com**

Thank you!