The Data Science of Quarterback Scouting

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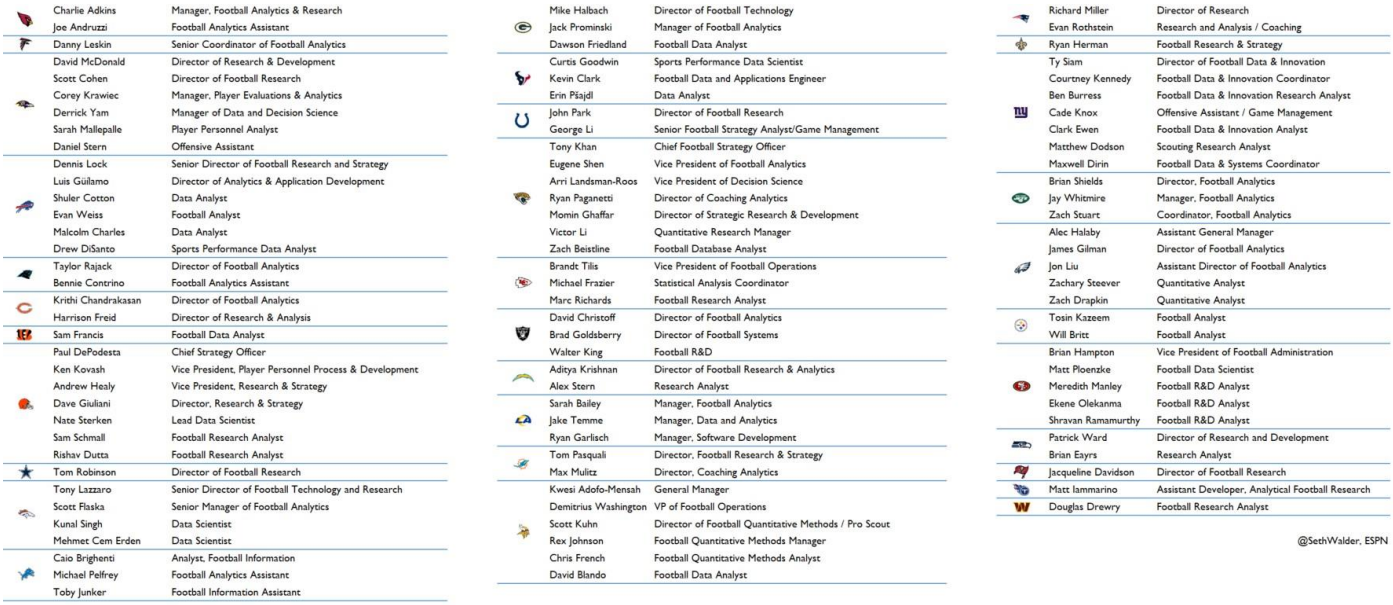
*Stats updated to the 2022 offseason

Introduction

When looking at data analysis in sports, there is a spike in the usage of 'next gen statistics' after the Oakland A's Moneyball era in baseball. While teams like the A's and Red Sox began a race to spend their money as efficiently as possible through the practice of data science, professional teams outside the MLB are much slower to the punch. In fact, data analysis still has a ton of room to grow within the NFL. Take a look at this chart via Seth Walder (@sethwalder):



Charlie Adkins	Manager, Football Analytics & Research
Joe Andruzzi	Football Analytics Assistant
Danny Leskin	Senior Coordinator of Football Analytics
David McDonald	Director of Research & Development
Scott Cohen	Director of Football Research
Corey Krawiec	Manager, Player Evaluations & Analytics
Derrick Yam	Manager of Data and Decision Science
Sarah Mallepalle	Player Personnel Analyst
Daniel Stern	Offensive Assistant
Dennis Lock	Senior Director of Football Research and Strategy
Luis Güilamo	Director of Analytics & Application Development
Shuler Cotton	Data Analyst
Evan Weiss	Football Analyst
Malcolm Charles	Data Analyst
Drew DiSanto	Sports Performance Data Analyst
Taylor Rajack	Director of Football Analytics
Bennie Contrino	Football Analytics Assistant
Krithi Chandrakasan	Director of Football Analytics
Harrison Freid	Director of Research & Analysis
Sam Francis	Football Data Analyst
Paul DePodesta	Chief Strategy Officer
Ken Kovash	Vice President, Player Personnel Process & Development
Andrew Healy	Vice President, Research & Strategy
Dave Giuliani	Director, Research & Strategy
Nate Sterken	Lead Data Scientist
Sam Schmall	Football Research Analyst
Rishav Dutta	Football Research Analyst
Tom Robinson	Director of Football Research
Tony Lazzaro	Senior Director of Football Technology and Research
Scott Flaska	Senior Manager of Football Analytics
Kunal Singh	Data Scientist
Mehmet Cem Erden	Data Scientist
Caio Brighenti	Analyst, Football Information
Michael Pelfrey	Football Analytics Assistant
Toby Junker	Football Information Assistant
Mike Halbach	Director of Football Technology
Jack Prominski	Manager of Football Analytics
Dawson Friedland	Football Data Analyst
Curtis Goodwin	Sports Performance Data Scientist
Kevin Clark	Football Data and Applications Engineer
Erin Pšajdl	Data Analyst
John Park	Director of Football Research
George Li	Senior Football Strategy Analyst/Game Management
Tony Khan	Chief Football Strategy Officer
Eugene Shen	Vice President of Football Analytics
Arri Landsman-Roos	Vice President of Decision Science
Ryan Paganetti	Director of Coaching Analytics
Momin Ghaffar	Director of Strategic Research & Development
Victor Li	Quantitative Research Manager
Zach Beistline	Football Database Analyst
Brandt Tilis	Vice President of Football Operations
Michael Frazier	Statistical Analysis Coordinator
Marc Richards	Football Research Analyst
David Christoff	Director of Football Analytics
Brad Goldsberry	Director of Football Systems
Walter King	Football R&D
Aditya Krishnan	Director of Football Research & Analytics
Alex Stern	Research Analyst
Sarah Bailey	Manager, Football Analytics
Jake Temme	Manager, Data and Analytics
Ryan Garlisch	Manager, Software Development
Tom Pasquali	Director, Football Research & Strategy
Max Mulitz	Director, Coaching Analytics
Kwesi Adofo-Mensah	General Manager
Demitrius Washington	VP of Football Operations
Scott Kuhn	Director of Football Quantitative Methods / Pro Scout
Rex Johnson	Football Quantitative Methods Manager
Chris French	Football Quantitative Methods Analyst
David Blando	Football Data Analyst
Richard Miller	Director of Research
Evan Rothstein	Research and Analysis / Coaching
Ryan Herman	Football Research & Strategy
Ty Siam	Director of Football Data & Innovation
Courtney Kennedy	Football Data & Innovation Coordinator
Ben Burress	Football Data & Innovation Research Analyst
Cade Knox	Offensive Assistant / Game Management
Clark Ewen	Football Data & Innovation Analyst
Matthew Dodson	Scouting Research Analyst
Maxwell Dirin	Football Data & Systems Coordinator
Brian Shields	Director, Football Analytics
Jay Whitmire	Manager, Football Analytics
Zach Stuart	Coordinator, Football Analytics
Alec Halaby	Assistant General Manager
James Gilman	Director of Football Analytics
Jon Liu	Assistant Director of Football Analytics
Zachary Steever	Quantitative Analyst
Zach Drapkin	Quantitative Analyst
Tosin Kazeem	Football Analyst
Will Britt	Football Analyst
Brian Hampton	Vice President of Football Administration
Matt Ploenzke	Football Data Scientist
Meredith Manley	Football R&D Analyst
Ekene Olekanma	Football R&D Analyst
Shravan Ramamurthy	Football R&D Analyst
Patrick Ward	Director of Research and Development
Brian Eayrs	Research Analyst
Jacqueline Davidson	Director of Football Research
Matt Iammarino	Assistant Developer, Analytical Football Research
Douglas Drewry	Football Research Analyst

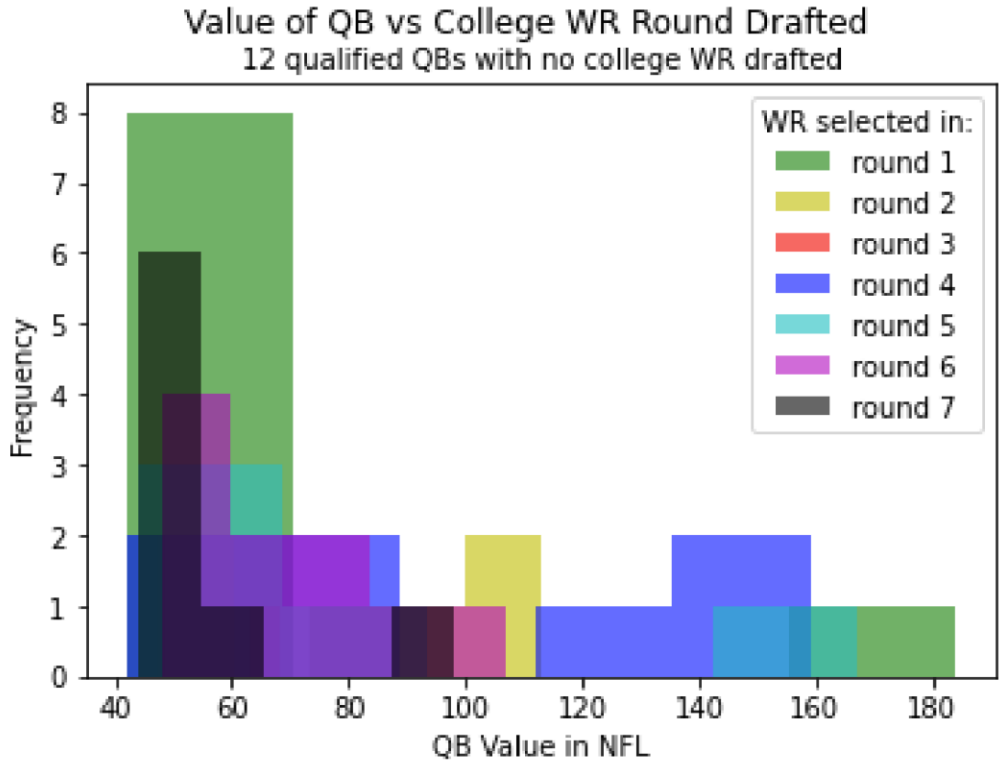
@SethWalder, ESPN

Of the roughly 100 names and positions listed, the word 'scout' is only used twice. While it is nearly certain that more than just two of these people work in their team's college scouting department, it is impossible to not wonder how much more success some teams could have if they had a person dedicated to the data analysis side of college scouting.

Since the year 2000, 279 draft picks have been spent on quarterbacks. Of those selected, 66 were first round picks. Despite this, only 13 unique starting quarterbacks have won the Super Bowl in this same time frame, making the position the most difficult to draft by far. In a league with an ever-growing passing presence, drafting the correct quarterback at the correct time can be a job saving decision for hundreds of employees in NFL scouting, managing, and coaching departments. With such a low success rate, the question with the most sought-after answer league wide is always "how can we find a Super Bowl winning quarterback." Data analysis can be used to help narrow the field.

Scouting QBs by Scouting WRs

An argument often heard when discussing any sport is that player X is only good because of player Y. Sometimes this argument is looked back on fondly. For example, the "Bud Dupree was only good in Pittsburgh because he had TJ Watt playing across from him" crowd would brag after Dupree's first year in Tennessee. Alternatively, it was the "Brady is boosted by Belichick" crowd who was left behind after Brady's Super Bowl win in Tampa. While the argument had mixed results in the pros, can it be applied more successfully in the case of scouting college quarterbacks?



The above chart is a histogram representing the number of wide receivers drafted, grouped by round selected, per quarterback with a weighted career approximate value (WCAV) (PFR) above 40. More specifically, for every quarterback with a WCAV greater than 40, represented is the number of and round(s) selected of their college wide receivers. For example, Pat Mahomes has a WCAV of roughly 70, and attended Texas Tech from 2014-2017. During this time, he played with wide receiver Keke Coutee, who was drafted in the 4th round. Therefore, there is a blue bar of frequency 1 sitting around the 70-mark on the x-axis (it is tucked in between and behind a few purple bars).

A WCAV cutoff of 40 was chosen to prevent cluttering of the chart. For perspective, 40 represents the difference between the career of Robert Griffin III, who scored just below 40, and Baker Mayfield, who scored just above 40 during his time with the Browns. Given that this is a career value, very young quarterbacks who haven't had the opportunity for multi-year success

have not surpassed the cutoff. For further perspective, some of the youngest quarterbacks with a qualifying WCAV include, but are not limited to, Pat Mahomes (70), Lamar Jackson (59), Deshaun Watson (52), Josh Allen (51), Kyler Murray (44), and Baker Mayfield (42).

Furthermore, to ensure that the quarterback actually played with the wide receiver in college and wasn't just a backup on his team when they were together, the wide receiver must have been drafted within one year of the quarterback. That is, if quarterback X was drafted in 2015, only wide receivers attending their college drafted in 2014-2016 are considered.

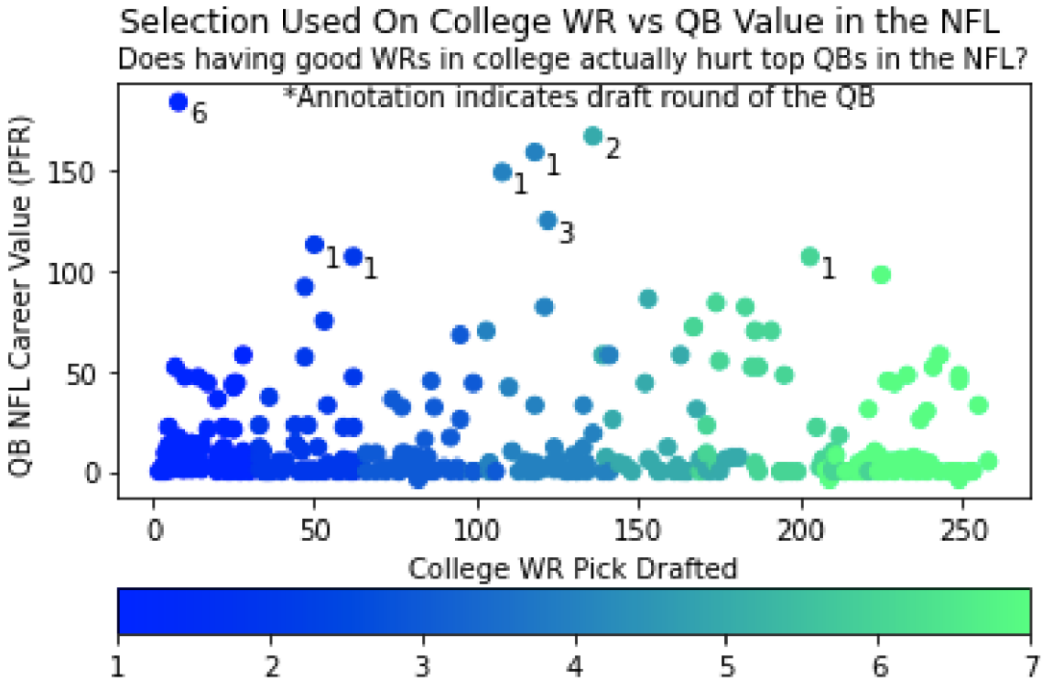
So, what does this all mean as far as drafting a quarterback? Looking at the histogram, there are interesting trends, particularly surrounding the success of quarterbacks who played with top tier wide receivers in college. The color green represents wide receivers selected in round one. The largest bar in the entire graph is green, sitting as far left as possible. This means that quarterbacks who play with very skilled wide receivers in college tend to be the least successful of the bunch (remember, everyone on this list is at least as successful as Baker Mayfield). Were these quarterbacks over-drafted due to the talent of their wider receiver cores? Interestingly, the black bar, for wide receivers drafted in round 7, follows a similar trend.

You will also notice a small green bar to far right of the graph, where Tom Brady lies. Brady, as you know, was a 6th round pick, who went to college with a wide receiver who would end up getting drafted in the 1st round, David Terrell. Terrell would have a rough career, only amassing a WCAV of 11. It's safe to say that the scouts of the time got these two mixed up and that Brady should have been the 1st round pick and Terrell the 6th, making the purple instead of green like it shows.

Furthermore, you'll notice that a majority of the graph consists of bars colored blue, light blue, and purple. This indicates that most successful quarterbacks in the NFL played with wide

receivers in college who were deemed to have round 4-6 talent. Are these wide receivers legitimately mid-round talents? Or are they just playing up to that level due to great quarterback play?

Finally, it is important to note the 12 quarterbacks who had *no* college wide receivers drafted. That is, 12 quarterbacks with careers better that Baker Mayfield's, who didn't once throw a competitive ball to an NFL caliber wide receiver until after the NFL draft.



The above graph shows the same trend as the histogram, but on a scatter plot and including quarterbacks with a WCAV less than 40. You will notice many of the trends discussed when looking at the histogram are confirmed here. There are the largest clusters in both of the bottom corners of the graph, where less successful quarterbacks who played collegiately with 1st and 7th round wide receivers are located , as well as in the upper middle, where you see a small cluster of 4 very successful quarterbacks who played with mid-round wide receivers in college. A trendline on this graph would likely show a slight rainbow shape.

There are a few interesting quarterbacks to monitor over the next few years. Can Kyler Murray (CeeDee Lamb) or Deshaun Watson (Mike Williams) break this trend? The two show promise but have a combined 1 playoff win in 8 years played. What about Joe Burrow (Jamar Chase, Justin Jefferson)? His data point is particularly interesting, as one of the highly touted wide receivers he played with in college is now on his same NFL team; a very rare scenario within the league. What about Kenny Pickett (Jordan Addison?) or CJ Stroud (Garret Wilson, Chris Olave, Jaxon Smith-Njigba?).

So, what conclusions can ultimately be made about quarterbacks by looking at their college wide receivers? Here are a few that stand out to me:

1) Top tier college wide receivers (round 1 selections) make quarterbacks appear better than they are.
2) The best quarterbacks will create mid-to-late round (4-6) selections out of their college wide receiver cores.
3) 12 qualified quarterbacks had none of their college wide receivers drafted, which is a trend worthy of further investigation

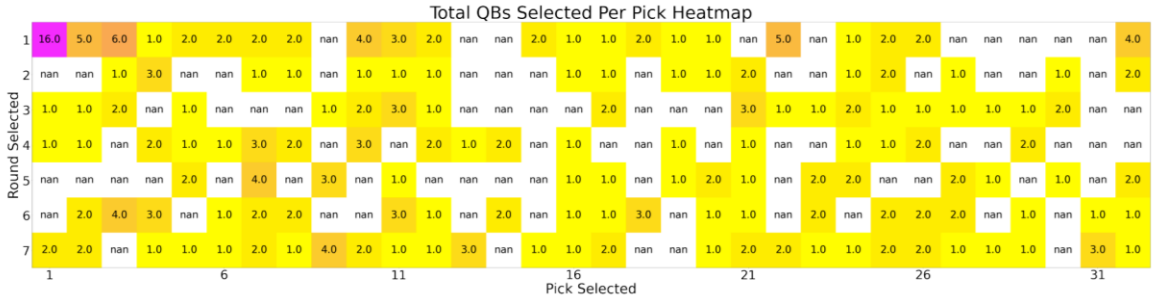
As a result, staying away from quarterbacks who had great wide receivers during their college careers could increase a team's odds of hitting at the position. In their stead, teams should favor quarterbacks who played with mid-round talent in college. Quarterbacks are difficult to scout. Why not use the easier-to-scout talent around them to help predict their NFL success?

Where Should You Draft Your quarterback?

The trend for quarterbacks has been consistent recently; draft them early or don't draft them at all. In fact, six of the last eight drafts have seen a quarterback drafted with the first

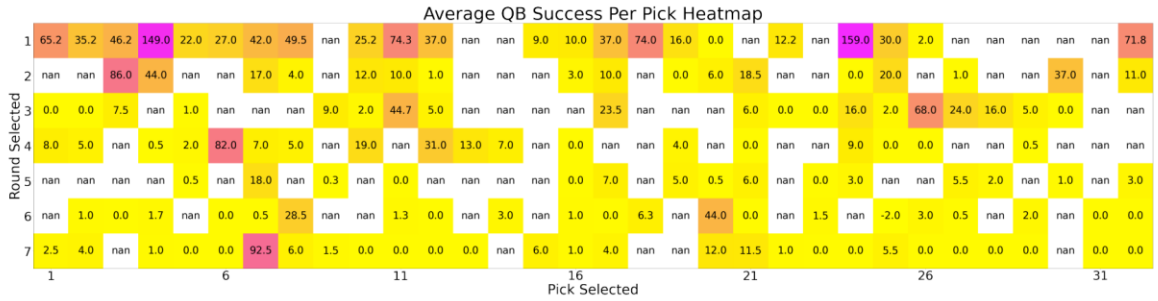
overall pick. Furthermore, there is serious discussion every single year regarding quarterback-needy teams trading up from the second round to late in the first in order to get an extra year on a rookie quarterbacks' contract, despite them not necessarily being seen as a first-round prospect. Sports commentators constantly weigh in on this themselves, with Nick Wright saying "If I was running a team, here's my rule for the GM: There are only 2 spots where you're allowed to draft a quarterback. In the top 10, or [in the] 6th round or later." on his show *What's Wright? With Nick Wright*.

With this being said, is there any truth to the idea that successful quarterbacks need to be drafted so early? Should teams trade up to pick their franchise quarterbacks?

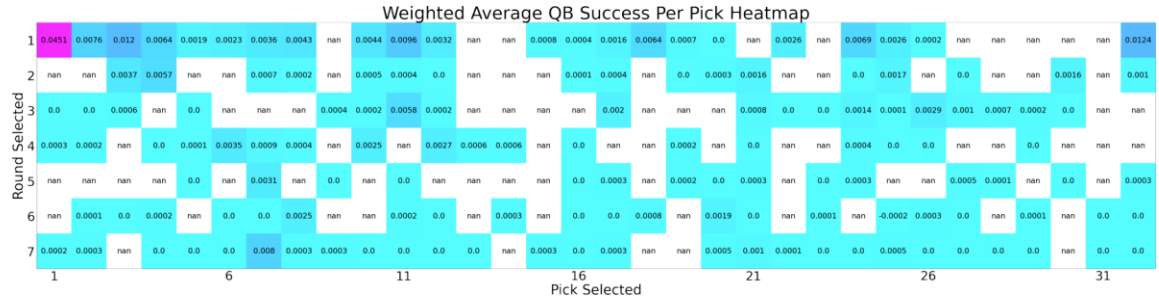


The above heatmap shows where quarterbacks are selected most in the draft since 2000. As you can see, the first overall pick is the most popular selection point, while other areas such as 2, 3, 10, and 32 trail closely behind. quarterbacks also seem to be less likely to get picked in the second round than in any other. In fact, the round totals are as follows: 67, 22, 28, 28, 26, 38, and 43, for rounds 1-7, respectfully. Perhaps this dip in round 2 is because teams are indeed reaching in round 1 for an extra year on the contract, leaving a skill void in round 2?

Now that it is known where quarterbacks are being selected in general, it must be figured out if teams are actually having success when they trade up.



The above heatmap shows the average success of quarterbacks picked at each selection, according to weighted career approximate value (WCAV) (PFR). quarterbacks selected in the top 12 have some of the best success, all picks considered. We also see good quarterbacks selected around picks 18, 24, and 32. The problems with this chart, of course, is that it benefits draft selections that only have one quarterback selected in them. For example, picks 4 and 24 have the top two scores in the second heatmap, but the first heatmap exposes them both as averages taken over just one quarterback. Both of the above heatmaps have their benefits and can be used efficiently, however the best heatmap would be one consisting of weighted averages, as seen below:



These values are shown using the weighted average formula: $W = \frac{\sum_{i=1}^{n} w_i X_i}{\sum_{i=1}^{n} w_i}$. They aim to give us a more accurate average of the quarterback success per each pick, taking in to account the amount of quarterbacks selected at each pick. This is best seen by relooking at picks 4 and 24, which are now overshadowed by multiple other selections throughout the draft. The evidence

is beyond clear now that the best quarterbacks are taken with the first overall selection. In fact, the difference between the value at the first selection and at any other selection is so difficult, that it makes the color differences at any other pick difficult to see. Despite this, there is still discern that the values at picks 3, 11, and 32 are all noteworthy. We even see small spikes in round 3 at pick 11 and in round 7 at pick 7, where Russell Wilson and Tom Brady prove that it is possible, albeit rare, to hit on a later round quarterback (Brady is moved to the 7th round in this display due to the presence of compensatory picks, which are not separately labeled in the graphic).

What can be taken from these heatmaps? First of all, quarterbacks are taken early, and often in the first round. This is for good reason, as, generally speaking, the best quarterbacks are taken early in the draft. The "trade up for pick 32 in order to get an extra contract year" trope has certainly had its success as well. Furthermore, it is possible to hit on a quarterback after the first round, although the best quarterbacks are taken in the top 12 and with pick 32, while the second-tier quarterbacks are usually picked elsewhere in the first round. While Nick Wright was correct in his opinion that top-10 selections yield the best quarterbacks, his assertion is still missing out on a wealth of talent later in the first round.

All things considered; the following conclusions can be made based on the above heatmaps:

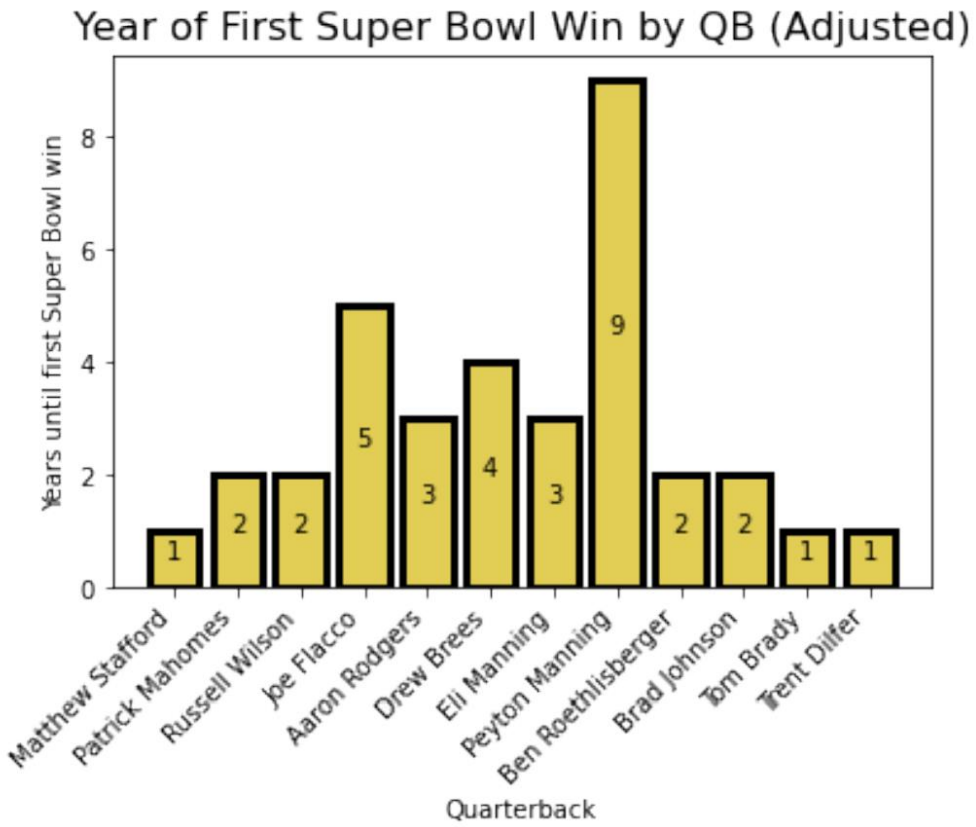
1) The first overall pick is indeed the most valuable in the draft (no surprise here).
2) Trading up for a non-first-overall quarterback when your original selection is in the top 12 is silly, as you are still in the hot zone for tier 1 quarterbacks.
3) Trading up from picks 13-31 could be beneficial, especially in such a hot quarterback market. It is not, however, 100% necessary.

4) Pick 32 may well be the second most important selection in the draft. Use it wisely. If you're not in the position to select a quarterback, its trade value is much higher than any draft pick trade chart would have it.
5) Drafting a quarterback outside of the first round is akin to playing the lottery: Everyone thinks they're getting a Russell Wilson, but most end up with a Josh Dobbs.

Ultimately, draft history can play a pretty large role in deciding present day drafting. While the variations of talent from draft class to draft class can and should affect one's draft decisions, the average success by pick over 20-plus years of drafting should have a considerable effect on a team's draft process and selections.

When Should You Move On from a Quarterback?

Many in the media argue and debate over which quarterback should be drafted by which team. You will often hear broadcasters discuss which players have the most potential, who is the most pro-ready, or which quarterback fits which scheme the best. However, half a decade after each draft, when said quarterbacks are ready to get their second NFL deals, the media always seems to agree on who should be resigned and who shouldn't. The general consensus always seems to be that if a quarterback was able to show any semblance of success during their rookie deal, they should be brought back at any cost as the position is viewed as incredibly difficult to draft. It is this way of thinking that sees both Super Bowl winner Patrick Mahomes and yet-to-be-a-playoff-winner Kyler Murray receive mega deals just a few years into their rookie deals. As this study sheds further insight and clarity into the quarterback drafting process, it is also time to rid the NFL of this archaic resigning practice, increase the turnover of quarterbacks, and play to win Super Bowls, not playoff games.



The above graph shows how many years it took a quarterback to win a Super Bowl (1-indexed), adjusted via two considerations:

1) A player's year count is reset back to 1 when they switch teams.
2) A player's year count only begins upon their first year of starting; years where a quarterback was not their team's primary starter do not count towards the players total.

One of the immediate observations you will make about this graph is that half of the quarterbacks who have won a Super Bowl since 2000 have done so in their first two years as a starter for their team. Perhaps more important, every one of these quarterbacks one a Super Bowl in their first five years of starting, which is also, coincidentally, the length of a first-round rookie's contract. The only exception to that rule is Peyton Manning, and thus such an exception

should be aptly named the ‘Peyton Manning exception’. Let’s explore this finding, as well as the exception, using a real-world example in Kyler Murray.

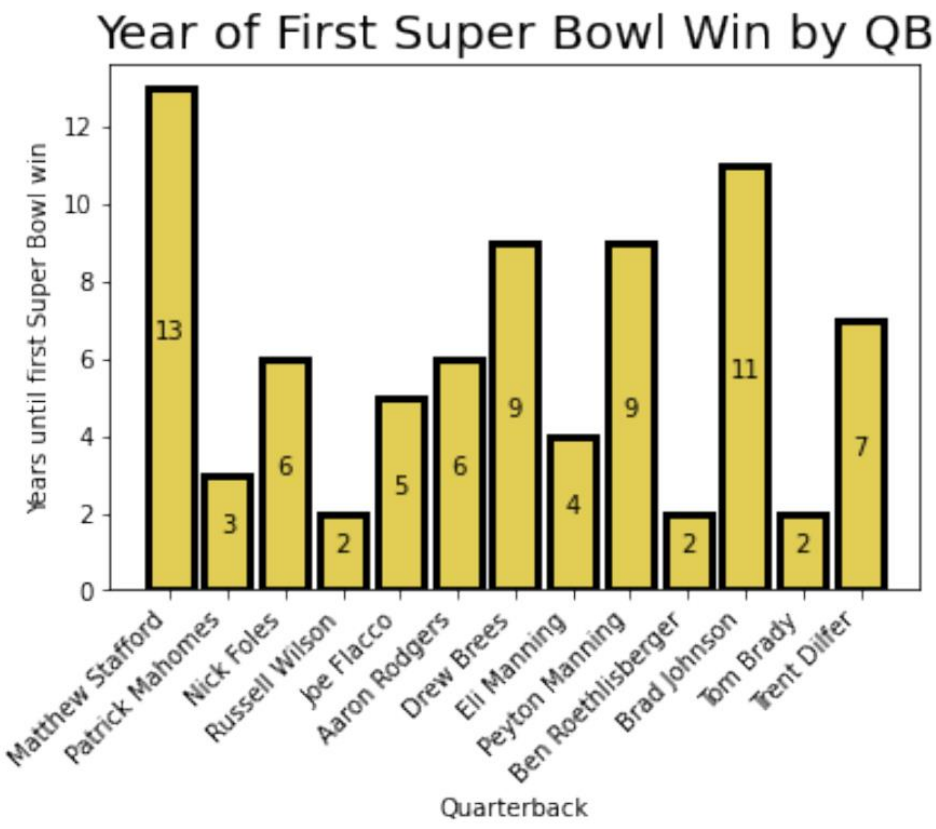
Murray is an incredibly intriguing quarterback. His raw athleticism and flashes of greatness make him a fan favorite and a long-term contract allows managers and coaches alike to score brownie points in the media and fanbase, particularly when he is playing well. Concurrently, and much less discussed, those same two traits also make him an easy scapegoat when he and his team aren’t playing well, taking much of the pressure off of those same managers and coaches in that tough position. That being said, his lack of overall success should not be ignored by those in the Cardinals front office. Regardless of many flashes of greatness Murray has had, he still has zero playoff wins on just one appearance in three whole years of playing. Many are quick to blame other factors for Murray’s lack of playoff success, however, regardless of how many excuses there are and their varying validity, Murray still has zero playoff wins.

The Cardinals are correct in their decision not to move off of Murray immediately. As aforementioned, he is only three years into his career. The previously mentioned data suggests that he still has two more years to achieve success in Arizona before the verdict on his career there can be made. However, his recently signed five-year extension keeps Murray in Arizona for an extra half-decade *after* this period expires. Assuming Super Bowls is the priority, such an extension so early into his career should worry the Cardinals, their fans, front office, coaching staff, players, and most importantly, Murray himself.

So where did it go wrong for Kyler? Kyler Murray was drafted on a team with a first-year coach, which means he was dropped into an experimental system with no proof of success on the professional level. Furthermore, following his rookie year, Murray had a complete

overhaul of his wide receiver room. While the players Arizona added (namely DeAndre Hopkins) were undoubtably more talented than his previous wide receiver core, Murray still had to spend an entire second year developing chemistry with new wide receivers, when that same chemistry should have been developed in his rookie season. In fact, while most young quarterbacks are offered some stability, Murray's top targets have consistently changed throughout his time in Arizona. For example, Patrick Mahomes could consistently rely on Tyreek Hill and Travis Kelce during his first five years in Kansas City. In part to such great stability, Mahomes won a Super Bowl. Meanwhile, Murray is projected to have a fourth most-targeted-receiver in his fourth season due to the loss of Christian Kirk (2021 Cardinals most targeted receiver), suspension of DeAndre Hopkins (2020), and retirement of Larry Fitzgerald (2019). A third reason for Murray's Arizona short comings could be his 2021 injury, which sidelined him for three games and seemingly ended an impressive stretch of his.

While none of the aforementioned problems are Murray's fault, it simply does not matter. The Cardinals have mismanaged the Kyler Murray era in Arizona and have cost him a great deal of success in his career. While his extension will allow him to make the money he deserves, it will not grant him the success he deserves unless he achieves it first in the next two seasons before his $40 million contract extension kicks in. Assuming Murray could have gotten the money he deserves elsewhere, the following chart suggests that he also could have won immediately elsewhere.



Above, you will see the same chart as before, this time with no adjustments. That is, just a pure count of the number of years in the NFL that it took each championship winning quarterback of this century to win their first Super Bowl. What this perception of the data suggests is that older quarterbacks still have value. When used in tandem with the first chart presented is this section, it is made apparent that it took Matthew Stafford, for example, 13 years in the league to win his first Super Bowl, but just one year after changing teams. Similar examples can be seen in the cases of Drew Brees, Trent Dilfer, and Brad Johnson, who all had Super Bowl success only after changing squads. Another peculiar case, that of Aaron Rodgers, suggests that it is also ok to reward extra years for players who do not start within the first few years of their careers.

Ultimately, the combination of these two charts suggest that it would have been entirely possible for Kyler Murray to have success both financially and in the Super Bowl had he switched teams. While there would almost certainly be widespread backlash against the Cardinals if they were to let Kyler go, they could have traded him just this offseason, acquired multiple first round picks in exchange, and actually built a core team worthy of a young super star quarterback rather than panicking and cobbling together aging stars such as JJ Watt, AJ Green and Zach Ertz, all while trading draft capital for 'proven' talent like Hollywood Brown (who has surpassed 60 receptions just once in his 3 year career despite being a first round pick and playing with a former MVP quarterback), and faking a being championship level team despite not once proving that they are even capable competitors. From a winning games perspective, it makes little sense for the Cardinals to have resigned Kyler Murray unless they truly view him as similarly skilled to Peyton Manning.

The Kyler Murray experiment, as well as many more that will soon see come to pass, will stand as perfect examples as to why teams should have a high turnover rate at quarterback. We all know that the quarterback position is the most difficult to draft in all of sports. That is exactly why teams should be absolutely certain that they are in a Super Bowl winning position before signing a quarterback to a massive new deal and losing a large chunk of their available salary for the following half decade.

Ultimately, a few key takeaways can be made from the two charts presented in this section.

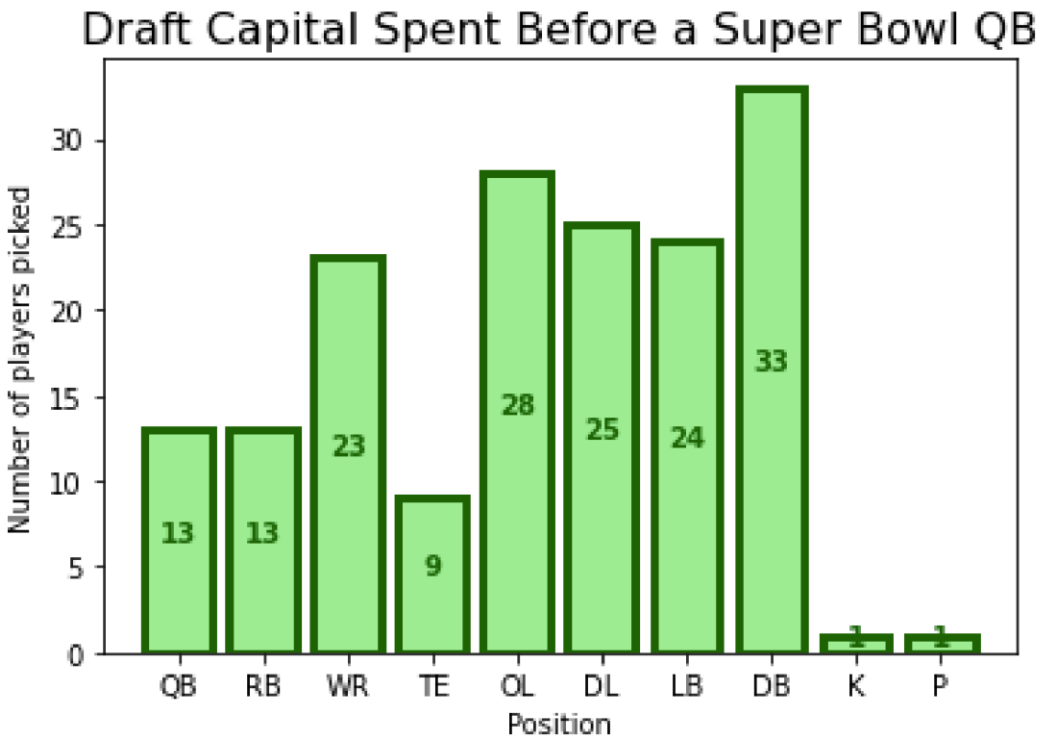
1) Half of all Super Bowl winning quarterbacks will win their first Super Bowl for their team within their first two years of starting.

2) All Super Bowl winning quarterbacks will win their first Super Bowl for their team within their first five years of starting.
3) Experienced quarterbacks should be recycled, but not necessarily reduced or reused. While it may not make sense for a team to resign a quarterback who has not won a Super Bowl for them, that same quarterback can be of tremendous value to a different team.
4) The Peyton Manning Exception should be observed only when a quarterback is viewed as similarly talented to Peyton Manning.

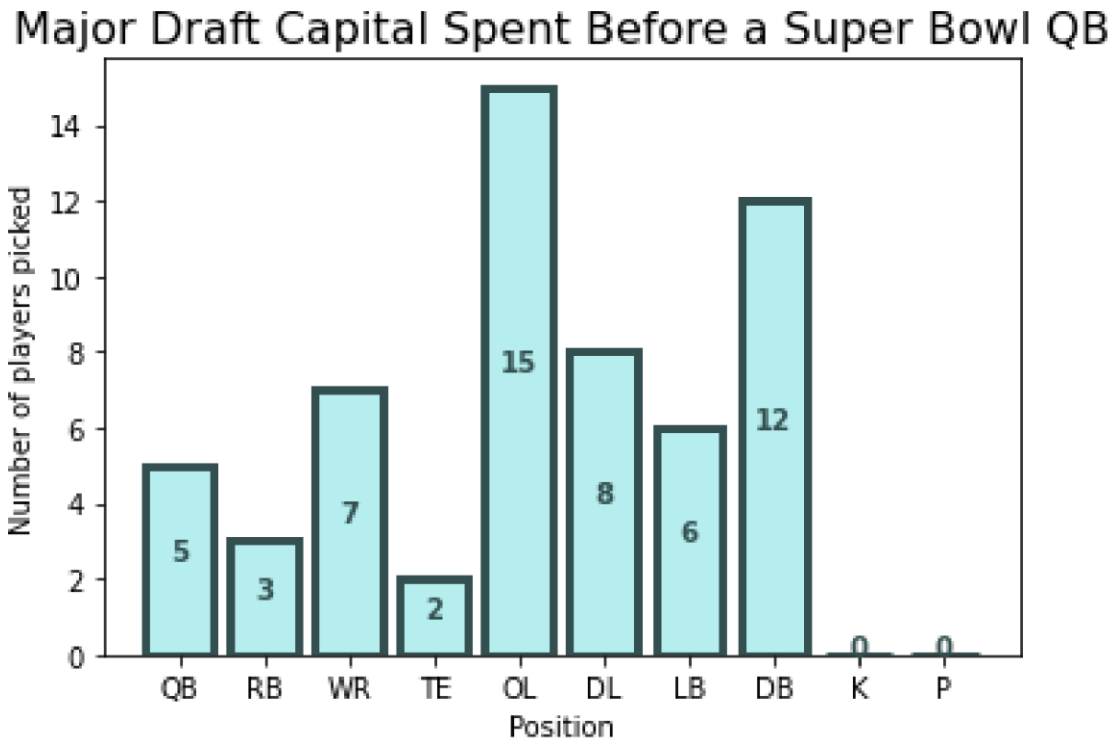
Ultimately, the movement of quarterbacks across the NFL should be much more fluent than it currently is. The difficulty of finding a franchise quarterback should encourage teams to have high turnover at the position, not discourage it. Teams that do not have Super Bowl caliber rosters should worry more about creating those rosters than finding a superstar quarterback (Kyler Murray Cardinals), while teams with Super Bowl caliber rosters should do the opposite and immediately focus on finding that last piece at quarterback (Matt Stafford Rams).

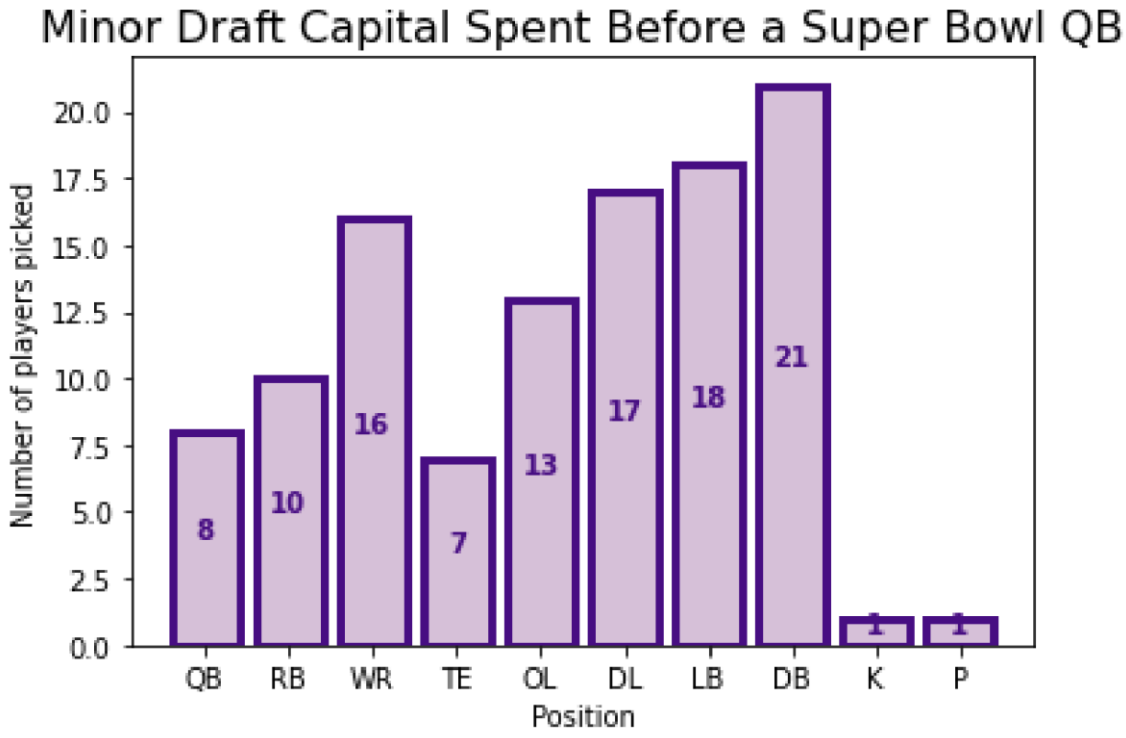
Drafting Around Your quarterback

Oftentimes talk around young quarterbacks also revolves around their supporting cast. When discussing the NFL success of quarterbacks in their early years, the talent levels of their offensive lines, weaponry corps, and defense are typically a large part of the debate. That being said, is there a recipe to properly acquiring talent around a young NFL quarterback? How can a front office best approach building a surrounding cast capable of winning a Super Bowl with their young quarterback?



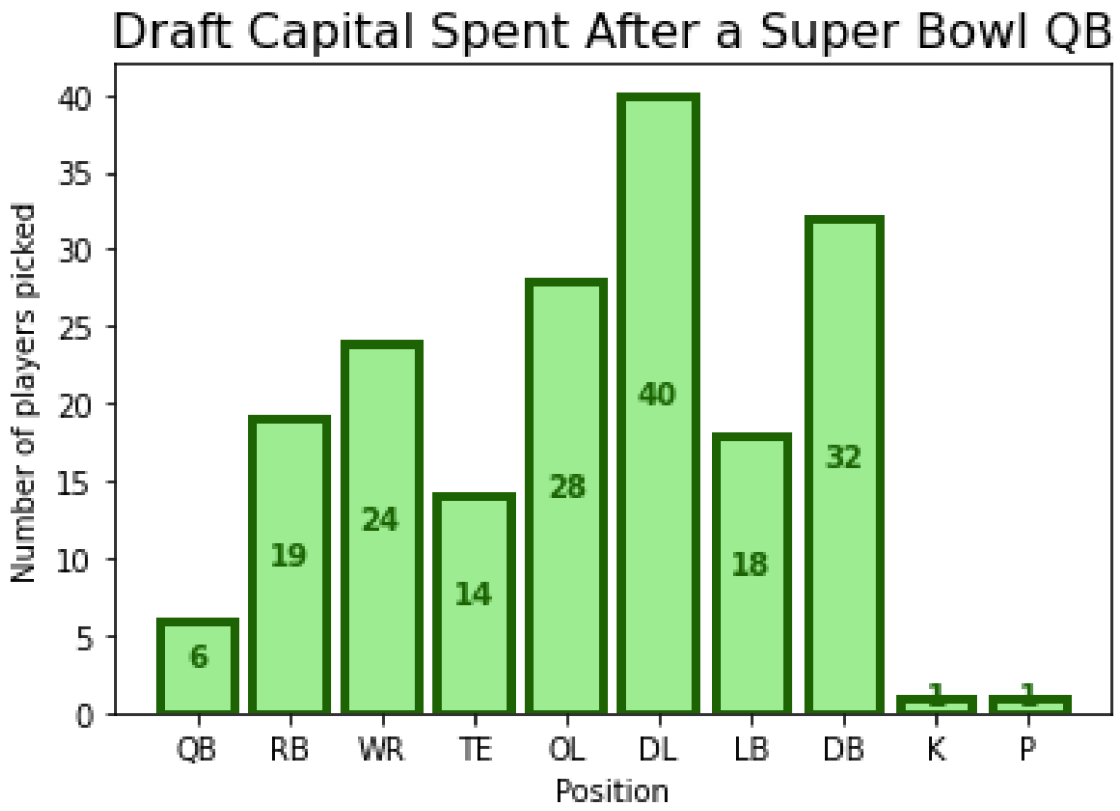
The above graph shows the draft capital spent by teams before drafting a future Super Bowl winning quarterback. The range spans five years, including the year that the quarterback himself was drafted. For example, Pat Mahomes was drafted in 2017. Therefore, the Chiefs draft picks represented in this chart are from the years 2013-2017, a five-year range. Five years was the chosen span as it is the length of a first-round rookie's contract. Furthermore, only quarterbacks who won the Super Bowl on their drafted team are considered.


Major Draft Capital Spent Before a Super Bowl QB
Number of players picked
0
2
4
6
8
10
12
14
5
3
7
2
15
8
6
12
0
0
QB
RB
WR
TE
OL
DL
LB
DB
K
P
Position

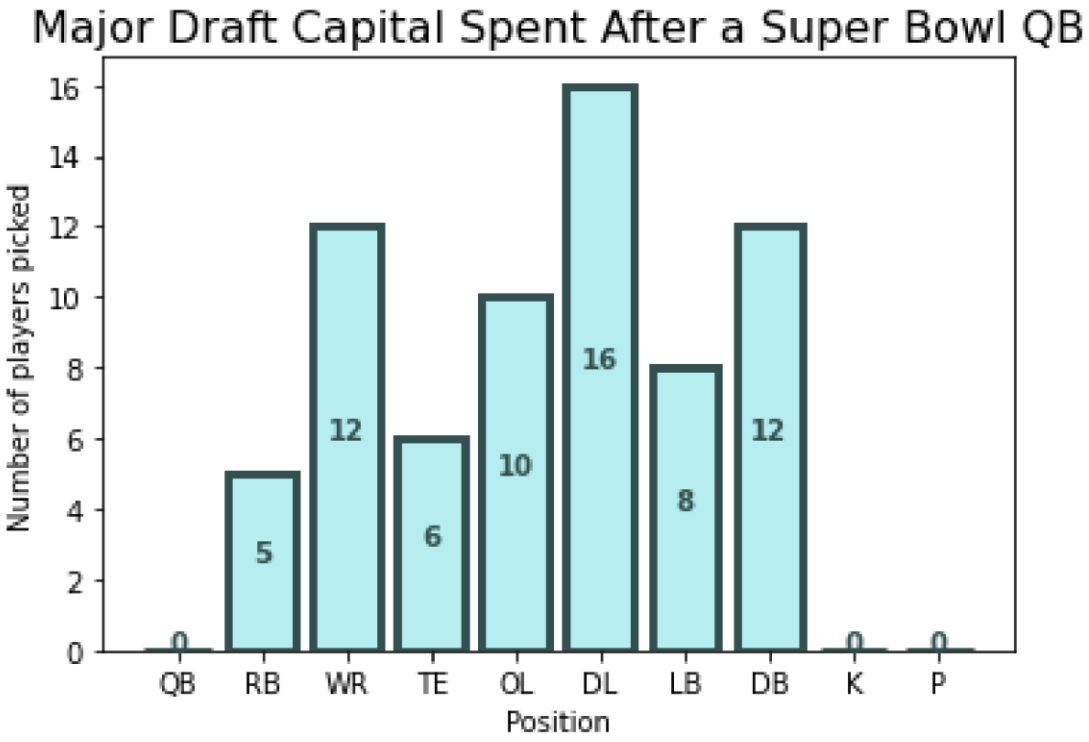

Minor Draft Capital Spent Before a Super Bowl QB
Number of players picked
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
8
10
16
7
13
17
18
21
1
1
QB
RB
WR
TE
OL
DL
LB
DB
K
P
Position

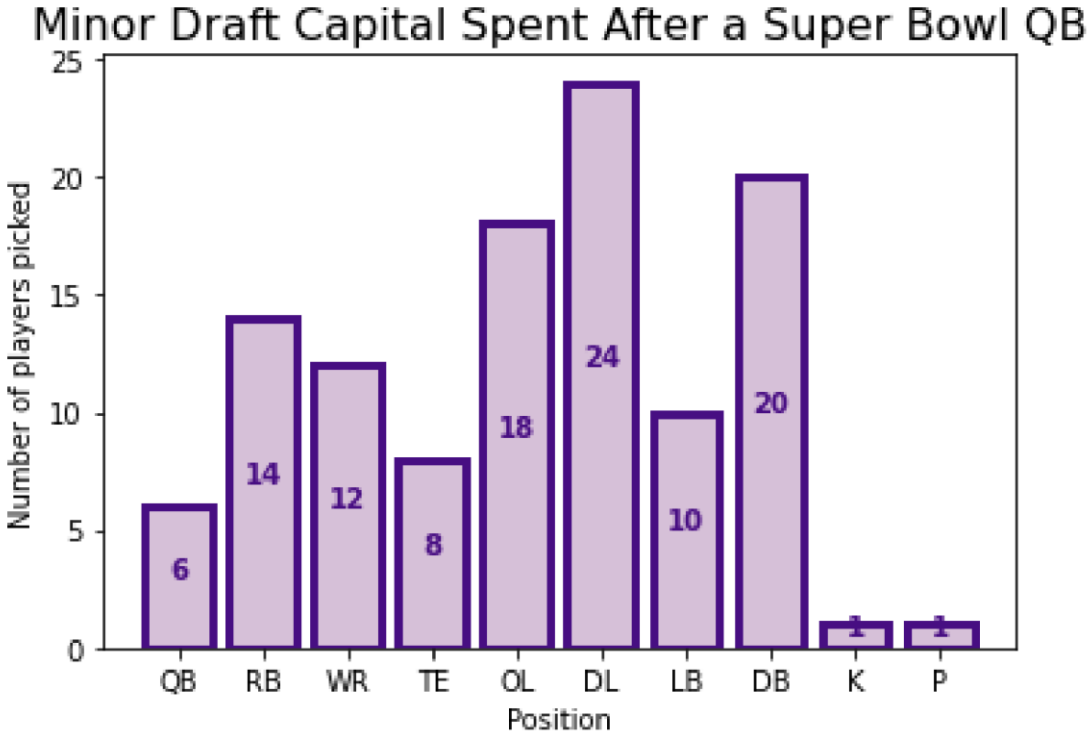
Further breaking down of this data allows us to gage the perceived importance of each position. The blue chart above shows where major draft capital (rounds 1-3) was spent in that same five-year span, while the purple chart allows us the same look at minor draft capital (rounds 4-7). An important trend shown in the blue chart is that teams will often reinforce their offensive line and secondary prior to drafting a future Super Bowl winning quarterback. The need for top tier offensive linemen is apparent and was showcased during the rookie season of Joe Burrow, where a questionable offensive line led to him getting seriously hurt. The urgency to build a secondary is more curious as pass rush is often viewed as the most important part of a modern defense. That being said, the influx of major draft capital spent on defensive backs in preparation for a Super Bowl winning quarterback is slightly more curious. The outlier here could simply be because the defensive back position includes both safeties and corner backs, but will likely require further research to confirm. Both the green and purple charts also showcase an overwhelming number of defensive backs drafted.

Also worth noting is the number of offensive weapons picked in the later rounds of these drafts. While the number of offensive linemen selected actually dipped, despite the number of rounds being considered increased from 3 to 4 from the blue chart to the purple, the number of selected running backs, wide receivers, and tight ends all more than doubled. It appears as if teams are securing the more difficult to draft positions by picking offensive linemen and defensive backs early, while trying to hit it big on late round weapons which tend to have a higher late round success rate.



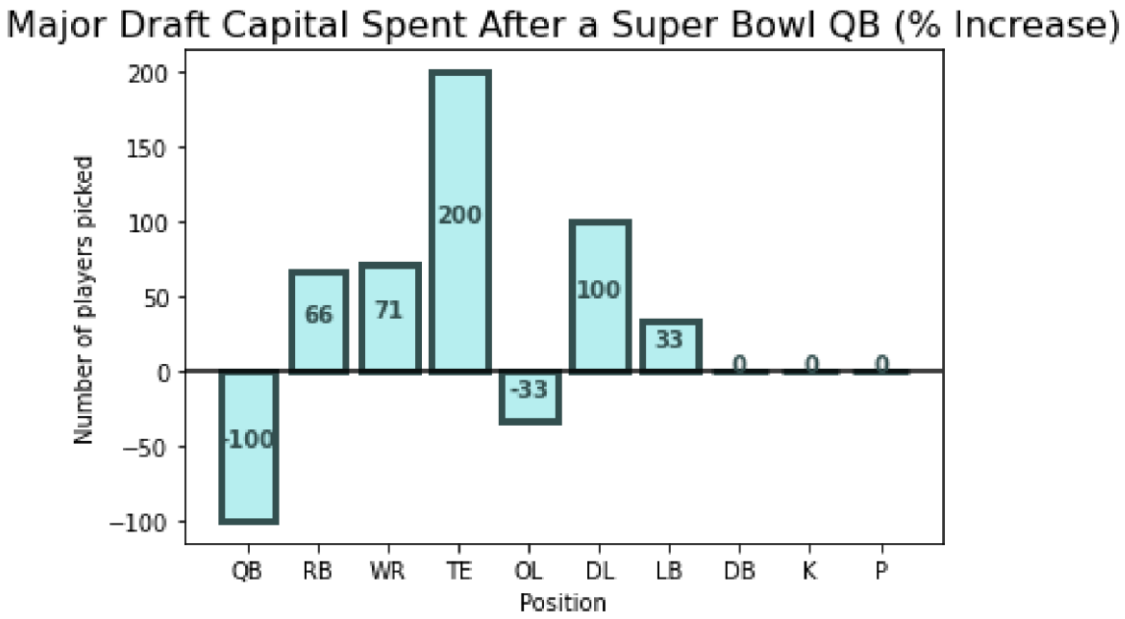
The above graph shows how teams reinforced their quarterbacks through their following five years of draft picks. For example, Russell Wilson was picked in 2012. Therefore, players picked by the Seahawks from 2013-2017 are considered. Once again, five years was chosen as it is the length of a first-round rookie's contract.

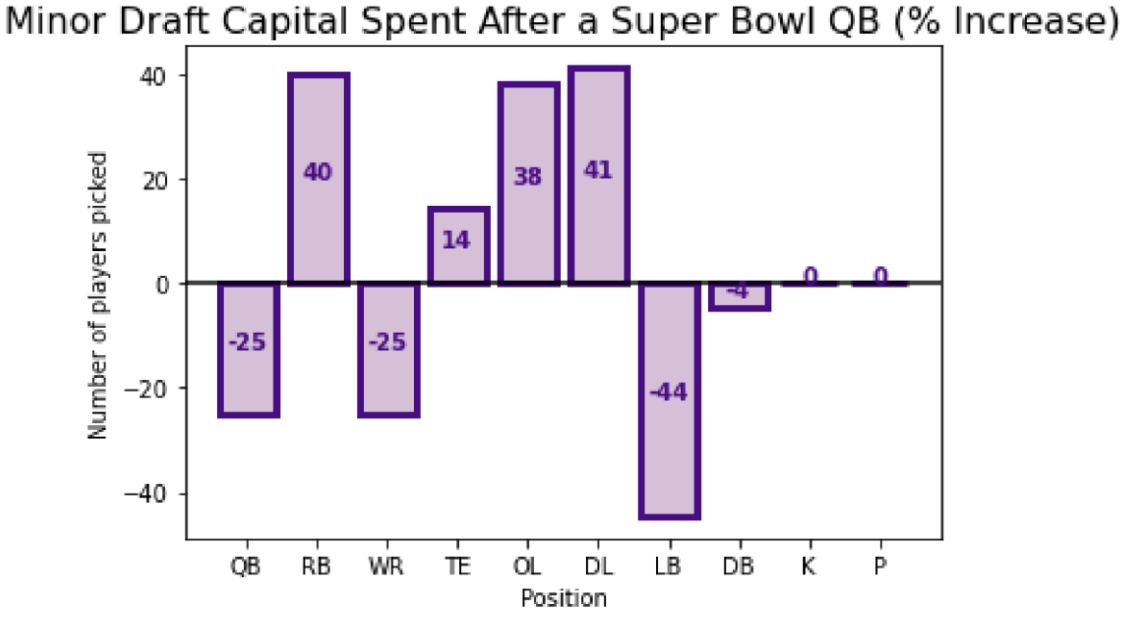




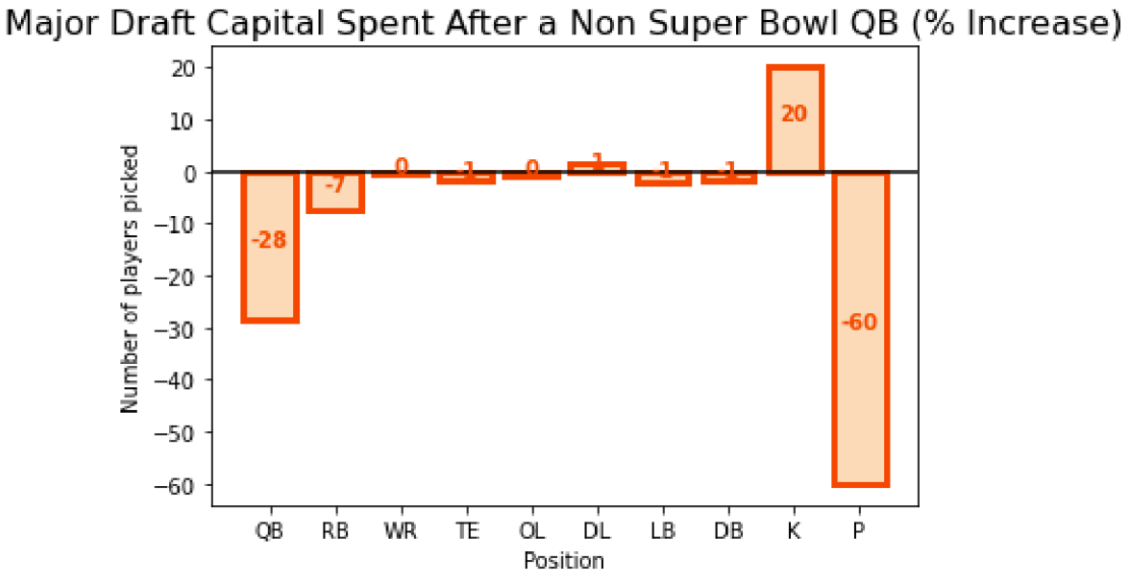
Further breaking down of this data reveals that Super Bowl winning teams greatly change their drafting strategy after drafting their Super Bowl winning quarterback. The biggest change

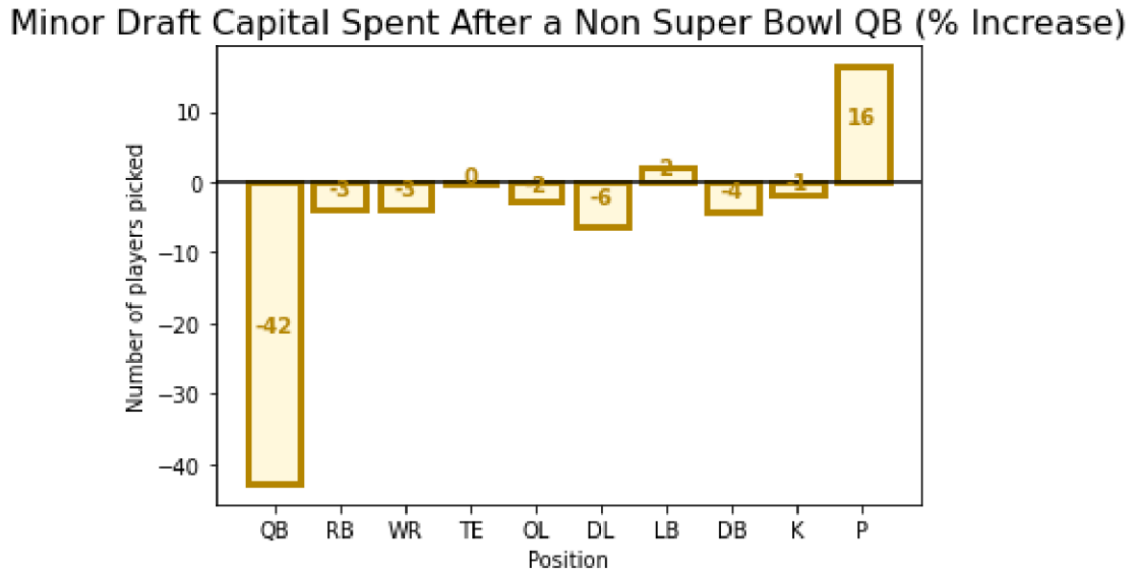
here can be seen in the teams' selections of first-round talent. As stated, prior to drafting their quarterback, most teams focused on selecting offensive line and defensive backs. While many similar selections are still made post quarterback selection, the focus has greatly shifted to defensive line and offensive weaponry. While the number of first-round offensive linemen decreased and the number of first-round defensive backs stayed the same, the number of first-round running backs, wide receivers, tight ends, and defensive linemen all increased. Likely this increase is such due to the nature of those positions, where each of the four often see its rookie play at a high level immediately, needing little time to adjust to the NFL lifestyle. While it is no secret that wider revievers are entering the league more pro ready than ever, this trend has also been seen in runningbakcs, where first round selections like Najee Harris often have an immediate impact and third round selections like Alvin Kamara, Kareem Hunt, or David Montgomery have proven that mid round picks can do it too if given an opportunity. Concurrently, recent tight end selections such as Kyle Pitts or Pat Freiermuth have proven similar ideals about their own position while players like Myles Garrett and Max Crosby prove that edge rushers can be found to have an immediate impact all around the draft as well. In an attempt to showcase the altering draft strategies in an easier manner, here is their percent changes by position in both the major and minor draft capital categories:





The changes in draft strategy presented by theses charts are important. Not only do teams that alter their draft strategies win, but those who stick to their old ways lose. Below are the changes in draft strategies for teams who draft a quarterback and do not win a Super Bowl with him:





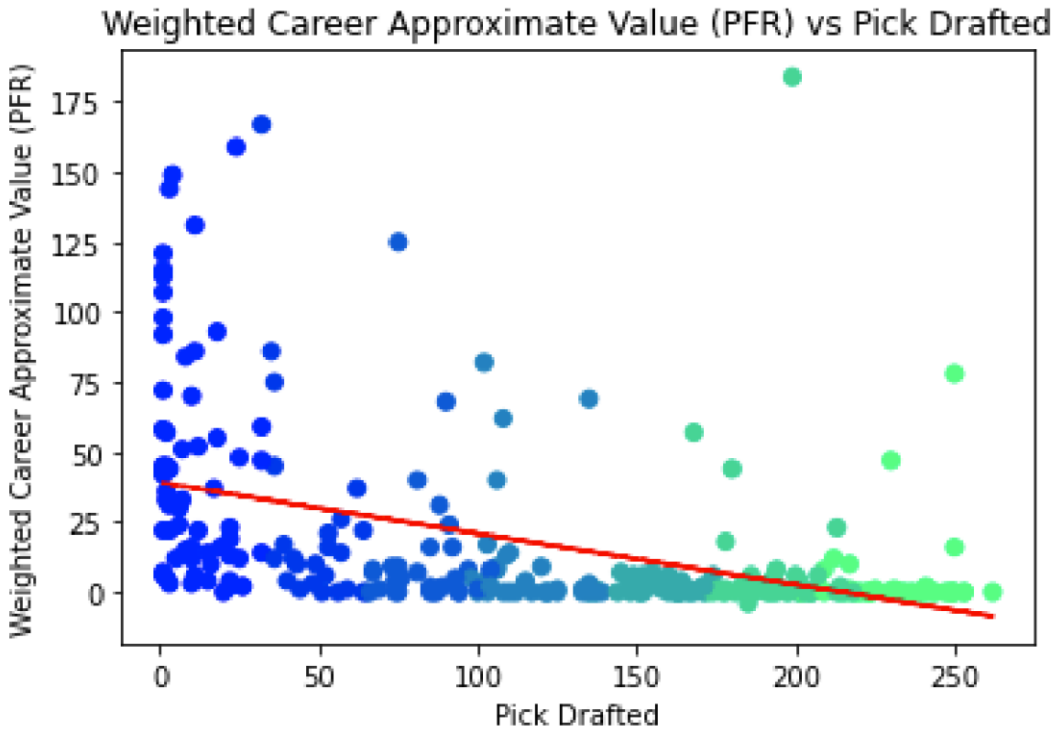
Note that the largest non-special teams or quarterback change presented in these charts sits at just seven percent. By not altering their draft strategy, front offices are putting their young quarterbacks at a disadvantage. All things considered, the following conclusions can be taken from this section:

1) Teams should focus on building from the trenches outward on offense, and the secondary inward on defense. Protecting one's quarterback while figuring out others are two important talents that take time to develop.
2) More plug-and-play positions should be drafted after a quarterback as been selected to free cap space and fill out a roster.
3) A change in draft strategy is necessary after a quarterback is drafted.

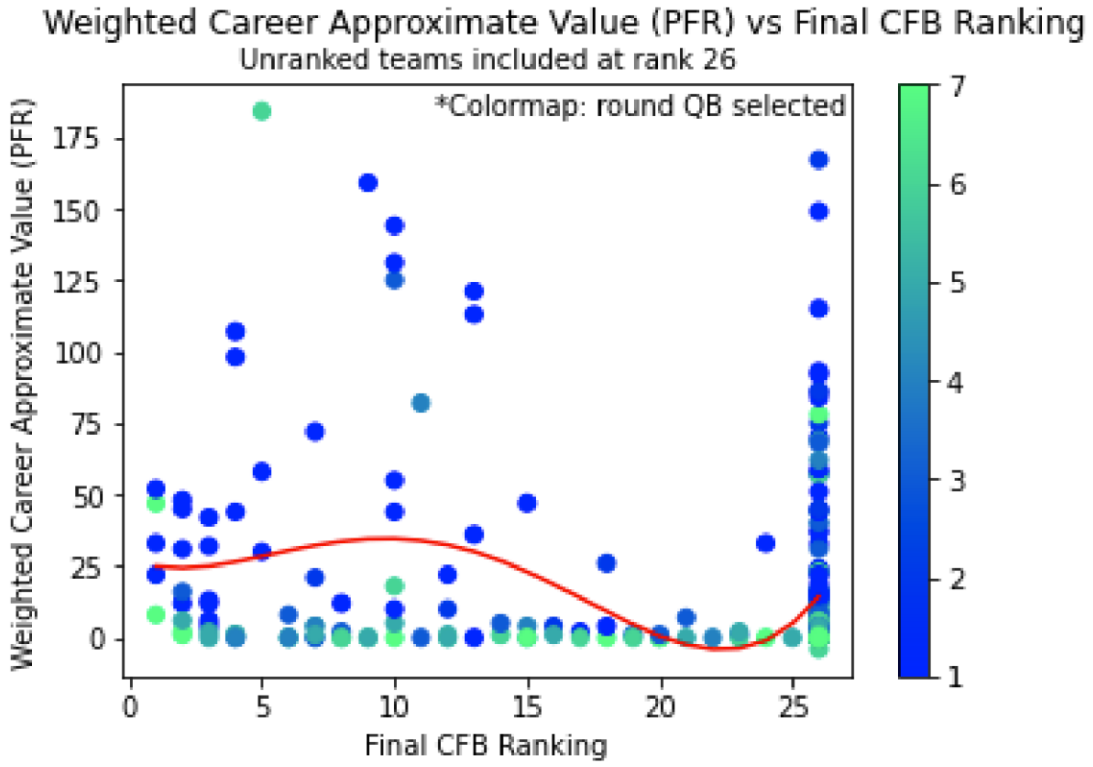
Ultimately, the importance of hitting in the draft cannot be understated. The draft is the best way to find cheap and valuable talent in the NFL. While many different strategies can be used to determine which players best fit a team's system, positional value should be heavily considered and where a team is located in the quarterback finding process should play into that value system heavily.

Quick Graphs

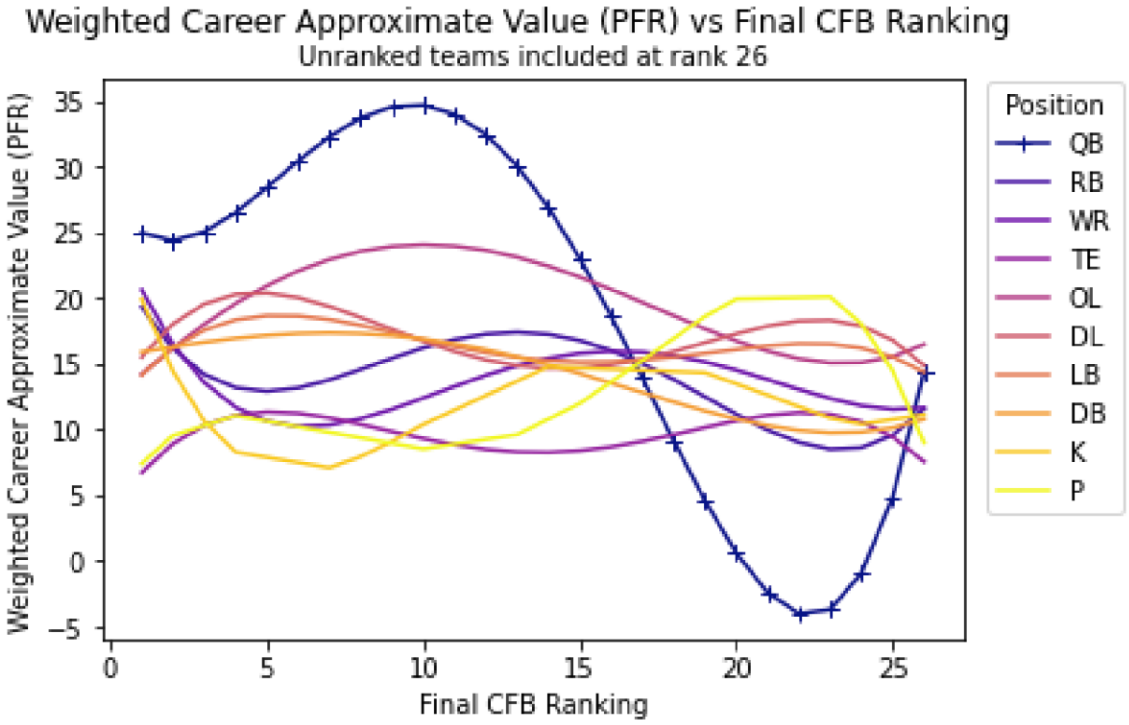
There are too many factors to be considered in quarterback drafting. Unfortunately, not all of them can be fit in to one research paper. That being said, a 'lightning round' of sorts can be used to collect some extra, less detailed information about the draft process as a whole. Below are some charts that explore that idea.



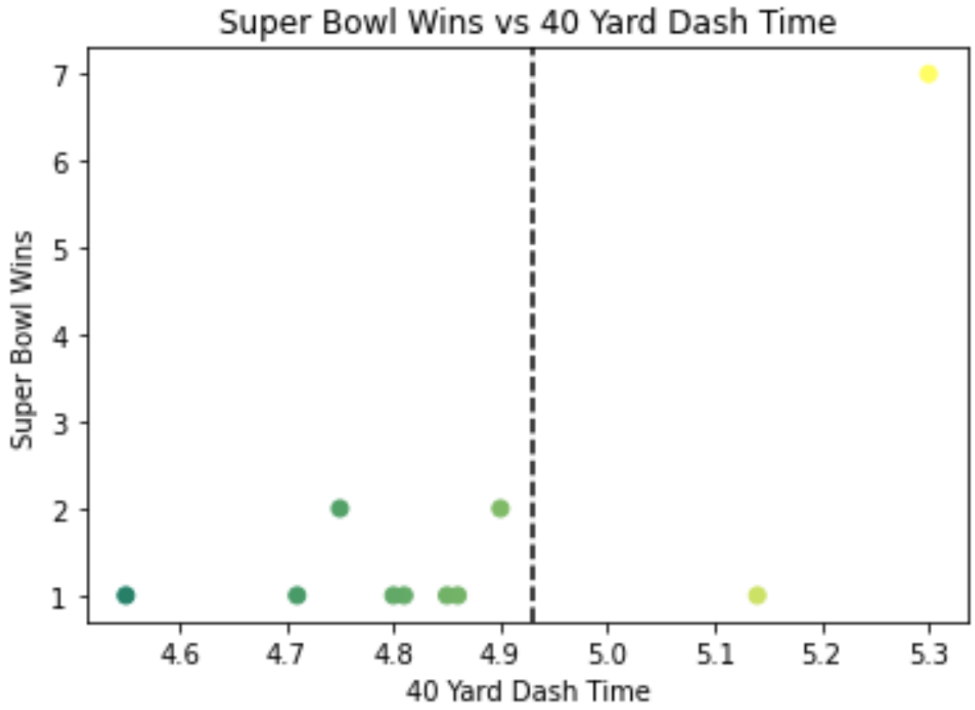
The above chart uses the previously utilized WCAV metric to measure the success of quarterbacks selected at different points in the draft. The color of the dots represents the round in which the player was selected. While the highest tier of quarterback is typically a first-round selection, it is certainly not unheard of to hit on a mid or late round quarterback. Perhaps more pressing, it is also far from a guarantee to hit on a quarterback that is drafted early.



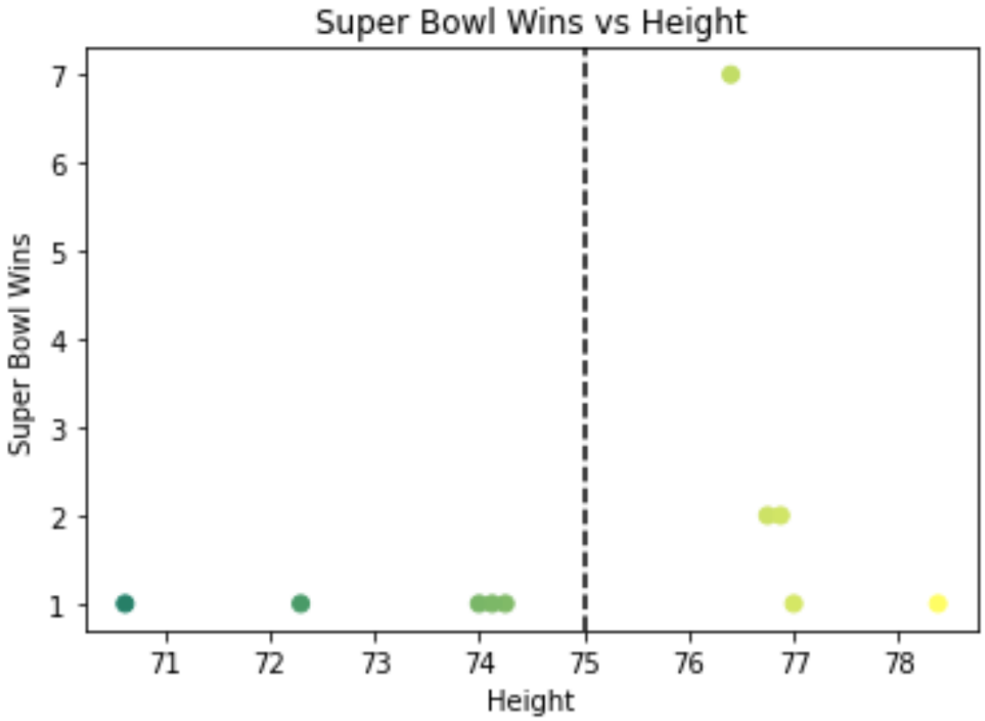
In tandem with the histogram used in the "Scouting quarterbacks by Scouting wide receivers" section, the above chart looks at if a team can measure a quarterback's success by looking at the success of their team as a whole. It's worth noting that quarterbacks who lead their team to a final ranking around 10 in college tend to preform the best in the NFL. Concurrently, quarterbacks selected from unranked teams also tend to do really well. There is a severe dry spell from quarterbacks whose college teams fell into the lower top-25 rankings.



This chart works in tandem with the chart above it but shows quarterbacks on the same scale as all other position groups. The quarterback position easily has the largest range in success. Interestingly, offensive line and quarterback show similar trends. On the other hand, quarterback seems to have a nearly opposite trend to that of both wide receivers and punters.



The above chart explores the idea that having a fast quarterback gives you better odds at winning the Super Bowl. The black dotted line represents the average quarterback 40-yard dash time. You'll notice that most of the quarterbacks fall in front of this line, albeit not by much, giving an advantage to quarterbacks who can move slightly better than average.

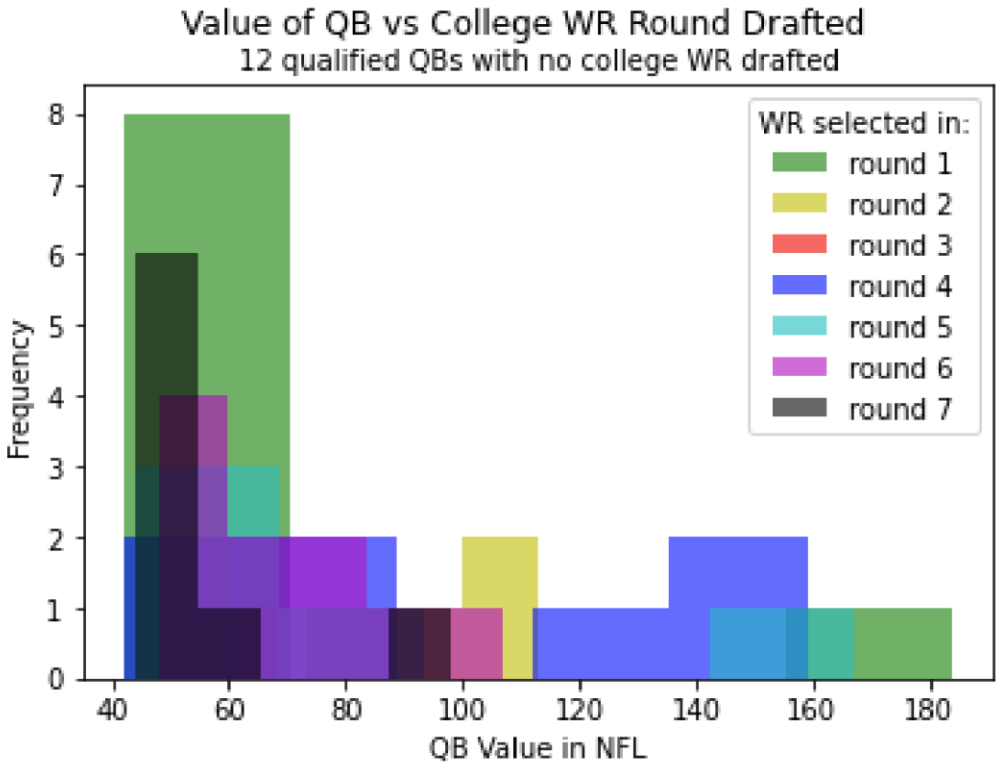


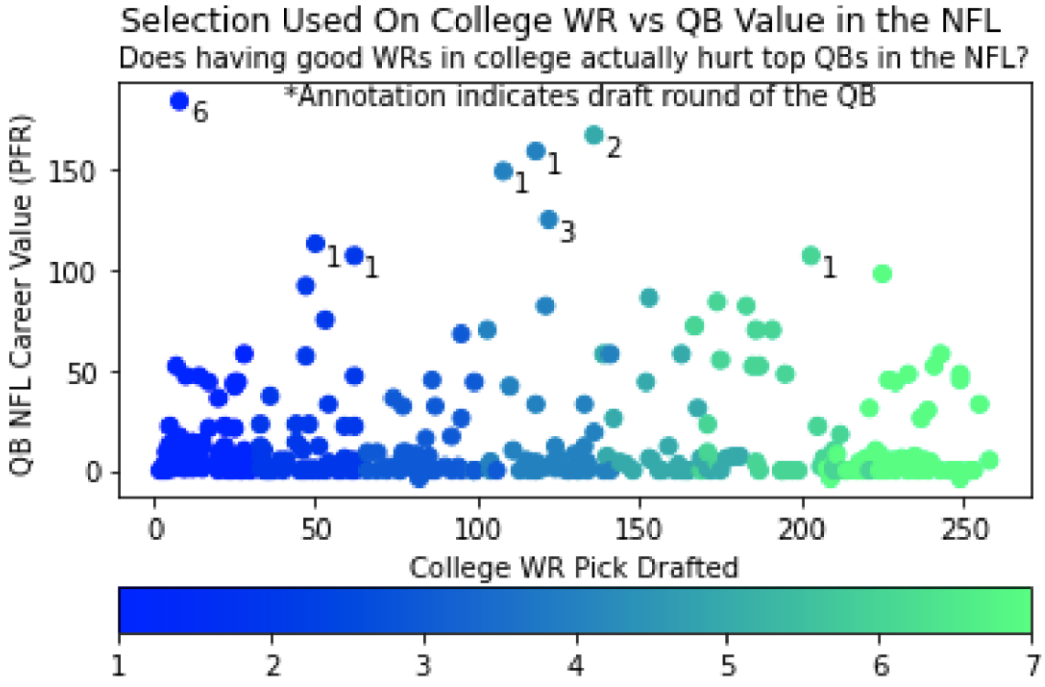
The above chart explores the idea that quarterbacks best operate above a certain height. Once again, the black dotted line represents the average height for a quarterback. There is a very even spread across the x-axis here, suggesting that the height of a quarterback is not a good indicator of their future success.

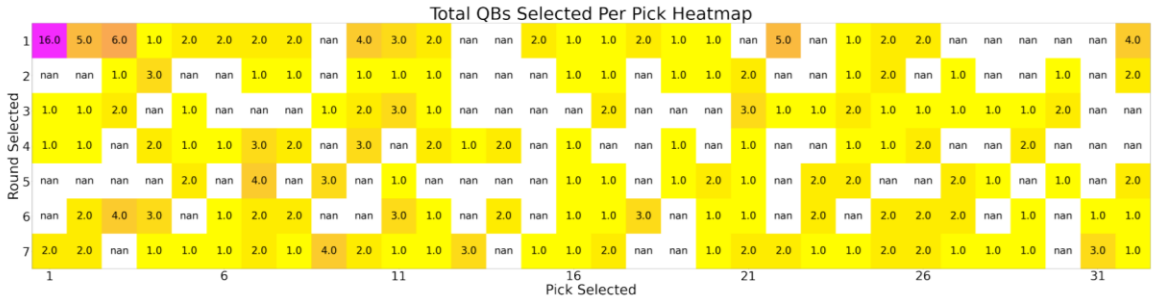
Conclusion

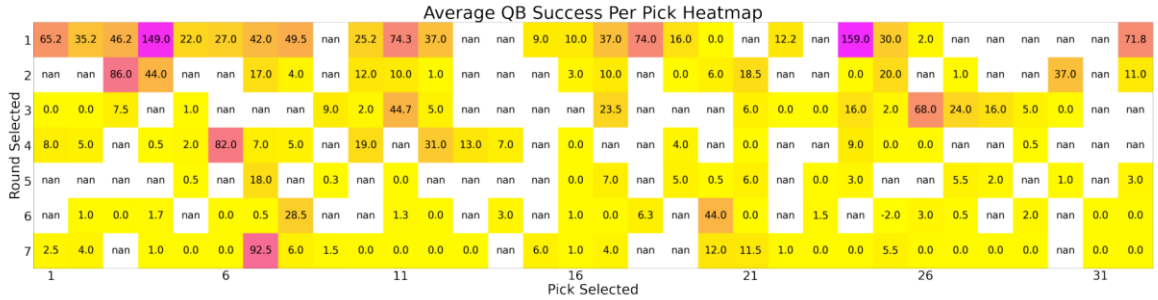
The field of data science is new. Some people fear it and its findings, while most tend to embrace the new era of sports analysis. The use of data in the NFL will continue to grow regardless, as teams will begin to find more success as they merge the old manner of scouting with the new. While the applications of data science in football are certainly unlimited, the research presented in this paper attempts to present just a fraction of findings, some more controversial than others, that will be useful to front offices and couch GMs alike.

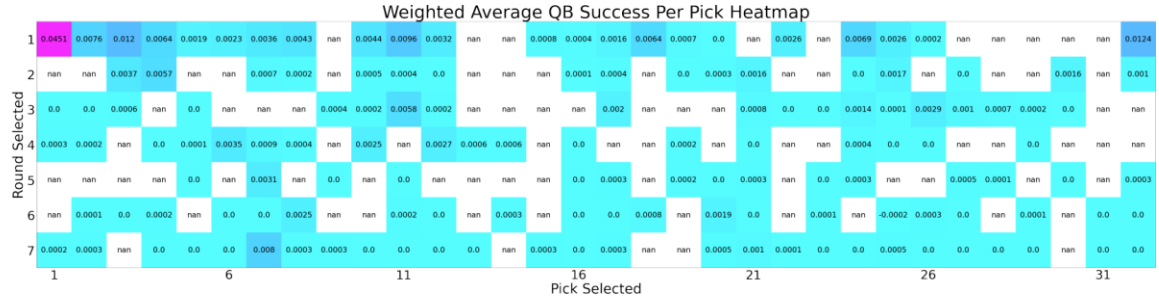
Chart Glossary

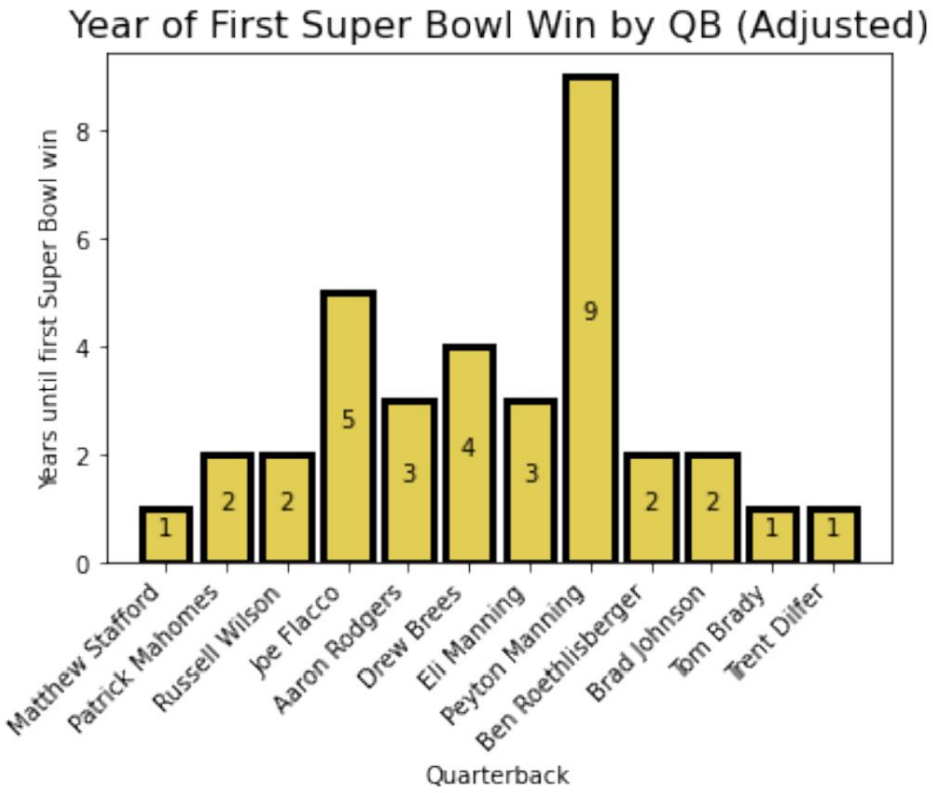


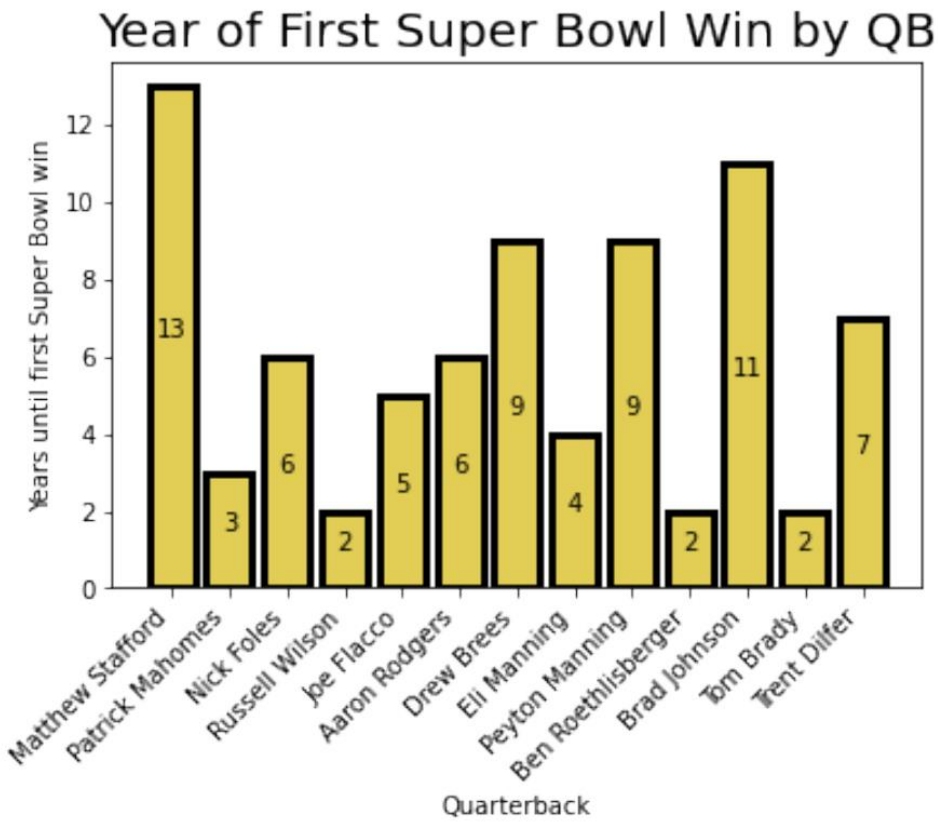


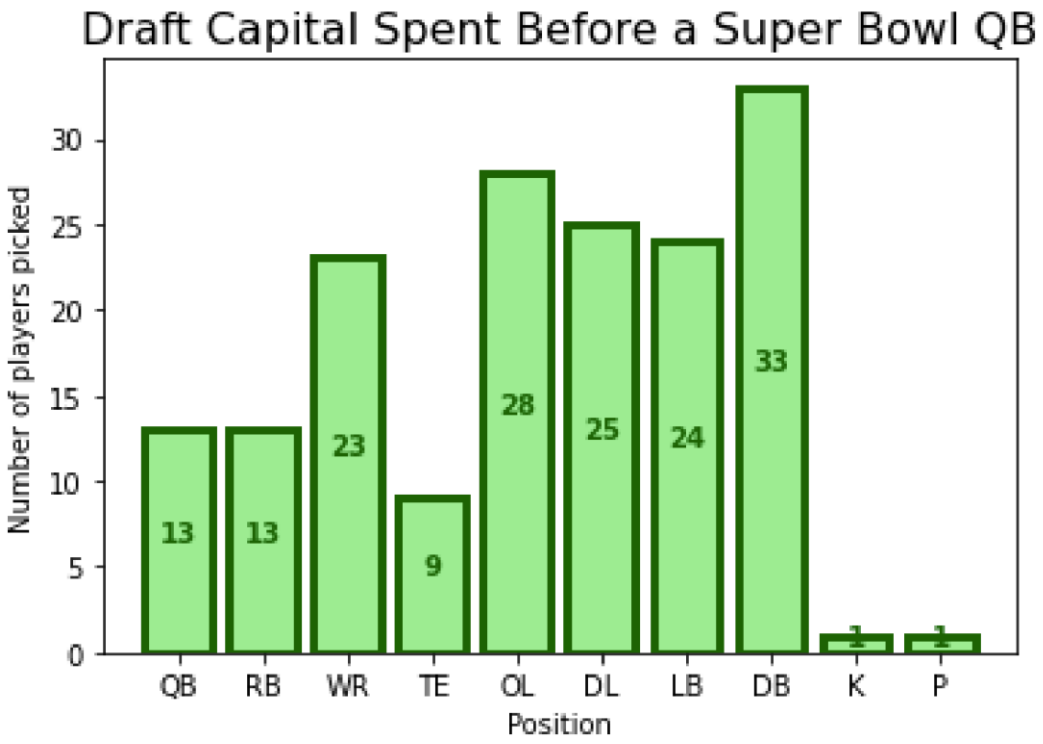

Total QBs Selected Per Pick Heatmap
Round Selected
Pick Selected
1 16.0 5.0 6.0 1.0 2.0 2.0 2.0 2.0 nan 4.0 3.0 2.0 nan nan 2.0 1.0 1.0 2.0 1.0 1.0 nan 5.0 nan 1.0 2.0 2.0 nan nan nan nan nan 4.0
2 nan nan 1.0 3.0 nan nan 1.0 1.0 nan 1.0 1.0 1.0 nan nan nan 1.0 1.0 nan 1.0 1.0 2.0 nan nan 1.0 2.0 nan 1.0 nan nan 1.0 nan 2.0
3 1.0 1.0 2.0 nan 1.0 nan nan nan 1.0 2.0 3.0 1.0 nan nan nan nan 2.0 nan nan nan 3.0 1.0 1.0 2.0 1.0 1.0 1.0 1.0 1.0 2.0 nan nan
4 1.0 1.0 nan 2.0 1.0 1.0 3.0 2.0 nan 3.0 nan 2.0 1.0 2.0 nan 1.0 nan nan 1.0 nan 1.0 nan nan 1.0 1.0 2.0 nan nan 2.0 nan nan nan
5 nan nan nan nan 2.0 nan 4.0 nan 3.0 nan 1.0 nan nan nan nan 1.0 1.0 nan 1.0 2.0 1.0 nan 2.0 2.0 nan nan 2.0 1.0 nan 1.0 nan 2.0
6 nan 2.0 4.0 3.0 nan 1.0 2.0 2.0 nan nan 3.0 1.0 nan 2.0 nan 1.0 1.0 3.0 nan 1.0 1.0 nan 2.0 nan 2.0 2.0 2.0 nan 1.0 nan 1.0 1.0
7 2.0 2.0 nan 1.0 1.0 1.0 2.0 1.0 4.0 2.0 1.0 1.0 3.0 nan 1.0 1.0 2.0 nan nan 1.0 2.0 2.0 1.0 1.0 2.0 2.0 1.0 1.0 1.0 nan 3.0 1.0
1 6 11 16 21 26 31

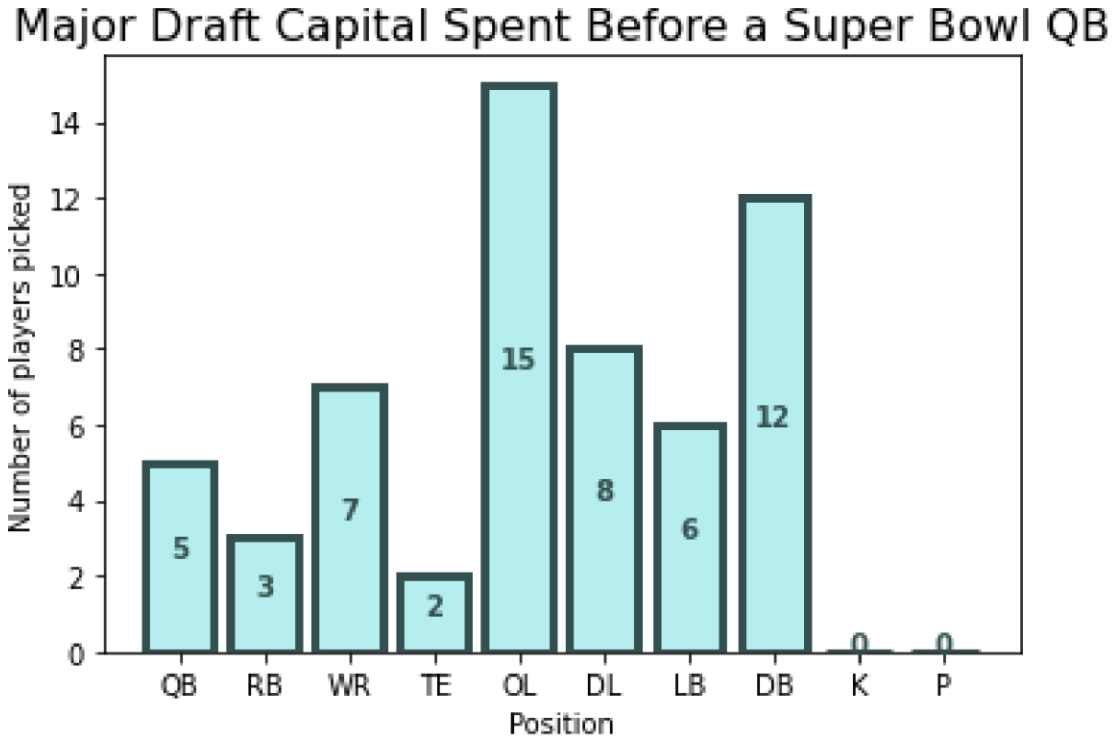

Average QB Success Per Pick Heatmap
Round Selected
Pick Selected
1 65.2 35.2 46.2 149.0 22.0 27.0 42.0 49.5 nan 25.2 74.3 37.0 nan nan 9.0 10.0 37.0 74.0 16.0 0.0 nan 12.2 nan 159.0 30.0 2.0 nan nan nan nan nan 71.8
2 nan nan 86.0 44.0 nan nan 17.0 4.0 nan 12.0 10.0 1.0 nan nan nan 3.0 10.0 nan 0.0 6.0 18.5 nan nan 0.0 20.0 nan 1.0 nan nan 37.0 nan 11.0
3 0.0 0.0 7.5 nan 1.0 nan nan nan 9.0 2.0 44.7 5.0 nan nan nan nan 23.5 nan nan nan 6.0 0.0 0.0 16.0 2.0 68.0 24.0 16.0 5.0 0.0 nan nan
4 8.0 5.0 nan 0.5 2.0 82.0 7.0 5.0 nan 19.0 nan 31.0 13.0 7.0 nan 0.0 nan nan 4.0 nan 0.0 nan nan 9.0 0.0 0.0 nan nan 0.5 nan nan nan
5 nan nan nan nan 0.5 nan 18.0 nan 0.3 nan 0.0 nan nan nan nan 0.0 7.0 nan 5.0 0.5 6.0 nan 0.0 3.0 nan nan 5.5 2.0 nan 1.0 nan 3.0
6 nan 1.0 0.0 1.7 nan 0.0 0.5 28.5 nan nan 1.3 0.0 nan 3.0 nan 1.0 0.0 6.3 nan 44.0 0.0 nan 1.5 nan -2.0 3.0 0.5 nan 2.0 nan 0.0 0.0
7 2.5 4.0 nan 1.0 0.0 0.0 92.5 6.0 1.5 0.0 0.0 0.0 0.0 nan 6.0 1.0 4.0 nan nan 12.0 11.5 1.0 0.0 0.0 5.5 0.0 0.0 0.0 0.0 nan 0.0 0.0
1 6 11 16 21 26 31

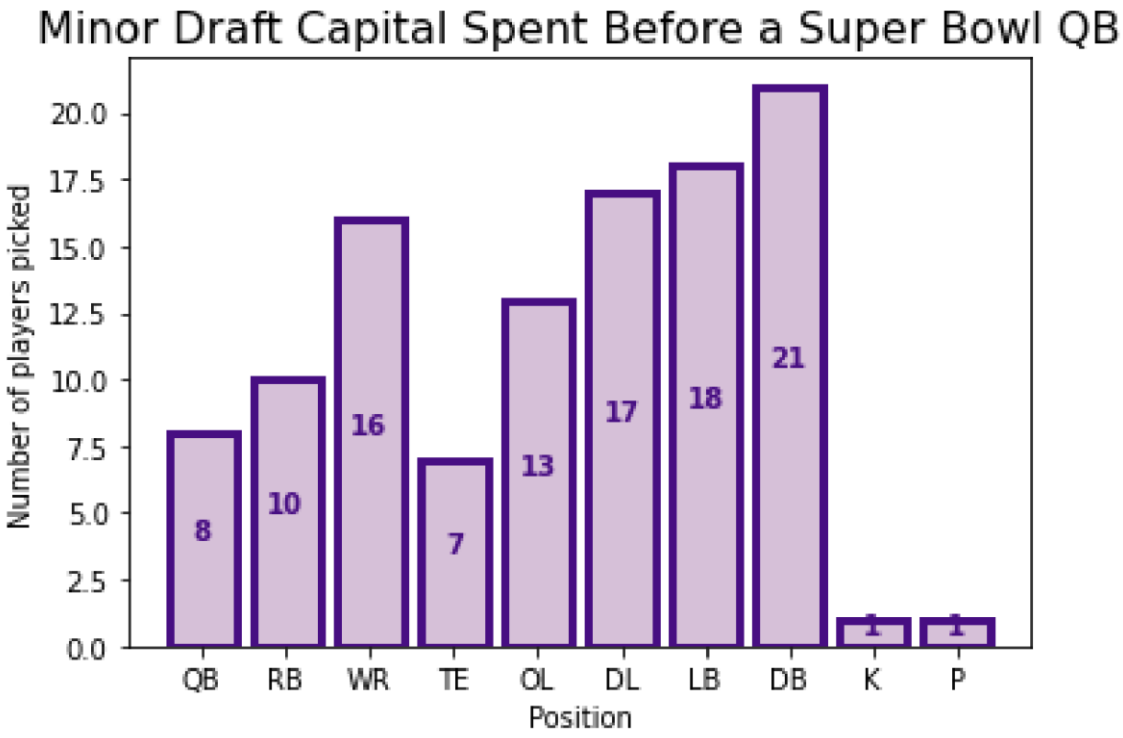

Weighted Average QB Success Per Pick Heatmap
Round Selected
Pick Selected
1 0.0451 0.0076 0.012 0.0064 0.0019 0.0023 0.0036 0.0043 nan 0.0044 0.0096 0.0032 nan nan 0.0008 0.0004 0.0016 0.0064 0.0007 0.0 nan 0.0026 nan 0.0069 0.0026 0.0002 nan nan nan nan nan 0.0124
2 nan nan 0.0037 0.0057 nan nan 0.0007 0.0002 nan 0.0005 0.0004 0.0 nan nan nan 0.0001 0.0004 nan 0.0 0.0003 0.0016 nan nan 0.0 0.0017 nan 0.0 nan nan 0.0016 nan 0.001
3 0.0 0.0 0.0006 nan 0.0 nan nan nan 0.0004 0.0002 0.0058 0.0002 nan nan nan nan 0.002 nan nan nan 0.0008 0.0 0.0 0.0014 0.0001 0.0029 0.001 0.0007 0.0002 0.0 nan nan
4 0.0003 0.0002 nan 0.0 0.0001 0.0035 0.0009 0.0004 nan 0.0025 nan 0.0027 0.0006 0.0006 nan 0.0 nan nan 0.0002 nan 0.0 nan nan 0.0004 0.0 0.0 nan nan 0.0 nan nan nan
5 nan nan nan nan 0.0 nan 0.0031 nan 0.0 nan 0.0 nan nan nan nan 0.0 0.0003 nan 0.0002 0.0 0.0003 nan 0.0 0.0003 nan nan 0.0005 0.0001 nan 0.0 nan 0.0003
6 nan 0.0001 0.0 0.0002 nan 0.0 0.0 0.0025 nan nan 0.0002 0.0 nan 0.0003 nan 0.0 0.0 0.0008 nan 0.0019 0.0 nan 0.0001 nan -0.0002 0.0003 0.0 nan 0.0001 nan 0.0 0.0
7 0.0002 0.0003 nan 0.0 0.0 0.0 0.008 0.0003 0.0003 0.0 0.0 0.0 0.0 nan 0.0003 0.0 0.0003 nan nan 0.0005 0.001 0.0001 0.0 0.0 0.0005 0.0 0.0 0.0 0.0 nan 0.0 0.0
1 6 11 16 21 26 31

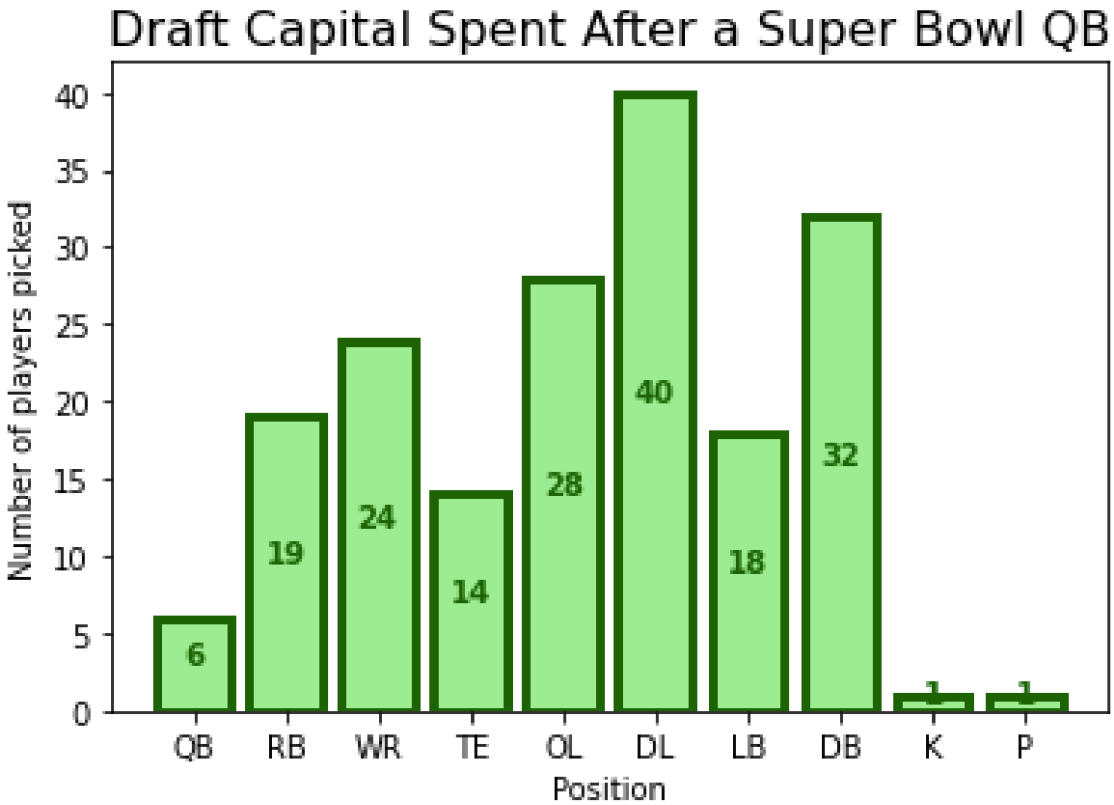

Year of First Super Bowl Win by QB (Adjusted)
Years until first Super Bowl win
0
2
4
6
8
1
2
2
5
3
4
3
9
2
2
1
1
Matthew Stafford
Patrick Mahomes
Russell Wilson
Joe Flacco
Aaron Rodgers
Drew Brees
Eli Manning
Peyton Manning
Ben Roethlisberger
Brad Johnson
Tom Brady
Trent Dilfer
Quarterback

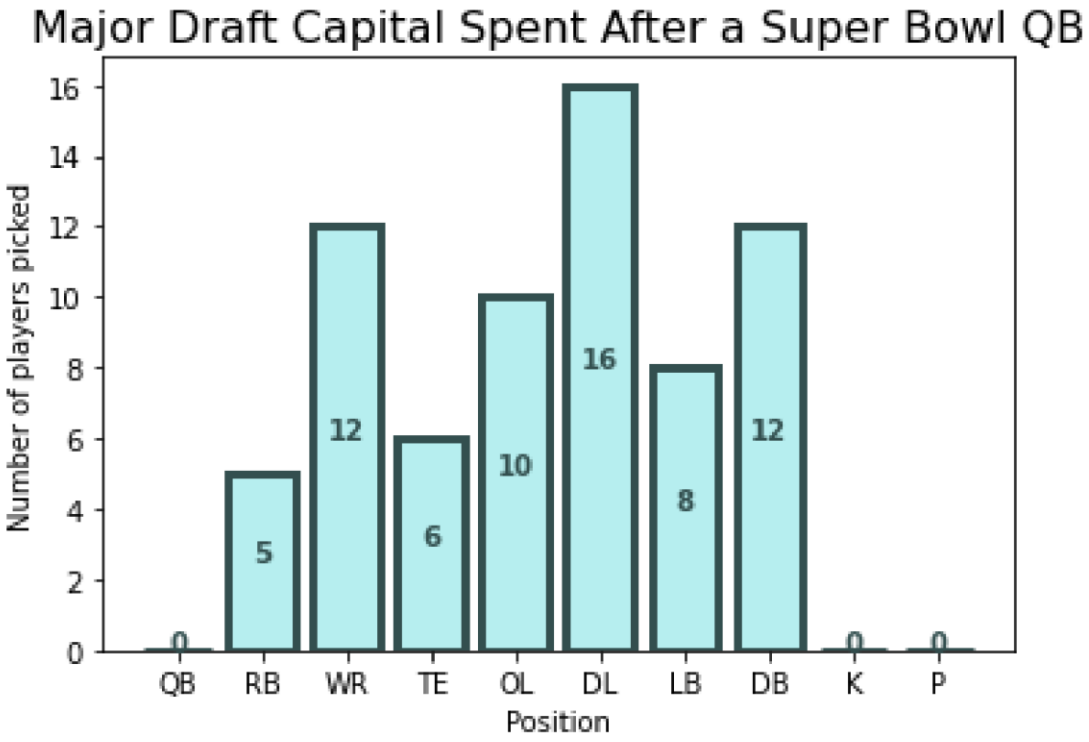

Year of First Super Bowl Win by QB
Years until first Super Bowl win
0
2
4
6
8
10
12
13
3
6
2
5
6
9
4
9
2
11
2
7
Matthew Stafford
Patrick Mahomes
Nick Foles
Russell Wilson
Joe Flacco
Aaron Rodgers
Drew Brees
Eli Manning
Peyton Manning
Ben Roethlisberger
Brad Johnson
Tom Brady
Trent Dilfer
Quarterback

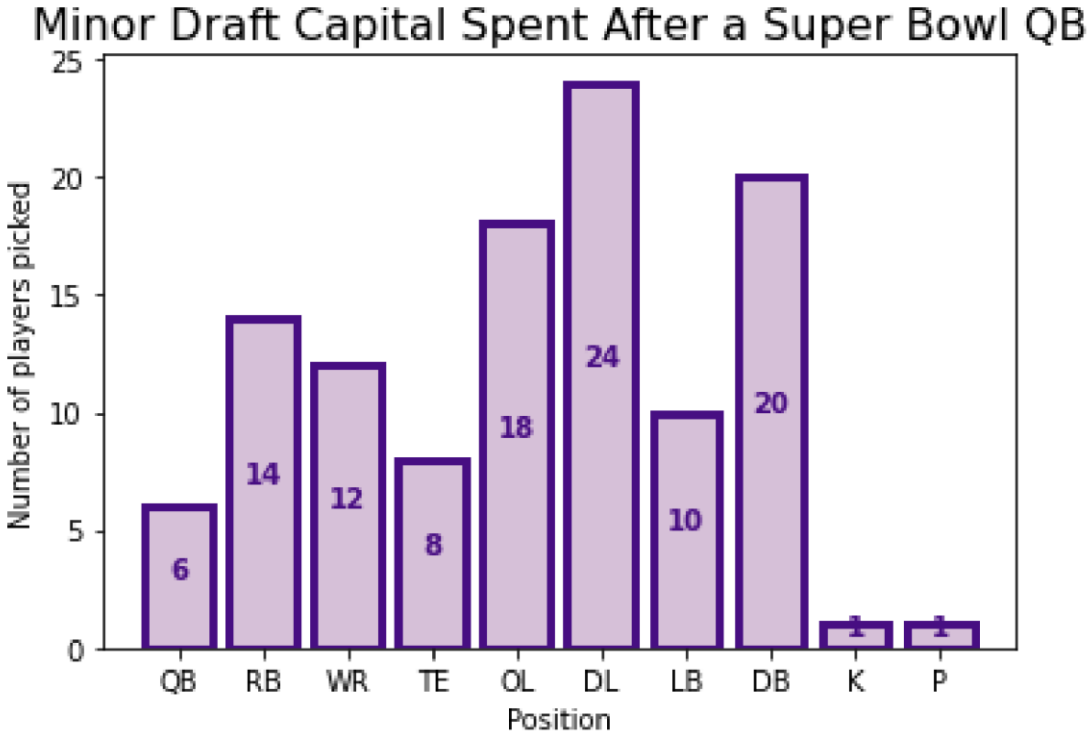

Draft Capital Spent Before a Super Bowl QB
Number of players picked
0
5
10
15
20
25
30
13
13
23
9
28
25
24
33
1
1
QB
RB
WR
TE
OL
DL
LB
DB
K
P
Position

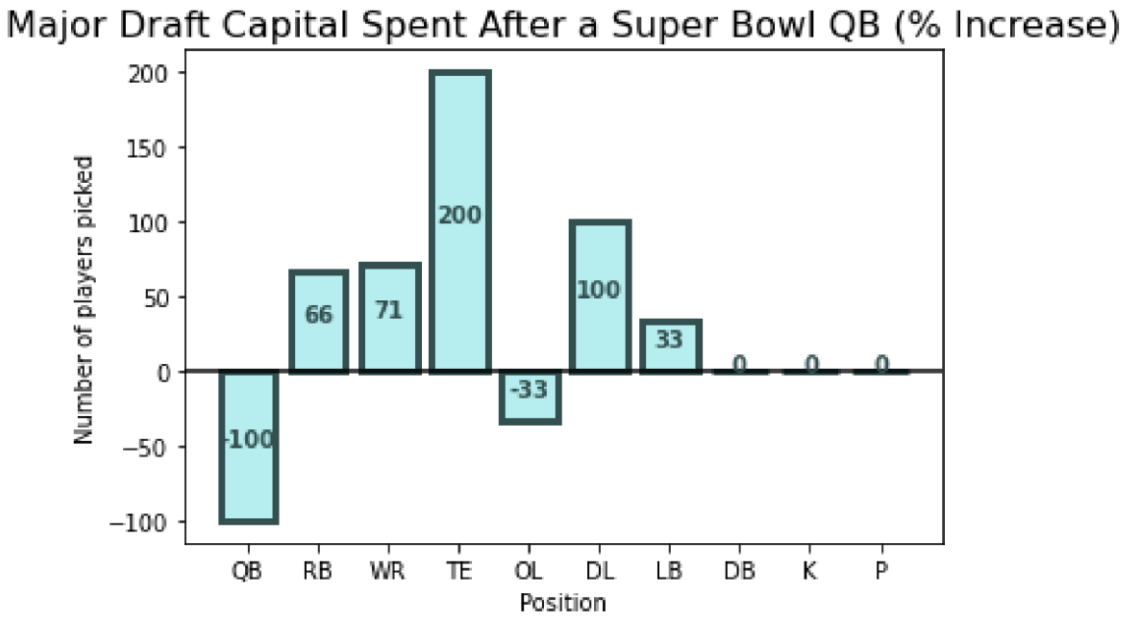

Major Draft Capital Spent Before a Super Bowl QB
Number of players picked
0
2
4
6
8
10
12
14
5
3
7
2
15
8
6
12
0
0
QB
RB
WR
TE
OL
DL
LB
DB
K
P
Position

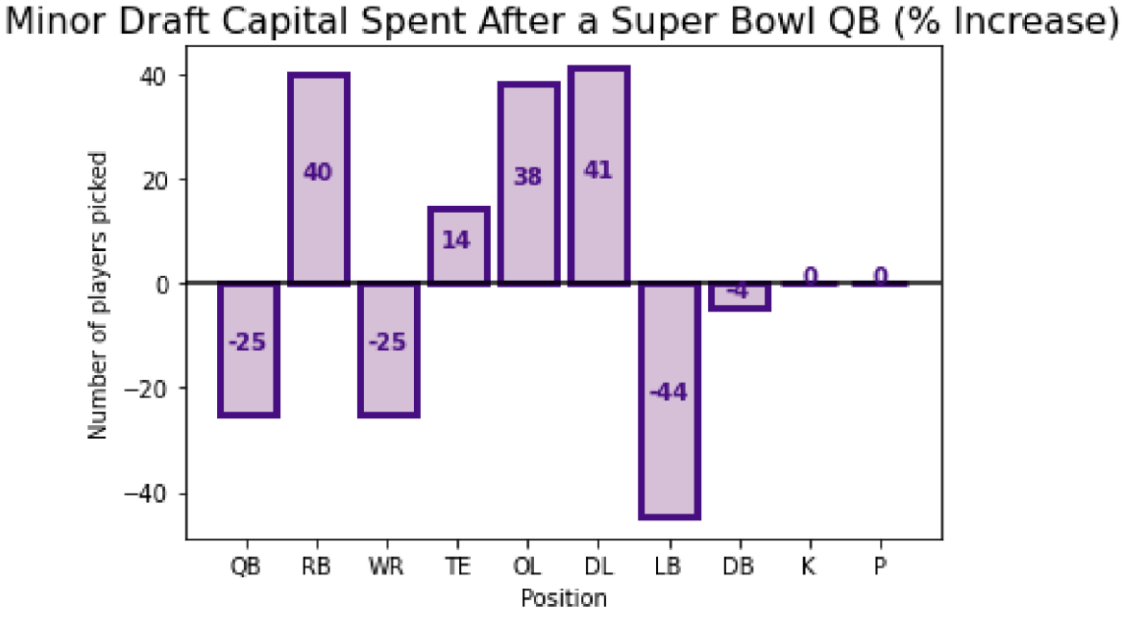

Minor Draft Capital Spent Before a Super Bowl QB
Number of players picked
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
8
10
16
7
13
17
18
21
1
1
QB
RB
WR
TE
OL
DL
LB
DB
K
P
Position


Draft Capital Spent After a Super Bowl QB
Number of players picked
0
5
10
15
20
25
30
35
40
6
19
24
14
28
40
18
32
1
1
QB
RB
WR
TE
OL
DL
LB
DB
K
P
Position

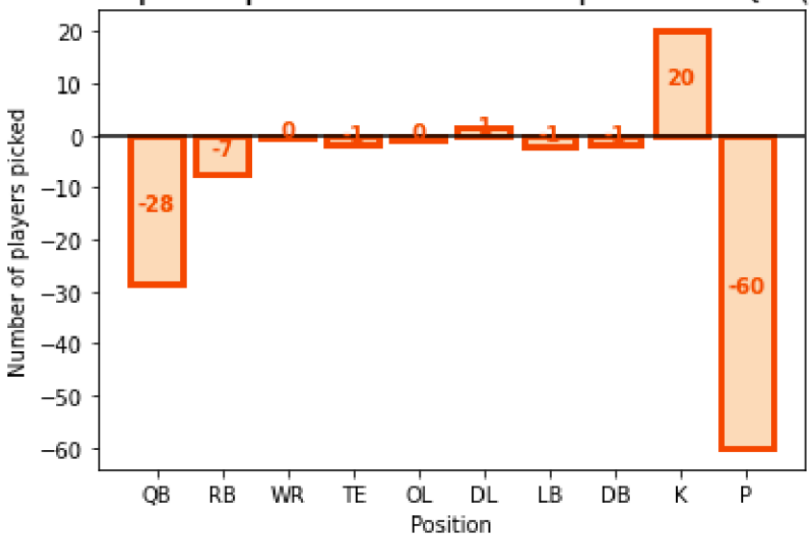

Major Draft Capital Spent After a Super Bowl QB
Number of players picked
0
2
4
6
8
10
12
14
16
0
5
12
6
10
16
8
12
0
0
QB
RB
WR
TE
OL
DL
LB
DB
K
P
Position


Minor Draft Capital Spent After a Super Bowl QB
Number of players picked
0
5
10
15
20
25
6
14
12
8
18
24
10
20
1
1
QB
RB
WR
TE
OL
DL
LB
DB
K
P
Position

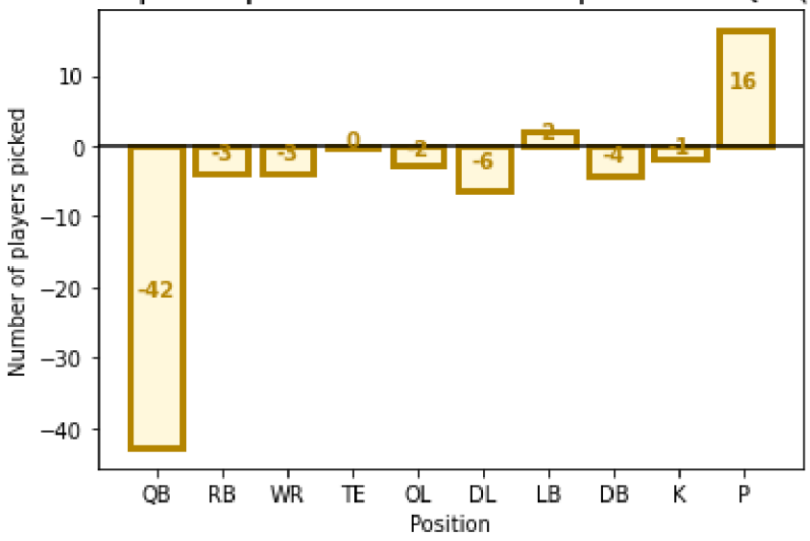

Major Draft Capital Spent After a Super Bowl QB (% Increase)
Number of players picked
200
150
100
50
0
−50
−100
-100
66
71
200
-33
100
33
0
0
0
QB
RB
WR
TE
OL
DL
LB
DB
K
P
Position

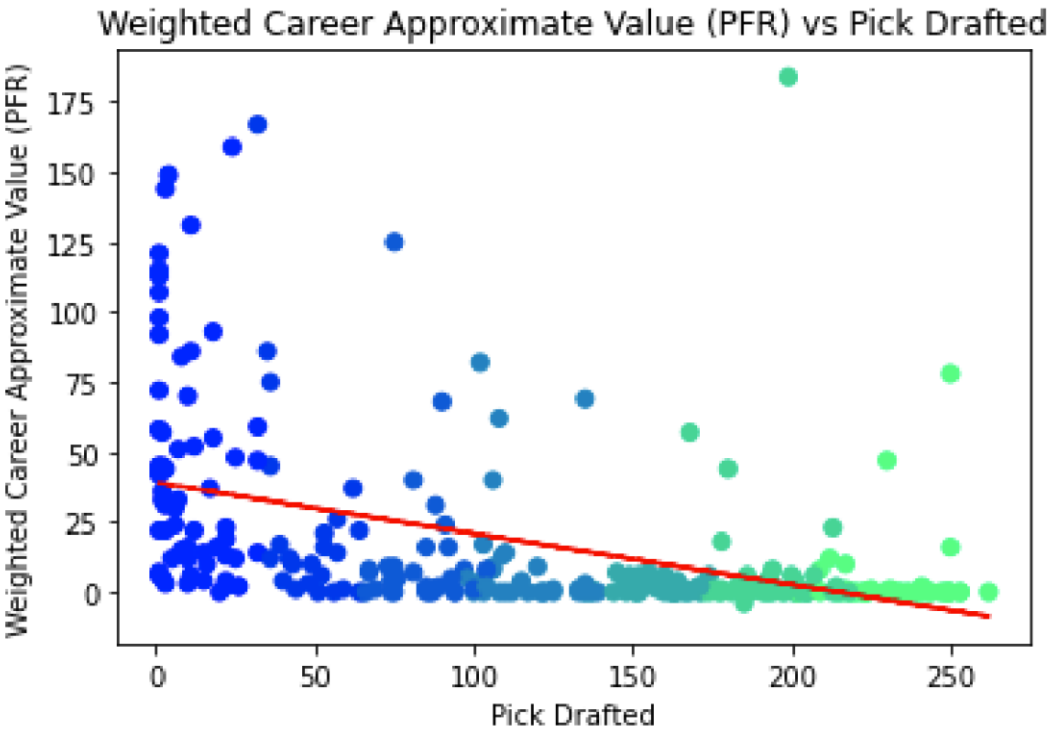

Minor Draft Capital Spent After a Super Bowl QB (% Increase)
Number of players picked
40
20
0
−20
−40
-25
40
-25
14
38
41
-44
-4
0
0
QB
RB
WR
TE
OL
DL
LB
DB
K
P
Position

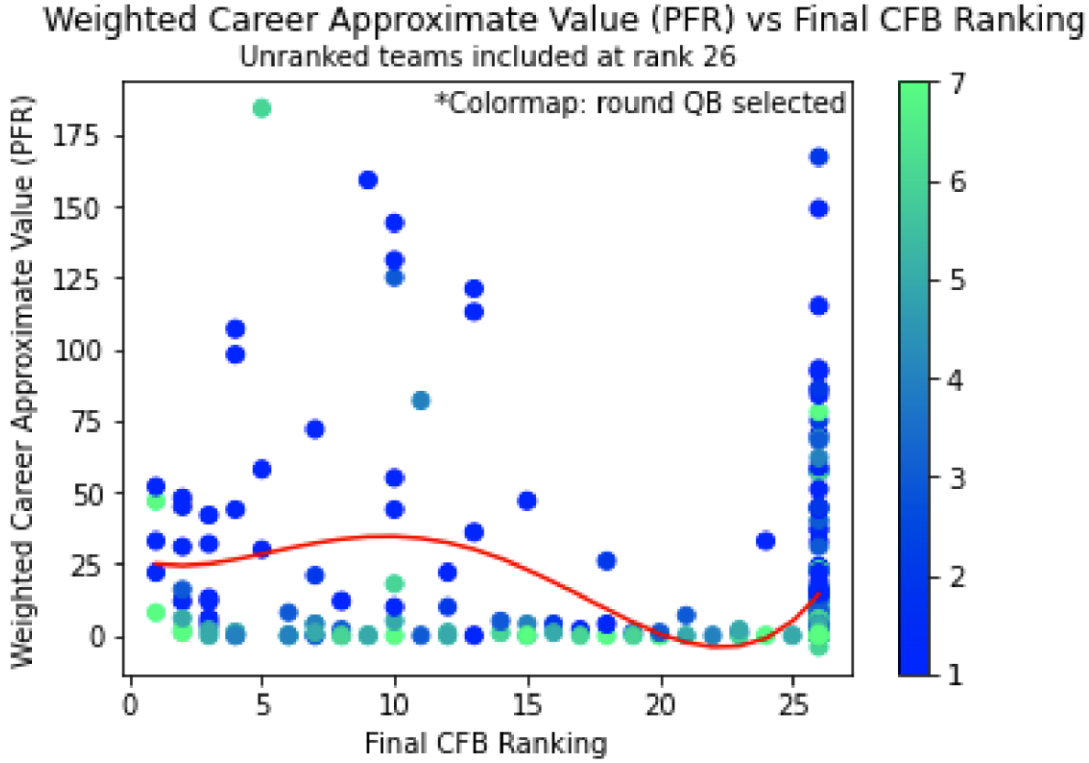
Major Draft Capital Spent After a Non Super Bowl QB (% Increase)

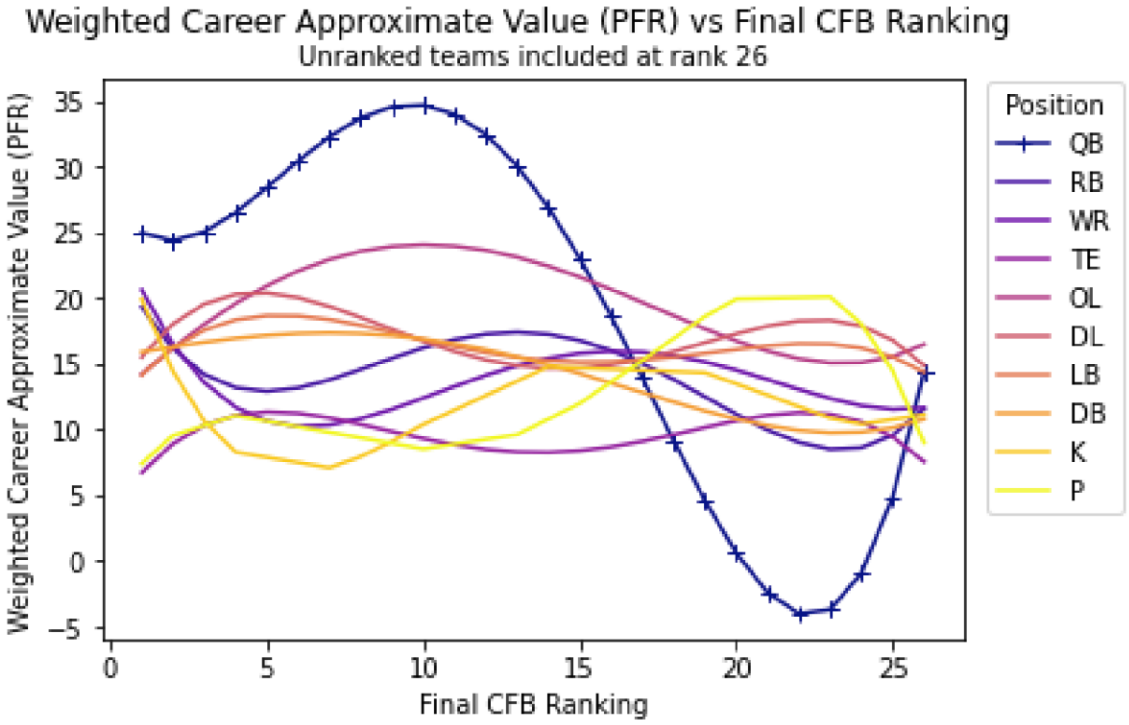


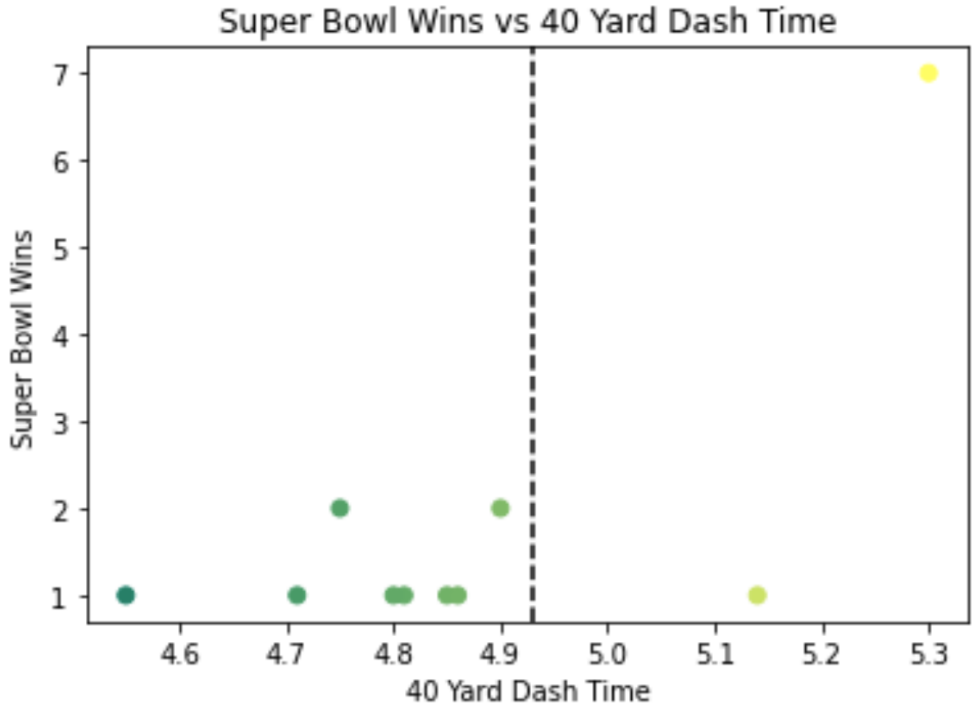
Minor Draft Capital Spent After a Non Super Bowl QB (% Increase)

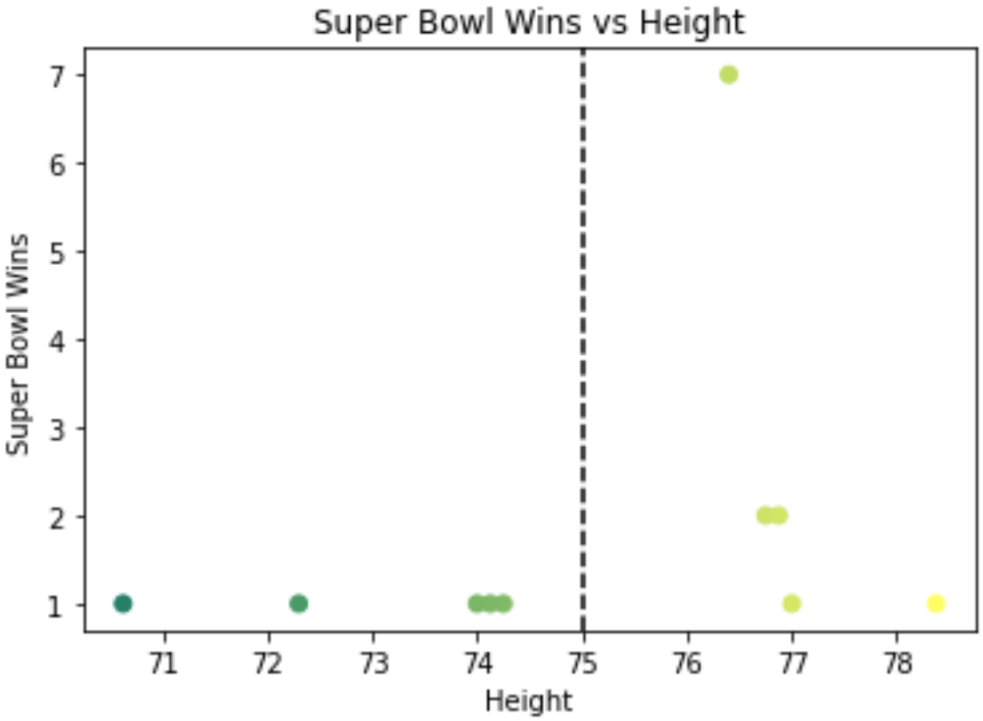



Weighted Career Approximate Value (PFR) vs Pick Drafted
Weighted Career Approximate Value (PFR)
175
150
125
100
75
50
25
0
0
50
100
150
200
250
Pick Drafted


Weighted Career Approximate Value (PFR) vs Final CFB Ranking
Unranked teams included at rank 26
*Colormap: round QB selected
Weighted Career Approximate Value (PFR)
175
150
125
100
75
50
25
0
0
5
10
15
20
25
Final CFB Ranking
7
6
5
4
3
2
1


Weighted Career Approximate Value (PFR) vs Final CFB Ranking
Unranked teams included at rank 26
Weighted Career Approximate Value (PFR)
Final CFB Ranking
Position
QB
RB
WR
TE
OL
DL
LB
DB
K
P


Super Bowl Wins vs 40 Yard Dash Time
Super Bowl Wins
40 Yard Dash Time


Super Bowl Wins vs Height
Super Bowl Wins
Height
1
2
3
4
5
6
7
71
72
73
74
75
76
77
78