Salary Cap Allocation to the Right Quarterbacks

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Introduction-

The National Football League is by far the most valuable sports league on the planet. Its 32 teams combine for a value of $163 billion (Berkley, 2023). In other words, if all 32 teams merge into one company, it would be the 58th richest country in the world, ahead of tech giants like Adobe, Verizon, and Netflix (Dyvik, 2023). But with all this money comes a sense of urgency. Over the last five years, $800 million have been spent on fired coaches and front office staff, including the Tennessee Titans cutting ties with Jon Robinson, their general manager who had signed a four year extension just months prior to his firing (Shefter, 2022).

The best way to assure job security is to win. Of the seven coaches fired after the 2021 season, only one, Brian Flores of the Miami Dolphins, was fired after a winning season, and his departure came with a lot of criticism and controversy (Sports Reference, 2023). However, winning in the NFL is no easy task; there is a reason football fans live and die by the saying ‘any given Sunday.’ One way teams can gain a competitive advantage is through manipulating the salary cap, the fixed number of money each team is allowed to spend on their players for a season. For example, Eagles GM Howie Roseman signed quarterback Jalen Hurts to a record five year, $255 million dollar contract in the offseason following 2022, but the structure of the contract allows for Hurts to not account for more than $22 million, or 10%, against the Eagles’ cap hit until 2026 (Spotrac, 2023). Time and time again, the quarterback has been proven as the most important position on the football field, including by Wharton School statistics professors Jason Mulholland and Shane T. Jensen (Mulholland & Jensen, 2019). Knowing the importance and significance of quarterback play and the salary cap on team success, my question is can I create a model that can be used to predict how good a team will be given their quarterback, how good he is, and how much you have to pay him?

Why is this important?

For starters, if I can solve salary cap allocation in the National Football League I would be a millionaire instantly, and a proud owner of a Super Bowl ring. More importantly, a model that can accurately predict a team's success could save people's jobs. Following the 2016 season, Derek Carr of the then Oakland Raiders signed a five year, $125 million contract, making him the highest paid player in the NFL (NFL, 2017). The timing of Carr's contract was interesting, as he led the Raiders to a 12-3 start before breaking his leg on Christmas Eve, dropping out of the MVP conversation and leaving Connor Cook to start in the team's road playoff game against the 9-7 Houston Texans, which they lost (Associated Press, 2017). With Carr returning to full health ahead of the 2017 season, aspirations were high for head coach Jack Del Rio and GM Reggie McKenzie.

However, no fairy tail story was told in Oakland over Derek Carr's five year contract. Quite the opposite in fact, as Jack Del Rio would be fired following the Raiders 6-10 campaign in 2017 (Greenspan, 2018). Offensive guru Jon Gruden was hired as HC in replacement of Del Rio to bring Carr back to his near MVP form, but Gruden had no success either.

Over the course of his record setting contract, the Raiders and Carr failed to even make the playoffs until year five, when Carr helped guide the Raiders to a 10-7 season and Wild Card berth where they lost to the Cincinnati Bengals. That 2021 season was the lone winning season during the contract, with a total record of 35-46 over the five seasons (Sports Reference, 2023). After the completion of the 2021 season, Carr was the quarterback for the firing of Jon Gruden during the 2021 season, the release of interim Head Coach Rich Bisaccia, the firing of GM McKenzie in 2019, and the firing of his replacement Mike Mayock following 2021 (Sports Reference, 2023).

Using Derek Carr as a case study, it becomes apparent that you cannot just throw money at a star player, or someone you believe is a star player. While Carr received the full amount of money he signed on the dotted line for, he never won a playoff game. Head Coaches and General Managers were used as the scapegoat, but I argue the root of the problem is salary cap allocation, especially for a quarterback who never 'passed the eye test'. A large variable in my research is figuring out how to measure the impact of a quarterback. Carr made one Pro Bowl during his five year contract, and threw for 4,200 yards once, but these statistics are handpicked and by no means convey the whole story.

What do the experts say?

One journal article I read aims to find and explain patterns in teams that spend their money more evenly and teams that invest a lot of money into their star players. For Texas State researcher Richard Borghesi, he chose to calculate the relationship of player compensation to player production through observed data creating a numerical value with draft round, age, experience, games played, games started, and Pro Bowls. The ultimate goal of the paper is to suggest what positions are worth investing your money into, being less concerned with individual performance relative to the pay and focusing on the aggregate. His final model is a calculation of each position accounting for outstanding variables such as injuries, and the outcome is that the relationship between positional spending and team success is most prominent at the quarterback, tight end, and defensive line positions (Borghesi, 2008). This paper was published in 2008, but it seemingly predicted the future as the Super Bowl winning 2022 Kansas City Chiefs were led by highest paid QB and league MVP Patrick Mahomes, 1st team All-Pro TE Travis Kelce, and highest paid non QB and 1st team All-Pro DT Chris Jones (Foote, 2023).

Another journal article I read was by Jason Mulholland and Shane T. Jensen, in which they run similar testing to that of Borghesi, while also acknowledging and considering the rookie pay scale. Borghesi's article was published in 2008, a few years ahead of the revised CBA, which introduced the biggest change to roster building philosophy since the addition of the salary cap. The addition of the rookie pay scale meant that 2011 first overall pick Cam Newton was locked into a predetermined contract, four years, $23 million, preventing him from signing a contract similar to Jamarcus Russel's six years, $68 million from a few years prior as the league's top draft choice (Gold & Mestel, 2019). With rookies locked into team friendly contracts, maximizing the first four years of a star players rookie contract can be a key factor in winning the Super Bowl. Mulholland and Jensen suggest that due to the emergence of quarterback Russell Willson still on his rookie contract, and a plethora of players outperforming their rookie contracts (Richard Sherman, Bobby Wagner, Golden Tate, Doug Baldwin, Malcolm Smith, K.J. Wright, Byron Maxwell, Walter Thurmond, J.R. Sweezy), the 2013 Seattle Seahawks were able to take of business and win the Super Bowl. Mulholland and Jensen further observed 'uncompensated wins,' or wins above what is expected relative to the player's cap hit. Between the 2011 and 2015 seasons, Russell Wilson ranks first in uncompensated wins per season (4), and Cam Newton is second (2.5). Among the top 10 are five other quarterbacks on rookie contracts, Teddy Bridgewater is fourth (2), Andy Dalton is sixth (1.8), Jameis Winston is eighth (1.7), Derek Carr is ninth (1.6), and Ryan Tannehill is tenth (1.4) (Mulholland & Jensen, 2019). Having a quarterback on a rookie contract seems like the ultimate cheat code, and to a certain extent it is. There have been 12 Super Bowls since the rookie pay scale was introduced, only the 2011 matchup between the triumphant Eli Manning knocking off Tom Brady for a second time, and the 2016 masterclass from Tom Brady leading his team from a 28-3 deficit against Matt Ryan

being the two matchups without a quarterback on a rookie contract. However, a quarterback on a rookie contract has only three times. Joe Flacco defeated Colin Kaepernick in a matchup of rookie QB contracts, the following year Russell Wilson's 2013 Seahawks manhandled the Denver Broncos, and 2019 saw Patrick Mahomes defeat the San Francisco 49ers with Jimmy Garappolo at the helm. The 2017 season presents itself as an outlier, as second year star quarterback Carson Wentz tore his ACL and was sidelined for Super Bowl LII, which saw Nick Foles (signed to a veteran contract worth less than Carson Wentz) complete the underdog story and outclass the Goliath that is Tom Brady. If you count the one-two punch of Carson Wentz and Nick Foles as a rookie QB contract winning the Super Bowl, that's four of twelve, or 33% of Super Bowls won by a signal caller whose pay doesn't match their production (Shoefield, 2023).

In their journal article "NFL Salary Cap Allocation: Matching Theory with Observed Behavior," IUP professors Chris Jeffords and Todd Potts operate in the theoretical world, creating a model to best allocate salary across the offense, defense, and specialists (kicker, punter and long snapper). The professors draw from previous work, and test how much money teams should actually allocate to specific positions. Most researchers, including Mulholland and Jensen, agree that 15% of a given team's salary cap is the optimal amount to assign to the starting quarterback (Mulholland & Jensen, 2019), but Jeffords and Potts built a model in an attempt to test that theory. Ultimately, their data concludes that teams are slightly overspending at the quarterback position, and need to spend slightly more at the cornerback position (Jeffords & Potts, 2019).

There are three other articles that I looked into for my research that still offer great insights even though they are not peer reviewed. Firstly, undergraduate student Prasad Gosavi of the University of Connecticut aimed to make a model very similar to mine, starting with the

question “Is it possible to determine a correlation between a NFL team’s winning percentage and the percentage of their salary cap dedicated to their starting quarterback” (Gosavi, 2022). This lead Gosavi down the path of using percentage of the salary cap paid to the starting quarterback, and two controlled variables, interconference win percentage, and strength of schedule, to answer the question. Unfortunately, Gosavi was not able to determine a true correlation given the data set and resources presented to them. Kenneth Goit, another undergraduate student researcher from Middle Tennessee State, tackled the salary cap question from a completely different side. They specifically looked at quarterbacks signed on the open market in free agency, where players have higher amounts of leverage and teams know less about the player they are writing eight or nine figure checks to. Goit concludes that signing a starting quarterback in free agency is typically not beneficial for the NFL franchise, going as far as saying that unless you have a quarterback who is “truly elite,” you might be better off trying your luck again at a new quarterback on a rookie deal (Goit, 2018). There is certainly evidence to support that, but it can also be easily refutable. The San Francisco 49ers traded three first round picks to move up in the draft to select Trey Lance 3rd overall in 2021, but after two seasons, the team opted to move forward with 2022 ‘Mr. Irrelevant’ Brock Purdy. The once hailed ‘chosen one’ was traded to the Dallas Cowboys for a mere 4th round pick (DeArdo, 2023). Countless other recent examples include Sam Darnold and Zach Wilson on the Jets, Johnny Maziel, Brandon Weeden, and Baker Mayfield on the Browns, Malik Willis of the Titans and Josh Rosen of the Arizona Cardinals to name a few (Gaines et al., 2023). Interestingly, Goit chooses to create their own measurement of QB production, calling the weighted aggregation of various traditional stats Quarterback Productivity Rating, or QPR. Lastly, I looked into a Ringer article by Kevin Clark, a well known NFL writer. Intriguingly, he looked into the top two combined salaries of championship teams.

At the time of writing, in 2019, only the 1994 49ers have won the Super Bowl tying up over 21.5% of their cap into 2 players. The 2016 Falcons, with Julio Jones and Matt Ryan, came one first down short of winning the Super Bowl while combining for nearly 25% of the cap (Clark, 2019). However, since 2019, the 2022 Chiefs completely shattered this phenomenon, with Patrick Mahomes and Chris Jones combining for 31.2% of the teams salary cap (Spotrac, 2023).

Methods-

While prior research has centered around how much and where to allocate resources on a macro level, I want to attack the problem from a different angle. Instead of how much money is the right amount to assign to each position, especially at the quarterback position, is the player fit for the money on an individual basis? Just because data analysis says you should pay your quarterback 15% of your salary cap doesn't mean you should pay any starting quarterback 15% of your salary. If you want to win, specifically in January and February, you better pay the right quarterback.

To do this, I have created a model that can project how many wins a team will have in the regular season, and how they will perform in the playoffs. My model uses three dependent variables to test against my independent variable. The dependent variables I have chosen are Pro Football Reference's Approximate Value to measure the production of a quarterback, Defensive-Adjusted Value Over Expected to measure the team's defense, and the percentage of the salary cap the starting quarterback takes up (Cap%) to measure QB pay.

Approximate Value, or AV, is defined as "an attempt to put a single number on the seasonal value of a player at any position from any year (since 1960)" (Sports Reference, 2023).

AV is by no means the perfect number for evaluating a player, but it serves as a concise data point to differentiate between the skill and impact a player has over a season.

Defensive-Adjusted Value Over Expected, or DVOA, is “a method of evaluating teams, units, or players. It takes every single play during the NFL season and compares each one to a league-average baseline based on situation… Performance is also adjusted for the quality of the opponent” (Schatz, 2023). In other words, DVOA is an advanced analytic that assigns a percentage above or below the league average taking into account opponent, situation, and other factors beyond just the box score. It is important to note that a negative DVOA indicates a defense performing above the average, with the teams furthest away from 0 being the ones with the best defenses.

Measuring salary cap can be tricky, because every NFL team operates under a slightly different salary cap. Teams can rollover some of the money they don’t spend one year over to the next. For example, the league salary cap in 2023 will be $224 million, but adjusting for rollover, the Houston Texans will have a maximum of $231 million to spend (Spotrac, 2023). In figure 1, you can see this quirk, as 2022 Dak Prescott is paid slightly more than 2022 Derek Carr, but Carr takes up a slightly higher percentage of the salary cap.

Figure 1 also shows my raw data, where you can see the past three years of the top 10 highest paid quarterback charted. To start, I only charted the number of playoff games won by the quarterback in the given season, but this left me unsatisfied. Firstly, in the example of Kirk Cousins and Jared Goff last year, neither one of the NFC North quarterbacks won a playoff game, but Kirk Cousins at least made the playoffs. To account for this, I made a dummy variable, where 1 means the quarterback made the playoffs, and 2 means he did not. However, this still doesn't account for a quarterback who failed to win a playoff game, but had enough regular

season success to warrant a first round bye, such as 2021 Aaron Rodgers. To account for this, I once again pivoted, moving my data set to a scale of 0 to 5, where 0 means the quarterback missed the playoffs, 1 means the quarterback lost on Wild Card weekend, 2 means the quarterback lost on Divisional Round weekend, 3 means the quarterback lost in their Conference Championship game, 4 means the quarterback lost in the Super Bowl, and 5 means the quarterback won the Super Bowl.

Results-

Using Figure 1, I made two regression equations, one using regular season wins as the independent variable, and the other using playoff round as the independent variable. Figures 2 and 3 show these two regression equations. Note that because Cap% and DVOA are percentages, their coefficients need to be divided by 100 to be accurately explained. You can see the updated figures at the end of the tables highlighted in yellow.

Immediately, Figure 2 and 3 give us some interesting results. Using the adjusted R squared, about 59% of the variation in regular season wins and about 47% of the variation in playoff success can be explained by how good and how much you pay your quarterback, and how good your defense is. Surprisingly, Figure 2 suggests that QB Cap% has almost 0 impact on team success, requiring a raise in the amount of salary cap assigned to quarterback to be 29 percentage points just to add one win to the final season total. In the last three years, no team has spent more than 17.4% (2021 Seattle Seahawks, Russell Wilson) of their salary cap on their quarterback, suggesting 29% would be an impossible number. Alarmingly, adding 29 percentage points gives the team an extra win, when in reality, teams should expect many less wins the more

they spend on the quarterback, especially when the quarterback takes up almost a third of all spendable money.

Where the model shines is in its perception of QB and defensive impact and on team success. In the regular season model, a quarterback with one better AV point adds almost half a win to the team's season. In 2022, Josh Allen was tied for the league lead in AV with 20, while Tua Tagovailoa only had an AV of 12. My model suggests that if everything else was equal, the quarterback play of 2022 Josh Allen would yield almost 4 more wins than if 2022 Tua Tagovailoa was calling the shots. As for the defense, upon first glance, it appears that defenses impact team success significantly less than quarterbacks do. However, the scale of DVOA is larger than AV, thus it is easier to gain or lose a percentage point of DVOA than AV. Refer to figure 4, where Joe Average is the baseline of an average quarterback with an average defense, average salary, and average production. Joe Defense uses everything at the average baseline, except Joe Defense has the highest graded defense of 2022, the 49ers (FTN Fantasy, 2023). Joe Defense is projected about 10.5 wins. Joe Amazing is the same baseline quarterback, only his production is the highest graded from the 2022 season (Josh Allen and Jalen Hurts shared the highest AV from the 2022 season), and he is projected about 2 extra wins. In short, my model suggests that having the best quarterback is more important than having the best defense, but only by about half as much as the difference between having Tua Tagovailoa and Josh Allen or Jalen Hurts.

Figures 4 and 5 show a test of my model, where I used data from five different quarterbacks to see how accurate my model is. Jalen Hurts was chosen due to his rookie contract and league leading success, although the maximization of his paycheck is not accurately explained in my model. Josh Allen was chosen due to his success combined with his average

contract. Josh Allen played the 2022 season in the second year of his six year, $258 million contract. However, due to salary cap manipulation, the Bills pay Josh Allen under $20 million against the salary cap until 2024, where his salary cap hit jumps above $45 million for the remainder of the contract (Spotrac, 2023). Daniel Jones was chosen as the quarterback I felt was the closest to average from the 2022 season. Tua Tagovailoa was selected to see how the model would account for injury, however in hindsight the only metric the model can use for that is how Pro Football Reference changes its calculation of AV for the player. Davis Mills was selected to see how the model interprets a bad quarterback on a bad team.

Also in figures 4 and 5 are hypothetical players. Expanding on the explanation of Joe Average, Joe Money, Joe Defense, Joe Amazing and Joe No, they are controlled cases to test how my model reacts to each variable. Joe Average hits every average across the board. 5% was chosen as the Cap% in part because of its simplicity. There is no good number from past data to use, but 5% is around the average salary cap of an average quarterback. My justification is in 2021, Ryan Tannehill was paid 5.83% of the salary cap and Jared Goff was paid 5.39% of the salary cap, and both had about average seasons (Spotrac, 2023). DVOA is at 0 because 0 is the baseline for DVOA, and an AV average of 10 is also subjective. My rationale for this was looking through assigned Approximate Values of 2022 quarterback, highlighted by Jimmy Garappolo with an AV of 10 (Sports Reference, 2023).

In figures 4 and 5, Joe Average produces about 8 wins and fits right in the middle of missing the playoffs and losing in the Wild Card round. These results align themselves perfectly with being average. Joe Money, using the highest QB salary in 2022, outputs a slightly better performance, which is obviously not an ideal result. Joe Defense, again using the 49ers #1 defense from 2022, produces a winning season, and even reaches the Divisional round of the

postseason. Joe Amazing gets more wins in the regular season, but still is projected to lose in the Divisional Round as defenses shine more in the playoffs than the regular season.

Figure 6 shows the observed real life results from the 2022 season, compared to the predictions from my model. Jalen Hurts perfectly hits his projections, however he would rather have gotten the ball back in the Super Bowl in an effort to win than to perform how the model projected. Josh Allen's asterisk is due to the incompletion of his game against the Cincinnati Bengals, however a win in that Monday Night game would have been his 14th of the season. In his playoff game against the Bengals, one could argue that he and his team underperformed, leading to an early exit. The opposite can be said for Daniel Jones and the New York Giants, whose 9 win season earned them a Wild Card appearance against the 13 win Vikings. In the playoffs, where randomness is heightened, Daniel Jones earned the win, advancing him to the second round where he fell to the Philadelphia Eagles. Tua Tagovailoa did not play in his playoff game due to injury, however the Miami Dolphins overall season perfectly matched the model. The 2022 Houston Texans and quarterback Davis Mills break the model. His poor play on a bad team cannot be accurately measured by model.

Discussion-

I hypothesize the problem here is the training data. The model only works with three years worth of data, and only the top 10 highest paid quarterbacks. Top 10 quarterbacks are not expected to lose a lot of games, nor should they perform badly. The baseline for my model, the intercept coefficient for regular season wins, is just over 4. To perfect the model, the baseline should be as close to 0 as possible. And the same can be said for the postseason model, whose intercept coefficient is -1.5. These numbers are the reason that Davis Mills is projected twice as

many wins as he actually won, and why Davis Mills is projected a negative chance to even make the playoffs.

Another key contributor to the training data problem is that the 11th highest paid quarterback in 2020 was Colts backup Jacoby Brissett, who threw a total of 8 passes all year. Colts GM Chris Ballard entered scramble mode once Pro Bowl QB Andrew Luck surprisingly retired just weeks before the 2019 season. One move he made was signing Jacoby Brissett to a lucrative contract for Brissett, but one that would handicap the Colts. Ballard attempted to keep the teams' championship window open, signing Phillip Rivers as the third highest paid QB in 2020, but the team failed to even make the playoffs, and had two quarterbacks rostered at over $20 million against the salary cap (Mock, 2022).

I want to shame the teams and GMs who have thrown and continue to throw all their eggs into the wrong basket. At what point do you give up on your quarterback who wants too much money for the talent he offers? Derek Carr had the Raiders at 12-3 while making drops in the bucket, but general manager Reggie McKenzie believed Carr could do the same while being the league's highest paid player, and ultimately that mindset cost him his job.

Until Justin Jefferson's burst onto the scene as an All-Pro receiver on a rookie contract, the Vikings, handicapped by Kirk Cousins being a top paid QB, had sporadic success at best. Even with Justin Jefferson, the Vikings have yet to win a playoff game. Since Kirk Cousins' tenure started in 2018, the Vikings have two playoff appearances, including one win over the New Orleans Saints in overtime in 2019. Cousins is widely regarded as a good quarterback, but his large cap hit prevents the Vikings from building a team around him that can win in January (Sports Reference, 2023).

Future Work-

I decided to run one final test in my battles with a model that doesn't understand the salary cap. Interestingly, in figure 7 and 8, which omit Cap% as a variable all together, the adjusted R squared in regular season wins goes up to 60% and the variation in playoff success jumps to 49%. This would suggest that Cap% actually throws off my model more than it helps my data.

And honestly, what if for years economists and fans alike have overvalued salary cap manipulation? In 2022, the highest paid quarterback won the Super Bowl. In 2021, the ninth highest paid quarterback (who was acquired via trade and therefore pay was split between two teams) won the Super Bowl. In 2020, the fourth highest paid quarterback won the Super Bowl. That guy's name is Tom Brady, who won 7 Super Bowls. It seems having the right guy is the most sure fire way to be in contention for the Lombardi Trophy each year. But for everyone else, every team that does not have the retired Tom Brady or the guy chasing after his legacy, Patrick Mahomes, you have to be careful with how you spend your money.

My model is not perfect, quite far from it, but I have identified ways to make the model even better. The perfect solution is to use data points that are more advanced and accurate. AV could solve the problem of Davis Mills and the 2022 Houston Texans if the stat went both negative and positive like DVOA does, but what about a successful attempt at calculating Wins Above Replacement (WAR) like baseball has?

Joe Schoen signing Daniel Jones to a four year, $160 million was the impetus behind my research (Camenker, 2023). As a fan, I felt the Giants signed away their future. I believed that a quarterback of the talent and production of Daniel Jones taking up so much money is no more beneficial than backups Tyrod Taylor or Tommy Devito could be making next to nothing against

the salary cap. So far in 2023, Jones has been plagued with injuries, and in place of him Tyrod Taylor and Tommy Devito have added a spark to their offense, seemingly proving my belief that the Giants would be better off without Daniel Jones and with an extra $40 million. A successful attempt at creating a stat like WAR would be crucial for future work, allowing you to calculate how important Jones is to the Giants, and thus how much they should pay him.

I also think other elements of the salary cap should go into the model. How much money goes into the defense? What about incorporating 'uncompensated wins' from Mulholland and Jensen? The 2022 Philadelphia Eagles benefited greatly from Jalen Hurts being paid under 1% of the salary cap, Devonta Smith, Jordan Davis, Reed Blankenship and Landon Dickerson on rookie contracts.

Ultimately, there is no perfect philosophy for roster construction or salary cap allocation. The real world is not a model. The real world is not made of numbers. The real world is one simulation. A simulation made of unique humans unquantifiable to the most advanced super computers. Even 2022 Patrick Mahomes is significantly different from 2023 Patrick Mahomes. However, recent advanced analytics have helped teams decide what to do on 4th down from a mathematical standpoint, so what's stopping the analytics community from achieving a similar level of support with roster construction?

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Appendix-

Team	Year	Rank	Player	Cap Dollars	Cap%	Playoffs?	Wins	Playoff Round	Reg Wins	AV	DVOA
KC	2022	1	Patrick Mahomes	$35,793,381	17.16%	1	3	5	14	19	-2.0%
MIN	2022	2	Kirk Cousins	$31,416,668	14.98%	1	0	1	13	13	5.9%
DET	2022	3	Jared Goff	$31,150,000	14.31%	2	0	0	9	16	7.2%
GB	2022	4	Aaron Rodgers	$28,533,569	13.25%	2	0	0	8	13	6.1%
WAS	2022	5	Carson Wentz	$28,294,119	13.22%	2	0	0	8	4	-4.4%
BAL	2022	6	Lamar Jackson	$23,016,000	11.23%	1	0	1	10	12	-9.1%
DAL	2022	7	Dak Prescott	$19,730,000	8.96%	1	1	2	12	11	-10.6%
LV	2022	8	Derek Carr	$19,375,000	9.36%	2	0	0	6	12	10.7%
CAR	2022	9	Sam Darnold	$18,858,000	8.84%	2	0	0	7	4	2.6%
IND	2022	10	Matt Ryan	$18,705,882	8.79%	2	0	0	4	7	1.3%
SEA	2021	1	Russell Wilson	$32,000,000	17.40%	2	0	0	7	12	1.4%
MIN	2021	2	Kirk Cousins	$31,166,666	16.64%	2	0	0	8	13	0.9%
GB	2021	3	Aaron Rodgers	$27,073,568	14.54%	1	0	2	13	15	-2.4%
ATL	2021	4	Matt Ryan	$26,912,500	14.55%	2	0	0	7	10	12.9%
SF	2021	5	Jimmy Garoppolo	$26,400,000	13.49%	1	2	3	10	12	-10.2%
PIT	2021	6	Ben Roethlisberger	$25,910,000	13.82%	1	0	1	9	9	-0.6%
LV	2021	7	Derek Carr	$22,125,000	11.63%	1	0	1	10	12	-1.0%
IND	2021	8	Carson Wentz	$21,305,882	11.15%	2	0	0	9	14	-3.3%
LAR	2021	9	Matthew Stafford	$20,000,000	10.69%	1	4	5	12	15	-12.1%
DAL	2021	10	Dak Prescott	$17,200,000	8.19%	1	0	1	12	14	-11.4%
SEA	2020	1	Russell Wilson	$31,000,000	15.53%	1	0	1	12	17	-2.5%
LAR	2020	2	Jared Goff	$28,842,682	14.15%	1	1	2	10	10	-15.3%
IND	2020	3	Philip Rivers	$25,000,000	10.42%	2	0	0	11	13	3.6%
TAM	2020	4	Tom Brady	$25,000,000	12.25%	1	4	5	11	15	-12.4%
PIT	2020	5	Ben Roethlisberger	$23,750,000	11.83%	1	0	1	12	10	-18.9%
NO	2020	6	Drew Brees	$23,650,000	11.94%	1	1	2	12	10	-18.1%
TEN	2020	7	Ryan Tannehill	$22,500,000	10.21%	1	0	1	11	16	9.5%
GB	2020	8	Aaron Rodgers	$21,642,000	10.61%	1	1	3	13	18	-6.1%
LV	2020	9	Derek Carr	$21,500,000	9.77%	2	0	0	8	14	9.9%
WAS	2020	10	Alex Smith	$21,400,000	10.24%	1	0	1	7	1	-13.2%

Figure 1: Raw data from the 2020, 2021, and 2022 NFL season

SUMMARY OUTPUT- REGULAR SEASON											
Regression Statistics											
Multiple R	0.7947143										
R Square	0.6315708										
Adjusted R S	0.5890598										
Standard Err	1.5799822										
Observations	30										
ANOVA											
	df	*SS*	*MS*	*F*	*ignificance F*						
Regression	3	111.26173	37.087242	14.856624	7.821E-06						
Residual	26	64.904939	2.4963438								
Total	29	176.16667									
	Coefficients	*tandard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*			
Intercept	4.1045583	1.5368861	2.6706978	0.0128809	0.9454437	7.263673	0.9454437	7.263673			
Cap%	3.4808764	11.729883	0.2967529	0.769013	-20.63024	27.591996	-20.63024	27.591996			0.0348088
AV	0.4070327	0.0753504	5.4018644	1.167E-05	0.2521477	0.5619177	0.2521477	0.5619177			0.4070327
DVOA	-14.79754	3.3499976	-4.417178	0.0001565	-21.68355	-7.911517	-21.68355	-7.911517			-0.1479754

Figure 2: Regression model of the regular season

SUMMARY OUTPUT- POST SEASON

Regression Statistics	
Multiple R	0.7262725
R Square	0.5274718
Adjusted R Sc	0.4729493
Standard Erro	1.1268399
Observations	30

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	3	36.852696	12.284232	9.6743904	0.0001835
Residual	26	33.01397	1.2697681		
Total	29	69.866667			

	Coefficients	*tandard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*	
Intercept	-1.578822	1.0961038	-1.440394	0.1616903	-3.831895	0.6742521	-3.831895	0.6742521	
Cap%	2.4763417	8.3657269	0.2960103	0.7695736	-14.71966	19.67234	-14.71966	19.67234	0.0247634
AV	0.1868773	0.0537397	3.4774504	0.0017961	0.0764137	0.2973409	0.0764137	0.2973409	0.1868773
DVOA	-10.73593	2.3892109	-4.493506	0.000128	-15.64703	-5.82484	-15.64703	-5.82484	-0.1073593

Figure 3: Regression model of the postseason

Player	Salary	DVOA	AV	Pred. Wins
Jalen Hurts	0.73%	-13.3%	20	14.238695
Josh Allen	7.85%	-14.0%	20	14.590116
Daniel Jones	4.05%	10.9%	15	8.738093
Tua Tagovailc	3.88%	0.1%	12	9.1092112
Davis Mills	0.56%	7.8%	7	5.8190724
Joe Average	5.00%	0.0%	10	8.3489292
Joe Money	17.16%	0.0%	10	8.7722038
Joe Defense	5.00%	-14.8%	10	10.538964
Joe Amazing	5.00%	0.0%	20	12.419256
Joe No	5.00%	19.3%	7	4.2719068

Figure 4: Table testing my regression model corresponding to figure 2

Player	Salary	DVOA	AV	Pred. Wins
Jalen Hurts	0.73%	-13.3%	20	3.6046812
Josh Allen	7.85%	-14.0%	20	3.8561482
Daniel Jones	4.05%	10.9%	15	0.1544132
Tua Tagovailc	3.88%	0.1%	12	0.7490523
Davis Mills	0.56%	7.8%	7	-1.094216
Joe Average	5.00%	0.0%	10	0.4137686
Joe Money	17.16%	0.0%	10	0.7148918
Joe Defense	5.00%	-14.8%	10	2.0026868
Joe Amazing	5.00%	0.0%	20	2.2825418

Figure 5: Table testing my regression model corresponding to figure 3

Player	Reg. Wins	Playoff Round
Jalen Hurts	14	4
Josh Allen	13*	2
Daniel Jones	9	2
Tua Tagovailoa	9	1
Davis Mills	3	0

Figure 6: Table comparing the predicted results from figures 4 and 5 to observed results from the 2022 NFL season

SUMMARY OUTPUT- REGULAR SEASON without Cap%										
Regression Statistics										
Multiple R	0.7939288									
R Square	0.630323									
Adjusted R S	0.6029395									
Standard Err	1.5530707									
Observations	30									
ANOVA										
	df	*SS*	*MS*	*F*	*ignificance F*					
Regression	2	111.04189	55.520947	23.018361	1.464E-06					
Residual	27	65.124773	2.4120286							
Total	29	176.16667								
	Coefficients	*tandard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*		
Intercept	4.4652157	0.9246965	4.8288446	4.825E-05	2.5678952	6.3625362	2.5678952	6.3625362		
AV	0.412831	0.0715334	5.7711638	3.875E-06	0.2660566	0.5596055	0.2660566	0.5596055		0.412831
DVOA	-14.72000	3.2829076	-4.483831	0.0001219	-21.45597	-7.984033	-21.45597	-7.984033		-0.147200

Figure 7: Regression model of the regular season without Cap%

SUMMARY OUTPUT- POST SEASON without Cap%										
Regression Statistics										
Multiple R	0.7251754									
R Square	0.5258793									
Adjusted R S	0.4907593									
Standard Err	1.1076373									
Observations	30									
ANOVA										
	df	*SS*	*MS*	*F*	*ignificance F*					
Regression	2	36.741437	18.370718	14.973765	4.212E-05					
Residual	27	33.12523	1.2268604							
Total	29	69.866667								
	Coefficients	*tandard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*		
Intercept	-1.322245	0.659486	-2.004963	0.0550878	-2.675399	0.0309083	-2.675399	0.0309083		
AV	0.1910023	0.051017	3.7438925	0.0008679	0.086324	0.2956807	0.086324	0.2956807		0.1910023
DVOA	-10.68078	2.3413428	-4.561816	9.886E-05	-15.48481	-5.876738	-15.48481	-5.876738		-0.1068078

Figure 8: Regression model of the postseason without Cap%