Performance and Contract Value in the NFL

MA 346 – Data Science
Prof. Nathan Carter
Juan Carlos Ferreyra and Aidan Dilo
December 3rd, 2025

I. Project Goals and Summary Results

The goal of this project is to understand how a player's on-field performance in their first season with a team relates to the financial value of the contract they sign. Because different positions contribute to the game in very different ways, we focus on each position's key performance metric—passing yards for quarterbacks, rushing yards for running backs, and receiving yards for wide receivers. Our central research question is: *Which of the position's key statistics is more closely correlated with the value of a player's contract on their first season on a team, and overall, how does this differ through the positions?*

We merged two large Kaggle datasets: one containing detailed offensive performance statistics from 2012–2024, and another containing NFL contract information from 2000–2023. After extensive cleaning, standardization, and alignment across both sources, we built a unified dataset linking a player's contract value to their average seasonal performance in their first year with a team.

Our statistical analysis shows that while performance is significantly associated with contract value for all three positions, the strength of that relationship varies. Wide receivers show the strongest correlation, while receiving yards explain the most variation in contract value. Quarterbacks and running backs both show moderate correlations, each around 0.43, meaning performance still matters but is less predictive of contract value compared to wide receivers. Overall, our results indicate that wide receiver production is the most directly tied to contract value within the first-season context of our dataset.

Beyond the correlation results, the visual trends we observed added helpful context. Quarterbacks showed the most scattered relationship between yards and contract value, with high contracts not always matching high passing production. Running backs displayed the least linearity overall, while wide receivers showed a much clearer upward trend, where players with stronger receiving numbers generally earned larger contracts. Taking the analysis a step further, we also explored a "Moneyball-style" angle by checking whether other stats like passing touchdowns for quarterbacks, rushing attempts for running backs, or targets for wide receivers, were even stronger predictors than the traditional yardage metrics. Interestingly, some of these secondary stats performed slightly better, suggesting that teams may be valuing efficiency, usage, or scoring opportunities just as much as raw yardage when deciding how much to pay a player.

II. Data Source and Relevance

For this project, we used two publicly available datasets from different users on Kaggle that together provide the information needed to analyze how a player's on-field performance correlates with the financial value of their NFL contract. The first dataset, "NFL Stats 2012–2024," contains detailed weekly and seasonal statistics for offensive players, defensive players, and teams. Because our goal is to evaluate how offensive performance relates to contract value, we use only the file "weekly_player_stats_offense.csv." This file includes all major offensive metrics, such as passing yards, rushing attempts, receptions, touchdowns, target share, and yards after catch, as well as essential qualitative information like player name, team, position, and season. These

variables allow us to measure a player's actual production on the field and then aggregate weekly statistics into meaningful season-level performance indicators.

The second dataset, "NFL Contract and Draft Data," provides contract information for NFL players from 2000 to 2023. This dataset includes each player's total contract value, guaranteed money, and normalized values adjusted relative to the salary cap for the signing year. These normalized metrics are especially important because the NFL's salary cap increases annually; using normalized values allows us to compare contracts fairly across different years. While this dataset also contains draft pick information, that information is secondary to our analysis. The variables of primary interest are the contract terms, which allow us to quantify the financial investment teams make in a player.

Together, these two datasets are well-suited for our objective: linking seasonal offensive performance metrics with contract values to study potential relationships between how players perform on the field and how they are compensated. The offensive stats dataset captures a player's measurable contribution to their team in a given season, while the contract dataset captures the financial outcome associated with that season or subsequent signing year. By merging these datasets on player identity, team, position, and season, we constructed a unified dataset that directly supported our research question.

III. Data Transformation and Merging

a. NFL Stats 2012–2024 – Offensive Players

Since we combined two separate Kaggle datasets that were created independently and covered different time periods, a substantial amount of data preparation was necessary before the two sources could be merged reliably. Our primary goal during this stage was to create a clean, consistent, season-level dataset where each row represents a player's performance in a given year alongside the value of the contract they signed that same year.

The original offensive statistics file contained more than 300 columns, including many stats that were either irrelevant for offensive players (e.g. defensive and special teams stats), or had derived calculations. To simplify the dataset, we removed:

- Columns with more than 90% missing data,
- Columns representing highly specific or rarely recorded events,
- Columns containing pre-calculated values such as "average," "delta," or "career,"
- and redundant variations of the same statistic.

After this filtering, we manually reviewed the remaining variables and retained roughly 50 core offensive performance metrics that we thought were most relevant (such as passing yards, receptions, rushing attempts, touchdown metrics, air yards, yards after catch, and efficiency measures like YPA and catch rate). The NFL Stats Dataset records performance one row per player per week – In order to compare performance to specific contract years, we needed to transform it into a season-level dataset. To do this, we grouped each player's weekly stats by season, averaged all their performance numbers, and kept their basic info the same. This gave us one clean record

per player per season, which is exactly what we needed to line up their stats with the contract they signed that year.

The contract data originally covered 2000–2023, while our NFL statistics ran from 2012–2024. After reviewing the contract dataset more closely, we found that the most recent complete contract year was actually 2022. To keep both datasets aligned, we restricted our analysis to the overlapping seasons from 2012 to 2022. After this filtering, we were left with roughly 5,000 rows of season-level player performance.

b. NFL Contract Dataset 2000-2023

The contract dataset originally had more than 12,000 rows from 2000-2023, but since our performance data starts in 2012, we removed all contracts signed before 2012. We also dropped contracts from 2023-2024 because those seasons don't have complete player stats yet. From there, we kept only the fields we actually needed, such as player name, position, team, signing year, total value of contract, guaranteed money, and the normalized contract values that account for salary cap changes. We also filtered the list to the key offensive players (QB, RB, WR), so it lined up with our offensive-only stats. After all the trimming, this left us with a much cleaner contract table of roughly 3,000 rows.

Comparing the two datasets further, we noticed additional discrepancies that would cause problems during the merge. Team names weren't formatted the same, as one dataset used the usual three-letter codes, while the other sometimes used full names or even combinations like "DAL/KC" when a player was traded. Player names also had differences, like suffixes ("Jr.", "II") or small spelling variations.

To address this, we standardized all 32 NFL team codes across both datasets and made sure that trade entries mapped to the team the player was joining, like for example, if a record showed "DAL/KC," we kept "KC" as the destination team. For player names, we used similarity matching to line up names that referred to the same player even if they were written differently. We set a threshold of 86% similarity, which kept the matching strict enough to avoid incorrect pairings but flexible enough to catch cases like *"Gardner Minshew II"* matching with *"Gardner Minshew."* After the names and teams were aligned, we also extracted each player's first season with a team before merging. This gave us a clean dataset where players appear once per team in the year they first joined, so someone like Tom Brady can show up multiple times, but only once for each team he played on.

c. Merging the Datasets

After cleaning and standardizing both datasets, we made sure each player showed up only once per team per season. If someone appeared more than once, it was only because they played for different teams in different years, which is exactly what we expected. Once everything looked consistent, we were ready to merge the two sources.

To combine them, we used a right join with the contract data as the base. Since our project focuses on contract value, we wanted to make sure every contract stayed in the final dataset, even

if a player didn't have a full set of stats for that season. We matched the datasets using the standardized player names and team codes, and we used a built-in check (validate="1:1") to confirm that each contract lined up with one season of stats without creating duplicates.

After the merge, we removed leftover columns that were no longer needed, such as temporary team fields, duplicate player identifiers, and intermediate matching keys. This left us with a clean merged table containing 1,108 rows and 71 columns, representing each player's first season with a team paired with their contract details and their averaged offensive performance metrics.

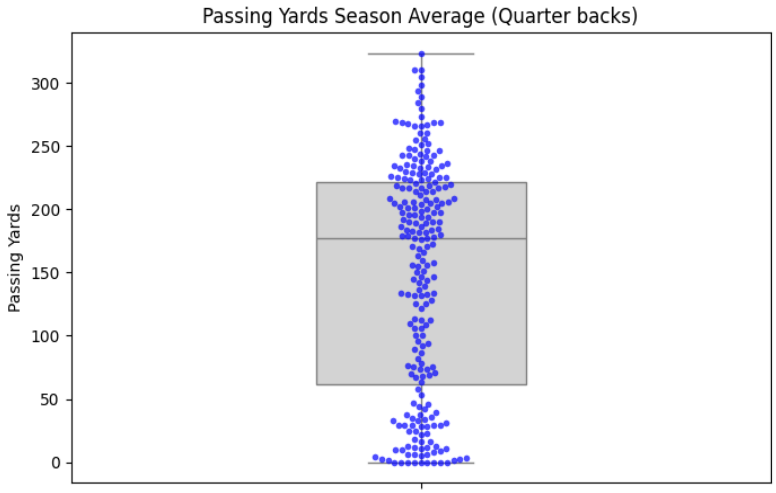
With the merged dataset finalized, we exported it as a Parquet file so it was ready for the statistical analysis phase.

IV. Statistical Analysis

Our statistical analysis centers around how a player's performance in their first season with a team relates to the value of the contract they signed. Because player performance looks very different across positions, we can't directly compare stats like rushing yards, passing yards, and receiving yards against each other. A quarterback will almost always lead in passing yards, running backs dominate rushing yards, and wide receivers naturally accumulate the most receiving yards.

Instead of forcing all positions into a single metric, we evaluate each position using the statistic that best represents its role on the field. This leads us back to our main research question: *Which of the position's key statistics is more closely correlated with the value of a player's contract on their first season on a team, and overall how does this differ through the positions?*

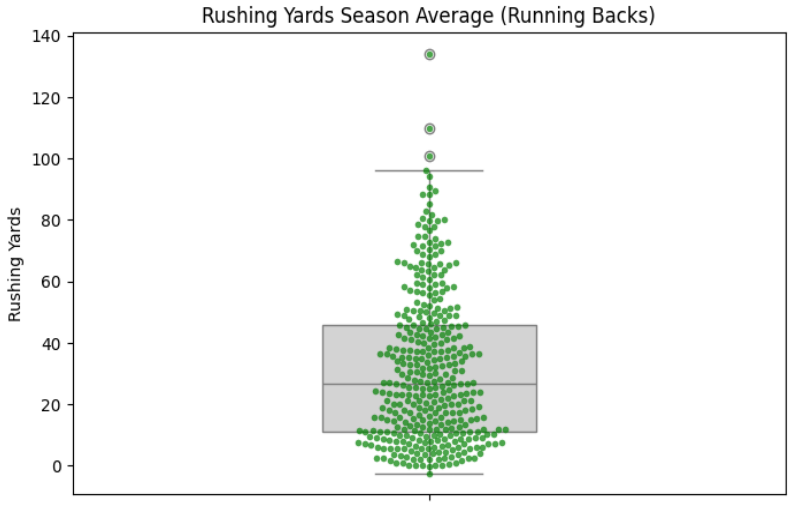
a. Key-Statistic Distribution



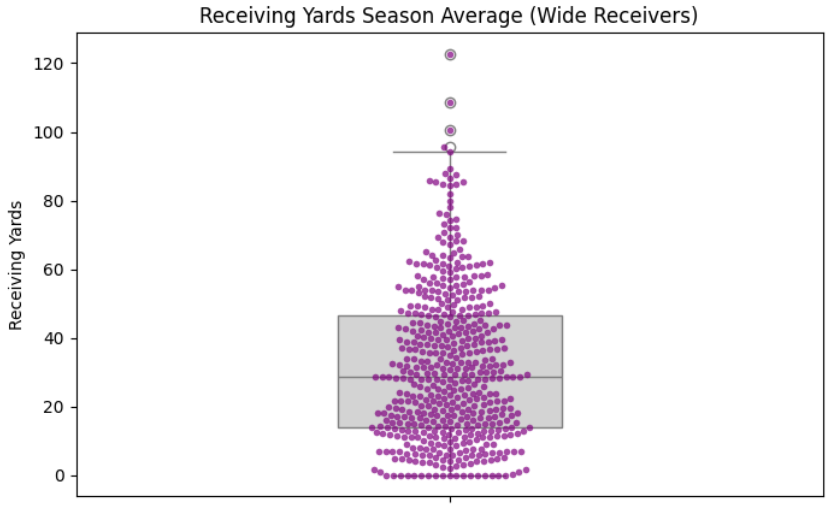
The quarterback distribution shows a much wider spread than the other positions. Elite quarterbacks can average close to **300 passing yards per game**, and the bulk of quarterbacks fall between roughly **150–250 yards**. We also see a long tail on both ends—some players average near zero if they had limited playtime, while others push into the high-200s over a season.

This distribution has a noticeably different shape compared to running backs and wide receivers, reflecting the natural variability in quarterback roles, offensive systems, and total pass attempts.

Running backs show a much tighter distribution, with most players averaging between **1**0 and 40 rushing yards per game. Only a handful of outliers approach or exceed 100 yards per game, and these points represent high-volume feature backs.



Compared to quarterbacks, the scale is far smaller, and the distribution is much more concentrated. The overall shape is similar to wide receivers, which makes sense given that both groups typically accumulate fewer yards per play and rely on specific play designs to generate production.



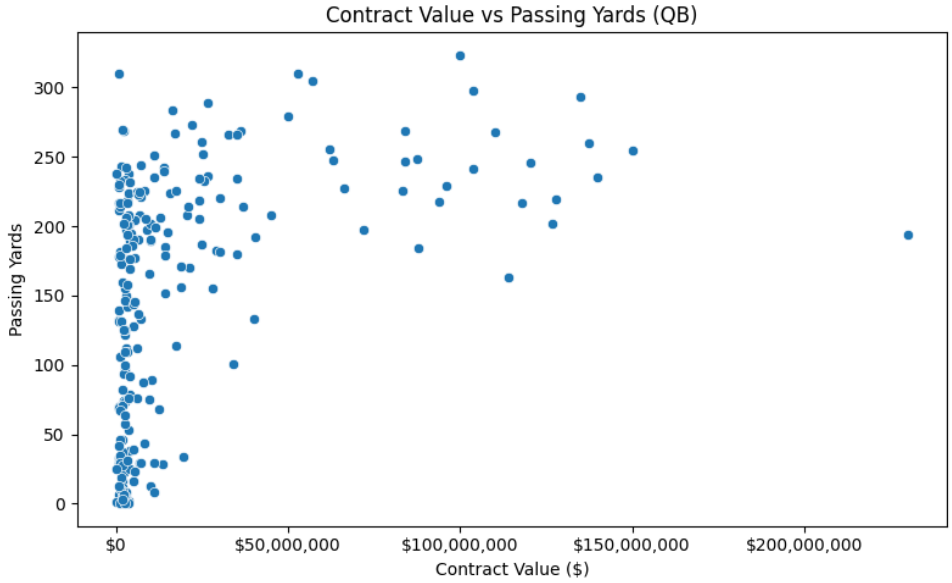
Wide receivers sit between the two other positions in terms of dispersion. Most players fall around 15–45 receiving yards per game, with top wide receivers reaching the 100–120 yard range. Similar to running backs, the shape is narrower and more compact than quarterback passing yards.

This distribution follows a pattern close to the running back distribution, further emphasizing that quarterback production operates on a completely different scale and variability profile.

These visuals show that quarterbacks play on a completely different yardage scale, often reaching 300 yards per game, while running backs and wide receivers top out closer to 100 and follow much tighter distributions. Because of these natural differences, comparing yardage across positions wouldn't make sense. Instead, each position needs to be evaluated using its own key statistic, which is the approach we take in the rest of the analysis.

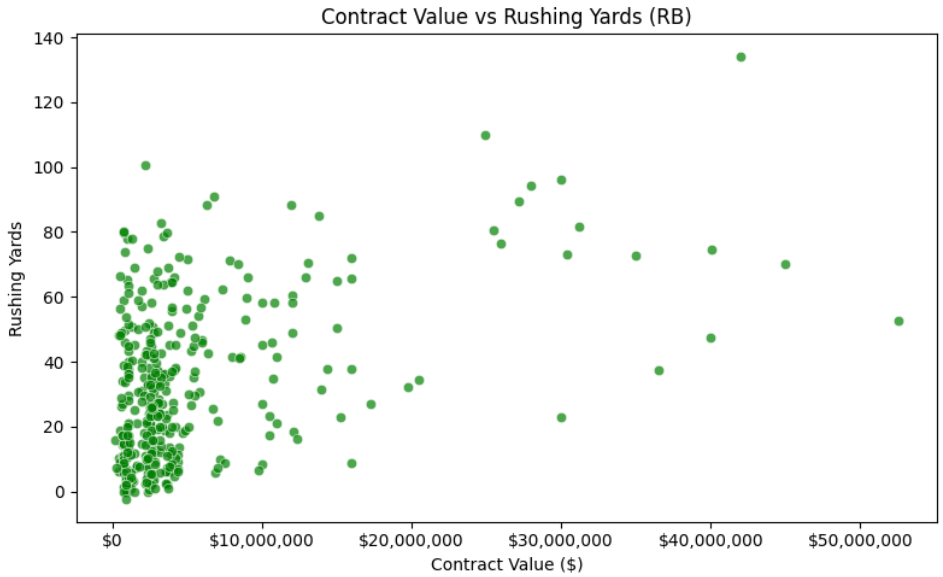
b. Correlation Analysis: Visuals

To understand how strongly on-field performance is connected to contract value, we compare each position's key statistic, passing yards for quarterbacks, rushing yards for running backs, and receiving yards for wide receivers against the total value of the contract signed in that season. By visualizing these relationships first, we get an initial sense of whether the data follows any sort of linear trend. We later quantify these patterns using the Pearson correlation test, which measures the strength of linear association between two continuous variables.



For quarterbacks, the plot shows a very wide spread of passing-yard averages across all levels of contract value. There is a clear "vertical line" effect, where many quarterbacks have extremely different levels of on-field production even when their contract values are similar. Elite quarterbacks with massive deals do appear on the right side of the graph, but higher contract values do *not* consistently line up with higher passing yards.

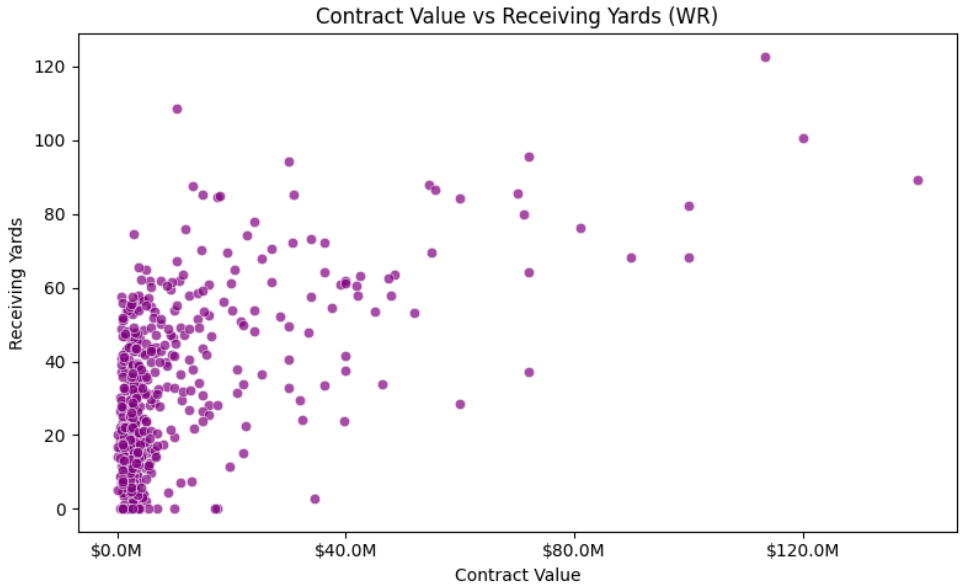
This suggests that for quarterbacks, contract value isn't tied as closely to their yardage output as we might expect. Factors such as leadership, system fit, playoff performance, draft status, or reputation likely play a much larger role. Visually, this group shows the least linearity of the three positions.



Compared to quarterbacks, running backs show a clearer trend. While there is still a wide spread at low contract values, the distribution begins to open slightly as contract value increases.

Higher-value contracts tend to belong to backs with stronger rushing-yard averages, although the pattern is not perfectly tight.

Running backs operate on a much smaller yardage scale, but when looking at the shape of the data, we do see more visual linearity than quarterbacks. This indicates that run-game production is more directly factored into contract decisions for RBs.



Wide receivers show a trend similar to running backs: the higher the contract value, the more likely the player is to have higher receiving-yard production. The relationship isn't perfect, but compared to quarterbacks, we see a much cleaner upward pattern.

High-value receiver contracts tend to cluster toward players producing between 60–120 receiving yards per game, and there is far less of the "vertical line" pattern we observed with quarterbacks.

We see how the running back and wide receiver key-statistics against contract value follow more linearity than the quarter back comparison. There is a prominent vertical line with quarterbacks, where the more the contract is valued does not automatically mean that the player will be completing more yards. While less evident, this trend seems to follow (at least visually) to the other correlation graphics. We quantify this relationship to properly compare it. Additionally, we opt to evaluate whether the key-statistic on-field performance is associated with the monetary value of a player's first season on a team's contract. We can do this through a Pearson correlation test, which measures linear relationships between two continuous variables.

C. Correlation Analysis: Metrics

To accurately measure how strongly each position's key statistic relates to contract value, we ran a Pearson correlation test for quarterbacks, running backs, and wide receivers. As mentioned previously, this test quantifies the strength of a linear relationship between two

continuous variables. For us, this means determining if there is a correlation each position's yardage metric and the player's contract value.

Hypotheses

- **Null Hypothesis (H_0):** There is no linear association between a player's key performance metric and the value of their contract.
- **Alternative Hypothesis (H_1):** There *is* a linear association between a player's key performance metric and the value of their contract.

	Position object	Performance Vari...	Sample Size (n) i...	Correlation (r) flo...	p-value float64
0	QB	Passing Yards	232	0.4333917461	4.846955117e-12
1	RB	Rushing Yards	372	0.4363129347	1.013998468e-18
2	WR	Receiving Yards	499	0.5667327794	9.736643845e-44

Across all three positions, the p-values are extremely small – far below any conventional significance threshold. This means we reject the null hypothesis for quarterbacks, running backs, and wide receivers. Our statistical test shows that there is a significant association between each position's key performance metric and the monetary value of their first-season contract.

With a correlation being identified, we must take note that the strength of the correlation does vary between the different positions. Wide receivers show the strongest relationship, with receiving yards having the highest correlation to contract value. Quarterbacks and running backs both have moderate correlations of around 0.43, meaning performance still matters but explains less of the variation in their contracts. Overall, receiving yards account for roughly 56% of the variation in wide receiver contracts, while the key statistics for quarterbacks and running backs explain closer to 43%.

Overall, the Pearson correlation test confirms that a player's performance in their first season with a team is statistically linked to the contract they receive, regardless of position. However, the strength of that relationship varies:

- **Strongest for wide receivers**,
- **Moderate for running backs**,
- **Moderate for quarterbacks**, with quarterbacks showing the least clear visual trend despite similar correlation strength.

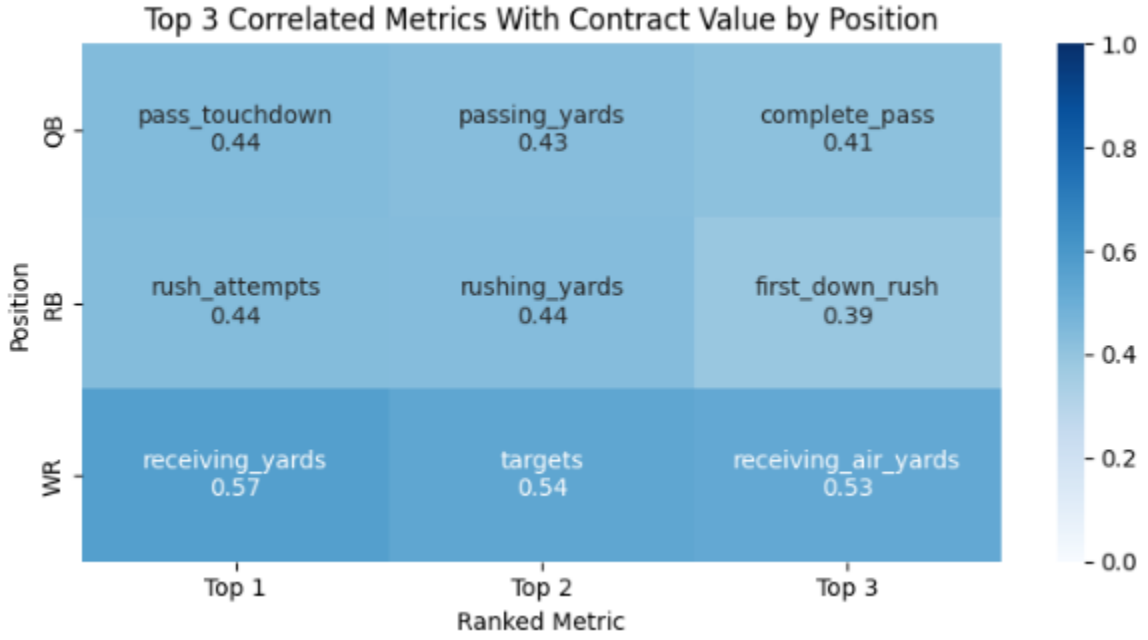
These results suggest that while teams value performance across all positions, wide receiver production is the most directly tied to contract value within our dataset and first-season framework.

D. Wildcard Correlation Analysis: Metrics

Inspired by the movie "Moneyball", which is based on a data-analyst introducing the importance on focusing of under looked metrics in sports (in that case, specifically baseball)

through data, we decided to ask the following question: *While the key-metrics are the most important for each position, are they necessarily the ones that have the strongest association with the contract value?*

In order to clarify this question, we can manually inspect the variables that are in the dataset, and try to separate them into the relevant positions (as for example, any receiving related metric won't be relevant to QBs, and arguably may be somewhat relevant for RBs, but this would be more of an exception). We decide to designate the statistics to each position, based on relevance and exploring the most common metrics for each position through reliable websites like ESPN. Through iteration, we are able to evaluate the strongest predictors of contract value for each position, attempting to find any metric that we would not have considered otherwise.



Several concepts can be explored through these results. Firstly, the original metrics we evaluated as most important are present, but they present a different result for each position. Firstly, for the quarter back and running back positions, the original metrics are the second highest correlation value, being slightly exceeded by other metrics. For quarter backs, we notice how passing touchdowns are a stronger predictor of contract value, which can be understood through the lower frequency of this metric for players who aren't "top players" (as quarterbacks will have a large variation of passing yards per game, but only the best quarterbacks are able to do passing touchdowns consistently. Then, for running backs, we see how rushing attempts are a better predictor (slightly) than rushing yards. This can be explained by how players who earn more can often be more confident, so they are trusted more by their quarterback, regardless of their performance. Finally, we see how receiving yards the most important predictor of contract value is, however it is preceded by targets, which is surprising, as we would have expected for targets to be more common for star players or players with a more expensive contract.

V. Conclusion

This project set out to see how much a player's on-field performance in their first season with a team connects to the value of the contract they sign, and how this connection varies across quarterbacks, running backs, and wide receivers. After merging and analyzing both datasets, we found that performance does play a role—but not equally for every position. Wide receivers showed the strongest relationship between their main statistic (receiving yards) and contract value. Quarterbacks and running backs also showed meaningful relationships, just not as strong, which makes sense given how differently each position contributes to the game and how many other factors teams consider when offering contracts.

There are also several things we could explore in future work. Our analysis focused mainly on each position's key yardage stat, but players bring value through many other metrics, such as touchdowns, efficiency, usage, and more. Looking at a wider range of stats or building full regression models might reveal which combination of variables best predicts contract value. We also only looked at a player's first season with a team; comparing multiple years or tracking how performance changes across contract cycles could give an even better picture of what teams are paying for. Expanding the analysis in these ways would help us understand player valuation in the NFL even more clearly.