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Evaluating Talent Acquisition in the NFL

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Abstract

Expert analysts and team managers provide their opinions on how well NFL teams and players have done, but these methods are generally based on experience and often times lack objectivity. Using the many statistics that are recorded for NFL players, we investigate an objective, metric-based method to evaluate the talent acquired in the NFL. With the creation of an effective method to grade talent using both a cost and success metric, we investigate many factors of the NFL including statistical trends in the NFL draft, misconceptions regarding the overvaluing or undervaluing of draft picks or specific positions, the effect of age on player performance, and even the simple question of which teams draft the best.

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1. Introduction

The application of different sciences and technology to society can bring with it extraordinary results. Sometimes these applications cause drastic changes in the physical appearance of a society while other times, these applications are much more subtle and the result is much less obvious. One form of science which can be applied to many aspects of society is statistical analysis. The world is full of numbers and one of the greatest ways to take advantage of this is to gather those numbers, interpret what those numbers mean, and use these interpretations to learn more about the world around us or even change the way people think about a certain subject matter. An example of a societal issue where statistical analysis can be applied is the evaluation of talent. Businesses, schools, organizations and more must make decisions whether or not the people they decide to employ, accept, or associate with are worth their respective costs, whether it is monetary or any other form of cost. The answer to these problems lies in data analytics.

Professional sports, some of the biggest businesses in the world, are one of the many interesting topics to which data analytics can be applied. In professional and many amateur leagues, records are kept for all players and detail many of their successes and failures during their sporting career. The National Football League is an example of one of these organizations. The NFL is a professional sports league for American football. Thirty two professional teams compete every year in this multibillion dollar business to win the Super Bowl and receive the coveted Lombardi Trophy and the title of National Football League Champions. In order to compete at the highest level, NFL teams recruit young talent out of college in the hopes that their abilities will lead their team to a championship title.

Expert analysts and team managers provide their opinions on how well these NFL draftees have done, but these methods are generally based on experience and often times lack objectivity. Using the many statistics that are recorded for NFL players, we investigate an objective, metric-based method to evaluate the talent acquired in the NFL. With the creation of an effective method to grade talent, we can investigate many factors of the NFL including statistical trends in the NFL draft, misconceptions regarding the overvaluing or undervaluing of draft picks or specific positions, and even a simple question of which teams draft the best.

Throughout the rest of the report, our group provides the background research and methodology that went into creating an effective method to evaluate NFL talent acquisitions. Using this method we examine many interesting topics including the draft efficiency of NFL teams, possible errors in NFL draft thinking, values of different positions, the effect of age on player performance, and more. Finally, we show that although our method of grading players is designed to be used for the NFL, the same methodology can be used in other sports or even other areas outside of sports such as college admissions or workplace productivity.

2. Background

2.1 - Statistical Analysis in Sports

Our method of looking at statistics and drawing conclusions from these statistics is an idea that has been happening in every sport; not just football. Other sports such as basketball, baseball, and hockey have all adopted methods for evaluating players based on statistics. Right now there is no absolute way to look at a player but by branching out and looking at different values one can make a more general evaluation for every player.

2.1.1 – Basketball

Basketball has developed numerous metrics for looking at and evaluating player performance and success. One metric is the P.E.R. or Player Efficiency Rating which utilizes Equation 1 that uses positive and negative statistics to determine a score per minute [1]. Equation 1 holds true where $factor = \left(\frac{2}{3}\right) - \left[\frac{.5*\left(\frac{lgAST}{lgFG}\right)}{2*\left(\frac{lgFG}{lgFT}\right)}\right]$, $VOP = \left[\frac{lgPTS}{lgFGA - lgORB + lgTO + .44*lgFTA}\right]$, and $DRBP = \left[\frac{lgTRB - lgORB}{lgTRB}\right]$.

Equation 1: Equation for calculating the Player Efficiency Rating of an NBA player

$$(1)\ PER = \frac{1}{Min} * \left(3Pts + \left[\left(\frac{2}{3}\right) AST\right] + \left[\left(2 - factor * \left(\frac{tmAST}{tmFG}\right)\right) * FG\right] + \left[FT * .5 * \left(1 + \left(1 - \left(\frac{tmAST}{tmFG}\right)\right) + \left(\frac{2}{3}\right) * \left(\frac{tmAST}{tmFG}\right)\right)\right] - [VOP * TO] - [VOP * DRBP * (FGA - FG)] - \left[VOP * .44 * \left(.44 + (.56 * DRBP)\right) * (FTA - FT)\right] + [VOP * (1 - DRBP) * (TRB - ORB)] + [VOP * DRBP * ORB] + [VOP * STL] + [VOP * DRBP * BLK] - \left[PF * \left(\left(\frac{leagueFT}{leaguePF}\right) - .44 * \left(\frac{leagueFTA}{leaguePF}\right) * VOP\right)\right]\right)$$

The positive values include scoring points, assists, steals, and any metric that helps the team in an offensive or defensive category while the negatives include turnovers, missed shots, etc. Once the negatives are subtracted from the positives the score is divided by the player's total playing time.

Another basketball metric that is in use today, although not as popular as the P.E.R. rating system, is the EFF of Efficiency system [1]. This metric takes Equation 2 and sticks to this to a key.

Equation 2: Equation used when dealing with the Efficiency system

$$(2) \qquad (PTS + REB + AST + STL + BLK - FG\, missed - FT\, missed - TO)$$

The reason this metric is not as favorable as the P.E.R. for NBA analysts is because the equation does not account for playing time so the statistics for certain players can become quickly skewed. The P.E.R. and our developed metric both account for playing time, whether it is time played or games played, which makes those metrics less likely to become skewed by non-starters and injuries. The Euroleague and Eurocup use a similar metric system to the EFF system but use a different set of statistics with the equation. The main difference is this metric, the Performance Index Rating system, takes into account fouls drawn and fouls committed as seen in Equation 3.

Equation 3: Equation used when dealing with the Performance index Rating system

$$(3) \qquad (Points + Rebounds + Assists + Steals + Blocks + FoulsDrawn) - (MissedFieldGoals + MissedFreeThrows + Turnovers + ShotsRejected + FoulsCommitted)$$

2.1.2 – Baseball

Baseball is a game of statistics. Players are constantly being valued based on how they compare to others at their position and how they compare to previous greats of the game. There are so many statistics revolving around baseball for not only offense but defense as well. Pitchers are constantly looking at previous matchups against opposing hitters as well as batting average and other statistics. Coaches, especially as of recently, are placing more of an emphasis on matchup statistics when putting in a relief pitcher to face a particular batter. A man named Bill James took all of these mathematical and statistical analytics and combined them into what he coined Sabermetrics [2].

The term Sabermetrics is derived from the acronym SABR, which stands for the Society for American Baseball Research. The basic theory behind Sabermetrics is taking a statistic and applying a weight to that statistic for a representation of how useful to a team said player is in a given category. There are multiple equations within Sabermetrics for both offensive and defensive players. The basis for measuring the success of offensive players revolves around Equation 4.

Equation 4: Equation for determining success of offensive players

$$Runs = \frac{(Hits+Walks)(Total\ Bases)}{At\ Bats+\ Walks} \tag{4}$$

By using Equation 4 and applying the linear weights of (.41) 1B + (.82) 2B + (1.06) 3B + (1.42) HR for the "total bases" category one can use this statistic to look at how productive a player is compared to another player of the same position. This approach has been accepted in baseball analytics and is similar to what we are attempting to do with our referenced and developed metrics of success.

2.1.3 – Hockey

Hockey is different from basketball and baseball in that it does not use complicated formulas to determine how well a player is when compared to other players. Hockey does not have a set-in-stone metric, but does have two metrics that are still in use today.

The first metric is the Old School method which focuses more on intangible statistics such as work ethic and performance under pressure. This metric did, however, have a plus/minus system that takes the difference between the positive and negative points a player accumulates throughout at game. A positive point is earned when the player's team scores a goal when his team is shorthanded (down a player) or even strength while a negative point is earned when the opposing team scores a goal while the teams are even strength. This method is called Old School because it is not as useful as the New School method since the Old School method largely deals with the overall team's success and not the actual players themselves.

The New School metric for hockey is broken into two components being With or Without You (WOWY) and Goals Versus Threshold (GVT) [3]. WOWY is a system similar to the plus/minus system that compares the goals for and goals against of the team while a player was in the lineup to when said player was not in the lineup. The second component of the New School metric is GVT. GVT is measured in goals and values more how well a player fulfilled their role on the team. Some examples of this would be how many goals an offensive player has scored or how many stops a goalie has made. This component of the New School metric separates the game into offensive statistics, defensive statistics, and goaltending statistics. Taking this approach allows for a more specific look into each position and allows for more comparison between players of similar positions similar to what our metrics aim to do.

2.2 - The NFL Draft and Free Agents

Metrics in other sports make clear that statistical analysis in sports has been going on for a while and is a well-developed field of research. What we are looking to accomplish in our analysis is more than simple data collection and review. We are looking to find patterns within this data and explain why the collected data is relevant to football teams. When teams are striving to improve in the offseason, the draft is one the most important fields to improve in since knowing how to draft successfully along with knowledge of player growth is essential.

2.2.1 – Origins of the NFL Draft

The National Football League draft was instituted in 1936 so that every team in the league could have an equal opportunity at acquiring the new players. Before the draft was used, any players that wished to play in the NFL would express their interest directly to that specific team. The team and management would then make the decision whether they wanted this player to join their squad or if they were not a good fit for the team. Although it made it easy for a player to talk to and possibly play for his favorite team it also was much more likely to make the different teams in the league uneven. If one team was a fan favorite or was more likely to win than the others than more players would want to join that team and help reinforce both patterns as they would be recruiting all the new talent in the league and could have a larger roster than any other team.

To solve this problem the nine teams gathered at the Ritz-Carlton Hotel in Philadelphia, and they wrote 90 names of potential players that might join the league and play. The draft went on for nine rounds with every team getting a single selection each round until all nine rounds were completed. Although 81 players were chosen by the teams, when asked if they wanted to play in the NFL many had already decided to get jobs outside the NFL, and only 24 players had actually decided to join the league when they had been chosen during the draft. The number of teams in the league increased as football became a more popular sport, and as such they wanted to keep the length of the draft reasonable. The teams decided to decrease the total number of rounds to compensate for the increase in the number of teams picking per round. The draft is currently 7 rounds long with each of the 32 teams initially having at least a single pick in each round.

2.2.2 – Compensatory Draft Picks

The National Football League decided that they would add compensatory picks into the draft which could then be used to compensate or punish teams for the players they lost at the end of the year or for the actions they committed during the season. The main reason for these picks is to compensate a team that lost more free agents in the offseason than they had gained the year before. These picks are added after all the normal picks have been chosen in the round. These picks are not added during the first or second round but can be added to any round afterwards. When the NFL established the compensatory picks they decided to limit the total number of picks given out to the total number of teams in the league, which currently stands at 32 compensatory picks. If less than the 32 picks are given out then the last set of picks are awarded to the teams as if a hypothetical 8^{th} round was being drafted. The National Football League also uses this power of giving and taking picks to punish a team by revoking their pick for that round and then replacing it with a pick later in that round, a pick in a different round, or even revoking that pick completely. An example of such a punishment was used against the New England Patriots in the 2008 draft for their illegal filming of the opposing team's defensive calls in 2007. The severity of the penalty depended on if they made it to the playoffs or not. The penalty could take away their first, second or third draft round pick with no compensation.

2.2.3 – Value of Draft Picks

The teams also find it helpful to trade picks for other picks in the draft, current players in the league, or even picks that will be used in future drafts. Many teams use these trades to advance their picks to a position earlier in a round or to trade a higher round player which they may not need for multiple lower round players which could turn into a great player with a little work. Many factors come into play when trading future round picks and players for current picks and many of the decisions come down to team management where they have to decide which is more important for the team and which can help the team succeed more. The easier solution for trading current picks for current picks is that one can assign a value for each and every trade pick which can then be double checked to make sure the trade is even and fair. Jimmy Johnson, the coach for the Dallas Cowboys during the early 1990s decided to make a table with values for every pick so that the teams would have an easier time deciding which trades were fair. These values are shown in Table 1.

Table 1: Value of Draft Picks

Overall	Draft Points	Overall	Draft Points	Overall	Draft Points	Overall	Draft Points	Overall	Draft Points	Overall	Draft Points	Overall	Draft Points	Overall	Draft Points	Overall	Draft Points
1	3000	33	580	65	265	97	112	129	43	161	28	193	15.2	225	2.9	257	0.4
2	2600	34	560	66	260	98	108	130	42	162	27.6	194	14.8	226	2.8	258	0.4
3	2200	35	550	67	255	99	104	131	41	163	27.2	195	14.4	227	2.7	259	0.4
4	1800	36	540	68	250	100	100	132	40	164	26.8	196	14	228	2.6	260	0.4
5	1700	37	530	69	245	101	96	133	39.5	165	26.4	197	13.6	229	2.5	261	0.4
6	1600	38	520	70	240	102	92	134	39	166	26	198	13.2	230	2.4	262	0.4
7	1500	39	510	71	235	103	88	135	38.5	167	25.6	199	12.8	231	2.3	263	0.4
8	1400	40	500	72	230	104	86	136	38	168	25.2	200	12.4	232	2.2		
9	1350	41	490	73	225	105	84	137	37.5	169	24.8	201	12	233	2.1		
10	1300	42	480	74	220	106	82	138	37	170	24.4	202	11.6	234	2		
11	1250	43	470	75	215	107	80	139	36.5	171	24	203	11.2	235	1.9		
12	1200	44	460	76	210	108	78	140	36	172	23.6	204	10.8	236	1.8		
13	1150	45	450	77	205	109	76	141	35.5	173	23.2	205	10.4	237	1.7		
14	1100	46	440	78	200	110	74	142	35	174	22.8	206	10	238	1.6		
15	1050	47	430	79	195	111	72	143	34.5	175	22.4	207	9.6	239	1.5		
16	1000	48	420	80	190	112	70	144	34	176	22	208	9.2	240	1.4		
17	950	49	410	81	185	113	68	145	33.5	177	21.6	209	8.8	241	1.3		
18	900	50	400	82	180	114	66	146	33	178	21.2	210	8.4	242	1.2		
19	875	51	390	83	175	115	64	147	32.6	179	20.8	211	8	243	1.1		
20	850	52	380	84	170	116	62	148	32.2	180	20.4	212	7.6	244	1		
21	800	53	370	85	165	117	60	149	31.8	181	20	213	7.2	245	0.95		
22	780	54	360	86	160	118	58	150	31.4	182	19.6	214	6.8	246	0.9		
23	760	55	350	87	155	119	56	151	31	183	19.2	215	6.4	247	0.85		
24	740	56	340	88	150	120	54	152	31.8	184	18.8	216	6	248	0.8		
25	720	57	330	89	145	121	52	153	31.2	185	18.4	217	5.6	249	0.75		
26	700	58	320	90	140	122	50	154	30.8	186	18	218	5.2	250	0.7		
27	680	59	310	91	136	123	49	155	30.4	187	17.6	219	4.8	251	0.65		
28	660	60	300	92	132	124	48	156	30	188	17.2	220	4.4	252	0.6		
29	640	61	292	93	128	125	47	157	29.6	189	16.8	221	4	253	0.55		
30	620	62	284	94	124	126	46	158	29.2	190	16.4	222	3.6	254	0.5		
31	600	63	276	95	120	127	45	159	28.8	191	16	223	3.3	255	0.45		
32	590	64	270	96	116	128	44	160	28.4	192	15.6	224	3	256	0.4		

Table 1 does take into account the compensatory picks that have recently been added to the draft by adding values in a slowly decreasing fashion to the end of the draft until they hit a minimum value of 0.4. The first pick is the most valuable at 3000 while the last couple picks are minimal with values at 0.4. Since this table of values was developed in the early 1990s we decided to check the trades of the most recent drafts and make sure that these values were still in use.

2.2.4 – Free Agents

Another way to acquire players in many sports is through the process of free agents. Free agents are players who do not have a respective team at the moment or whose contract has expired with an old team and is in the process of making a new contract. Any team in the league can make an offer for a free agent and usually the only team required to pay is the team that signed the new contract with the player. In the NFL there are three types of free agents which each have different restrictions to how the player can be acquired.

The two easiest free agents to acquire are the undrafted free agents and the unrestricted free agents. Both of these free agents are allowed to take offers and negotiate with any team in the league for any period of time. The only difference between these two categories is that the undrafted free agents are rookie players who were not initially picked by a team in the NFL draft, while the unrestricted free agents were drafted by, and played for a team in the NFL for more than four years and their contract has currently expired with the team. Undrafted free agents most commonly have negotiations with teams directly after the NFL draft as each team has a list of players that they want to get during the draft but can only select seven of them. Most teams end up talking to an average of about ten other undrafted free agents after the draft so they can test their skills at a training camp.

The last is the most complicated of the free agents and that is the restricted free agents, these are the players that have played only three seasons or less for any team in the league and their contract has expired. The team that the player had a contract with makes the player a qualifying offer for a new contract. Since the player has only a few seasons experience with this team they are allowed to talk to other teams and possibly negotiate new offers with any other team before a certain date which occurs a week before the draft. If the player manages to get a new offer from another team and chooses to accept this offer the former team has the option of matching the offer and keeping the player or, if the old team chooses not to match the offer then the league may compensate them for the loss of the player with an extra draft pick in the next draft and the new team receives the player with the contract agreed upon. The position of the draft pick depends on the level of the qualifying offer that the original team gave to the player.

2.3 - Approximate Value

Our next metric is not one of cost like the acquisition of players through the draft and free agency, but rather a metric of value. This metric, known as Approximate Value, will serve as the value metric for most of our analysis. Approximate Value is a metric coined by the founder of pro-football-reference.com, Doug Drinen, in an attempt to put a single number on the seasonal value of a player at any position from any year [4]. Approximate Value is not and should not be considered a be-all; end-all metric for determining how well a certain player does. For example, not every single 16 AV player is better than a certain 14 AV player. However, the collection of 16 AV players as a group is better than the group of 14 AV players which makes Approximate Value a good standard for comparing players of every position.

Approximate Value is calculated under three assumptions. The first assumption being that the offensive line is exactly as good as the offense as a whole. There are some obvious flaws to this assumption, but that is why this is an *Approximate Value*. One flaw is that Approximate Value over credits runner and passers who have good lines as well as lines that are fortunate enough to have superstars behind them. The second assumption behind Approximate Value is that the offensive line is equally important in the running game as it is in the passing game. The third assumption is that the ratio of pass-thrower importance to pass-catcher importance is constant from team to team.

Approximate Value is pretty complex in that there are multiple steps taken from the actual statistic into converting the numbers to an AV. To determine the offensive points per drive Drinen has developed a formula involving points scored and possession. The formula is

Equation 5: Formula for Offensive Points per Drive

$$(5)\ OPPD = \frac{(7*TDs+3*(FieldGoalsMade))}{(TDs+FGA+Punts+TO)}$$

which equates to the total points the offense scores on said drive. These points then have to be divided amongst each player on the offensive unit. Drinen then breaks down the point distribution for each offensive position in Table 2. The rest of the percentage is split among special teams and kickers.

Table 2: Table of the percentage of the offensive points per drive for each position

Position	Percentage of Offensive Points Per Drive
Quarterback	7.4%
Running Back	10.0%
Fullback	2.5%
Wide Receiver	11.7%
Tight End	3.9%
Offensive Line	15.5%

Table 3 shows every equation that is needed in order to calculate an offensive player's Approximate Value regardless of position. For example, a made-up player named Player A is a quarterback for a team in the NFL. In order to find the AV for Player A it is first necessary to find his team's total_offensive_points so these points can be divided amongst the offensive players evenly. The offensive line receives 5/11 of the total offensive points of the team and the rest are split amongst the skill positions. The points for a quarterback, once determined, are used to calculate Player A's Approximate Value.

Table 3: Equations used to calculate Approximate Value for offensive players

team_offense_points = 100 * (team offensive points per drive) / (league average offensive points per drive)
offensive points per drive = (7*(rushTD+passTD) + 3*FG) / (rushTD + passTD + turnovers + punts + FGA)
team_points_for_o_line = 5 / 11 * team_offense_points
individual_points = [(games played) + 5*(games started)*(pos_multiplier)] * (all_pro_multiplier)
approx_value = (individual_points) / (sum of individual_points for all players on team) * (team_points_for_o_line)
team_points_for_skill_positions = team_offense_points - team_points_for_o_line
team_points_for_rushers = team_points_for_skill_positions * (.22) * [(team_rsh_yards / team_total_yards) / .37]
approx_value = (rushing yards) / (team rushing yards) * team_points_for_rushers
team_points_for_passers = (team_points_for_skill_positions - team_points_for_rushers) * .26
team_points_for_receivers = (team_points_for_skill_positions - team_points_for_rushers) * .74
approx_value = (receiving yards) / (team receiving yards) * team_points_for_receivers

approx_value = (passing yards) / (team passing yards) * team_points_for_passers

There are a few variables that need some explaining in Table 3. One such variable is found in the individual_points statistic for the offensive line where there are two different multipliers that take into account pro-bowl and all-pro selections for each offensive lineman. Pro-Bowl and All-Pro are both selections made by the Associated Press. Those chosen are considered the best at their positions for that year and play in the Pro-Bowl held just before the Super Bowl. The pos_multiplier is as follows: 1.2 for tackles, 1.0 for guards and centers, 0.3 for fullbacks, and 0.2 for tight ends. The all_pro_multiplier is as follows: 1.9 for first-team AP all-pro, 1.6 for second-team AP all-pro, and 1.3 for a pro-bowler who was not first- or second-team all-pro.

The next variable that needs explaining shows up in the Approximate Value calculation for running backs. There is a bonus/penalty for this position based on whether the running back's yards per rush is better than the league average or worse than the average. If it is better than the average, the bonus is .75 * [(yards per rush) - (league yards per rush by RBs)] and the penalty is 2 * [(yards per rush) - (league yards per rush by RBs)].

The last clarification that needs to be made in Table 3 is the bonus/penalty process for passers. Similar to the rushers, the bonus is applied if the passer's adjusted yards per attempt were larger than the league average. The bonus is .5 * [(Adjusted yards per attempt) - (League average adjusted yards per attempt)] and the penalty is 2 * [(Adjusted yards per attempt) - (League average adjusted yards per attempt)].

Table 4 is every equation that is needed in order to calculate the Approximate Value of a defensive player. There are a few bonuses like in the offensive equations but their values are the same as those described above.

Table 4: Equations used to calculate Approximate Value for defensive players

team_defense_points = 100 * [(1 + 2 M - M^2) / (2 M)]
team_points_for_front_7 = (2/3) * team_defense_points
team_points_for_secondary = (1/3) * team_defense_points
individual_points = [(games played) + 5*(games started) + sacks + 4*(fumble recoveries) + 4*(interceptions) + 5*(defensive TDs) + (tkl_constant)*(tackles)] + (all_pro_bonus)
approx_value = [(individual_points) / (sum of individual_points for all front-seven players on the team)] * team_points_for_front_7
approx_value = [(individual_points) / (sum of individual_points for all defensive backs on the team)] * team_points_for_secondary

Approximate Value is definitely what the name implies; an approximation. AV does look into how each player performs independent of the team however, which makes it a good measure to look at when comparing players. We will attempt to make ties between AV and the NFL draft process.

2.4 - Fantasy Points

Another metric of performance of a player, Fantasy Points, is directly related to statistics rather than relying on a formula as Approximate Value did. Fantasy Points are the values that are assigned to players in the NFL for each individual accolade at their respective positions. For example, a quarterback receives points for a passing touchdown, passing yards, and rushing yards. The values of each statistic and the amount of yards or TDs that a quarterback gets will determine that player's fantasy score for that game. This points system goes for all offensive players. Some fantasy leagues do individual defensive players, but most opt for lumping a team's defense and special teams units together when calculating Fantasy Points.

A fantasy team is composed of around 15 players with 9 starters and 6 bench players. Each week, the manager of the fantasy team is allowed to make acquisitions and change the starting lineup up until the game with the players on said team has started. After every game has been played that week, the final score comprised of the total Fantasy Points for each of that team's starters is compared to his opponent's team and the team with the highest score wins that matchup.

Fantasy Points reward a certain player for an achievement that he makes while playing in his game. Therefore if a running back gets a TD he will receive compensation in the form of 6 Fantasy Points. With that in mind, however, players are also able to lose Fantasy Points for actions that hurt their team during the game. Say Eli Manning, the New York Giants' quarterback, throws an interception while throwing to a receiver. This interception will drop Eli's fantasy score that day by 2 points. The same concept applies for fumbles for all players and points allowed and yardage allowed for defensive units. A complete table of how Fantasy Points are divided up and distributed to positions can be found in Table 5. Since Fantasy Points are a direct reflection of how well a player is performing, it is possible to use these points as a basis for comparison when looking at NFL players.

Table 5: Fantasy Points scoring breakdown of each position in a standard ESPN fantasy football league

Offense: **Quarterbacks (QB), Running Backs (RB), Wide Receivers (WR), Tight Ends (TE)** 6 pts per rushing or receiving TD 6 pts for player returning kick/punt for TD 6 pts for player returning or recovering a fumble for TD 4 pts per passing TD 2 pts per rushing or receiving 2 pt conversion (note: teams do not receive points for yardage gained during the conversion) 2 pts per passing 2 pt conversion 1 pt per 10 yards rushing or receiving 1 pt per 25 yards passing	**Bonus Points** 2 pts per rushing or receiving TD of 40 yards or more 2 pts per passing TD of 40 yards or more (note: the player must score a touchdown to score the points) **Penalty Points** -2 pts per intercepted pass -2 pts per fumble lost
Kickers (K) 5 pts per 50+ yard FG made 4 pts per 40-49 yard FG made 3 pts per FG made, 39 yards or less 2 pts per rushing, passing, or receiving 2 pt conversion 1 pt per Extra Point made	**Penalty Points** -2 pts per missed FG (0-39 yds) -1 pt per missed FG (40-49 yds) (note: a missed FG includes any attempt that is blocked, deflected, etc.)
Defensive/Special Teams (D) 10pts for 0 points allowed 7pts for 2-6 points allowed 4pts for 7-13 points allowed 1pt for 14-17 points allowed 0 pts for 18-21 points allowed -1pts for 22-27 points allowed -4pts for 28-34 points allowed -7pts for 35-45 points allowed -10pts for 46+ points allowed	3 pts per defensive or special teams TD 2 pts per interception 2 pts per fumble recovery (Note: includes a fumble by the opposing team out of the end zone) 2 pts per blocked punt, PAT, or FG (Note: a *deflected* kick of any kind does not receive points) 2 pts per safety 1 pt per sack

2.5 - Summary

By looking at these analyses for other sports it was easier to create and modify our metrics to properly represent the data from the National Football League. The cost metric was clarified further with the background research done into the NFL draft and the values that the different teams use. To do the same narrowing process with the talent metrics we looked for metrics that were already devised such as Approximate Value. Using this and other stats such as

Fantasy Points we were able to devise questions to focus our research and find appropriate results.

3. Research Questions

For us to have the ability to evaluate talent in the NFL, we must create a metric which can be used to grade all players. In order to do this, we must define ways in which to measure both the cost and success of a player. With these two metrics established, our group can examine a multitude of research topics involving the NFL including player performance, the draft, and more. From our knowledge of the NFL, we developed four different categories of research questions which, with a proper grading method, we can investigate and provide answers to.

3.1 - Team Related

For team related research, we wanted to investigate two different questions. First, we wanted to see which teams have drafted the best and worst in the NFL. With the data we can collect, we can examine the efficiency of the NFL teams' drafts by looking at the value of players they acquire and the cost they get them at. Comparing these numbers between all teams will give us a good picture of who has done the best and the worst. Second, we want to see if individual player skill results in team wins. By examining the value of the individual players on NFL teams, we can see if that individual talent translates into team wins.

3.2 - Position Related

Examining specific positions in the NFL will also provide some interesting analysis. We can examine which positions provide the highest value for NFL teams. We can also compare the highest valued position to which position has the most cost invested into acquiring players. A final position related research topic we would like to explore is if any of these positions are undervalued or overvalued.

3.3 - Draft Related

The NFL draft can also be critiqued using our developed grading method. Examining the drafts since 2000, we can see if the values of higher picks are actually worth as much as the teams like to make them out to be. We can also examine the draft trade values shown in Table 1 and see if the values placed on the overall draft picks are correct.

3.4 - Age Related

Age is another factor that we can examine with our developed success metrics. Specifically, we want to see how much a player's age or time spent in the league affects their performance on the playing field. Examining these trends can lead to better knowledge of the timetable it takes to fully develop players or even how long players can stay at the top of their game.

3.5 - Summary

We developed a set of research questions which, using a grading metric for NFL players, we can answer and provide more insight into the NFL. The questions established relate to four different topics in the NFL: team success, positional differences, draft beliefs, and the effect of age on players. These research questions are merely a sample of what could possibly be studied using an NFL player database. Through the analysis of the data we have decided to research, our group hopes that the conclusions made may result in a change of thinking among NFL teams whether it be the way teams scout upcoming players, the positions they acquire in the draft, the value of the picks teams have, or any other possible change our research may bring to the NFL.

4. Methodology and Data Collection

4.1 - Cost and Success Metric Evaluation

When evaluating NFL draft talent acquisition, both success and cost must be assessed. In order to create a meaningful and objective method of evaluation, it is important to find a metric to grade both cost and success in a way that can be easily used for the majority of NFL player base and is independent of subjective analysis. Finding an acceptable measure of cost and success will be the backbone of this assessment.

4.1.1 - Cost Metric Evaluation

Some different ways to determine cost are salary, draft number and time to develop. The salary of an individual player is one way to view the cost of that specific player. One reason salary is a good way to judge a player's cost is because every player has a salary and therefore has a monetary value placed on him by his team. Another reason salary is a good judgment of player cost is because there is a salary cap which every NFL team must abide by. This prevents some players from having an inflated salary because they are on the richest team. There are also some reasons why salary would not be a good assessment of a players cost. One such reason is that the salary cap has changed drastically over the years making it hard to compare one year to the next. Another reason against using salary as a cost judgment is because the salary cap has not always been around; so early salary values may not be as valid as more current salary values. Salary is not always the best measure of cost because a player's salary will change based on how well he performs. Therefore, player salaries are not solely a measure of a player's cost. The salaries for individual players as well as entire teams can be found at the USA Today sports website, which display their data like Figure 1 and Figure 2 [5].

2009-10 NFL Salaries by Team

TEAM	TOTAL PAYROLL	AVG SALARY	MEDIAN	STD DEV
New York Giants	$ 138,354,866	$ 2,470,622	$ 890,000	$ 3,718,306
Miami Dolphins	$ 126,383,421	$ 2,256,846	$ 978,290	$ 3,206,135
Houston Texans	$ 122,258,610	$ 2,037,643	$ 848,640	$ 3,159,274
New Orleans Saints	$ 121,552,424	$ 1,992,662	$ 870,000	$ 2,580,010
Chicago Bears	$ 120,672,110	$ 2,154,859	$ 820,616	$ 3,353,848
New York Jets	$ 120,634,420	$ 2,079,903	$ 762,750	$ 2,776,685
Pittsburgh Steelers	$ 119,292,960	$ 2,056,775	$ 792,500	$ 2,761,268
San Diego Chargers	$ 117,458,935	$ 2,025,154	$ 927,880	$ 3,540,888
Green Bay Packers	$ 113,959,603	$ 1,931,518	$ 812,500	$ 2,647,804
Tennessee Titans	$ 113,494,050	$ 2,141,397	$ 1,010,000	$ 2,099,092
Carolina Panthers	$ 112,963,398	$ 1,947,644	$ 823,700	$ 3,120,365
Oakland Raiders	$ 111,527,250	$ 2,065,319	$ 830,000	$ 2,634,432

Figure 1: A screenshot of Team Salaries from USA Today.

2009-10 New England Patriots Salaries

Team Salaries

PLAYER	BASE SALARY	SIGN BONUS	ALL BONUSES	CAP VALUE	SALARY	POSITION
Brady, Tom	$ 5,000,000			$ 14,627,280	$ 8,007,280	Quarterback
Moss, Randy	$ 4,900,000	$ 1,500,000		$ 9,757,280	$ 6,507,280	Wide Receiver
Kaczur, Nick	$ 2,000,000			$ 3,014,280	$ 5,507,280	Outside Linebacker
Springs, Shawn	$ 1,750,000	$ 2,700,000		$ 2,757,280	$ 4,557,280	Cornerback
Light, Matt	$ 4,250,000			$ 5,708,950	$ 4,257,280	Outside Linebacker
Sanders, James	$ 620,000	$ 1,800,000		$ 2,507,280	$ 3,707,280	Safety
Faulk, Kevin	$ 2,900,000			$ 4,254,280	$ 3,507,280	Running Back
Green, Jarvis	$ 2,500,000			$ 4,107,280	$ 3,507,280	Defensive End
Burgess, Derrick	$ 2,000,000			$ 2,000,000	$ 3,501,560	Defensive End
Baker, Chris	$ 1,600,000	$ 1,500,000	$ 1,607,280	$ 2,007,280	$ 3,207,280	Tight End
Wright, Mike	$ 620,000	$ 1,800,000		$ 1,757,280	$ 3,107,280	Defensive Tackle
Taylor, Fred	$ 1,550,000	$ 1,450,000		$ 2,282,280	$ 3,007,280	Running Back
Neal, Steve	$ 2,500,000			$ 3,407,280	$ 2,607,280	Outside Linebacker
Koppen, Dan	$ 2,400,000			$ 4,007,280	$ 2,507,280	Outside Linebacker
Morris, Sammy	$ 900,000			$ 1,382,280	$ 2,507,280	Running Back

Figure 2: A screenshot of Player Salaries from USA Today.

Another way to view the cost of a player is through their draft number. The assumption has to be made that the higher a player is drafted the more they would cost. The relative cost of each draft number has been calculated and can be seen in Table 1 in Chapter 2. One reason this may not be a good judgment of cost is because a player may be drafted because of a team's needs. Because teams will try to draft players in the positions they need most, high picks may go to players in positions that actually cost less to that particular team. For instance, a team may draft a lineman early on with many notable skill positions still available. However, this team may be fine with their current skill positions and will pass on what other teams may consider a higher draft pick and thusly a more costly player. The draft number for all players dating back to 1936 can be found at drafthistory.com as seen in the small example shown in Table 6 [6].

Table 6: A small portion of the draft history database from drafthistory.com.

2011						
Round	**Pick**	**Player**	**Name**	**Team**	**Position**	**College**
1	1	1	Cam Newton	Panthers	QB	Auburn
	2	2	Von Miller	Broncos	LB	Texas A&M
	3	3	Marcell Dareus	Bills	DT	Alabama
	4	4	A.J. Green	Bengals	WR	Georgia
	5	5	Patrick Peterson	Cardinals	DB	Louisiana State
	6	6	Julio Jones	Falcons	WR	Alabama
	7	7	Aldon Smith	49ers	DE	Missouri
	8	8	Jake Locker	Titans	QB	Washington
	9	9	Tyron Smith	Cowboys	T	USC
	10	10	Blaine Gabbert	Jaguars	QB	Missouri
	11	11	J.J. Watt	Texans	DE	Wisconsin
	12	12	Christian Ponder	Vikings	QB	Florida State
	13	13	Nick Fairley	Lions	DT	Auburn
	14	14	Robert Quinn	Rams	DE	North Carolina
	15	15	Mike Pouncey	Dolphins	G	Florida
	16	16	Ryan Kerrigan	Redskins	LB	Purdue
	17	17	Nate Solder	Patriots	T	Colorado
	18	18	Corey Liuget	Chargers	DT	Illinois
	19	19	Prince Amukamara	Giants	DB	Nebraska
	20	20	Adrian Clayborn	Buccaneers	DE	Iowa

A final way to view cost of a player is the time it takes the player to develop. Some players are drafted and end up on the bench for a few years before finally reaching the field, while others make debuts during their rookie year. This is a numerical value that is easily accessible, but there is one downside to this method. The time it takes a player to develop can be dependent on the team's needs. For instance, a team drafts a quarterback because their previous one retired. In this case, the rookie would have a greater chance of starting their first game during their rookie season than a quarterback drafted when the team already has a definitive starting quarterback. Even though this drafted player may take time to develop, this time may be deemed useful by the team because he is gaining valuable experience as a backup and playing in practices.

4.1.2 - Team Success Metric Evaluation

Success can also be evaluated from two perspectives, the team as a whole or an individual player. Each of these perspectives has their own categories. A team's success can be viewed through team stats, team revenue, team record and power rankings. An individual player's success can be viewed through career stats, and playing time.

When evaluating both team stats and an individual's player stats, there is one common problem. It has to be determined what stats are considered good and what are considered bad. It is hard to be unbiased and determine what number is the cutoff to being "successful." Also an individual player's statistics can be hard to judge success on because some positions do not offer a lot of statistics. This can be troublesome when trying to compare a quarterback's success to an offensive lineman's success. Statistics for all players dating back to 1997 can be found at NFL Complete Statistics: 1997-2011 - Standings and Team Stats website in charts like Figure 3 and Figure 4 [7].

Player	Att	Yds	Yds/Att	Long	TD
BenJarvus Green-Ellis	181	667	3.7	18	11
Stevan Ridley	87	441	5.1	33	1
Danny Woodhead	77	351	4.6	12	1
Tom Brady	43	109	2.5	13	3
Kevin Faulk	17	57	3.4	9	0
Shane Vereen	15	57	3.8	19	1

Figure 3: A chart from NFL Complete Statistics: 1997-2011- Standings and Team Stats.

2011-2012 Complete NFL Team Statistics-Standings

2010-2011 Complete NFL Team Statistics-Standings

2009-2010 Complete NFL Team Statistics-Standings

2008-2009 Complete NFL Team Statistics-Standings

2007-2008 Complete NFL Team Statistics-Standings

2006-2007 Complete NFL Team Statistics-Standings

2005-2006 Complete NFL Team Statistics-Standings

Figure 4: The layout of data from NFL Complete Statistics: 1997-2011- Standings and Team Stats.

When viewing a team's success through their revenue, the assumption must be made that the more revenue a team generates the better the team's success. One flaw in this assumption is that some teams still generate revenue because of their location or their number of devoted fans. For instance, in a Forbes article the Dallas Cowboys were declared the most valuable team for the last six years in a row. They also generated the largest revenue in 2011 and all of this despite not being to the Super Bowl in the last 16 years. In 2011, the Dallas Cowboys failed to even make the playoffs. Many attribute this large revenue to the fact that they are "America's Team" [8]. As this example shows, revenue is not always a good judgment of a team's success.

A team's success can also be viewed through their regular season and playoff record. These values are easy to compare and easy to access. The one problem with using a team's record as an assessment of success is that some team's records may be influenced by their schedule. Some teams might have an easier schedule therefore their record would be potentially better than it should be.

A final way to view a team's success is to focus on their Power Rankings. Power Rankings is a system done by ESPN to rank each NFL team every week according to how the team performed during that week. The one major problem with using Power Rankings as an assessment of a team's success is that it is very subjective because these rankings are given based on the decisions of NFL analysts.

4.1.3 - Player Success Metric Evaluation

When viewing the success of an individual player, their amount playing time could be one metric considered. Playing time for individual players is mainly determined by games played and games started, but there is one problem with this method of evaluating a player's success. The problem is that playing time does not necessarily reflect success. Although a player may play a game or even start, it does not mean he played well. Games played is a simplistic way to try and judge success because the assumption is that the more games a player plays, more importantly starts, the more successful that player is.

As discussed in Chapter 2, there have been some attempts to evaluate a player's statistics in the past. Some of these include fantasy football scores and Pro-Football Reference's "AV." Fantasy football scores are one simple way other people have attempted to evaluate a player's statistics. Since individual positions are given their own points, any position can be compared to another. Although this may seem like a flawless way to assess the statistics of a player, a quarterback will still usually get the most Fantasy Points because a quarterback has more stats that generate points for him. Doug Drinen of Pro-Football Reference has also created a method of grading player through his system known as Approximate Value, “AV.” The “AV” has a specific method to grade each player according to their position. This value which is mathematically acquired can be used to compare players’ values, even in different positions. For the purpose of this project, AV could directly be translated to a player’s success.

4.2 - Adopted Grading Metrics

After examining many methods of viewing cost and success, we came to the conclusion that there were five measures, two for cost and three for success, that were the best for use in this evaluation.

4.2.1 - Adopted Cost Metrics

The two cost measures are both draft position related. We have decided that the NFL draft is the best way to find a source of cost for two reasons. The first is that every NFL team has the same amount of picks initially in the draft and therefore it acts as a standard across all teams. Secondly, for the purposes of our evaluation, we primarily examine how good draft picks are so the using a draft-based metric is a logical choice. The first measure we have chosen for cost is called Round Points. Every team is initially given the same amount of picks in the draft, one per round for 7 rounds. With this metric, players are given a value based on what round they are drafted in. The other point system is called Draft Points. This method gives players a point value based on what overall pick in the draft that player is. These numbers were established as a way for teams to fairly trade draft picks and the chart of these values can be found in Table 1. The use of this chart will be described later.

4.2.2 - Adopted Success Metrics

The three success metrics we chose are based on easily obtainable stats. First, the “Approximate Value” score created by Pro-Football Reference is one method for success. Through this method, most positions are given a score which is directly related to his stats for the year. Much like Approximate Value, “Fantasy Points” are another performance number which can be used to measure NFL success using the stats players have accrued at their respective positions. The third grading metric is an “Appearance Score” which we created for our evaluation. In this method players are given a score based on how much they “appear” in the NFL and what percentile of the player base they are. With this method, the score is not limited to NFL use only but can also be applied to other sports and applications as well with minor adjustments.

4.3 - Appearance Score

The method we developed for measuring a player’s success is a metric we have called “Appearance Score,” abbreviated AS. The idea behind this score is that the more a player appears in the NFL, the more valuable he is. Using data that gives a player’s games played, games started, and Pro-Bowl and All-Pro team selections, a yearly score can be given to a player. This score is a yearly summation and awards points based on what percentile of the NFL player base a particular player is.

The first assumption made when creating this score is that there is approximately 1696 players in the NFL with 32 teams consisting of a 53 man roster. For every stat in question, we assume that the player becomes a percentage of that total. Teams are allowed to have 45 players available for any given regular season game. With 32 teams and approximating that every player that dresses at least gets to play, the ratio becomes 1440/1696. Similarly, teams start 22 players so the ratio here becomes 704/1696.

The Pro-Bowl and All-Pro rosters are the final area of examination for this stat. The NFL Pro-Bowl teams are two teams which consist of the best players from AFC and NFC in their respective conference. Players are selected based on fan votes and coach’s and player’s polls.

The number of people on the roster changes on a yearly basis but it is roughly 100 total for both teams. This brings the Pro-Bowl ratio to 100/1696. The NFL All-Pro team is selected by the Associated Press to be what they consider the best NFL selection of NFL players for the year. The number of players selected to be All-Pro also changes on a yearly basis but there are approximately 65 players selected per year. The All-Pro Ratio becomes 65/1696.

A few other situations were considered to be a reason for players to get some Appearance Score but some flaws were found and they were eliminated from the process. Initially, playoff game appearances were considered as a possible area of observation but we deemed that playoff game appearances are too heavily influenced by team success as opposed to individual merit and therefore any score relating to playoff games was scrapped. Originally, the MVP and Offensive and Defensive Player of the Year awards were also another area of consideration for the Appearance Score. However, due to the fact that these awards are given to a single player during a season, it would highly inflate the score of the player who won the award.

As shown below, the calculation of the Appearance Score is a summation of all the areas of consideration. The point total assigned to each individual stat is the rounded inverse of the player base ratio determined earlier and also shown below. In short, the less likely it is for a player to appear in a given category, the more points they will get. This methodology can also be applied to other sports as these statistical categories exist in most professional sports. The percentile based score can also be modified to give value to people or operations outside of sports if the proper criteria can be determined.

<u>How to Obtain Score</u>

1. 1 point for every Game Played
2. 2 points for every Game Started

3. 14 points for Pro Bowl appearance
4. 22 points for being named to All-Pro Team

The AS is a yearly sum of these scores.

For example, assume there is a player named Joe Random in the NFL. For the first three games of the season, he sees no playing time. During game four, he replaces the starter during the game and gets a game played. During game five, the same situation occurs and Joe gets a second game played. From game six on, Joe is named the starter and starts in every game for the rest of the season. After the season is over, Joe also gets a selection to the Pro Bowl; however, he does not receive an All-Pro selection. In this scenario, Joe Random has played in 13 games, started 11 games, and was selected to be in the Pro Bowl. With these numbers, Joe would have an Appearance Score of 49 (13*1 + 11*2 + 14). Just to show the scale of this number, the max Appearance Score a player can get is 84 and the lowest is 0.

4.4 - Grading Metric Comparison

With our chosen grading metrics described in previous sections, it is important to analyze the similarities and differences between them as the use of different metrics may provide slightly different results. In this section, we will examine the differences and comparisons between these metrics more thoroughly.

4.4.1 - Cost Metric Comparison

To grade a player's cost, we can use either their draft trade values or their Round Point values. The draft trade value chart is used by NFL teams to help owners and general managers make fair trades during the NFL draft. The origin and use of this chart is explained more thoroughly in Section 1.2. Each player receives a number, which we call Draft Points, ranging from 3000 to 0 based on which number overall pick he was with early picks receiving the higher numbers and, for our purposes, a higher cost. Undrafted free agents are given a score of 0 for this method because they are acquired outside of the draft and therefore can be signed by a team at no cost in terms of our draft related metrics. The other method of grading cost is much simpler but not necessarily more accurate than the draft trade values. To give a player Round Points, we need to look at which round they were selected in the NFL draft. The NFL draft has 7 rounds so players are given a score ranging from 0 to 7. Players selected in round one are given a score of 7 while round 7 draftees are given a cost of 1. Similar to draft trade values, free agents are given a cost of zero.

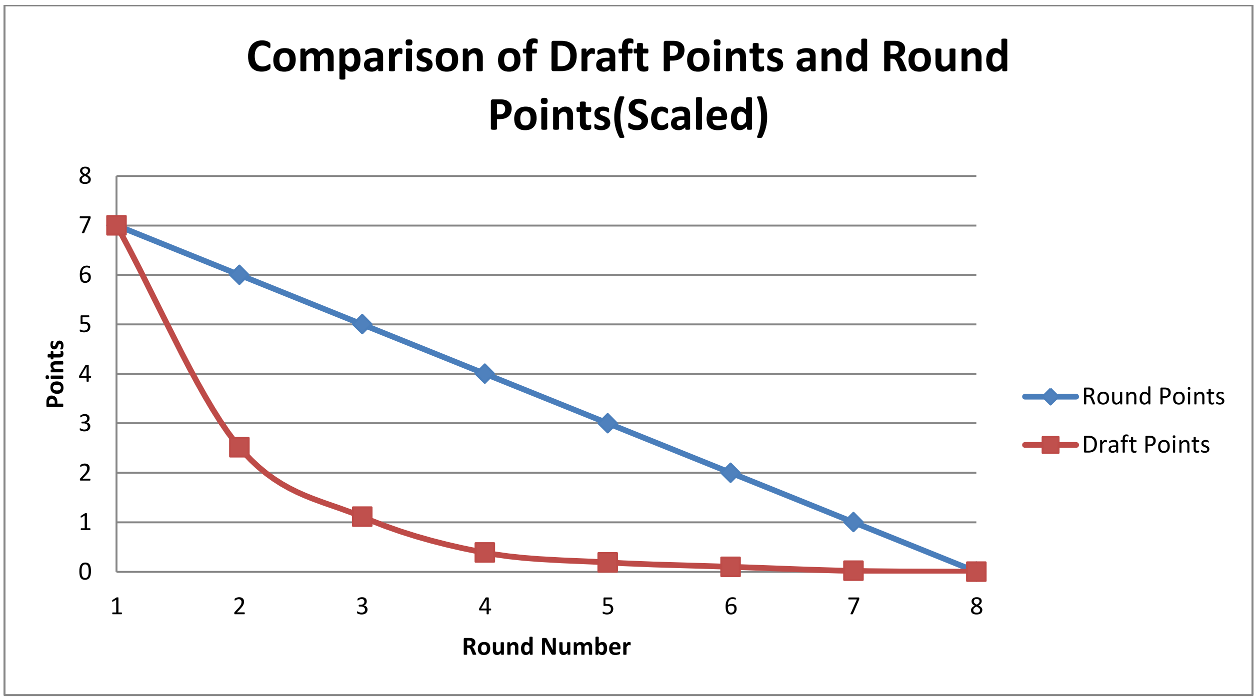


Figure 5: Comparison of Draft Points to Round Points

Figure 5 shows the two metrics for grading a player's cost scaled to 7, the highest value for the Round Points. Each data point on the chart represents the average cost of a player in the labeled round where the 8^{th} round is considered the round when free agents are selected by teams. This graph shows that the two methods for determining the cost of a player are slightly different. A common trait between the two metrics is that the higher round incurs a higher cost than the lower rounds and free agents which receive zero cost. The difference is that Round Points grades players assuming there is a linear relationship between the round the player was selected and his cost while with Draft Points, the relationship between round selected and cost is exponential. These two methods of grading will be the metrics for grading cost for the rest of our analysis.

4.4.2 - Success Metric Comparison

To grade player success, we have selected three metrics to grade by: Approximate Value, Appearance Score, and Fantasy Points. Approximate Value and Fantasy Points are similar in that players receive a score based on their statistics. However, Approximate Values can be given to numerous positions while the established Fantasy Point methods are only able to provide a score for skill positions. Currently, the Approximate Value formula has no way to calculate an AV for kickers. The group decided to create an Approximate Value for kickers using the relationship between Fantasy Points and Approximate Value. The sum of Fantasy Points and the sum of Approximate Values were graphed for running backs, quarterbacks, tight ends, and wide receivers. The trend lines were added to all four graphs and the trend lines' corresponding linear equations were added for each graph. Figure 6 through Figure 9 were created under these guidelines for data since the 2000 season. It was determined that the average of slopes of the four trend line equations would be useful in calculating an Approximate Value for kickers. The average came out to be 0.066025. The equation to calculate the Approximate Value for kickers became

Equation 6: Equation used to calculate Approximate Values for kickers.

$$y = 0.066025x$$

The “y” variable in Equation 6 stands for the Approximate Value and the “x” variable stands for the Fantasy Points. Then the Fantasy Points of kickers are put in place of the “x” and Approximate Values for kickers are produced.

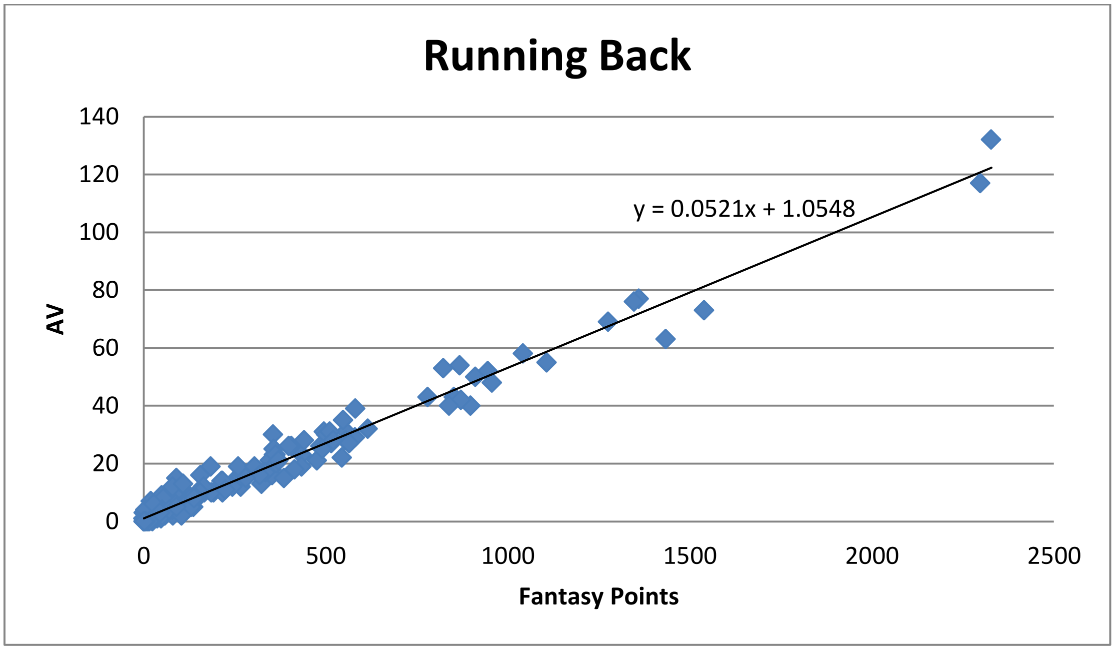


Figure 6: Sum of Fantasy Points vs. Sum of Approximate Value for Running Backs.

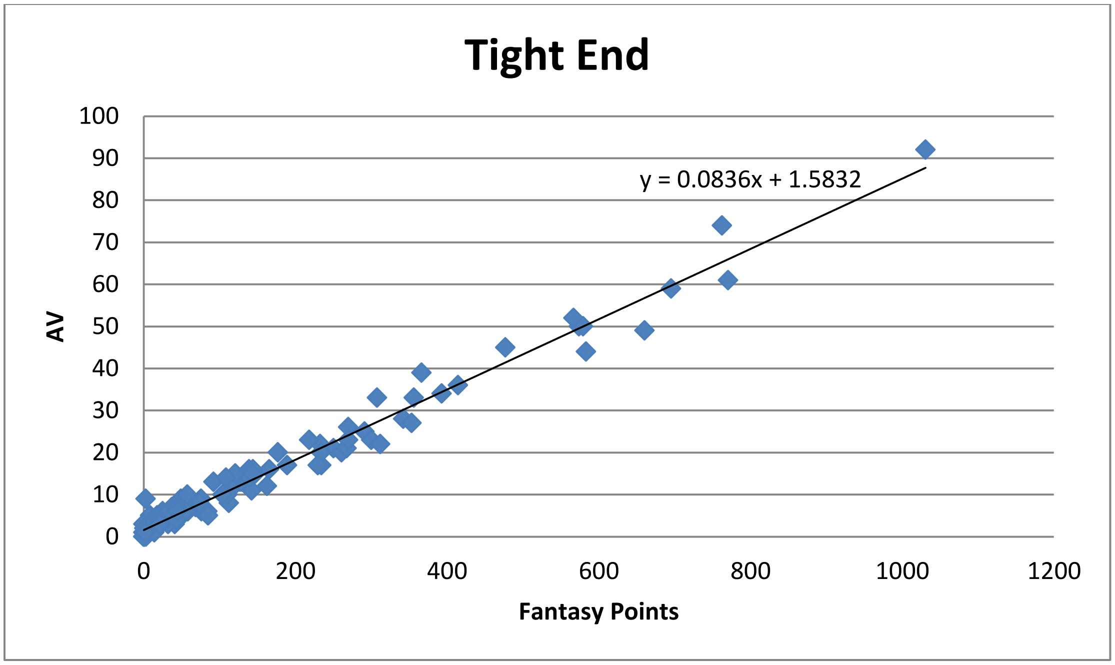


Figure 7: Sum of Fantasy Points vs. Sum of Approximate Value for Tight Ends.

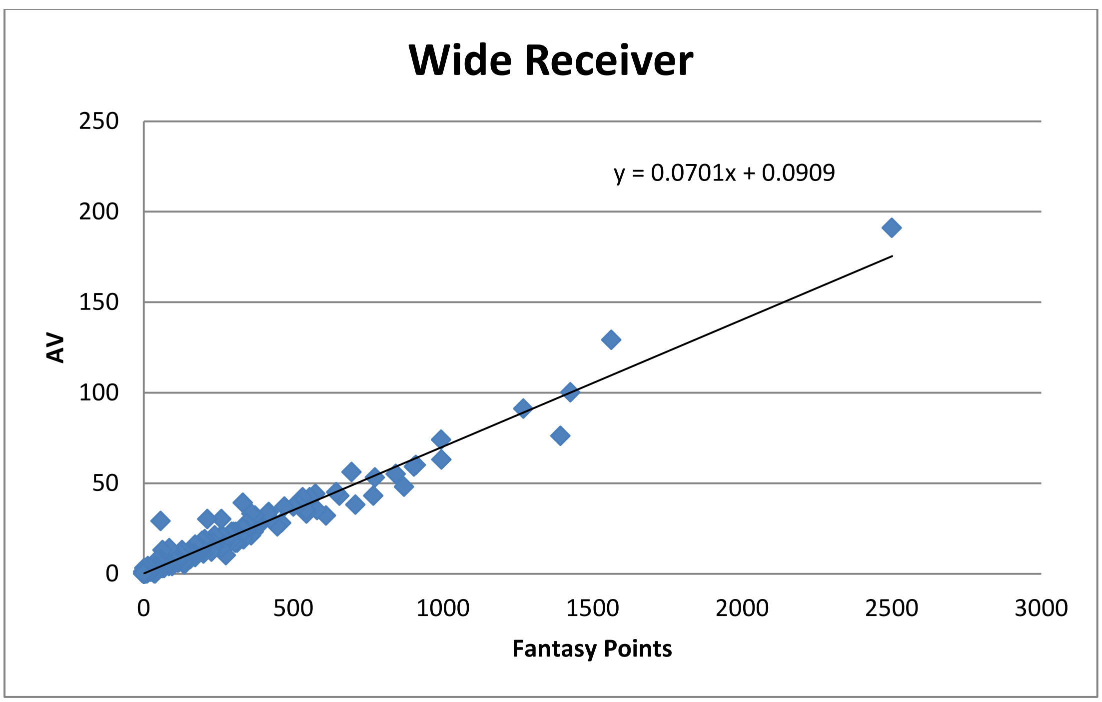


Figure 8: Sum of Fantasy Points vs. Sum of Approximate Value for Wide Receivers.

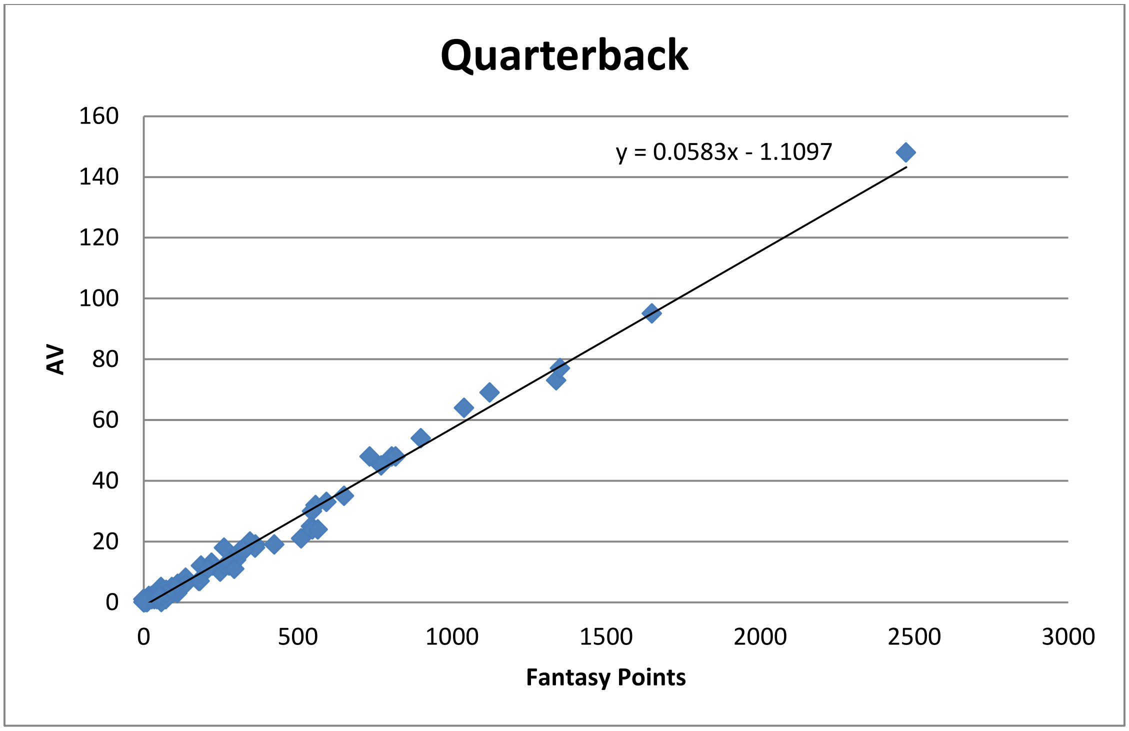


Figure 9: Sum of Fantasy Points vs. Sum of Approximate Value for Quarterbacks.

Upon examining Figure 6 through Figure 9, a linear relationship can be seen between AV and Fantasy Points for their corresponding positions. This relationship means that both metrics provide a nearly identical score for the players that need to be examined. For this reason, we feel that AV is a better metric for a statistic based success grade as it allows us to provide a success grade to a larger number of NFL players. Approximate Value will be the main grading metric for statistic-based success. Alternatively, there is also the Appearance Score metric we have developed, which does not provide a score based on performance and stats but rather on the percentiles of NFL player base. Figure 10 shows the relationship between AV and AS by showing every player's career sum of Approximate Value against his career sum of Appearance Score.

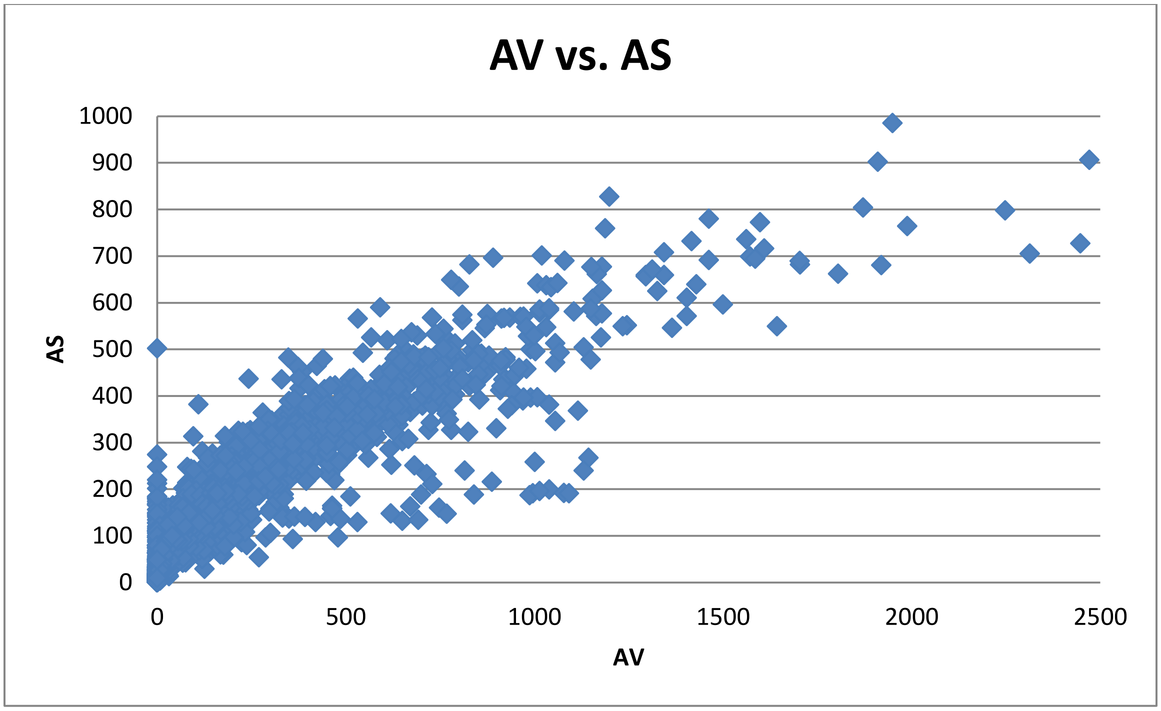


Figure 10: Graph of AV vs. AS

The graph shows that the two scores are somewhat linearly related however many data points are too divergent from the trend to assume a linear relation. Since Appearance Score can be calculated for any position while Approximate Value can only be determined for specific positions, there are also many cases when a player has an AV of zero and an AS of some value. In general, as a player's AV increases, his AS increases, which should be expected and shows that our Appearance Score method has some merit. Because these two methods use two distinctly different ways to find a grade for success, they are both valuable metrics for our analysis.

For the rest of this report, these metrics provide the backbone for all research and analysis. The two cost metrics which will be used are Draft Points and Round Points while success is determined using Approximate Value and Appearance Score.

4.5 - Database Creation

For our report, we determined that we would gather a variety of data for the NFL from the 2000 season until the 2012 season. Gathering 13 seasons worth of player data gives us a large enough database to perform a sufficient analysis. With the different sorts of information that we compared, we needed to use multiple sources in order to cover all the data that we wanted. One of our first and most important sources came after looking for different types of ranking systems that had already been created. The website Pro Football Reference establishes a standard for comparing players without having to rely on just the stats of a player alone, since many are not easy to compare from one position to another [9]. The data for the standard of Approximate Value can be seen in Figure 11 where the table is given by roster of a team in a specific year, and information is given about position, age, years played in the NFL and their Approximate Value.

Roster ProBowl(*), 1st-team All-Pro(+), · Glossary · SHARE · Embed · CSV · PRE · LINK · ?

No.		Age	Pos	G	GS	Wt	Ht	College/Univ	BirthDate	Yrs	AV	Drafted (tm/rnd/yr)
48	Danny Aiken	24	LS	16	0	250	6-4	Virginia	8/28/1988	1	0	
16	Kamar Aiken	23	WR	1	0	212	6-2	Central Florida	5/30/1989	1	0	
26	Will Allen	34	DB			196	5-10	Syracuse	8/5/1978	11	0	New York Giants / 1st / 22nd pick / 2001
	Armond Armstead	22	DT			298	6-5	USC	8/3/1990	Rook		
24	Kyle Arrington	26	DB	16	12	196	5-10	Hofstra	8/12/1986	3	5	
88	Jake Ballard	25	TE			256	6-6	Ohio State	12/2/1987	2	0	
30	Josh Barrett	28	DB			226	6-2	Arizona St.	11/22/1984	4	0	Denver Broncos / 7th / 220th pick / 2008
	Marcus Benard	27	LB			256	6-2	Jackson St.	7/26/1985	3		
92	Jake Bequette	23	DE	3	0	274	6-5	Arkansas	2/21/1989	Rook	0	New England Patriots / 3rd / 90th pick / 2012
38	Brandon Bolden	22	RB	10	0	220	5-11	Mississippi	1/26/1990	Rook	2	
12	Tom Brady	35	QB	16	16	225	6-4	Michigan	8/3/1977	12	18	New England Patriots / 6th / 199th pick / 2000
84	Deion Branch	33	WR	10	4	193	5-9	Louisville	7/18/1979	10	2	New England Patriots / 2nd / 65th pick / 2002
61	Marcus Cannon	24	OL	16	1	358	6-5	TCU	5/6/1988	1	2	New England Patriots / 5th / 138th pick / 2011
25	Patrick Chung	25	DB	12	7	207	5-11	Oregon	8/19/1987	3	3	New England Patriots / 2nd / 34th pick / 2009
23	Marquice Cole	29	DB	14	1	184	5-11	Northwestern	11/13/1983	3	1	
63	Daniel Connolly	30	G	14	14	311	6-4	SE Missouri St.	9/2/1982	7	8	
96	Jermaine Cunningham	24	LB	12	3	248	6-2	Florida	8/24/1988	2	3	New England Patriots / 2nd / 53rd pick / 2010
71	Brandon Deaderick	25	DT	14	5	297	6-4	Alabama	8/19/1987	2	3	New England Patriots / 7th / 247th pick / 2010
42	Jeff Demps	22	RB			175	5-7	Florida	1/8/1990	Rook	0	
37	Alfonzo Dennard	23	CB	10	6	204	5-10	Nebraska	9/9/1989	Rook	3	New England Patriots / 7th / 224th pick / 2012
46	James Develin	24	RB	1	0	251	6-3		7/23/1988	1	0	
21	Ras-I Dowling	24	DB	6	0	198	6-1	Virginia	5/9/1988	1	0	New England Patriots / 2nd / 33rd pick / 2011
	Jeremy Ebert	23	WR			200	5-11	Northwestern	4/6/1989	Rook		New England Patriots / 7th / 235th pick / 2012
43	Nate Ebner	24	DB	15	0			Ohio St.	12/14/1988	Rook	1	New England Patriots / 6th / 197th pick / 2012
11	Julian Edelman	26	QB	9	3	198	6-0	Kent St.	5/22/1986	3	4	New England Patriots / 7th / 232nd pick / 2009

Figure 11: www.Pro-Football-Reference.com Data on Approximate Value

The other data that Pro Football Reference had to offer was the information dealing with players that were chosen to be on the All-pro team or selected to go to the Pro-Bowl [10]. This information as shown in Figure 12 shows a table of all the players that were elected to the All-pro team or voted to go to the pro-bowl. Since the data only includes those players that were chosen only the names were needed from this section so that they could be placed into a category in Microsoft Access to reflect this information.

All-Pros Glossary · SHARE · Embed · CSV · PRE · LINK · ?

Pos		Tm	Age	Yrs	G	GS	Cmp	Att	Yds	TD	Int	Att	Yds	TD	Rec	Yds	TD	Tkl	Sk	Int	All-pro teams
QB	Peyton Manning	DEN	36	14	16	16	400	583	4659	37	11	23	6	0	0	0	0	0	0.0	0	Associated Press: 1st Team All-NFL Pro Football Writers: 1st Team All-NF Pro Football Focus: 1st Team All-NFL
QB	Aaron Rodgers	GNB	29	7	16	16	371	552	4295	39	8	54	259	2	1	-1	0	0	0.0	0	Associated Press: 2nd Team All-NFL Pro Football Focus: 2nd Team All-NFL
RB	Adrian Peterson	MIN	27	5	16	16	0	0	0	0	0	348	2097	12	40	217	1	0	0.0	0	Associated Press: 1st Team All-NFL Pro Football Writers: 1st Team All-NF Pro Football Focus: 1st Team All-NFL
RB	Marshawn Lynch	SEA	26	5	16	14	0	0	0	0	0	315	1590	11	23	196	1	0	0.0	0	Associated Press: 1st Team All-NFL Pro Football Writers: 1st Team All-NF
RB	Alfred Morris	WAS	24	Rook	16	16	0	0	0	0	0	335	1613	13	11	77	0	0	0.0	0	Associated Press: 2nd Team All-NFL
RB	Jamaal Charles	KAN	26	4	16	15	0	0	0	0	0	285	1509	5	35	236	1	0	0.0	0	Associated Press: 2nd Team All-NFL
FB	Vonta Leach	BAL	31	8	16	13	0	0	0	0	0	9	32	1	21	143	0	0	0.0	0	Associated Press: 1st Team All-NFL Pro Football Focus: 1st Team All-NFL
FB	Jerome Felton	MIN	26	4	16	7	0	0	0	0	0	0	0	0	3	35	0	0	0.0	0	Associated Press: 2nd Team All-NFL
WR	Calvin Johnson	DET	27	5	16	15	0	0	0	0	0	0	0	0	122	1964	5	0	0.0	0	Associated Press: 1st Team All-NFL Pro Football Writers: 1st Team All-NF Pro Football Focus: 1st Team All-NFL
WR	Brandon Marshall	CHI	28	6	16	16	0	0	0	0	0	1	-2	0	118	1508	11	0	0.0	0	Associated Press: 1st Team All-NFL Pro Football Writers: 1st Team All-NF Pro Football Focus: 2nd Team All-NFL
WR	Andre Johnson	HOU	31	9	16	15	0	0	0	0	0	0	0	0	112	1598	4	0	0.0	0	Associated Press: 2nd Team All-NFL Pro Football Focus: 1st Team All-NFL
WR	A.J. Green	CIN	24	1	16	16	0	0	0	0	0	4	38	0	97	1350	11	0	0.0	0	Associated Press: 2nd Team All-NFL Pro Football Focus: 2nd Team All-NFL
TE	Tony Gonzalez	ATL	36	15	16	15	0	0	0	0	0	0	0	0	93	930	8	0	0.0	0	Associated Press: 1st Team All-NFL
TE	Jason Witten	DAL	30	9	16	16	0	0	0	0	0	0	0	0	110	1039	3	0	0.0	0	Associated Press: 2nd Team All-NFL Pro Football Focus: 2nd Team All-NFL

Figure 12: www.Pro-Football-Reference.com example information about All-Pro or Pro-Bowl Data

We searched a number of sites in order to find data that gave us both the stats of a player along with their Fantasy Points, another one of our metrics. The best site we found for this information was Fantasy Football Today which gave us enough information to cover all the way back to the 2000 season [11].

Quarterback Stats: 2012

Regular Season

Want Custom Fantasy Scoring?
You are not logged in. You must be logged in and create a league profile to apply custom fantasy scoring to the stats, projections and rankings pages. Login or Register

Position: QB | RB | WR | TE | K | DEF | DL | LB | DB
Season: 2012 | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 | 2004 | 2003 | 2002 | 2001 | 2000
Week: 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17
Playoffs: Wild-Card | Divisional Playoffs | Conference Championships | Super Bowl
Options: Last 3 Weeks | Last 5 Weeks | Season | Playoffs

FF Today Default Scoring: Review Scoring — My FF Today

			Passing					Rushing			Fantasy	
Player Sort First: Last:	Team	G	Comp	Att	Yard	TD	INT	Att	Yard	TD	FFPts	FFPts/G
1. Drew Brees	NO	16	422	670	5,177	43	19	15	5	1	437.4	27.3
2. Aaron Rodgers	GB	16	372	553	4,303	39	8	54	259	2	409.1	25.6
3. Tom Brady	NE	16	401	638	4,827	34	8	23	32	4	404.6	25.3
4. Cam Newton	CAR	16	280	485	3,869	19	12	127	741	8	391.6	24.5
5. Matt Ryan	ATL	16	422	615	4,719	32	14	33	138	1	383.8	24.0
6. Peyton Manning	DEN	16	400	583	4,667	37	11	23	7	0	382.1	23.9
7. Tony Romo	DAL	16	425	648	4,903	28	19	30	49	1	368.1	23.0

Figure 13: www.fftoday.com Data Used to Retrieve Fantasy Points Scored by Players

Figure 13 shows how the Fantasy Point's data was organized by position, showing players from across the entire league. This information for AV, Pro-Bowl, All-Pro, and Fantasy Points is already in a table form so we simply had to copy the information over to a spreadsheet and make sure that the tables looked correct. Once all the information was in these spreadsheets they were added to the Microsoft Access file along with all the other information so that they could be called up in any query. In order to cover the information for the draft classes and order of draft picks we used the Draft History website [6].

2011

Round	Pick	Player	Name	Team	Position	College
1	1	1	Cam Newton	Panthers	QB	Auburn
	2	2	Von Miller	Broncos	LB	Texas A&M
	3	3	Marcell Dareus	Bills	DT	Alabama
	4	4	A.J. Green	Bengals	WR	Georgia
	5	5	Patrick Peterson	Cardinals	DB	Louisiana State
	6	6	Julio Jones	Falcons	WR	Alabama
	7	7	Aldon Smith	49ers	DE	Missouri
	8	8	Jake Locker	Titans	QB	Washington
	9	9	Tyron Smith	Cowboys	T	USC
	10	10	Blaine Gabbert	Jaguars	QB	Missouri
	11	11	J.J. Watt	Texans	DE	Wisconsin
	12	12	Christian Ponder	Vikings	QB	Florida State
	31	31	Cameron Hayward	Steelers	DE	Ohio State
	32	32	Derek Sherrod	Packers	T	Mississippi State
2	1	33	Ras-I Dowling	Patriots	DB	Virginia
	2	34	Aaron Williams	Bills	DB	Texas
	3	35	Andy Dalton	Bengals	QB	Texas Christian
	4	36	Colin Kaepernick	49ers	QB	Nevada

Figure 14: www.drafthistory.com and the 2011 draft

Figure 14 also shows how the information was recorded by year of the draft. The three columns on the left show that the picks are not only recorded as a number during a round but also as an overall value in the entire draft. In order to double check that Jimmy Johnson's draft values in Table 1 are currently being used in the league we analyzed the data from previous draft trades which was found on the Pro Sports Transactions website within their NFL section under draft pick transactions [12]. Figure 15 shows how Pro Sports Transactions recorded the different trades which were then sorted through by hand to find the trades that only included draft picks for that current draft.

Overall #	Round #	Team	Transactions	
Round 1				
1	1-1	Colts		
2	1-2	Rams	Redskins Traded 2012 first round pick (#6-Morris Claiborne), 2012 second round pick (#39-Janoris Jenkins), 2013 first round pick (?-?), 2014 first round pick (?-?) to Rams for 2012 first round pick (#2-Robert Griffin III) on 2012-03-13	
3	1-3	Vikings	Browns Traded 2012 first round pick (#4-Matt Kalil), 2012 fourth round pick (#118-Jarius Wright), 2012 fifth round pick (#139-Robert Blanton), 2012 seventh round pick (#211-Scott Solomon) to Vikings for 2012 first round pick (#3-Trent Richardson) on 2012-04-26	
4	1-4	Browns	Vikings Traded 2012 first round pick (#3-Trent Richardson) to Browns for 2012 first round pick (#4-Matt Kalil), 2012 fourth round pick (#118-Jarius Wright), 2012 fifth round pick (#139-Robert Blanton), 2012 seventh round pick (#211-Scott Solomon) on 2012-04-26	
5	1-5	Buccaneers	Jaguars Traded 2012 first round pick (#7-Mark Barron), 2012 fourth round pick (#101-Omar Bolden) to Buccaneers for 2012 first round pick (#5-Justin Blackmon) on 2012-04-26	
6	1-6	Redskins	Rams Traded 2012 first round pick (#2-Robert Griffin III) to Redskins for 2012 first round pick (#6-Morris Claiborne), 2012 second round pick (#39-Janoris Jenkins), 2013 first round pick (?-?), 2014 first round pick (?-?) on 2012-03-13	Cowboys Traded 2012 first round pick (#14-Michael Brockers), 2012 second round pick (#45-Alshon Jeffery) to Rams for 2012 first round pick (#6-Morris Claiborne) on 2012-04-26

Figure 15: www.prosportstransactions.com and their tabulation for trades made between picks

This data was then plugged into an excel spreadsheet so that the equations could be used later on to solve the question at hand. The first time the information was plugged in it looked like that of Figure 16 showing the two names of the teams trading and a list for which picks were traded for either side. The names of the teams were not necessary information but were used to quickly check that a trade had not been added multiple times to the spreadsheet.

Team 1	Team 2	Team 1 Picks Traded	Team 2 Picks Traded	Team 1 Draft Points	Team 2 Draft Points
Jaguars	Redskins	16, 49	10	1410	1300
Browns	Chiefs	26,70	21	940	800
49ers	Broncos	45, 108, 141	36	563.5	540
Colts	Redskins	53, 152	49	400.6	410
Bears	Redskins	62, 127	53	329	370
Lions	Seahawks	75, 107, 154, 205	57, 157, 209	336.2	368.4

Figure 16: Initial Spreadsheet for traded draft picks

The table in Figure 16 was then expanded to include a table of all the draft pick values for Jimmy Johnson's method such that the numbers could simply be typed in so that they would reference that specific value and equations could be used to calculate the differences among other solutions.

4.6 - Microsoft Access

The next step was to create a Microsoft Access database. After all of the data was collected into Excel sheets, it was then imported into Microsoft Access. Each graph seen in this project was then produced using a combination of Access and Excel.

The first step to create a graph was to create a query. In Access, a query is a way to pull together, manipulate, or create new data tables. The types of queries used in this project were select, append, update, and make table. The select query was the type of query used the most throughout the project as it pulls information in from multiple tables based upon the users' needs. For example, a select query can pull all NFL players whose name begins with the letter "M" and show their respective stats. The select query allows for a much easier time sorting the tables into the necessary data for the graphs. The append and update queries were used as well, which add new data to an already existing table in Access. The append and update queries allow tables in Access to be updated and extended as needed. The final query type used was the make table query, which simply creates a table from selected records. To create each graph, a select query is formed in Access. When a query is formed, the first step is to choose the tables that contain the necessary data. Once the tables are chosen, links are created between fields of the tables to unite records that are related as can be seen in Figure 17.

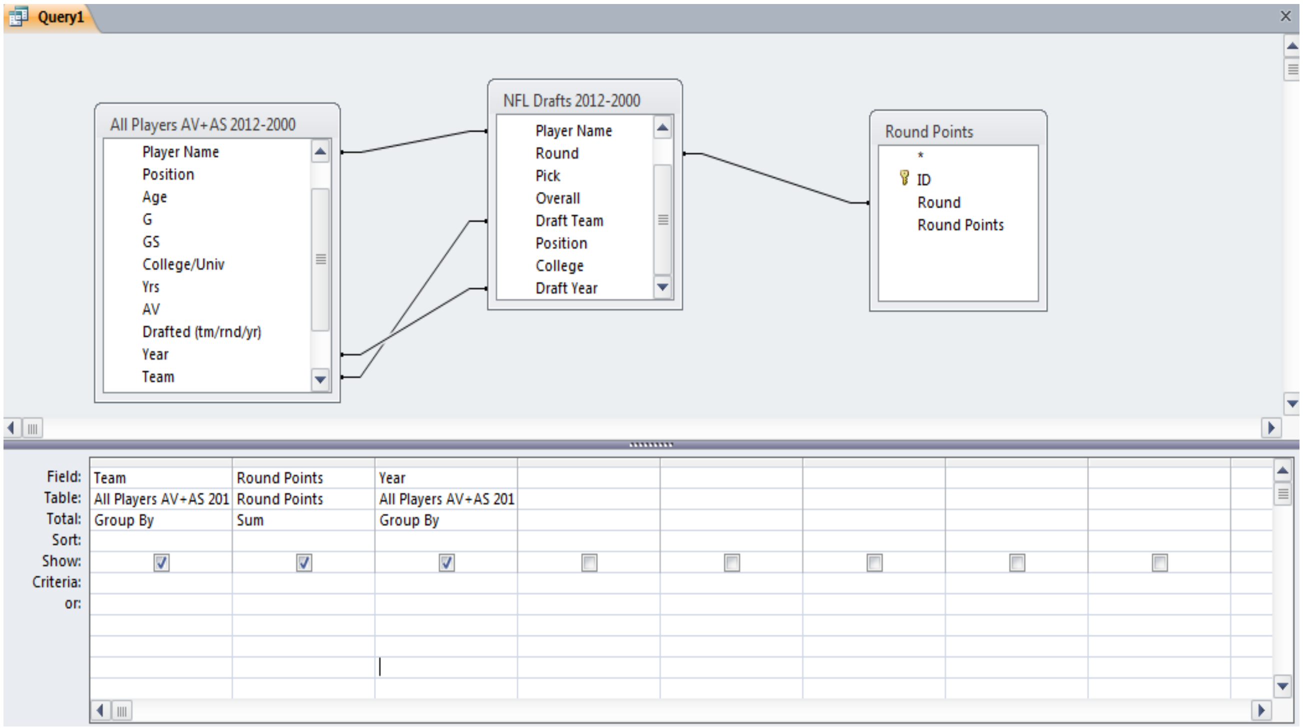
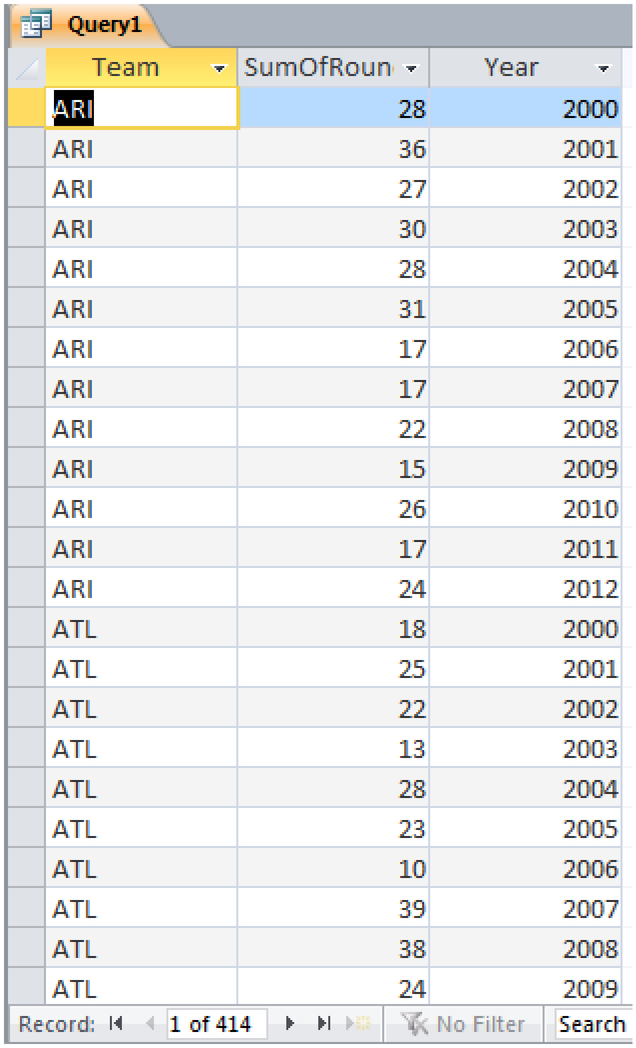


Figure 17: This picture displays the typical query page in Microsoft Access.

In the example of Figure 17, each of the lines represents one link. When a link is present, only records that match both ends of the link will appear in the query's results unless otherwise specified. So the link between the records "Player Name" in Figure 17 only allows the query to show results when the player name from the NFL Draft table matches the player name from the All Players AV+AS table. So in this case any records of free agents would not show up in the query results because of this single link. When all of the necessary links are in place, the records needed for the graph are chosen as can be seen in the bottom half of Figure 17. This specific query was designed to output the sum of the Round Points for each team for each year. A small section of this query result can be seen in Figure 18.



Query1

Team	SumOfRoun	Year
ARI	28	2000
ARI	36	2001
ARI	27	2002
ARI	30	2003
ARI	28	2004
ARI	31	2005
ARI	17	2006
ARI	17	2007
ARI	22	2008
ARI	15	2009
ARI	26	2010
ARI	17	2011
ARI	24	2012
ATL	18	2000
ATL	25	2001
ATL	22	2002
ATL	13	2003
ATL	28	2004
ATL	23	2005
ATL	10	2006
ATL	39	2007
ATL	38	2008
ATL	24	2009

Record: 1 of 414 No Filter Search

Figure 18: This picture shows the results of a query after it has been run.

The results from each query are then copied and pasted into Excel sheets. Then the graph of that data is formed. For some of the scatter plot graphs, the individual points needed to be labeled. To do this a macro needed to be created in Excel. The first step to creating this macro was to open Microsoft Visual Basic for Applications, a program built-in to Microsoft Office. Once the program was open, a module was created as can be seen in Figure 19. Whenever a graph needed to be labeled it was moved into a new sheet and then Microsoft Visual Basic was opened and the macro in Figure 19 was run [13].

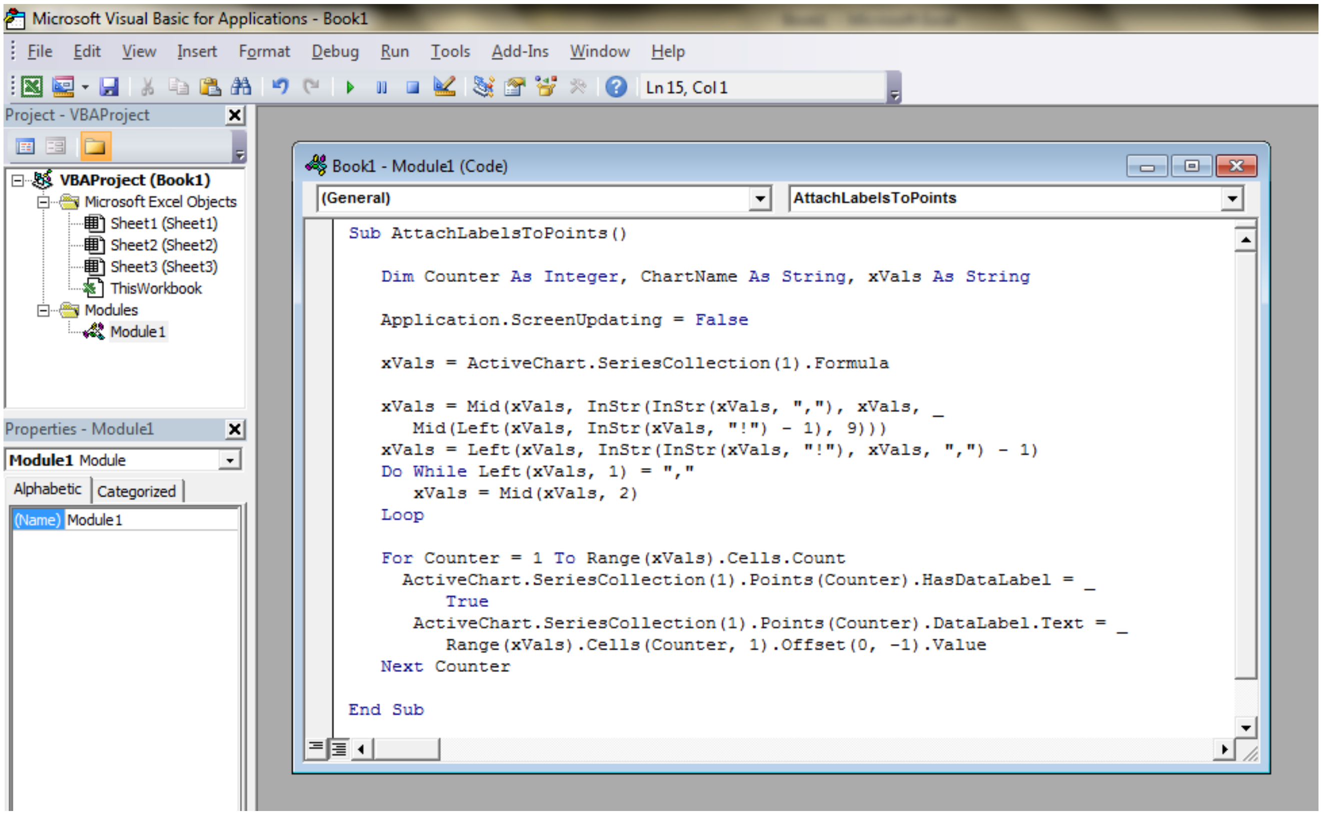


Figure 19: This picture shows the macro created for labeling data points in Excel.

4.7 - Summary

Our methodology consisted of determining success metrics for NFL players, cost metrics for draftees, and collecting all the data into a single database so we could do different analyses. The success metrics we determined were Approximate Value, Fantasy Points, and Appearance Score. Of these, Appearance Score is our own developed metric that is complementary to Approximate Value as Fantasy Points show a similar outcome as Approximate Value in analyses. Our database was created using Microsoft Access which builds off of Microsoft Excel. Access brings in multiple Excel sheets with data and allows user organization as well as comparison between said data.

5. Results and Discussion

In this chapter, our group provides in depth analysis for the research questions described in chapter 3. Using the metrics we established for grading player performance and various graphs and tables, we examine four categories of interesting topics in the NFL.

5.1 - Team Related

The first topic when thinking about the NFL draft is how well a team drafts from year to year. The way we are going to evaluate this is by using out cost and success metrics that we established in previous chapters. Once we determine which teams have drafted the best the next question is to find out if that draft success translates into wins in the NFL.

5.1.1 – Which Team Drafted the Best and Worst?

We, as a group, have thought of different ways to analyze and evaluate every team's draft results and determine who drafted the best. The decision was made that the best way to determine who drafted the best was to look at a graph of success versus cost and look for the team that had the greatest success at the least cost. The only decision that needed to be made was which metric of cost and success would be used for our analysis. The in-depth analysis will focus on the success metric Approximate Value and the cost metric Round Points. Another important notion to keep in mind is that the conclusion at the end of this section will be for draft performance of this century rather than on a yearly basis. This gives more data which makes our analysis more consistent. The best way to look at how well teams have drafted is to break down the teams into their divisions and compare them to their divisional opponents. This is because the teams that must be beaten to advance to the playoffs are within each other's division.

Looking at Figure 20; a graph showing the Approximate Value of a team's players, with every icon on each line representing a different year since 2000, versus the Round Points the team had to use to acquire their draftees; gives a profound look into how well each team in the NFC North has drafted and how well those drafted players have performed.

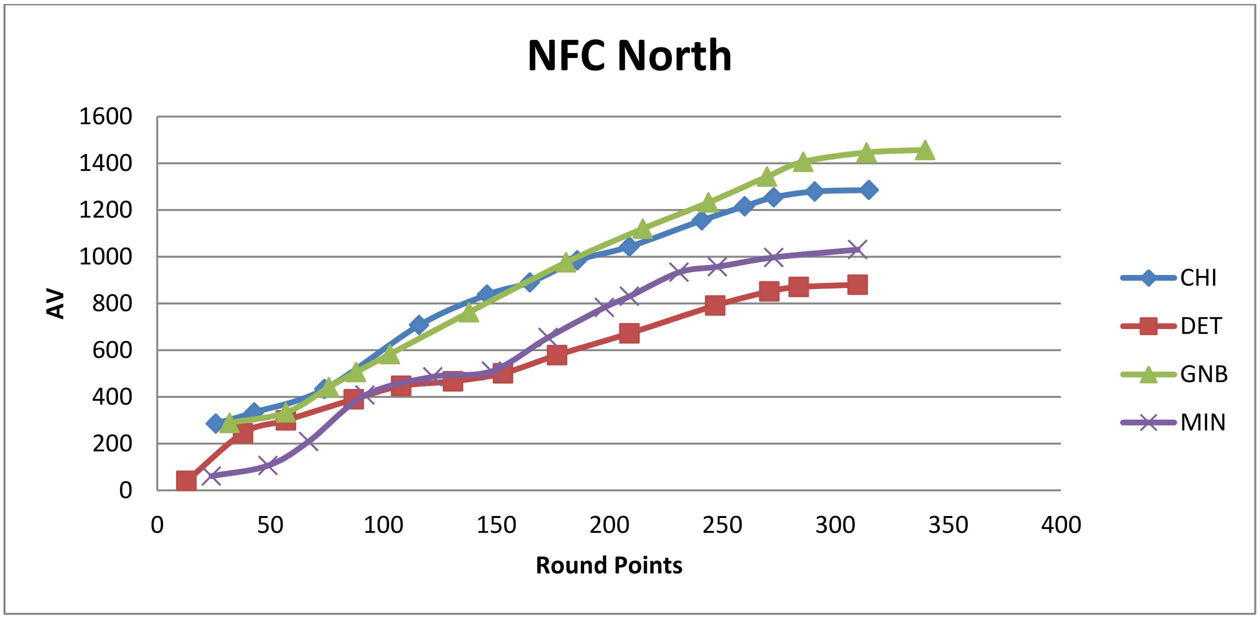


Figure 20: Graph of Approximate Value versus Round Points for NFC North

The Green Bay Packers have spent the most Round Points acquiring players, but also have the highest Approximate Value in their division. This is enough information to say that the Packers have drafted the best in the NFC North. The team with the least Approximate Value in this division is clearly the Detroit Lions. They started off their drafting with a higher success rate than the Minnesota Vikings, but were overtaken in less than five years of poor drafting.

The next division to look deeper into is the NFC South. As seen in Figure 21, the Carolina Panthers have drafted above and beyond the other teams since the beginning of our analysis.

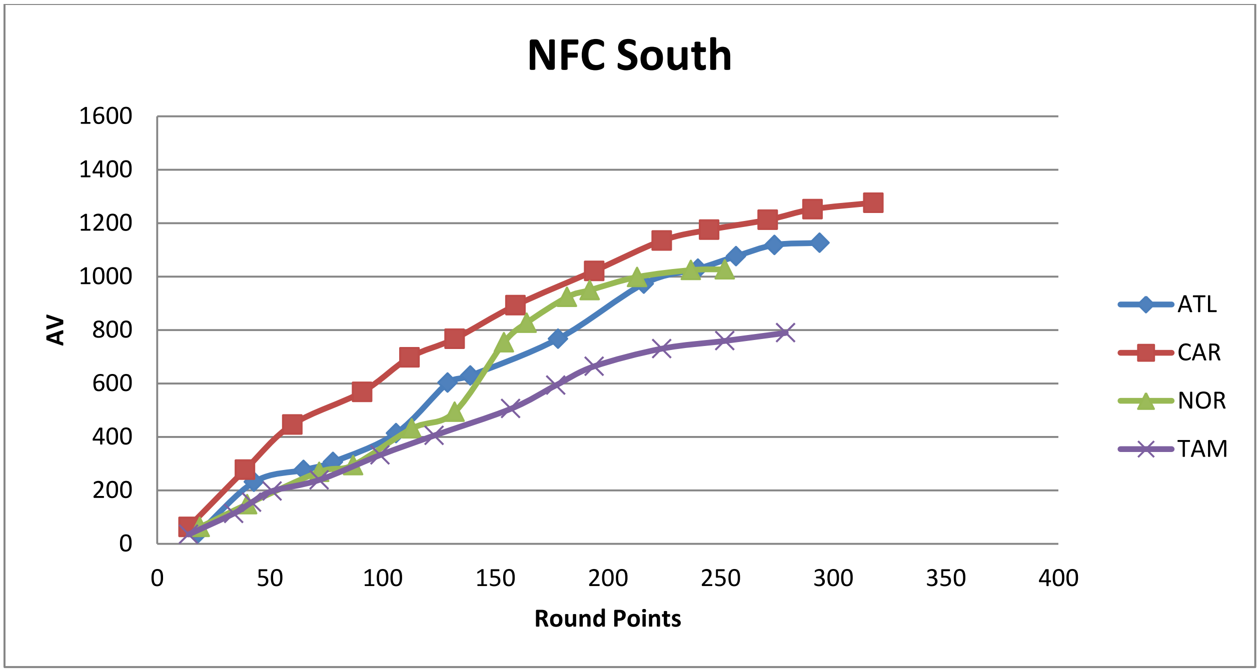


Figure 21: Graph of Approximate Value versus Round Points for NFC South

Atlanta proved to be a consistent team in terms of drafting from year to year while the New Orleans Saints' drafts proved to fluctuate heavily. The team that consistently underperformed in the offseason was the Tampa Bay Buccaneers. Through the first few years of the analysis they were on par with the Saints in terms of Approximate Value, but they never gained much from any draft class which caused them to accumulate the least total Approximate Value in the division.

A division that has teams with ups and downs shoving one another out of the first place spot; the NFC West is a tightly contested division in our analysis. From Figure 22 the loser in this division is clear with the St. Louis Rams bringing up the rear with less than 800 Approximate Value points when every other team has over 1000.

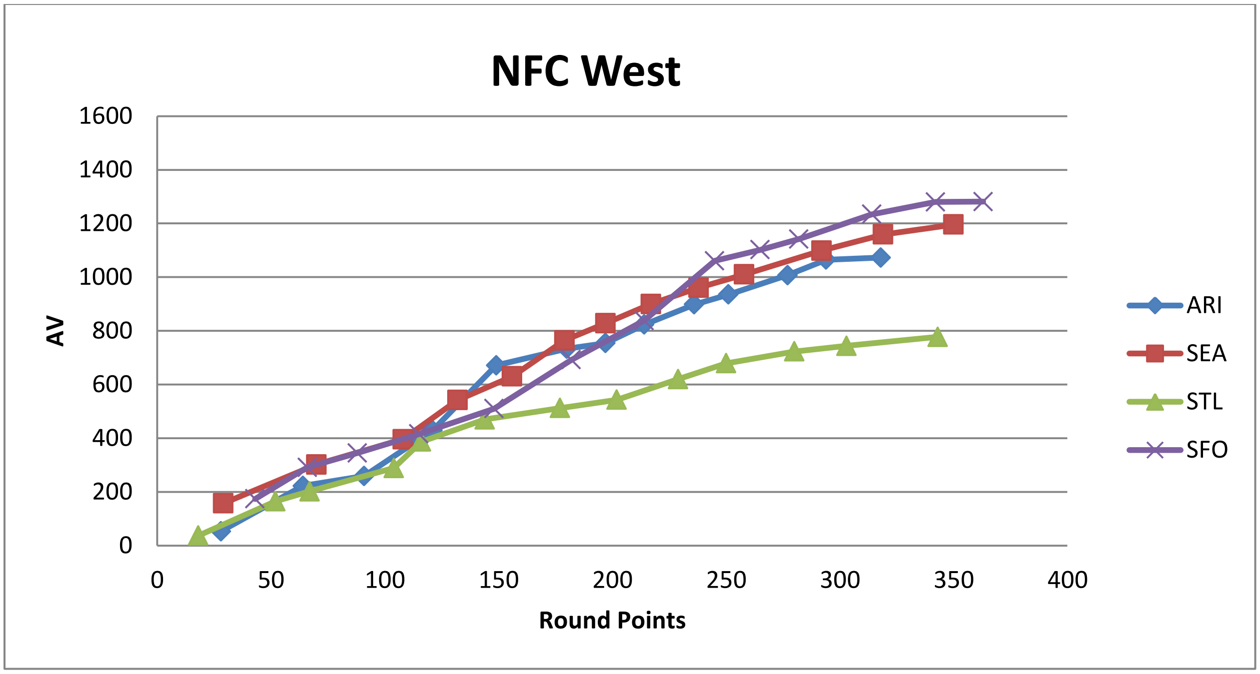


Figure 22: Graph of Approximate Value versus Round Points for NFC West

The team with the highest value for Approximate Value in this division has changed on an almost yearly basis with the Seattle Seahawks holding the throne for over 4 years, the Arizona Cardinals reigning supreme for a year and the San Francisco 49ers coming out on top in the latter half of our evaluation and maintaining this lead. All three teams proved capable of worthy drafts as well as poor drafts but the 49ers were the winners in the end.

The final division needing a look in the NFC is the East division. This division appears to be much more even than the other two in the NFC, as there is no apparent “loser” in this division. It is clear to see from Figure 23 that the Washington Redskins hands down have the lowest Approximate Value; however every team did not spend a relatively equal number of Round Points like in the other three.

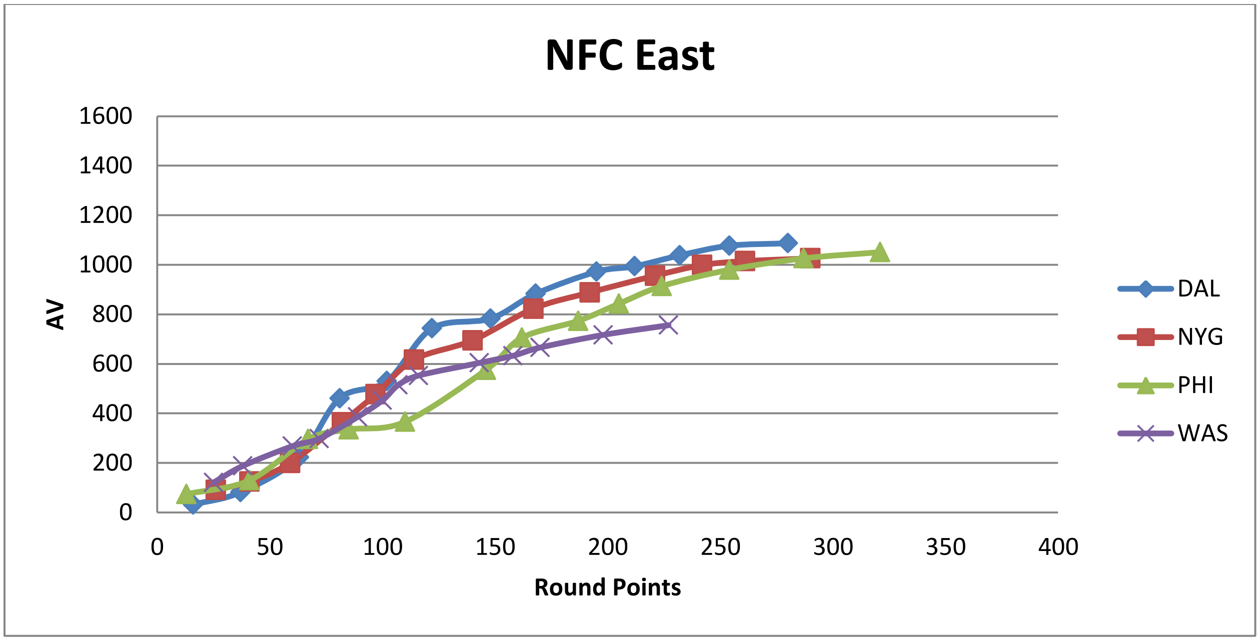


Figure 23: Graph of Approximate Value versus Round Points for NFC East

The Redskins have only used 227 Round Points since 2000 whereas the other teams in their division have used at least 280. This could make the analysis tricky, so in order to increase simplicity the final factor for determining the overall success of a team's draft is the total Approximate Value. This will be held throughout the entire evaluation regarding team draft success until efficiency is looked at. That being said, the Washington Redskins drafted the worst out of the NFC East and the Dallas Cowboys have drafted the best.

Now that the NFC's "winners and losers" have been determined, we must now look at the AFC to determine the best and worst drafting teams in that conference. The first division up for evaluation is the AFC North. As the standings from year to year will show, the top two teams in this division are consistently the Baltimore Ravens and the Pittsburgh Steelers. Whether there is a correlation between draft success and team success will be determined in the next section. This case shows some positive evidence for that reasoning, as seen in Figure 24, since the Steelers and the Ravens have the highest Approximate Values in the AFC North.

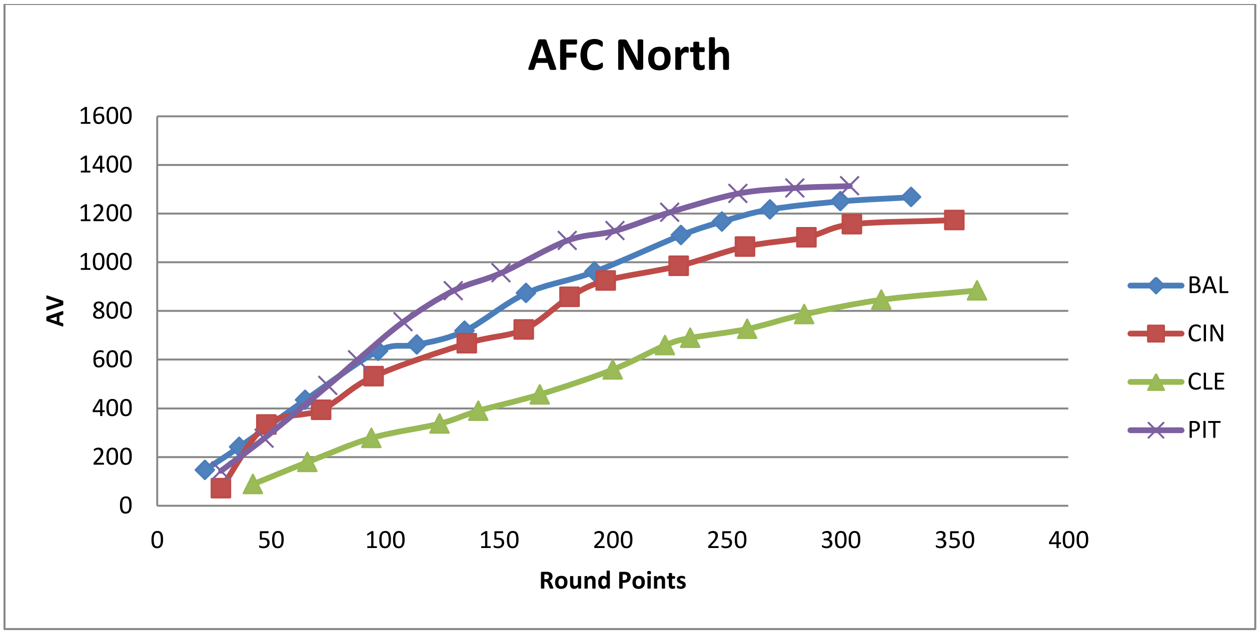


Figure 24: Graph of Approximate Value versus Round Points for AFC North

The Steelers have managed a higher Approximate Value while using fewer Round Points than the Ravens so they are the clear winner in this division. The loser in this division is without a doubt the Cleveland Browns who have been consistently worse than every other team in their division since 2000.

If the AFC North's division looked close, then take a look at Figure 25 and check out the jostling between the two top drafting teams in the AFC South; the Indianapolis Colts and the Jacksonville Jaguars.

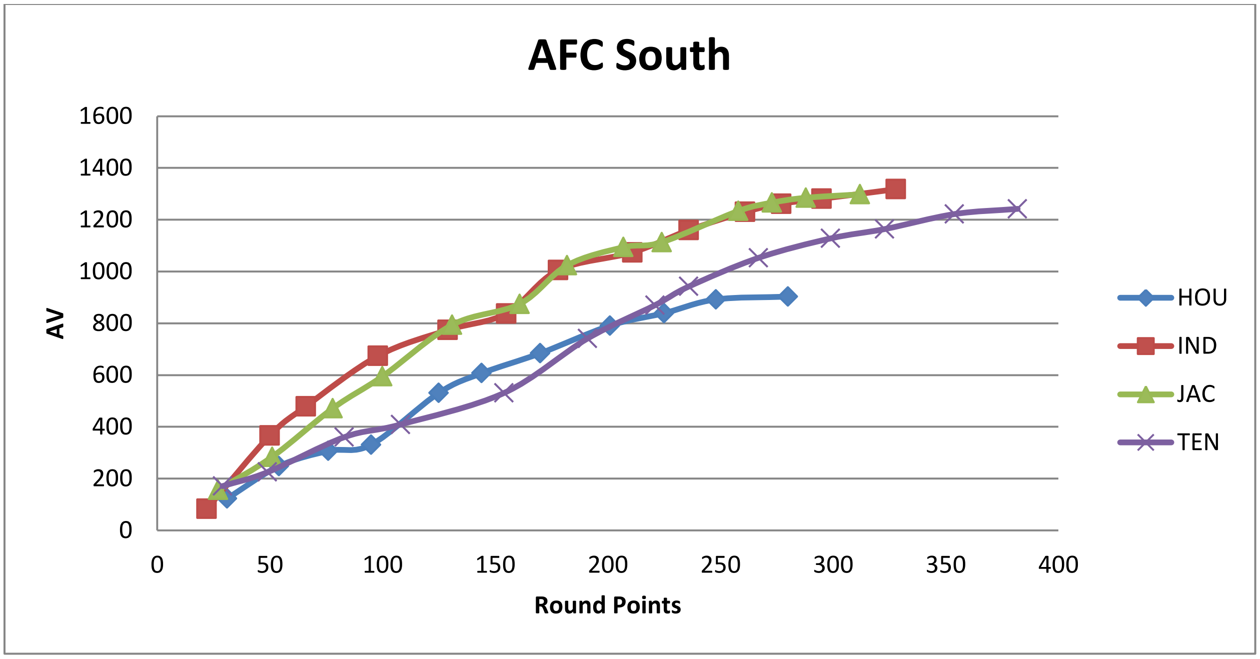


Figure 25: Graph of Approximate Value versus Round Points for AFC South

The Colts have managed to scrape the ever so slightest lead of 20 Approximate Value points over the Jaguars. They have managed to spend a few more Round Points than the Jaguars have in recent years which most likely contributed to this lead. The worst drafting team in this division for a few years was the Tennessee Titans, however they have drafted strong in the past few years edging out the Houston Texans avoiding a last place finish in our analysis. The Texans, however, have only been in the NFL since 2002 so having fewer Round Points than other teams is to be expected.

Most of the divisions to this point have had a clear loser with multiple teams fighting for that top spot in their respective division. However, the AFC West is quite the opposite with a clearly defined winner and the other three teams close to one another for the last place spot. The San Diego Chargers are clearly the winners in this division by a wide margin as shown in Figure 26.

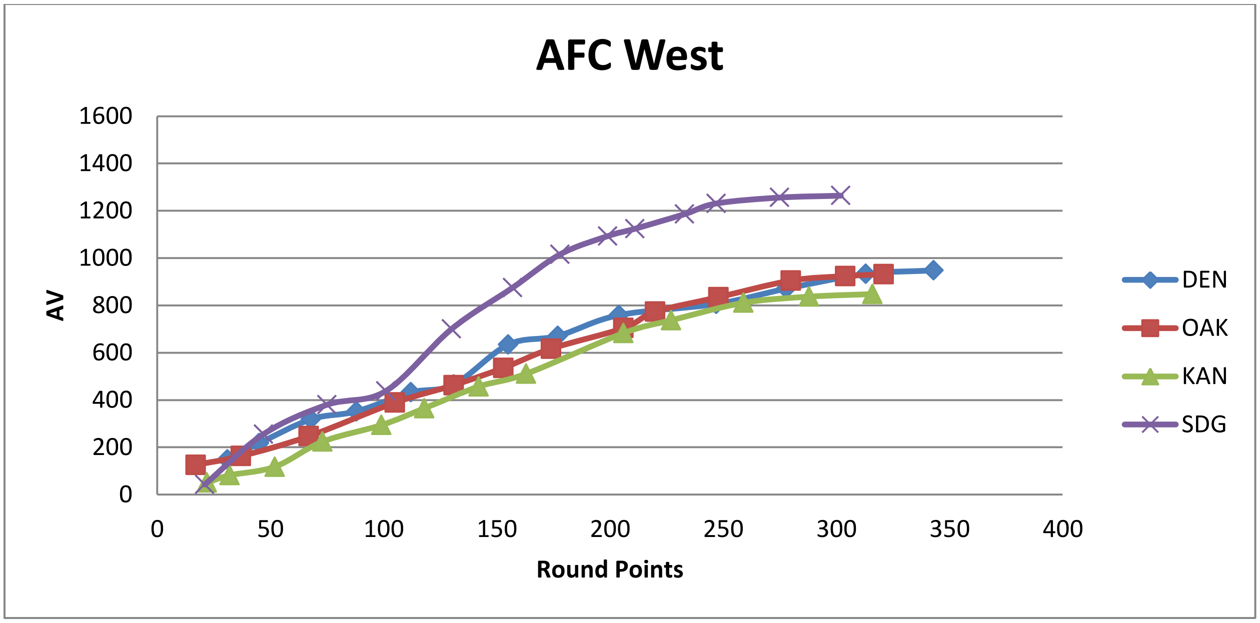


Figure 26: Graph of Approximate Value versus Round Points for AFC West

The Denver Broncos, Oakland Raiders, and Kansas City Chiefs however are virtually tied for the last place spot. The Raiders and Broncos are separated by a miniscule 16 Approximate Value points. If it were not for the Chief's poor drafting in the last few years of our evaluation there may have been a potential three-way tie for the worst drafting team in the division.

A division that is clear-cut in that there are no teams close to another in terms of draft success, the AFC East is the easiest division to determine a winner and loser in. Figure 27 shows that the New England Patriots, notorious for trading away draft picks in exchange for different picks or even picks in a later draft, are well above any other team in terms of overall Approximate Value.

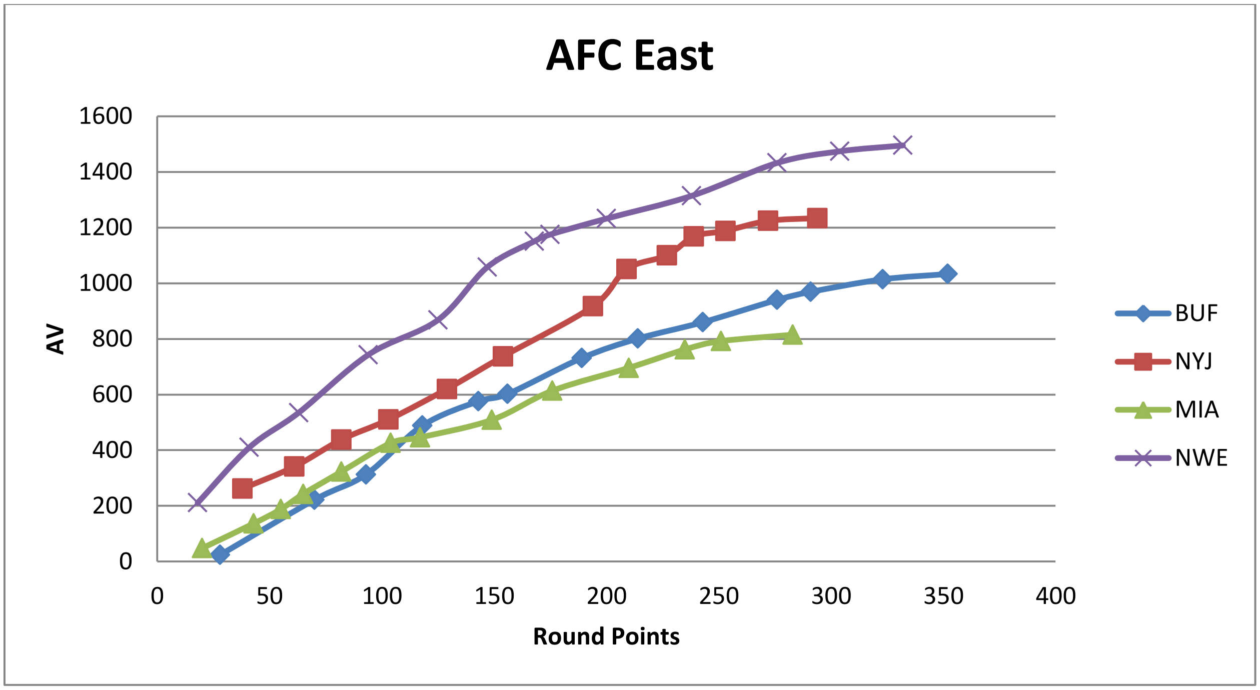


Figure 27: Graph of Approximate Value versus Round Points for AFC East

The worst drafting team in this division was at one point the Buffalo Bills; however after a few years from the start of our evaluation the Miami Dolphins have surpassed the Bills for the honor of worst drafting team in the AFC East.

From the results of the individual analyses of every division in the NFL we can generate a list of best and worst drafting teams. One way to determine the absolute winner and loser in the NFL is to compare the Approximate Values for every winner and loser and find the highest for the winner and lowest for the loser. The best drafting teams are as follows; Green bay Packers, Carolina Panthers, San Francisco 49ers, Dallas Cowboys, Pittsburg Steelers, Indianapolis Colts, San Diego Chargers, and New England Patriots. The worst drafting teams are as listed; Detroit Lions, Tampa Bay Buccaneers, St. Louis Rams, Washington Redskins, Cleveland Browns, Houston Texans, Kansas City Chiefs, and Miami Dolphins.

A complete graph of total Approximate Value versus total Round Points for every team since 2000 is found in Figure 28.

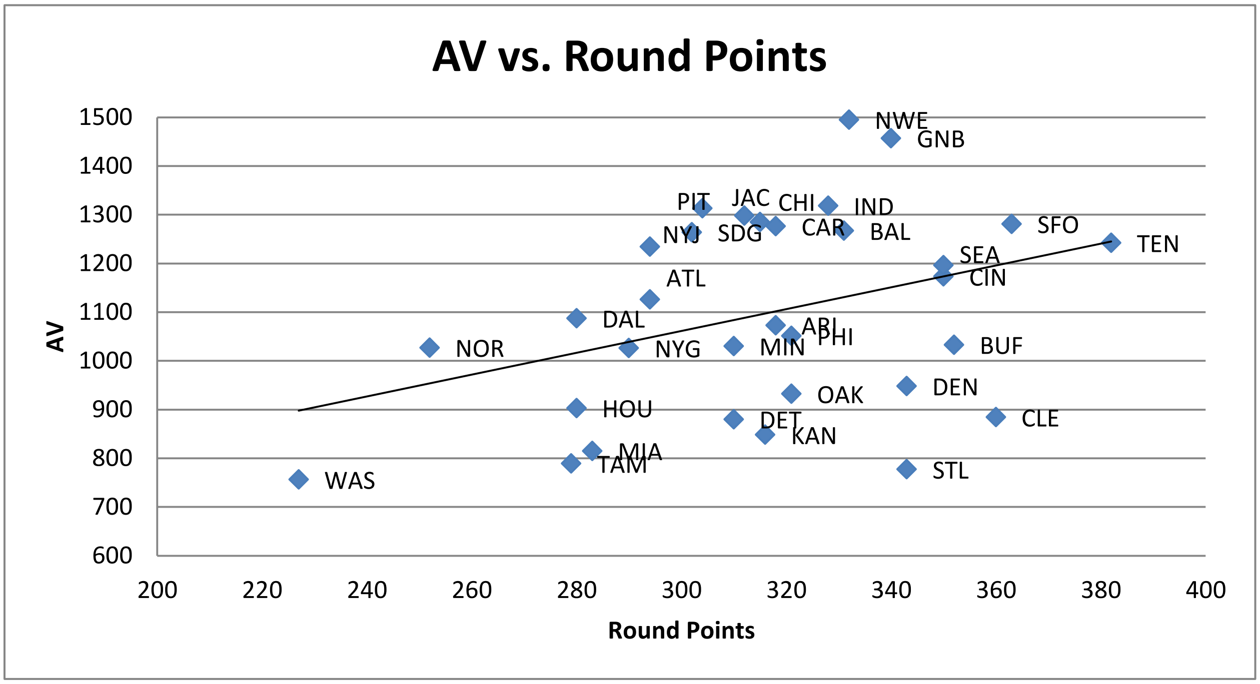


Figure 28: Graph of total Round Points versus total Approximate Value since 2000

This graph shows that the New England Patriots have the highest Approximate Value and the Washington Redskins have the lowest Approximate Value. An important concept to keep in mind for this data is the total Approximate Value is for draftees only. This data does not include free agents or any acquisitions outside of the draft date.

Now we will look at two success metrics, Approximate Value and Appearance Score, to see which team actually gets the most value out of their picks and which team gets the least value out of their picks. Table 7 shows the scaled Approximate Value as well as the scaled Appearance Score for each team in the NFL. The final column is of particular interest here because it is the average or composite score between the two columns and is the basis for our conclusion.

Table 7: Table of overall Success of draftees

Rank	Draft Team	Scaled AV	Scaled AS	Average
1	GNB	95	77	86
2	NWE	100	72	86
3	SFO	71	100	86
4	TEN	66	84	75
5	IND	76	72	74
6	CAR	70	75	73
7	BAL	69	76	72
8	CHI	72	70	71
9	JAC	73	68	70
10	PIT	75	62	68
11	SDG	69	59	64
12	NYJ	65	59	62
13	SEA	60	64	62
14	CIN	56	55	56
15	ARI	43	54	49
16	DAL	45	49	47
17	ATL	50	40	45
18	HOU	42	47	44
19	BUF	37	49	43
20	MIN	37	42	40
21	NYG	37	41	39
22	PHI	40	35	37
23	OAK	24	48	36
24	NOR	37	32	35
25	CLE	17	34	26
26	DEN	26	22	24
27	DET	17	27	22
28	KAN	12	24	18
29	MIA	8	17	13
30	TAM	4	19	12
31	STL	3	17	10
32	WAS	0	0	0

Interestingly, the Patriots have the highest Approximate Value but they do not have the highest average cost metric score. This belongs to the Green Bay Packers who, although they appear to be tied with other teams due to the rounded values, slightly edge out the Patriots and 49ers. The Redskins have the worst value of success out of any NFL team. Also something important to remember, these metrics are on a per year basis and do not take into account any free agents that are picked up by teams because this analysis is evaluating draft success only.

A better way to determine which team has drafted the best would be to look at which teams acquired the most productive players for the least cost. The lower the cost of the players the better for the team financially and if the team is still getting productive players then that team is drafting more efficiently. Even though teams may not be drafting and getting as much productivity out of their players, they are getting the most value for the money they spend when drafting efficiently. Table 8 illustrates the ratios of draft success versus draft cost. What this table demonstrates is how *efficiently* a team drafts instead of which team drafts and gets the most productivity out of their picks. The values in this table are scaled from 100 – 0 in order to make the values more meaningful. The higher the scaled value the higher the actual ratio is and therefore the more efficiently a team drafted.

The last column is the column of focus because averages take in more data and are more reliable than a single column. The team with the highest success to cost average ratio according to Table 8 is the Pittsburgh Steelers. Note that this team is not the team with this highest Approximate Value total but the team that gets the most success from their players while using the least cost in the draft. The team with the lowest ratio, the least efficient drafting team in the National Football League, is the St. Louis Rams. They get the least value out of their picks even though they have more Approximate Value points than the Washington Redskins; who interestingly enough had the least Approximate Value but have a ratio of around 30 beating out the Rams by a large margin.

Table 8: Table of Ratios of Success of Drafted Players versus the Cost of Drafting Those Players

Rank	Draft Team	Scaled AV/RP	Scaled AV/DP	Scaled AS/RP	Scaled AS/DP	Average
1	PIT	92	99	92	89	93
2	IND	78	100	87	100	91
3	GNB	90	94	85	82	88
4	NWE	100	93	83	72	87
5	BAL	70	86	90	94	85
6	CHI	81	81	94	81	84
7	JAC	85	63	94	58	75
8	CAR	78	57	100	59	73
9	DAL	72	61	94	65	73
10	NYJ	86	56	98	51	73
11	SDG	86	58	90	51	71
12	NOR	81	51	96	48	69
13	TEN	44	72	63	88	67
14	SFO	56	47	96	63	66
15	NYG	57	62	73	68	65
16	ATL	70	56	68	48	61
17	SEA	51	58	58	60	57
18	PHI	45	52	39	49	46
19	MIN	47	38	57	40	46
20	ARI	50	26	69	29	44
21	CIN	49	33	47	28	39
22	OAK	29	23	57	36	36
23	HOU	43	24	49	22	34
24	TAM	25	26	47	38	34
25	BUF	30	28	38	33	32
26	WAS	48	12	60	10	32
27	MIA	27	24	40	30	30
28	KAN	19	22	27	29	24
29	DEN	22	26	7	22	19
30	DET	26	0	36	0	15
31	CLE	9	5	13	8	9
32	STL	0	0	0	3	1

The results of our analyses yielded that the New England Patriots had a higher Approximate Value than any other team but when analyzed in conjunction with Appearance

Score the Green Bay Packers win out over any other team. The team with the least success from drafting in this century belongs to the Washington Redskins.

As far as efficiency goes the Green Bay Packers, although they have the highest Approximate Value, pale in comparison to the Pittsburg Steelers. The least efficient team in the NFL is the St. Louis Rams with a scaled draft ratio of 1. They may have more Approximate Value than teams such as the Redskins, but the cost they incur makes their ratio of success to cost much lower than any other team in the NFL. Contrary to the drafting techniques of the Rams, the Pittsburgh Steelers' drafting patterns are the most cost-effective and should therefore be adapted for other teams looking to improve their drafting as they are able to acquire the most success while incurring the least cost in terms of the metrics we have created.

5.1.2 – Does a Team's Draft Success Translate into NFL Wins?

Another question one might ask about NFL draft success is whether this success carries over from the postseason to the regular season. One would imagine that the better a team's drafted players perform during the regular season, the more wins that team would receive. Since Approximate Value is a measure of how well a player contributes to a team's success, the best way to verify this is to look at a graph of regular season wins versus Approximate Value of said team's draft picks. We will also take a look at our own metric of Appearance Score versus wins.

The assumption before looking at this relationship was that the higher a team's Approximate Value the more wins said team will have recorded. Figure 29, a graph of the total wins each team has earned and the total Approximate Value of the teams' drafted players, shows that there is a strong correlation between the Approximate Value of a team and the number of wins said team has received. There are no glaring outliers in this data; however the Houston Texans are slightly bucking the trend. Houston is a special team in our analysis because they have only been in the NFL since 2002 and therefore have had fewer draft picks than other teams. This means that the Houston Texans' players Approximate Value totals are limited to fewer years than the other teams in the NFL.

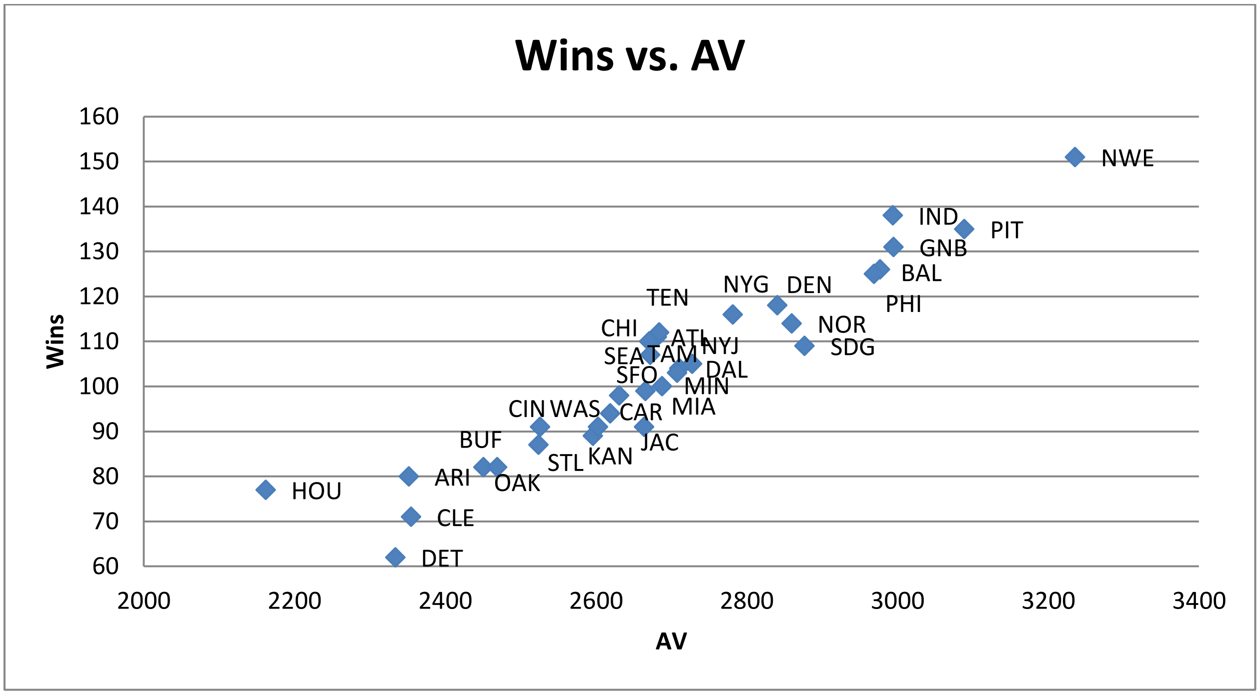


Figure 29: Graph of Wins versus the Approximate Value of that team's draft picks since 2000

When dealing with our metric of success, Appearance Score, the correlation is similar although the outlier is more obvious. Figure 30 shows the discrepancy between the Houston Texans and the rest of the NFL. This graph shows the total wins each NFL team has amassed since 2000 as well as the total Appearance Score of each team's drafted players since 2000.

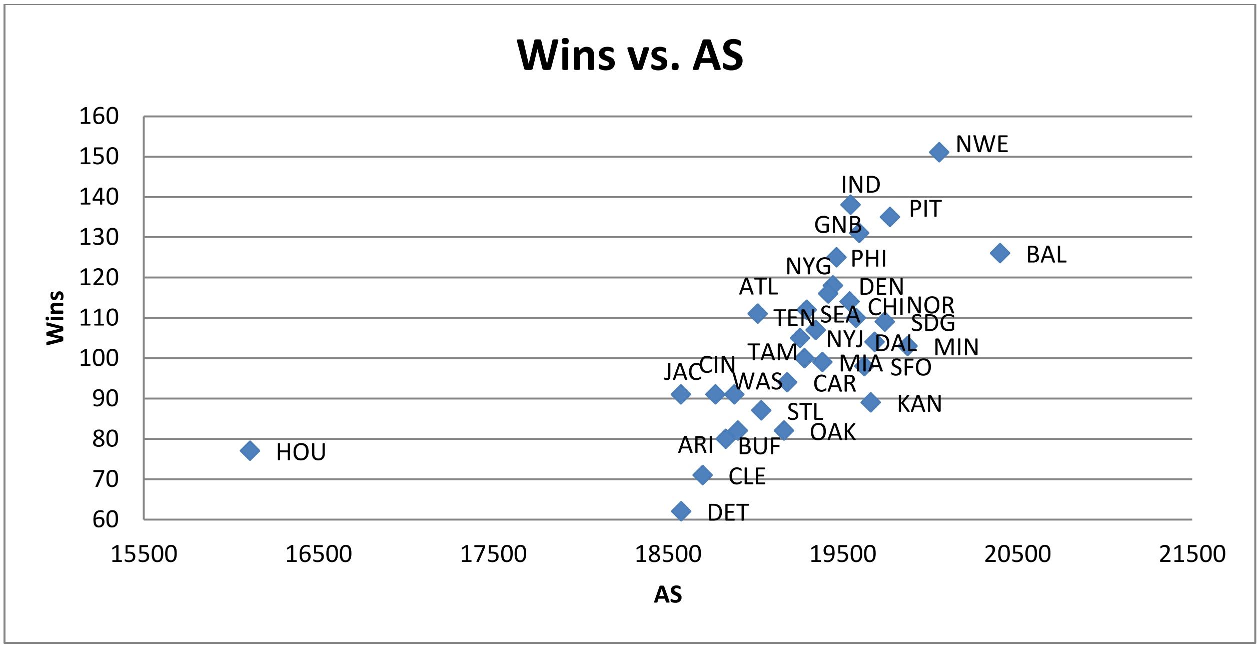


Figure 30: Graph of Wins versus Appearance Score of that team's draft picks since 2000

The divergence is due to how Appearance Score is calculated. Players gain points towards their Appearance Score for playing and starting in games as well as being named to pro-bowls. Because Houston has not been in the NFL as long as every other team in the NFL, the players on the Texans have not accumulated many points towards their Appearance Scores. If Houston were to be removed from the data for making this graph then the relationship would look near identical to Figure 29.

After looking at the data, the conclusion to our question was simple to come to. The higher a team's Approximate Value or Appearance Score, the more wins said team earns. That being said, the higher the level that the drafted players perform at the more wins a team can expect to win as a direct result of this performance.

5.2 – Position Related

Another topic of this project relates to NFL positions. Three questions were posed for this topic and are as follows: what are the most valuable positions, what positions are invested in the most, and what position is the most undervalued and overvalued in the NFL draft. We came to the conclusion that to assess these questions two graphs had to be created. One graph would be the average Round Points versus the average Appearance Score and the other graph would be the average Round Points versus the average Approximate Value. This approach allowed us to evaluate NFL positions on two different value metrics. By using average values, it allows us to compare success of different positions to each other even though there are many more players at certain positions than others. For example, there are more wide receivers in the league than quarterbacks therefore a sum would skew the values. Under these restrictions, Figure 31 and Figure 32 were created. Each point on the graphs represents a single NFL position. Some positions were removed because they did not have a large enough sample size of players. Also punters were removed from the Approximate Value graph because there is no Approximate Value calculated for that position.

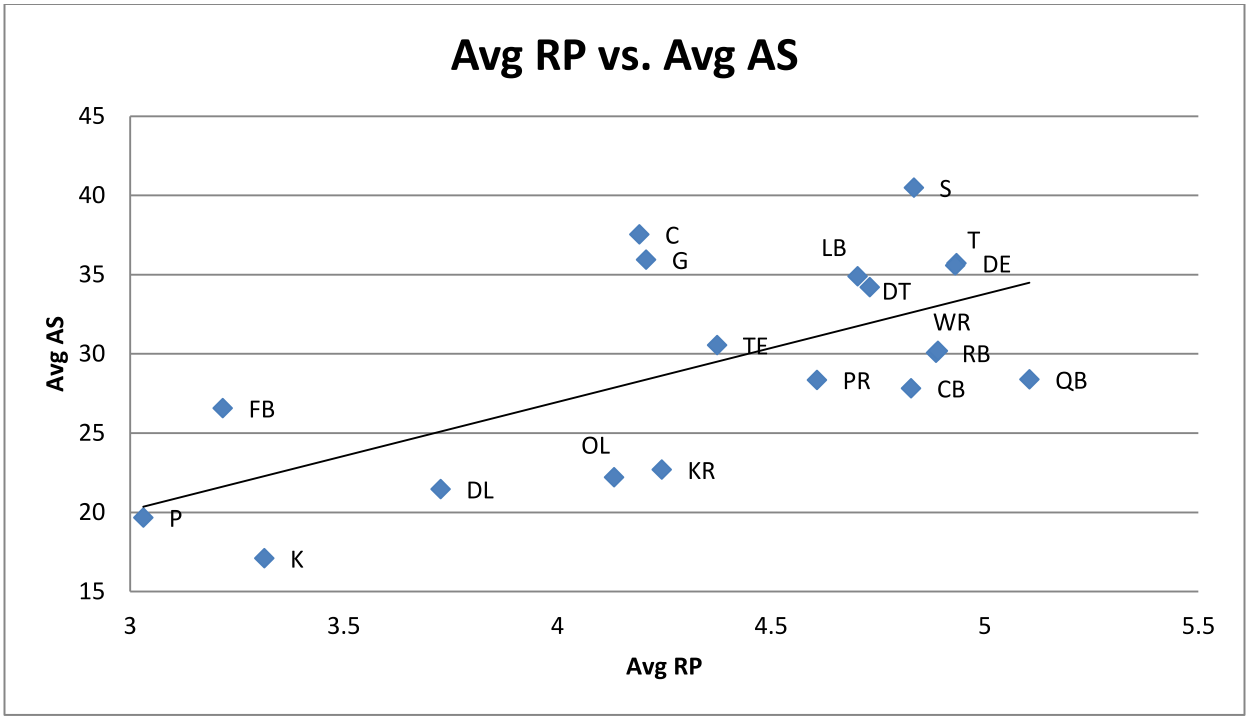


Figure 31: Average Round Points vs. Average Appearance Score per year for each major position.

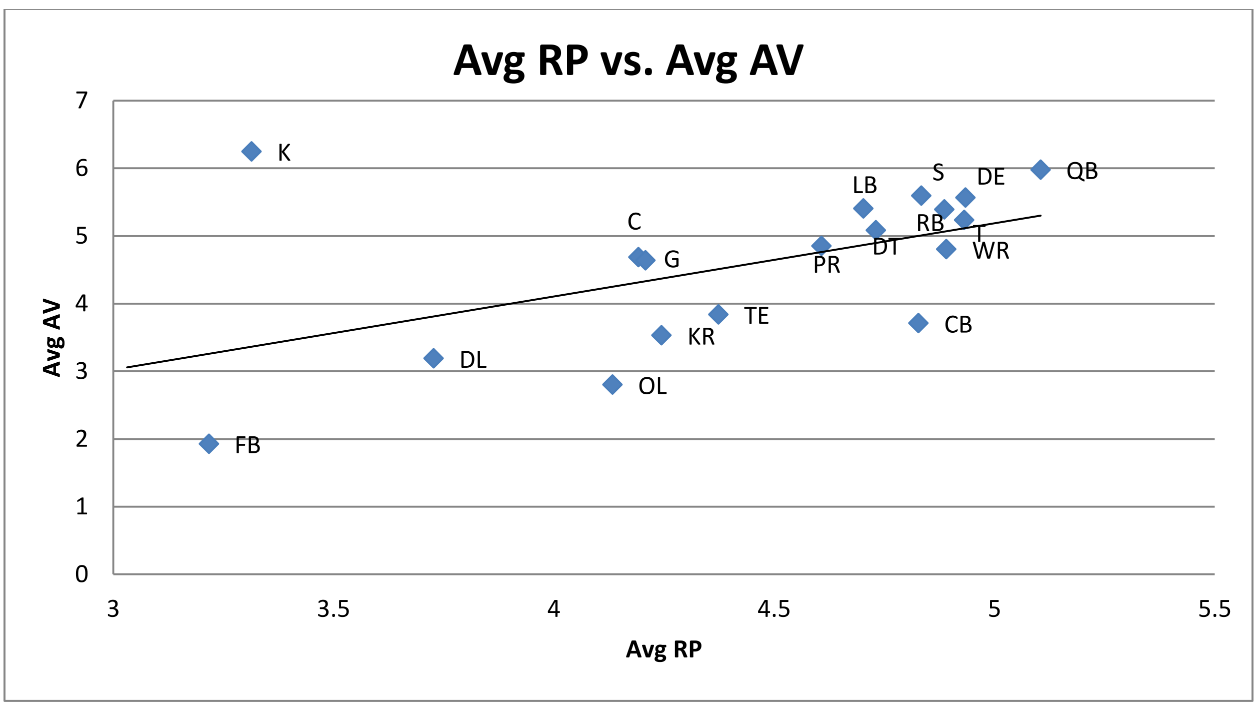


Figure 32: Average Round Points vs. Average Approximate Value per year for each major position.

5.2.1 – Which position is the most valuable?

The most valuable position depends on what metric is being considered. To determine the most valuable position, each figure is examined for the points which are vertically the highest. When Appearance Score is used to determine the most valuable position, then according to Figure 31 safeties, centers, and guards are the most valuable positions. Safeties earn an average of 40.5 Appearance Score per year, the most out of all NFL positions. Close behind are centers and guards which earn an average of 37.5 and 35.9 Appearance Score per year respectively. According to the Approximate Values in Figure 32, the most valuable positions are kickers, quarterbacks, and safeties. Kickers, quarterbacks, and safeties earn an average of 6.24, 5.97, and 5.59 Approximate Value per year respectively. Safeties are among the most valuable according to both metrics therefore safeties can be considered the most valuable position overall.

5.2.2 – Which position is invested in the most?

The next question posed was which position was invested in the most. The metric best suited to analyze this was Round Points. The points furthest to the right on the graphs indicate the positions that are invested in the most. Upon inspecting Figure 31 and Figure 32, quarterbacks, defensive ends, and tackles are invested in the most with 5.10, 4.93, and 4.93 Round Points per year respectively. This trend can be seen in the NFL draft over the last thirteen years. Quarterbacks have been drafted first overall in ten out of the last thirteen drafts. In the three drafts that quarterbacks were not drafted first, either a defensive end or tackle was picked. This clearly indicates that quarterbacks are invested in the highest among all positions in the NFL followed closely behind by defensive ends and tackles.

5.2.3 – Which positions are undervalued and overvalued in the NFL Draft?

Some positions are undervalued in the NFL draft. To determine what positions are undervalued, a trend line was added to both graphs. If a point appears far above the trend line, then that particular position is undervalued. As can be seen in both figures, centers and guards are undervalued. They cost an average of 4.19 and 4.20 Round Points per year respectively, but they produce an average of 37.5 and 35.9 Appearance Score and 4.68 and 4.63 Approximate Value per year. As can be seen in Figure 31 and Figure 32 centers and guards are consistently in the upper left half of the graphs, which indicates that they are undervalued in both metrics. In Figure 32, kickers also seem to be undervalued. They only cost an average of 3.31 Round Points, but they produce an average of 6.24 Approximate Value. One position in particular is overvalued in both figures. Cornerback costs an average of 4.82 Round Points, but produce 27.8 Appearance Score and 3.71 Approximate Value per year. They are far below each graph's trend line.

This information could help NFL teams during the draft. The data clearly shows that centers and guards need to be given a higher priority in the draft as they perform well contrary to the amount that teams invest in them. Also teams should look into reducing the amount they invest into cornerbacks because, according to both value metrics, they are vastly overrated. A final piece of information an NFL team could take from this data is that safeties are the best as far as performance on the field and therefore should be invested in accordingly.

5.3 - Draft Related

5.3.1 - Are Higher Picks Overrated?

If one looks at the first five values for Jimmy Johnson's table for values of different draft picks, you can see that the first three values are much higher than any of the other values in the chart. One would think that since the first pick is 3000 while halfway through the same round the value of the 16th pick is only 1000 that these first round picks are severely exaggerated and overvalued. Another important note is that the values past the 100th overall pick do not even exceed 100 as can be seen in Table 1. This large difference between the first round and later rounds leads many to think that the NFL is putting a lot more value on the first round picks than they are really worth.

To answer this question it is important to see how our metrics measure up when grouped up by round. In Figure 33 we compare our four different metrics on the same scale by averaging each round and scaling the entire graph by setting the values for round 1 of each metric equal to 100%. Figure 33 shows how low the Draft Point values are compared to the rest of our metrics. This chart also includes free agents as a hypothetical 8th round of the draft although both Draft Points and Round Points assume a value of zero for this round as no draft picks are expended to acquire these players. The problem with this initial graph is that both Approximate Value and Appearance Score give values to these undrafted "8th round" free agents. In order to match this data correctly to the values for Round Points and Draft Points the final values must be scaled down to zero to see if the Draft Points do actually overvalue the first couple picks of the draft.

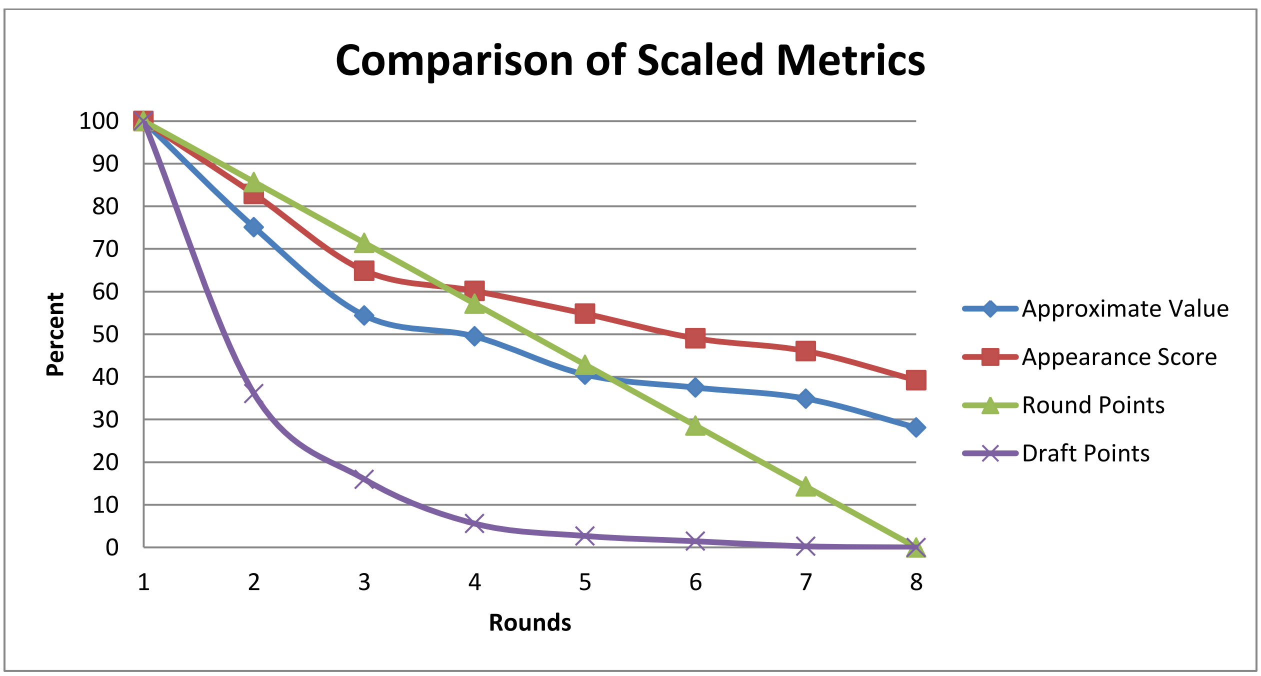


Figure 33: Comparison of All Metrics by Round of the Draft Using Round 1 as 100% of value

This scaling is done by taking the 8th round values for both Approximate Value and Appearance Score and subtracting them from the rest of data points and then dividing all these data points by the value of the first round. By subtracting the 8th round values then dividing by the first round values the first round will be set at 100% while the rounds afterwards will be a smaller percentages and more comparable to the original lines of Draft Values, and Round Points. This calculation is done to the Approximate Value and Appearance Scores in Figure 34.

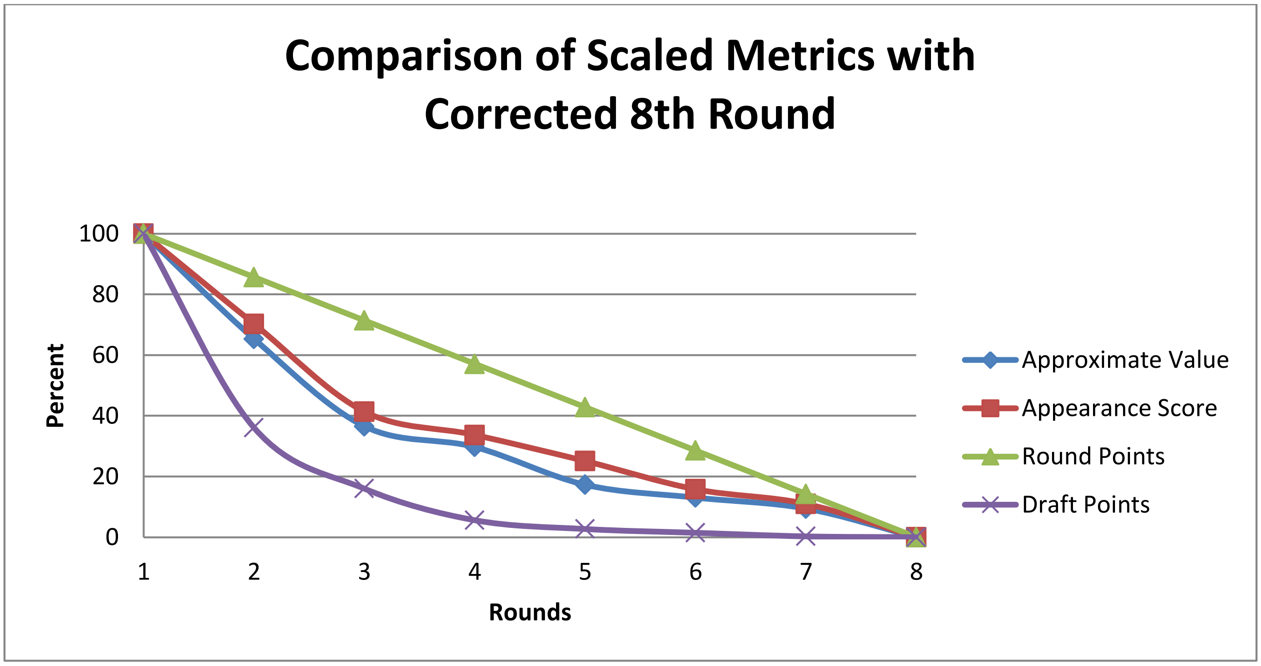


Figure 34: Comparison of All Metrics by Round of the Draft with Round 1 Counting as 100% and Round 8 set to zero

Figure 34 more clearly shows the relation between the current values for Draft Points and the talent metrics of Approximate Value and Appearance Score. A conclusion that can be drawn from Figure 34 is that yes the values for the initial picks of the draft are too large and these first players to be drafted are being overvalued. These charts show that the values for the 2nd and 3rd rounds need to be slightly less than doubled, while rounds four through seven have to be largely improved to reflect the talent acquired through these last couple rounds.

Using the averaged values for the rounds we were able to take a cleaner but more general look at whether the values for the cost of the player were close to the talent of the player. The problem with this data is that the values at the beginning of the round can be quite different than those at the end of a round. Figure 35 was created in order to look at the draft values for each individual pick in the draft and compare it to a scaled version of the Draft Points metric.

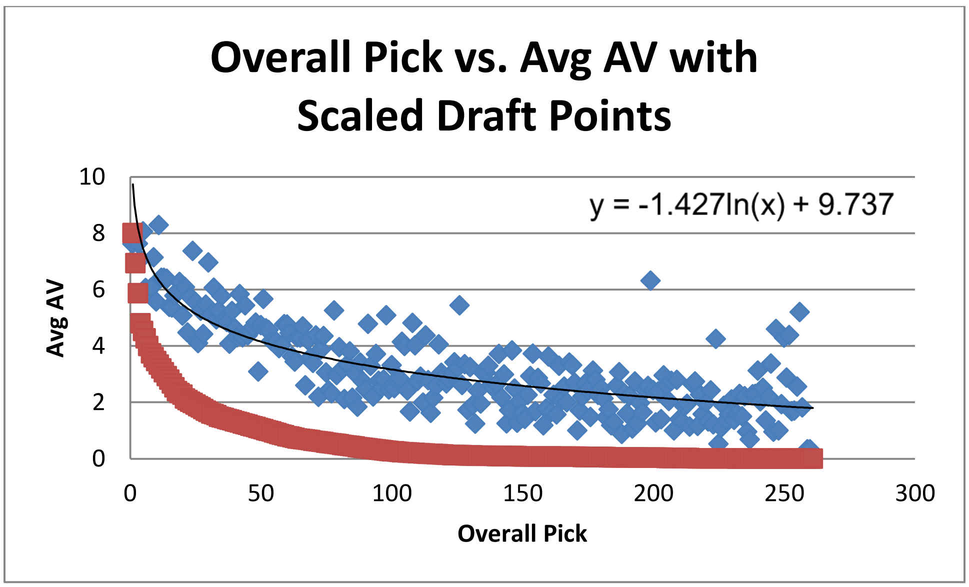


Figure 35: Average AV for Each Pick in the Draft Compared to the Values of Draft Points

By looking at Figure 35 one can see that the red boxes for Draft Points are severely below the different values of Approximate Value for each pick of the draft. The data also shows that the values for the first pick and the last pick are a lot closer than expected and the curve that would fit the AV is a lot flatter than Jimmy Johnson's values. There are outliers in the data as fewer players are being averaged for every point so a player like Tom Brady who was drafted as the 199th pick overall but has an average AV of just under 14 will skew the data for that draft pick. The black trend line seen in Figure 35 would be a closer fit to the actual values of the AV for each round, the exact equation for this line is listed inside the graph. The initial values of this function may have to be mitigated slightly as the function is the natural log.

This increase of values would reflect the amount of talent that still can be extracted from the later rounds of the draft. Although this would make it easier for teams to trade for the first pick of the draft it is highly unlikely than any team with that initial pick would give it up because they can choose any superstar from collegiate football and not worry about another team selecting that player before them. The other important point to note here is that most players that are drafted in the first and second rounds of the NFL draft are players who play high scoring positions such as quarterback, running back, wide receiver, or tight end. These positions generally are more valued than any of the other positions because they are directly related to scoring. It may be more effective for NFL coaches to trade their second or third round picks for multiple later round picks so that they can maximize the talent they acquire as long as they do not need the higher round picks to fill one of the more important roles related to scoring. It also makes the initial pick for a team that much more important if this pick has a lot more value to it than any other in the draft.

5.3.2 – Are Draft Trade Values Correct?

To make sure that Jimmy Johnson's table had the correct values and that it was being used by the teams in the NFL we had to look further into the trades that were occurring between the teams. As mentioned in section 4.5 we used Pro Sports Transactions to record which teams were making trades and what draft positions they were trading. To continue where Figure 16 leaves off we expand the chart to that of Figure 36. In Figure 36 the first two columns record the two teams involved in the trade and are useful to check and make sure that none of the trades were repeated. The third and fourth columns associate the pick values that were traded from each team respectively. In the next two columns the specific values for each of the draft picks were added up so that each team had a total value for their side of the trade. The seventh column calculates the difference between the previous two columns to see how far apart the two teams were when they made the trade.

2009								
Team 1	Team 2	Team 1 Picks Traded	Team 2 Picks Traded	Team 1 Draft Points	Team 2 Draft Points	Difference	Percentage Off Team 1	Percentage Off Team 2
Buccaneers	Browns	19, 191	17	891	950	59	6.621773288	6.210526316
Eagles	Browns	21, 195	19	814.4	875	60.6	7.441060904	6.925714286
Ravens	Patriots	26, 162	23	727.6	760	32.4	4.452996152	4.263157895
Packers	Patriots	41, 73, 83	26, 162	890	727.6	162.4	18.24719101	22.31995602
Patriots	Raiders	47, 124, 199	40	490.8	500	9.2	1.874490628	1.84
Seahawks	Bears	68, 105	49	334	410	76	22.75449102	18.53658537
Bills	Cowboys	75, 110	51	289	390	101	34.94809689	25.8974359
Colts	Dolphins	61, 165	56	318.4	340	21.6	6.783919598	6.352941176
Broncos	Steelers	79, 84	64, 132	365	310	55	15.06849315	17.74193548
Jets	Lions	76, 115, 228	65	276.6	265	11.6	4.193781634	4.377358491
Giants	Eagles	91, 164	85	162.8	165	2.2	1.351351351	1.333333333
Buccaneers	Cowboys	120, 229	117	56.5	60	3.5	6.194690265	5.833333333
Patriots	Ravens	137, 141	123, 198	73	62.2	10.8	14.79452055	17.36334405
Broncos	Ravens	149, 185	141	50.2	35.5	14.7	29.28286853	41.4084507
Cowboys	Falcons	156, 210	143	38.4	34.5	3.9	10.15625	11.30434783
Vikings	Redskins	158, 221	150	33.2	31.4	1.8	5.421686747	5.732484076
							11.84922886	12.34005652
							10.68698621	10.40216357

Figure 36: Trades of Draft Picks in 2009 Including Difference Calculations

The range on the difference values is quite large because some of the trades deal with a pick in the first round which could be a value of over 1000 while others that dealt with trades at the end of the draft were values are much closer to single digits. To check all the numbers as a whole it is a better idea to make this difference a percentage of the total value for either side of the trade which is what is shown in the final two columns. These final columns were then averaged to find a valid percentage for how far off these trades were from being a fair. As can be seen in the 2nd row from the bottom two rows under the table the values were around 11 to 12% off. By excluding a single trade involving the Broncos and Ravens which is acting as an outlier to the rest of the data, both percentages go down to just over 10%. These values are quite close to a fair trade considering that these teams only start out each draft with a single pick in each round. Since they only have a single pick in each round these values for picks can be far between so they must resort to choosing the value that gets close enough so that both teams can agree that it will be a fair trade. This same analysis of the draft picks was done on the 2010 draft and the 2011 draft. The 2010 draft had average percentage differences of roughly 5.5% excluding the largest outlier while the 2011 draft had averages of roughly 8% without the single outlier. This data is a strong point to show that the chart of values made by Jimmy Johnson is still in use today and that a large majority of the coaches have accepted these values.

With between ten and twenty trades each year which consist of solely draft picks it is that much more important that the values for each pick are correct. These values need to reflect the amount of talent a team can receive for the respective picks. If these values for picks are not correct then teams trading their draft picks may not be getting the most fair trade. The other issue is that the graphs in Figure 34 are showing the average values for each round which means as a whole the entirety of round 1 is overvalued and the later rounds are each undervalued. If these values are corrected and the new values are accepted like Jimmy Johnson's first table of values then the values of the draft picks will appropriately model the amount of talent received.

5.4 - Age Related

5.4.1 - How Does Age Affect Player Performance?

From the data collected, another area which is interesting to examine is how a player's age or years played in the league affect their success. The NFL eligibility rule states that a player cannot join the league until it has been three years since he has completed high school. Between the 2000 and 2012 season, the average age of a rookie player was approximately 23.3 years of age. Common experience would suggest that a player's skill level would increase as a player got older until they eventually reached the peak of their career where their stats would finally begin to see some decline. Using the Approximate Value success metric, this trend can be observed and we can see if this prediction is accurate and also see when the peak in a player's performance actually occurs.

In Figure 37, the graph depicts the NFL player base from 2000 to present, sorted into their corresponding age. Each age is accompanied by an average Approximate Value which the players achieved during the season they were that listed age. Players ages 21 and younger as well as 39 and older were omitted from the graph as these groups represented approximately the lowest and highest 0.05% of the player base, respectively. Doing so removed any outliers from the graph.

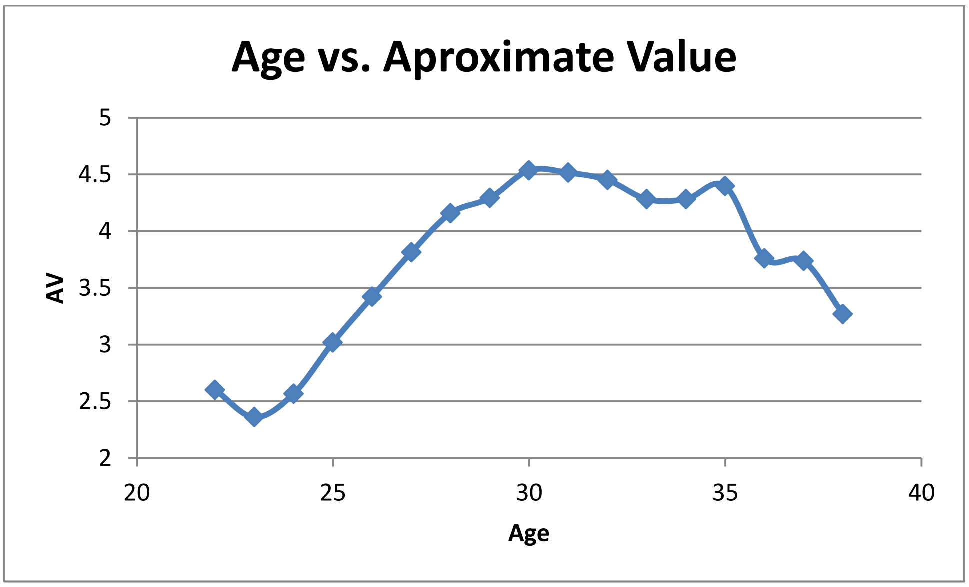


Figure 37: Plot of NFL player base's age and the corresponding average AV

From this plot, a clear trend can be seen which matches the original hypothesis: player skill will increase to a maximum point and then begin to decline. Ages 22 to 24 are clearly the lowest point in terms of the average skill level of the players in the NFL. This is reasonable as many new players in the league spend the early years of their career with limited or no playing time thus resulting in the lower Approximate Value. The success of players appears to increase as they age until roughly age 30, when they seem to reach a plateau. Age 30 to 35 seems to be the time where players reach the peak of their career. After this time period, the AV decreases until players are simply too old to play in the league.

When examining Figure 37, it is also important to see exactly how many players are in each age group. In other words, what percentage does each age represent out of the NFL players over the last thirteen seasons. Table 9 shows the percentile of each player age from 2000 to 2012.

Table 9: Percentiles of player ages from 2000-2012 seasons

Age	Number of Players	% of Player Base	Age	Number of Players	% of Player Base
20	1	0.00%	34	393	1.56%
21	137	0.55%	35	270	1.07%
22	1140	4.54%	36	167	0.67%
23	2889	11.50%	37	110	0.44%
24	3598	14.32%	38	78	0.31%
25	3292	13.10%	39	42	0.17%
26	2893	11.51%	40	25	0.10%
27	2423	9.64%	41	18	0.07%
28	2016	8.02%	42	14	0.06%
29	1724	6.86%	43	11	0.04%
30	1378	5.48%	44	6	0.02%
31	1084	4.31%	45	2	0.01%
32	821	3.27%	46	2	0.01%
33	595	2.37%	47	1	0.00%

The data from Figure 37 and Table 9 together provide a deeper insight to an NFL player's development. Figure 37 shows that ages 22-24 are the rookie seasons, ages 25-29 are the developmental years when the players consistently increase in performance, ages 30-35 are the years when players generally achieve their greatest success, and 35 and older is a decline in skill. While this trend in skill may be directly related to age, some of this trend could also be related to the data in Table 9. Ages 22-29 represent almost 80% of the NFL since 2000 while ages 30-35, the peak years, represent only 18%. The numbers in Figure 37 may be directly related to this. The majority of players are part of the younger group, both rookies and developing players, and the Approximate Value for this group is generally lower than the rest of the league while the peak age group makes up a much smaller portion of the league but has a higher Approximate Value. Teams are more likely to keep players on their team if they are young enough to allow for development and/or the player has shown they are successful. Therefore, there tends to more players in the NFL in the younger age group because they are more likely to satisfy both of those conditions. Older players, generally 30 or over, are already past their developmental prime and have to have some sort of history of success in the NFL to stay with their team. With these two things in mind, the younger ages have more players but more diversity in terms of the success they have while the older player are far less in number but more consistent in the success they bring.

5.4.2 - How Does Years Played Affect Performance?

Figure 38 brings a bit more clarity to this issue. The plot shows similar data to Figure 37, however instead of age, players' Approximate Value is grouped according to the number of years they have played in the league with their rookie season being years played equal to zero. Players who have played in the league 16 years or longer have been omitted as they represent only 0.05% of the NFL population and their rarity causes outliers in the data.

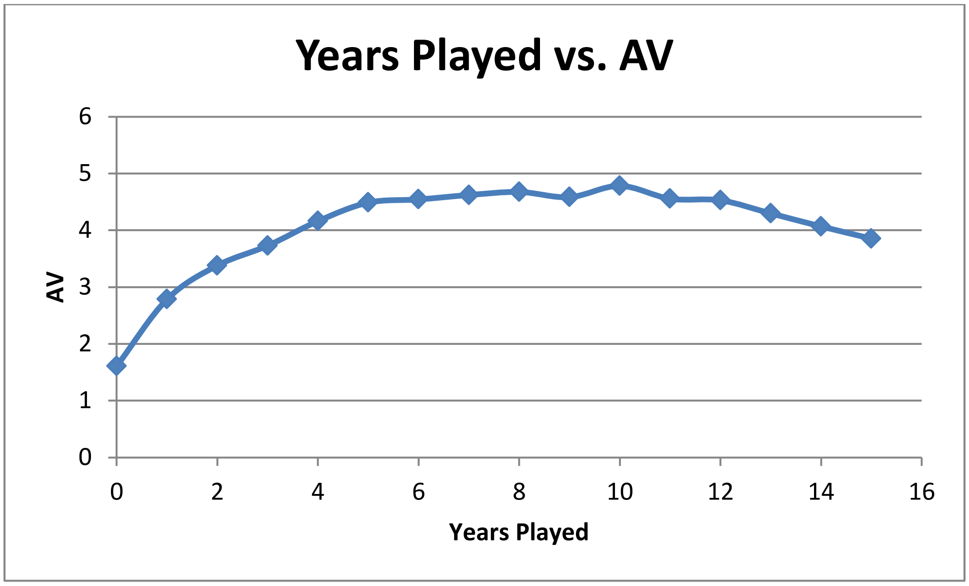


Figure 38: Plot of NFL player base's years played and the corresponding average AV

This graph more accurately depicts the trend in player development. The same problems regarding the retention of players still remain. The older a player gets, or in this case the longer a player stays in the league, the less likely a team is to keep a player for development. From the graph, players undergo a very steep increase in average AV from their rookie season to year 2. During years 3 to 5, there is still improvement in success; however, the rate at which the players improve has greatly decreased. A plateau in player performance appears once a player reaches his 6th year in the league and stays around the same level until his 10th year. From that point on, player performance decreases until they are no longer in the league. This data also supports the original hypothesis that there is a clear trend where players go through a development period where their success increases until they reach their max potential and eventually decline as they age.

With this information, there are a few lessons which NFL teams may find valuable when analyzing players they have drafted or acquired through free agency. The first piece of information involves player development. From Figure 37 and Figure 38, players are generally at their statistical worst when they enter the league or are very young. However, their statistical value increases significantly over the first few years in the league. If NFL teams want to be successful, they must make sure their roster is able to perform and many times keeping a player too long or hoping for player improvement will result in more losses. From the information provided, it is a good assumption that a player, if they are given playing time, should show improvement by their third year in the league. If no significant improvement is shown after two years of experience, the best thing to do would be to look for a trade or possibly even drop a player if his production is extremely low. The second lesson involves a player's peak performance and when to try and keep them on a team. The data provided shows that players reach their peak value once they have spent five years in the league or are roughly age 30. At this point in a player's career, they are both experienced and knowledgeable about the game but at the same time, their physical ability has not yet diminished. The advice NFL teams can take here is that if a team has a player meeting either one of these criteria and are at a high level of performance, that level of success is most likely at its maximum point but the player should remain at that level for another five years. Teams should take this information into consideration when signing their star players during the peak of their career. Avoiding long-term contracts with players most likely to fail will result in better records for those teams. With the data provided and the advice given, teams can make better educated decisions regarding player development and retention especially during the many phases of a player's career including their beginning, peak, and downfall.

5.5 - Summary

Using the cost and success metrics we have established, we examine the research questions described in chapter 3. By observing many statistical trends we have found many intriguing facts regarding the NFL, its player base, and the draft. We discovered that the Pittsburgh Steelers are the most efficient team in the NFL draft since 2000. The summation of individual skill on a team does lead to more wins in the regular season. In regards to the value certain positions give to a team; centers, guards, and kickers are undervalued while cornerbacks are overvalued in the NFL draft. We also found that NFL teams place a much higher importance on the picks during the first round of the draft while our research indicates that the average talent in the later rounds is higher than NFL teams give credit for. Our study found that players go through three statistical phases during their career which can be seen by examining their performance based on age and years played in the league. These conclusions may be valuable for NFL teams to examine, or even other sports and businesses, as they can see the types of information which can be found using our grading methods.

6. Conclusion

Over the course of nearly seven months, our group investigated ways to use data analytics to evaluate talent in the National Football League. We examined many ways in which to give players a grade based on their performance. Through our research we determined that we could use various metrics to give players a grade for both their cost to their team as well as a grade for their success on the football field. The two cost metrics we established were "Draft Points" and "Round Points" which both provide players with a number based on their selection in the NFL Draft. For success, two metrics were also used. One metric was a previously developed "Approximate Value" which gave players a grade based on their statistics at their respective positions. Our group also developed a new metric for grading success called "Appearance Score." The basics of this metric are broad and can be applied to many other sports and even areas outside of sports as long as proper numeric alternatives can be substituted.

Using these metrics, we examined many areas of interest in the NFL and were able to find some results which many NFL teams may find appealing. The Green Bay Packers are the team that has drafted the best players since 2000. However, the Pittsburgh Steelers have managed to be the most cost-effective drafting team in the NFL, having the best ratio of player success to player cost. Our group also showed that the cumulative success of individual players does in fact translate to more wins.

By examining NFL positions, we have also found many interesting findings regarding these positions. In terms of statistical performance at a given position, safeties provide the highest value. Despite this, quarter backs, defensive ends, and tackles are the most invested in and have been selected first overall since the 2000 draft. Centers, guards, and kickers are undervalued while cornerbacks are overvalued in the draft.

We also determined that there are a few misconceptions about the draft as well. We found that NFL teams do follow the draft trade value chart developed by Jimmy Johnson but this chart does not accurately reflect the talent that is present in the draft. NFL teams place too much value into the first round of the draft while our grading metrics show that good talent can be found throughout the entire draft although the performance does decrease later in the draft.

Age also plays a huge role in player performance based on our analysis. Players go through three stages during their career which we approximate based on player age and also years played in the league. Players initially go through a rapid development period where the value significantly increases in a short period of time. This phase is then followed by the peak of their career around age 30 during which their performance is consistent and will last roughly five years. Following this stage, player performance decreases until their retirement.

Using the metrics we have established, these are only a portion of the many research topics which can be explored. The metrics we established also transcend the sport which we are specifically examining. The idea of using two metrics, one for success and one for cost, can be applied to analyze almost any topic in society as long as the correct data is present. Two examples we have specifically thought of would be college admissions or worker evaluation. For college admissions, it is important to determine whether students were worth accepting. The value of accepted students can be evaluated by examining their cost and success. Some success metrics may be grades, athletic success, or other areas which may directly bring some form of value for the school. In terms of cost, some students are scholarships and other form of aid which can be converted into a metric of cost. By comparing the two metrics, admissions offices can see whether or not admitted students were worth the cost of admission. Similarly, this method can be applied to the workplace by examining the cost and success of employees.

As a product of our research, we have not only developed a way to grade NFL talent acquisition but also a method for grading the acquisitions of many groups in society. By developing a statistical, objective way to grade the cost and success of some subject matter, people can evaluate if their acquisitions were worth what they paid for. Using those same metrics and examining a large database of acquisitions, these groups can investigate whether or not they are making the right decisions or if they may have misconstrued thinking in terms of selecting someone. These are just a few of the benefits of which data analytics can bring to society.

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