Optimizing draft strategies in fantasy football

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Abstract

Data was collected from ESPN.com and Pro Football Reference to determine a conditionally optimal auction draft strategy contingent on correct risk estimation in a fantasy football league. The study considers several draft styles including point based drafting, value based drafting, risk-averse drafting and risk neutral drafting. It attempts to determine the risk level that provides risk neutral drafting, as well as the ways risk neutrality can increase a team owner's utility, where utility is directly related to the fantasy point output of a team. The paper finds that risk neutrality involves hedging auction bids by 10% and using a position specific pricing and discount bonus of the same amount. Using value based bidding in a risk-neutral scenario was confirmed as the best overall auction draft strategy for increasing utility, but in a draft with multiple risk neutral bidders, bidding with risk aversion was a conditionally optimal strategy.

Introduction

Fantasy Football Overview

Fantasy football is an interactive, often online, game played within a group of people. Such a group is often termed a "league." Each of the people involved is considered an "owner" and runs a "team." Each owner selects players in the National Football League for his team.

Based on the performance of those players in real games against NFL opponents, each owner receives points for his team. The number of points received depends on the conditions of the league, but as a rule, better players earn their owners more points. The more points a team receives, the more likely a team is to win its league, which may earn its owner money or simply bragging rights.

League Format

Even with a superficial understanding of the game, it is immediately apparent that obtaining the best players provides an owner with the best chance to increase his utility by winning. Acquiring players occurs just prior to the beginning of the NFL season in a process known as a draft. Most leagues do this draft online using a draft engine, often through ESPN.com or Yahoo's Fantasy Football portal. These drafts are separated into two major categories: snake and auction. A snake draft requires a random number generator to predetermine draft order for every team in the league. Then, each team makes a player selection in that defined order. The process is repeated, but in alternating forward and reverse order until every team has a full roster. This type of draft is currently very popular but that number is trending downwards in favor of the more complex auction draft.

In an auction draft, owners are again randomly defined in an order, but instead of selecting players in that order, owners nominate players. Then, each team bids on those players in a slightly modified English auction. Whichever owner bids highest retains that player for the year. In this internet-driven age, every owner has similar information about each player. Moreover, the online draft portal provides an estimated valuation for the player. This English auction has some important distinctions from a standard auction. Because each owner needs to fill his roster, the draft consists of a series of auctions which affect one another. Finally, each owner has a salary cap, a number set by the league to protect parity and prevent one owner with more money from buying all of the best players.

Draft Strategy

In order to understand a draft strategy, one must understand the rules of a league. For this analysis, I used standard league rules and a league of ten teams. Each team needs to fill its roster with several positions, within a salary cap set at $200, the default setting for ESPN leagues. The positions included are quarterback, running back, wide receiver, and tight end. A team will generally draft two quarterbacks, three running backs, five wide receivers, and two tight ends, but each team can draft a maximum number of three quarterbacks, four running backs, six wide receivers and three tight ends. Of these players, a team can only earn points for one quarterback, two running backs, three wide receivers, and a tight end. The remainder of a team's roster makes up its "bench." Players may be interchanged by the owner between the starters and the bench in between games due to performance, injury, or any other reason. Points are earned for passing, rushing, and receiving touchdowns (each is worth 6 points); passing yards (0.04 points); and rushing and receiving yards (0.1 points). Points are lost for interceptions thrown (-2 points). These rules are the standard rules for ESPN Fantasy Football, and therefore, applicable to many leagues.

Question

Rationality

This study will focus on the rationality of the draft strategy of each owner in an auction draft, and whether it is possible to define a conditionally optimal draft strategy. A rational strategy for one owner is playing to maximize only his own utility function. A utility function is denoted as follows:

$$U(Owner_i) = prob\left[P(Team_i) \geq P(Team_j)\right] \quad for\ all\ j$$

$Owner_i$ and *$Team_i$* refer to an owner and his team and *$P(Team_i)$* is the number of fantasy points produced by $Team_i$ while $Team_j$ is another team in the league. Thus, in order for an owner to maximize his utility, he must win his league.

All the strategies this paper will discuss are based on maximizing utility, or more clearly, maximizing a fantasy team's expected point output, thereby increasing the probability that the team wins its league. It is crucial to recognize that increasing mean points is not necessarily the same as increasing utility. For example, injuries provide risk that could decrease probability of winning, despite an increased mean. There are multiple possible sources of bias for draft strategies, including owners having favorite players and teams. Most individuals who play fantasy football follow the NFL and have a favorite team, so bias toward those players should be balanced among owners in a league. This study does not consider personal biases in the drafting of a team, only utility.

Risk

An initial review seems to suggest owners currently draft with very high amounts of risk aversion. They over spend on low performing bench players and under spend on high performing all-star players. Risk aversion, in theory, is a valid strategy, considering the various ways players can lose value. Injuries, like the one that afflicted Dallas Clark during the 2010-11 season, can render a player valueless for the majority of a season. Performance can be surprisingly poor, like that of Ryan Matthews the same season. Trades can occur, decreasing a player's value, as what happened with Randy Moss in week four of the same season. However, being overly risk-averse can hurt a team and lead to a decreased probability of victory. For that reason, this study looks to find the actual risk of drafting a given player.

Other Questions

Another question could arise on the basis of the nomination system discussed earlier. In fact, the nomination aspect of an auction draft is an opportunity for owners to manipulate the system, but in practice, that does not occur. Instead, I found that owners tend to nominate players in order of highest expected return. This is because the owner who nominates a player in this system has a slight edge in retaining that player for the season. Owners must bid in one-dollar increments, providing an edge to the nominating owner for obtaining players with fractional value. An owner can nominate a player valued at $1.50, place an initial bid of one dollar, and expect no other owner to bid, given the winner's curse at a price of two dollars--a loss of fifty cents in value. In the auction system, the player was awarded to the owner with the highest valuation. The price level is always rounded down.

Draft Strategies

There are many feasible draft strategies in a fantasy football draft. In fact, many of them are combinations of a few basic ideas. The first, and simplest, is to draft the best viable player available. The term "viable fantasy player" generally refers to a player expected to play in all 16 games in a season and contribute a meaningful number of points to a team. Alternatively, there are players who will not contribute and are nonviable. The best viable player is the one most likely to earn an owner the most points. The bidding function used to determine a bid in this format is as follows:

$$V(X_i) = P(X_i) * \left(\frac{Budget}{P_{necessary}}\right) * (1 - R)$$

$V(X_i)$ is the bid valuation, $P(X_i)$ is the point output for player *i* of position *X*, *Budget* is the $200 (in most leagues) salary cap, $P_{necessary}$ is the number of points required to win and *R* is the risk aversion factor.

While most of the above values are self-explanatory, the risk aversion factor may be difficult to understand. In general, risk aversion refers to trading variance in exchange for the mean. For example, a risk-averse investor would prefer a stock giving a return of mean 100 and variance 10 to a stock giving a return of mean 105 and variance 20 due to the latter stock's possibility of a very low return, whereas a risk neutral person would accept the second stock due to its higher mean return. A risk seeking person would also take the second stock because he enjoys the thrill of a risk. We will not consider this type of strategy. In fantasy football drafts, the same idea holds. A risk-averse owner will not bid for very talented players; instead he will win players who are in the next tier, but still fantasy starters. Meanwhile, a risk neutral owner will buy the best players, but because of the salary cap structure, he will be unable to bid on any second tier players, and will be forced to fill the remainder of his roster with replacement-level players. This allows a risk-averse owner to have a roster full of players near the median of the fantasy viable player pool, whereas a risk neutral owner has players from both extremes of the pool. In this manner, even though a risk neutral owner has a higher possible mean fantasy point output, a risk-averse owner has low variance in output.

The method by which this is applied to models of bidding is based on the fact that risk-averse owners can afford to bid lower than risk neutral owners consistently, and rely on the salary cap to prevent riskier owners from bidding on players near the median of the player pool. In this manner, we can discount all valuations by a certain risk aversion coefficient, with the expectation that the fact that better players are bid upon first and the salary cap will take effect on risk neutral teams. A higher *R* means the owner is more risk-averse, and his bid is discounted more due to said risk.

The second draft strategy requires meeting the needs of the team. Every team needs to fill out the roster spots mentioned above. This draft strategy requires choosing players that will start for your team and spending less money on other players. When combined with point-based drafting, it combines the strength of the two systems in a logical way. The bid valuation appears as follows:

$$V(X_i) = \begin{cases} P(X_i) * \left(\frac{Budget}{P_{necessary}}\right) * (1 - R), & if\ T(X) \leq j - 1 \\ 1, & otherwise \end{cases}$$

T(X) is a function that provides the amount of players in a given position *X* on the team already. It is important to note that the minimum value of a player is \$1, which is the source of cost of the j^{th} player drafted. Depending on the sophistication of the point influences, there can be more gradations for value changes. An example of greater positional influences would include a pricing factor as follows:

$$V(X_i) = \begin{cases} P(X_i) * \left(\frac{Budget}{P_{necessary}}\right) * (1 - R) * (Price\ Bonus), & if\ T(X) \leq 1 \\ P(X_i) * \left(\frac{Budget}{P_{necessary}}\right) * (1 - R) * (Price\ Discount), & if\ T(X) \leq j - 1\ and\ T(X) > 1 \\ 1, & otherwise \end{cases}$$

In this case, the *Price Bonus* term is meant to provide increased value to players who would be the owner's first at a given position. The *Price Discount* is the inverse of the *Price Bonus* and decreases a player's value in order to save money and allow for drafting a full 12-player roster. This intuitively makes sense, but provides an example of a possibility for winner's curse that may cause loss of value. The hybrid without price bonuses is the most popular draft strategy currently in use (Fry, Lundberg and Ohlmann 2007) in a fantasy league, but many owners shade their bidding in the manner of pricing bonuses. In fact, this strategy is often used for actual drafts in the NFL and the NBA, leagues when drafted players are expected to step in and contribute immediately

The draft strategy this paper works with most is called Value Based Drafting (VBD) (Bryant 2001). VBD considers a player's point output, but rather than comparing that number to zero as a point based draft strategy would use, it compares that number to the baseline output, or replacement level, for his position. VBD suggests a bid as follows:

$$V(X_i) = [P(X_i) - P(X_r)] * \left(\frac{Budget}{P_{necessary}}\right) * (1 - R)$$

Here, X_r is the replacement-level player. Value Based Drafting, when combined with a position oriented system, allows for greater differentiation between players and helps select the best player available. This is intuitive because even a poor Quarterback earns more points than a valuable Tight End. A purely points based system would suggest drafting the Quarterback higher than the Tight End, while a smarter, value based system would draft the Tight End higher. Value drafting can be combined with any of the draft techniques above, by replacing the $P(X_i)$ function with the $P(X_i) – P(X_r)$ for a positional approach. Value Based Drafting with positional influences is the technique being studied in this paper as a possibly ideal draft strategy.

Finally, there are many draft strategies aimed not at improving one's team, but at other goals. An owner may want to draft his favorite players or draft players purely for trade value. These scenarios are not considered here because they do not necessarily fulfill the goal of increasing an owner's utility. Utility is only dependent on the probability of winning a league, and choosing players to prevent them from landing on other teams does not directly increase probability of winning in a league as it may lead to over-spending for unwanted players or poor positional selections.

Studying draft strategies in fantasy football is valuable because fantasy football is played by 30 million people in North America alone, and many leagues involve betting. It is estimated that $100 million changes hands each year in fantasy football leagues. Moreover, this auction is similar to other markets, like the actual drafting of players in sports leagues and the market for foreclosed homes, where every prospective buyer has the same information and each has a cap on cost, when the winner's curse outweighs the utility of purchasing the home.

Methodology

Data

Specifying data is particularly important because fantasy football experiences differ between expectations and outcomes. Although most owners have similar values for a player, they do not know how that player will perform with regard to those valuations. In order to reconcile expectations with results, I chose to study the results of a season and to apply those as the expected values for next season's performance. This type of analysis has drawbacks: it does not account for changes occurring in the offseason. However, it can be used in conjunction with injury data to develop an estimate of risk, or the variance in total point output. Total point expectation is the main form of output used to study efficacy of a draft strategy, but including variance is the only effective way to study risk.

Strategies

In order simulate a real league and draft strategies, valuations were chosen as follows. I chose these techniques based on the various possible draft styles. Determining which team number had which draft style was arbitrary.

Figure 1: owner draft strategies

Team	Strategy	Risk Aversion	Pricing Bonus	Price Discount
1	Point Based Drafting	High	No	No
2	Value Based Drafting	High	No	No
3	Point Based Drafting, Weak positional influences	High	No	No
4	Value Based Drafting, Weak positional influences	High	No	No
5	Point Based Drafting, Strong positional influences	High	Yes	Yes
6	Value Based Drafting, Strong positional influences	High	Yes	Yes
7	Point Based Drafting, Weak positional influences	Low	No	No
8	Value Based Drafting, Weak positional influences	Low	No	No
9	Point Based Drafting, Strong positional influences	Low	Yes	Yes
10	Value Based Drafting, Strong positional influences	Low	Yes	Yes

We can now define the valuations thusly:

Figure 2: owner valuations

Team	Value
1	$V(X_i) = P(X_i) * \left(\frac{Budget}{P_{necessary}}\right) * (1 - R)$

2	$V(X_i) = [P(X_i) - P(X_r)] * \left(\frac{Budget}{P_{necessary}}\right) * (1-R)$
3	$V(X_i) = \begin{cases} P(X_i) * \left(\frac{Budget}{P_{necessary}}\right) * (1-R), & if\ T(X) \le j-1 \\ 1, & otherwise \end{cases}$
4	$V(X_i) = \begin{cases} [P(X_i) - P(X_r)] * \left(\frac{Budget}{P_{necessary}}\right) * (1-R), & if\ T(X) \le j-1 \\ 1, & otherwise \end{cases}$
5	$V(X_i) = \begin{cases} P(X_i) * \left(\frac{Budget}{P_{necessary}}\right) * (1-R) * (Price\ Bonus), & if\ T(X) \le 1 \\ P(X_i) * \left(\frac{Budget}{P_{necessary}}\right) * (1-R) * (Price\ Discount), & if\ T(X) \le j-1\ and\ T(X) > 1 \\ 1, & otherwise \end{cases}$
6	$V(X_i) = \begin{cases} [P(X_i) - P(X_r)] * \left(\frac{Budget}{P_{necessary}}\right) * (1-R) * (Price\ Bonus), & if\ T(X) \le 1 \\ [P(X_i) - P(X_r)] * \left(\frac{Budget}{P_{necessary}}\right) * (1-R) * (Price\ Discount), & if\ T(X) \le j-1\ and\ T(X) > 1 \\ 1, & otherwise \end{cases}$
7	$V(X_i) = \begin{cases} P(X_i) * \left(\frac{Budget}{P_{necessary}}\right) * (1-R), & if\ T(X) \le j-1 \\ 1, & otherwise \end{cases}$
8	$V(X_i) = \begin{cases} [P(X_i) - P(X_r)] * \left(\frac{Budget}{P_{necessary}}\right) * (1-R), & if\ T(X) \le j-1 \\ 1, & otherwise \end{cases}$
9	$V(X_i) = \begin{cases} P(X_i) * \left(\frac{Budget}{P_{necessary}}\right) * (1-R) * (Price\ Bonus), & if\ T(X) \le 1 \\ P(X_i) * \left(\frac{Budget}{P_{necessary}}\right) * (1-R) * (Price\ Discount), & if\ T(X) \le j-1\ and\ T(X) > 1 \\ 1, & otherwise \end{cases}$
10	$V(X_i) = \begin{cases} [P(X_i) - P(X_r)] * \left(\frac{Budget}{P_{necessary}}\right) * (1-R) * (Price\ Bonus), & if\ T(X) \le 1 \\ [P(X_i) - P(X_r)] * \left(\frac{Budget}{P_{necessary}}\right) * (1-R) * (Price\ Discount), & if\ T(X) \le j-1\ and\ T(X) > 1 \\ 1, & otherwise \end{cases}$

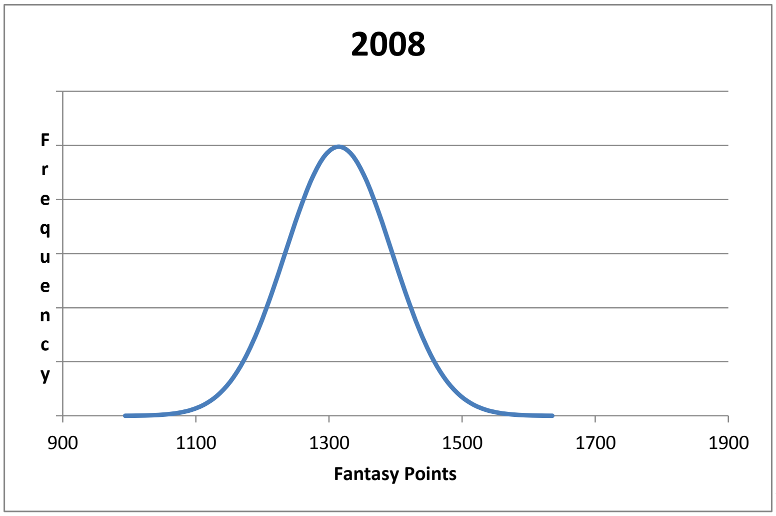
The questions of risk aversion and pricing bonus are interesting as well, because the amount of risk affects the possible pricing bonus. For example, a risk-averse person would use a very small positional bonus due to fear of player injury or other underperformance.

Results

Goals

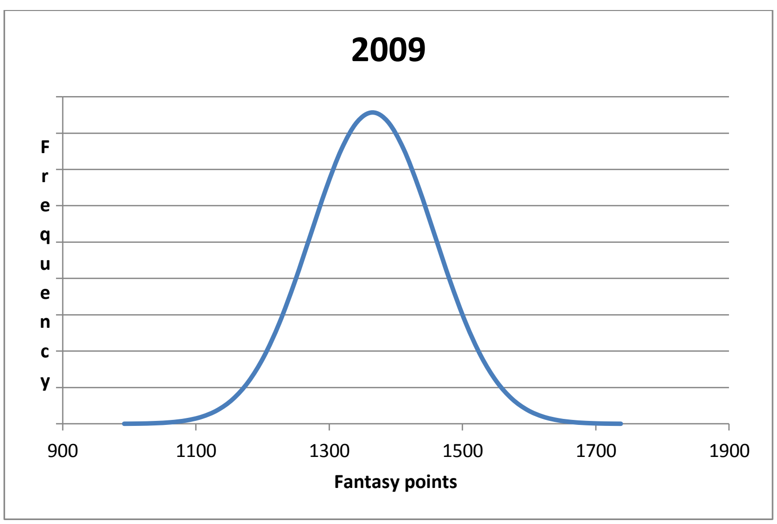
The total value to win a league is an important number because it provides a goal for fantasy owners to work toward. I calculated the number of points scored by fantasy teams in 2008 and 2009 by computing the value of the average fantasy viable Quarterback (QB), Running Back (RB), Wide Receiver (WR), and Tight End (TE), as well as the standard deviation of the same set. By multiplying by the number of players occupying those positions on a team, I was able to develop a model for mean and standard deviation number of points by teams in a ten team league. By plotting point outputs in ESPN standard leagues, I found that Gaussian curves best approximated production, and used this model to describe my hypothetical league. This means that there are many owners with teams who score near the mean for point output, a few owners scoring well above the mean and a few owners scoring far below the mean. In order to win his ten team league, an owner needs to be in the top 10% of his league. The Z score for .9 is approximately 1.29 standard deviations above the mean, suggesting that a league winning owner must draft a team that scores more than 1.29 standard deviations above the league average.

Figure 3: points scored in ten team leagues in 2008 Mean: 1314.6 Standard Deviation: 80.21



[1]

Figure 4: **points scored in ten team leagues in 2009** Mean: 1365.1 Standard Deviation 93.13



[1] Please note that the data for all charts and statistical analysis is from pro-football-reference.com and ESPN.com; a full citation is on the Works Cited page.

Using the method above, in 2008, the total fantasy point output required to win a league was approximately 1418. In 2009, that number increased to 1485. To get an idea of where these numbers are in comparison to total fantasy points in those years, see Figures 3 and 4. Each of these charts shows the spectrum of fantasy results for a team.

2009 was a particularly high scoring fantasy year (Harris 2010), so if we use that year as baseline we may find a goal point total. 1500 points, by virtue of being the above goal in a very high scoring season, should fit in the top 10% of a league almost every year. It is visible on both of these charts that 1500 is comfortably in the top 10% of fantasy scores, placing an owner with such a score in a good position to win his league. We now have a baseline for point-oriented drafting schemes, but this will not apply to value based drafting strategies. Such schemes use the difference between the goal and a replacement level team. A replacement level team will score the sum of a group of replacement level players. By adding up the scores for a series of replacement players, we obtain a mark of 1000 points for a replacement. The difference between 1500 and 1000 is 500 points, therefore, a value based team needs to choose a team earning 500 points over the replacement level in order to win its league.

Risk

Risk is dependent on three major aspects: position, injuries and performance decrease. Position is important because different players have different likelihoods of consistent success. Tight ends are known for being unpredictably successful while running backs are thought to show more longevity. Therefore, we must calculate risk by position. Injury calculations are simply games played by viable players over total games available. This may underestimate injury risk as some players develop injuries before the season begins, making them nonviable, despite being drafted. On the other hand performance risk, which is calculated by comparing performance from one season to the next, may easily overestimate risk. That value fails to include players outperforming their expectations and improving. Still, only allowing for negative variation in performance provides a high range for possible risk aversion coefficients, which would help to compensate for underestimation from injuries and find a total risk figure near the actual risk.

The injury risks are as follows:

Figure 5: games played by fantasy viable players in 2008

2008	Games Played	Total Games Possible	Risk
QB	314	320	0.01875
RB	456	480	0.05
WR	912	960	0.05
TE	312	320	0.025

Figure 6: games played by fantasy viable players in 2009

2009	Games Played	Total Games Possible	Risk
QB	311	320	0.028125
RB	467	480	0.027083
WR	916	960	0.045833
TE	304	320	0.05

Performance risk can be calculated for 2009 based on the difference in performance from 2008, which is often used by fantasy owners as a predictor of performance in the next season.

Figure 7: underperformance in 2009 compared to performance in 2008

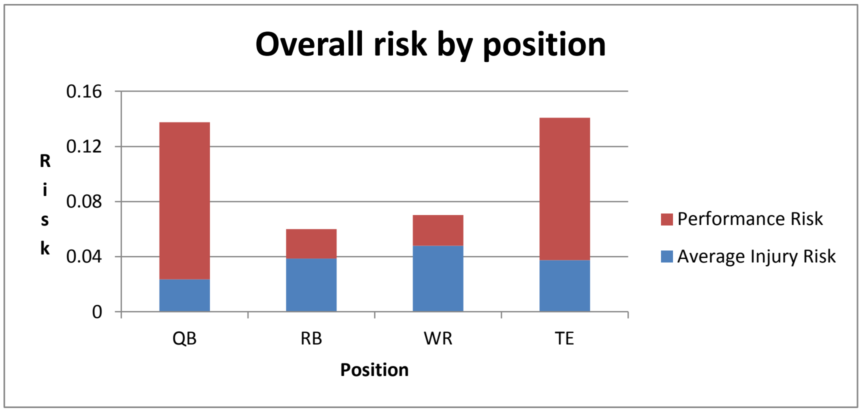
	Players Underperforming	Ratio of Underperformance	Risk
QB	8	0.885755	0.114245
RB	7	0.978474	0.021526
WR	15	0.9777	0.0223
TE	4	0.89665	0.10335

By averaging the amount of injury risk from 2008 and 2009, and then combining with the performance risk from 2009, we may calculate total risk.

Figure 8: Complete Player Risk

Position	Average Injury Risk	Performance Risk	Total Risk
QB	0.023438	0.114245	0.137683
RB	0.038542	0.021536	0.060078
WR	0.047917	0.0223	0.070217
TE	0.0375	0.10335	0.14085

Figure 9: Complete Player Risk



Risk Aversion

Figures 8 and 9 illustrate a few important points. Namely, injury risk is fairly consistent among players, regardless of position. Performance risk, however, varies widely. Running backs show little performance risk, but quarterbacks and tight ends can experience a large degree of performance risk with regard to their predicted information. All of these risk values are near enough the algebraic mean of .10175 that we can feel safe assuming .1 as a value for real risk and a risk coefficient for risk neutral owners.

The risk coefficient depends on whether the owner is risk-averse or not. If an owner is particularly risk-averse, he could increase his risk aversion coefficient, decreasing the ratio of spending on starters to spending on bench players. Risk aversion can also play a role in defining the bonus and discount for a positional draft strategy. The bonus functions opposite to the risk aversion coefficient; it allows an owner to overpay for a prized player, increasing the possible financial loss if that player gets injured. Therefore, for a very risk-averse owner, the risk aversion coefficient should be large and the bonus should be very small. To determine that number, we can compare valuations without risk to the valuations used most often in ESPN fantasy leagues.

Comparing draft values with a risk aversion coefficient of zero and the values used in drafts on ESPN.com, we can find the risk aversion coefficients people generally use for drafting by finding the slope of a regression line and subtracting from 1.

Figure 10: calculating actual risk

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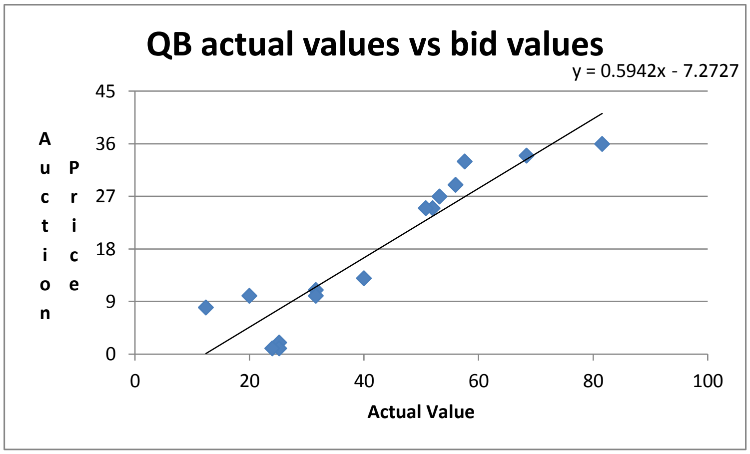

In Figure 10, the x-axis is performance of quarterbacks during 2009 adjusted to give a bid value without a risk value. The y-axis is those quarterbacks' draft auction values this year. We must recognize then, that the coefficient on x in the above chart is the correct risk adjustment, in the equations as (1-r), for a team. The least squares regression line implies that if a player's expected performance increases by enough to raise his non risk adjusted value by $1, his risk adjusted value increases by $0.6. This means that the discount for the risk adjusted value is 0.4. This chart does not include quarterbacks who changed teams, retired, or were suspended for part of the year. The coefficient value of 0.4 = (1 – 0.6) was chosen to match these results, as shown in Figure 11. The lower risk value was selected as .1 based on the true estimates calculated above. Then, to determine how a price discount would appear for a risk-averse owner, we used the same 1:4 ratio.

Figure 11: coefficients for various draft strategies

Team	Strategy	Risk Aversion Coefficient	Pricing Bonus	Price Discount
1	Point Based Drafting	0.4		
2	Value Based Drafting	0.4		
3	Point Based Drafting, Weak positional influences	0.4		
4	Value Based Drafting, Weak positional influences	0.4		
5	Point Based Drafting, Strong positional influences	0.4	1.025	0.975
6	Value Based Drafting, Strong positional influences	0.4	1.025	0.975
7	Point Based Drafting, Weak positional influences	0.1		
8	Value Based Drafting, Weak positional influences	0.1		
9	Point Based Drafting, Strong positional influences	0.1	1.1	0.91
10	Value Based Drafting, Strong positional influences	0.1	1.1	0.91

Auction Results

Based on Figures 2 and 11, we can create initial player values for every owner. Figure 12 gives an example of these player values for Aaron Rodgers, a Quarterback. Note that the subtitle *1* or *j-2* refers to the player being bid upon, not the number of players on the team. If there is not a subtitle, the team is either bidding on the j^{th} player, or the team does not have positional preferences. The column labeled “Team 2 no risk” is the valuation used to determine the actual risk aversion coefficient above.

Figure 12: valuations of each draft strategy

Aaron Rodgers (Green Bay Packers)					
Fantasy Position	QB	Team 4 (j-1)	81.6	Team 7	1
Fantasy Points	405	Team 4	1	Team 8 (j-1)	73.44
Value Points	204	Team 5 (1)	32.724	Team 8	1
Real Prices	36	Team 5 (j-1)	32.076	Team 9 (1)	53.46
Team 1	32.4	Team 5	1	Team 9 (j-1)	44.226
Team 2	48.96	Team 6 (1)	49.4496	Team 9	1
Team 2 No Risk	81.6	Team 6 (j-1)	48.4704	Team 10 (1)	80.784
Team 3 (j-1)	32.4	Team 6	1	Team 10 (j-1)	66.8304
Team 3	1	Team 7 (j-1)	48.6	Team 10	1

By running an auction with all ten teams pitted against one another, we can find the results of various bidding valuations. The results of this auction appear in Figure 13. note that the remainder of the results portion deals almost entirely with points rather than utility, but as a rule, higher point output corresponds to higher utility as a higher point output makes the likelihood of winning a league higher.

Figure 13: results of auction described above

Team	Strategy	Risk Aversion	Expected Point Total from Starting Lineup
1	Point Based Drafting	High	1002
2	Value Based Drafting	High	1190
3	Point Based Drafting, Weak positional influences	High	1040
4	Value Based Drafting, Weak positional influences	High	1301
5	Point Based Drafting, Strong positional influences	High	1356
6	Value Based Drafting, Strong positional influences	High	1409
7	Point Based Drafting, Weak positional influences	Low	1398
8	Value Based Drafting, Weak positional influences	Low	1394
9	Point Based Drafting, Strong positional influences	Low	1410
10	Value Based Drafting, Strong positional influences	Low	1523

Confidence Interval of Points

Points are not the only important piece of information. It is also important to consider that a player has 10% likelihood to drastically lose value. We must mimic a repeated simulation by finding the variance of the figures above for each team. Essentially, if we played 1000 seasons, we would find that in every season 1.2 of the 12 players on the roster drastically lost value and needed to be replaced, but the players that were replaced changed every season. The ideal way to do this would be to simulate 1000 drafts and simulate those 1000 seasons. Then, we could calculate the number of times each team won the league and generate a probability for each team to win the league and each owner's utility based on this draft strategy. Because auction draft values do not change, bidding would be approximately identical over time and the only simulation required would be that of injuries. This is still beyond the means of this study; instead, we will look at the 95% confidence interval, which will approximate the range of probable scores. Comparing these ranges will allow for a less precise, but still valuable view of expected utility given the draft strategy.

To calculate a confidence interval, we must first determine the likely loss of value for a high risk team and then do the same for a low risk team. By assuming that a high risk team, in the case of an injury, would exchange the player ranked in the top 1/8th of the total number of fantasy viable players at that position for the player it drafted in the bottom 7/8th of the same group, we may find the average drop-off for those owners. We can do the same thing for risk-averse owners by measuring the difference between 3/8th and 5/8th of the number of fantasy viable players. The reason for working with these fractions relies on the assumption that there are five risk-averse teams and five risk neutral teams and universal distribution of two or more players per team. For example, risk neutral teams would draft quarterbacks 1-5 and 16-20, while risk-averse teams draft quarterbacks 6-15. If we treat the average risk neutral team as owning quarterbacks 3 and 18, the drop off is from the top 1/8th of players to the bottom 1/8th of players. The same logic can be applied to risk neutral teams which, on average, would own quarterbacks 8 and 13, or the quarterbacks closest to the third eighth and fifth eighth. The assumption is that all risk neutral teams are approximately the same, and all risk averse teams are the same as well.

Figure 14

Loss due to an injury by position	Risk-averse	Risk Neutral	P(loss of value)
Quarterback	328-279=49	353-251=102	.0583
Running Back	193-160=33	252-140=212	.1303
Wide Receiver	129-100=29	179-84=95	.2109
Tight End	115-98=17	164-75=89	.0583

Figure 14 above shows the drop-off at a given position for risk neutral teams and risk-averse teams, as well as the probability that this drop-off occurs. The explanation for the loss calculation is above, but in order to calculate probability, we first used the facts that 10% of players get injured and that if the loss of value happens to a bench player, it does not affect a team's output. Then, we combined that information with possible loss of multiple players at one position to get the same figures for running back and wide receiver. Finally, we used this information to calculate standard deviation for each team. The standard deviation of expected total points is below:

Figure 15

	Risk-averse	Risk Neutral
Standard deviation	21.8194	93.8053

This clearly shows the trade-off risk-averse owners are making between increased mean and lower uncertainty. However, when we apply these standard deviations to the results from Figure 13, we see that even the greater certainty might not be particularly helpful.

Figure 16

Team	Risk Aversion	Expected Point Total	95% Range	Bottom Limit	Upper Limit
1	High	1002	43.6388	980.1806	1023.819
2	High	1190	43.6388	1168.1806	1211.819
3	High	1040	43.6388	1018.1806	1061.819
4	High	1301	43.6388	1279.1806	1322.819
5	High	1356	43.6388	1334.1806	1377.819
6	High	1409	43.6388	1387.1806	1430.819
7	Low	1398	187.611	1304.1947	1491.805
8	Low	1394	187.611	1300.1947	1487.805
9	Low	1410	187.611	1316.1947	1503.805
10	Low	1523	187.611	1429.1947	1616.805

Analysis of Draft Results

These points seem to show the value of a strong positional schematic. Risk neutral teams were rewarded in this system by being able to consistently outbid risk-averse teams, but these teams were unable to bid on many high quality players. Because the auction runs from good players to bad ones, usually based on relative value rather than pure points, owners like 8 and 10 swoop in early, bid up a player, and win him. They soon lose money and are very limited for the majority of the auction. It is important we remember that every owner has to fill all twelve of his roster spots and that every player commands at least one dollar. That means the maximum an owner can spend on one player is not $200 as the salary cap implies, but rather $189. Therefore, when an owner spends heavily in the beginning of a draft, he is severely handicapped during the middle, as evidenced by teams 8 and 10. Team 10 bid and won the top two players available (Aaron Rodgers and Chris Johnson), but was left with only fifty dollars to fill ten roster spots, four of which were in his starting lineup. Owner 8 used a similar style, drafting four of the next five players, including two quarterbacks. A league like this does not incentivize having multiple quarterbacks, meaning the lack of sophisticated positional influences was truly damaging. Positional influences are most important with quarterback and tight ends because most leagues only play with one player at each position. Quarterback is, therefore, the most damaging position to have weak positional influencesThis fits almost exactly with the risk-averse owner's model developed earlier. Risk neutral owners bid early, and risk-averse owners are able to take advantage in the middle rounds of bidding.

Another interesting detail is that Teams 8 and 10 often ended up bidding head to head, pushing the price up between the two because both were risk neutral and had high price ceilings. To see the effects of risk neutral bidding, I ran an auction with owner 10 and nine owners who were identical to owner 6. In this scenario, Owner 10 was able to retain several good players for a relatively low price because the other owners had much lower maximum prices. The result was a very high expected point total for team 10 – 1623. In short, if every other owner is risk-averse, bidding in a risk neutral manner can be extremely effective.

The results seem to reiterate that Team 10 is consistently fairly strong, indicating that that the high risk aversion coefficient was high enough to be irrational and that in most environments, value based drafting and risk neutrality was an optimal tactic combination for increasing utility. However, in an environment with multiple risk neutral bidders, bidding with risk aversion might be an optimal strategy. For example, Team 6 was able to take advantage of the bidding wars between the two riskier owners and came away with a very good likelihood of success, as is evidenced by Figure 16.

Conclusion

Fantasy owners often appear too risk-averse, as was illustrated by the difference between the coefficient on the regression of the fantasy auction prices on fantasy value and the calculated risk expected. The auction simulations supported the idea that risk aversion values are too high. The lower risk aversion values were far more successful in drafting a team with a higher point total, implying a higher expected utility. It also appears that having strong positional influences, as well as a value based drafting strategy is the best way to obtain a team with high output.

Limitations

This study includes several key limitations, mostly due to the difficulties of a more complete analysis. For example, most owners make minor adjustments to their teams week by week. This is possible because NFL teams play only once per week and a player has different expectations against different teams. These changes, however, would be extremely difficult to consider when determining final point totals because they require a model for performance against a given team, which requires many inputs to develop. Moreover, final point totals are not always the metric for success in a league. Instead, teams are often paired against each other, playing a “matchup” once a week. The team with the higher point total in that week wins the matchup. League champions are often determined by winning percentage (or record) over a season. This system is very common in fantasy football leagues but is very difficult to model. Ultimately, the strong correlation between point total and winning percentage makes such a model effectively unnecessary. The largest limitation, however, is the incomplete analysis of injury and actual utility. Mean team points are strongly positively correlated with owner’s utility, but the actual measure of owner utility is based on probability of winning the league, which can only be determined by simulating multiple seasons and finding probabilities for each draft strategy winning the league.

Extensions

This study could be extended to looking at the limitations above. It could also be applied to further applications involving real sports leagues in the NFL draft. Many sports gambling options include betting on draft outcomes, and developing a model for that field could prove lucrative. I think the model shown above is helpful for fantasy owners and websites like ESPN to develop their player valuations. These valuations can shape the way people draft, so a more accurate valuation can differentiate a strong, parity-laden league from an unequal one.

Works Cited

Bryant, Joe. "Principles of VBD." *Fantasy Forecast Magazine*, June 7, 2001.

ESPN. *ESPN Fantasy Football Scoring Leaders 2009.* August 1, 2009. http://games.espn.go.com/ffl/leaders?seasonId=2009&seasonTotals=true (accessed December 1, 2010).

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Fry, Michael J, Andrew W Lundberg, and Jefrey W Ohlmann. "A Player Selection Heuristic for a Sports League Draft." *Journal of Quantitative Analysis in Sports*, 2007: 5.

Harris, Christopher. "The Value Based Drafting Method." *ESPN.* July 4, 2010. http://sports.espn.go.com/fantasy/football/ffl/story?page=nfldk2k10vbd (accessed December 5, 2010).

Sports Reference LLC. *Pro Football Reference.* June 1, 2010. http://www.pro-football-reference.com/ (accessed December 1, 2010).

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