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A PROBABILITY BASED APPROACH FOR THE ALLOCATION OF PLAYER DRAFT SELECTIONS IN AUSTRALIAN RULES FOOTBALL

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ABSTRACT
Australian Rules Football, governed by the Australian Football League (AFL) is the most popular winter sport played in Australia. Like North American team based leagues such as the NFL, NBA and NHL, the AFL uses a draft system for rookie players to join a team's list. The existing method of allocating draft selections in the AFL is simply based on the reverse order of each team's finishing position for that season, with teams winning less than or equal to 5 regular season matches obtaining an additional early round priority draft pick. Much criticism has been levelled at the existing system since it rewards losing teams and does not encourage poorly performing teams to win matches once their season is effectively over. We propose a probability-based system that allocates a score based on teams that win 'unimportant' matches (akin to Carl Morris' definition of importance). We base the calculation of 'unimportance' on the likelihood of a team making the final eight following each round of the season. We then investigate a variety of approaches based on the 'unimportance' measure to derive a score for 'unimportant' and unlikely wins. We explore derivatives of this system, compare past draft picks with those obtained under our system, and discuss the attractiveness of teams knowing the draft reward for winning each match in a season.

KEY WORDS: AFL, probability, draft, importance.

INTRODUCTION

The AFL draft system has been designed to favour teams anchored to the bottom of the ladder. This enables those teams to improve their player lists and propel themselves up the ladder during future seasons by having a first choice of picking rookie players. Currently, the order of the AFL draft coincides with the inverse order of the ladder as it stands at the conclusion of the home and away season. This system allocates the first draft choice to the team that finished last (or sixteenth), the second draft choice to the team that finished fifteenth, and the sixteenth draft choice to the team that finished first. Subsequent rounds of the draft replicate the exact order of the first round.

A highly contentious issue surrounding the AFL draft has been the allocation of priority picks. A priority pick is a draft choice provided to a team prior to the first round of the national draft. From 1997 to 2005, priority picks were provided to teams that won fewer than five games during the regular season. In effect, if a team finished last with less than five wins, they received a priority pick in addition to the first choice in the national draft, thus enabling the club to receive the two best available players. This system provided teams with poor win/loss records with little incentive to win games during the latter part of the season and actually provided clubs with an incentive not to win five games.

The draft systems of other major world sports are somewhat comparable to that of the AFL. Major League Baseball (MLB) and the American National Football League (NFL) both allocate draft choices using inversed final season standings (Grier and Tollison, 1994; Spurr, 2000). However, neither competition provides priority picks and thus does not provide additional reward for winning only a handful of games.

Several studies have assessed the incentive effects of draft systems and their impact on team performance. Taylor and Trogdon (2002) assessed the performance of teams following initiatives by the NBA to reduce team incentives to win or lose games. After controlling for venue and the quality of each team, these authors found that when draft choices were decided on inverse rankings (1983-84 season), non-playoff teams were 2.5 times more likely to lose games than teams likely to feature in the playoffs. However, when the NBA modified the draft system and gave all teams an equal probability of obtaining the first draft choice (1984-85 season), non-playoff teams were as likely to win as play-off bound teams. Finally, when the lottery system became weighted during the 1989-1990 season, non-playoff teams were 2.2 times more likely to lose when compared to teams qualifying for the playoffs (Taylor and Trogdon, 2002). These findings demonstrate the profound impact of providing incentives for teams to lose games and head towards the bottom of the ladder. Furthermore, it highlights that an incentive based system such as the process employed by the AFL increases the likelihood that teams will lose additional matches during the latter part of the season since they are unlikely to feature in the finals.

In this paper we use a model that allocates a *Draft Point Reward* (*DPR*) to each team when they win a match. This reward varies in value from 0 to 1 depending upon the Unimportance of the match. The cumulative sum of *DPR*, known as the *DScore*, is used to determine the final draft picks at the conclusion of the regular season.

We will begin our work by defining the criteria our model should meet. We then outline the methods employed, and consider the operational aspects of the model.

METHODS

Our system is based on Carl Morris' famous work on the most important points in tennis (Morris, 1977). He defined the importance of a point as the difference between two conditional probabilities: the probability a server wins the game given that he wins the next point, minus the probability a server wins the game given that he loses the next point. Here we are not considering points in a game, but rather matches in a season, and it is the Unimportant matches that appeal to us. We calculated Unimportance so that it is independent of the opposing team.

Criteria

In devising the system of selection for the AFL national draft, we designed our model based on the following:

Teams with a reduced probability of making the finals are rewarded incrementally higher for winning matches of high Unimportance

Teams that have qualified for the finals are ineligible for any reward.

DPR is restricted to a 16-week period commencing from the end of Round 6.

DPR is higher for teams unlikely to win, and is further enhanced by the Unimportance of a match in terms of making the finals.

No *DPR* is given in defeat, so teams must win to obtain a reward.

A priority system is in place to protect teams that have continuous runs of losses, but it is not implemented at the expense of rewarding victory.

The way in which the number of matches 'needed to win' is calculated is based upon the minimum number of wins needed by a team in the remainder of the season based solely upon making the final 8 (*F*8). Obviously this is not precisely known until the end of the season; however a reasonable estimation can be made.

Probabilistic model

The heart of our model is based upon reworking Morris' equation to suit our purpose of determining how Unimportant a match is to a team's finals aspirations. There are a number of things that we need to evaluate first, such as what measures are required in our assessment of what makes a match Important, and, in turn, Unimportant. A regular AFL season constitutes 22 matches and we need to consider the probability of a team making the finals based upon the number of matches won at round *r*. There are a number of features in our probabilistic model that were used to determine how much a team was rewarded for winning a match. The process is as follows:

Determine the minimum number of wins (*Par Wins*) required for team i to make the final 8 after round r.

Check if team i at round r has already made the final 8 or cannot make the final 8. If neither of these events are true, we determine the probability of team i making the finals at the completion of round r.

Calculate the Unimportance of match $r+1$ for team i using the above results.

Allocate the *Draft Points Reward* (*DPR*) based on the above measures.

Determination of projected wins to make the final8

There are two possible approaches to determining the number of wins required to make the final 8 at round r for team i. We could either use the final season's required wins and impose that retrospectively on the completed season, or use a projected requirement during the season and keep this result even at the end of the season. For example, in season 2004, the eighth placed team won 12 of 22 matches to make the finals. Ultimately, differing results make it difficult to predict this result during the season. However, the attraction of our model is that teams must know the rewards of winning their next match prior to the game as an incentive to win. They should also be confident this reward does not change post game. So we used a projected final 8 wins, or *Par Wins*, during the season and maintain these values to seasons end, despite minor variations in predictions (see Appendix Eq 1).

This does, on occasion, return a result that is not possible. For example, a team with 4 wins at the completion of round 7, and sitting in 8th place, yields a *Par Wins* of 8.57. Therefore we round to the nearest 0.5, using 0.25 and 0.75 as the round off points. In this example, we round to 8.5, and this is interpreted as team i requiring 8.5 wins (minimum) from the remaining 15 games to make the finals.

Determination of the probability of making the final 8

At the heart of the second stage of the process is the binomial distribution. A number of other methods were considered, such as simulating the remainder of the season using success probabilities for each team using $p = 0.5$, or varying p; also averaging the number of wins of all teams and forward multiplying to determine the number of wins needed to make the final 8. Ultimately, it was both simplicity and a reduction of variability that settled our choice. We define the probability of team i at the completion of round r making the final 8 as $\Pr_i(F8/\mathrm{r})$. Using $B(x, n, p)$ (the cumulative binomial distribution function with x = number of successes, n = number of trials and p = probability of success), we have Equation 2 (see Appendix Eq 2).

Notably, one must consider the value of p_i. We have chosen to look at two methods, the first, and predominant choice in our results, is the classic coin toss model $p_i = 0.05$. The second method uses the winning ratio ($p_i = \mathrm{TW}_i/\mathrm{r}$). One could be tempted to use successful prediction probabilities such as those determined by Stefani and Clarke (1992); or the simpler winning ratio. However, we wanted the system to be as simple as possible, and the introduction of a nested probability model may complicate this idea. A brief treatment of this is given in the discussion section.

The unimportance of a match

We define the Importance for team i at the end of round r, or $I_i(r)$, as Equation 3 (see Appendix Eq 3).

Now we unpack the two components of Importance (see Appendix Eq 4 and 5).

By using the binomial cumulative density function to model the probability of making the finals based on winning or losing the next match, we can, in turn, calculate the Unimportance of a match. Through some neat cancellation of terms we obtained a simple result for the Unimportance (see Appendix Eq 6).

Allocation of Draft Point Reward (DPR)

The allocation of *DPR* is simply the Unimportance probability multiplied by the probability of not making the final 8 at round r. In this way, the Unimportance is tempered by the likelihood of making the final 8. Teams that cannot make the final 8 receive the highest weight possible (1), that is, the full Unimportance probability, as long as they win the match. The allocation of *DPR* for team i at round r is given by the following Equation 7 and 8 (see Appendix Eq 7 and 8).

Using the DScore for the national pre-season draft

The use of the *DScore* towards draft selections encompasses some parts of the AFL's latest policy on priority picks. For our *DScore* system, the teams are ranked 1 through 16, with the highest *DScore* attracting pick 1, and the lowest pick 16. This ordering remains for the subsequent iterations of the draft with one exception. Current AFL policy dictates that a team that wins less than or equal to 4 matches in a season receives a priority pick in the second round of the draft. As a method of protecting teams that may never win another match after round 6, we employ a similar priority pick system, whereby a team that wins less than or equal to 5 matches in a season receives a priority pick at the start of the second round of the draft. This is a little more generous than the AFL system, however the bottom side will not necessarily end up with the first draft pick under the *DScore* model.

RESULTS

We begin by examining how the system operated for 2005 in finer detail. We then cover some interesting scenarios, and investigate the implications of the model.

The 2005 season

For season 2005, a number of teams remained in contention for the final 8 right through to the last round. The final round saw five teams competing for three finals places. One win separated 6th through 10th at seasons end. Notably, half a win separated last (16th) from 14th and all three bottom sides received a reward from the AFL for winning less than or equal to 5 matches. Table 1 outlines the final results of three draft systems; first the variable success *DScore* model, then the 50-50 *DScore* model, and finally the AFL system (Figure 1). Note that there is little variation when using a team's win ratio to determine $\Pr_i(F8/r)$ instead of the simpler $p_i = 0.5$, and henceforth we will only consider the equal success probability model.

Table 1. Draft pick comparison for *DScore* and actual draft system for the 2005 AFL season.

Team	***DScore*** $p_i = TW_i/r$	***DScore*** $p_i = .05$	**AFL Draft System**
Carlton	9	9	4
Collingwood	7	7	5
Hawthorn	5	3	6
Essendon	2	2	7
Richmond	11	11	8
Brisbane	4	4	9
Fremantle	6	6	10
Western Bulldogs	1	1	11
Port Adelaide	3	5	12
Melbourne	14	13	13
Geelong	15	14	14
Kangaroos	13	15	15
St Kilda	10	10	16
Sydney	8	8	17
West Coast	16	16	18
Adelaide	12	12	19
Priority	17	17	1
Priority	18	18	2
Priority	19	19	3

Carlton, Collingwood and Hawthorn received priority picks 1, 2 and 3 respectively under both the AFL model and our model, although ours comes into effect in round 2 of the draft. Variations in the 2005 season round-by-round results are given in Figure 1.

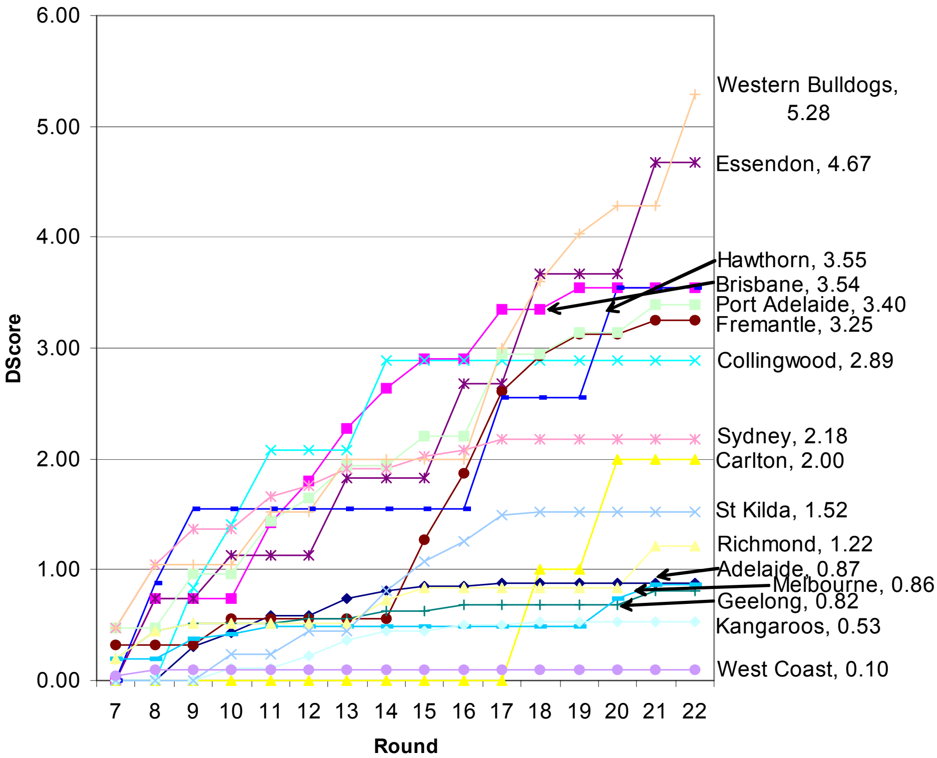

Figure 1. *DScore* by Round by teams for 2005.

Variation of the *DScore* throughout the season is evident; with the number 1 pick changing teams 11 times during the season - twice in the last three rounds. Also, picks 3 to 7 provided extremely close results in the final round, given that if Collingwood had won its last match against the Western Bulldogs they could have secured pick 3 (instead of 7) and cost the Western Bulldogs first pick. So a win to Collingwood under the *DScore* model would see a rise to pick 3, however a win under the AFL model would have seen a drop to pick 5.

An evaluation of the incentive of the DScore model
Ideally the *DScore* model should evidence high *DPR* continuously for low placed teams, given they win. Table 2 outlines the number of teams in contention for the number one pick in the last round, and three rounds before the end of the home and away season under the *DScore* model. The first overall draft pick changed teams in the last round during seasons 2001, 2005, and in the last 3 rounds during seasons 1997, 1999, 2001, 2003, 2004, 2005. There was a blowout in the *DScore* in 2000 and thus, the race for the top draft pick was over by round 20. However, six teams fought it out for picks 2 to 7. Of course, these matches were not played with the *DScore* incentive and therefore imposing it retrospectively is hypothetical.

Table 2. Number of teams in contention for the number one draft pick going into the final round of seasons 1997 to 2005.

Season	Number of teams in contention for Pick 1, Round 22	Teams in contention for Pick 1, Round 19
2005	2	5
2004	2	3
2003	3	5
2002	2	5
2001	3	4
2000	1	5
1999	2	5
1998	1	6
1997	4	6

Aside from the 1998 and 2000 seasons, the race for the number one draft pick would have remained alive and well prior to the final round.

Importance
Of interest to us was when the maximum value of importance occurs for each team. We then sorted the teams by final ladder position (FLP) and calculated the mean and standard deviation of the round, as given in Figure 2.

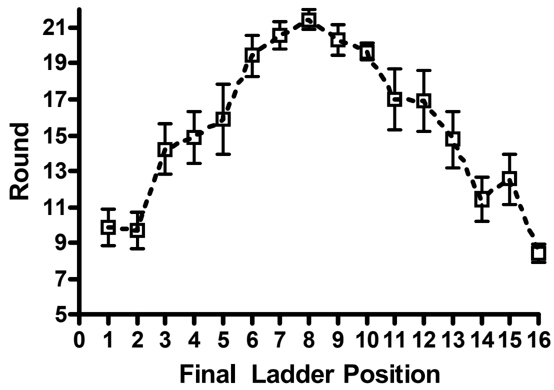

Figure 2. Error bars of maximum round of importance by Final Ladder Position (1997-05).

As shown in Figure 2, the teams finishing in the top 2 and bottom 3 have their most important games generally in the early rounds of the season (note that we have only considered round 6 onwards). All other teams heading towards the middle of the ladder have maximal important matches later in the season. As one would expect, the 8th *FLP* has the maximal importance match in the last three rounds.

DISCUSSION

It is somewhat difficult to measure the effect of our model on past results as we are implementing our method retrospectively. As a consequence, where players would end up under our model would be different to reality and therefore team success may change. Even so, the findings are still an eye-opener, and indeed motivate poorer teams toward success. As was shown in the results section, for the final round of 1998, the 1st and 2nd draft pick had been decided. However, 11 teams could still be playing in expectation of a change in their draft pick with a victory. The ‘ideal’ advocate of our system was the final round of 2003. Geelong played St Kilda, and it could be argued they were playing for ‘nothing’, sitting 10th and 13th on the ladder - no finals place or priority pick at stake. Under our *DScore* system the winner of that match would take 1st pick and the loser potentially 3rd. The match played on Saturday had Geelong prevail by 19 points, snatching 1st pick. Remarkably, the result was not yet settled, with the Sunday encounter between Hawthorn (9th) and Richmond (10th), (again two sides with nothing to play for), pivotal in the *DScore* outcome. Hawthorn won by 4 points, winning their fourth game in a row, snatching the number 1 pick on the last game of the home and away season!

Alternatives
A criticism that may be leveled at the *DScore* system is that teams which continually lose are never rewarded. A possible way of assisting teams that consistently lose may be to reward a 'gallant' defeat. Calculating an expected and actual margin, then smoothing the difference, is an approach used in other areas of sport analysis, such as tennis as in Bedford and Clarke (2000). They used their model to predict and improve upon ATP ratings in tennis based on margin of victory rather than win or loss. Once again, a team may play so poorly as to never get within the expected margin, and the same problem arises. We believe the priority criteria is a reasonable approach to combat this, and we can only hope teams would 'try harder' to win to obtain better draft picks, and in turn, enhance their future chances, rather than 'lie down' and be rewarded for defeat.

A point of interest raised in the methods section was the possible inclusion of a team's relative skill into the system, either using probabilities such as those pioneered by Stefani and Clarke (1992), or more arbitrary measures such as a win ratio to weight the *DPR*. The use of an 'opponent' weight would see some rather unattractive scenarios. Specifically, the use of a probability based multiplier on the *DPR* introduces only occasional need for lowly placed teams to win, as they need only defeat one successful team and reap a high *DPR*, thereby obtaining a high draft pick. This is a clear disincentive as the *DScore* system is designed to encourage teams to win every game possible.

CONCLUSIONS

In this paper, we have developed a unique system for player allocation in the AFL draft using probabilistic principles designed to encourage success. Whilst the AFL system was not designed to encourage teams to lose, it does reward teams that only win a small amount of games. Our model, known as the *DScore* model, uniquely encourages teams to strive for victory with a high draft pick as the prize, especially when the game (and their season) is - in terms of the finals - Unimportant. Utilizing this principle of unimportance, we cited exciting and motivating cases whereby otherwise 'meaningless' encounters become a battle for high draft picks. The *DScore* model may also have a broad appeal, with potential outcomes easily publishable in daily newspapers and on the internet, with the relevant draft permutations providing a motivator not only for the club, but for the supporters alike.

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KEY POINTS

- Draft choices are allocated using a probabilistic approach that rewards teams for winning unimportant matches.
- The method is based upon Carl Morris' Importance and probabilistic calculations of making the finals.
- The importance of a match is calculated probabilistically to arrive at a DScore.
- Higher DScores are weighted towards teams winning unimportant matches which in turn lead to higher draft selections.
- Provides an alternative to current draft systems that are based on 'losing to win'.

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APPENDIX

Equations (Eq):

Eq 1: $$Par\ wins_i(r) = \max\left(\left\lceil \frac{\left(TW_{8^{\text{th}}\ \text{ranked team}}(r)\right)\times 22}{r} \right\rceil - TW_i(r), 0\right)$$

We formally define the number of wins required after round r for team i as $Par\ wins_i(r)$ *; and the total number of wins for team i at the completion of round r as* $TW_i(r)$. *Using the 8*[th] *ranked team at any round r as the ideal Par proportion in determining the wins required to make the finals.*

Eq 2: $$\Pr_i(F8\mid r) = 1_{\{Par\,Wins_i(r)=0\}} + 1_{\{(Par\,Wins_i(r)>0)\cap(Par\,Wins_i(r)\le 22-r)\}}\left[1 - B\left(\text{Par wins}_i(r) - 1; 22-r, p_i\right)\right]$$

where $1_{\{a\}}$ *is the indicator function taking value 1 if condition a is true and 0 if false.*

Eq 3: $$I_i(r) = \Pr_i(Make\,F8\mid Win\,match\ r+1) - \Pr_i(Make\,F8\mid Lose\,match\,r+1)$$

Eq 4: $$\begin{aligned}&\Pr_i(Make\,F8\mid Win\ match\,r+1) = \\ &1_{\{Par\,Wins_i(r)=0\}} + 1_{\{(Par\,Wins_i(r)>0)\cap(Par\,Wins_i(r)\le 22-r)\}}\left[1 - B\left(Par\,Wins_i(r) - 2; 22-(r+1), p\right)\right]\end{aligned}$$

Eq 5: $$\begin{aligned}&\Pr_i(Make\,F8\mid Lose\ match\,r+1) = \\ &1_{\{Par\,Wins_i(r)=0\}} + 1_{\{(Par\,Wins_i(r)>0)\cap(Par\,Wins_i(r)\le 22-r)\}}\left[1 - B\left(Par\,Wins_i(r) - 1; 22-(r+1), p\right)\right]\end{aligned}$$

Eq 6: $$\begin{aligned}U_i(r) &= 1 - I_i(r) \\ &= 1 + \Pr_i\left(Make\,F8\mid Lose\,match\ r+1\right) - \Pr_i\left(Make\,F8\mid Win\,match\ r+1\right) \\ &= 1 + \left[1 - B(x;n,p)\right] - \left[1 - B(x-1;n,p)\right] \\ &= 1 + \left[1 - \sum_{k=0}^{x} b(k;n,p)\right] - \left[1 - \sum_{k=0}^{x-1} b(k;n,p)\right] \\ &= 1 + \left[1 - \left(b(0;n,p) + b(1;n,p) + \cdots + b(x;n,p)\right)\right] - \left[1 - \left(b(0;n,p) + b(1;n,p) + \cdots + b(x-1;n,p)\right)\right] \\ &= 1 - b(x;n,p)\end{aligned}$$

So,

$$U_i(r) = 1 - b\left(Par\,Wins_i; 22-(r+1), p\right)$$

Noting $b(x;n,p)$ *(the discrete binomial distribution function with x = number of successes, n = number of trials and p = probability of success) in the final result, Unimportance is simple to evaluate, relying on a discrete rather than continuous result, and given the values of Par Wins, can be easily computed using a scientific calculator.*

Eq 7: $$DPR_i(r) = 1_{\{i\,wins\,match\,r\}}\cdot 1_{\{r>6\}}\cdot U_i(r)\cdot\left(1 - \Pr_i\left(F8\mid r\right)\right)$$

where $1_{\{a\}}$ *is the indicator function taking value 1 if condition a is true and 0 if false. The Draft Score, or DScore, for team i at round r is simply the sum of the DPR:*

Eq 8: $$DScore_i(r) = \sum_{k=7}^{r} DPR_i(k),\ r\in\{7,..,22\}$$