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Predictive Sports Analytics Using an Exponential Power Function

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ABSTRACT
This paper introduces a predictive sports analytics model that can be used to i) rank teams, ii) estimate win probability, and iii) calculate the expected winning margin (spread) of a game. The model is based on an exponential distribution function and is solved using a log-loss function and maximum likelihood estimates (MLE). The most appealing aspect of this quantitative approach is that the model is objective, transparent, and testable. Readers can verify all calculations and results as the model does not employ any black box method. We apply this model to the 2018-2019 NFL season to rank teams, estimate scores, and make predictions across all pairs of teams. The model predicted more than 70% of the NFL games correct, and has $R^2 = 26\%$ when comparing estimated spreads to actual spreads. This model can also serve as an objective approach to assist committees determine which teams should be selected for college post season tournaments such as the NCAA basketball tournament and the College Football Playoffs.

Keywords
Sports Analytics, Probability Models, Exponential Functions, Quantitative Models, Linear Regression

1 INTRODUCTION

Sports analytics has experienced a dramatic growth at the professional and college levels. Sports modeling methods are used by teams to uncover statistics, information, and trends that can be used to improve game results, and help improve strategy decisions such as player selection, college drafts, salary arbitration, and post-season tournament selection. Much of the current sports analytics environment, however, is based on utilizing descriptive statistics to improve decision making ability. Herein, we introduce a predictive sports analytics model based on quantitative methods. More specifically, we show how quantitative models can be used to predict the winning team, estimate win probability, and calculate expected winning margin using an exponential distribution.

These techniques are extremely useful for college sports where committees are tasked with selecting teams for post-season tournaments such as the college football playoffs and NCAA basketball tournaments, and where ranking teams is often difficulty due to a small sample size and non-overlapping game schedules. Currently, many of the college post-season tournament teams are selected based on subjective opinions and a set of criteria that is not made public.

Approaches in this paper provide a transparent and objective sports analytics model to enable committee members to rank teams based on actual game results and using a transparent and objective metric. We apply this model to the 2018-2019 season and provide predictions across all pairs of game. The model has a 70% success rate for predicting the winning team and R2=26% for predicting home team winning margin compared to actual margin.

2 METHODOLOGY

The methodology used for the sports prediction model is based on an exponential distribution function and power function model. The methodology follows that in Kissell & Poserina (2017) and applies the approach to NFL 2018-2019 full season game results data. The model uses the team's rating and a home field advantage metric to estimate win probability, and a linear regression model to estimate expected winning margin (score). This approach is described as follows:

Let,

x = home team rating, $x \sim Exponential(x)$

y = away team rating, $y \sim Exponential(y)$
h = home field advantage parameter

Then, the probability that the home team will win is calculated as follows:

$$Prob(Home\ Team\ Win) = \frac{x+h}{x+y+h}$$

Alternatively, the probability that the away team will win is calculated as follows:

$$Prob(Away\ Team\ Win) = \frac{y}{x+y+h}$$

For example, suppose that the home team has a rating of $x = 6$, the away team has a rating of $y = 3$, and there is a home field advantage benefit of $h = 1$. Then, the probability of each team winning is:

$$Prob(Home\ Wins) = \frac{6+1}{6+3+1} = 0.60 = 70\%$$

$$Prob(Away\ Wins) = \frac{3}{6+3+1} = 0.30 = 30\%$$

The expected home team winning margin, also known as the spread, is measured as the home team score minus away team score, e.g.,

$$S = Home\ Team\ Score - Away\ Team\ Score$$

Where, $S > 0$ indicates the home team won the game, $S < 0$ indicates the away team won the game, and $S = 0$ indicates the game ended in a tie. Spread S is calculated using a linear regression model that incorporates the home team win probability. A basic formulation of this regression is as follows:

$$S = b_0 + b_1 \cdot prob + e$$

However, often due to small sample bias and not having a large enough cross-section of games played across all teams, this regression does not necessarily ensure that $S = 0$ when the home team win probability is $p = 0.5$. Thus, we make an adjustment to the model as follows:

$$S = d_1 \cdot (p - 0.5) + e$$

For simplicity in notation going forward, we let $p^* = (p - 0.5)$. Then our spread regression model is:

$$S = d_1 \cdot p^* + e$$

In this model the intercept term at $p = 0.5$ is $d_0 = 0$, thus, ensuring that the estimated spread at $p = 0.5$ is $S = 0$.

Estimating Team Ratings

Team rating is determined using maximum likelihood estimation (MLE) techniques and incorporating all game results as follows:

$$Max \quad L = \prod_{i=1}^{n} g_i(x)$$

where,

$$g_i(x) = \begin{cases} \dfrac{x_{h(i)} + x_0}{x_{h(i)} + x_{a(i)} + x_0}, & Home\ Team\ Wins \\ \dfrac{x_{h(i)} + x_0}{x_{h(i)} + x_{a(i)} + x_0}, & Away\ Team\ Wins \\ 1/2\,, & Tie\ Game \end{cases}$$

$x_k > 0$ for k=1, 2, …, m
x_k = team k rating
$x_{h(i)}$ = home team in game i rating
$x_{a(i)}$ = away team in game i rating
x_0 = home field advantage
n = total number of games
m = total number of teams
i = i^{th} game

One difficulty that occurs when we maximize a likelihood functions consisting of percentages it that the product of percentages converges to zero rather quickly which makes solving for the model parameters extremely difficult and almost impossible. For example, for an average probability of $p = 0.60$ and n=48 observations (e.g., three weeks of games), the loss function is $L =$

$0.60^{46} = 2.25 \cdot 10^{-11}$. And after five weeks of games n=80, the loss function is $L = 1.79 \cdot 10^{-18}$. Computers are not efficient at solving problems with these many decimal places. Luckily, in this situation, we can transform the problem using logs. Basic calculus shows that the value x^* that maximizes a function $f(x)$ is the same value that maximizes the log of the function, $\log(f(x))$. Thus, maximizing the log-likelihood function results is the same optimal solution as maximizing the original likelihood function.

Hence, team rating parameters are estimated via maximizing the following log-likelihood:

$$Max \quad L^* = \sum_{i=1}^{n} \log(g_i(x))$$

The results of this maximization are shown in Table 1: Team Ratings Sorts from Highest (Best) to Lowest (Worst). The three highest ranked teams for NFL 2018-2019 are #1 Los Angeles Rams (10.000), #2 New Orleans Saints (9.748), and #3 New England Patriots (9.206). The Super Bowl 2018-2019 was played between the #1 Los Angeles Rams and #3 New England Patriots, so the model proved effective at uncovering and ranking the best teams. The three lowest ranked teams are #30 Arizona Cardinals (0.410), #31 Oakland Raiders (0.408), and #32 San Francisco 49ers (0.0001). The home field advantage benefit rating was HFA=0.84.

Table 1: Team Rating Sorted from Highest (Best) to Lowest (Worst)

Ranking	HomeTeam	Rating	Ranking	HomeTeam	Rating	Ranking	HomeTeam	Rating
1	Los Angeles Rams	10.000	13	Tennessee Titans	3.147	25	Detroit Lions	0.983
2	New Orleans Saints	9.748	14	Seattle Seahawks	2.892	26	Miami Dolphins	0.809
3	New England Patriots	9.206	15	Minnesota Vikings	2.201	27	Green Bay Packers	0.602
4	Los Angeles Chargers	7.816	16	Washington Redskins	1.676	28	New York Jets	0.558
5	Kansas City Chiefs	7.710	17	Cleveland Browns	1.579	29	Tampa Bay Buccaneers	0.514
6	Houston Texans	4.365	18	Atlanta Falcons	1.346	30	Arizona Cardinals	0.410
7	Chicago Bears	4.173	19	Carolina Panthers	1.306	31	Oakland Raiders	0.408
8	Indianapolis Colts	3.843	20	Denver Broncos	1.247	32	San Francisco 49ers	0.0001
9	Pittsburgh Steelers	3.780	21	Cincinnati Bengals	1.101		HFA	0.84
10	Dallas Cowboys	3.589	22	Buffalo Bills	1.025			
11	Philadelphia Eagles	3.589	23	Jacksonville Jaguars	1.018			
12	Baltimore Ravens	3.443	24	New York Giants	1.017			

Thus, the probability that the NY Jets (#28) will beat the Buffalo Bills (#22) when playing at home is:

$$P(NY\ Jets(Home) > Buffalo\ Bills\ (Away)) = \frac{0.558 + 0.84}{0.558 + 1.025 + 0.84} = 58\%$$

If the Jets are playing at home they are favored to win (58% win probability) even though the Bills are ranked higher. If the Bills are playing the Jets at home, the Bills are favored to win (77% win probability). This model is able to differentiate probabilities based on whether the team is playing at home or on the road.

Estimating Regression Coefficients

After estimating team ratings, we can calculate home team probability. If the home team win probability is calculated to be p, then we estimate the expected home team win margin from the following regression equation:

$$S = d_1 \cdot p^* + e$$

where $p^* = p - 0.5$. The parameter of the model d_1 is calculated via linear least squares as follows:

$$d_1 = \left((p - 0.5)' \cdot (p - 0.5)\right)^{-1} (p - 0.5) \cdot S$$

As mentioned above, this formulation of the spread model guarantees that the expected spread at $p = 0.5$ is $S = 0$. This in intuitive since $p = 0.5$ implies that the home team has a 50%-50% change of winning the game, so the average win scores should be $S = 0$.

The results of our spread prediction regression model are shown in Table 2: Spread Regression Summary Results. This model has $d_1 = 28.53$ and is statistically significantly with $tStat(p^*) = 9.7038$, $R^2 = 0.26$, and regression error $SeY = 12.333$.

The best-fit spread regression model is:

$\hat{S} = (p - 0.5) \cdot 28.53$

Therefore, if the home team win probability is estimated to be $p = 0.75$, then the estimated home team winning spread is calculated as follows:

$\hat{S} = (0.75 - 0.50) \cdot 28.53 = 7.13$

Table 2: Spread Regression Summary Results						
Regression Statistics						
R Square	0.261					
Standard Error	12.333					
Observations	268					
Regression Parameters						
	Coefficients	*Std Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
d0	0	#N/A	#N/A	#N/A	#N/A	#N/A
d1	28.53	2.9400	9.7038	2.89E-19	22.741033	34.318291

3 RESULTS

The results of our prediction model for NFL 2018-2019 season across all pairs of teams are calculated based on the team ratings in Table 1 and the spread regression results in Table 2. In total, there are 992 unique pairs of game match-ups with each team playing at home and on the road against every other team in the league. The estimated home team winning spread across all pairs of teams in shown in Table 3: NFL 2018-2019 Prediction Table.

The Super Bowl for 2018-2019 was played between the Los Angeles Rams (#1 Ranking) and New England Patriots (#3 Ranking). Our prediction model estimated the LA Rams to be the favorite by 0.585 pts. This can be verified directly from Table 3. Since the Super Bowl is played at a neutral site, we need to estimate the winning spread in two ways: first for LA Rams as the home team and second for NE as the home team. This is as follows:

LA Rams (home team) vs. NE Patriots (away team): LA Rams favored by +1.17
NE Patriots (home team) vs. LA Rams (away team): NE Patriots favored by +0.03

We can transform this model for the LA Rams winning as the home and away team as follows:

LA Rams (home team) vs. NE Patriots (away team): LA Rams win by +1.17
LA Rams (home team) vs. NE Patriots (away team): LA Rams lose by -0.03

Therefore, the expected winning margin is LA Rams to win by (0.5*(1.17 + -0.03) = 0.585

The winning team of Super Bowl 2018-2019 was the NE Patriots by 10pts. Using the regression results from our spread model, we find the probability of NE Patriots beating the LA Rams by 10 pts is 23% or approximately 1 in 4 times.

4 CONCLUSION

In this paper we introduced a sports prediction model to i) rank teams, ii) estimate win probability, and iii) calculate the expected home team winning spread. The modeling approach uses a log-likelihood function and maximum likelihood estimates (MLE) to determine team rating parameters for each team, and then performs a second regression that incorporates calculated home team winning probability to estimate home team winning spread. The model was applied to NFL 2018-2019 game data, and the model estimated the winning team correctly in more than 70% of the games and had $R^2 = 0.26$ for the spread prediction estimate. The model was applied to 992 unique pairs of games across all team (both home and away games) to predict home team winning margin.

In addition to using the sports prediction model to estimate win probability and winning margin, the model can also be used as an objective decision-making tool and assist tournament committees such as the BCS to help determine which teams should be selected for college football post season College Football Playoffs and the NCAA selection committee to help determine the group of 64 teams to be included in the NCAA basketball tournament. One of the more appealing aspects of this sports prediction model is that the model is independent, objective, and transparent, all of which as essential characteristic for any post season tournament that is not based fully on record alone (such as the case with professional sports).

5 REFERENCES

Kissell, Robert and James Poserina (2017), *Optimal Sports Math, Statistics, and Fantasy*, New York: Elsevier/Academic Press.

6 APPENDIX

Table 3: NFL 2018-2019 Prediction Table

HomeTeam\Away Team	Arizona Cardinals	Atlanta Falcons	Baltimore Ravens	Buffalo Bills	Carolina Panthers	Chicago Bears	Cincinnati Bengals	Cleveland Browns	Dallas Cowboys	Denver Broncos	Detroit Lions	Green Bay Packers	Houston Texans	Indianapolis Colts	Jacksonville Jaguars	Kansas City Chiefs	Los Angeles Chargers	Los Angeles Rams	Miami Dolphins	Minnesota Vikings	New England Patriots	New Orleans Saints	New York Giants	New York Jets	Oakland Raiders	Philadelphia Eagles	Pittsburgh Steelers	San Francisco 49ers	Seattle Seahawks	Tampa Bay Buccaneers	Tennessee Titans	Washington Redskins
Arizona Cardinals	-	-0.5	-6.7	1.4	-0.3	-7.7	0.9	-1.7	-6.9	0.0	1.7	5.0	-7.9	-7.3	1.4	-10.3	-10.3	-11.1	3.0	-3.9	-10.9	-11.0	1.4	5.4	7.2	-6.9	-7.2	14.3	-5.7	5.9	-6.2	-2.1
Atlanta Falcons	9.8	-	-3.2	5.1	3.6	-4.5	4.7	2.3	-3.5	3.9	5.4	8.1	-4.8	-3.9	5.2	-8.0	-8.0	-9.2	6.5	-0.1	-8.8	-9.0	5.2	8.5	9.8	-3.5	-3.8	14.3	-2.0	8.8	-2.6	1.9
Baltimore Ravens	11.8	7.4	-	8.8	7.6	0.2	8.4	6.6	1.3	7.8	8.9	10.7	-0.1	0.8	8.8	-4.1	-4.2	-5.7	9.7	4.6	-5.2	-5.6	8.8	11.0	11.8	1.3	0.9	14.3	2.8	11.2	2.2	6.2
Buffalo Bills	9.1	2.3	-4.2	-	2.5	-5.5	3.7	1.2	-4.5	2.8	4.4	7.3	-5.7	-5.0	4.2	-8.7	-8.8	-9.8	5.6	-1.2	-9.5	-9.7	4.2	7.7	9.1	-4.5	-4.8	14.3	-3.1	8.1	-3.7	0.8
Carolina Panthers	9.7	3.3	-3.3	5.0	-	-4.6	4.6	2.2	-3.6	3.8	5.3	8.0	-4.9	-4.0	5.1	-8.1	-8.1	-9.2	6.4	-0.2	-8.9	-9.1	5.1	8.4	9.7	-3.6	-3.9	14.3	-2.1	8.7	-2.7	1.7
Chicago Bears	12.1	8.2	2.6	9.4	8.4	-	9.1	7.4	2.4	8.6	9.6	11.2	1.0	1.9	9.4	-3.0	-3.1	-4.7	10.3	5.6	-4.2	-4.6	9.5	11.4	12.1	2.4	2.0	14.3	3.8	11.6	3.3	7.1
Cincinnati Bengals	9.3	2.6	-4.0	4.4	2.8	-5.2	-	1.5	-4.3	3.1	4.7	7.5	-5.5	-4.7	4.4	-8.5	-8.6	-9.6	5.9	-0.9	-9.3	-9.5	4.4	7.9	9.3	-4.3	-4.6	14.3	-2.8	8.3	-3.4	1.0
Cleveland Browns	10.1	4.1	-2.5	5.8	4.3	-3.8	5.3	-	-2.8	4.6	6.0	8.6	-4.1	-3.3	5.8	-7.5	-7.5	-8.7	7.1	0.7	-8.3	-8.6	5.8	8.9	10.1	-2.8	-3.1	14.3	-1.3	9.3	-1.9	2.6
Dallas Cowboys	11.8	7.6	1.8	8.9	7.8	0.4	8.6	6.8	-	8.0	9.1	10.8	0.1	1.0	8.9	-3.9	-4.0	-5.5	9.9	4.8	-5.0	-5.4	8.9	11.1	11.9	1.5	1.1	14.3	3.0	11.3	2.4	6.4
Denver Broncos	9.6	3.1	-3.5	4.9	3.3	-4.8	4.4	2.0	-3.8	-	5.1	7.9	-5.0	-4.2	4.9	-8.2	-8.3	-9.3	6.3	-0.4	-9.0	-9.2	4.9	8.2	9.6	-3.8	-4.1	14.3	-2.3	8.6	-2.9	1.5
Detroit Lions	9.0	2.1	-4.4	4.0	2.3	-5.6	3.5	1.0	-4.7	2.7	-	7.2	-5.9	-5.1	4.0	-8.8	-8.9	-9.9	5.5	-1.3	-9.6	-9.8	4.0	7.6	9.0	-4.7	-5.0	14.3	-3.2	8.0	-3.8	0.6
Green Bay Packers	7.9	0.5	-5.9	2.4	0.7	-6.9	1.9	-0.7	-6.1	1.0	2.7	-	-7.2	-6.5	2.4	-9.8	-9.8	-10.7	4.0	-3.0	-10.4	-10.6	2.5	6.3	8.0	-6.1	-6.4	14.3	-4.8	6.8	-5.3	-1.1
Houston Texans	12.2	8.4	2.9	9.6	8.5	1.6	9.3	7.6	2.6	8.7	9.7	11.3	-	2.1	9.6	-2.8	-2.9	-4.5	10.4	5.8	-4.0	-4.3	9.6	11.5	12.2	2.6	2.3	14.3	4.1	11.7	3.5	7.3
Indianapolis Colts	12.0	7.9	2.2	9.1	8.0	0.8	8.8	7.1	1.9	8.3	9.3	11.0	0.5	-	9.2	-3.5	-3.6	-5.2	10.1	5.1	-4.7	-5.0	9.2	11.2	12.0	1.9	1.5	14.3	3.4	11.4	2.8	6.7
Jacksonville Jaguars	9.1	2.3	-4.3	4.1	2.5	-5.5	3.6	1.1	-4.5	2.8	4.4	7.3	-5.8	-5.0	-	-8.7	-8.8	-9.8	5.6	-1.2	-9.5	-9.7	4.2	7.7	9.1	-4.5	-4.9	14.3	-3.1	8.1	-3.7	0.7
Kansas City Chiefs	13.0	10.4	6.1	11.2	10.5	4.9	11.0	9.8	5.8	10.6	11.3	12.4	4.6	5.4	11.2	-	0.6	-1.1	11.8	8.4	-0.5	-0.9	11.2	12.5	13.0	5.8	5.5	14.3	7.1	12.6	6.6	9.6
Los Angeles Chargers	13.0	10.4	6.1	11.2	10.5	5.0	11.0	9.9	5.9	10.7	11.4	12.4	4.7	5.5	11.3	0.8	-	-1.0	11.8	8.5	-0.4	-0.8	11.3	12.5	13.0	5.9	5.6	14.3	7.1	12.7	6.7	9.6
Los Angeles Rams	13.2	11.1	7.4	11.8	11.2	6.3	11.6	10.6	7.2	11.3	11.9	12.8	6.1	6.8	11.8	2.4	2.3	-	12.3	9.4	1.2	0.8	11.8	12.9	13.2	7.2	6.9	14.3	8.3	13.0	7.8	10.4
Miami Dolphins	8.6	1.4	-5.0	3.3	1.6	-6.2	2.8	0.3	-5.3	2.0	3.6	6.6	-6.5	-5.7	3.4	-9.2	-9.3	-10.2	-	-2.1	-9.9	-10.1	3.4	7.0	8.6	-5.3	-5.6	14.3	-3.9	7.5	-4.5	-0.1
Minnesota Vikings	10.9	5.5	-0.9	7.1	5.7	-2.2	6.7	4.5	-1.2	6.0	7.3	9.5	-2.6	-1.7	7.1	-6.2	-6.3	-7.6	8.3	-	-7.2	-7.5	7.1	9.8	10.9	-1.2	-1.6	14.3	0.3	10.1	-0.3	4.1
New England Patriots	13.1	10.9	7.0	11.6	11.0	5.9	11.4	10.4	6.8	11.1	11.7	12.7	5.6	6.4	11.6	1.9	1.8	0.03	12.1	9.1	-	0.2	11.6	12.8	13.2	6.8	6.5	14.3	7.9	12.9	7.5	10.2
New Orleans Saints	13.2	11.0	7.3	11.7	11.1	6.2	11.6	10.6	7.0	11.3	11.8	12.7	5.9	6.7	11.8	2.2	2.1	0.4	12.2	9.4	1.0	-	11.8	12.8	13.2	7.0	6.8	14.3	8.1	12.9	7.7	10.4
New York Giants	9.1	2.3	-4.3	4.1	2.5	-5.5	3.6	1.1	-4.5	2.8	4.4	7.3	-5.8	-5.0	4.1	-8.7	-8.8	-9.8	5.6	-1.2	-9.5	-9.7	-	7.7	9.1	-4.5	-4.9	14.3	-3.1	8.1	-3.7	0.7
New York Jets	7.8	0.3	-6.0	2.2	0.5	-7.1	1.7	-0.9	-6.3	0.8	2.5	5.7	-7.4	-6.7	2.2	-9.9	-9.9	-10.8	3.8	-3.2	-10.5	-10.7	2.2	-	7.8	-6.3	-6.6	14.3	-5.0	6.6	-5.5	-1.3
Oakland Raiders	7.2	-0.6	-6.7	1.4	-0.3	-7.7	0.9	-1.7	-6.9	0.0	1.7	5.0	-7.9	-7.3	1.4	-10.3	-10.3	-11.1	3.0	-4.0	-10.9	-11.0	1.4	5.4	-	-6.9	-7.2	14.3	-5.7	5.9	-6.2	-2.1
Philadelphia Eagles	11.8	7.6	1.8	8.9	7.8	0.4	8.6	6.8	1.5	8.0	9.1	10.8	0.1	1.0	8.9	-3.9	-4.0	-5.5	9.9	4.8	-5.0	-5.4	8.9	11.1	11.9	-	1.1	14.3	3.0	11.3	2.4	6.4
Pittsburgh Steelers	11.9	7.8	2.1	9.1	8.0	0.7	8.8	7.0	1.8	8.2	9.3	11.0	0.4	1.3	9.1	-3.6	-3.7	-5.3	10.0	5.1	-4.7	-5.1	9.1	11.2	11.9	1.8	-	14.3	3.3	11.4	2.7	6.7
San Francisco 49ers	4.9	-3.3	-8.7	-1.4	-3.1	-9.5	-1.9	-4.4	-8.9	-2.8	-1.1	2.3	-9.7	-9.2	-1.4	-11.5	-11.5	-12.1	0.2	-6.4	-11.9	-12.0	-1.4	2.8	4.9	-8.9	-9.1	-	-7.9	3.4	-8.3	-4.8
Seattle Seahawks	11.4	6.7	0.6	8.1	6.9	-0.8	7.8	5.8	0.3	7.1	8.3	10.3	-1.1	-0.2	8.1	-5.0	-5.0	-6.5	9.2	3.7	-6.0	-6.4	8.2	10.5	11.5	0.3	-0.1	14.3	-	10.8	1.2	5.4
Tampa Bay Buccaneers	7.6	0.0	-6.2	2.0	0.2	-7.3	1.5	-1.1	-6.5	0.6	2.2	5.5	-7.5	-6.8	2.0	-10.0	-10.1	-10.9	3.6	-3.4	-10.6	-10.8	2.0	5.9	7.6	-6.5	-6.8	14.3	-5.2	-	-5.7	-1.5
Tennessee Titans	11.6	7.1	1.0	8.4	7.2	-0.3	8.1	6.2	0.7	7.5	8.6	10.5	-0.7	0.3	8.5	-4.5	-4.6	-6.1	9.4	4.1	-5.6	-6.0	8.5	10.8	11.6	0.7	0.4	14.3	2.3	11.0	-	5.8
Washington Redskins	10.3	4.3	-2.2	6.0	4.5	-3.5	5.6	3.3	-2.5	4.8	6.2	8.8	-3.8	-3.0	6.0	-7.3	-7.3	-8.5	7.3	0.9	-8.1	-8.4	6.0	9.1	10.3	-2.5	-2.9	14.3	-1.0	9.4	-1.6	-