Comparing the Predictive Information Content of College Football Rankings

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Abstract

The method in Fair and Shiller (1990) is used in this paper to compare the predictive information content of various college football ranking systems. The results show that a number of systems have useful independent information. Optimal weights for the systems are estimated, and the use of these weights produces a predictive system that is more accurate than any of the individual systems. The results also provide a fairly precise estimate of the size of the home field advantage.

1 Introduction

Each week during a college football season there are many rankings of the Division A teams. Some rankings are based on votes of sports writers, and some are based on computer algorithms. The computer algorithms take into account things like win-loss record, margin of victory, strength of schedule, and the strength of individual conferences. Since 1998 a subset of the computer rankings has been used in tandem with the Associated Press and ESPN/USA Today writers' polls

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by the NCAA and the Bowl Championship Series (BCS) to determine which two teams play in the national championship game. This paper uses the comparison method in Fair and Shiller (1990) to compare nine computer ranking systems. The rankings are first converted into predictions and then the predictions are compared.

The nine ranking systems are 1) Matthews/Scripps Howard (MAT), 2) Jeff Sagarin's USA Today (SAG), 3) Richard Billingsley (BIL), 4) Seattle Times/Anderson & Hester (SEA), 5) Atlanta Journal-Constitution Colley Matrix (COL), 6) Kenneth Massey (MAS), 7) David Rothman (RTH), 8) Peter Wolfe (WOF), and 9) Dunkel (DUN). The first eight of these systems were used by the BCS in the 2001-02 season. Each system uses a different algorithm, and since the introduction of the BCS by the NCAA, there has been much controversy concerning which is the best system for determining which teams play in the national championship game. Just recently the NCAA decided that any system that included margin of victory in its algorithm would be dropped for the upcoming 2002-03 season.

The algorithms are generally fairly complicated, and there is no easy way to summarize their main differences. Each system more or less starts with a team's win-loss record and makes adjustments from there. An interesting system to use as a basis of comparison is one in which *only* win-loss records are used, and this system, denoted REC, is also analyzed in this paper.

An extensive bibliography on college football ranking systems is on the website: *http://www.cae.wisc.edu/~ dwilson/rsfc/rate/biblio.html*. There does not appear to be in the literature any analysis like that in this paper. Much of the literature is concerned with developing models or algorithms for predicting games or for ranking teams. For example, an interesting recent model for national football league scores is in Glickman and Stern (1998). This paper instead takes rankings that already exist and asks if the rankings have independent information. In this sense the paper requires no knowledge of football; it is evaluating other people's knowledge. Another interesting question in this literature is how various predictions compare to the Las Vegas odds. Zuber, Gander, and Bowers (1985) do this for national football league games. In future work it would be of interest to see how the combined regression in this paper does against the Las Vegas odds for college football games.

2 The Data and Creation of the Prediction Variables

There are 117 Division A teams. These teams are listed in Table 5. Each system ranks the teams from 1 through 117 each week. For a given week let R_{ik} denote the rank of team i by system k. Each week there are about 50 games. For a game between teams i and j, let $Y_{(i,j)} = (S_i - S_j)/(S_i + S_j)$, where S_i is the point score for team i and S_j is the point score for team j. $Y_{(i,j)}$ is the margin of victory or loss normalized by the total point score. Also, let $W_{(i,j)}$ be 1 if i wins and 0 if i loses. Finally, let $H_{(i,j)}$ be 1 if i is the home team, -1 if j is the home team, and 0 if neither team is at home (as for bowl games).

The systems do not predict games; they simply rank teams. We use a system's rankings for the week to create what will be called a "prediction variable" for each game for the week for that system. This variable, denoted $Q_{(i,j)k}$, is the ranking difference normalized to lie between 0 and 1: $Q_{(i,j)k} = -(R_{ik} - R_{jk})/117$, where

k denotes the system. For the system that uses only win-loss records (REC), the prediction variable is taken to be the percent to date of games won by i minus the percent won by j: $Q_{(i,j)REC} = WIN_i/(WIN_i + LOSS_i) - WIN_j/(WIN_j + LOSS_j)$, where WIN denotes the number of games won up to the time and $LOSS$ denotes the number of games lost. We thus have one prediction variable per system. None of these variables uses information on home field for the upcoming games. It is thus not necessarily the case that a positive value for $Q_{(i,j)k}$ implies that the people running the system would predict team i to beat team j if they were forced to make a prediction. If i were ranked only slightly ahead of j and j had home field advantage, j might be predicted to win. The treatment of home field advantage is discussed in the next section.

Data were collected for four years, 1998, 1999, 2000, and 2001, and for ten weeks per year beginning with week 6. (1998 is the first year of the BCS.) This resulted in a total of 1594 games. For 2000 there were 115 Division A teams; for 1999 there were 114, and for 1998 there were 112. The normalizing divisor in creating $Q_{(i,j)k}$ thus differed by year. Not all observations were available for all systems. It will be seen in the next section how this problem was handled.

The data were obtained from various web sites. Most of the rankings were obtained from Kenneth Massey's site: *http://www.masseyratings.com/cf/compare.htm*.[1] The rankings for COL were obtained from *http://www.colleyrankings.com*. The points for COL, which are used at the end of Section 4, were also obtained from this site. The scores

[1]Only data for the latest week are available on this site. We are indebted to Mr. Massey for sending us the past data via email.

and home field information for the 1998 and 1999 seasons were obtained from *http://www.cae.wisc.edu/˜ dwilson/rsfc/history/howell*, and the scores and home field information for the 2000 and 2001 seasons were obtained from *http://cbs.sportsline.com*.

There are two possible outcome variables to predict: the percentage point spread ($Y_{(i,j)}$) and simply win/loss ($W_{(i,j)}$). The point spread would appear to be the more interesting variable to examine since it has more information in it. If, say, teams i and j are playing and one system has i ranked 10 and j ranked 40 and another system has i ranked 12 and j ranked 20, it seems reasonable to assume that the first system is suggesting a larger margin of victory, even though both are suggesting that team i should win. There is a possible problem with using $Y_{(i,j)}$, however, which is that a superior team may ease off to avoid embarrassing the other team. In this case the point spread would not reveal the true strength of the winning team and the true weakness of the losing team. Both outcome variables are used below, and it will be seen that the main conclusions are not sensitive to which variable is used. Most of the paper focuses on $Y_{(i,j)}$, the percentage point spread.

3 The Test

The Fair-Shiller (FS) (1990) test is quite simple. It was developed in the context of evaluating different forecasts from econometric models. The test is to regress the actual value of a variable on a constant and various predicted values of the variable. If one predicted value dominates the others in the sense that it contains all the information that the others do plus some, it should have a significant coefficient estimate and the others should have insignificant ones. If instead each predicted value contains useful information that is not in the others, then all the predicted values should have significant coefficient estimates.

In the present context either $Y_{(i,j)}$ or $W_{(i,j)}$ is regressed on $H_{(i,j)}$ and the $Q_{(i,j)k}$ variables. Adding $H_{(i,j)}$ is the way that home field information is used. This information may be useful in predicting the actual outcome, and, as noted in the previous section, it is not in any of the prediction variables. We are in effect looking to see if the prediction variables of the systems have useful predictive information after taking into account home field advantage.

Note that we are not including a constant term in the regression. In constructing the variables it is arbitrary which team is i and which is j, and so including a constant term is not appropriate.

4 Results

As noted in Section 2, data on 1594 games were collected for the 1998–2001 period. All observations were available for the systems MAT, SAG, COL, MAS, and DUN. (All observations are also available for REC, which just uses data on win-loss records.) All but 6 observations were available for BIL. The first set of regressions used these six systems along with REC, which allowed 1588 observations to be used. Results for nine regressions are reported in Table 1. The first seven regressions use each system by itself (along with the home field advantage variable), the eighth uses all seven systems, and the ninth excludes MAT and MAS.

Table 1
Regressions using 1588 Observations
Left hand side variable is $Y_{(i,j)}$
Right hand side variables are $H_{(i,j)}$ and $Q_{(i,j)k}$

	H	MAT	SAG	BIL	COL	MAS	DUN	REC	SE	R^2	%right
1	.084	.652							.384	.258	.693
	(8.35)	(22.17)									
2	.077		.658						.381	.268	.703
	(7.71)		(22.81)								
3	.083			.717					.384	.259	.697
	(8.24)			(22.22)							
4	.085				.564				.393	.224	.679
	(8.28)				(20.05)						
5	.079					.650			.382	.265	.704
	(7.83)					(22.59)					
6	.087						.677		.380	.273	.695
	(8.75)						(23.12)				
7	.086							.567	.395	.215	.681
	(8.33)							(19.42)			
8	.081	-.017	.338	.164	-.367	.086	.290	.244	.377	.287	.717
	(8.05)	(-0.10)	(2.18)	(1.78)	(-2.97)	(0.53)	(3.11)	(3.13)			
9	.081		.373	.170	-.352		.301	.247	.377	.287	.715
	(8.15)		(3.53)	(1.88)	(-3.35)		(3.39)	(3.21)			

Estimation technique: OLS; t-statistics are in parentheses.

When each system is included by itself, the coefficient estimate for its prediction variable is positive and highly significant. The system that has the lowest standard error of the regression is DUN with .380. The next best is SAG with .381. The worst is REC with .395, and the second worst is COL with .393. When all seven systems are included (regression 8 in Table 1), the standard error falls to .377. Five of the seven prediction variables are significant at the 95 percent level for a two tailed test. The insignificant variables are MAT and MAS. When these two variables are excluded (regression 9), the standard error is the same to three decimal places.

Focusing on regression 9, the coefficient estimate for COL is negative (-.352), with a t-statistic of -3.35. COL thus contributes significantly to the explanation of $Y_{(i,j)}$, but with a negative weight. COL is thus estimated to have independent information, where the information is such that given the values of the other prediction variables, the weight for COL is negative. Regarding MAS, it is interesting to note that although it has the third lowest standard error when each system is considered by itself, it is estimated to have no independent information when included with the others. The FS method has the advantage of allowing this kind of result to be seen. To repeat, the negative result for MAS does not mean that MAS is necessarily a poor predictor when considered in a one by one comparison with the others; it just means that MAS has no value added given the other rankings.

The home field advantage variable is highly significant in Table 1, with a coefficient around .08. A coefficient of .08 says that the home team has an advantage of .08 in the percentage point spread. For example, for a total point score of 52, which is the mean total point score across all 1594 games, the advantage is 4.2 points. In percentage terms this advantage is considerably larger than the estimate of 4.68 by Harville and Smith (1994) for college basketball games, since the mean total point score for college basketball games is much larger than 52.

The regressions in Table 1 can be used to predict winners and losers. If the predicted value from a regression is positive, this is a predicted victory for team i. If i in fact won, this is a correct prediction; otherwise not. The last column in Table 1 presents for each regression the percent of the games predicted correctly as to winner. The range is from 67.9 percent for COL alone to 71.7 percent for regression 8. Although this percent is likely to be of interest to many people, note that it is not the criterion used to obtain the estimates. The regression minimizes the sum of squared residuals; it does not necessarily maximize the percent of games predicted correctly.

Table 2 is the same as Table 1 except the left hand side variable is $W_{(i,j)} - 0.5$ instead of $Y_{(i,j)}$, where $W_{(i,j)}$ is 1 if i wins and 0 if i loses. Subtracting 0.5 from $W_{(i,j)}$ and not including a constant term in the regression constrains the constant term to be 0.5, which is equivalent to constraining the constant term to be zero in the $Y_{(i,j))}$ regressions.

The results in Table 2 are quite similar to those in Table 1. When the systems are considered by themselves, DUN has the lowest standard error, and when all systems are included, MAT and MAS are not significant. The last column in the table is computed in the same way as in Table 1. If the predicted value from a regression is positive, which means that the predicted value of $W_{(i,j)}$ is greater than 0.5, this is taken as a predicted victory for team i. The last column is the percent of games predicted correctly. The range is from 67.9 percent for REC alone to 72.2 percent for regression 9.

It is clear that the conclusions are not sensitive to the use of $Y_{(i,j)}$ or $W_{(i,j)}$, and the rest of this paper will focus on $Y_{(i,j)}$.

There are 104 observations missing for SEA, and the next step was to include SEA in the combined regression excluding these observations. This is the first regression in Table 3. It is still the case that MAT and MAS are not significant. SEA is significant, with a negative coefficient estimate, and COL is now no longer significant. Including SEA has essentially wiped out COL. The second regression in Table 3 excludes MAT and MAS, and it is still the case in this regression that

Table 2
Regressions using 1588 Observations
Left hand side variable is $W_{(i,j)} - 0.5$
Right hand side variables are $H_{(i,j)}$ and $Q_{(i,j)k}$

	H	MAT	SAG	BIL	COL	MAS	DUN	REC	SE	R^2	%right
1	.079	.648							.446	.192	.694
	(6.76)	(18.97)									
2	.072		.660						.443	.204	.706
	(6.20)		(19.68)								
3	.078			.726					.444	.200	.699
	(6.68)			(19.47)							
4	.080				.559				.453	.165	.680
	(6.74)				(17.22)						
5	.073					.652			.443	.201	.709
	(6.31)					(19.52)					
6	.082						.684		.441	.211	.695
	(7.10)						(20.15)				
7	.081							.583	.452	.169	.679
	(6.84)							(17.46)			
8	.075	-.133	.412	.220	-.541	.096	.307	.403	.436	.229	.721
	(6.45)	(-0.69)	(2.29)	(2.06)	(-3.79)	(0.51)	(2.85)	(4.47)			
9	.076		.390	.220	-.564		.308	.412	.436	.229	.722
	(6.58)		(3.20)	(2.10)	(-4.63)		(3.00)	(4.61)			

Estimation technique: OLS; t-statistics are in parentheses.

COL is not significant. Note that the measures of fit (standard error, R-squared, and percent right) are not directly comparable to those in Table 1 because the sample periods differ.

There are 393 observations missing for RTH and 496 missing for WOL. Some of the missing observations overlap, and if all 10 systems are included in the regression, there are a total of 552 missing observations. The first regression in Table 4 includes all ten systems excluding the 552 observations. It is still the case that MAT and MAS are not significant. It is now the case that COL is significant and SEA is not. Of the two new variables, WOL is not significant.

Table 3
Regressions using 1484 Observations
Left hand side variable is $Y_{(i,j)}$
Right hand side variables are $H_{(i,j)}$ and $Q_{(i,j)k}$

	H	MAT	SAG	BIL	COL	MAS	DUN	REC	SEA	SE	R^2	%right
1	.084	.084	.432	.160	-.113	.100	.245	.349	-.532	.378	.286	.715
	(8.05)	(0.44)	(2.554	(1.66)	(-0.69)	(0.56)	(2.48)	(4.07)	(-2.85)			
2	.084		.521	.169	-.093		.268	.345	-.485	.378	.286	.712
	(8.09)		(4.44)	(1.77)	(-0.58)		(2.86)	(4.10)	(-2.80)			

Estimation technique: OLS; t-statistics are in parentheses.

Table 4
Regressions using 1042 Observations
Left hand side variable is $Y_{(i,j)}$
Right hand side variables are $H_{(i,j)}$ and $Q_{(i,j)k}$

	H	MAT	SAG	BIL	COL	MAS	DUN	REC	SEA	RTH	WOL	SE	R^2	%right
1	.090	.036	.826	.194	-.481	-.182	.285	.516	-.279	-.550	.352	.394	.262	.689
	(6.81)	(0.12)	(3.234	(1.62)	(-2.25)	(-0.62)	(2.36)	(4.14)	(-1.04)	(-2.38)	(1.20)			
2	.089		.799	.197	-.423		.266	.454	-.114	-.477		.394	.260	.689
	(6.78)		(4.22)	(1.65)	(-2.02)		(2.34)	(3.91)	(-0.48)	(-2.29)				

Estimation technique: OLS; t-statistics are in parentheses.

The second regression in Table 4 excludes MAT, MAS, and WOL. Again, COL is significant and SEA is not, contrary to the case in Table 3. The new system RTH has a negative coefficient estimate. BIL is now barely significant at the 95 percent level.

The main conclusions to be drawn from Tables 1–4 are the following. 1) MAT and MAS appear to contain no useful independent information. This is also true of WOL, although this result is based on fewer observations. 2) Either COL or SEA contains useful independent information with a negative weight, but it is not clear which dominates. SEA dominates COL in Table 3, but the reverse is true in Table 4. More weight should probably be put on Table 3 because it uses more observations, so there is a slight edge for SEA. RTH also has a negative coefficient estimate in Table 4. 3) BIL barely hangs around in terms of significance, and it is a close call whether it should be dropped. 4) SAG, DUN, and REC do very well. Their significance is robust across the various regressions. It is interesting that REC does so well, since it is only based on win-loss records. It does not do well by itself (see Table 1), but it clearly has independent information when included with the other systems. This means that there is useful information in the win-loss records that is not being used by the other systems. 5) The estimate of the home field advantage is always fairly precise and hovers around .08.

One final point should be made. A few of the systems assign points to teams, rather than just ranking them. For COL observations are available for all four years for the points. To see whether using points is better than using ranks, a second prediction variable was created for COL. This variable is $(P_i - P_j)/RANGE$, where P_i is the point value assigned to team i, P_j is the point value assigned to team j, and $RANGE$ is the point range for the particular week (i.e., the maximum number of points given to a team by COL for the week minus the minimum number). This is the normalized point difference. When this variable was used in place of $Q_{(i,j)k}$ for COL in Table 1, the results were as follows. For COL considered by itself, the results were slightly better. The standard error was .391 versus .393. On the other hand, for the ninth regression in Table 1, the t-statistic for the COL variable was only -1.19, compared to -3.35 in the table. According to this result there is no independent information in the new COL variable.

5 Use of the Combined Regression

Because the prediction variables are so highly correlated with each other, it takes a fairly large number of games to get any precision in the combined FS regressions. For purposes of the discussion in this section, we will take the ninth regression in Table 1 as the combined regression of choice, since it is based on the most observations. The main reservations about it is whether BIL should be included. Also, if one were willing to drop 104 observations, it may be that SEA should replace COL.

An important question about the combined regression is how well it does in stability tests. To examine this, an F test was used to test the hypothesis that the coefficients for 1998 and 1999 (736 observations) are the same as those for 2000 and 2001 (852 observations). Using the ninth equation in Table 1, the F value was 3.97 with 6,1576 degrees of freedom. The 5 percent critical value is 3.67, and the 1 percent critical value is 6.88. The hypothesis of stability is thus rejected at the 5 percent level, but not the 1 percent level. If BIL is dropped from the equation, the F value is 2.60, and the 5 and 1 percent critical values are 4.37 and 9.02. In this case the hypothesis is not rejected at even the 5 percent level. The stability results are thus fairly supportive of the equation.

Regression 9 in Table 1 dominates each of the individual regressions in using more information and having a better fit. It uses in an optimal way the information in the four systems, SAG, BIL, COL, and DUN and the information in the win-loss records, REC. It dominates in the sense that it predicts the percentage point spread better than any individual system. (Remember that all regressions are using the information in the home field advantage variable.)

Given that the combined regression dominates the individual regressions, it would be of interest to use on a week to week basis. The regression could be used as follows. After SAG, BIL, COL, and DUN make their rankings for the week, enough information is available to create all the right hand side variables for any upcoming game. The four rankings are known, the win-loss records are known, and the upcoming home field information is known. The regression is then simply used to predict the percentage point spread for the game. Again, this is a prediction that should be on average more accurate than any predictions made from the individual regressions because it uses more information.

At the same time these predictions were made, the combined regression could also be used to create a ranking of all the teams. This is done as follows. Given the rankings by SAG, BIL, COL, and DUN for the week and the win-loss records, use the regression to predict what the percentage point spread would be if team i played team j on a neutral field ($H_{(i,j)} = 0$). If the predicted spread is positive, i gets a point; otherwise j gets a point. Do this for all possible match ups, and rank the teams by number of points. As an example, this was done for the last week of 2001 (before the bowl games), and the ranking is presented in Table 5. Also presented in Table 5 for each team are its win-loss record, its ranking by each of the four systems, and the ranking that the BCS chose. It is interesting to note that because COL has a negative weight, when it ranks a team high, this has, other things being equal, a negative effect on the regression's ranking, and vice versa. For example, Oklahoma is ranked higher by the regression in Table 5 than it otherwise would be because COL ranked it fairly low. Overall, SAG has the most influence on the

Table 5
Ranking using Regression 9 in Table 1
Last Week of 2001 (before Bowl Games)

		REC .248	SAG .373	BIL .170	COL -.352	DUN .301	BCS
1	Miami FL	11 - 0	1	1	1	1	1
2	Nebraska	11 - 1	3	2	2	5	2
3	Florida	9 - 2	2	7	8	2	5
4	Texas	10 - 2	4	10	9	3	7
5	Oklahoma	10 - 2	6	9	11	6	11
6	Colorado	10 - 2	5	4	5	4	3
7	Oregon	10 - 1	7	3	3	10	4
8	Maryland	10 - 1	11	5	10	15	10
9	Illinois	10 - 1	12	6	6	18	8
10	Tennessee	10 - 2	8	8	4	13	6
11	Washington State	9 - 2	10	12	12	20	12
12	Virginia Tech	8 - 3	24	18	27	11	21
13	LSU	9 - 3	18	14	13	8	13
14	Texas Tech	7 - 4	19	24	29	9	29
15	Stanford	9 - 2	9	11	7	23	9
16	Kansas State	6 - 5	14	36	30	7	39
17	Florida State	7 - 4	16	21	25	16	22
18	Georgia	8 - 3	22	17	20	17	18
19	Syracuse	9 - 3	20	16	16	19	17
20	Fresno State	11 - 2	15	29	14	25	19
21	Southern California	6 - 5	26	25	37	12	40
22	Michigan	8 - 3	17	23	18	21	16
23	Ohio State	7 - 4	30	20	31	14	25
24	South Carolina	8 - 3	23	19	19	26	14
25	UCLA	7 - 4	13	27	21	28	23
26	Brigham Young	12 - 1	21	13	17	54	20
27	Oregon State	5 - 6	41	37	60	24	42
28	Washington	8 - 3	25	15	15	31	15
29	Alabama	6 - 5	32	38	39	22	41
30	North Carolina State	7 - 4	40	35	41	27	34
31	Boston College	7 - 4	38	31	38	32	35
32	Arkansas	7 - 4	34	22	26	29	26
33	Texas A&M	7 - 4	27	33	28	34	28
34	Hawaii	9 - 3	44	34	32	30	31
35	Georgia Tech	7 - 5	35	30	45	43	36
36	Iowa State	7 - 4	28	43	36	41	33
37	Michigan State	6 - 5	46	47	57	33	51
38	North Carolina	7 - 5	29	40	34	36	32
39	Indiana	5 - 6	49	41	61	35	53
40	Iowa	6 - 5	33	57	47	39	45

Table 5 (continued)
Ranking using Regression 9 in Table 1
Last Week of 2001 (before Bowl Games)

		REC	SAG	BIL	COL	DUN	BCS
		.248	.373	.170	-.352	.301	
41	Louisville	10 - 2	31	26	22	63	27
42	Clemson	6 - 5	48	32	50	46	46
43	Notre Dame	5 - 6	42	50	53	40	43
44	Oklahoma State	4 - 7	56	39	74	45	59
45	Pittsburgh	6 - 5	55	48	55	38	57
46	Penn State	5 - 6	43	54	48	37	47
47	Boise State	8 - 4	45	59	43	48	49
48	Bowling Green State	8 - 3	47	46	35	53	50
49	Marshall	10 - 2	36	52	24	62	30
50	Central Florida	6 - 5	67	73	73	42	78
51	Utah	7 - 4	37	65	42	57	44
52	Minnesota	4 - 7	69	62	85	44	71
53	East Carolina	6 - 5	60	70	66	50	63
54	Virginia	5 - 7	66	51	71	47	62
55	New Mexico	6 - 5	65	68	69	51	69
56	Purdue	6 - 5	50	53	44	49	48
57	Auburn	7 - 4	39	28	23	61	24
58	Wake Forest	6 - 5	57	49	56	59	55
59	Wisconsin	5 - 7	52	66	65	55	56
60	Arizona	5 - 6	61	56	63	52	58
61	Colorado State	6 - 5	53	55	49	56	52
62	Southern Mississippi	6 - 5	62	69	68	60	70
63	Mississippi	7 - 4	51	42	40	66	38
64	Toledo	9 - 2	58	44	33	70	37
65	UNLV	4 - 7	73	72	89	64	79
66	South Florida	8 - 3	74	81	64	67	75
67	Arizona State	4 - 7	59	74	70	65	60
68	TCU	6 - 5	72	45	59	71	76
69	Louisiana Tech	7 - 4	54	58	46	80	54
70	Cincinnati	7 - 4	79	63	62	68	77
71	UAB	6 - 5	78	71	77	74	83
72	Middle Tenn State	8 - 3	71	64	51	77	67
73	Mississippi State	3 - 8	70	75	76	58	68
74	Northwestern	4 - 7	68	76	80	76	73
75	Missouri	4 - 7	64	80	75	78	64
76	Air Force	6 - 6	82	60	79	85	80
77	Troy State	7 - 4	76	61	58	84	65
78	Memphis	5 - 6	86	79	82	73	86
79	Miami (Ohio)	7 - 5	63	90	52	75	61
80	N Illinois	6 - 5	77	82	67	81	74

Table 5 (continued)
Ranking using Regression 9 in Table 1
Last Week of 2001 (before Bowl Games)

		REC .248	SAG .373	BIL .170	COL -.352	DUN .301	BCS
81	Kent	6 - 5	81	88	72	79	81
82	Kentucky	2 - 9	80	85	90	69	82
83	West Virginia	3 - 8	84	84	88	72	84
84	Temple	4 - 7	91	67	84	83	88
85	San Diego State	3 - 8	90	87	99	82	91
86	North Texas	5 - 6	87	95	86	86	94
87	Rice	8 - 4	75	92	54	93	66
88	Utah State	4 - 7	94	78	94	96	95
89	Baylor	3 - 8	89	86	92	87	85
90	Southern Methodist	4 - 7	88	94	87	88	90
91	Western Michigan	5 - 6	85	97	81	92	87
92	Kansas	3 - 8	83	77	83	91	72
93	Akron	4 - 7	93	91	93	94	96
94	Ball State	5 - 6	92	93	78	90	92
95	San Jose State	3 - 9	95	101	97	95	97
96	New Mexico State	5 - 7	99	96	91	102	99
97	Vanderbilt	2 - 9	98	83	98	97	98
98	Tulane	3 - 9	101	98	100	98	100
99	California	1 -10	97	89	96	89	89
100	Nevada	3 - 8	96	105	95	99	93
101	Wyoming	2 - 9	100	100	108	104	101
102	Buffalo	3 - 8	105	103	106	103	107
103	Central Michigan	3 - 8	102	112	103	100	102
104	Army	3 - 8	104	104	102	101	103
105	Louisiana–Lafayette	3 - 8	107	106	111	108	109
106	Ohio	1 -10	103	114	109	105	105
107	Duke	0 -11	106	99	112	106	106
108	Texas–El Paso	2 - 9	108	111	110	114	108
109	Tulsa	1 -10	111	107	116	113	110
110	Eastern Michigan	2 - 9	116	116	115	111	117
111	Houston	0 -11	109	108	114	107	113
112	Connecticut	2 - 9	112	109	107	116	112
113	Rutgers	2 - 9	113	102	101	112	104
114	Louisiana–Monroe	2 - 9	110	113	105	115	111
115	Idaho	1 -10	114	115	113	110	114
116	Navy	0 -10	115	110	117	109	115
117	Arkansas State	2 - 9	117	117	104	117	116

regression's rankings since it has the largest weight.

If the combined regression were used on a week to week basis, observations for the previous week could be added and the equation reestimated before the predictions and new ranking were made. This would add about 50 observations per week. Also, as time goes on the ranking systems not included could be added to the regression to see if the extra observations have improved the ability of the regression to pick out more systems with independent information.

6 Conclusion

This paper has shown that there is independent predictive information in a number of the computer football ranking systems and in simply the win-loss records themselves. A fairly precise estimate of the size of the home field advantage has been obtained, which is about 8 percentage points for the percentage point spread. Because there is independent information in more than one system's prediction variable, a combined system using estimated weights is on average more accurate than any individual system. The combined system could be used to make real time predictions and to produce a ranking. As noted in the introduction, an interesting question for future research is how the combined system compares to the Las Vegas odds in terms of predictive accuracy.

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