College Football Rankings and Market Efficiency

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The results in this article show that various college football ranking systems have useful independent information for predicting the outcomes of games. 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. These results may be of interest to the Bowl Championship Series in choosing which teams to play in the national championship game. The results also show, however, that none of the systems, including the optimal combination, contains any useful information that is not in the final Las Vegas point spread. It is argued that this is a fairly strong test of the efficiency of the college football betting market.

Keywords: *football rankings; market efficiency*

There are a number of tests in the literature of the efficiency of sports betting markets. The first study was that of Pankoff (1968), who tested the efficiency of the football betting market. Studies that have followed include those of Zuber, Gandar, and Bowers (1985); Sauer, Brajer, Ferris, and Marr (1988); Gandar, Zuber, O'Brien, and Russo (1988); Camerer (1989); Golec and Tamarkin (1991); Brown and Sauer (1993); Woodland and Woodland (1994); Dare and MacDonald (1996); Gray and Gray (1997); Gandar, Dare, Brown, and Zuber (1998); Avery and Chevalier (1999); and Dare and Holland (2004). One type of test is to regress the actual point spread on a constant and the betting spread and to test the null hypothesis that the constant is 0 and the coefficient of the betting spread is 1. This tests for the unbiasedness of the betting spread. Another type of test is to add other variables to the regression, such as relative measures of the two teams' past performances, and

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to test the null hypothesis that the coefficients of these measures are 0. (This can be done either with or without the coefficient of the betting spread constrained to be 1.) A third type of test is to examine various betting rules, such as always betting for or against the favorite or for or against the home team, and to see if any of the rules make money after commission charges.

The overall evidence is somewhat mixed, but it generally does not reject the hypothesis of market efficiency. The hypothesis of unbiasedness is almost never rejected, and relative past performance measures are generally not significant in regressions with the betting spread included. In some cases, however, betting rules appear to be profitable, although if they are profitable, they are usually barely so. Avery and Chevalier (1999) examined the predictions of experts. They did not run regressions but simply compared how various experts did against the betting spread in the professional football market. Their results show (their Table 2, p. 506) that none of the experts did better than random relative to the betting spread, which is consistent with the hypothesis of market efficiency. In a recent article, Dare and Holland (2004), correcting some previous specifications in the literature, find slight bias favoring the home underdog in the National Football League betting market but probably not large enough to be exploited.

This article first shows that various college football ranking systems have useful independent predictive 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. For 1,582 college football games between 1998 and 2001, the optimal system explains 38.2% of the actual point spread variance and predicts 72.9% of the games correctly with respect to the winner. This analysis also produces a fairly precise estimate of the home-field advantage, which is 4.30 points, with an estimated standard error of 0.43 points.

A test of the efficiency of the college football betting market is to add the betting spread to the optimal-system regression. This is a fairly strong test, in that the regression uses information from a number of computer ranking systems, some of it independent information. It will be seen that when the betting spread is added to this regression, all the other variables lose their significance, both individually and jointly, including the home-field advantage variable. In other words, the betting spread completely dominates. There is no information in any of the predictions using the computer rankings that is not in the betting spread. The hypothesis of market efficiency is thus not rejected by what seems to be a fairly strong test. Using the betting spread, 44.5% of the actual point spread variance is explained, and 74.7% of the games are predicted correctly with respect to winner.

THE COLLEGE FOOTBALL RANKING SYSTEMS

Each week during a college football season, there are many rankings of the Division I-A teams. Some rankings are based on the votes of sports writers, and some are based on computer algorithms. The computer algorithms take into account

TABLE 1: Correlation Coefficients Using 1,582 Observations

	MAT	*SAG*	*BIL*	*COL*	*MAS*	*DUN*
SAG	.973					
BIL	.910	.905				
COL	.945	.917	.866			
MAS	.969	.973	.917	.940		
DUN	.915	.920	.910	.844	.924	
REC	.863	.836	.799	.928	.870	.779

NOTE: MAT = Matthews/Scripps Howard; SAG = Jeff Sagarin's *USA Today*; BIL = Richard Billingsley; COL = *Atlanta Journal-Constitution* ColleyMatrix; MAS = Kenneth Massey; DUN = Dunkel; REC = win-loss record.

things such as 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 by the National Collegiate Athletic Association (NCAA) and the Bowl Championship Series (BCS) to determine which two teams play in the national championship game. This article compares nine computer ranking systems. The rankings are first converted into predictions, and then the predictions are compared.

The nine ranking systems are (a) Matthews/Scripps Howard (MAT), (b) Jeff Sagarin's *USA Today* (SAG), (c) Richard Billingsley (BIL), (d) *Seattle Times*/Anderson & Hester (SEA), (e) *Atlanta Journal-Constitution* ColleyMatrix (COL), (f) Kenneth Massey (MAS), (g) David Rothman (RTH), (h) Peter Wolfe (WOL), and (i) Dunkel (DUN). The first eight of these systems were used by the BCS in the 2001-2002 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. In 2002, the NCAA decided that any system that included margin of victory in its algorithm would be dropped for the upcoming 2002-2003 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 article. It is shown in Table 1 that the prediction variables derived from the different ranking systems are highly correlated, which is expected given that win-loss records play a large role in each system.

An extensive bibliography on college football ranking systems is available on David Wilson's (n.d.) Web site. There does not appear to be in the sports literature a comparison of rankings such as that done here. Much of the literature is concerned with developing models or algorithms for predicting games or ranking teams. For example, an interesting recent model for National Football League scores is in Glickman and Stern (1998). The analysis here instead takes rankings that already exist and asks if the rankings have independent information. In this sense, this article requires no knowledge of football; it is evaluating other people's knowledge.

THE DATA AND CREATION OF THE PREDICTION VARIABLES

There were 117 Division I-A teams in 2001. These teams are listed in Table A1 in the appendix. 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 $Y_{(i,j)}$ denote the actual point spread (the score for team i minus the score for team j). Regarding the home team, let $H_{(i,j)}$ equal 1 if i is the home team, –1 if j is the home team, and 0 if neither team is at home (as in bowl games).

The systems do not predict games; they simply rank teams. We use a system's rankings for the week to create what is called a "prediction variable" for each game for the week for that system. This variable, denoted $Q_{(i,j)k}$, where k denotes the system, is simply the difference in the rankings: $-(R_{ik} - R_{jk})$. For the system that uses only win-loss records (REC), the prediction variable is taken to be (in percentage points) the percentage to date of games won by i minus the percentage won by j: $Q_{(i,j)\text{REC}} = 100\{[\text{WIN}_i / (\text{WIN}_i + \text{LOSS}_i)] - [\text{WIN}_j / (\text{WIN}_j + \text{LOSS}_j)]\}$, where WIN denotes the number of games won to date, and LOSS denotes the number of games lost. We thus have one prediction variable per system. It is important to note that 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 4 years—1998, 1999, 2000, and 2001—and for 10 weeks per year beginning with Week 6 (1998 is the 1st year of the BCS). This resulted in a total of 1,588 games. For 2000, there were 115 Division I-A teams; for 1999, there were 114; and for 1998, there were 112. 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 (2005) site.[1] The rankings for COL were obtained from Colley (2005). The scores and home-field information for the 1998 and 1999 seasons were obtained from Howell (2002), and the scores and home-field information for the 2000 and 2001 seasons were obtained from SportsLine.com (2005).

THE TEST

The comparison of the predictions uses the test in Fair and Shiller (1990) (FS). This test was developed in the context of evaluating different forecasts from econometric models. It is related to the literature on encompassing tests (see, e.g., Davidson & MacKinnon, 1981; Hendry & Richard, 1982) and the literature on the optimal combination of forecasts (see Granger & Newbold, 1986). 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. The specific differences between this test and related tests in the literature are discussed in FS, and this discussion is not repeated here.

In the present context, $Y_{(i,j)}$ 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. We are not including a constant term in the regression, contrary to the usual FS use. In constructing the variables, it is arbitrary which team is i and which is j, and so including a constant term is not appropriate. If a constant term were added, this would be saying that other things being equal, $Y_{(i,j)}$ equals a constant. But any value of the constant other than 0 would make no sense given that the choice of which team is i and which is j is arbitrary.

COMPARISON RESULTS

As noted in "The College Football Ranking Systems" above, data on 1,588 games were collected for the period from 1998 to 2001. All observations were available for the systems MAT, SAG, COL, MAS, and DUN. (All observations are also available for REC, which uses only 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 1,582 observations to be used. Table 1 first shows the correlation of the seven prediction variables for which 1,582 observations were available. As expected, the correlation coefficients are quite high, ranging from .779 to .973.

The main results are in Table 2, in which nine regressions are reported. 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. 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 SAG, with 16.71. The next best is DUN, with 16.73. The worst is REC, with 17.71, and the second worst is COL, with 17.52. When all seven systems are included (Regression 8 in Table 2), the standard error falls to 16.46. Five of the seven prediction variables are significant at the 5% confidence level for a

TABLE 2: Regressions Using 1,582 Observations

	H	*MAT*	*SAG*	*BIL*	*COL*	*MAS*	*DUN*	*REC*	SE	R^2	*% Correct*
1	4.52	.314							16.95	.343	0.707
	(10.26)	(27.72)									
2	4.13		.320						16.71	.361	0.719
	(9.50)		(28.94)								
3	4.44			.344					16.97	.341	0.710
	(10.06)			(27.62)							
4	4.62				.273				17.52	.298	0.693
	(10.14)				(24.87)						
5	4.21					.315			16.80	.355	0.721
	(9.63)					(28.49)					
6	4.70						.324		16.73	.360	0.707
	(10.80)						(28.81)				
7	4.69							.313	17.71	.283	0.691
	(10.18)							(23.90)			
8	4.24	–.050	.217	.073	–.166	.051	.117	.127	16.46	.382	0.729
	(9.75)	(–0.79)	(3.66)	(2.09)	(–3.53)	(0.82)	(3.29)	(3.72)			
9	4.30		.217	.075	–.171		.119	.132	16.46	.382	0.729
	(9.93)		(5.38)	(2.17)	(–4.25)		(3.53)	(3.89)			

NOTE: Left-hand-side variable is $Y_{(i,j)}$. Right-hand-side variables are $H_{(i,j)}$ and $Q_{(i,j)k}$. Estimation technique: ordinary least squares. Figures in parentheses are *t* statistics. MAT = Matthews/Scripps Howard; SAG = Jeff Sagarin's *USA Today*; BIL = Richard Billingsley; COL = *Atlanta Journal-Constitution* ColleyMatrix; MAS = Kenneth Massey; DUN = Dunkel; REC = win-loss record.

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 two decimal places.

Focusing on Regression 9, the coefficient estimate for COL is negative (–.171), with a *t* statistic of –4.25. COL thus contributes significantly to the explanation of $Y_{(i,j)}$, but with a negative weight. COL is thus estimated to have independent information, whereby 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 added value given the other rankings.

The home-field advantage variable is highly significant in Table 2, with a coefficient between about 4.1 and 4.7. The mean total point score across all 1,582 games is 52, and so in percentage terms, the home-field advantage is about 8%. This estimated advantage is considerably larger than the estimate of 4.68 points of Harville and Smith (1994) for college basketball games, because the mean total point score for college basketball games is much larger than 52.

The regressions in Table 2 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, it is not. The last column in Table 2 presents for each regression the percentage of the games predicted correctly as to the winner. The range is from 69.1% for REC alone to 72.9% for Regressions 8 and 9. Although this percentage 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.

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. The second regression in Table 3 excludes MAT and MAS, and it is still the case in this regression that COL is not significant. The measures of fit (*SE*, R^2, and percentage correct) in Table 3 are not directly comparable with those in Table 2 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 10 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. The second regression in

TABLE 3: Regressions Using 1,479 Observations

	H	*MAT*	*SAG*	*BIL*	*COL*	*MAS*	*DUN*	*REC*	*SEA*	SE	R^2	*% Correct*
1	4.43	–.035	.268	.074	–.079	.048	.102	.174	–.181	16.46	.385	0.725
	(9.82)	(–0.48)	(4.16)	(2.04)	(–1.27)	(0.70)	(2.73)	(4.65)	(–2.55)			
2	4.46		.275	.076	–.078		.106	.179	–.182	16.45	.385	0.723
	(9.95)		(6.16)	(2.10)	(–1.28)		(2.98)	(4.86)	(–2.76)			

NOTE: Left-hand-side variable is $Y_{(i,j)}$. Right-hand-side variables are $H_{(i,j)}$ and $Q_{(i,j)k}$. Estimation technique: ordinary least squares. Figures in parentheses are *t* statistics. MAT = Matthews/Scripps Howard; SAG = Jeff Sagarin's *USA Today*; BIL = Richard Billingsley; COL = *Atlanta Journal-Constitution* ColleyMatrix; MAS = Kenneth Massey; DUN = Dunkel; REC = win-loss record; SEA = *Seattle Times*/Anderson & Hester.

TABLE 4: Regressions Using 1,040 Observations

	H	*MAT*	*SAG*	*BIL*	*COL*	*MAS*	*DUN*	*REC*	*SEA*	*RTH*	*WOL*	SE	R^2	*% Correct*
1	4.79	–.086	.468	.101	–.196	–.130	.135	.244	–.093	–.170	.121	16.86	.376	0.717
	(8.62)	(–0.80)	(4.93)	(2.28)	(–2.47)	(–1.20)	(3.01)	(4.56)	(–0.93)	(–1.97)	(1.11)			
2	4.76		.391	.100	–.188		.113	.217	–.065	–.183		16.86	.374	0.716
	(8.60)		(5.53)	(2.26)	(–2.42)		(2.67)	(4.33)	(–0.74)	(–2.36)				

NOTE: Left-hand-side variable is $Y_{(i,j)}$. Right-hand-side variables are $H_{(i,j)}$ and $Q_{(i,j)k}$. Estimation technique: ordinary least squares. Figures in parentheses are *t* statistics. MAT = Matthews/Scripps Howard; SAG = Jeff Sagarin's *USA Today*; BIL = Richard Billingsley; COL = *Atlanta Journal-Constitution* ColleyMatrix; MAS = Kenneth Massey; DUN = Dunkel; REC = win-loss record; SEA = *Seattle Times*/Anderson & Hester; RTH = David Rothman; WOL = Peter Wolfe.

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 added, RTH, has a negative coefficient estimate.

The main conclusions to be drawn from Tables 2, 3, and 4 are the following: (a) MAT and MAS appear to contain no useful independent information. This is also true of WOL, although this result is based on fewer observations. (b) 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. (c) SAG, DUN, and REC do very well. Their significance is robust across the various regressions. It is interesting that REC does so well, considering that it is based only on win-loss records. It does not do well by itself (see Table 2), but in the results, 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. (d) The estimate of the home-field advantage is always fairly precise and hovers between about 4.1 and 4.8 points.

Robustness Checks

The results in Tables 2 to 4 are not sensitive to the following choices of variables. The same conclusions are reached if (a) $Y_{(i,j)}$ is replaced with $Y_{(i,j)}$ divided by the total points scored in a game; (b) $Y_{(i,j)}$ is replaced by $W_{(i,j)} - 0.5$, where $W_{(i,j)}$ is 1 if team i won and 0 if team j won; and (c) $Q_{(i,j)}$ is replaced with $Q_{(i,j)}$ divided by the total number of Division I-A teams in the year (either 117, 115, 114, or 112). In other words, the results are robust to normalizing $Y_{(i,j)}$ to lie between –1 and 1 and to normalizing $Q_{(i,j)}$ to lie between –1 and 1. They are also robust to using the simple win-loss variable.

Regarding the use of $Y_{(i,j)}$ versus the win-loss variable, the more interesting variable would appear to be $Y_{(i,j)}$, because it has more information in it. If, say, teams i and j are playing, and one system has i ranked 10th and j ranked 40th and another system has i ranked 12th and j ranked 20th, 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. It turns out, however, as just noted, that the conclusions are not sensitive to which variable is used.

USE OF THE COMBINED REGRESSION

Because, as Table 1 shows, the prediction variables are highly correlated with one another, 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 take the ninth regression in Table 2 as the combined regression of choice, because it is based on the most observations. The main reservation about this choice is whether one should drop 104 observations and replace COL with SEA.

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 (732 observations) are the same as those for 2000 and 2001 (850 observations). Using the ninth equation in Table 2, $F(6, 1{,}570) = 2.25$. The 5% critical value is 3.67, and so the hypothesis of stability is not rejected at the 5% level. The stability test is thus supportive of the equation.

Regression 9 in Table 2 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 point spread better than any individual system. (Remember that all regressions are using the information in the home-field advantage variable.)

The combined regression can be used to create a ranking of all the teams. This is done as follows. Use the coefficients in equation 9 in Table 2 except the coefficient of the home-field advantage variable to compute V_i for each team i, where

$$V_i = -.217R_{i\text{SAG}} - .075R_{i\text{BIL}} + .171R_{i\text{COL}} - .119R_{i\text{DUN}}$$
$$- .132 \times 100[\text{WIN}_i / (\text{WIN}_i + \text{LOSS}_i)].$$

Then rank the teams by the size of V_i. This ranking ensures that in one-on-one matchups on a neutral playing field, equation 9 predicts that no team would lose to a team ranked below it.

As an example, this was done for the last week of 2001 (before the bowl games), and the ranking is presented in Table A1 in the appendix. Also presented in Table A1 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 A1 than it otherwise would be, because COL ranked it fairly low. Overall, SAG has the most influence on the regression's rankings because it has the largest weight.

Rankings based on combined regressions such as Regression 9 are candidates for the BCS to use in its decision-making process. These regressions use in an optimal way information in all the ranking systems. Even though multicollinearity is high among the prediction variables, Regression 9 shows that the variables do contain independent information.

TABLE 5: Regression 9 in Table 2 With Betting Spread (*LV*) Added

LV	H	*SAG*	*BIL*	*COL*	*DUN*	*REC*	SE	R^2	*% Correct*
1.030	0.77	.051	−.017	−.065	−.030	.055	15.60	.445	0.747
(13.37)	(1.57)	(1.27)	(−0.51)	(−1.67)	(−0.88)	(1.70)			

NOTE: Estimation technique: ordinary least squares. Figures in parentheses are t statistics. Test of hypothesis that all coefficients except that of *LV* are zero: $F(6, 1{,}576) = 0.96$. SAG = Jeff Sagarin's *USA Today*; BIL = Richard Billingsley; COL = *Atlanta Journal-Constitution* ColleyMatrix; DUN = Dunkel; REC = win-loss record.

A TEST OF MARKET EFFICIENCY

A test of the efficiency of the college football betting market is to add the betting spread to Regression 9 in Table 2. Data for the 1,582 games on the final Las Vegas line point spread (denoted *LV*) were obtained from The Gold Sheet (2005). The results of adding *LV* to Regression 9 are presented in Table 5.

None of the coefficient estimates in Table 5 is significant except that of *LV*. For the test of the hypothesis that all the coefficients except that of *LV* are 0, $F(6, 1{,}576) = 0.96$. The 5% critical value is 2.10, and so the hypothesis is not rejected. The coefficient estimate of *LV* is 1.030, with an estimated standard error of 0.077 ($t = 13.37$), and so it is not significantly different from 1. Although not shown in Table 5, *LV* was added to each of the other regressions in Table 2, and in each of these cases, its coefficient estimate was not significantly different from 1, and all the other coefficient estimates were insignificant, both individually and jointly.

The hypothesis that the college football betting market is efficient is thus not even close to being rejected by what would appear to be a fairly strong test. No computer ranking system or combination of systems has any useful predictive information not in the final Las Vegas point spread.

CONCLUSION

This article 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 4.3 points. 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 can be used to rank the teams, and this ranking might be of interest to the BCS in its decision-making process.

On the other hand, there is no information in the ranking systems that is not in the final Las Vegas betting spread, and there is information in the betting spread that is not in the ranking systems. The hypothesis of market efficiency is not close to being rejected.

APPENDIX

TABLE A1: Ranking Using Regression 9 in Table 2: Last Week of 2001 (before bowl games)

Rank	*School*	*REC (.132)*	*SAG (.217)*	*BIL (.075)*	*COL (–.171)*	*DUN (.119)*	*BCS*
1	Miami (Florida)	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	Stanford	9-2	9	11	7	23	9
13	Texas Tech	7-4	19	24	29	9	29
14	Virginia Tech	8-3	24	18	27	11	21
15	Louisiana State University	9-3	18	14	13	8	13
16	Kansas State	6-5	14	36	30	7	39
17	Florida State	7-4	16	21	25	16	22
18	Fresno State	11-2	15	29	14	25	19
19	Georgia	8-3	22	17	20	17	18
20	Syracuse	9-3	20	16	16	19	17
21	Michigan	8-3	17	23	18	21	16
22	Southern California	6-5	26	25	37	12	40
23	Ohio State	7-4	30	20	31	14	25
24	University of California, Los Angeles	7-4	13	27	21	28	23
25	South Carolina	8-3	23	19	19	26	14
26	Brigham Young	12-1	21	13	17	54	20
27	Washington	8-3	25	15	15	31	15
28	Oregon State	5-6	41	37	60	24	42
29	Alabama	6-5	32	38	39	22	41
30	North Carolina State	7-4	40	35	41	27	34
31	Texas A&M	7-4	27	33	28	34	28
32	Boston College	7-4	38	31	38	32	35
33	Georgia Tech	7-5	35	30	45	43	36
34	Iowa State	7-4	28	43	36	41	33
35	Arkansas	7-4	34	22	26	29	26
36	North Carolina	7-5	29	40	34	36	32
37	Hawaii	9-3	44	34	32	30	31
38	Michigan State	6-5	46	47	57	33	51
39	Iowa	6-5	33	57	47	39	45
40	Indiana	5-6	49	41	61	35	53

(continued)

APPENDIX TABLE A1 (continued)

Rank	*School*	*REC (.132)*	*SAG (.217)*	*BIL (.075)*	*COL (–.171)*	*DUN (.119)*	*BCS*
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	Marshall	10-2	36	52	24	62	30
49	Utah	7-4	37	65	42	57	44
50	Bowling Green State	8-3	47	46	35	53	50
51	Central Florida	6-5	67	73	73	42	78
52	Minnesota	4-7	69	62	85	44	71
53	Auburn	7-4	39	28	23	61	24
54	East Carolina	6-5	60	70	66	50	63
55	Purdue	6-5	50	53	44	49	48
56	Virginia	5-7	66	51	71	47	62
57	Wisconsin	5-7	52	66	65	55	56
58	New Mexico	6-5	65	68	69	51	69
59	Wake Forest	6-5	57	49	56	59	55
60	Colorado State	6-5	53	55	49	56	52
61	Mississippi	7-4	51	42	40	66	38
62	Arizona	5-6	61	56	63	52	58
63	Southern Mississippi	6-5	62	69	68	60	70
64	Toledo	9-2	58	44	33	70	37
65	University of Nevada, Las Vegas	4-7	73	72	89	64	79
66	Arizona State	4-7	59	74	70	65	60
67	Louisiana Tech	7-4	54	58	46	80	54
68	South Florida	8-3	74	81	64	67	75
69	Texas Christian University	6-5	72	45	59	71	76
70	University of Alabama at Birmingham	6-5	78	71	77	74	83
71	Cincinnati	7-4	79	63	62	68	77
72	Northwestern	4-7	68	76	80	76	73
73	Middle Tennessee State	8-3	71	64	51	77	67
74	Mississippi State	3-8	70	75	76	58	68
75	Missouri	4-7	64	80	75	78	64
76	Air Force	6-6	82	60	79	85	80
77	Miami (Ohio)	7-5	63	90	52	75	61
78	Troy State	7-4	76	61	58	84	65
79	Memphis	5-6	86	79	82	73	86
80	Northern Illinois	6-5	77	82	67	81	74
81	Kent	6-5	81	88	72	79	81
82	Kentucky	2-9	80	85	90	69	82

(continued)

APPENDIX TABLE A1 (continued)

Rank	School	*REC (.132)*	*SAG (.217)*	*BIL (.075)*	*COL (–.171)*	*DUN (.119)*	*BCS*
83	West Virginia	3-8	84	84	88	72	84
84	San Diego State	3-8	90	87	99	82	91
85	Temple	4-7	91	67	84	83	88
86	North Texas	5-6	87	95	86	86	94
87	Rice	8-4	75	92	54	93	66
88	Baylor	3-8	89	86	92	87	85
89	Utah State	4-7	94	78	94	96	95
90	Western Michigan	5-6	85	97	81	92	87
91	Kansas	3-8	83	77	83	91	72
92	Southern Methodist	4-7	88	94	87	88	90
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	Nevada	3-8	96	105	95	99	93
100	California	1-10	97	89	96	89	89
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	Houston	0-11	109	108	114	107	113
111	Eastern Michigan	2-9	116	116	115	111	117
112	Connecticut	2-9	112	109	107	116	112
113	Louisiana-Monroe	2-9	110	113	105	115	111
114	Rutgers	2-9	113	102	101	112	104
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

NOTE: REC = win-loss record; SAG = Jeff Sagarin's *USA Today*; BIL = Richard Billingsley; COL = *Atlanta Journal-Constitution* ColleyMatrix; DUN = Dunkel; BCS = Bowl Championship Series.

NOTE

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 e-mail.

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