The Glitch That Stole Christmas From The Pac-10

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ABSTRACT

The Bowl Championship Series (BCS) employs a multi-criteria decision model (MCDM) to determine eligibility to play in the most elite college football bowls at the end of the season. MCDM's are widely used in business and government to make important decisions, including those with tremendous financial impacts. The BCS college bowls have the biggest payouts involving several million dollars. This year, the PAC-10 could have been the first football conference to place two teams in the BCS bowl. What a Merry Christmas that would have been! The payout would have been $2.75 million or $275 thousand per team. Unfortunately, due to the use of a faulty MCDM that distorts the relationship between those football programs considered, a glitch in the BCS formula stole the Rose Bowl prestige and the money from the PAC-10 during the Christmas holidays. Using appropriate multipliers, the economic impact in PAC-10 communities could have been very significant. The implication for future competition through enhanced athletic facilities, for example, could have a sustained economic impact for several years in those communities. It will be demonstrated in this paper that had the BCS employed a valid and consistent algorithm for determining a final score, even with the BCS's own data, the University of California would have a higher score than the University of Texas and the PAC-10 would have benefited by $2.75 Million, and they would have a much merrier Christmas than they had from playing in the Holiday Bowl.

"The BCS Stole My Lunchbox"-*Detroit Free Press,* December 9, 2004

INTRODUCTION

Multi-criteria decision models (MCDMs) have been used many times in the attempt to capture the impact of several criteria on a decision outcome (Nagel, 1984; Nagel, 1985; and Nagel, 1987) The purpose of this paper is to demonstrate how the misuse of measurement for developing an MCDM index can result in an inaccurate answer, which can have serious impacts and implications for those involved (Teasley, 1989). This paper will focus on the Bowl Championship Series (BCS) as just one example of how this problem occurs in everyday life. Other examples involve decisions about personnel selection or promotion, site selection (Teasley, 1994), purchasing (Teasley and Harrell, 1996), or the rating of cities, hospitals (Teasley, 1996), universities (Teasley, 1995), political campaign choices (Teasley, 1991), and etc.. with regard to their comparative quality. MCDMs are frequently employed to make decisions where the use of one simple criterion is insufficient. The use of two or more criteria, however, typically requires the index maker to generate a common denominator in order for all the scores or measures to be combined accurately into one summative score. They are often tempted, as with the BCS, to reduce scores to ranks and then to tally the ranks. While this is a simple solution, it often distorts the results. This "Glitch" or error in the formula or algorithm was the final nail in the fifth place coffin for the University of California and wound up "stealing" or costing the PAC-10 conference $2.75 million that should have been split equally between the ten conference teams. It cost those ten communities $275,000 each in direct economic impact and more in indirect effects often measured by multipliers. Moreover, it might mean that conference schools may have a diminished probability of BCS Bowl representation in the future, thus compounding any current direct and indirect benefits that might be calculated.

In this paper, we will demonstrate a simple solution that renders accurate results every time. In doing so, we will even accept as valid all the data used by the BCS from poll results and the various computer-generated scores as indications of the "power" of each team.

"THE BCS BECOMES THE SOPRANOS OF COLLEGE FOOTBALL,"—*ASSOCIATED PRESS*, DECEMBER 6, 2004: BOWLS AND THE BCS: A VERY BRIEF HISTORICAL REVIEW

Before the BCS, there were various major and minor bowls where football teams could be invited to play at the end of their season as a "reward" for their good performance. The major bowls had aligned themselves with major conferences so that the Rose Bowl always featured the best of the PAC-10 and the Big 10, the Orange Bowl took the champion of the Big 12, while the Sugar Bowl invited the Southeastern Conference champion as its home team representative. What that often meant was that the top two or three teams never played each other at the end in the bowl games. This year, for example, under the previous arrangement, USC would have played in the Rose Bowl, Oklahoma in the Orange and Auburn in the Sugar. Then, the polls would vote on the "popularity" ranking of the teams based on how they looked in their respective bowl games. The same thing would have happened last year, except LSU (the eventual BCS champion) was the SEC representative.

What the BCS accomplishes is the head-to-head competition between the "top" two teams. This works well when there is not a third team capable of claiming to be number one or, especially, number two. Last year it was USC and this year it is an undefeated Auburn team. Both were probably given less credit because of weaker schedules in those respective years. In any event, two of the top three teams did play each other, while that would not happen under the prior bowl arrangement.

"BCS IS A MASTER OF DISASTER,"--*KNOXVILLE NEWS,* DECEMBER 9, 2004: HOW THE BCS EVOLVED.

The BCS was first established in 1998, when Commissioner Roy Kramer of the SEC and other conferences designed a system to invite two teams to play for the national championship in one bowl game. It was designed to maintain good relations with the bowls and their relatively large payouts to the college teams and with their respective conferences. This year, payouts for the BCS bowls are over fourteen million dollar range for each school that plays in one of them. One should surmise that the Kramer group was not trained in MCDMs or index development and that they wished for the foundation of their measurement system to be the long standing polls of sports writers and football coaches that began with the Associated Press Poll in 1936. But, there were questions about the validity of those polls, and those validity questions might exacerbate if some of those polled were biased. This year, for example, Coach Mack Brown of Texas apparently lobbied for votes for his team and four coaches ranked the University of California (the fourth ranked team) at number seven, two ranked them number eight, perhaps as a result of that lobbying, but the actual votes are not made public. One reason that Texas passed California in the BCS is that the difference between those two teams lessened in the final coaches poll.

Those polls issued ranks, and so the Kramer group wanted other scores that could be within a similar range as 1 to 10, etc. It added a compilation of computer scores which were ranked and added together for a final rank, a strength of schedule score, which was also ranked, the number of losses during the season (which in the top 10 teams is usually between 0 and 2), and a bonus for defeating teams in the top 15. The major point to keep in mind was that if you did not want the screwiest looking ranking system—one invalid on its face—and you started with ranked data (e.g., from 1 to 10), then the other elements of the MCDM would need to "look like" ranks to give the appearance of a common denominator. And, that is the problem. This year's BCS formula is simpler and also more accurate that the previous BCS formulas. It only uses the two major polls and the composite computer score (an MCDM in itself). Since the computer scores utilize different scoring schemes they yield very different looking scores, e.g., from 334 to .838 for the number one team, the BCS reverted to its old way of using the resulting ranks to generate the final computer average outcome.

"ANOTHER YEAR, ANOTHER FORMULA THAT JUST DOESN'T ADD UP RIGHT,"--*KANSAS CITY STAR*, DECEMBER 6, 2004: HOW ONE PLUS ONE CAN EQUAL THREE—MEASUREMENT METHODS MADE TERRIBLY SIMPLE

There are four levels of measurement. In ascending order of accuracy, they are: nominal, ordinal, interval, and ratio. Focusing on ordinal and interval levels, they are as they imply. Ordinal level data are ranks, while interval level data are scores that specify the distance between two objects or teams. In a nutshell, if football teams are ranked from 1 to 10, we cannot know the distance between them. Is the number one team two, three or ten points better than the number two team, we cannot know from the mere ranked information. Power scores, on the other hand, like those generated by computers often have conversions so that a team with a score of 100 might be considered three points better than a team whose score was 97 (a similar conclusion could be derived if the teams were scored 1.00 to .97). Interval level data tell us both rank and distance. Following this logic, if one team were scored at .99 and the other at .98 then we would know there was very little difference, i.e., the interval was small, between those two teams. If you rounded those numbers the nearest whole and summed them, the result would be 1+1 = 2. On the other hand, if you converted those two numbers to ranks and added them, then 1+2 would equal 3. Based on the original scores, this is how a mathematical glitch could make 1 + 1 equal 3. What happens is the ranks spread and distort the difference between the two teams and their respective scores and this, in essence, was the glitch in the BCS algorithm that condemned California to the Holiday Bowl with its minor bowl payoff. For a team, like UC-Berkeley, which is trying to build its football program to compete big time, the effect may linger for years to come. Now, let's apply this measurement faux pax to the current reality.

"CAL'S DROP OUT OF THE BCS GAME IS COSTLY FOR PAC-10,"— *LOS ANGELES TIMES*, DECEMBER 7, 2004

When Texas nudged California out of the fourth BCS spot, Cal was moved from a spot in the Rose Bowl, which is typically represented by a PAC-10 team. Cal's fall was from a New Year's Day bowl to the Holiday Bowl. While there was a loss in prestige, there was also a significant drop in financial reward for the PAC-10. Typically, a BCS bowl pays over $14 million to the teams involved. Under the BCS rules, a second team from a major BCS conference needs to finish fourth to go to a BCS bowl. Since Southern Cal and Oklahoma played for a national championship in the Orange Bowl, the race between Texas and Cal for fourth would mean a BCS spot and considerable additional revenue.

Under BCS rules, a second team from a BCS conference in a BCS bowl does not receive the full $14 million, but a lower amount of about $4.5 million. Those amounts are split evenly within the conferences. So, on the surface, it would seem that the BCS decision cost the PAC-10 $450 thousand per team. Since team expenses are paid off the top before the split and since Cal went to another bowl with a much lower payout ($2 million), the actual total cost to the PAC-10 was $2.75 million, or $275,000 per team.

"BCS FUMBLES THE BALL AT THE GOAL LINE AGAIN,"— *NEW YORK POST*, DECEMBER 6, 2004: EXAMINING THE RESULTS FOR 2004 COMPARED WITH "PERCENTAGE" RESULTS

Table One reports the actual scores for the top ten BCS teams after the NCAA regular season ended. From that table, one can see the diversity of computer strength scores as well as the scores in the coaches and writers polls respectively. Looking at the coaches and writers polls the top team, Southern California, received scores of 1490 and 1599 respectively in those two polls. There were 61 college football coaches and 65 sports writers who participated in those two polls. For each voter, the first place team received 25 points, second place 24 points, etc. with teams getting no points from any voter getting a zero. If each coach had voted Southern Cal number one, then its score would have been 1525, and if each sportswriter had voted Southern Cal number one, the score would have been 1625—with the difference being the 100 points (i.e., 4*25) since there were four more voters. This is a more accurate and closer scoring of the top two teams (with ratios of 1490 to 1459 and 1599 to 1556) than the 2 to 1 ratios that the use of ranks would have generated.

Table One Actual Computer Strength Scores and Major Poll Scores

	Computer Strength Scores					I	Poll Scores	
Team	**Anderson**	**Billingsley**	**Colley**	**Massey**	**Sagrin**	**Wolfe**	**Coaches**	**Writers**
So. Cal	0.837	325.948	0.9917	2.606	100.08	8.571	1490	1599
Oklahoma	0.838	334.347	0.9895	2.566	97.24	8.971	1459	1556
Auburn	0.833	319.712	0.9796	2.403	92.06	8.224	1435	1525
Texas	0.798	297.992	0.9266	2.318	91.93	7.662	1281	1337
California	0.779	271.557	0.8814	2.406	95.32	7.493	1286	1399
Utah	0.804	278.160	0.8954	2.473	92.62	7.499	1215	1345
Georgia	0.738	276.381	0.8195	2.039	86.15	6.503	1117	1117
Va. Tech	0.724	268.165	0.8853	2.143	88.48	6.791	1037	1111
Boise St.	0.776	282.042	0.8715	2.085	90.86	7.145	943	960
Louisville	0.705	259.557	0.7868	2.240	88.54	6.525	1066	1183

Table Two calculates the "percentage" scores for the computer strength scores and the poll scores. The percentage scores are actually reported as rates—not percentages—but rates times 100 equals the percentage and it really does not matter much how they are reported as long as the intervals and ratios remain proportional. The "percentage" scores are calculated by dividing each score by the highest score for each computer poll or human poll. Hence, the highest percentage score for each criterion is 1.0 or equal to one hundred percent. Each of the other scores equals the relative proportion of the highest score in the category. By doing this, the appropriate intervals are maintained between the numbers.

Table Two Percentaged Scores from Raw Scores Derived by Dividing Each Score by the Highest Score

Team	**Anderson**	**Billingsley**	**Colley**	**Massey**	**Sagarin**	**Wolfe**	**Coaches**	**Writers**
So. Cal	0.9988	0.9749	1.0000	1.0000	1.0000	0.9554	1.0000	1.0000
Oklahoma	1.0000	1.0000	0.9978	0.9847	0.9716	1.0000	0.9792	0.9731
Auburn	0.9940	0.9562	0.9878	0.9221	0.9199	0.9167	0.9632	0.9538
Texas	0.9523	0.8913	0.9343	0.8895	0.9186	0.8541	0.8598	0.8362
California	0.9296	0.8122	0.8888	0.9233	0.9524	0.8352	0.8632	0.8749
Utah	0.9594	0.8320	0.9029	0.9490	0.9255	0.8359	0.8155	0.8412
Georgia	0.8807	0.8266	0.8263	0.7824	0.8608	0.7249	0.7497	0.6986
Va. Tech	0.8640	0.8021	0.8927	0.8223	0.8841	0.7570	0.6960	0.6948
Boise St.	0.9260	0.8436	0.8787	0.8001	0.9079	0.7965	0.6330	0.6004
Louisville	0.8413	0.7763	0.7934	0.8596	0.8847	0.7273	0.7155	0.7398

Table Three shows what happens if the intervals are maintained and not distorted by first converting interval scores to ranks. The coefficient of determination (r-square) equals the relative proportion of variance accounted for by the two variables or indicators. An r-square of 1.0 means that there is perfect correlation between the two variables. If five teams—for example, a,b,c,d, and e were scored on two measures x and y, which had the following distributions respectively, 1,2,3,4,5 and 6,7,8,9,10, the coefficient of determination would be 1.0, indicating perfect correlation.

Table Three Determination Matrix of R-Squares
Between Coaches and Writers Polls and their Corresponding Percentage Scores

	Coaches%	Writers%
Coaches	1.000	
Writers	0.937	1.000
BCSCoaches	1.000	1.000
BCSWriters	1.000	1.000

This would be accomplished since the intervals or variance in the distributions of numbers has equal intervals of 1 between each of the numbers. What this means in Table three is that the Coaches Poll Score (with a high of 1490) is exactly correlated with the percentage scores (with a high of 1.0). There has been no distortion in the rates or proportions of the intervals. Thus, the coaches and writers actual poll scores, the BCS percentage analysis as a percent of the highest possible score (e.g., 1490) and the percentage scores developed here based on the highest actual score where the high score is 1.0, are all perfectly correlated and all yielding the same results as an indicator. On the other hand, the .937 determination coefficient between the coaches percent scores and the writers actual scores means that those two sets of scores overlapped about 93.7 percent of the time. Still pretty close, but not perfect. Hence, losing one poll (i.e., the AP) may not be critical.

Table Four reports the inter-correlations or inter-determinations between the various computer scores and their resulting percentage scores which are calculated by dividing all the other scores by the highest score. In this manner, a common denominator is obtained without distorting the intervals between the numbers. This is indicated by the diagonal through the heart of the matrix. Those diagonal scores in every case, but one, is 1.0, which demonstrates that the actual computer scores reported in Table One are perfectly correlated with the percentage computer scores reported in Table Two. The lone exception is between the BCS Computer Average Score and the Percentage Computer Average.

Table Four Determination Matrix of R-Squares
Between the Computer Scores and Their Corresponding Percentage Scores

	A&H%	Billingsly%	Colley%	Massey%	Sagarin%	Wolfe%	ComAvg%
A&H	1.000						
Billingsly	0.783	1.000					
Colley	0.841	0.839	1.000				
Massey	0.615	0.465	0.563	1.000			
Sagarin	0.643	0.506	0.605	0.801	1.000		
Wolfe	0.880	0.869	0.002	0.891	0.746	1.000	
ComAvg	0.887	0.801	0.901	0.789	0.805	0.889	0.899

The BCS computer average score was calculated by the BCS as follows. The actual scores were converted to ranks, with the highest score=25 and second=24, etc. for the top 25 teams. The highest and lowest scores were eliminated, and the sum of the four middle rank scores was determined to calculate the BCS Computer Score Average. Similarly, the Percentage Computer Average was achieved by converting the computer scores to percentage scores or rates of the highest actual score and summing the four middle scores—eliminating the highest and the lowest percentage. What results is a coefficient of determination of .899, which means that the BCS conversion process distorted over ten percent of the result. In most cases, it would not matter much, but in this case it obviously did.

Table Five reports the "percentage" score for the computers and the BCS "percentage" that was actually reported for the BCS in proportion to the maximum number of points a team could have under the coaches (i.e., 1525) and the writers (i.e., 1625) polls. Remember, that those percentages correlate perfectly with the respective ratios to the highest score achieved. The results are achieved because the intervals between the numbers in the two distributions of scores for each team is exactly the same on a proportional basis. The percentage basis for the computer scores is calculated as a ratio to the highest actual score achieved because the highest possible score is uncalculated, the highest actual score is easily determined, and the correlation between those two sets of scores would be perfect anyway.

Table Five shows no difference in the rankings of the first three teams (Sorry Auburn!). What Table Five does clearly show is that California should have been ranked fourth and Texas fifth if an accurate algorithm for summing the scores had been employed by the BCS. The glitch in this case was when the BCS converted the computer scores to ranks before summing a final score. This year the process is more accurate for the polls because a percentage approach was used for the writers and the coaches polls, but the computer score approach remained the same as last year since those scores were converted to ranks before they were summed.

Table Five Rankings of Top Ten Football Teams Using Percentaged Scores

Team	Computer%	Coaches%	Writers%	BCSTotal%	Rank by %
So. Cal	0.9934	0.9770	0.9840	0.9848	1
Oklahoma	0.9956	0.9567	0.9575	0.9699	2
Auburn	0.9465	0.9410	0.9385	0.9420	3
Texas	0.9084	0.8400	0.8228	0.8571	5
California	0.8942	0.8433	0.8609	0.8661	4
Utah	0.9033	0.7967	0.8277	0.8426	6
Georgia	0.8241	0.7325	0.6874	0.7480	8
Va. Tech	0.8431	0.6800	0.6837	0.7356	9
Boise St.	0.8576	0.6184	0.5908	0.6889	10
Louisville	0.8176	0.6990	0.7280	0.7482	7

Table Six answers the question: What if the BCS had first ranked and then summed the writers and coaches polls the same as it did for the computer score polls. The results here are very similar to those in Table Five. Once again, the first three teams ranked as shown, but once again, California is ranked fourth and Texas is ranked fifth. What this clearly demonstrates is that if the BCS had used a consistent formula or algorithm for determining its final ranking, California would have been in the Rose Bowl and the PAC-10 would have an extra $2.75 million. In other words, this glitch or flaw in the formula and the inconsistent approach to calculating scores before they were summed is what dropped California to fifth place behind Texas.

"WHOA! SIX COMPUTER RANKINGS HAVE BIG BYTE"—*THE MERCURY NEWS*, DECEMBER 11, 2004

The headline is absolutely correct, even though the article concluded with concerns about the coaches poll. When score intervals are distorted and that distortion increases the range of scores, it has the impact of giving that particular criterion (i.e., the computer scores) a higher weight or importance. (Teasley, 1989), and that is exactly what happened with the computer scores since their intervals were exaggerated by converting their actual computer scores to ranks. One method for demonstrating that impact is through sensitivity analysis. One form of sensitivity analysis is threshold analysis which calculates the break-even scores in the model.

Table Six Ranking Based on Consistently Converting Scores to Ranks

	Rank Scores Coaches	Writers	Coaches	Writers	CompAvg	Total Score	Ranking
So. Cal	25	25	1.0000	1.0000	0.970	0.9900	1
Oklahoma	24	24	0.9600	0.9600	0.990	0.9700	2
Auburn	23	23	0.9200	0.9200	0.920	0.9200	3
Texas	21	20	0.8400	0.8000	0.880	0.8400	5
California	22	22	0.8800	0.8800	0.800	0.8533	4
Utah	20	21	0.8000	0.8400	0.830	0.8233	6
Georgia	19	18	0.7600	0.7200	0.670	0.7167	7
Va. Tech	17	17	0.6800	0.6800	0.650	0.6700	9
Boise St	16	16	0.6400	0.6400	0.760	0.6800	8
Louisville	18	19	0.7200	0.7600	0.520	0.6667	10

Table Seven reports the break-even thresholds comparing just Texas and California. The scores in the first part of the table show the actual scores that were reported for those two teams in the BCS reports. Cal beat Texas 1399 to 1337 in the writers poll, 1286 to 1281 in the coaches poll, but it lost to Texas by.080 points in the computer poll—.880 to .800. How could such a small difference matter? It's all about the rate of difference, i.e., 10%. Since this is an unweighted analysis, all the weights are set equally at 1.0 for each criterion. The allocation percentages are the proportion of each criterion score that each team received. So, California got over fifty-one percent of the writers points between the two, got slightly more than fifty percent of the coaches points, but Texas got more than fifty-two percent of the points in the computer polls. A straightforward interpretation is that while Cal was ahead by 1.23% (1.13% + .10%) on the writers and coaches polls, it was behind Texas by 2.38% on the computer scores, and thus the computer scores is what determined the outcome.

Table Seven Sensitivity and Threshold Analysis of Current BCS Scores

Sensitivity Analysis					
		Threshold		**Analysis**	
		Writers	Coaches	Computers	Sums
1.	Texas	1337	1281	0.880	2618.88
2.	California	1399	1286	0.800	2685.80
	Weights	1.00	1.00	1.00	3.00
Allocation Percentages					
1.	Texas	48.87%	49.90%	52.38%	50.38%
2.	California	51.13%	50.10%	47.62%	49.62%
Threshold Values					
1.	Texas	1276.79	1223.37	0.8404	
2.	California	1464.97	1346.58	0.8377	
	Weights:	2.02	12.81	0.52	

Table Seven shows the threshold values toward the bottom of that table. From those, we can see what scores would have made a difference. If Texas had gotten 1276 points or less on the writers poll, or 1223 points or less on the coaches poll, or 840 points or less on the computer scores, then California would be playing in the Rose Bowl this year. But "if" is a pretty big word. Overall, Table Seven shows that there would need to be a roughly sixty (60) vote swing between Cal and Texas in the coaches poll to change the result. Similarly, looking at the threshold weights, we can see that if the writers poll were weighted greater than 2.02 then Cal would have won and the coaches poll would need a weighting of about 13 to change the outcome. What this demonstrates is that the closeness of the coaches poll basically eliminates it as a discriminating criterion and the whole thing comes down to writers versus computers, but the flawed scoring scheme gave the computers twice the impact or weight.

"COACHES DESERVE PUBLIC WHIPPING,"— *SAN DIEGO UNION-TRIBUNE*, DECEMBER 9, 2004

Much consternation exists about the fact that Coach Mack Brown of Texas had lobbied for votes among his colleagues. Some of the findings that might have been affected by such lobbying were that two coaches ranked Texas second, four coaches ranked California seventh and two coaches ranked California as high as eighth. Coach Mack Brown and his brother, Watson Brown, were both voters, but the voting results by coaches was kept a secret so how those coaches voted is not public knowledge. Coach Mack Brown also receives a $50,000 bonus if Texas plays in a BCS bowl—a very nice Christmas present! So, many people believed that this lobbying and conflict of interest sullied the coaches poll and affected the outcome but, as we have shown, it did not.

Table Eight shows a sensitivity and threshold analysis adding the points to California's score that might have come from the eight votes cited above. We know from Table Seven that California needs about 60 more coaches points to "win." If the four voters ranking California as seventh had ranked them fourth, then that would be twelve points (4*(7-4)), and if the two coaches who ranked Cal eighth had ranked them fourth, that would be another eight points (2*(8-4)), and if the two voters who ranked Texas as number two had ranked the Longhorns seventh, that would mean another ten votes (2*(7-2)), and that would have totaled 30 points, only half what was needed to change the outcome. Table Eight adds the thirty points to California's coaches poll score, and even so, the outcome does not change. Clearly, the process of developing the computer scores has dominated the outcome of the BCS final scores that determined who played in the four elite bowls.

Table Eight Sensitivity and Threshold Analysis of Revised BCS Scores

Sensitivity Analysis					
		Threshold		**Analysis**	
		Writers	Coaches	Computers	Sums
1.	Texas	1337	1281	0.880	2618.88
2.	California	1399	***1316***	0.800	2715.80
	Weights	1.00	1.00	1.00	3.00
Allocation Percentages					
1.	Texas	48.87%	49.33%	52.38%	50.19%
2.	California	51.13%	50.67%	47.62%	49.81%
Threshold Values					
1.	Texas	1306.62	1251.91	0.8600	
2.	California	1431.52	1346.58	0.8186	
	Weights:	1.51	1.85	0.76	

"BOWL CHAMPIONSHIP SERIES ISN'T PERFECT BUT IT'S NOT EVIL,"—*LAPORTE COUNTY HERALD-ARGUS*, DECEMBER 7, 2004: SOME CONCLUSIONS

Forget about the fact that California struggled to beat Southern Mississippi by merely ten points in its last contest. Forget about the fact that Coach Mack Brown may have lobbied for votes and that he and his brother could have changed some of the votes in order for the Texas coach to receive his $50,000 bonus. These conclusions follow from this research.

- The final BCS outcome was eventually determined by a mathematical glitch in the way that the BCS constructed a final computer score by first converting the raw scores to ranks and then summing the rank scores.
- That simple maneuver exaggerated the impact of the computer scores, which favored Texas, and "stole" $2.75 million from the PAC-10's Christmas Bowl fund.
- Adding the little tweak of percentage scores to the BCS computer calculations would continue to improve that formula or algorithm for determining a national championship between the top two teams and also who should be ranked fourth or sixth.
- In the same way, strength of schedule or other appropriate criteria could be added to the BCS formula in the future. Factor analysis of BCS criteria shows that the outcome is about 70 percent record and about 24 percent strength of schedule. This percentage method would make additional criteria more accurate than similar contortions in the original formula, like dividing the strength of schedule score by four to make it fit within the ranks.
- No proposed tweak would change the fact that voters can be biased by friendships. Public record of voting might keep coaches more honest.
- The computer scorers should reveal their formulas and data as well so results can be replicated. Computers are not biased by friendships, but they are biased in the manner that their scoring system is developed. Some computer schemes will favor certain criteria over others. That was obvious in Table Four where the determination coefficients between computer scores was often .5 or less, which means that about half of those particular computer scores are measuring something different.
- A little tweak can never fix all the bias problems that have been reported about the BCS, but the "glitch" that stole $2.75 Million from the PAC-10's Christmas can easily be eliminated.

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