Using New Iterative Methods and Fine Grain Data to Rank College Football Teams

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Michael Rowell & Chadd Williams
Pacific University
History of BCS

• Bowl Championship Series
  – Ranking since 1998
  – Undergone reconstruction

• Computer Rankings
  – No longer use scores
  – Common Data
    • Location, Date, Strength of Schedule, Outcome of a Game
Importance of BCS Rankings

• Determines who plays in the National Championship Bowl
• Breaks conference ties
• Influences selections of many bowl games
Using the BCS computer rankings, we determined how often the rankings were able to predict the outcome of a bowl game.

- Assuming the higher ranked team should win the game

<table>
<thead>
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<th>1998</th>
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<td>70.0</td>
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<td>57.1</td>
<td>46.7</td>
<td>70.6</td>
<td>47.1</td>
<td>33.3</td>
<td>56.6</td>
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</table>

- 56.6% is not statistically significant
- \( p \)-value = 0.0673
Preliminary Results

<table>
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<tr>
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<td>64.7</td>
<td>58.8</td>
<td>46.7</td>
<td>60.0</td>
</tr>
</tbody>
</table>

- Difference of Scores
- $p$-value < .01
- Indication that scores can help rank teams
  - What about even finer grain data?
Play-by-Play Method

• Finer grain data comes from play-by-play statistics
• Stats should reflect team success
  – Help predict the outcome of a game
  – Indicate the magnitude of a win or loss
Getting the Statistics

• Designed a web-crawler to download the web pages that contained play-by-play stats
• Wrote a parser that extracted the data we needed so it could be imported into a database
2

New Mexico St.

PUNT 12:31 40 PUNT 11:00 48 3 8 1:31

- (1st and 10) NMSU drive start at 12:31.
- (1st and 10) PENALTY NMSU false start 5 yards to the NMSU35.
- (1st and 15) Chase Holbrook pass complete to Chris Williams for 2 yards to the NMSU37 (Jackson, Eric; Leverette, Geor).
- (2nd and 13) Justine Buries rush for 11 yards to the NMSU48 (Williams, Travi; Johnson, Demeri).
- (3rd and 2) Chase Holbrook pass incomplete to Brandon Allen.
- (4th and 2) Jared Kaufman punt 43 yards to the SLU9, Jackson, Eric return 7 yards to the SLU16 (Dan White; Davon House).

3

Southeastern La.

PUNT 11:00 16 PUNT 09:32 23 3 7 1:28

- (1st and 10) SLU drive start at 11:00.
- (1st and 10) Lucas, Jay rush for 2 yards to the SLU18 (Dante Floyd; Jared Naylor).
- (2nd and 8) Babin, Brian pass incomplete to Lucas, Jay.
- (3rd and 8) Babin, Brian pass complete to Gilbert, Mario for 5 yards to the SLU23 (La’Auli Fonoti).
- (4th and 3) Samples, Cody punt 33 yards to the NMSU44, fair catch by Chris Williams.

4

New Mexico St.

PUNT 09:32 44 TD 06:15 7 56 3:17

- (1st and 10) NMSU drive start at 09:32.
- (1st and 10) Justine Buries rush for no gain to the NMSU44 (Powell, Marquis).
- (2nd and 10) Chase Holbrook pass complete to Chris Williams for 4 yards to the NMSU48 (Jackson, Eric).
- (3rd and 6) Chase Holbrook pass complete to Derek Dubois for 10 yards to the SLU42, 1ST DOWN NMSU (Richardson, Ant).
- (1st and 10) Justine Buries rush for 4 yards to the SLU38 (Powell, Marquis).
- (2nd and 6) Tonny Glynn rush for 8 yards to the SLU30, 1ST DOWN NMSU (Jackson, Eric; Williams, Travi).
- (1st and 10) Chase Holbrook pass complete to Derek Dubois for 2 yards to the SLU28 (Powell, Marquis).
- (2nd and 8) Chase Holbrook pass complete to Chris Williams for 28 yards to the SLU0, 1ST DOWN NMSU, TOUCHDOWN, clock 06:15.
- (1st and 0) Ryan Jastram kick attempt good.
- (1st and 0) NMSU ball on NMSU30.
- (1st and 0) Ryan Jastram kickoff 57 yards to the SLU13, Ross, Byron return 27 yards to the SLU40.
Play-by-Play Statistics

• Only retrieved full sets of play-by-play data for the past 3 seasons
• Ran over 40 different statistics on data from the 2007-2008 season
• Results seen indicate a percentage of accuracy based on the 32 bowl games played that year
<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Description</th>
<th>Value</th>
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</thead>
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<tr>
<td>3rd Down Conversions</td>
<td>65.6</td>
<td>3rd Down Conversions Given Up</td>
<td>65.6</td>
</tr>
<tr>
<td>Yards Per Play*</td>
<td>59.4</td>
<td>Yards Given Up Per Play</td>
<td>59.4</td>
</tr>
<tr>
<td>Yards Per Play Not Including Punts*</td>
<td>62.5</td>
<td>Yards Given Up Per Play Not Including Punts*</td>
<td>59.4</td>
</tr>
<tr>
<td>1st Down Per Set of Downs*</td>
<td>68.8</td>
<td>1st Down Per Set of Downs - 1st Half*</td>
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<tr>
<td>% of Total Yards Gained on 1st Down</td>
<td>50.0</td>
<td>% of Total Yards Gained on 2nd Down*</td>
<td>40.6</td>
</tr>
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<td>59.4</td>
</tr>
<tr>
<td>% Yards Gained Toward 1st Down - Rushing for Short Yards</td>
<td>53.1</td>
<td>% Yards Gained Toward 1st Down - Rushing in 1st Half*</td>
<td>62.5</td>
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<tr>
<td>% Yards Gained Toward 1st Down - Variable Point Gap</td>
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<td>Defensive Big Plays*</td>
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<td>Maroon Zone Scores Per Attempt*</td>
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<tr>
<td>Red Zone Scores Per Attempt*</td>
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<td>Defensive Big Plays on 3rd Down*</td>
<td>53.1</td>
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*Game Within 14 Points
<p>| | | | |</p>
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<td>53.1</td>
</tr>
</tbody>
</table>

*Game Within 14 Points*
**BCS Comparison**

- Percentages indicate the accuracy when predicting games that include at least 1 team ranked by the BCS
- 2007 - 2008 season

<table>
<thead>
<tr>
<th>Play-by-Play Statistics</th>
<th>%</th>
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<tbody>
<tr>
<td>3rd Down Conversions</td>
<td>64.7</td>
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<tr>
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<tr>
<td>1st Down Per Set of Downs*</td>
<td>70.6</td>
</tr>
<tr>
<td>1st Down Per Set of Downs, 1st Half*</td>
<td>58.8</td>
</tr>
<tr>
<td>BCS Method</td>
<td>47.1</td>
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</tbody>
</table>

*Game within 14 points*
Combination of Statistics

• We had 4 play-by-play statistics that did well in 2007-2008
• Combined 3 statistics and each statistic is given a weight
  – Ran all possible weight combinations on our 3 years of data
Combination of Statistics

- Looked for combinations that hit a peak percentages when predicting the outcome of bowl games
- Best combinations for 2008-2009

<table>
<thead>
<tr>
<th>1st Down Per Set of Downs*</th>
<th>1st Down Per Set of Downs in 1st Half*</th>
<th>3rd Down Conversions</th>
<th>Overall Accuracy</th>
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<td>100</td>
<td>73.5</td>
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</tbody>
</table>

*Game within 14 points

Weights for each Statistic (%)
Combination of Statistics

- Looked for combinations that hit a peak percentages when predicting the outcome of bowl games
- Best combinations for 2008-2009

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<tr>
<td>0</td>
<td>0</td>
<td>100</td>
<td>73.5</td>
</tr>
</tbody>
</table>

Weights for each statistic

- Combos: 73.3%
- BCS: 33.3%

*Game within 14 points

• Combinations do well overall, and are significantly better than the BCS Method
Combination of Statistics

• No combination of statistics worked consistently from year to year
• Look for another method to find appropriate combinations
Week-By-Week Learning

• Ran combinations week-by-week, keeping track of the best weights
• Average those weights and use the averages to calculate the overall ranks
Week-by-Week Results

Overall Accuracy of Statistics Individually

Accuracy (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>1st Down Per Set of Downs*</th>
<th>1st Down Per Set of Down in 1st Half*</th>
<th>3rd Down Conversions</th>
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<td>100</td>
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<tr>
<td>2008</td>
<td>80</td>
<td>100</td>
<td>100</td>
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</tbody>
</table>
Week-by-Week Results

Individual Statistics Compared to Combination of Statistics

Accuracy (%)

<table>
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<tr>
<th>Year</th>
<th>1st Down Per Set of Downs*</th>
<th>1st Down Per Set of Down in 1st Half*</th>
<th>3rd Down Conversions</th>
<th>Combination of Week-by-Week Averages</th>
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</thead>
<tbody>
<tr>
<td>2006</td>
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<td></td>
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<tr>
<td>2007</td>
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<tr>
<td>2008</td>
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Week-by-Week Results

Individual Statistics Compared to Combination of Statistics

Graph showing accuracy (%)

- 1st Down Per Set of Downs*
- 1st Down Per Set of Down in 1st Half*
- 3rd Down Conversions
- Combination of Week-by-Week Averages
- Peak Combination
Comparison to BCS

- Accuracy is based only on games that include at least one team ranked by the BCS computer rankings

<table>
<thead>
<tr>
<th></th>
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<th>2007</th>
<th>2008</th>
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<tr>
<td>Combination of Week-by-Week Learning</td>
<td>58.8</td>
<td>64.7</td>
<td>53.3</td>
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<tr>
<td>Peak Combination</td>
<td>70.6</td>
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<td>73.3</td>
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<tr>
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<td>70.6</td>
<td>47.1</td>
<td>33.3</td>
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</table>
Play-by-Play Conclusions

- Evidence of accuracy when using play-by-play statistics to develop rankings
- Combinations of statistics can be more accurate than a single play-by-play statistic
Future Work

• Many other play-by-play statistics that can be combined
• Find a more effective method of determining which weights to use for the combinations of play-by-play statistics

• http://www.math.pacificu.edu/~rowell/football/index.html
Questions?
## Statistics to Pursue

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<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
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<td>67.6</td>
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<td>Percent Yards Gained Toward 1st Down, Rushing, 1st Half*</td>
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<td>Yards Per Play, No Punts*</td>
<td>56.3</td>
<td>62.5</td>
<td>50.0</td>
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</tbody>
</table>

*Game within 14 points
Overview

Develop Rankings

Team Value

Generate Game Values with Strength of Schedule

Generate Game Values
Similar Methods

• Started by developing some iterative methods that use statistics similar to the BCS
  – Development of Game Values
    • Difference of scores
(1st and 10) Justine Bunes rushes for 4 yards to the SLU38 (Powell, Marquis).

(2nd and 6) Tony Grammy rushes for 8 yards to the SLU30, 1ST DOWN NMSU (Jackson, Eric; Williams, Travi).

(1st and 10) Chase Holbrook pass complete to Derek Dubois for 2 yards to the SLU28 (Powell, Marquis).

(2nd and 8) Chase Holbrook pass complete to Chris Williams for 28 yards to the SLU0, 1ST DOWN NMSU, TOUCHDOWN, clock 06:15.

(1st and 0) Ryan Jastram kicks field goal good.

(1st and 0) NMSU ball on NMSU30.

(1st and 0) Ryan Jastram kicks field goal 57 yards to the SLU13, Ross, Byron return 27 yards to the SLU40 (B. Biamonte; Nick Ply).
"1", "Robertson", "R"
"2", "Toler", "Burl"
"3", "O'Keith", "Marcus"
"4", "McArthur", "Geoff"
"5", "Sproles", "Darren"
"6", "Roberson", "El"
"7", "Terry", "James"
"8", "Cross", "Garrett"
"9", "Strang", "Vincent"
"10", "Makonnen", "J"
"11", "Manderino", "C"
"12", "Wilson", "Travis"
"13", "Echemandu", "A"
"14", "Alsup", "Carlos"
"15", "Saba", "Ayot"
"16", "Washington", "Ras"
"17", "Dennis", "Davin"
"18", "Casey", "Brian"
"19", "Arrington", "JJ"
"20", "Rodgers", "Aaron"
"21", "Polite", "Antoine"
"22", "Hall", "Brandon"
"23", "Lyman", "Chase"
"24", "Morris", "Danny"
"25", "Broussard", "Jo"
"26", "Staples", "Ezekiel"
"27", "Rislov", "Scott"
"28", "Eugene", "Bruce"
"29", "Tolbert", "Henry"
"30", "Douglas", "Tramon"

- (1st and 10) Justine Burris rush for 12 yards.
- (1st and 10) Chase Holbrook pass to Marquis.
- (2nd and 8) Chase Holbrook pass complete.
- 1st and 0 Ryan Jastram kick return 15 yards for touchdown.
- 1st and 0 NMSU ball on MISU 35.
- 1st and 0 Ryan Jastram kick off (B. Baiamonte; Nick Ply.)
```sql
SELECT G.Date, V.TeamID, OffenseTeamID, GameID, SUM(IF(D QuarterStart < 3, MadeFirstDown, 0)) / SUM(IF(P Down = 1 AND D QuarterStart < 3, 1, 0)) AS METRIC, TeamName, VScores, HScores
FROM Plays AS P, Drives AS D, Games AS G, CurrentScore AS C, Teams T, FinalScore AS F
WHERE P.GameID = G.GameID
AND P.DriveID = D.DriveID
AND C.GameID = G.GameID
AND C.DriveID = D.DriveID
AND C.PlayNumber = P.PlayNumber
AND OffenseTeamID = T.TeamID
AND F.GameID = G.GameID
AND (ABS(C.HScore - C.VScore) <= 14)
AND (G.Date < '2006-02-01' AND G.Date >= '2007-03-01')
AND OffenseTeamID
GROUP BY G.GameID, OffenseTeamID
ORDER BY G.Date, G.GameID ASC
LIMIT 0, 30
```
Combinations of Two

- Began combining two statistics together
- Each of the statistics will be given a weight
  - Weight of Stat 1 * Game Value using Statistic 1
  - (100 - Weight of Stat 1) * Game Value using Statistic 2

- Add the two parts together to get a final game value
Combination Outcome

1st Down Per Set of Downs in 1st Half* combined with 3rd Down Conversions

* Close Game Statistic
Combination Outcome

Combining statistics can create greater accuracy

* Close Game Statistic