“The Mathematics of the Billion Dollar Bracket”

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How Does it Work?

- 4 sub-brackets (Regionals) of teams seeded 1 through 16
- 1 vs 16, 2 vs 15, 3 vs 14, ..., 8 vs 9
- There are 32 first round games, 16 second round games, 8 third round games, 4 quarterfinal games, 2 semifinal games, and 1 title game for a total of 63 games.
Warren Buffet’s Challenge

• The Quicken Loans Billion Dollar Bracket would pay out 1 billion dollars to a contest entrant who picks all 63 games correctly prior to the start of the tournament

• Limited to 15 million entries

• Users need to have Yahoo ID and give out personal information (collected by Quicken and Berkshire Hathaway)
What is the Probability of Winning?

- What is the probability of winning the bracket challenge?
- A number thrown out on the news a lot was 1 in 9,223,372,036,854,775,808 or over 1 in 9.2 quintillion.
- This is the probability of correctly predicting 63 tosses of a fair coin in a row.
1 in 9.2 Quintillion

• Not an appropriate figure
• 9.2 Quintillion possible winning brackets
• Not all are equally likely
• What are the real odds of winning?
“The Experts”

- Tim Chartier of Davidson College, Jeff Bergen of DePaul University and other “experts” weighed in.
- They held seminars, posted You Tube Videos, and had Bracket Parties.
- At the end of the day, nobody even came close.
Real Odds of Winning

• Bergen estimates 1 in 128 billion under best case scenario conditions that make a lot of assumptions.

• The actual number is between 1 in 128 billion and 1 in 9.2 quadrillion.
Buffett’s Challenge

• Limited to 15 million entrants. Even if there were 15 million unique brackets entered (all done by “expert analysis”), the probability of somebody winning would be

\[
\frac{15,000,000}{128,000,000,000} \approx \frac{1}{8500}
\]
Buffett’s Money

• His money was never in any real danger.

• Quicken Loans got a lot of free information they would have otherwise needed to pay to gather.
How to Expertly Fill Out a Bracket?

• Some Common Strategies
  – Always Pick Higher Seeded Teams (Until Final Four)

  – Use probability-based prediction from an expert like Jeff Sagarin or Ken Massey

  – Look at the Las Vegas lines for round as “experts” have created a market
Other Less Scientific Strategies

• Pick the team you like the best

• Pick the team whose mascot would win in a fight

• Put team names on two bowls of dog food and see which bowl the dog eats from first
Looking for Expert Advice


- 65 vetted scientific ranking systems for ranking college basketball teams

- Well known experts like Massey, Sagarin, Pomeroy, Wolfe, and Burrus
Why So Many Opinions?

• Different Factors may play into different ranking systems. Audience Poll: Rank these different factors from Most to Least Important:
  
  • A) Margin of Victory (winning by 2 or by 20)
  • B) Location of Game (home, away, neutral)
  • C) Strength of Opponent
  • D) Strength of Opponent’s Other Opponents.
Ratings Percentage Index

- The NCAA’s official ranking system which is used to determine which teams do and do not play in the NCAA tournament

- Also, used by the NCAA selection committee to seed 1 through 16 for each region
For the RPI,

C) Strength of Opponents (Counts for 50%)
D) Strength of Opponents’ Other Opponents (Counts for 25%)

B) Location of Game (home, away, neutral) (Counts for the 25% of the Winning Percentage)

A) Margin of Victory (winning by 2 or by 20) (Counts for Nothing...Just like the BCS for Football)
Home vs Away Adjustment

• 1 win is not always equal to 1 win. 1 loss is not always equal to 1 loss
  – Wins at home are worth 0.6 wins
  – Wins at neutral site are worth 1.0 win
  – Wins on the road are worth 1.4 wins
  – Losses at home are worth 1.4 losses
  – Losses on the road are worth 1.0 loss
  – Losses on the road are worth 0.6 losses
Example

• Suppose you wanted to rank the following four teams by RPI, do so using the following data:

<table>
<thead>
<tr>
<th>Home Team</th>
<th>Score</th>
<th>Road Team</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>75</td>
<td>Texas A&amp;M</td>
<td>57</td>
</tr>
<tr>
<td>Rice</td>
<td>72</td>
<td>Houston</td>
<td>66</td>
</tr>
<tr>
<td>Texas</td>
<td>66</td>
<td>Rice</td>
<td>69</td>
</tr>
<tr>
<td>Texas A&amp;M</td>
<td>65</td>
<td>Rice</td>
<td>59</td>
</tr>
<tr>
<td>Houston</td>
<td>81</td>
<td>Texas</td>
<td>77</td>
</tr>
<tr>
<td>Texas</td>
<td>55</td>
<td>Texas A&amp;M</td>
<td>65</td>
</tr>
</tbody>
</table>
RPI For Rice

Won 2 Home Games, Won 1 Road Game, and Lost 1 Road Game.

- Their raw record is 3-1 with a winning percentage of $\frac{3}{4}=0.75$
- Their weighted record is 2.6-0.6 with a winning percentage of $\frac{2.6}{3.2} = 0.8125$ (WP)
Other Components

• Opponents’ Winning Percentage (OWP): What was the average winning percentage of Rice’s opponents in all games where they did not play Rice?

• No Weights for Home/Away

• Texas A&M is 100%; Houston is 100% and Texas is 0%

• \( \frac{1.00+1.00+1.00+0}{4} = 0.75 \) (OWP)
Other Components

- Opponent’s Opponent’s Winning Percentage (OOWP): Average of Opponent’s OWP:
  - Texas A&M’s OWP is \((1+1+0)/3 = .667\)
  - Houston’s OWP is \((0.667+0)/2 = .333\)
  - Texas’s OWP is \((.667+0+.5)/2 = .389\)
  - Rice’s OOWP is \((.667+.667+.333+.389)/4 = .514\)
Rice’s RPI

- Total RPI is:
  \[(.8125)(.25) + (.75)(.5) + (.514)(.25)\]
  \[= .7066\]
<table>
<thead>
<tr>
<th>Rank</th>
<th>School</th>
<th>W-L</th>
<th>Pct</th>
<th>RPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Florida</td>
<td>32-2</td>
<td>0.9412</td>
<td>0.6764</td>
</tr>
<tr>
<td>2</td>
<td>Arizona</td>
<td>30-4</td>
<td>0.8824</td>
<td>0.6731</td>
</tr>
<tr>
<td>3</td>
<td>Kansas</td>
<td>24-9</td>
<td>0.7273</td>
<td>0.6610</td>
</tr>
<tr>
<td>4</td>
<td>Wichita State</td>
<td>33-0</td>
<td>1.0000</td>
<td>0.6522</td>
</tr>
<tr>
<td>5</td>
<td>Villanova</td>
<td>28-4</td>
<td>0.8750</td>
<td>0.6455</td>
</tr>
<tr>
<td>6</td>
<td>Wisconsin</td>
<td>26-7</td>
<td>0.7879</td>
<td>0.6418</td>
</tr>
<tr>
<td>7</td>
<td>Iowa State</td>
<td>26-7</td>
<td>0.7879</td>
<td>0.6391</td>
</tr>
<tr>
<td>8</td>
<td>Virginia</td>
<td>28-6</td>
<td>0.8235</td>
<td>0.6371</td>
</tr>
<tr>
<td>9</td>
<td>Duke</td>
<td>26-8</td>
<td>0.7647</td>
<td>0.6371</td>
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<tr>
<td>10</td>
<td>Creighton</td>
<td>26-7</td>
<td>0.7879</td>
<td>0.6332</td>
</tr>
</tbody>
</table>
At the Bottom (2013-2014)

<table>
<thead>
<tr>
<th>Rank</th>
<th>School</th>
<th>W-L</th>
<th>Pct</th>
<th>RPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>340</td>
<td>New Hampshire</td>
<td>5-24</td>
<td>0.1724</td>
<td>0.3747</td>
</tr>
<tr>
<td>341</td>
<td>Houston Baptist</td>
<td>4-23</td>
<td>0.1481</td>
<td>0.3679</td>
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<tr>
<td>342</td>
<td>Mississippi Valley State</td>
<td>6-23</td>
<td>0.2069</td>
<td>0.3611</td>
</tr>
<tr>
<td>343</td>
<td>Bethune-Cookman</td>
<td>5-25</td>
<td>0.1667</td>
<td>0.3605</td>
</tr>
<tr>
<td>344</td>
<td>Lamar</td>
<td>3-25</td>
<td>0.1071</td>
<td>0.3580</td>
</tr>
<tr>
<td>345</td>
<td>The Citadel</td>
<td>4-25</td>
<td>0.1379</td>
<td>0.3562</td>
</tr>
<tr>
<td>346</td>
<td>Southern Utah</td>
<td>1-27</td>
<td>0.0357</td>
<td>0.3551</td>
</tr>
<tr>
<td>347</td>
<td>Maryland-Eastern Shore</td>
<td>5-23</td>
<td>0.1786</td>
<td>0.3531</td>
</tr>
<tr>
<td>348</td>
<td>Grambling</td>
<td>4-23</td>
<td>0.1481</td>
<td>0.3504</td>
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<tr>
<td>349</td>
<td>Presbyterian</td>
<td>4-26</td>
<td>0.1333</td>
<td>0.3415</td>
</tr>
</tbody>
</table>
Women’s Basketball

- Larger Gaps in RPI
- Easier to predict with brackets since favorites tend to win
- Would have been more of a threat to Warren Buffett’s Challenge if such a challenge were made for women’s basketball
# RPI Comparison

<table>
<thead>
<tr>
<th>Men’s Rank</th>
<th>Name</th>
<th>RPI</th>
<th>Women’s Rank</th>
<th>Name</th>
<th>RPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Florida</td>
<td>.676</td>
<td>1</td>
<td>Notre Dame</td>
<td>.718</td>
</tr>
<tr>
<td>10</td>
<td>Creighton</td>
<td>.633</td>
<td>10</td>
<td>Texas A&amp;M</td>
<td>.638</td>
</tr>
<tr>
<td>25</td>
<td>N. Carolina</td>
<td>.608</td>
<td>25</td>
<td>Ok. State</td>
<td>.610</td>
</tr>
<tr>
<td>64</td>
<td>Mid Tenn</td>
<td>.567</td>
<td>64</td>
<td>Geo. Wash</td>
<td>.565</td>
</tr>
<tr>
<td>100</td>
<td>Ore. State</td>
<td>.537</td>
<td>100</td>
<td>Fresno St.</td>
<td>.548</td>
</tr>
</tbody>
</table>
World Cup 2014

• 32 team tournament
• 8 Groups of 4 teams
  – 4 Permutations of 2 for $4 \times 3 = 12$ possible orderings of the top 2 in each group.
  – $12^8 = 429,981,696$ ways of picking the 16 correct slots in from pool play to round of 16
  • Many of you with much more soccer knowledge than me will know that it’s a lot easier than 1 in a half a billion to pick these correct outcomes (not one game but 3 games are played...less chance of upsets)
World Cup 2014

• After that, there are 15 games played in a format similar to the Sweet 16 from College Basketball

• Probability of picking the correct winners assuming equal probability for the whole tournament is $1/(12^8 \cdot 2^{15})$ or 1 in 14 trillion
College World Series 2014

• Issue comes in the fact that there are 8 teams split into two groups of 4
  – Each group of 4 plays double elimination tournament
  – Some “if necessary games”
  – Two group winners play a best two out of three final (losses from initial group play don’t carry over)
What’s Next?

• 2014-2015 basketball season:
  – Will there be another billion dollar bracket challenge?

• Advice: Don’t spend too much time trying to get the perfect bracket...that time is probably better spent doing other things.