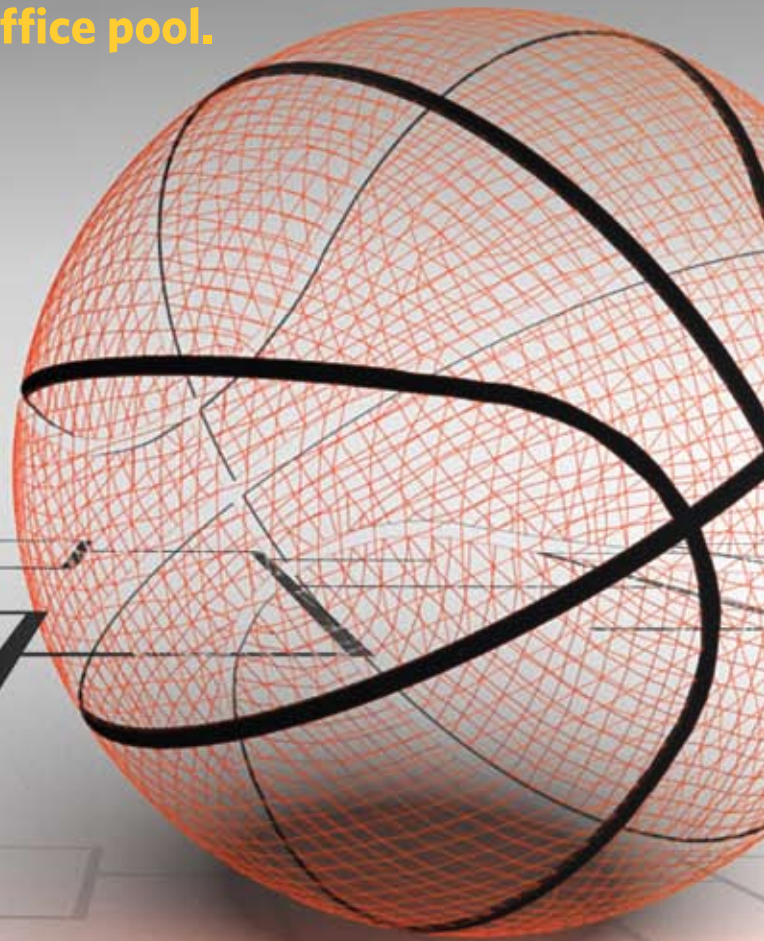


The Science of

BY ANDREW SIMONELLI

The computerized ranking system of three Georgia Tech professors could keep you from taking a bath in your annual March Madness office pool.



Bracketology

SOME PICK TEAMS BASED ON THEIR RECORD, others make their picks based on a team's rankings. There are those who lead with their heart, choosing a team because they or someone they know attended that school, or because they like the school's location, the team's colors, or its mascot. And then there are those who just flip a coin.

I am referring to March Madness office pools, an annual ritual for 37 million people. The object is to project the winners of all 63 games (excluding the play-in game) of the National Collegiate Athletic Association (NCAA) Men's Division I Basketball Championship Tournament. The stakes can be high—lucrative cash prizes—or even higher—bragging rights around the water cooler.

Although I don't participate in an office gambling pool, I am, without hesitation, a yearly player in ESPN's Tournament Challenge (a free sweepstakes that prohibits gambling) and, not so admittedly, a yearly loser. Take last year, for instance. According to ESPN, about 48 percent of pool participants like me predicted that the University of North Carolina Tar Heels would reach the tournament finals. Like me, about one-third of participants were expecting them to be crowned tournament champions. And yet again like me, about 42 percent of participants projected that the Tar Heels' opponent would be the University of California, Los Angeles Bruins.

That matchup never happened, labeling my bracket a loser. Much to the chagrin of Tar Heel nation (and me), UNC was bumped in the semifinal by its rival, the Kansas University Jayhawks. And UCLA fell to the Tigers of the University of Memphis.

The Jayhawks ultimately outlasted the Tigers in an overtime thriller, claiming their first championship in 20 years—an outcome predicted by fewer than 15 percent of pool players. Among them

were three Georgia Tech professors, whose ranking system has for the past nine years outperformed all leading ranking systems, including the Associated Press's poll of sportswriters, the ESPN/USA Today coaches poll, the NCAA's own seeding system, and a leading rating system—the Ratings Percentage Index (RPI)—that is used by the NCAA to determine team selections and tournament seeds.

All Wins Aren't Created Equal

It all began after Georgia Tech missed out on participating in the annual tournament some years ago. Sports analysts had considered the team to be a win or two short of making the field. Discussing the team's fate, professors Paul Kvam and Joel Sokol recalled a game in which Georgia Tech was defeated by the University of Tennessee on a last-second half-court shot. Sokol, an assistant professor in the H. Milton Stewart School of Industrial and Systems Engineering, says that he and Kvam, a professor of statistics, wondered whether the improbable shot really meant that Georgia Tech was a worse team than if the shot had failed.

To test their thesis, they did some research and found that close games are essentially tossups, with the higher-ranked opponent winning barely more than half the time. As a result, the professors concluded, winning a close game shouldn't be worth as much as winning easily. Similarly, losing a close game shouldn't hurt a team's ranking as much as losing in a rout. Kvam and Sokol also concluded that losing closely to a top-tier team reveals just as much about a team's overall quality as clobbering a weak opponent.

The two, joined by fellow engineering professor George Nem-

March Madness by the Numbers

Average Office Pool Players per Year **37,000,000**

Money at Stake **\$2,500,000,000**

Estimated Loss of Workforce Productivity **\$1,700,000,000**

SOURCES: NEWSWEEK, CNN MONEY, BAKERSFIELD CALIFORNIAN



From left, Paul Kvam, Joel Sokol, and George Nemhauser

hauser, decided to develop a system that would take all this into account and simultaneously remove any outcome influence created by the “home-court advantage,” or the commonly accepted assumption (backed by data) that a team has a greater probability of victory when playing on its home court. The result, based on a logistical regression and a Markov chain, was a predictive-modeling computerized ranking system designed to determine the better team in a head-to-head matchup.

Sokol says that the team’s model, dubbed the LRMC, differs from traditional ranking systems in three ways. Not only does the LRMC factor in the margin of victory; it couples performance with the quality of each opponent. It also differs from traditional methods in that it barely distinguishes between a win and a loss if the final score is close. In the RPI system, for instance, a win is always just that—a win.

Model Mechanics

Inverting a matrix using linear algebra, the professors developed their Markov chain to couple an opponent’s overall strength and how well a team performed against that opponent. Strength of schedule and game results are typically used in other ranking systems such as the RPI, but in those systems, teams are awarded bonus points for playing stronger opponents regardless of the outcome. In other words, outcomes and schedule strength are computed independently on a season-long basis. With the LRMC system, the benefit of playing stronger opponents is larger depending on how the team fares against the opponent. Outcomes and opponent strength are factored together on a game-by-game basis.

The second part of the LRMC formula is a logistical regression that uses only basic scoreboard data—the margin of victory and where the game was played (i.e., at home, away, or on neutral territory).

“The home-court advantage is a huge determining factor in

whether a team wins or loses,” Sokol says. The team of professors analyzed results of games in the same season that featured the same opponents but with one game played on each team’s respective home court. In order to predict that a team that won on its own court could re-create the win on its opponent’s home court, said Sokol, “the break-even point for margin of victory is about 20 points to 22 points.”

This home-court advantage needs to be considered when evaluating outcomes because NCAA tournament games are played at neutral sites. The regression accounts for this powerful variable. The two components are then calculated giving each team a mathematical score and ranked accordingly.

Road Test

But just how well does the predictive model work?

The LRMC experienced its first major test in 2004 when it projected that the professors’ own Georgia Tech would reach the Final Four. Most ranking systems had the team exiting two rounds earlier. The professors feared that projecting their own team to do so well would bring added scrutiny if it failed. It didn’t happen. Georgia Tech advanced to the Final Four and eventually danced its way into the finals.

Not surprisingly, the LRMC made a name for itself. And among those taking notice was the NCAA, which doesn’t use ranking systems that are influenced by margins of victory for fear of encouraging bad sportsmanship when teams seek to run up the score. As a result of discussions with the NCAA, Sokol says that he and his colleagues now supply the association with a “less-pure” version of the rankings that takes out the margin. While this ranking system is less reliable than the pure LRMC, Sokol says he understands the reason for the NCAA’s policy.

For me and the other sports pool players, however, the LRMC could be our key to finally unlocking the mystery of bracketology. But before we celebrate prematurely, Sokol issues a caveat: There are no guarantees. For example, the LRMC couldn’t predict George Mason

And the Winner Is

Number of Final Four teams accurately picked by each methodology during the past nine seasons.

LRMC—30

NCAA seeding—23

AP and ESPN polls—23

RPI—21

University's Cinderella run through the tournament and into the semifinals in 2006.

He explains this is because there are two kinds of upsets. The first is a true upset, where the better team loses. The second is a "fake upset," when the worse team is mistakenly favored to win. He said the LRMC is designed to identify the fake upsets but that no system can detect the true ones.

"There are always going to be upsets," Sokol says, "and real

upsets are never going to be predictable."

Good luck making your picks in 2009, and before you do, make sure you visit the LRMC website (www.isye.gatech.edu/~jsokol/lrmc). But let's keep this secret between us. I want to win for once.

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Comparing the Polls

The LRMC versus other leading polls (March 16-18, 2008); Kansas University was the eventual winner.

LRMC	AP Sportswriters Poll	RPI
1. Kansas	1. North Carolina	1. Tennessee
2. Memphis	2. Memphis	2. North Carolina
3. UCLA	3. UCLA	3. Memphis
4. Duke	4. Kansas	4. UCLA
5. North Carolina	5. Tennessee	5. Kansas
6. Tennessee	6. Wisconsin	6. Texas
7. Wisconsin	7. Texas	7. Duke
8. Clemson	8. Georgetown	8. Georgetown
9. Stanford	9. Duke	9. Xavier
10. Texas	10. Stanford	10. Drake

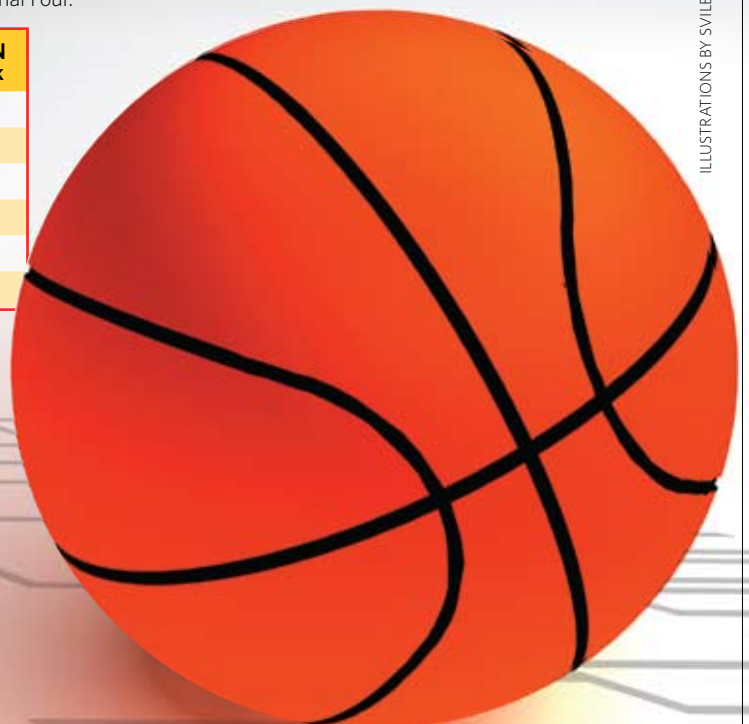
SOURCES: LRMC; POMEROY RANKINGS; ESPN

Diamonds in the Rough

The LRMC has been successful at identifying lower-ranked teams with the potential to make a tournament run despite their rankings by other systems. All the following teams eventually made it to the Final Four.

Year	Team	LRMC Rank	RPI Rank	AP Rank	ESPN Rank
2000	Florida	5	18	13	11
2001	Maryland	3	22	11	11
2002	Indiana	10	20	26	27
2004	Georgia Tech	4	16	14	15
2005	Michigan State	8	22	15	15
2006	Florida	8	15	11	10

SOURCE: LRMC



ILLUSTRATIONS BY SVILEN MILEV