

Teaching Statistics: Analyzing Voting Data from Dancing with the Stars

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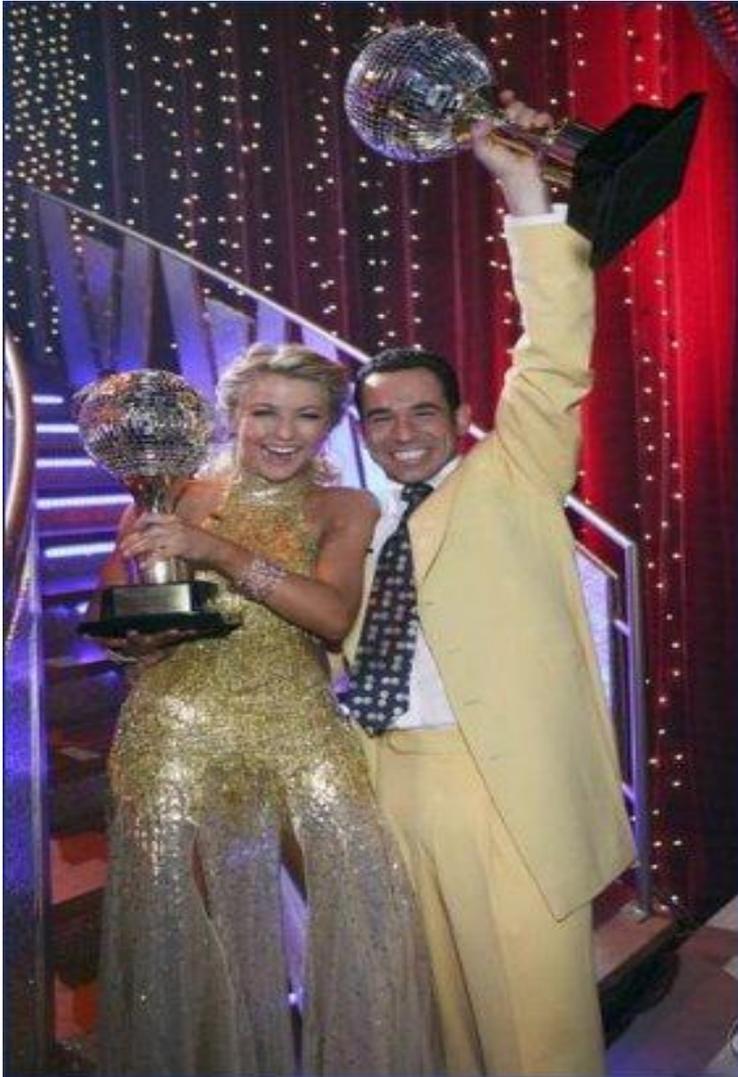
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Outline

- Structure of the Voting
- Old Voting System: Ordinal Rankings
- New Voting System: Percentages
- Optimal Voting Strategies
- Conclusions

Dancing with the Stars



- Celebrity Dancing Competition
- 13th season underway on ABC
- Spinoff of Britain's Strictly Come Dancing

Structure of Dancing with the Stars

- Approximately 12 celebrity contestants are paired with professional dance partners.
- Each couple dances one at a time in front of 3 judges.
- At the conclusion of the dance, each judge gives the contestants a score of 1 through 10.
- American public can also vote for the contestant they want to move to the next round.

Structure of the Vote

- Each contestant has a static phone number for the whole season.
- Fans can call up to 5 times per phone line and send 5 texts per text number.
- Phone lines open at start of the show and close $\frac{1}{2}$ hour after the show's conclusion.
- Fans can vote via internet voting up to 14 hours after the show airs (5 votes per email address).

Important Facts

- Contestants dance during a two-hour live telecast on Monday night and then the results are announced live the next night on Tuesday evening's results show.
 - Voting is certified by an accounting firm but final vote tallies are not released to the public.
 - You can't vote for whom you want to eliminate only for whom you want to keep.

Tallying the Vote

- Each contestant gets a score ranging from 3 to 30 from the judges for each dance (up to 3 dances total per week).



What is the Score?

- When host Tom Bergeron says that they have “Combined the Judges Scores with America’s Votes,” what does he mean?
 - In Seasons 1 and 2, he meant a system involving ordinals.
 - In Seasons 3 through present, he means a system involving percentages.

Ordinal Rankings

- Ordinals are data which are ordered rankings.
- Ordinals were formerly used in figure skating to reduce judge bias.
- When data are sorted (from largest to smallest), a rank is assigned to where it is in the list where rank 1 is the largest value.
- Ties are broken by assigning rank of the mean of the ranks of what constituted the tie so that the sum of all ranks is preserved.

Example

	Raw Score	Ranking
Dancer 1	27	1
Dancer 2	25	2.5
Dancer 3	25	2.5
Dancer 4	24	5
Dancer 5	24	5
Dancer 6	24	5
Dancer 7	21	7
Dancer 8	20	8
Dancer 9	15	9
Dancer 10	12	10

Adding Up Rankings

- When Tom Bergeron said that they combined the judges scores with the fan votes, what is meant was that they:
 - found the rankings for the judges scores;
 - found the rankings for the fan votes;
 - added the rankings;
- The lowest overall score (highest sum of ranks) gets eliminated.

Example - Continued

	Judges Score	Rank	Fan Votes	Rank	Sum of Ranks
Dancer 1	27	1	7,041,210	1	2
Dancer 2	25	2.5	6,799,791	2	4.5
Dancer 3	25	2.5	4,238,331	3	5.5
Dancer 4	24	5	789,039	7	12
Dancer 5	24	5	469,498	8	13
Dancer 6	24	5	799,499	6	11
Dancer 7	21	7	2,302,303	4	11
Dancer 8	20	8	287,399	9	17
Dancer 9	15	9	181,418	10	19
Dancer 10	12	10	1,781,290	5	15

Why Use Ordinals

- The producers of the show used ordinals in order to “lessen” the influence of the voting public.
 - Whether you win by 1 vote or a million over your next highest competitor, your ranking stays the same.
 - Similar to philosophy behind the Electoral College in electing a president...one outlier of a state should not influence the raw vote as may happen in a direct election of a president.

Uses of Rankings in Sports

- This sort of system is used all of the time.
- Example: Associated Press Top 25 Football Poll
 - 60 sportswriters rank teams from 1 through 25; ranked 1st yields 25 points and ranked 25th yields 1 point.
 - If in a certain week, Alabama has 1497 points (out of a maximum of 1500), one way of obtaining that score would be 58 1st place votes, 1 2nd place vote, and 1 3rd place vote.

Problems with Ordinals

- What ended up happening is that the effects of the judges got lessened to the point that the producer's plans backfired.
- The “Jerry Rice effect” led to the elimination of the ordinal ranking system.



Jerry Rice

- Hall of Fame wide receiver for the San Francisco 49ers
- Paired with professional dance partner Anna Trebunskaya in season two of DWTS
- Was runner-up to season champion Drew Lachey despite having the lowest judges score for 5 dances that season (was never in the top 3 in any dance except for finale when there were only 3 contestants left)

Week of 4 Contestants Left

- The professional judges despised Jerry Rice's dancing as his combined judges score was well below the other 3 contestants.
- The fan vote is an estimate based on internet fan polls (in millions).

	Judges	Ordinal	Fans	Ordinal	Total
Drew Lachay	55	1.5	11.3	1	2.5
Jerry Rice	41	4	9.2	2	6
Stacy Keibler	55	1.5	7.7	3	4.5
Lisa Rinna	53	3	7.3	4	7

What Happened?

- Lisa Rinna was eliminated.
- Judges and producers were angry.
- The voting system was changed for the next season.
- Instead of ordinals, the final tally was based on percentages.

Assigning Percentage

- Find the sum of the raw scores.
- Divide each raw score by the sum of the raw scores to get a percentage for that raw score.
- Now, when Tom Bergeron says that they combined the judges scores with the fan votes, what is meant is that they:
 - found the percentages for the judges scores;
 - found the percentages for the fan votes;
 - added the percentages and the lowest overall score (sum of percentages) gets eliminated.

Example - Updated

	Judges Score	Percent	Fan Votes	Percent	Sum of %
Dancer 1	27	12.44%	7,041,210	28.52%	40.96%
Dancer 2	25	11.52%	6,799,791	27.54%	39.06%
Dancer 3	25	11.52%	4,238,331	17.17%	28.69%
Dancer 4	24	11.06%	789,039	3.20%	14.26%
Dancer 5	24	11.06%	469,498	1.90%	12.96%
Dancer 6	24	11.06%	799,499	3.24%	14.30%
Dancer 7	21	9.68%	2,302,303	9.32%	19.00%
Dancer 8	20	9.22%	287,399	1.16%	10.38%
Dancer 9	15	6.91%	181,418	0.73%	7.65%
Dancer 10	12	5.53%	1,781,290	7.21%	12.74%

Jerry Rice Revisited

- What would have happened if the new system had been in place in season 2?
 - Jerry Rice would have been eliminated.

	Judges	Percent	Fans	Percent	Total
Drew Lachay	55	26.96%	11.3	31.83%	58.79%
Jerry Rice	41	20.10%	9.2	25.92%	46.01%
Stacy Keibler	55	26.96%	7.7	21.69%	48.65%
Lisa Rinna	53	25.98%	7.3	20.56%	46.54%

Is the Voting System Fair?

- Which system do you think is more fair?
 - Ordinal Rankings
 - Adding Percentages
- Despite the tweaking to give the judges more power to proportionally punish poor dancers, the system has not left the fans powerless.
 - Judges Grade Inflation!
- Example 1 - Billy Ray Cyrus.

Billy Ray Cyrus

- Country music singer and television actor
- Father of pop star Miley Cyrus
- Finished 5th in season 4 of DWTS despite some terrible judges scores (His judges scores were in last place in 6 of 11 dances he performed.)



Tweaking the Vote

- Despite the new scoring system, the fans saved Billy Ray from elimination numerous times.
- The fan vote is an estimate based on internet fan polls (in millions).

	Judges	Percent	Fans	Percent	Total
Apolo Ohno	54	17.5%	8	19.0%	36.5%
Joey Fatone	59	19.1%	7.2	17.1%	36.2%
Laila Ali	59	19.1%	7.4	17.6%	36.7%
Ian Ziering	54	17.5%	6	14.3%	31.8%
Billy Ray Cyrus	38	12.3%	7.4	17.6%	29.9%
John Ratzenberger	45	14.6%	6	14.3%	28.8%

Polarizing Contestants

- Remember that you vote for whom you want to keep.
 - Can't vote to get rid of somebody
- Contestants who are loved or hated tend to do better than those whom people feel indifferent towards.
- Kate Gosselin and Bristol Palin illustrate this.

Kate Gosselin

- Perhaps the most polarizing contestant of all time
- Reality TV star of TLC's Jon and Kate Plus 8...later Kate Plus 8 after divorcing Jon
- Was shown repeatedly yelling at and degrading her dance partner Tony Dovolani in season 10



What Happened?

- Dancing with the Stars received its highest ratings ever - ranking #1 for two straight weeks (beating American Idol for the first time ever).
- People tuned in to see Kate dance because:
 - She was a bad dancer (had very low judges scores).
 - She was shown brutally yelling at her dance partner blaming him for her poor dancing.
 - She was a very popular and public figure from her reality show and her recent divorce.

What Happened

- The two largest Facebook groups associated with DWTS in season 10 were:
 - Kate Gosselin to win Dancing with the Stars
 - Get Kate Gosselin off Dancing with the Stars.
- She was finally eliminated when her enemies found the mathematically best way to “vote against her.”

How to “Vote Against”

- Instead of voting for one other contestant
- Vote for every other contestant to the max

	Judges Score	Percent	Fan Votes	Percent	Sum of %
Kate Gosselin	14	12.73%	3,000,000	42.86%	55.58%
Nicole Scherzinger	26	23.64%	1,000,000	14.29%	37.92%
Evan Lysacek	25	22.73%	1,000,000	14.29%	37.01%
Erin Andrews	23	20.91%	1,000,000	14.29%	35.19%
Chad Ochocinco	22	20.00%	1,000,000	14.29%	34.29%

	Judges Score	Percent	Fan Votes	Percent	Sum of %
Kate Gosselin	14	12.73%	3,000,000	15.79%	28.52%
Nicole Scherzinger	26	23.64%	4,000,000	21.05%	44.69%
Evan Lysacek	25	22.73%	4,000,000	21.05%	43.78%
Erin Andrews	23	20.91%	4,000,000	21.05%	41.96%
Chad Ochocinco	22	20.00%	4,000,000	21.05%	41.05%

Bristol Palin

- Daughter of former Vice Presidential nominee Sarah Palin
- Finished 3rd on Season 11 in Fall of 2010
- Had the lowest judges score on 12 dances yet finished in 3rd place (made it to the finals)



Shocking Elimination

- In the semifinals, pop star Brandy, who got a perfect score of 30 on one of her two dances, was eliminated while Bristol Palin made it to the finals with a lower judges score.
- Fans were outraged!
 - ABC affiliates fielded over a million angry phone calls; numerous groups threatened advertiser boycotts.
 - A Wisconsin man shot his television set which led to a 15-hour police standoff due to this result.

Was it Really Shocking?

- No, it was not shocking to those who looked at raw voting data from Dialidol.
- Dialidol is a website which features software which allows your computer's modem to call your favorite contestant's phone number.
 - The site publishes running tallies of the vote throughout the course of the voting time.
 - These data can be used to infer the population percentage of votes received for each contestant.

Sample Biases

- The sample data shown on the website are the number of votes and the number of busy signals received for each contestant as an aggregate of all of those who voted using this software.
- Sample is biased:
 - towards those who care enough to use the site to vote repeatedly;
 - towards those who own a computer with a modem dialer;
 - against those who vote via cell phone;
 - against those who vote via text message;
 - against those who vote via email address.

Making Predictions

- Need to understand the role of the busy signal
 - Is a busy signal a “good” or a “bad” thing?
- A busy signal is “good” for that contestant.
 - It means other people are voting for him...if you can't get through, everyone else is calling for him...if you can get through every time, it means he has no other fans voting for him except you.
- This result avoids bias in the sample.
 - Measures the population results without dependence on the sample results
 - It doesn't matter whom you vote for but it acts as a proxy of how busy a contestant's phone line is.

Analyzing the Data

	Judges Total	Percent	DI Busy %	Att/100 Rec	Percent	Sum of Percent
Jennifer Grey	60	26.32%	49.54	198.176774	21.48%	47.79%
Kyle Massey	58	25.44%	54.64	220.458554	23.89%	49.33%
Bristol Palin	53	23.25%	65.83	292.654375	31.72%	54.96%
Brandy	57	25.00%	52.70	211.41649	22.91%	47.91%

- Note that the inference is not perfect since Brandy was eliminated and not Jennifer (well within the margin of error).
- Bristol making the top 3 is not shocking.
- Judges' grade inflation means they only have themselves to blame for the result.

Optimal Strategy: When to Vote

- Phone lines open at the start of the show and close 30 minutes after the show is done airing.
- Don't wait for the end of the show to start voting.
- Don't vote just after your favorite stops dancing and gets their judges score.
- Vote when the show starts to air.
- Vote during a commercial or while another contestant is dancing.

Concluding Thoughts

- DWTS is a fun show with some interesting mathematics involved with the voting process.
 - Is it a popularity contest or does the winner actually reflect the celebrity with the most dancing talent?
 - Would any ranking system that allows the fans to vote not be a popularity contest?
 - Would giving the judges more power help or hurt the show?
 - Were fans voting for Bristol Palin as a proxy vote for her mother for political office? Does it matter?