Probability Analysis of Bingo

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Abstract:

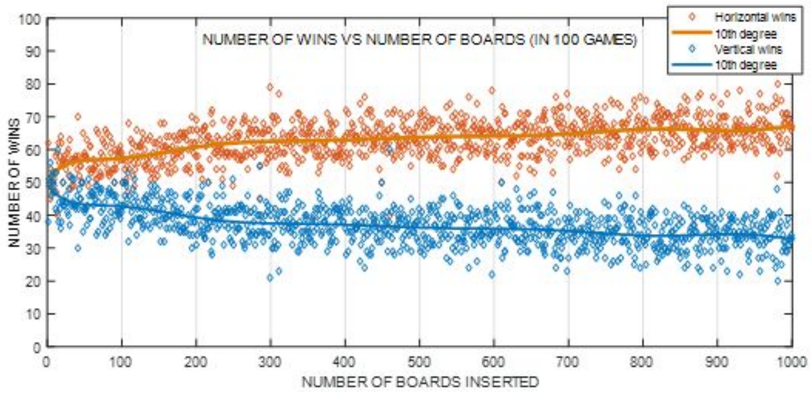
Bingo is a simple, well-known game in which the outcome depends on probability and statistics. A common misconception of the game is to think that winning is equal in any pattern, including horizontal and vertical patterns. We first played 100 games of bingo to determine the relationship between horizontal and vertical wins. We also created a program that replicated the two different scenarios of winning, comparing our results to our real-life data. We are examining our real-world results to our theoretical data that we acquired from MatLab and Arthur Benjamin, Joseph Kisenwether, and Ben Weiss's research. As technology advances, human error will become less of a complication, and knowledge of probability and algorithms are necessary. This research will help showcase how actuality can be replicated through simulation.


```
for NB=1:1000
  for Board=1:NB %Generates number of
  boards
  ROWa=0;
  COLUMNa=0;
  M=zeros(5,5);
  N1=randperm(75); %N1=Generates random
  integers one through 75
  . . . (restarts conditions)
  for n=1:75 %Classifies numbers to their
  respective Letter interval and creates a
  5 by 5 Matrix/board
  . . .
  end
  end
  BINGO=
  [B(1:5);I(1:5);N(1:5);G(1:5);O(1:5)]';
  BINGO(3,3)=0;
  n1=Board*5-4;
  n2=(Board*5);
  BINGOh(n1:n2,1:5)=BINGO; % Stacks boards
  in a matrix vertically
  BINGOv(1:5,n1:n2)=BINGO; % Stacks boards
  in a matrix horizontally
  end
  BINGOh;
  BINGOv;
  ROW1=zeros(1,100);
  COLUMN1=zeros(1,100);
  for GAMES=1:100 % Runs a hundred games
  Call=randperm(75); % generates 75 numbers
  and stores them in a vector
  Mh=BINGOh;
  Mv=BINGOv;
  . . . (restarts conditions)
    for S=1:75 %goes through the BINGOs
    matrix and marks the spots that are
    called   during the round

      a=Call(S);
          if BINGOWin==0 % if the call
  matches a number in the matrix it
  replaces it   with a 0

              Mh(Mh==a)=0;
              Mv(Mv==a)=0;
```

Methods:

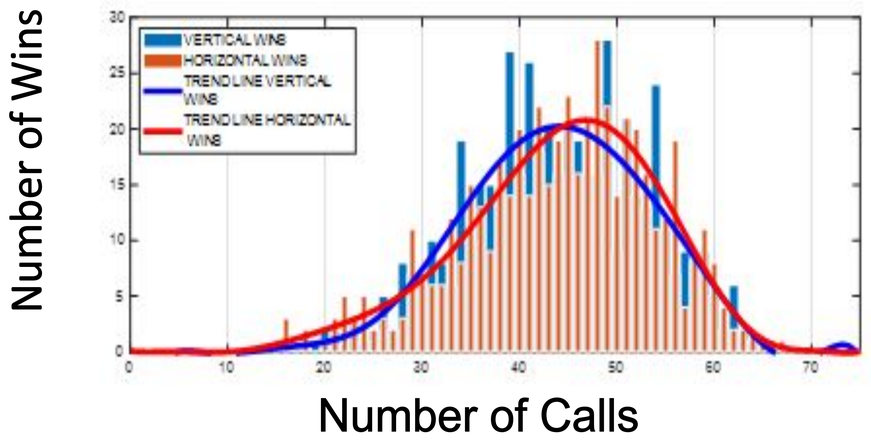
Assume BINGO is achieved at the tenth draw: there are 75! equally likely sequences for bingo numbers. For winning, there are 75 equal numbers, while there are 12 different ways to arrange the shape 4311 for horizontal bingo, and 12 different ways to arrange the shape 4100 for vertical bingo. There are 9! ways to arrange the nine numbers for the shape and there are 65! ways for the other 65 numbers after the tenth call. However, we have to include the binomial coefficients to bring into factor the ways the shape can be made.

After adding the probabilities for each shape possible before bingo is achieved on the tenth draw, we can conclude that the research conducted by Benjamin is informative and accurate. Assuming we win on the tenth draw, horizontal bingo has a probability of about 0.09415, while vertical has a probability of about 0.03652, a ratio of about 2.5.



Results:

- **We found that while playing bingo with one card, the number of times that vertical won was equal to the number of times horizontal won.**
- **This was verified through our real life BINGO playing results and through our code.**
- **We found that playing BINGO with a large amount of cards yielded twice as many horizontal wins as vertical.**
- **This was verified through our code**



Conclusion:

Based on the results we have gathered from our research we can conclude that a horizontal bingo is more probable to win sooner than a vertical bingo based on the amount of boards in play. However, with a single board there is a 50/50 chance of winning either way, as backed by our experimental data. This is applicable in the real world as simulation is crucial to model the results of a system, such as simulating a bridge under stressful conditions to test its strength.

Reference:

Arthur Benjamin, Joseph Kisenwether & Ben Weiss (2017) The BINGO Paradox, Math Horizons, 25:1, 18-21, DOI: 10.4169/mathhorizons.25.1.1

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