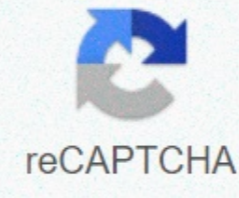




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## Banzhaf power index

They're equals! If you're not interested in mathematics, you can say. Well, although I included all the math, I also wrote this page to be accessible to those without a strong math background. I've also written to entertain myself, and I hope it entertains you too. I got some positive feedback, so go ahead and you can take a chance. Live a little! If you don't understand how the Electoral College works, we suggest you read a little more about it now. The National Archives and Records Administration holds a full page of the U.S. Electoral College of Federal Registration. Click on the Frequently Asked Questions picture and what is the Electoral College on the menu just below the eagle? link. Banzhaf and his previous methods were published in various legal journals, especially villanova law journal, Winter 1968 [1]. I learned of Banzhaf's work in an article by Ian Stewart in the July 1995 issue of Scientific American [6] and searched for other rescilious articles. Here's a list of relevant references I know. The basic principle of Banzhaf's method is that voting power is based on your ability to change--- or rather, to replace the outcome of the election with ---. Keep in mind that this is a bit difficult to think about because you don't vote directly for a candidate in a block voting system. Banzhaf's method then calculates the likelihood that a citizen's vote will change the bloc's decision, and then determines the likelihood that the bloc's votes will change the outcome of the election. Note: The Electoral College system does not actually require voters to give their electoral votes to candidates who are thrown out of the popular vote. In addition to showing the absurdity of the system, this failure also does not surprise any attempt at analysis. Rarely do these things happen. On NARA's Electoral College site, see the 1988, 1976 and 1972 elections to give a few new examples. So the two numbers we need to calculate the Banzhaf Power Index are the probability of an individual changing the outcome of a bloc's decision and the possibility of changing the bloc's election result. Banzhaf uses simple unifying analysis to reach the possibilities for each block. He claims (and quoted): In order for an individual voter to give a critical vote, other voters in the group must be evenly divided. M is the formula for the number of combinations that M people can create by dividing them into two equal groups!  $M! / M!$  This expression comes from the standard combinatorial formula for the number of ways in which you can select p elements (in this case, voters for voting candidate #1) from n total elements (i.e. total voters). This is a combination of quantity (n,p) and  $= n! / (n - p)! p!$  Banzhaf continues: ... When calculating how many times each person can vote a critical vote, the function must be multiplied by account 2 for voting for two different candidates. ... Think of a group of N+1 citizen voters where N is a double number. The total number of ways each citizen-elect can vote for one of the two main candidates is  $2 \times 2^N$ . Each will only be able to give a critical vote in which other N citizen-voters are evenly divided into two groups: N/2 votes yes and N/2 voting nay. This, as mentioned earlier, can be  $2 \times N! / N! / N! / N! / 2!$  Way. Therefore, the following portion of individual citizen-voter combinations will be critical in determining the outcome of a vote.  $2 \times N! / N! / N! / N! / (2 \cdot 2^N)$  You might think this possibility has an inverse linear relationship with the block's population. However, as Banzhaf and others have shown, this is not true. Probability relates to the reverse square root of the block population. This is quite surprising at first glance, but you can either accept the following equations as evidence, or do it yourself and see. That's why Banzhaf continues to achieve the ultimate possibility of simplifying expression and using Stirling's approach to factorial large numbers that are critical in determining the decision of an individual voter bloc. This inverse frame-root-relationship gives. ... The factorial of large numbers can be very closely related to the following formula known as the Stirling formula. [For those who are not familiar with mathematical representation, wavy equal sign means approximately equal] The function that converts this value to the previous formula by ensuring that N/2 is equal to m is  $2 \times m \cdot e^{-m} \cdot \sqrt{2 \pi m}$ , which is the first factor in Banzhaf's Power Index. (breath, breath) The next factor can't really be calculated directly with a simple (ahem) formula like Stirling's approximate. Or at least, I don't know one (and aren't satisfied). Looks like Banzhaf is, too. He said in a footnote (quite dry, if you can editorialize for a moment) ... Naturally there are some shortcuts that can be done in the application of calculations, when calculations are done manually or with the use of an electronic computer. However, they are beyond the scope of this article. [5] On another occasion, Banzhaf spoke a little more about what he had done. [1960] Calculations of [this] step of the Electoral College's analysis were actually done in two slightly different different methods, using two similar techniques on two fundamentals. The first performance was performed by Lloyd S. Shapley and Irwin Mann (both helped [1]) in the formula of matter. The words in the above excerpt [square paratheses] are my attempts to have clear references to Banzhaf's words in the context of this web page. With these changes, there is no change in what Banzhaf means. Now the question is, what did Shapley and Mann do to calculate their numbers? There was a slightly different definition of the power of a bloc in the bloc voting system but that doesn't matter for the current purpose. The important thing was that they used a very general approach to computational probabilities on large sets of possible outcomes, known as the Monte Carlo approach. This will surprise a few mathematicians and computer scientists. For those of you who don't know the Monte Carlo technique, the brief explanation is that you sample possible output several times

