

# Fractal Voting

In this voting method, each voter rates each candidate in the following manner. The most favored and least favored candidates are identified. The most favored is given a rating of 1 and the least favored 0. Now the voter proceeds to derive a rating for each of the other candidates relative to most favored and least favored. Each of these will receive a fractional rating between 0 and 1 that fits into one computer word. For the sake of discussion we can assume a 32 bit computer word. The first bit would determine whether the candidate was most favored (1) or least favored (0). There could be more than one most favored or least favored candidate. The second bit ( $2^{-1}$ ) would determine if the candidate was less than or greater than  $\frac{1}{2}$  (0 or 1, respectively). Subsequent bits would determine further subdivisions. The voting software would give the voter a choice of how many subdivisions or slots to start with. For instance, if the voter chose to start with 4 slots, he or she would be presented with a screen with a line subdivided into 4 segments and a list of candidates. The voter could then drag each candidate from the list onto one of the 4 slots or subdivisions. Then each candidate would be represented by 3 bits. Likewise, to separate the candidates into 8 groups would take 4 bits etc. The voter could potentially separate the candidates into  $2^{30}$  groups which would be far more than even the most astute voter would probably need to distinguish among the candidates. The voter need not be aware of the numbers that are attached to each slot. The candidates in any particular slot would be preferred to those in the slot to the left and indifferent among the candidates in the same slot. Following is an example in which a voter has specified 4 slots. Candidate J is most preferred and candidate K is least preferred. H is preferred to I which is preferred to A, B, C, D, E and F. B, C and E are indifferent and are preferred to A, D and F which are indifferent to each other.

The voter only need distinguish among the candidates to his own individual sensitivity level. For instance, if he or she prefers only to distinguish between good and bad candidates, this would only take 2 slots or 2 bits (1 bit is needed just to inductate “most preferred” or “least preferred.”) Now say the voter has distinguished among the candidates so that all slots except one contain 1 candidate. The remaining slot contains 3 candidates and the voter wishes to distinguish among these. He or she need only right click on that slot and a menu comes up giving him or her the choice to subdivide that slot. He or she then chooses how many slots to subdivide that slot into. For instance, the voter may think that he or she needs 8 slots to distinguish among the 3 candidates properly. After choosing 8 from the submenu, the screen refreshes to show a line divided into 8 segments with the 3 candidates listed on the side. Again the voter drags these candidates onto the proper slot. Now he can choose to view the entire line-up of candidates. Note that he does not need to subdivide each of the original slots. For instance, in the example above he could choose to subdivide the second slot and distinguish among E, C and B, but remain indifferent among A, F and D in the first slot. He or she need only go into as much detail as he or she prefers, and then only on as many line segments or slots as he or she prefers. Since expanding any line segment brings up similar choices as were made on the previous screen, we call this method fractal voting. From Wikipedia the definition of fractal is the following:

a **fractal** is "a rough or fragmented geometric shape that can be subdivided in parts, each of which is (at least approximately) a reduced-size copy of the whole".

The definition corresponds exactly to this method of voting in that, when a voter wishes to distinguish among candidates, he or she need only click on that line segment or slot corresponding to those candidates to bring up a screen again with a line subdivided into segments that represents a closer up examination of the original slot.

This method of voting has several advantages over Range Voting:

- 1) Every vote is a "full strength" vote. In Range Voting it's possible for a voter to submit a "partial strength" vote if he doesn't pin his most favored candidate to the maximum range vote and his least favorite candidate to the minimum range vote.
- 2) The voter need not be concerned with assigning numbers to candidates. The software does that for him. He or she only need be concerned with ranking the candidates and indicating intensity of ranking. The method is completely visual and easy to implement via touch screen or mouse clicking.
- 3) The voter can choose his or her own sensitivity level. For instance, if he or she wants to vote "approval style," he or she need only separate the candidates into 2 slots. So the arbitrariness of choosing what range to use (whether to use 1-10 or 1-100, for instance) is eliminated.
- 4) The voter can go into detail selectively in those parts of the overall ranking that concern him or her while doing a rough ranking in other parts of the overall scale. In range the voter needs to consider each candidate over the whole scale.
- 5) The binary ranking submitted by each voter is a logical consequence of the voting method, but the voter need not be concerned with numbers at all. He or she need only be concerned with a visual on-screen representation of the rankings.

Each voter will submit one binary computer word that contains a ranking for each candidate which in turn is a number between 0 and 1. A voter can abstain from voting on any candidate; the result is the same as giving that candidate a 0 or "least preferred" status. To choose the winner, one need only tote up the scores for each candidate over all voters. The figure of merit, which can be considered voter satisfaction or social utility, is the same as the winning score. This can then be divided by the voting population to get a normalized figure of merit or social utility between 0 and 1.

We can compare fractal voting with other methods because the voter's submitted ballots under fractal allows us to derive the votes that would be submitted under any other voting method. For instance, the "most favored" candidate under fractal would be the Plurality vote. If there are multiple "most favored" candidates, a random selection among them would be a suitable way of deciding the Plurality vote since Plurality allows only one

candidate to be voted for. With Approval the threshold would have to be assumed. A threshold of 0.5 is reasonable since the voter has ranked everyone above that threshold closer to “most favored” and vice versa. It should also be easy to derive the Range votes, and they should correspond very closely to Fractal. Fractal allows more individual sensitivity than range because the Range limits set the sensitivity for each voter whereas with Fractal the individual determines the selectivity. In each case the votes would have to be normalized to the 0-1 range. They are already normalized for Plurality and Approval and are easily normalized for range. Then the voting methods can be compared by writing a computer program that first chooses one of the possible profiles for each of the voters and conducts a theoretical election. Over a large number of such elections, it would be possible to statistically compare the performance of the various voting methods.