

Incentivization Around Party Platforms Under Different Voting Systems

Brett Biscoll

Computational Modeling for Policy and Security Analysis

Dr. Kyle A. Joyce

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For the final project, I attempted to capture a broad array of simulations in order to identify emergent patterns. I ran three separate Behaviorspace entries to generate results; one for each voting system I was analyzing- First past the post/plurality voting (FPTP), top two runoff voting, and approval voting. As a quick summary, the plurality system has the winner dictated by simply having the most votes, top two runoffs have an open field where all finishers below the top two are eliminated and another election cycle is ran, and approval, which is won by whoever has the highest 'approval rating', where each voter can cast 1 vote for any, all or none of the listed candidates.

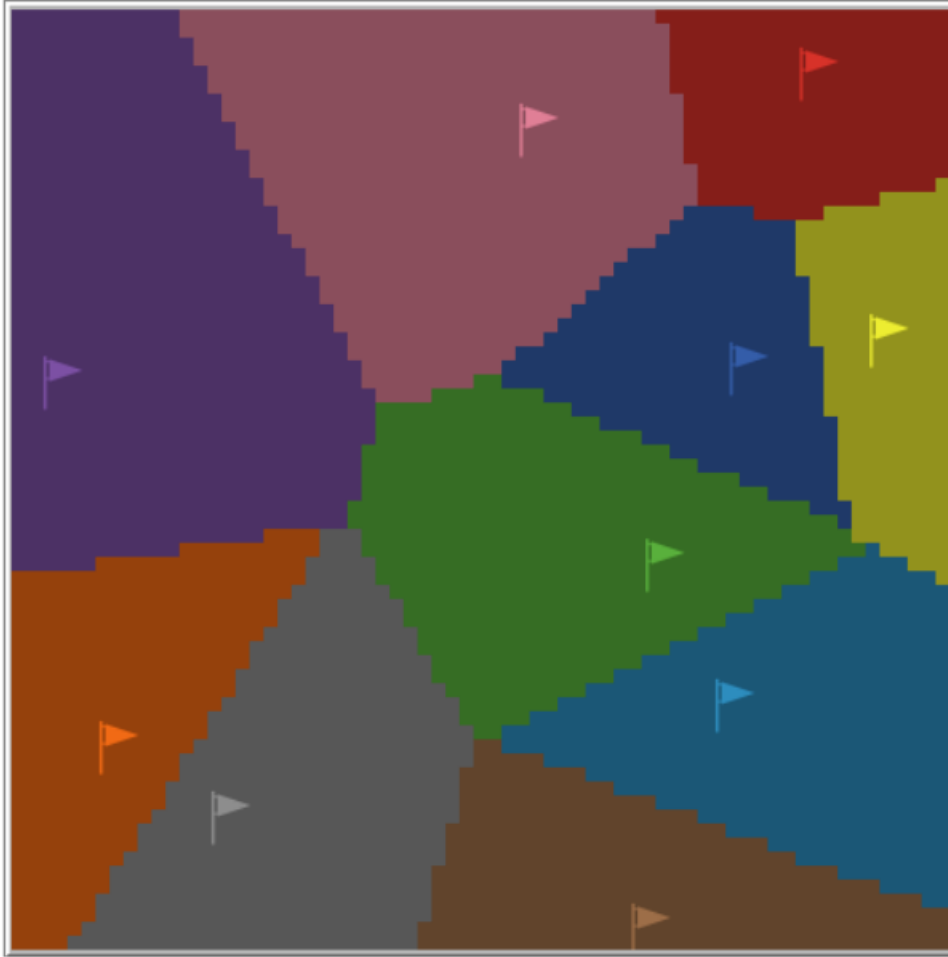
For the simulations of plurality voting, my parameters varied only in the number of parties present in the election series. These numbered from two parties setups to ten party setups. I ran twenty repetitions of each cycle to find generally repeatable findings.

For reporters, I took the coordinates of the winner's platform, as well as the reporters that reported coordinates for each party in the simulation. Note that I had all reporters running in each simulation; i.e. party-paths-party-2 would return no results when run for a two-party election series, as the turtles begin counting with 0. During my data cleaning phase, I removed null responses from these cells.

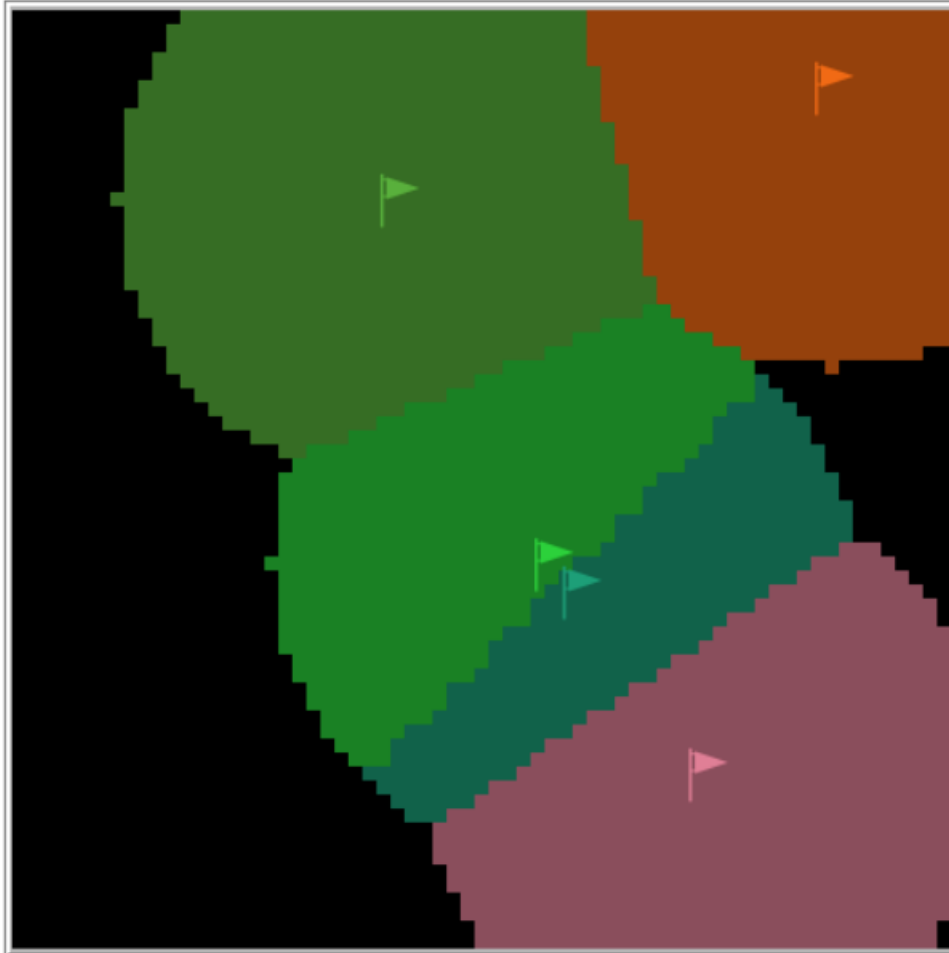
Additionally, the model as originally run can go on indefinitely; the termination point is artificial. While programming I usually used a 200-tick limit, but due to the number of runs I was planning to do (180) and the apparent stasis of most models well before then, I used an ending tick of 100 cycles. As we will, see most models reached an equilibrium well before this point.

The next system being examined, the top two runoff system, is similar in that the number of parties is the main factor being varied. However I used a different set of parties compositions for simulation, with 3 party, 5 party, and 10 party configurations. The reasoning behind this is that a top-two runoff with two candidates is functionally analogous to a plurality voting system with two candidates; results from this would be redundant as I assume the political parties do not reconfigure platforms mid-election cycle. Further, I noted that phenomena in the plurality voting simulations seemed similar amongst high and low sets of parties; therefore I selected three parties to cover the less crowded field (possibly imitating the UK election landscape, where three major parties in the Conservatives, Labour and Liberal Democrats vie in most elections excluding regional parties), five parties for a medium sized field (imitating the German system of a handful of parties with high election thresholds to eliminate minor parties), and ten parties on the far end of the spectrum for a highly crowded field (imitating highly multiparty democracies). For reporters, I used the same series as in the plurality voting simulation, to gain like results for comparison.

Lastly was the approval voting simulation. Here I ran simulations for 2 party systems, as well as 3, 5, and 10 party systems; however, there is a further wrinkle in the approval voting simulation not needed in the others. This being how the voters decide who they approve of most. For this simulation I kept to the credo of simple agents without perfect information; voters do not vote strategically and each uses the same criteria. This criteria is the distance from them where they will vote for a candidate. This symbolizes voters accepting voters whose platforms are 'close enough' to them. While slightly harder to visualize vs the 'pick-your-favorite' method off the other two candidates, it can be visualized with relative ease. See below:



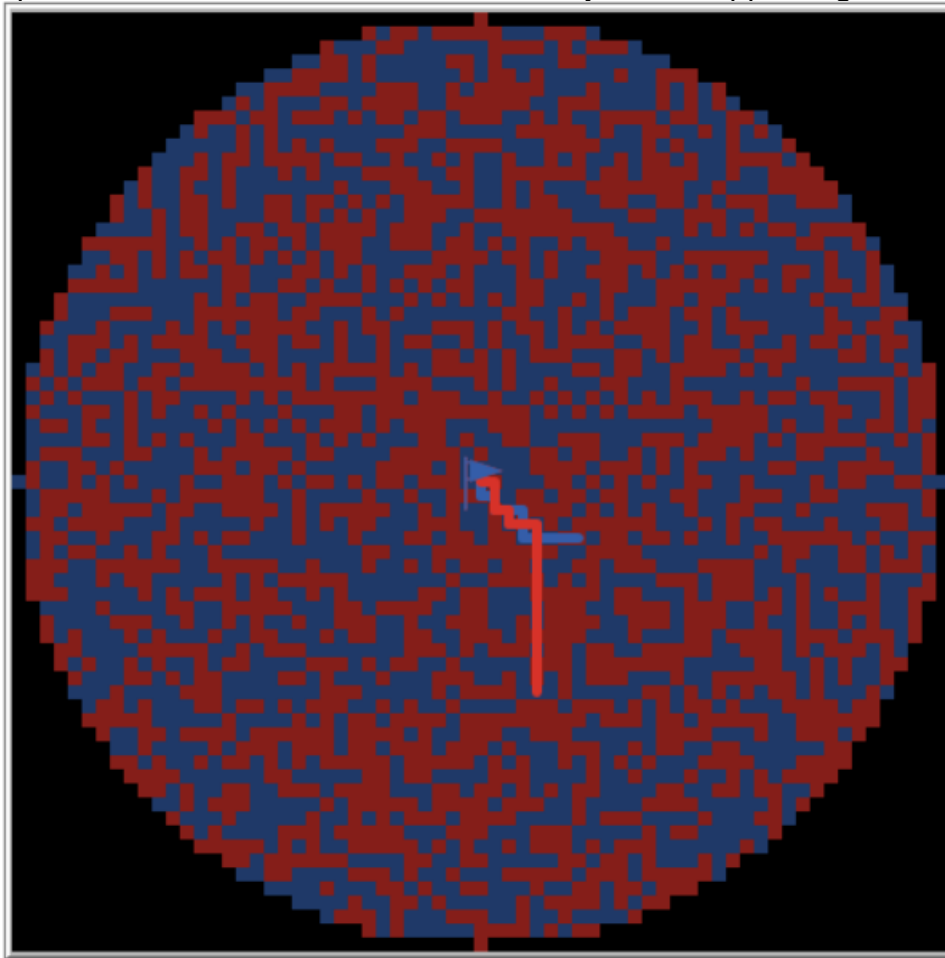
This is the visualization for my plurality voting model. Here, each patch is identifying their closest candidate and casting their vote accordingly, being marked with a similar shade as their candidate accordingly to help show relative vote shares; purple, pink and green are each doing well while yellow is struggling to find support with red sapping voters in the top-right and blue sapping them to the left. Below for contrast is an example of an approval voting field:



Coloration rules are similar to plurality, with voters identifying their closest candidates and being shaded accordingly; however, for approval voting, make note that the voters can approve of multiple candidates; thus, dark green and bright green can coexist as viable candidates with a possibility of winning here, while orange is losing voters as its 'radius of approval' bleeds off beyond the spectrum of voters. Additionally, note the 'dark' voters with no candidates close enough for approval; these are the sit at home voters with more radical policy preferences.

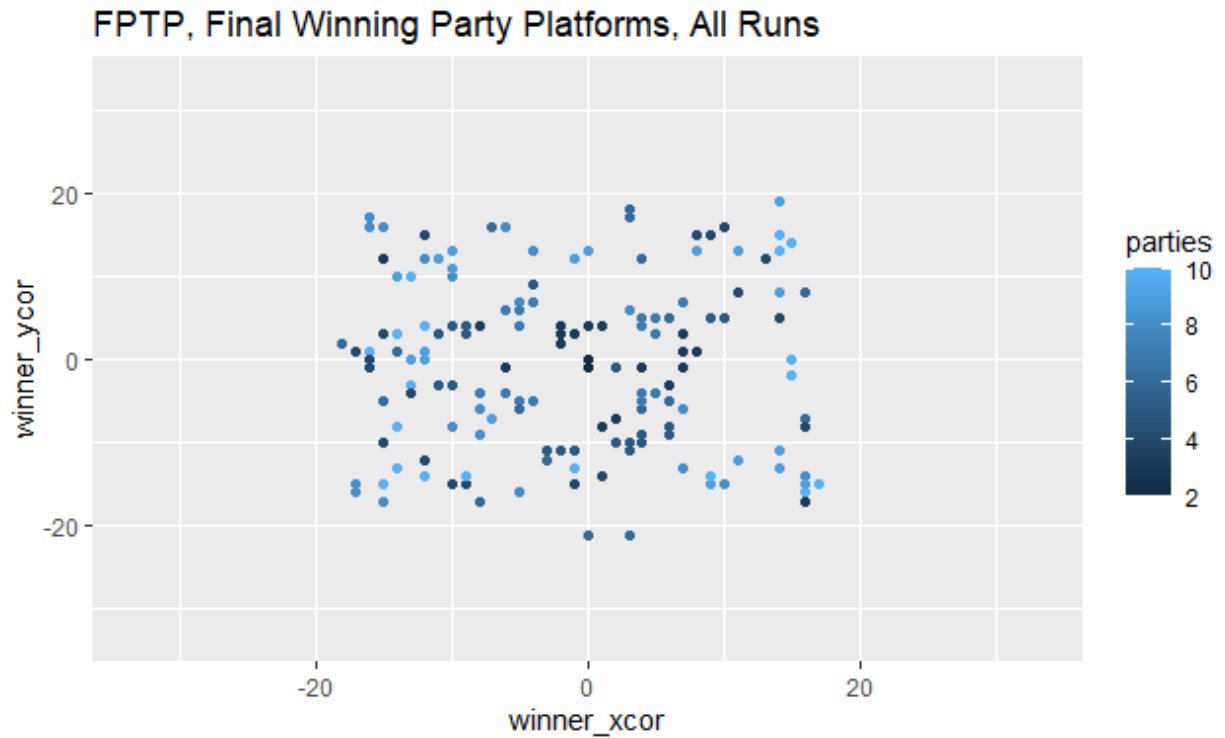
Returning to the parameters, the question is how much distance will voter's tolerate? Under the assumption, I test three settings; a 12-patch range, tolerating only a radius of 12 patches from themselves; 25, approving of candidates less than half the distance of the entire space away; and the incredibly generous 32, accepting candidates the full

spectrum across on either axis individually, but disapproving of those further away.

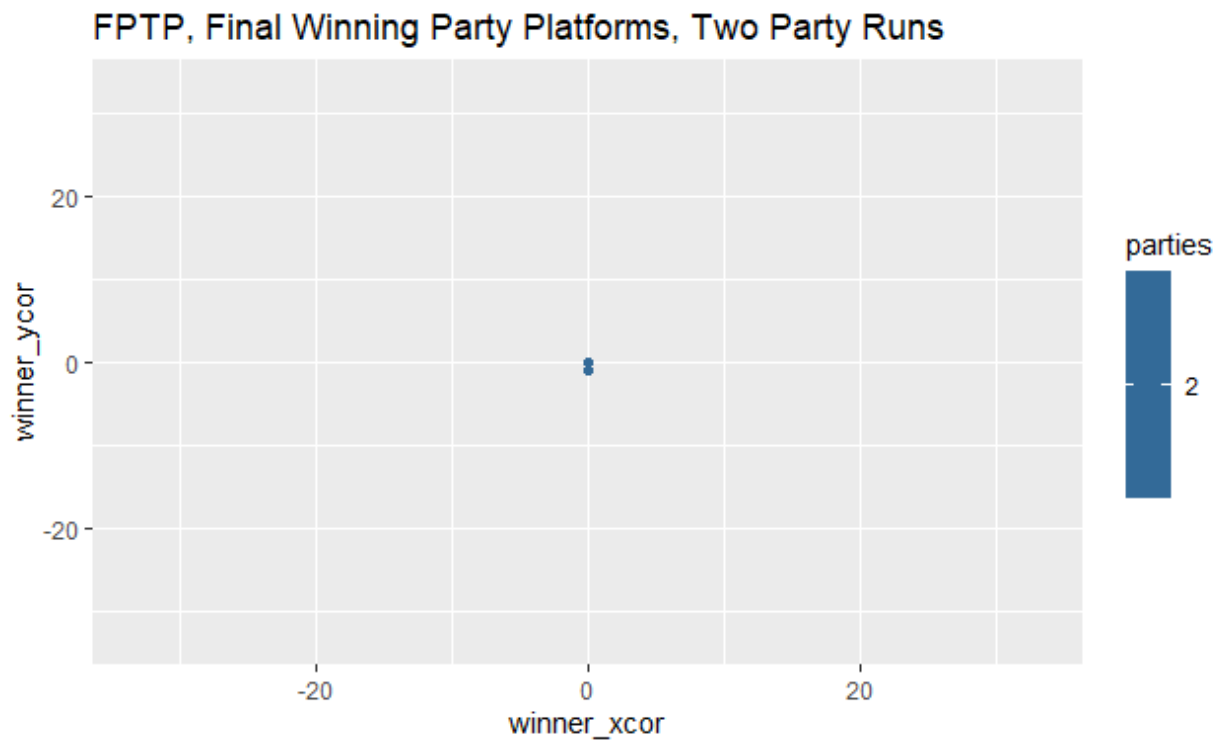


Note that when faced with two equally acceptable candidates, shading is random in approval but the voters in radius cast votes for both candidates. Lastly, reporters here are the same as in the plurality and top two runoff simulations.

For the findings under each model must be approached from several directions in order to be properly understood. First of all is the plurality voting model, the 'baseline' we are working with in the United States. To get a quick snapshot of the results produced by this model, we go to the winning platform coordinates at the conclusion of the simulations at tick 100. To reiterate, the space occupied by the parties is a two-policy two-dimensional platform space, with each coordinate representing a specific worldview; coordinate $(-33, -33)$ describes an extremist in both the x and y axis. The actual policies are deliberately left unnamed as the spectra of politics can change over time (i.e. left and right wing mean something different in the US than in France or Korea, or even in the same country during the French Revolution, World War 2 and the present day; however we assume the spectrum is stable in a descriptive fashion over time. Using shading I show how different crowd sizes (of parties) motivate different results:



An apparent trend of the multiparty elections is that the more parties contesting, the more extreme candidates are viable. Narrowing down on the 2-party simulations, we see something rather jarring;

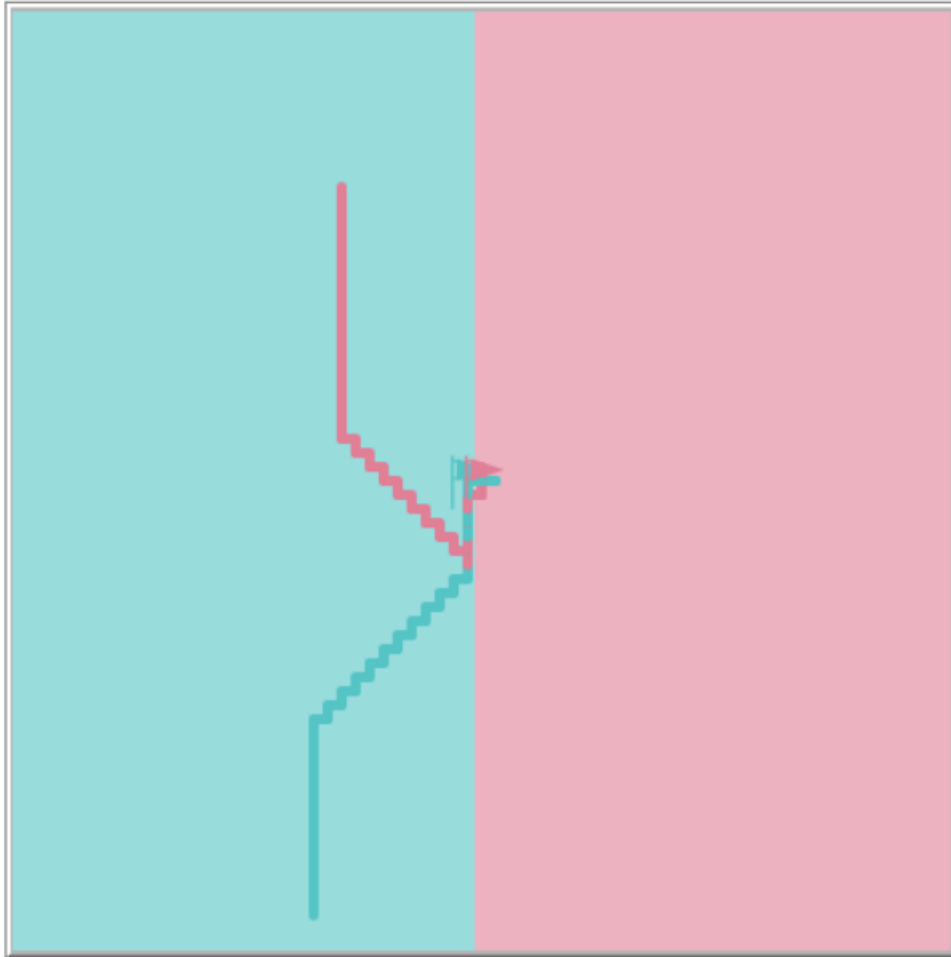


Precisely two different winning campaign platforms at step 100 for two-party systems in the plurality simulations. Initially I believed this to be an error due to the extreme consistency, but a filtering of the results available indicates that it is merely a case of overlap, and the true results are even more homogenous than realized:

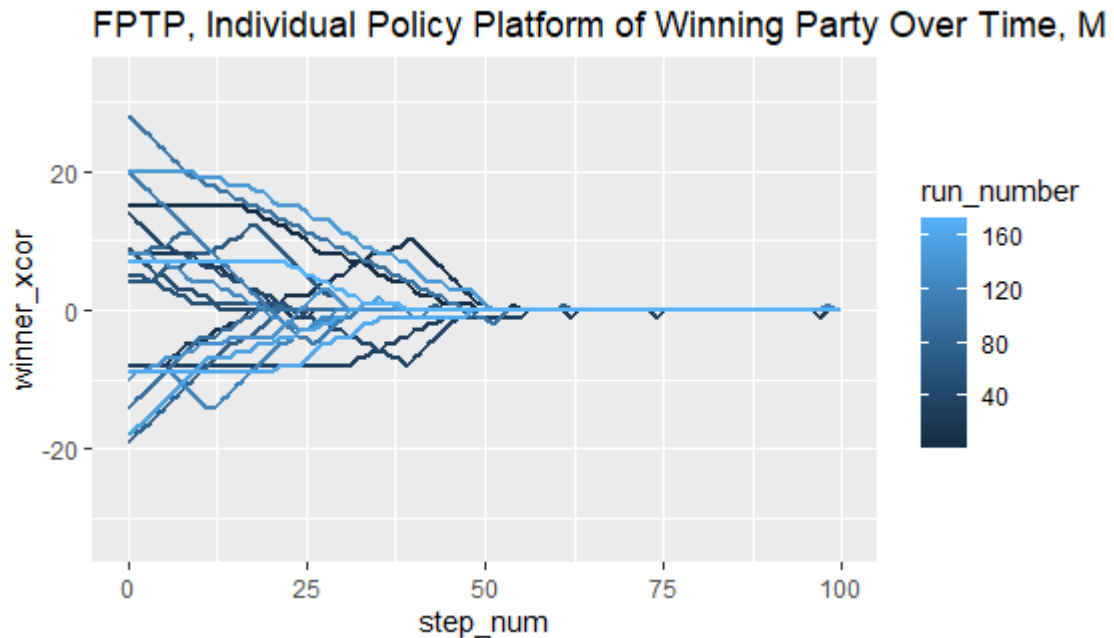
```
> fptp_clean %>%
+   filter( parties == 2,
+     step_num == 100) %>%
+   print()
# A tibble: 20 x 5
  run_number parties step_num winner_xcor winner_ycor
    <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
1      1      2    100      0      0
2     10      2    100      0      0
3     19      2    100      0      0
4     28      2    100      0      0
5     37      2    100      0      0
6     46      2    100      0      0
7     55      2    100      0      0
8     64      2    100      0      0
9     73      2    100      0      0
10    82      2    100      0      0
11    91      2    100      0      0
12   100      2    100      0      0
13   109      2    100      0      0
14   118      2    100      0      0
15   127      2    100      0      0
16   136      2    100      0     -1
17   145      2    100      0      0
18   154      2    100      0      0
19   163      2    100      0      0
20   172      2    100      0      0
```

For explanation, the above code shows the data being filtered to the 100th and final step and all runs outside two-parties being filtered out; here we see that of the twenty simulations, each ended up at the exact median point.

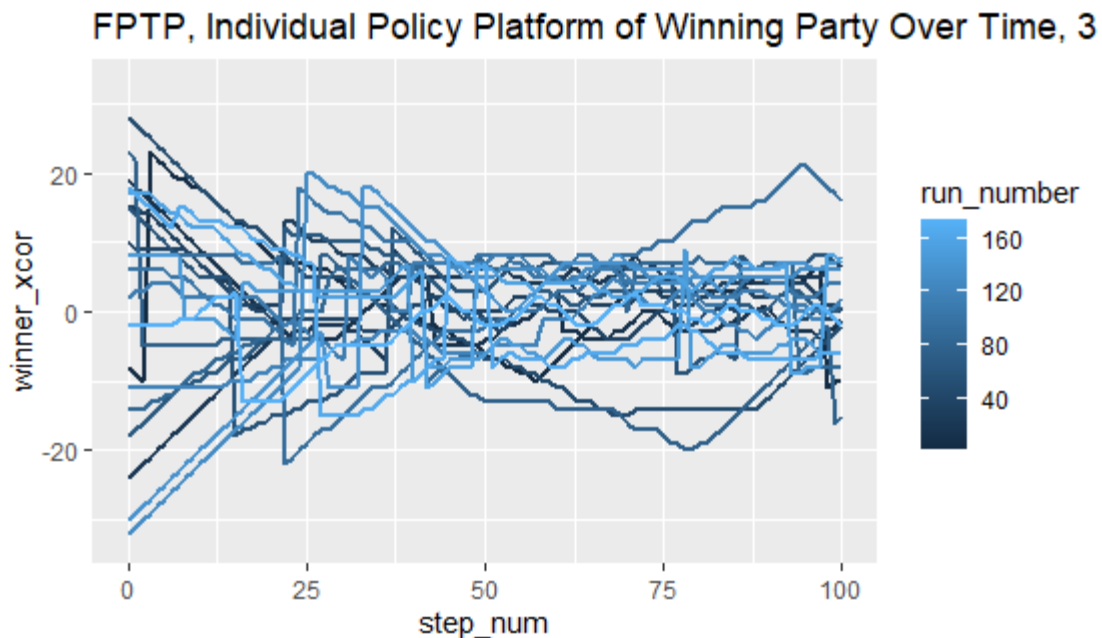
A viewing of the model reveals what is going on. In the two party system with plurality elections, we see repeatedly that the drive to a competitive platform pulls parties towards the center, to appeal to a maximal number of voters. Thus the trend towards essentially identical platforms where the voter's decision is determined by a single step in one coordinate away or totally at random. While some may object to the two party system promoting moderation, this does have mirrors in real life that we will circle back towards.



Sticking to the two-party system for the moment, an overlay of the Y-platforms of parties in this system shows the convergence to the center:



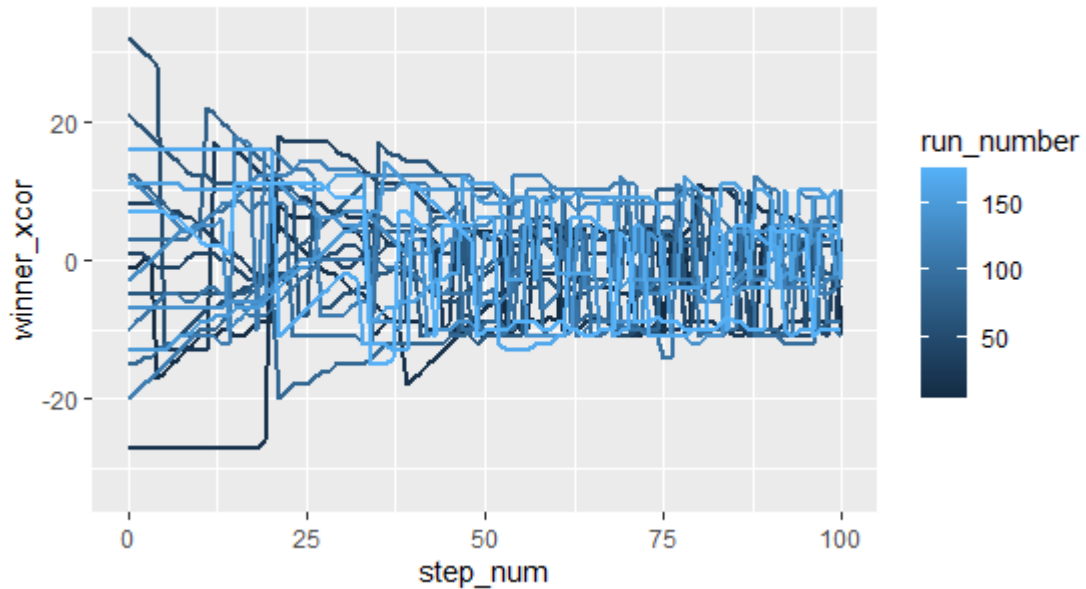
Regardless of the starting platform, political Darwinism dictates that fitness is by getting the most to vote for you, and one gets this with a broadly appealing centrist position. But this is only for a two-party system; what about multiparty? Looking at the individual policy when the number of parties $p > 2$ reveals something less directly enlightening:



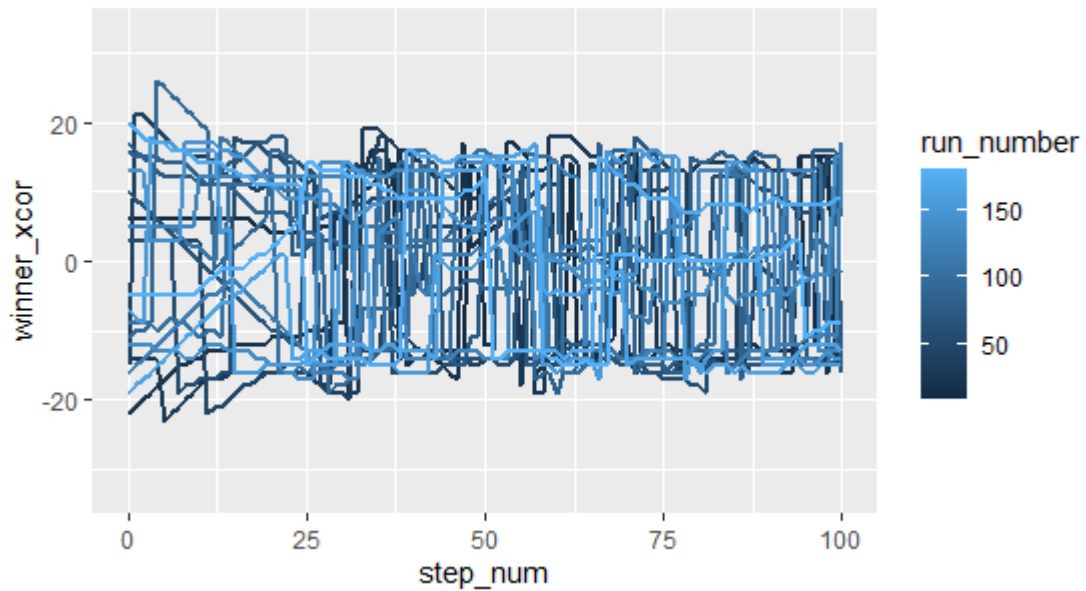
This compiles platforms in a 3 party simulation. While the effect of narrowing down the platforms away from extremism can be seen up until about step 50, they do not narrow down into a commonly acceptable median as with the two party system; additionally, a distinct set of outliers where a more extreme party wins are visible on the

edges. Looking into the simulation results for five and ten party configurations we see the same trend:

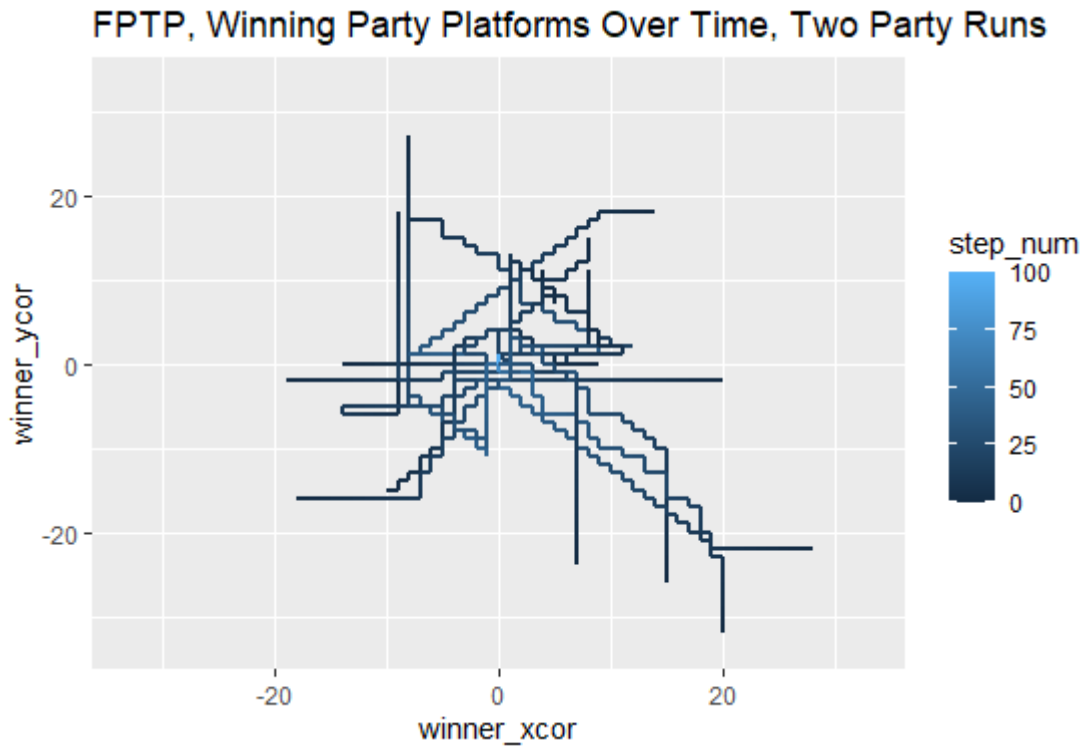
FPTP, Individual Policy Platform of Winning Party Over Time, 5



FPTP, Individual Policy Platform of Winning Party Over Time, 5

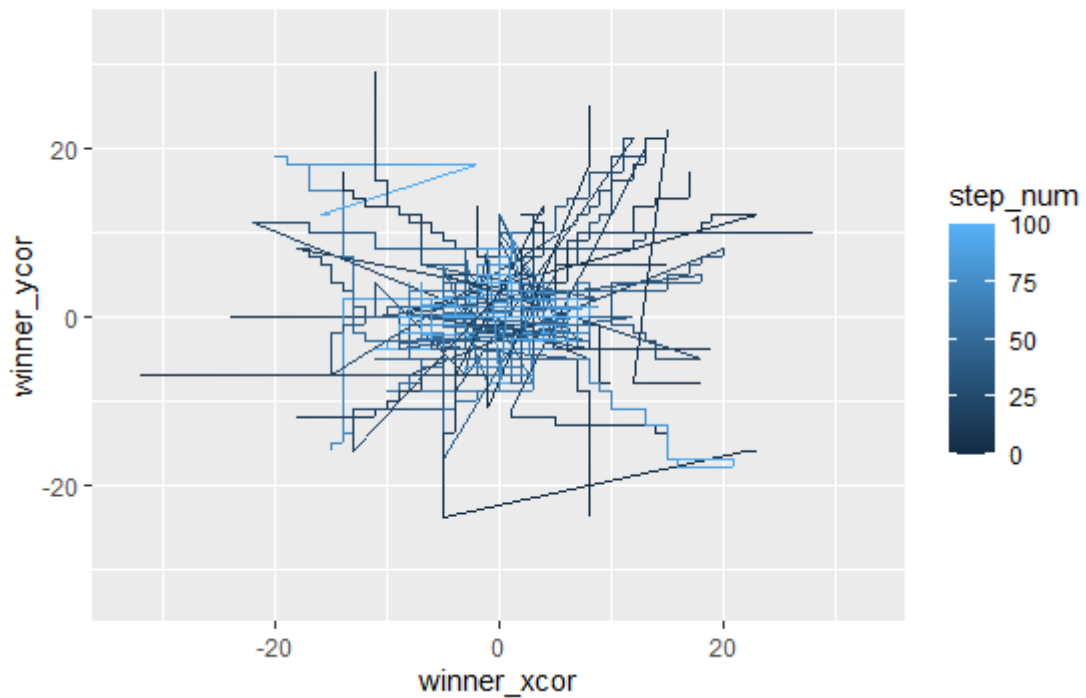


The additional parties cause less and less incentive to tack to the center. Another way to understand this is to investigate the path over time in two dimensions:



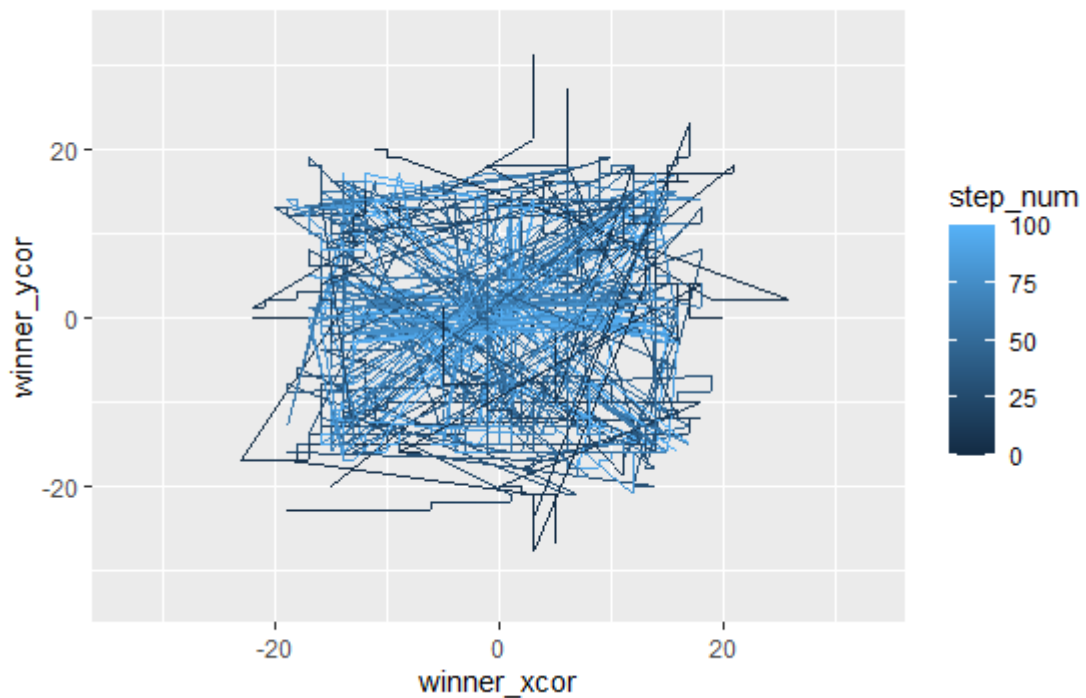
For the two-party configurations, we see the winning platforms assorted fairly randomly though away from the edges for the most part; however, looking towards the further point of the simulations (here represented by a light blue segment) we see that they converge towards the center. For a three-party system we generally see the same thing:

FPTP, Winning Party Platforms Over Time, 3-Party Runs



However, the convergence is towards a wider spread over the whole of the workspace. Lastly for a multi-party run of ten, we see that the convergence is hardly a convergence at all:

FPTP, Winning Party Platforms Over Time, Multi (10) Party Run

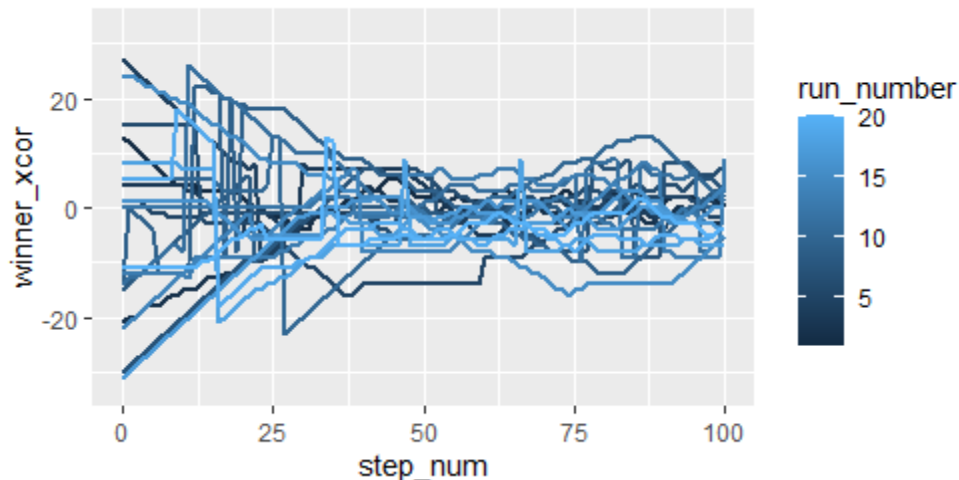


Edge cases remain selected against, but there is a wide berth in the center where the winning platforms are starting roughly 50 steps into the simulation.

While I will analyze these findings more thoroughly, the takeaway primarily from the plurality system is that 1) the two-party form promotes convergence towards the center, and 2) the multiparty form allows winners with more extreme platforms.

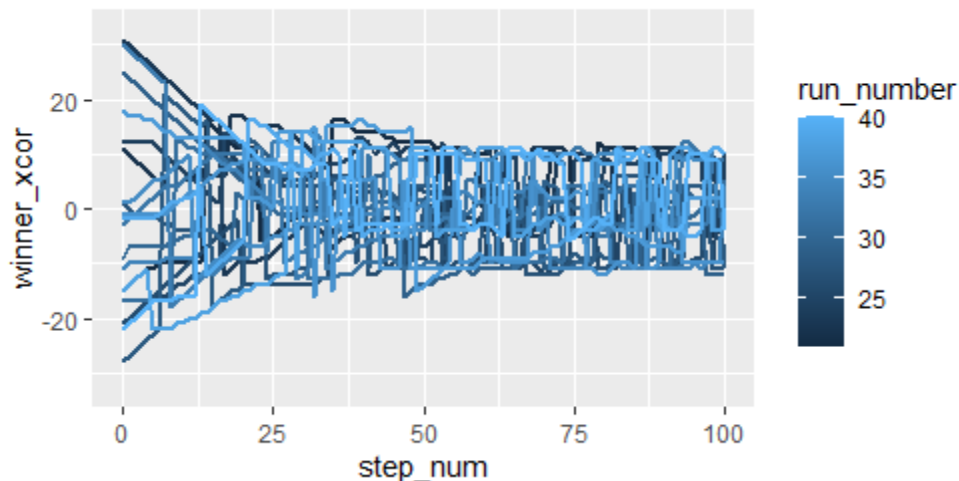
The top two runoff system had likewise interesting results. Firstly looking at how the Y-policy of the winning party developed over time in a three party system, we see a similar convergence as with the two party system;

Top Two, Individual Policy Platforms Over Time, Three Party

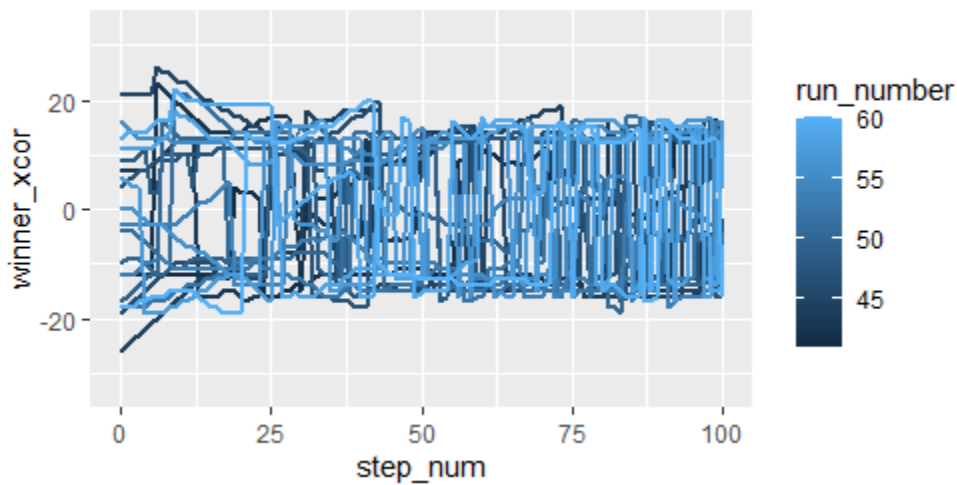


The extreme positions converge, while not as acutely as with the two party system, still to a noticeable degree. With the five- and ten-party systems however, we see that convergence's effect limited;

Top Two, Individual Policy Platforms Over Time, Five Party

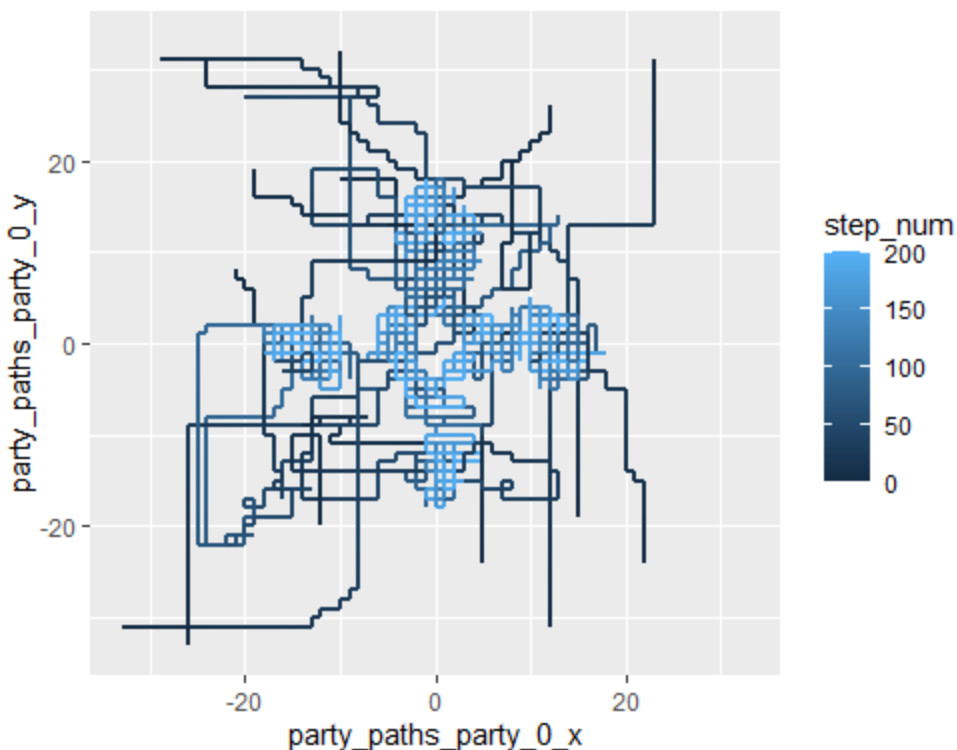


Top Two, Individual Policy Platforms Over Time, Ten Pa



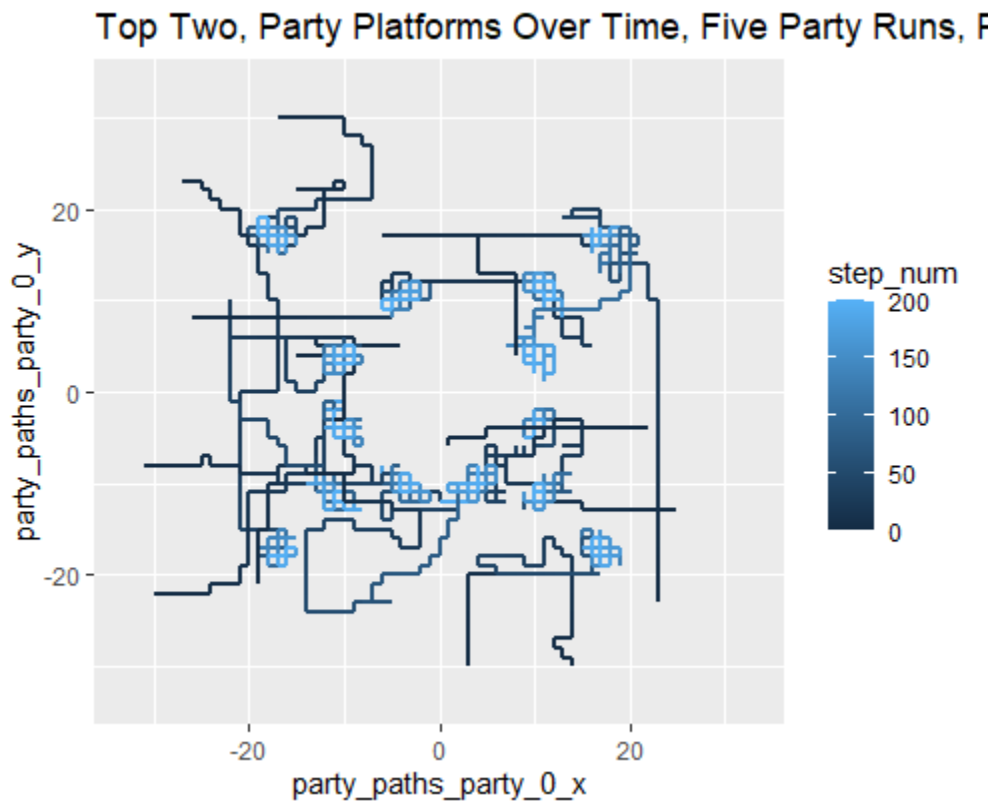
The trend of more parties allowing more extremism remains active here as well. As for the paths taken, we see a distinctly different phenomena than in the plurality system:

Top Two, Party Platforms Over Time, Three Party Runs.



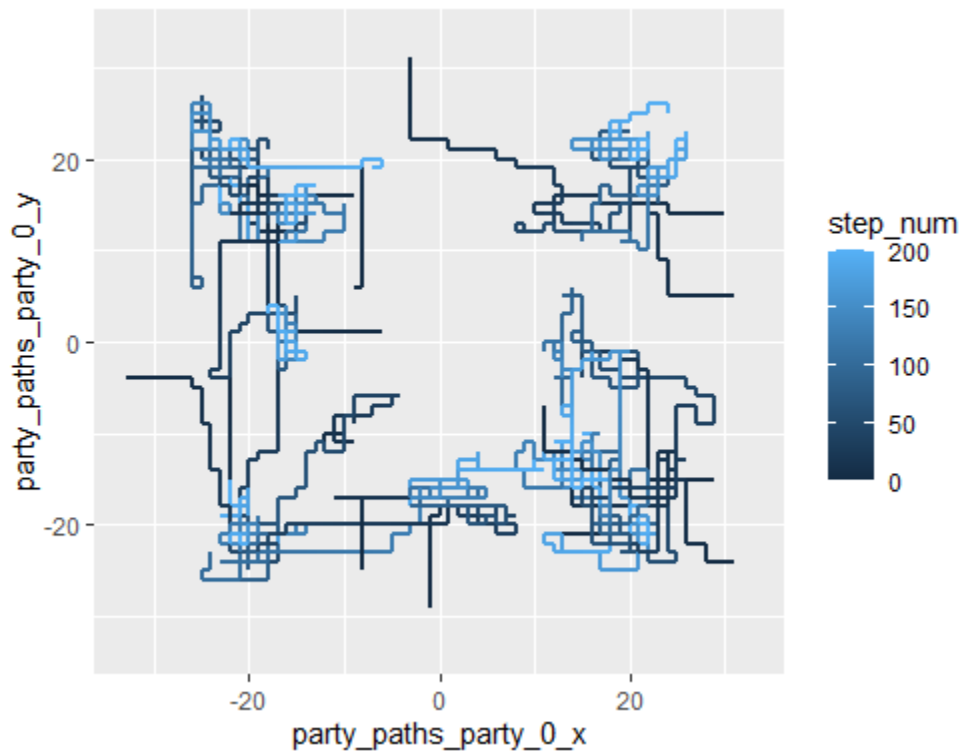
This graph shows individuals platform runs over time. I allowed these runs to continue an additional 100 ticks to allow the pattern to develop where the plurality system was mostly static, and a definite pattern of parties finding a political 'niche' emerges; there are distinct points in the left, right, top and bottom where the platforms

end their journeys and move away from the extremist edge. While the same pattern is present in the five party system, we do see a different place where the parties ultimately come to rest:

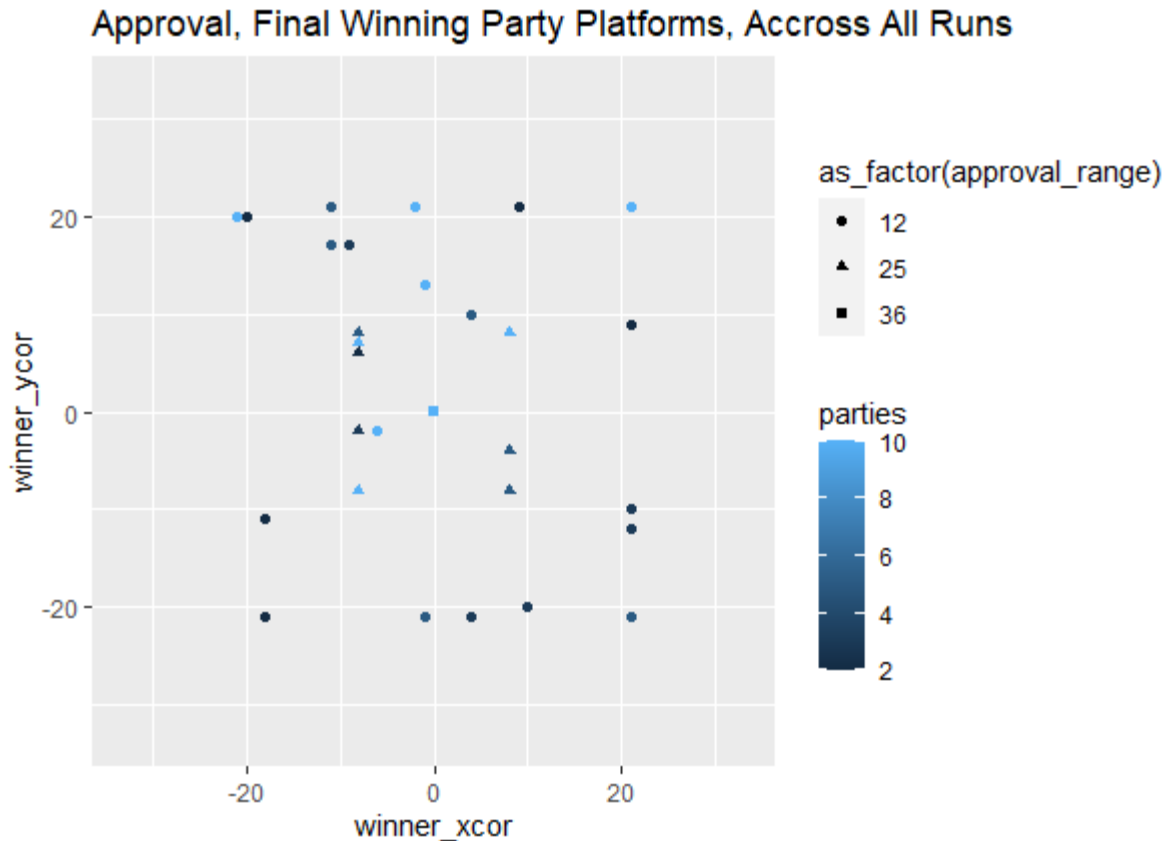


The niches here being more spread out and in fact avoiding the perfectly center position. For the ten party system, the extremism positioning is further developed:

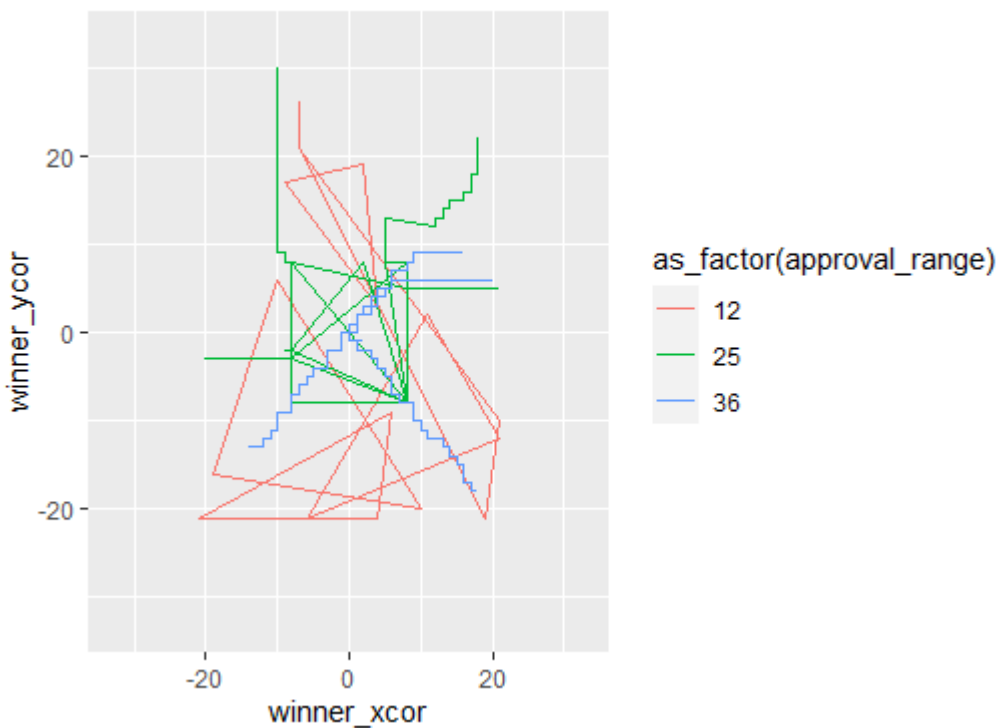
Top Two, Party Platforms Over Time, Ten Party Runs, F



This brings us to the approval voting system and its impacts. The approval system allowed for toggling of approval distance and party systems, and a plot of the two final resting positions shows a distinct relationship:

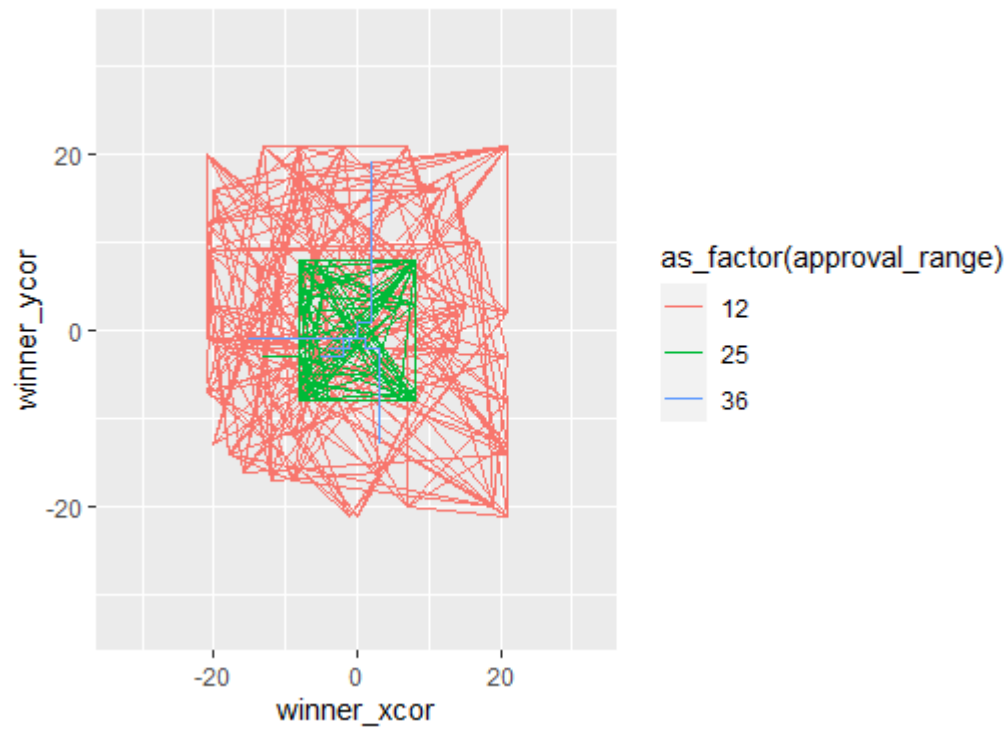


Approval, Winning Party Platforms Over Time, Three Parties



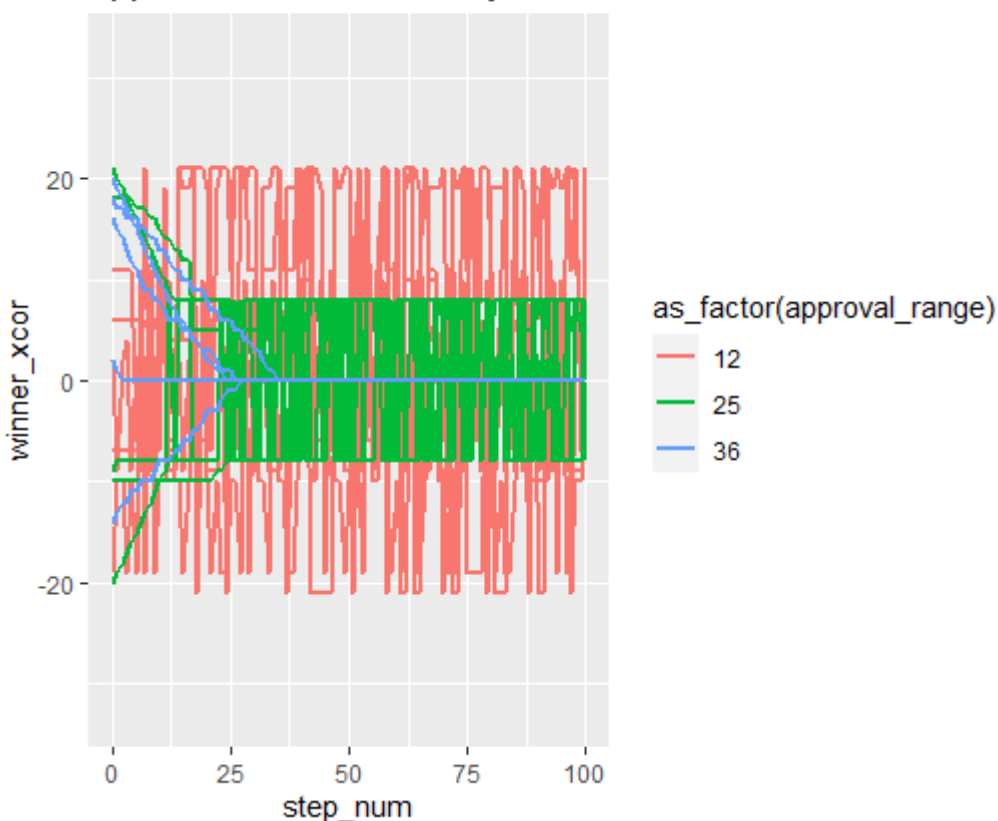
We see for maximal approval (blue) the parties converge towards the center; for medium approval (green) the party move towards a goldilocks zone defined by a box where the parties can travel within but moving without loses approval and therefore votes; lastly for orange there is a similar box forming but due to its size it is only partially visible here. When looking at a wider array of runs we see a clearer delineation of the goldilocks zones promoted:

Approval, Winning Party Platforms Over Time, Ten Parties



As for how the development of the winning party platform is impacted, we see something quite similar:

Approval, Individual Policy Platforms Over Time, Three Par

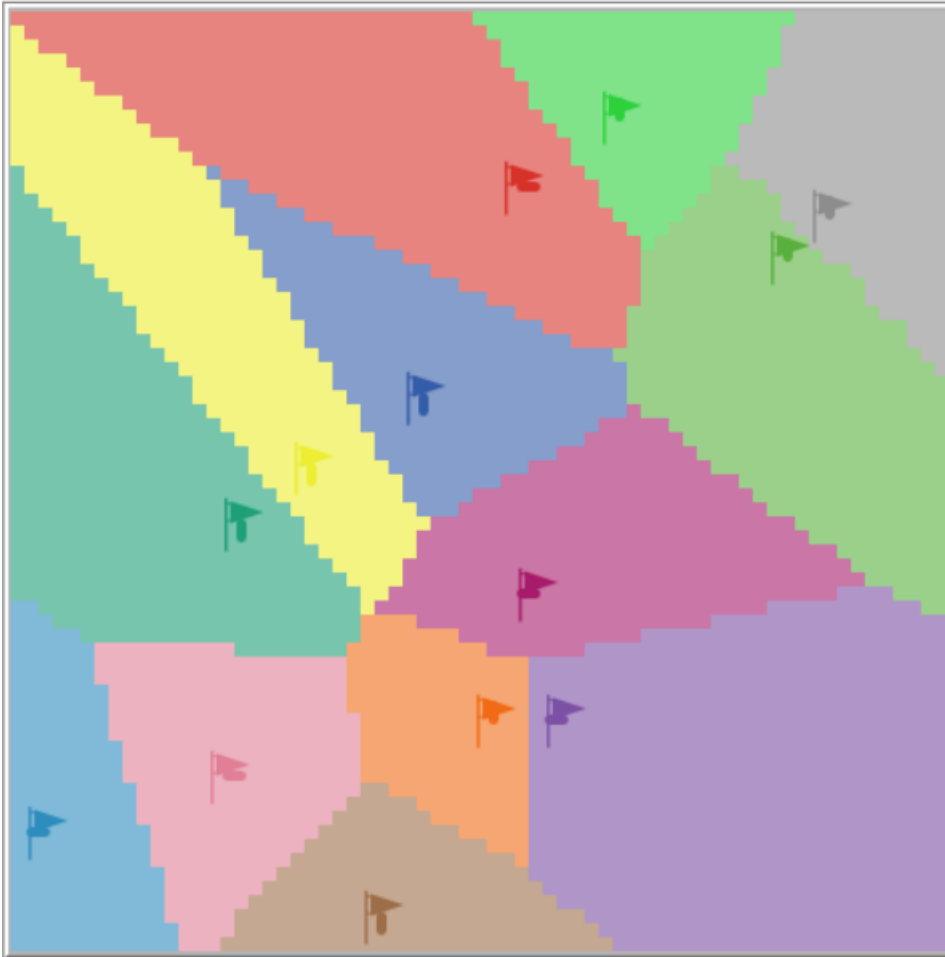


For the wide approval range, convergence matches the two-party plurality system; for medium and narrow approval ranges, the winning platform can fall into a more extreme range.

In summation, plurality voting in a two-party system promotes moderation; in a multi-party system it permits a winner with more extreme ideology. Runoff voting promotes some convergence that decreases with more parties entering the field; and allows parties to find a specific niche to represent in the political spectrum. Lastly, approval voting creates a 'goldilocks zone' of acceptability in which a party can thrive and be competitive in elections but stepping just outside removes them from the equation all together. The question becomes how these impacts come to be, and what real-world phenomena they represent.

For the two party system under plurality voting, I posit the moderation is similar to Hotelling's law (indeed, he had a similar analysis on median voting as in economics! (Hotelling, 1929)); indeed the parties need to appeal to the highest number of potential voters and do so by taking a broadly appealing platform. Therefore, the two-party system is a simple system for promoting moderation; however, this does not match with current beliefs about the state of American politics under a two-party system.

Furthermore, it breaks down significantly with the addition of multiple parties; the ability of a party to win a three-way plurality contest with 34% while the other candidates take 33% is a model of this. For a visual example, see below:



The Purple party takes the plurality election with just under 16% of the vote, in spite of being a relatively fringe position that does not appeal to much of the electorate; indeed, the Condorcet criterion (whether a winning candidate would win head to head versus any other party) appears to fail for matchups against orange, burgundy, blue, etc. Therefore, it is easy to see the system as unstable and rewarding platforms that happen to be unique, versus broadly appealing.

The implications of the runoff system are such that it promotes this exact competition between the top two. However, a similar issue exists in that unique placement in round one by one or two parties can present an unpalatable decision for many voters between 'terrible' and 'mediocre'; further, the apparent incentivization against the center in some contexts seems like a negative; parties in the first past the post system may move to the center to appeal to the most voters to reach the runoff, but find it to be crowded, resulting in further out parties progressing to round two; thus the parties inch away from the center, creating a type of no man's land where too much centrism without appealing to other voters result in competition over too few votes.

For approval system, the parties are irrelevant; the same patterns play out with two or ten parties. The party will drift towards an area where it maximizes the number of voters within its 'cone of indifference'; thus, extremism is punished and functionally made uncompetitive. Under my simulation, there is no strategic voting, and all voters use the same approval criterion (distance); thus once a party enters the goldilocks zone,

it has no incentive to move further, and remains in place. The approval system with a medium range has the most durable moderating effect of any of the above policies, a point policymakers should keep in mind when designing systems.

The discussion then moves to how this relates to the real world; I reiterate the earlier point that the incentives offered by the electoral system shape the resulting political life of the body. There are not a one-size fits all method that can be applied to every body politic; but the considerations should be made. For consensus making approval voting seems the most efficient; it punishes extremism and creates an acceptable goldilocks zone voters can live with. For a rotation of power, the runoff system seems more effective, siloing different parties to different sections of the electorate. The plurality system, while simplest and in some ways the most traditional, bears the negatives of allowing 'slicing and dicing' the electorate and allowing a party with little widespread appeal to take over. When constructing a voting system, these facts should be kept in mind. The implications are such that I would promote approval voting for any executive authority that requires consensus support, as it allows for the greatest appeal for most of the electorate.

As for where to take the model in the future, there were several directions I hope to revisit; amongst them are other forms of single-winner voting (including instant runoff voting; grade voting, the STAR system. Determining the incentives created by these systems for candidates and parties can offer policy makers a broader range of options that may better fit the situations created in real life.

Further, while my models were focused on single-winner systems, a better method may be to take the multi-winner approach as well as elections can be analyzed as national it is worth approaching the subject in its entirety as well as the constituent single-winner parts. Further, as many nations use multi-winner systems (such as Germany) it would allow for further voting methodologies to be tested.

Additionally, another area of expansion would be to reverse the model and determine how the voters are incentivized; prospectively I would create a system where voting was dictated by policy similarity, the voter's own position versus the other voters; candidates up for election and their platforms, and outputs being the voting options. The possibility of training a neural net to see how voters develop strategies to get the best possible candidate would be enlightening; I would anticipate seeing a version of Duverger's Law whereby plurality supports two party voting as all other candidates become noncompetitive.

The incentives of different voting systems shape the political life we all experience; being able to understand that process is pivotal in maintaining the health of the countries politics in the future.

Works Cited

Hotelling, H. (1929). Stability in Competition. *The Economic Journal*, 39(153), 41–57.
<https://doi.org/10.2307/2224214>