An Prediction Model Based on Majority-vote Model for Moscow Mayor Election

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ABSTRACT

This work reports a majority-vote model for the prediction of Moscow mayor election on September 8, 2013. With 3 extra parameters to control how voters hold or change their opinions. We evaluated the parameters as human density, influence and tolerance. Therefore, voters change of mind and voters' decisions may be influenced by the number of other votes nearby and personal characteristics.

INTRODUCTION

Majority-vote model are simple models used to study dynamical phase transitions.[1] The models simulate the simultaneous operations of multiple entities (agents), in an attempt to re-create and predict the actions of complex phenomena. In our work, we use our model based on majority-vote model to predict the election of Moscow mayor in 2013.

We consider the neighbours' opinions and social media's influence as main ways to change voters' party preference. Also, we defined the tolerance of a person which shows this voter determined or swinger.

The model is structured as a cellular automaton in which a two-dimensional lattice characterizes the geographical space of interaction.

DETAILS OF MODEL

In our case, the majority-vote model described in paper focus on the social contagion among voters, including influences from neighbours and global events like media, promotion, polls etc. We use bias to manually define the influence of global events. The transition rule makes people in the centre of Moore neighbourhood able to change their opinion for supporting party 1 or 0.

An initial distribution of voters is set in a grid Figure 1. The landscape is a 2-dimentional cellular automata grid with the shape of 200*200 square. The data of party supporters comes from Election of the Mayor of Moscow on Sept 8, 2013. In addition, data form List of districts and municipalities with data on population density and an questionnaire on August,2013 help us define the density and fraction of initial conditions. So, there are two candidates Sobynin and Navalny, each of them has 82.05% and 17.95% supporters respectively at the beginning. The initial parameters for the landscape of model are demonstrated in Table 1:

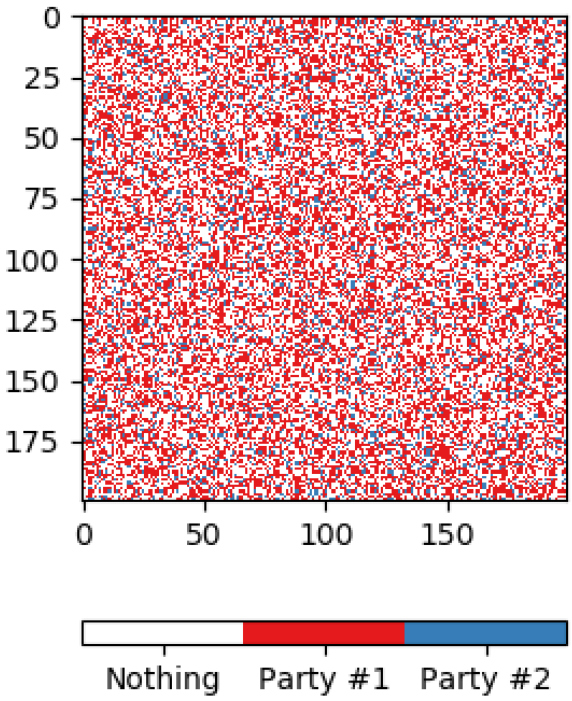

Figure 1 The figure of grid

Table 1 The parameters of grid

Name	Parameters	Description
Geography space	width, height	We use width*height to define the geography space of voters.
Human density	Human density	Human density is potion of voters on geography space
Voter distribution	Party1 or 2 percentage	The portion of supporters for party1/2

Each voter has several parameters for the future process of transition must be set before running the simulation. The attributes for each voter are demonstrated in Table 2:

Table 2 Attributes details of each person

Name	Attributes	Description
Party preference	Sobynin or Navalny	We use 1(red) or 0(white) on figure 1 instead of candidates respectively.
Influence	Alpha of influence	The ability of Influence stands for the strength of a person to persuade opponent.
Tolerance	Conviction	The ability of tolerance stands for the strength of a person to resist opposite opinion.
Global events	Party 1/2 bias	Bias is defined as a wide influence among all the voters in one of the parties.

At the beginning of simulation, although we have the distribution of landscape parameters from real data, we still need to figure out the distribution of the attributes

of each person. Basically, we use random statistic with a fixed portion for the distribution of party preference. In addition, an random statistic conform to inversed pow law distribution for the distribution of influence is set. What is more, we use normal distribution to assign the tolerance for each person. Lastly, global biases are set for adjustment.

Transition rule

For each voter supporting part 0, the transition of changing their opinion is depending on bias and neighbours' influence:

$$Mind\ change_0 = \sum_{k=1}^{n=8} Influence_1 + (Bias_1 - Bias_0)\text{-}Tolerance$$

If $Mind\ change > 0$ the person change his mind to support party 1, otherwise he kept his opinion.

For mind change of voter supporting party1 uses the same formula with reversed 0 and 1:

$$Mind\ change_1 = \sum_{k=1}^{n=8} Influence_0 + (Bias_0 - Bias_1)\text{-}Tolerance$$

Sensitivity analysis

Human density

The human density is defined as:

$$Human\ density = \frac{Total\ voters}{Grid\ space}$$

With a fixed condition, the different values of human density have different influence to the result of distribution of parties:

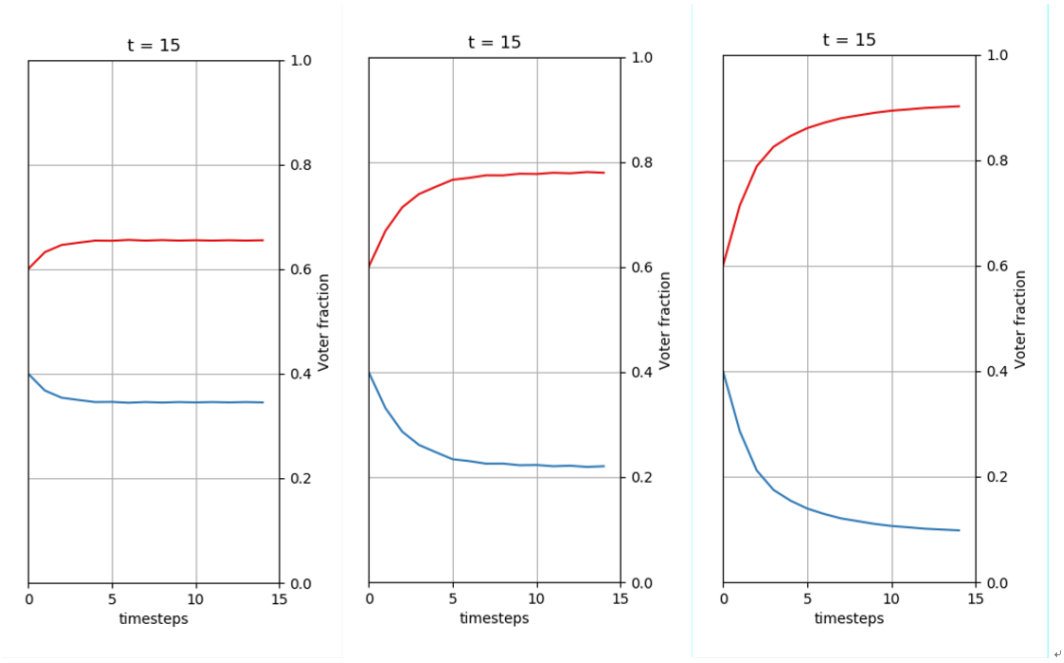

Figure 2 Human density with 0.3, 0.6, 1.0 respectively

As we can see from Figure 2, with a fixed 060%for party 1 and 40 %for party 0, the higher human density makes the party preference of voters more aggressive. In conclusion, the higher density could enhance appearance of majority-vote. That is because the higher human density accelerate the interaction between voters and their neighbours.

Influence and tolerance

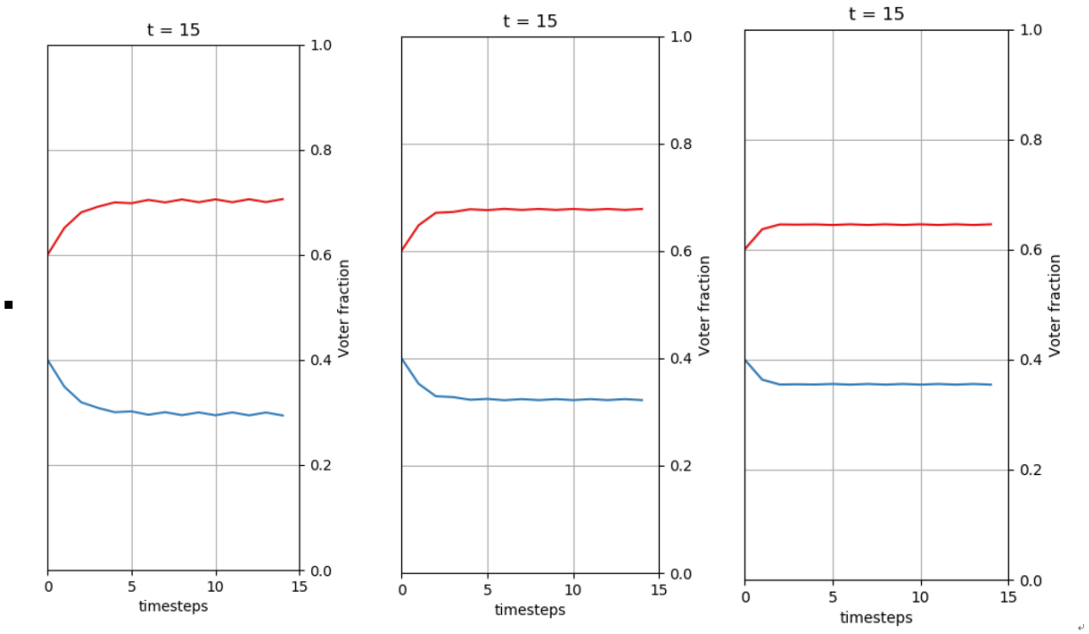

Figure 3 Tolerance with 0,3,6 respectively

The difference between influence of neighbours and tolerance of voter determined if the voter will change his mind from a local perspective (without bias). From Figure 3, with a fixed influence distribution, we adjust the mean value of tolerance (tolerance refers to normal distribution) from low to high. Here are things we fond: firstly, with increasing tolerance value (which means decreasing difference between influence and tolerance), the party preference is closed to initialized party preference (60% against 40%). So, we can say the voters are being more likely to hold their opinions. Secondly, in graph a of Figure 3, there is a slight oscillation. However, the oscillation is getting less in graph b and c of Figure 3. The oscillation means the strength of voters to exchange their opinion. Which also proves the first conclusion, all voters become more persistent for their opinions when difference decreased.

Validation

Figure 4 shows the configuration of parameters and their values, and figure 5 demonstrates the result of 75.23% people will support Sobynin (red) and the rest

support Navalny (white).

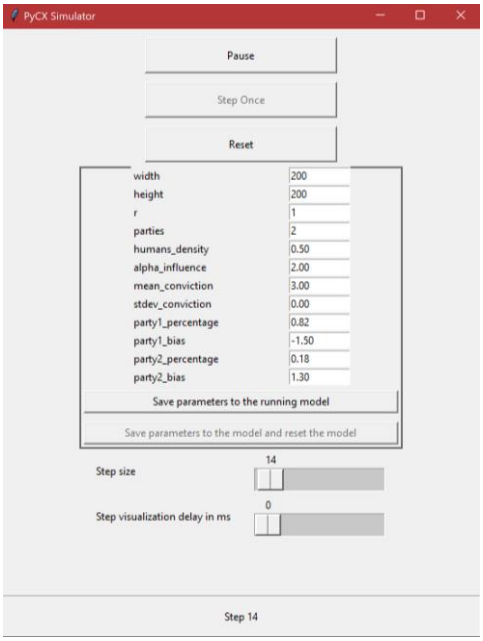

Figure 4 Configuration

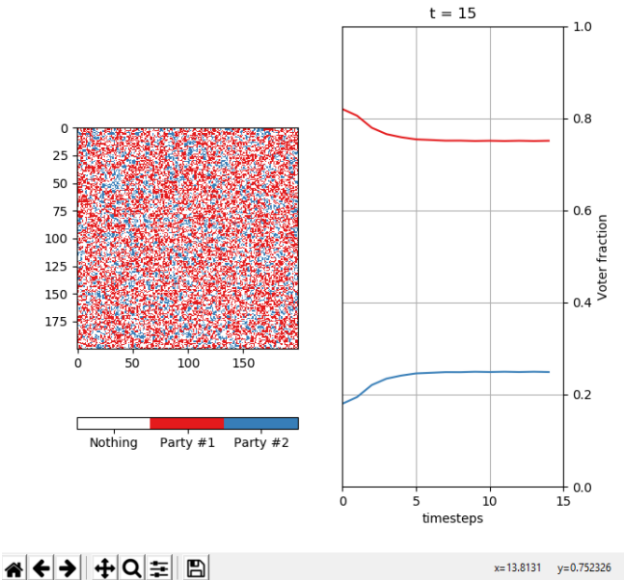

Figure 5 Results

CONCLUSION AND FUTURE WORK

As Table 3, this simulation confirms that the majority-vote model of probabilistic cellular automata is able to model the voting of Moscow mayor election with the error

of 1.42%.

Table 3 Results

	Sobynin	Navalny
Initial distribution	82,05%	17,95%
Actual Results	73.81%	26.19%
Model Results	75.23%	24.77%
Error in percentage	1.42%	1.42%

This simulation also shows that the model results are very sensible to global bias. Empirically, a huge media influence will be very helpful for competition.

All the voters were changing their mind during election. And this can be conducted from the various value of tolerance and influence of neighbours. It is evident in Figure 3

Some people change their mind frequently, especially when the mean value of tolerance is low. This can be seen form the oscillation of results of Figure 3.

In the future, we hope we could make our model more advanced. We will consider using social temperature[2] instead of influence-tolerance mechanism. And validating our model over and over again to make sure the result has practical significance.

REFERENCE

[1] J. Bricmont and H. Van Den Bosch, “Intermediate Model Between Majority Voter PCA and Its Mean Field Model,” *J. Stat. Phys.*, vol. 158, no. 5, pp. 1090–1099, 2014.

[2] S. Mechai, I. C. S. O. F. Opil, I. O. N. Formatioi, and C. Bef, “STATISTICAL MECHANICS OF OPINION OFRMATION AND COLECTIVE BEHAVOR: MICRO-SOCIOLOGY,” vol. 2, 1998.