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A multidimensional model of an electorate

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Abstract This work tries to reproduce some typical behaviours of a group of voters by an opinions model in which a voter has an opinion represented not by a single number but by a set of numbers , in this case three
Typical voters' behaviours are for example the formation of political parties , by the presence of opinion leaders or not , and suddenly changes of results of election due to traumatic news arrived before election day . . .
Electorate has been modelling using a cellular automata model where the voters' opinion is represented by three real number ranging from 0 to 100 . Electors live in a territory and each of them has several " friends " . The value of opinion changes both by spontaneous change and by a probabilistic interaction between a voter and each of his (or her) friends voters . This interaction depends from difference of voter's opinions .
.In this paper model is described and are showed preliminary but interesting results that show a capability of model to describe thing really happened ..

Key-words : Simulation , social system , cellular models , electorate's behaviour , mass-media influence , econophysics

1 Introduction

In the last years several physical-mathematical models has been developed by the aim to realise computer simulations to describe behaviour of social-economic and cultural systems [1],[2] ,[3], [4],[5] .and , in many cases , results of these simulations are very similar to real behaviour .

Generally these models are automata cellular models with people living in a territory who interact with neighbouring and whose opinions are represented by an integer , or real , number .
Temporal evolution of opinions is reproduced by a computer simulation that updates opinions values according to algebraic relations among opinion of a person and his or her neighbouring 's one .
Besides it's possible there is a spontaneous random change of opinion in every cycle of simulation program , .
This work shows a model that is an improvement of these models and whose aim is to reproduce some typical behaviours of real electorates .
In this model people's opinion is described not by an one number but by three numbers . Their values change according to the same relations but independently each other .
More than one number are used because a people hasn't " one " opinion but several opinions about different things (taxation , religion , foreigner policy and so on) so that a Christian and a Muslim can agree about taxation while two Christian can have very different ideas about economy policy .
Besides interaction between two person is random because in real life the contact doesn't always bring about an opinion change .
In the following a description of model will be given and preliminary results of simulation , showing born of political parties and influence of sudden new , will be showed .

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2 The model

We imagine people that live in a territory ; this territory is a square 30 unit side where there are 600 points (every point represents one person).. Results don't change changing these parameters
At the beginning of the simulation every point are assigned two randomly generated real positive numbers ,that represent their co-ordinates , ranging from 0 to 30 ..
Hence all points are randomly distributed inside. the square .
.
In a second step the simulation fixes a positive number (called " *radius* " (*ra)* hereafter) much smaller than square side , and , for every point , finds the points " friends " or "neighbours " .
Two points are considered friends if their distance (the usually distance of two points of a plane) is smaller or equal than *ra* .
These points are " friends " because they influence reciprocally their opinion according to the rules below explained

It is important to note that in our model , differently from models of other authors , the number of "neighbours " is not a constant but is changeable from point to point .
This fact represents the differences among people respect to the quantity and the intensity of social relations also if *ra* is the same for every person

In a following step every point is assigned three real positive numbers which represent his , or her , " vector opinion " . These numbers range from 0 to 100 In this paper is considered a three dimension opinion to permit the use of plots but the model can be extended to n-dimension opinion
The values of components of vector opinion of a person aren't the same . Formally for the i-th person the first component *opinion(i,1)* is a randomly generated number , the second component is

$$\text{opinion}(i,2) = \text{opinion}(i,1) + \text{unifrnd}(-1*\text{coe}/2, \text{coe}/2)$$

unifrnd(a,b) is function generating uniform random numbers between *a* and *b* and coe is a parameter equal for every people
The third component is calculated likewise
Every i-th point is assigned also a randomly real number *s(i)* ranging from 0 to 1 that represents the opinion change attitude according to the rule above explained
Finally program fixes two parameters *r1* and *r2* whose use will be explained below
.
Simulation program updates the components of opinion of every point for a given number of cycles.
In each cycle every people's opinion components are modified using the following rules:

Mutation Rule: program changes the value of the ii-th component of opinion of i-th people component if standard random generated number is less than *s(i)* . The amount of change is given by

$$\text{opinion}(i,ii) = \text{opinion}(i,ii) + \text{unifrnd}(-1*\text{sv}/2, \text{sv}/2),$$

Where *sv* is people-independent parameter .
This rule takes account spontaneous change . More complex is the rule taking account of influence of friends .
First of all program doesn't compare opinion of i-th people and average opinion of his or her friends, but it compares in sequence i-th people opinion and opinions of each of friends . If standard random generated number is less than *s(i)* ,program calculates the absolute value of their difference of opinion *(diff)* and

Assimilation Rule: if *diff >r2* nothing happens (high difference of opinion stops interaction)

If *r1<diff<r2* i-th people " goes away " friend .so that , if opinion of friend is greater than opinion(i) program updates opinion(i) (the code of component is omitted for clarity)

$$\text{opinion}(i) = \text{opinion}(i) + \text{diff}/2,$$

while if opinion of friend is less than opinion(i) program updates opinion(i)

$$\text{opinion}(i) = \text{opinion}(i) - \text{diff}/2,$$

If *diff<r1* i-th people goes nearer friend and his or her opinion is updated to a new value which is the arithmetic average of opinion(i) and opinion of friend

It's to note program has instructions which don't permit opinion to be negative or greater than 100

3 Preliminary results

Figures from 1 to 4 show both distribution of opinions in three dimensional plot and the distribution of first component of opinion . The situation showed are different . In first case , fig. 1 and 2 (few friends and interaction attractive only for similar opinions) there are no political parties ; the distribution of opinion is almost uniform . There is a concentration of opinion in extreme values 0 and 100 but probably this is an effect to instruction above remembered
. In the second case , fig. 3 and 4 (interaction prevalently attractive and a higher number of friends) there are two opinions clustershich can be identified as two political parties . It's to remember that both in " old democracy " and in " new democracy " there is a two parties political system .
It's to note parameters r1 and r2 are the same for every people and then there aren't opinion leader (defined as people with field of action greater of other one or as people " more attractive " then other) .

What are political elections in this model ? Obviously elections are a measure of voters opinion Now it is supposed voter decides whom to vote taking account of every component of vector opinion . In fact a voter can be attracted by the economic program of a party but in the same time can be repelled by its foreigner policy program Besides author has supposed political elections measures an " overall opinion " that is a linear combination of components of opinion .. The

coefficients α, β, χ of this combination represent the importance that voters give to a single matter of electioneering . The coefficients are supposed voter-indipendent but easily influenced by news ..
Then results of elections can change both by change of vector opinions and by change of coefficients due to an important new arrived before , also few days before , election day

Now we consider Table 1 with the numbers of votes taken by two parties : A and B . Party A is voted by people whose overall opinion ranges between 15 and 35 while party B is voted by people whose overall opinion ranges between 65 and 85. ,
Voters with opinions outside these ranges are considered to scatter their votes among many little parties
It has been considered electorate produced by the simulation program with parameters

ra=3 ; coe=24 ; r1=30 ; r2=26 ; sv=5 ;

α	β	χ	A	B
0.05	0.05	0.9	190	184
0.05	0.9	0.05	199	206
0.9	0.05	0.05	151	227

.

We have three different situations .
Now we admit that in a country there is an unforeseen and critical event a week before an election day . This event can modify the coefficients of Table 1 and then real results of election can be different respect to polls .
This fact can explain what happened in Spanish political elections in 2004 because it happened a week after the terrorist attack of 11 March in Madrid
.

4 Concluding remarks

The showed model is new and needs improvements and experimentation also by the aim to produce quantitative predictions but it seems to have capability to reproduce things , also unforeseen things , happened in real elections .

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Fig 1 Plot of opinion Simulation parameters ra=1.5 coe=7 ; r1=30 ; r2=15 ; sv=5 ; number of cycles 30

Fig. 2 Distribution of first component of opinion . Parameters same of Fig .1

Fig. 3 Plot of opinions . Parameters used ra=3 ; r1=30 ; r2=26 ; sv=5 ; coe=7 ; , number of cycles 30

Fig. 4 Distribution of first component of opinion. Parameters used same of Fig. 3

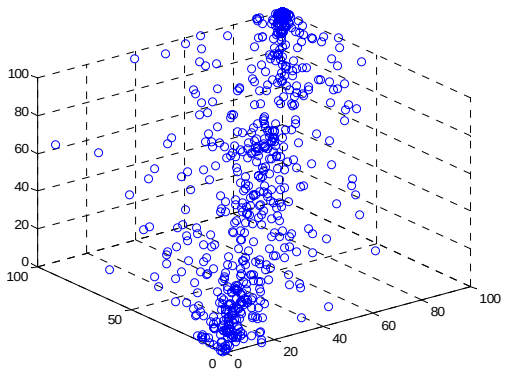

FIG. 1

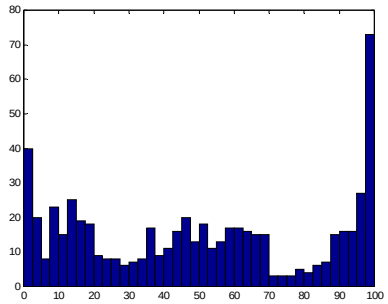

FIG. 2

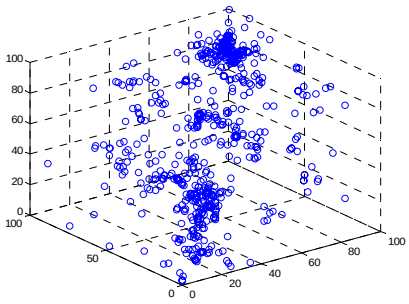
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FIG. 3

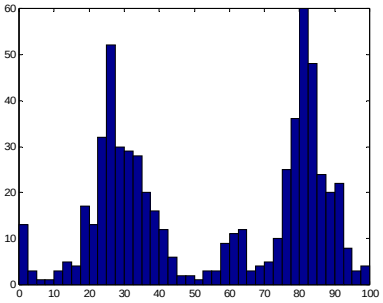
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FIG. 4