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Lecture Note

Application of Physics Model in prediction of the Hellas National election results

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Abstract

In this paper we use a new scientific field called "DemoscopoPhysics" based on chaos theory to predict the Hellenic National election results in the form of time series for Hellenic political parties, New Democracy (ND), Panhellenic Social-istic Movement (PASOK), Hellenic Communistic Party (KKE), Coalition of the Radical Left (SYRIZA) and (Popular Orthodox Rally) LAOS". Using the results of our previous article we reconstruct of the corresponding strange attractor for each political party achieved up to a 30 time steps out of sample prediction of the public survey. Also reducing the degrees of freedom to 4 we have capture the polarization of voters.

Keywords: DemoscopoPhysics, Chaos, Forecasting Model.

1. Introduction

In our previous work [1] we used a new scientific field called "DemoscopoPhysics" based on chaos theory, to predict the Hellenic Euro election results for New Democracy (ND), Panhellenic Socialistic Movement (PASOK), Hellenic Communistic Party (KKE), Coalition of the Radical Left (SYRIZA) and (Popular Orthodox Rally) LAOS political parties. At present work we use the same model to predict the Hellenic National election results. We have approached the prediction with two different ways. Taking into account the results of opinion polls we have done regression in intension to vote. These new data are the raw data now. If we had applied statistical methods to these data we would take static results with very short horizon forecasting. For this reason we apply dynamic methods based on chaos theory in order to show the hidden potential of each political party and make predictions with a time horizon of 30 days. In first case we used the same parameters of our previous article [1]. That means that the value of embedding dimension was 6 for prediction, i.e. the number of degrees of freedom was 6. In second case we have decreased the degrees of freedom to 4 to capture the polarization of voters.

2. Public Survey Time Series

To construct the time series we have taken into account the assessment vote from public surveys in Hellas from 16-1-2007 to 6-09-2009 the estimation of the election behavior of the unclarified vote based on previous elections, they were come into question the possible election results for the whole period. The number of raw data is 48 for each political party, and each data is the average value of 4 polling companies with mean error 1.5% for ND and PASOK political parties and 1% for other political parties. In order to reconstruct the phase space from experimental data these data should be constituted by sampled points of equal time-distances. In our case this condition is not fulfilled. For this purpose we inter-polate our raw data with cubic spline so we have create N=1057 points with a sample rate of 1 day.

3. Time series prediction

For a scalar time series, in our case the gallop poll time series, the phase space can be reconstructed using the methods of delays. The basic idea in the method of delays is that the evolution of any single variable of a system is determined by the other variables with which it interacts. Information about the relevant variables is thus implicitly contained in the history of any single variable. On the basis of this an "equivalent" phase space can be reconstructed by assigning an element of the time series series x_i and its successive delays as coordinates of a new vector time series $\vec{X}$. The reconstructed *m*-dimensional signal projected into the state space can exhibit a range of trajectories, some of which have structures or patterns that can be used for system prediction and modeling [1]. We predict evolution of the percentages of votes for each political party, by computing weighted average of evolution of close neighbors of the predicted state in the reconstructed phase space [1-5]. We used the values of τ and m from our previous article [1]. Actual and predicted time series for k=30 time steps ahead are presented at Figs 1.(a),(b),(c),(d),(e) for ND, PASOK, KKE, SYRIZA, LAOS respectively.

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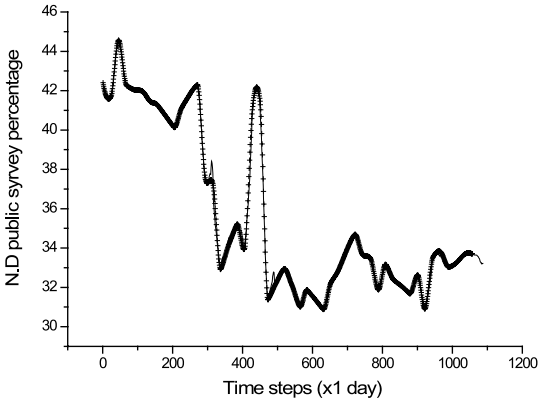
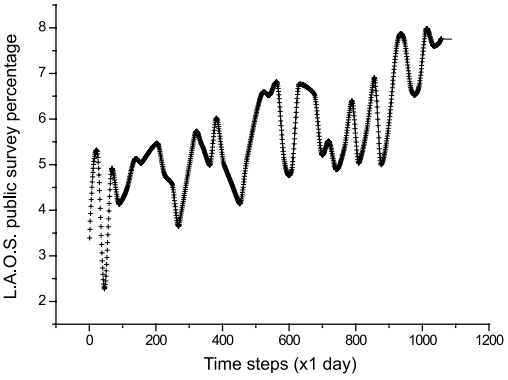


(a)



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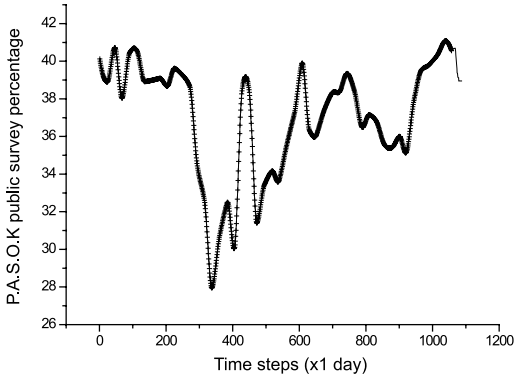
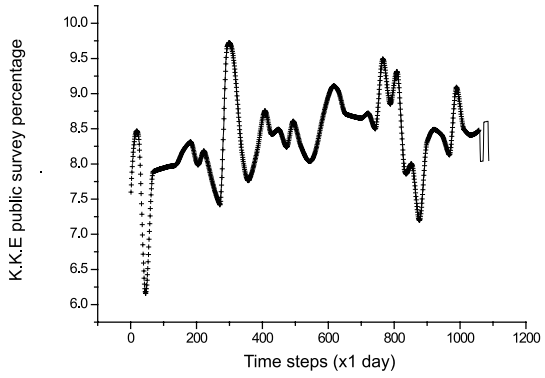


(b)

Figure 1. Actual (crosses) and predicted (solid line) time series for n=30 time steps ahead for ND(a), PASOK (b), KKE (c), SYRIZA (d), LAOS (e) political parties. The embedding dimension is m=6.

In order to capture the polarization of voters we have decreased the degrees of freedom to 4. We use as embedding dimension m = 4 keeping the values of delay time the same from our previous article [1] and the number of near neighborhoods nn, as a rule of thumb [6] equal to 3*m=12 ,for all political parties. Actual and predicted time series for k=30 time steps ahead are presented at Figs 2.(a), (b), (c), (d), (e) for ND, PASOK, KKE, SYRIZA, LAOS respectively.



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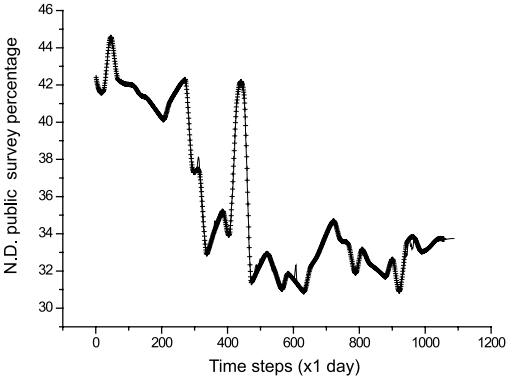
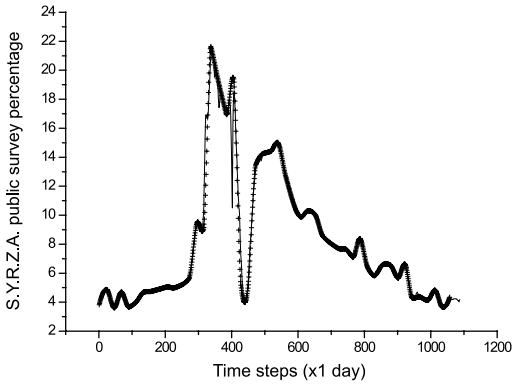


(a)



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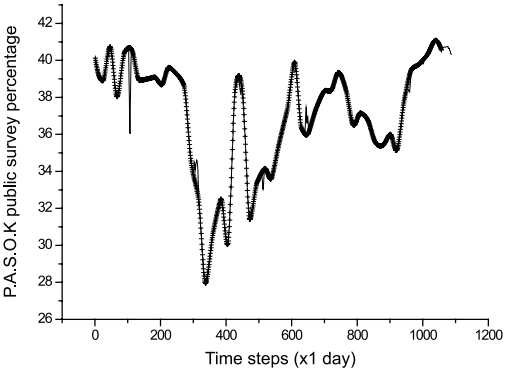
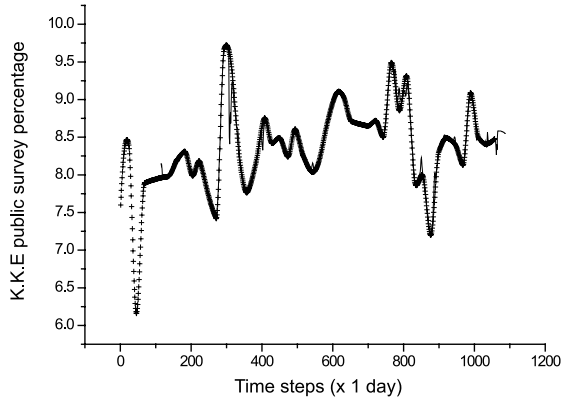


(b)



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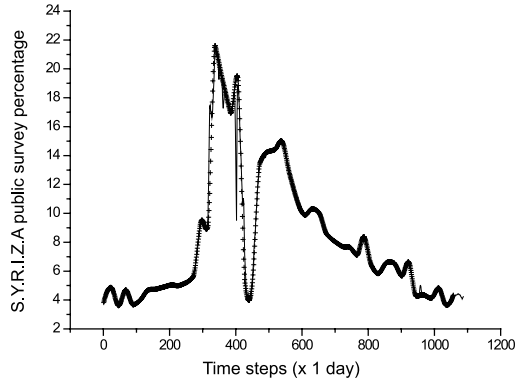

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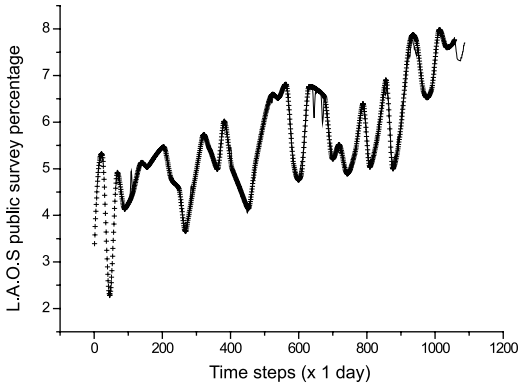

(e)

Figure 2. Actual (crosses) and predicted (solid line) time series for n=30 time steps ahead for ND (a), PASOK (b), KKE (c), SYRIZA (d), LAOS (e) political parties. The embedding dimension is m=4.

At table 1 we present our out of sample estimation about political survey estimation for two embedding dimensions. The first is m=6 and the second is m=4. We estimate the mean error as 1.5% for ND and PASOK and 1% for the other political parties.

Table 1. Political survey estimation

Political parties	Embedding dimension m=6 political survey estimation % for 4/10/2009	Embedding dimension m=4 political survey estimation % for 4/10/2009
ND	33.2 (Range 31.7 - 34.7)	34.0 (Range 32.5-35.5)
PASOK	39.0 (Range 37.5 - 40.5)	41.1 (Range 39.6-42.6)
KKE	8.6 (Range 7.6 - 9.6)	8.6 (Range 7.6 - 9.6)
SYRIZA	4.0 (Range 3.0 - 5.0)	4.1 (Range 3.1 - 5.1)
LAOS	7.8 (Range 6.8 - 8.8)	7.4 (Range 6.4 - 8.4)

The tables with predicted values can be found at appendix

4. Conclusion

In this paper, we applied a chaotic analysis to predict Greek political parties election results. From reconstruction of the systems' strange attractors, we achieved a 30 time steps out of sample prediction. The prediction with different degrees of freedom shown that, when the value of embedding dimension is 4 instead of 6 there is an increase of the percentage of larger political parties as N.D. and P.A.S.O.K. are. This can be interpreted as a polarization of voters which corresponds to a lesser degrees of freedom. The only exception is the percentage of SYRIZA political party. Even though the variation is too small and within mean error, we speculate that this behavior is due to that SYRIZA is composed of components that tend to come together in order to get more than 3%.

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Appendix

Prediction results with m=6

Table 1. Out of sample predicted values of ND

Time steps (x1 day) After 6-09-2009	Percentage %
1058	33.6932
1059	33.6808
1060	33.6662
1061	33.6562
1062	33.6518
1063	33.6475
1064	33.6445
1065	33.6444
1066	33.6432
1067	33.6410
1068	33.6419
1069	33.6372
1070	33.6354
1071	33.6177
1072	33.5863
1073	33.5754
1074	33.5623
1075	33.5219
1076	33.4901
1077	33.4645
1078	33.4083
1079	33.3559
1080	33.3015
1081	33.2780
1082	33.2425
1083	33.2054
1084	33.2248
1085 (4/10/2009)	**33.2014**
1086	33.2098
1087	33.2131

Table 2. Out of sample predicted values of PASOK

Time steps (x1 day) After 6-09-2009	Percentage %
1058	40.5973
1059	40.6261
1060	40.6437
1061	40.6556
1062	40.6642
1063	40.6708
1064	40.6759
1065	40.6800
1066	40.6833
1067	40.6861
1068	40.6884
1069	40.5275
1070	40.3279
1071	40.1000
1072	39.8583
1073	39.6164
1074	39.3818
1075	39.3532
1076	39.1449
1077	39.1309
1078	39.1186
1079	38.9486
1080	38.9486
1081	38.9487
1082	38.9488
1083	38.9489
1084	38.9490
1085 (4/10/2009)	**39.0100**
1086	38.9521
1087	38.9522

Table 3. Out of sample predicted values of KKE

Time steps (x1 day) After 6-09-2009	Percentage %
1057	8.47156
1058	8.47766
1059	8.47632
1060	8.47564
1061	8.20717
1062	8.03464
1063	8.03475
1064	8.03477
1065	8.03589
1066	8.03800
1067	8.03803
1068	8.04108
1069	8.04110
1070	8.04111
1071	8.22112
1072	8.59245
1073	8.59248
1074	8.59250
1075	8.60088
1076	8.60089
1077	8.60090
1078	8.60091
1079	8.60092
1080	8.60093
1081	8.60529
1082	8.60529
1083	8.60529
1084	8.60529
1085 (4/10/2009)	**8.60529**
1086	8.23031
1087	8.04966

Table 4. Out of sample predicted values of SYRIZA

Time steps (x1 day) After 6-09-2009	Percentage %
1058	4.27603
1059	4.22362
1060	4.19996
1061	4.18198
1062	4.18587
1063	4.18109
1064	4.17857
1065	4.17733
1066	4.19868
1067	4.20022
1068	4.20206
1069	4.22889
1070	4.23187
1071	4.23447
1072	4.23643
1073	4.23738
1074	4.23304
1075	4.23141
1076	4.22820
1077	4.22332
1078	4.21682
1079	4.17960
1080	4.17086
1081	4.13286
1082	4.12278
1083	4.11223
1084	4.07493
1085 (4/10/2009)	**4.04200**
1086	4.11756
1087	4.17539

Table 5. Out of sample predicted values of LAOS

Time steps (x1 day) After 6-09-2009	Percentage %
1058	7.76382
1059	7.76007
1060	7.75815
1061	7.75701
1062	7.75627
1063	7.75577
1064	7.75542
1065	7.75517
1066	7.75497
1067	7.75479
1068	7.75462
1069	7.75444
1070	7.75424
1071	7.75404
1072	7.75383
1073	7.75361
1074	7.75340
1075	7.75319
1076	7.75300
1077	7.75282
1078	7.75267
1079	7.75253
1080	7.75241
1081	7.75230
1082	7.75222
1083	7.75214
1084	7.75208
1085 (4/10/2009)	**7.75203**
1086	7.75198
1087	7.75195

Table 7. Out of sample predicted values of PASOK

Time steps (x1 day) After 6-09-2009	Percentage %
1058	40.6014
1059	40.6362
1060	40.6591
1061	40.6752
1062	40.6871
1063	40.6964
1064	40.7038
1065	40.7099
1066	40.7148
1067	40.7188
1068	40.7222
1069	40.7251
1070	40.7277
1071	40.7302
1072	40.7326
1073	40.7350
1074	40.7373
1075	40.7398
1076	40.7424
1077	40.7450
1078	40.6517
1079	40.6494
1080	40.6468
1081	40.6440
1082	40.5246
1083	41.5150
1084	41.5054
1085 (4/10/2009)	**41.1400**
1086	41.3486
1087	41.3345

Prediction results with m=4

Table 6. Out of sample predicted values of ND

Time steps (x1 day) After 6-09-2009	Percentage %
1058	33.7051
1059	33.7093
1060	33.7118
1061	33.7134
1062	33.7144
1063	33.7151
1064	33.7155
1065	33.7159
1066	33.7164
1067	33.7173
1068	33.7187
1069	33.7206
1070	33.7227
1071	33.7250
1072	33.7273
1073	33.7293
1074	33.7311
1075	33.7326
1076	33.7365
1077	33.7395
1078	33.7418
1079	33.7433
1080	33.7435
1081	33.7441
1082	33.7442
1083	33.8441
1084	33.0440
1085 (4/10/2009)	**34.0210**
1086	33.7431
1087	33.7429

Table 8. Out of sample predicted values of KKE

Time steps (x1 day) After 6-09-2009	Percentage %
1058	8.46480
1059	8.45107
1060	8.44201
1061	8.36346
1062	8.26502
1063	8.40075
1064	8.33451
1065	8.49595
1066	8.58316
1067	8.58394
1068	8.58193
1069	8.58199
1070	8.58179
1071	8.58150
1072	8.58122
1073	8.58097
1074	8.58076
1075	8.58058
1076	8.58042
1077	8.57530
1078	8.57500
1079	8.57462
1080	8.57412
1081	8.56672
1082	8.56577
1083	8.56463
1084	8.56326
1085 (4/10/2009)	**8.55340**
1086	8.55132
1087	8.54930

Table 9. Out of sample predicted values of SYRIZA

Time steps (x1 day) After 6-09-2009	Percentage %
1058	4.29189
1059	4.25894
1060	4.26232
1061	4.26044
1062	4.29114
1063	4.29753
1064	4.30341
1065	4.34795
1066	4.35447
1067	4.36044
1068	4.36577
1069	4.37030
1070	4.41954
1071	4.42308
1072	4.42524
1073	4.42605
1074	4.37725
1075	4.37429
1076	4.36942
1077	4.35928
1078	4.30312
1079	4.29436
1080	4.23743
1081	4.18433
1082	4.17295
1083	4.11939
1084	4.07005
1085 (4/10/2009)	**4.11370**
1086	4.17437
1087	4.23167

The out of sample predicted values are shown at Table-10

Table 10. Out of sample predicted values of LAOS

Time steps (x1 day) After 6-09-2009	Percentage %
1058	7.75525
1059	7.71735
1060	7.66712
1061	7.59912
1062	7.51564
1063	7.47506
1064	7.38964
1065	7.36555
1066	7.35044
1067	7.34044
1068	7.33716
1069	7.33166
1070	7.32766
1071	7.32460
1072	7.32207
1073	7.31979
1074	7.32213
1075	7.31917
1076	7.38301
1077	7.38162
1078	7.38074
1079	7.44708
1080	7.44766
1081	7.51058
1082	7.41226
1083	7.47757
1084	7.64057
1085 (4/10/2009)	**7.44136**
1086	7.69940
1087	7.69896