
Knowledge Discovery & Knowledge-Based Systems

DISCOVERING KNOWLEDGE IN PARLIAMENTARY ELECTIONS

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Abstract: *The aim of the paper is to present the new methodology of building the knowledge base of parliamentary elections. The knowledge base can be used for analysis the rules describing electorate preferences during voting process. Two case studies-Polish parliamentary elections of 2001 and 2007 - illustrate the considerations.*

Keywords: *parliamentary election, knowledge base.*

Introduction

Political parties, taking part in parliamentary elections, present their socio-political programmes to the society. The programmes, presented before elections, can be considered as the set of promises. After the election representatives of some parties are elected to the parliament, others are not.

The following question can be formulated. Can we get some information on electorate preferences during electorate campaign? Can we find what they are?

Analysis of socio-political programmes of each party, participating in elections, makes it possibly to identify sets of attributes to be used to describe elements of their programmes. Having the set of attributes and their values for all the parties participating in parliamentary elections, knowledge base can be construct. Knowledge base comprise all the information needed to characterize the election campaign.

Analysis of voting behaviour

Problems concerned with the analysis of electorate preferences as well as forecasting outcomes of parliamentary elections have been investigated by sociologists and political scientists for a long time. There is an extensive literature on statistical methods making it possible to anticipate attitudes of voters as well as results of parliamentary elections on the basis of opinion polls. However, the number of papers – at least those known to the authors – on applying methods of artificial intelligence for such a purpose is rather small. It should be emphasized that the authors were inspired to investigate the possibility of using these methods in such a case by discussions during preparation of the paper.

Conclusion resulted in the necessity to define examples being considered as well as attributes to describe them. Moreover, the values taken by attributes introduced were to be established. It was evident that political parties and groupings taking part in electoral campaign had to be treated as examples.

The problem of choosing attributes has been much more complicated. Initially, it was assumed that attributes were to be connected with election programmes of political parties and groupings taking part in election. Special

attention was paid to those elements of the programmes under consideration that were related to basic areas of economy and social life, such as tax system, health care system, economic growth.

The set of attributes describing electoral promises of political parties and groupings taking part in the electoral campaign of 1977 was assumed as the reference point. From sociological analyses it results that electorate preferences are not concerned with elements of socio-economic programmes of political parties and grouping only, but – to a considerable degree – their medial image is of significance. In keeping with results of these analyses the initial set of attributes was enlarged for the case of 2001 election. Moreover, political scientists suggested that for election of 2005 one has to take into account attributes corresponding to watchdogs and declare values. Table 1 presents the complete set of attributes applied for the description of political parties and groupings in election of 1997, 2001 and 2005. In each column the attributes used in the analysis of a particular election are given. It follows from this table that the significance of attributes undergoes changes. Some were used only once, others in all three cases considered.

Table 1. The set of attributes

	<i>Attribute</i>	1997	2001	2006
1.	<i>Economic policy</i>		X	X
2.	<i>Corporate tax</i>	X		
3.	<i>Personal income tax</i>	X	X	X
4.	<i>Agriculture</i>		X	X
5.	<i>Regional policy</i>		X	X
6.	<i>Unemployment</i>		X	X
7.	<i>Social security</i>	X		X
8.	<i>Health care system</i>		X	X
9.	<i>Education and research</i>	X	X	X
10.	<i>Internal safety</i>	X	X	X
11.	<i>Foreign policy</i>			X
12.	<i>Attitude towards the European Union</i>		X	X
13.	<i>Local democracy</i>	X		X
14.	<i>Character of the State</i>			X
15.	<i>Secret services</i>	X		X
16.	<i>Attitude towards the abortion law</i>	X		X
17.	<i>Attitude towards women</i>			X
18.	<i>Declared watchwords and values</i>			X
19.	<i>Declared political orientation</i>	X		X
20.	<i>Organisation of the electoral campaign</i>	X	X	X
21.	<i>Forms of the electoral campaign</i>			X
22.	<i>Reception of the electoral campaign by voters</i>			X

23	<i>Orientation of the electoral campaign</i>			X
24.	<i>Experience in governmental and parliamentary activities</i>		X	X
25.	<i>Results of the previous election</i>			X
26.	<i>Visible leader</i>		X	X
27.	<i>Election to Parliament</i>	X	X	X

In the analyses carried out by the authors the following problems, related to the character of decision attribute, were investigated.

For the decision attribute 1 the partition of examples into following classes is accomplished: Y1.1 – political parties and groupings having entered the Parliament; Y1.2 – political parties and groupings not having entered the Parliament.

Taking into account some specific situations that can occur in real life, sometimes it is reasonable to divide the first class Y1.1 into two subclasses: Y1.1.1 – political parties and groupings having entered the Parliament in a strong position, i.e. having a large number of seats; Y1.1.2 – political parties and groupings having entered the Parliament in a weak position, i.e. having a small number of seats.

In the case of decision attribute 2 the partition into three classes is carried on: Y2.1 – political parties and groupings that locate their position on the left side of the political scene; Y2.2 – political parties and groupings that locate their position in the middle of the political scene; Y2.3 – political parties and groupings that locate their position on the right side of the political scene.

Due to some difficulties with determining and adequate position of a particular party of grouping active on the Polish political scene, the partition into four classes can be useful: Y2.1 – parties or groupings that define their political views as leftist; Y2.2 – parties or groupings that define their political views as liberal; Y2.3 – parties or groupings that define their political views as rightist; Y2.4 – parties or grouping whose political views cannot be explicitly defined as belonging to one of three classes distinguished.

In the case of third decision attribute the number of classes is equal to the number of political parties and groupings taken into consideration.

For each of the decision attributes mentioned, it is possible to determine classification rules to a particular class.

If the decision attribute 1 is used, then obtained classification rules can be applied to determine: electorate preferences and programme or medial image differences among political parties or groupings having entered the Parliament (taking into account the number of seats received) and those that failed.

In the case of decision attribute 2, the classification rules generated can be applied to determine in detail programme or medial image differences among political parties and groupings belonging to given classes.

If the third decision attribute is used, then classification rules obtained can be applied to determine similarities or differences in programme or medial image among political parties and groupings considered.

The algorithm described above is relatively simple and efficient.

In second and third case, can be applied the approach based on the rough set theory, forwarded by Pawlak (1982, 1991).

The rules formed can be used in classification of new examples (i.e. ones that have not appeared in the learning process) for which class membership is not known. Such a classification is carried out through verification of fulfilment of conditions in the conditional parts of the rules.

The rules can also be used to identify the dependencies existing in the information set of the examples that have not been previously known explicitly. They can help in understanding and explaining the existing relations between attributes or class definitions.

The Case study 1. The Polish Parliamentary election 2001

The considerations concern the example of the elections to the Polish Parliament, which took place on September 23rd, 2001.

In the situation considered it is the set of eight political parties: SLD, UP, PO, SO, PiS, PSL, LPR, AWSP and UW. Only first six of these political organizations ultimately entered the Parliament. The attributes used to describe examples are presented below. The value that a given attribute can assume is given in brackets.

*a*₁: *unemployment* {1 – to make the Labour Code more flexible; 2 – to take actions making working personnel more mobile and to decrease cost of establishing new work places; 3 – to start public and interventional works; 4 – other proposals}.

*a*₂: *education and research* {1 – to increase governmental spending on education and research; 2 - free education at all the levels; 3 – to stop elimination of rural schools and to establish vocational colleges in small cities; 4 – to provide common access to Internet and learning of foreign languages}.

*a*₃: *personal income tax* {1 – to simplify the personal income tax system and to introduce linear personal income tax in the future; 2 – to introduce progressive personal income tax, tax on stock exchange transactions and tax on capital; 3 – to decrease the lowest rate of personal income tax and to establish pro-family policy; 4 – other proposals}.

*a*₄: *economic policy* {1 – government control of all strategic and monopolistic enterprises; 2 – government control of chosen strategic and monopolistic enterprises; 3 – restructurization of the public finance sector; 4 – government support of inexpensive housing projects}.

*a*₅: *health care system* {1 – to improve the existing health-care system and to increase governmental spending on this system; 2 – to eliminate the existing health-care system and to establish a new one; 3 – other proposals}.

*a*₆: *agriculture and regional policy* {1 – to protect the Polish agriculture against foreign competition; 2 – to make the industrial-agricultural complex a fly wheel of economy; 3 – to develop non-agricultural activities in villages and to promote infrastructural investments}.

*a*₇: *internal safety* {1 – to increase the efficiency of judiciary system; 2 – to make the Penal Code more repressive; 3 – to roll into one municipal guard and police; 4 – to develop citizen self-defence; 5 – other proposals}.

*a*₈: *attitude towards the European Union* {1 – to enter the European Union under advantageous conditions; 2 – pronounced backing the accession to the European Union; 3 – stout resistance to the accession to the European Union}.

*a*₉: *election to the Parliament* {1 – yes; 2 – no}.

*a*₁₀: *experience of government matters and services* {1 – yes; 2 – no}.

*a*₁₁: *visible leader* {1 – yes; 2 – no}.

*a*₁₂: *organization of the electoral campaign* {1 – professional, 2 – not professional}.

Table 2 presents the values of attributes taken into account for particular political parties and groupings. It can be considered as the knowledge base.

Table 2 Knowledge base describing the Polish parliamentary election of 2001

Attributes Parties	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}	a_{12}
SLD-UP	1	2	2	2	2	3	1	2	1	1	1	1
PO	1	4	1	3	2	2	3	2	1	2	1	1
SO	3	2	4	1	2	1	2	3	1	2	1	1
PiS	2	3	3	4	1	3	2	1	1	1	1	2
PSL	2	3	2	2	2	1	5	1	1	1	2	2
LPR	4	1	3	1	3	2	1	3	1	2	2	1
AWSP	2	4	3	4	1	3	2	1	2	1	2	2
UW	1	1	1	3	3	3	4	2	2	1	2	2

The decision attribute a_9 : “election to the Parliament” divides the set of examples into two classes in the following manner:

- class Y_{yes} : contains the political parties having entered the Parliament,
- class Y_{no} : contains the political parties not having entered the Parliament.

The Case study 2 – the Polish Parliamentary election 2007

The set of six political parties is taken into account: PO, PiS, LiD, PSL, Samoobrona and LPR. Only first four of these political parties ultimately entered the Parliament.

As a result of the analysis of the electoral campaign to the Polish Parliament 2007 thirty four attributes were identified. Twenty two attributes (a_1, \dots, a_{22}) characterize programmes of political parties taken into account. Seven attributes (a_{23}, \dots, a_{29}) are used to describe characteristics of political parties as well as watchwords and values presented by them. Four attributes (a_{30}, \dots, a_{33}) characterize the electoral campaign. The last attribute a_{34} describes results of the election. It is considered as the decision one. The detailed description of attributes taken into account and their values is given in Appendix.

Table 3 presents the values of the attributes for particular political parties.

Table 3. Knowledge base describing the Polish parliamentary election of 2007

Attributes Parties	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}	a_{12}	a_{13}
PO	2	2	1	2	1	1	1	1	1	1	1	1	2
PiS	1	1	1	1	1	2	2	3	3	2	1	2	1
LiD	3	2	2	2	2	3	2	2	2	2	2	3	1
PSL	2	2	1	2	2	1	2	3	3	3	3	1	2
Samoobrona	3	3	2	3	1	2	3	3	3	3	2	1	2
LPR	1	1	1	1	3	2	3	3	3	1	1	2	3

Attributes Parties	a ₁₄	a ₁₅	a ₁₆	a ₁₇	a ₁₈	a ₁₉	a ₂₀	a ₂₁	a ₂₂	a ₂₃	a ₂₄	a ₂₅	a ₂₆	a ₂₇
PO	2	1	1	1	1	1	1	1	1	1	2	1	1	2
PiS	1	1	1	1	2	1	2	2	2	1	2	1	2	1
LiD	2	2	2	3	1	2	3	1	3	2	2	2	1	3
PSL	2	3	1	1	3	1	3	3	2	1	1	2	2	3
Samoobrona	3	3	1	2	1	3	3	3	2	2	2	2	3	1
LPR	3	3	3	1	1	3	3	2	2	2	2	2	3	1

Attributes Parties	a ₂₈	a ₂₉	a ₃₀	a ₃₁	a ₃₂	a ₃₃	a ₃₄
PO	1	1	1	1	1	2	1
PiS	2	2	1	1	1	1	1
LiD	2	3	2	3	3	3	2
PSL	2	2	2	2	2	2	2
Samoobrona	2	4	3	2	2	1	3
LPR	3	5	3	2	1	1	3

Conclusion

The paper presents a new approach to the analysis of electoral campaign.

The application of voting procedures makes it possible to determine which political parties taking part in the election campaign are the winners and which are the losers. The main goal of every political party is to enter the parliament, in other words to be supported by large number of voters. To accomplish such a strategy, political parties have to work out and present their socio-political programmes.

The analysis of socio-political programmes presented by all the parties taking part in the election campaign, makes it possible to identify attributes that can be used to characterize these programmes. Having determined the set of attributes and their values it is possible to form knowledge base comprising all the information needed to characterize the election campaign under consideration.

In the paper results of the Polish parliamentary election of 2001 and 2007 are used, as the illustration of proposed methodology how to build a knowledge base.

Making use of this knowledge base one can make an attempt to answer the following question: why some parties received the large number of votes but other ones – not?.

In the situation considered in the paper, the decision attributes a_{34} : “election to the Parliament” divides the set of examples (i.e. the political parties) into three disjoint classes in the following manner:

- class Y_1 : contains the political parties having entered the Parliament with large support,
- class Y_2 : contains the political parties having entered the Parliament with small support,
- class Y_3 : contains the political parties not having entered the Parliament.

The process of formation of a class description on the basis of the set of examples having certain common properties, which distinguish a given class from the other ones. These descriptions can be represented in the form of rules of "IF *certain conditions are fulfilled* THEN *membership in a definite class takes place*" type. It means, that the algorithm of machine learning can be applied. Using machine learning analysis one can receive the answer for above mentioned question.

Bibliography

- [Brams, 2008] Brams S. The presidential election game. New Haven, CT: Yale University Press, Rev. ed. A. K. Peters.
- [Hołubiec, etc., 1997] Hołubiec J., Malkiewicz A., Mazurkiewicz M., Mercik J., Wagner D. Identification of ideological dimensions under fuzziness: the case of Poland. In: Consensus under fuzziness. Kluwer Academic Publishers, Boston/Londyn/Dordrecht.
- [Hołubiec, etc. 2007] Hołubiec J., Szkatuła G., Wagner D. Discovering electorate preferences in voting procedures. Homo Oeconomicus, vol 24, Nr 314, Accedo Verlagsgesellschaft, Munchen.
- [Hołubiec, etc., 2008] Hołubiec J., Szkatuła G., Wagner D. Machine learning approach for discovering electorate preferences during parliamentary election. Development in Fuzzy Sets, Intuitionistic fuzzy Sets, Generalized Nets and Related Topics, Applications, vol. II. Academic Publishing House EXIT, Warsaw.
- [Kacprzyk, etc., 2002] Kacprzyk J., Szkatuła G. An integer programming approach to inductive learning using genetic and greedy algorithms. W: L.C. Jain and J. Kacprzyk (eds.) *New learning paradigms in soft computing*. Studies in Fuzziness and Soft Computing. Physica-Verlag Heidelberg.
- [Szkatuła, etc., 2003] Szkatuła G., Wagner D. Programmes of parties versus their location on the political scene. Application of decision rules to describe the differences. In: Kacprzyk J., Wagner D. (eds.): *Group decisions and voting*. Akademicka Oficyna Wydawnicza EXIT, Warszawa.

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Appendix

1) Attributes describing programmes of political parties

a1 - Way of governing the State

1. to strengthen the State and radical struggle against social ills - PiS, LPR
2. to try to reach a political compromise - PO, PSL
3. no proposals submitted - LiD, Sam.

a2 - Assessment of the two-year period 2005-2007

1. period of improving the condition of State -PiS, LPR
2. period of increasing the arrogance of authorities -PO, PSL, LiD
3. ambivalent attitude - Sam.

a3 - Attitude to the vetting

1. need of consistent vetting - PiS, PO, PSL, LPR
2. need to end the vetting - LiD, Sam.

a4 - Attitude to the Church and religion

1. need of close cooperation between the State and Church - PiS, LPR
2. to separate the Church from the State but to have respect for religious values - PO, PSL, LiD
3. no proposals submitted - Sam.

a5 - Unemployment

1. to decrease non - wage cost of works including the decrease of insurance fee - PO, PiS, Sam
2. insurance fee and income tax deduction - LiD, PSL
3. no proposals submitted - LPR

a6 - Education and science

1. consistent programme base for all the subjects with parallel increase of the school autonomy necessary for the adjustment to market demands - PO, PSL
2. to increase governmental funds for science and education - PiS, LPR, Sam
3. to decrease the school age - LiD

a7 - Economy

1. economical freedom based on private property - PO
2. development of small and medium enterprises including tax deduction and availability of credit; introducing the system of guarantees for enterprises - PiS, Lid, PSL
3. to stop privatization and control privatized enterprises - LPR, Sam.

a8 - Taxes

1. to simplify the tax system by means of introducing linear tax - PO
2. tax amnesty for Poles coming back to Poland - LiD
3. to decrease the income tax especially for the poorest ones; pro family policy including rent deduction - Sam., LPR, PiS, PSL

a9 - Health - care system

1. partition of the National Health Fund into several competing funds and to define the basket of services - PO
2. introducing the payment for medical services - LiD
3. unrestricted Access to the Basic health care system including formation of the charity fund and to transfer some Mount of Money from Work Fund to health care system - LPR, Sam., PSL, PiS

a10 - Internal safety

1. to form centralized and coordinated centre to counteract the most serious risk at the State level - PO, LPR

2. to improve the weaponry and equipment of uniformed services; to built the all - Poland communication system for rescue services - PiS, LiD
3. no proposals submitted - PSL, Sam.

a 11 - Social policy

1. Introduction of family benefits new benefits for children and to extend the maternity leave for both parents - PO, PiS, LPR
2. introduction of home allowances and pension reform; to increase benefits and assistance to the poorest - LiD, Sam.
3. Introduction of the family tax and common tax return for families - PSL

a12 – Agriculture

1. use of European funds for development of The Polish agriculture - PO, PSL, Sam.
2. To support low – production and low – profit farms and strengthen family farms -PiS, LPR
3. to reintroduce structural rents and make more realistic insurance fee for farmers - LiD

a13 – Attitude to authorities and self-governments

1. administrative decisions should be made in accordance with the letter of the law - LiD, PiS
2. to decentralize and strengthen the property base of self-governments — PO, PSL, Sam
3. to restrict the autonomy of self-governments - LPR

a14 – Introducing the Euro currency

1. accession of Poland to the Euro zone not later than in 2015 - PiS
2. accession of Poland to the Euro zone as soon as possible - PO, PSL, LiD
3. to remain separate currency - LPR, Sam

a15 – Foreign policy

1. to back up the accession of the Ukraine, Georgia and Moldova to the European Union; to strengthen the role of Poland In relations with the neighbors to cooperate with countries of so called Weimar Triangle - PiS PO
2. good relations with all the neighbors, especially with the Ukraine and Germany - LiD
3. to make relations with Russia warmer - Sam., LPR, PSL

a16 – Attitude to the UE

1. to cooperate more closely with the European Union and take responsibility for its growth - PO, PiS, PSL, Sam.
2. joint foreign policy and attitude to Russia - LiD
3. to restrict cooperation with the UE - LPR

a17 – Attitude to the USA

1. to preserve the partnership in the framework of safety and economy systems - PO, PiS, LPR, PSL
2. to loosen relations - Sam.
3. no proposals submitted - LiD

a 18 – Attitude to the war in Iraq

1. to carry out mission responsibilities; no prolongation of the presence of Polish troops; to promote economy and political relations - PO, LiD, Sam., LPR

2. to prolong participation of the Polish troops in the mission; to strengthen position and safety of Poland - PiS
3. no proposals submitted - PSL

a19 - Safety of energy supply

1. diversification of energy suppliers and use of own resources including use of clean energy - PO, PiS, PSL
2. to promote common policy of energy supply within the European Union - LiD
3. to normalize the cooperation with Russia - Sam., LPR

a20 – Fight against corruption

1. -transparent administrative procedures - PO
2. -to continue activities of the Central Anticorruption Bureau - PiS
3. -no proposals submitted - PSL, LiD, Sam., LPR

a21 – Attitude to the abortion law

1. abortion is allowed only when the pregnancy threatens mother's health - PO, LiD
2. total ban on abortion - PiS, LPR
3. no proposals submitted - PSL, Sam.

a22 – Character of the State

1. not expensive, decentralized and public - spirited - PO
2. social solidarity - PiS, Sam., LPR, PSL
3. lawfull and nonpartisan - LiD

II) Attributes describing political parties and declared watchwords and values.

a23 – Organization of a political party

1. party with widely extended structures - PSL, PO, PiS
2. party with narrowly extended structures - LiD, Sam., LPR

a24 – Experience in governmental activities

1. long period of activities - PSL
2. short period of activities - PO, PiS, LiD, LPR, Sam.

a25 – Participation in activities of the former Parliament

1. having strong position - PO, PiS
2. having weak position - LiD, PSL, LPR, Sam.

a26 – Party image

1. modern - PO, LiD
2. conservative - PSL, PiS
3. opportunistic - LPR, Sam.

a27 – Position of a leader

1. distinctive dominating over the party - PiS, LPR, Sam.
2. distinctive cooperating with party members - PO
3. not distinctive - LiD, PSL

a28 – Declared political views

1. liberal - PO
2. centre - PiS, PSL, LiD, Sam.
3. rightist - LPR

a29 – Declared watchwords and values

1. social-liberal - PO
2. social-national - PiS, PSL
3. social-leftist - LiD
4. social-liberal - Sam.
5. Christian-national - LPR

III) Attributes describing the electoral campaign

a30 – Organization of electoral committees

1. professional - PO, PiS
2. not carefully prepared - PSL, LiD
3. amateurish - LPR, Sam.

a31 – Forms of running electoral campaign

1. run with the use of modern media means - PO, PiS
2. run with emphasis put on the direct access to votes - PSL, LPR, Sam.
3. run with emphasis put on the use of Internet - LiD

a32 – Orientation of the electoral campaign

1. addressed to all the votes - PiS, PO, LPR
2. addressed to town and city dwellers - PSL, Sam.
3. addressed to young people and stable leftist electorate - LiD

a33 – Characteristic of the electoral campaign

1. aggressive campaign based on watchwords and values - PiS, LPR, Sam.
2. peaceful campaign based on watchwords and values - PO, PSL
3. peaceful campaign based on the appearance of personages - LiD

IV) Decision attribute

a34 – Results of the election

1. entering the Parliament with strong support of votes - PO, PiS
2. entering the Parliament with small support of votes - LiD, PSL
3. not entering the Parliament - LPR, Sam.