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From the editor: Systems studies of voting systems and elections

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This collection of articles is presented to the reader in the framework of systems studies of elections as a class of service systems vital for democratic societies. Fundamentals of engineering systems, including those of systems servicing large customers such as electorates in local and national elections, are developed and studied at the Center for Engineering Systems Fundamentals, a part of the Engineering Systems Division at the Massachusetts Institute of Technology.

Besides studies of elections as such, studies of national and international political institutions are important for understanding the effectiveness of government. These institutions constitute an inseparable component of democracies, and studies of such institutions should help voters better understand their choices in electing government representatives. Particularly, studying mechanisms for adopting decisions in the legislature and those for interacting between the legislative and executive branches of the government should help electorates evaluate which promises of candidates on the ballot in an election are no more than wishful thinking, creating baseless expectations in voters, and which can be really implemented within boundaries imposed by these mechanisms on the spectrum of possible government decisions and compromises.

Understanding how the number of seats that a political party receives in the legislature of a state depends on the numbers of constituencies and on the share of votes received in an election by candidates representing political parties, as well as understanding to how many seats a state should be intited in the legislature of a Union of states, is critical for political stability both in countries and in continents. Articles on modeling political institutions constitute a sizable part of those included in this volume.

Regularities of the formation of political parties and voter political preferences are as an important factor for studying voter behavior as are features of voting rules. Articles reflecting quantitative studies of these regularities and features are presented in this volume. These studies establish and clarify connections between political and civic matters while emphasizing the difference between the two.

Systems studies of elections as such are currently conducted in four major directions. First, studying properties of voting rules and the perception of their fairness by voters is instrumental in making decisions on improving existing rules for determining election outcomes, or replacing these rules with those better in any reasonable sense. Second, developing techniques aimed at providing accuracy in reflecting the will of voters via cast votes and protecting cast votes against manipulation is critical for assuring society that every vote is counted, and these techniques should underlie the design of voting machines and strategies of auditing cast votes. Third, the allocation of voting machines and personnel on Election day that guarantees equal access to polls for every voter and secures service time at the polls within reasonable standards is key to effectively administering elections and making voters confident that every vote counts. Fourth, the quality of methods for evaluating public opinion about the candidates on the ballot and their campaigns, as well as that of methods for forecasting election outcomes, are a critical factor in fairly communicating election information to the voters via the media, in detecting biases of particular media outlets, and in distinguishing facts from political propaganda.

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While quantitative studies of elections in all the four directions have resulted in developing new and employing already known mathematical results and models, besides one work in the fourth direction, only works in the first two directions were submitted and are presented in this volume, along with works on studying political institutions. To a certain extent this fact reflects the state of affairs with research in the field, where interested mathematicians and computer scientists, traditionally dealing with mathematical modeling, usually incorporate corresponding scientific activities in their theoretical studies. In contrast, the importance of systems studies of administering elections seems to have often been overlooked by those who should have been major beneficiaries of such studies. Since studies on administering elections are mostly those of certain engineering systems that incorporate technological, managerial, and social solutions, they are rarely conducted without corresponding demand from election administrators, and this demand is not always present. As for quantitative studies of public opinion and the way the media communicate it to the electorates, such studies do not seem to be actively conducted.

Despite the difference between the origins of research in all the four directions, the absence of systems approach to studying election problems quantitatively contributes to the status quo under which most of the research results, even in the first two directions, remain no more than theoretical achievements. Neither voters as potential customers nor election authorities as potential beneficiaries of these achievements have a chance to see any difference in election systems until and unless systems designers rather than election administrators are in charge of incorporating these achievements into practical systems servicing elections. Since systems designers are rarely involved in developing election systems, and systems studies of election systems are not conducted as intensively as they should be conducted, these studies cannot offer doable solutions to election problems, leaving plenty of room for politics to affect the quality of services provided by the election systems in use, despite the fact that, by definition, this quality should be a civic matter.

The existing system of electing a US President can serve as an example illustrative of such a status quo.

The 220-year-old election rules aimed at servicing a particular manner of choosing a President, have transformed into an outlandish mathematical algorithm weirdly aggregating votes cast not for presidential candidates but determining which candidate wins [1]. Despite numerous mathematical studies of the key part of these rules – usually called the Electoral College – showing that the fairness of these rules is at least questionable, substantive discussion of the Electoral College remains limited to narrow academic circles. Even after the most controversial 2000 presidential election, due to the absence of public demand, all the attention has been artificially narrowed to technologies of casting and processing votes, though some studies of extreme outcomes that the existing election rules may engender have been done [2,3]. While many countries have been actively looking for improvements of presidential election rules based on scientific results in the field of the mathematics of voting [4–6], in the US, even approaches addressing deficiencies of the existing rules of electing a President are rarely communicated to American voters – the customers of the election system – at the national level [7–11].

Problems of security of cast votes in American elections and those of effectively allocating voting machines and personnel on Election day are treated similarly. Despite substantial theoretical progress in developing approaches addressing security of votes and auditing cast votes, the voting technologies in use are the subject of constant frustration and worry for many voters in every federal election [12]. As for allocating voting machines and personnel on Election day, even voting standards such as a maximum wait time to cast a vote have not become either federal or state standards in national elections [13–15].

Though numerous pollsters saturate radio, TV, and other media outlets, the quality of pollster comments looks dubious. While almost every pollster offers her/his “analysis” of the election dynamics, the pollsters should have been focusing on the quality of the polls and their statistical correctness, while leaving the analysis of the polls as such to statisticians and systems analysts specializing on elections. The absence of healthy competition of views on the value and trustworthiness of many polls makes comments of the pollsters in the media superior to those of election analysts. The status quo, when even obvious blunders of pollsters are rarely discussed in the media, owes much to insufficient incorporation of the mathematics of polling into systems studies of elections and to the absence of any feedback on the quality of polls from the electorate, allowing political propagandists to exploit this form of public service to advance their political agenda.

Finally, though particular aspects of voting systems and elections are studied and taught at departments of political science and government in American universities and colleges, systems studies of elections are not currently part of their curriculum. The absence of methodological works in systems studies of elections as service systems in this volume illustrates the lack of attention to such studies in the scientific community, though certain advances in systems studies of administering elections have recently been made [16–18].

One of the ideas underlying the creation of this volume was to ask scientists, who have contributed significantly to clarifying the intricacies and to understanding the complexity of voting systems and elections, to share their views and current results on the subject with a broad spectrum of potential readers. In this volume, applied mathematicians and systems scientists interested in researching voting systems and elections, as well as political and social scientists actively using mathematical modeling and mathematical methods in their studies of this subject, will find results relating to studying particular problems in voting systems and elections. Descriptions of problems that need attention of mathematicians and systems scientists are also present in the selected publications.

The issue features works on the mathematics of voting and on mathematical models for studying particular voting rules. Models for studying voter behavior, political institutions, political districting, and security of voting are a vital part of the volume. Applications of indices for measuring voting power and the fairness of representation in political institutions are demonstrated in several works selected for publication in the volume. A method for forecasting outcomes of US presidential

elections, which turned out to be one of the most accurate in forecasting the outcome of the 2004 election, represents a variety of approaches to forecasting election outcomes that are actively developed [19–22].

Finally, a special section of the volume is dedicated to upcoming and recently published books on the subject. A brief review of a book that presents a unique collection of data relating to Russian Parliamentary elections, along with the analysis of this data, is also part of this section.

Besides the chance to get acquainted with a variety of subjects covered in the volume, the reader will familiarize with a variety of styles which mathematicians, systems scientists, and political scientists exercise in addressing the subject of their research in the field of voting systems and elections. While referees of some submissions sometimes expressed their concern regarding the narrative style of the material presentation in these submissions, from my viewpoint, the employment of such a style indicates that works in corresponding directions have not drawn enough attention of mathematicians and systems scientists as yet. At the same time, each selected article written with the use of a narrative style outlines a set of problems that require attention of mathematicians and specialists who develop and analyze mathematical models of voting systems and elections, and drawing this attention was one of the goals of publishing this collection of articles.

I would like to express my deep appreciation to Professor Ervin Y. Rodin, Editor-in-Chief of *Mathematical and Computer Modelling* and one of the leading systems scientists, for his constant support of systems studies of voting systems and elections and for offering me an opportunity to organize this volume, which, as I hope, will contribute to promoting these studies. Constant attention and support from Professor Richard C. Larson, Director of MIT's Center for Engineering Systems Fundamentals and one of the leading researchers in the field of systems studies of service systems, were instrumental in conducting this work.

The volume has benefited greatly from invaluable assistance rendered by a group of mathematicians, systems scientists, and political scientists who agreed to serve as Advisory Board members for this volume. Fuad Aleskerov, John Patty, Alexander Vasin, Boris Goldengorin, Jeff Gill, and Rita Giuliano advised me about particular submissions and shared with me their vision of the volume subject, while David King, Richard Larson, and Maggie Penn helped a lot in discussing the structure of the volume and in shaping its content. The quality of the volume owes much to diligent work of numerous referees, anonymous to the authors. Time and knowledge invested by the referees in evaluating the submitted articles produced detailed referee reports that were critical in selecting the most interesting articles for publication in the volume.

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References

- [1] A. Belenky, Belenky: Counting votes for president, *Milford Daily News*, MA, February 5, 2008.
- [2] A. Belenky, *Extreme Outcomes of US Presidential Elections*, NISTRAMAN Consulting, Brookline, MA, 2003.
- [3] A. Belenky, *How America Chooses Its Presidents*, AuthorHouse, Bloomington and Milton Keynes, 2007.
- [4] M. Balinski, R. Laraki, A theory of measuring, electing, and ranking, *PNAS* 104 (21) (1997) 99–125.
- [5] D. Saari, *Chaotic Elections! A Mathematician Looks at Voting*, American Mathematica Society, Providence, RI, 2001.
- [6] S. Brams, *Mathematics and Democracy*, Princeton University Press, Princeton, Oxford, 2008.
- [7] A. Belenky, Commentary: The Good, the Bad, and the Ugly: Three proposals to introduce the nationwide popular vote in US presidential elections, *106 Michigan Law Review*, First Impression 110 (2008) 99–105.
- [8] A. Belenky, Massachusetts should reject the National Popular Vote Plan, *Telegram and Gazette*, February 14, 2008.
- [9] A. Belenky, Electoral College benefits voters in Vermont, *the Rutland Herald*, April 20, 2008.
- [10] A. Belenky, District vote proposal falls short, *the Baltimore Sun*, December 11, 2007.
- [11] A. Keyssar, Peculiar institution, *the Boston Globe*, October 17, 2004.
- [12] Editorial, Ballot Boxing, Congress should proceed cautiously in requiring new voting procedures., *the Washington post*, May 21, 2007.
- [13] A. Belenky, R. Larson, Faulty system for democracy, *the Boston Herald*, February 12, 2007.
- [14] A. Belenky, R. Larson, Voting should not be a heroic act of patience, *The Christian Science Monitor*, September 12, 2006.
- [15] A. Belenky, R. Larson, A call for creating service standards, *The Boston Globe*, February 20, 2007.
- [16] A. Belenky, R. Larson, Coping with voter queues in US Federal elections, *Campaigns and Elections*, 20, June 2008 (in press).
- [17] A. Belenky, R. Larson, To Queue or Not To Queue, In a US Presidential Election, that should NOT be a question!, *OR/MS Today*, June, 2006.
- [18] R. Larson, R. C. Services science: At the intersection of management, social, and engineering sciences, *IBM Systems Journal* 47 (1) (2007) 41–52. Also available at: <http://www.research.ibm.com/journal/sj47-1.html>.
- [19] R. Erikson, K. Sigman, A simple stochastic model for close US presidential elections, Working paper, Department of Political Science, Columbia University, 2000.
- [20] C. Wlezien, R. Erikson, The horse race: What polls reveal as the election campaign unfolds, *International Journal of Public Opinion Research* 19 (2007) 74–88.
- [21] R. Fair, *Predicting Presidential Elections and Other Things*, Stanford University Press, Stanford, CA, 2002.
- [22] E. Kaplan, A. Barnett, A new approach to estimating the probability of winning the presidency, *Operations Research* 51 (2003) 32–40.