Brazilian elections: voting for a scaling democracy


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Abstract

The proportional elections held in Brazil in 1998 and 2002 display identical statistical signatures. In particular, the distribution of votes among candidates includes a power-law regime. We suggest that the rationale behind this robust scaling invariance is a multiplicative process in which the voter’s choice for a candidate is governed by a product of probabilities. © 2002 Elsevier Science B.V. All rights reserved.

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The election is a fundamental democratic process and the vote certainly represents the most effective instrument for regular citizens to promote significant changes in their communities. General elections in Brazil are held every 4 years, when citizens vote for executive (president and state governors) as well as legislative (congressmen and state deputies) mandates. Voting is compulsory and ballots are collected in electronic voting machines. Previously, we reported a statistical analysis of the Brazilian 1998 elections showing that the proportional voting process for state deputies displayed scale invariance [1]. It was shown that the distribution of the number of candidates \( N \) receiving a fraction of votes \( v \) followed a power law \( N(v) \sim v^z \), where \( z \approx -1 \), extending over two orders of magnitude. The striking similarity in the distribution of votes in all states, regardless of large diversities in social and economical conditions in different regions of the country, was taken as an indication of a common mechanism in the decision process. The issue was raised, however, that this uniformity in behavior could be due to some peculiarity of the political rules valid at that moment. In 1998, the legislation

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allowed party alliances of all sorts, not necessarily reproduced from state to state and independent from the majority candidatures. Since then, the National Congress has approved new political rules. Any alliance of parties supporting a presidential candidate should be reproduced in all states with restrictions on the campaigns for Congress and local representation.

On October 6, 2002, 115,253,432 electors from Brazil’s 27 states chose from among 4210 candidates for federal and 11,717 for state deputies. The collection of ballots was entirely electronic, thus permitting a very rapid count and publication of the results [2]. We apply the same statistical treatment given to the results of the 1998 election for congressmen and state deputies. Votes for the candidates are normalized by the number of voters in their respective states. We then rank the candidate by his/her normalized number of votes and perform the statistics for the whole country. This is justified by the aforementioned compatibility found in the results of 1998 for each state, and verified again for the 2002 election.

Fig. 1(a) and (b) are the log–log plots of the voting distribution $N(v)$ using data of all candidates in Brazil competing for positions of state and federal deputies, respectively. The voting distributions for 1998 and 2002 are almost identical for both types of candidates. Furthermore, in all cases we can identify a well-defined region where the voting distributions follow a $1/v$ behavior. The remarkable similarity between the statistics of the 1998 and 2002 results, despite significant modifications of the electoral rules, indicates that the processes behind a voting decision are largely insensitive to external factors. We argue that this is a manifestation of a multiplicative relation of independent factors influencing the choice of the elector. The voting fraction $v$ of a candidate can be viewed as a “grand-process” depending on the successful completion of a number $n$ of independent “sub-processes”. Each sub-process could be associated with the characteristics of a given candidate or with his/her position on a particular political, social or economical issue. We can then link to each candidate a probability $p_i$ of performing sub-process $i$, so that his/her voting fraction is $v = p_1 p_2 \cdots p_n$. Assuming that the $p_i$’s are independent random variables, and considering $n$ sufficiently large we find, from the Central Limit Theorem, that the distribution of $v$ should be approximately log-normal. If the statistical dispersion of the data is large enough, the log-normal distribution can “mimic” the $1/v$ profile over a given range of values [3]. Deviations at small and large values of $v$ are expected to be due to finite size effects.

The statistical analyses of the 1998 and 2002 Brazilian elections indicate that the voting distribution is highly reproducible. It displays features of a “scale-free” phenomenon [4–6] where the governing decision-making mechanism can be adequately modeled in terms of a multiplicative process [3]. A candidate for the National Congress or for the State Houses is likely to be known by the voters through the media. When instruments of information are absent or ignored, the voting decision is probably determined by direct communication with friends, relatives, etc. In the case of municipal elections, for instance, the physical proximity of candidates and voters creates a different framework from the one found for state and federal elections. We performed the same data analysis to the results of Brazilian municipal elections held in 2000. No clear indication of power-law behavior was found even for the most populated cities.
Fig. 1. (a) Double logarithmic plot of the voting distribution for state deputies in 1998 (circles) and 2002 (triangles). The solid lines are the least-squares fits to the data in the scaling regions. The numbers indicate the scaling exponent. (b) Same as in (a) but for federal deputies.

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References