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Complexity of and algorithms for the manipulation of Borda, Nanson’s and Baldwin’s voting rules.

Summary: We investigate manipulation of the Borda voting rule, as well as two elimination style voting rules, Nanson’s and Baldwin’s voting rules, which are based on Borda voting. We argue that these rules have a number of desirable computational properties. For unweighted Borda voting, we prove that it is NP-hard for a coalition of two manipulators to compute a manipulation. This resolves a long-standing open problem in the computational complexity of manipulating common voting rules. We prove that manipulation of Baldwin’s and Nanson’s rules is computationally more difficult than manipulation of Borda, as it is NP-hard for a single manipulator to compute a manipulation. In addition, for Baldwin’s and Nanson’s rules with weighted votes, we prove that it is NP-hard for a coalition of manipulators to compute a manipulation with a small number of candidates. Because of these NP-hardness results, we compute manipulations using heuristic algorithms that attempt to minimise the number of manipulators. We propose several new heuristic methods. Experiments show that these methods significantly outperform the previously best known heuristic method for the Borda rule. Our results suggest that, whilst computing a manipulation of the Borda rule is NP-hard, computational complexity may provide only a weak barrier against manipulation in practice. In contrast to the Borda rule, our experiments with Baldwin’s and Nanson’s rules demonstrate that both of them are often more difficult to manipulate in practice. These results suggest that elimination style voting rules deserve further study.

Keywords: social choice; voting methods; manipulation; Borda voting; Nanson’s voting rule; Baldwin’s voting rule
doi:10.1016/j.artint.2014.07.005