CS590.04: Computational Microeconomics

A Social Choice Application (March 12, 2014)

Authors: Matt Dickenson

1 Motivation

My proposed project consists of three parts, centered around the implementation of a social choice web application. The Borda count rule serves as a useful voting method, for both normative and pragmatic reasons, although it is manipulable. Monte Carlo simulations will be used to estimate the probability of encountering undesirable outcomes and paradoxes using this method. The application can be used for data collection in future research projects, and to enhance public understanding of and familiarity with applied social choice.

2 Problem Definition

The software application will be useful for a group coordinating on a single outcome by aggregating their preferences, e.g. selecting a movie for a night out with friends. A user creates a poll by supplying a question ("What movie should we see?"), candidate options (movies) and voters (a list of email addresses to be contacted). A unique link will then be sent to each voter, who supplies her ranking of the choices. When all votes have been recorded, an email will be sent to all voters with the outcome (and possibly more info, such as anonymized rankings), and a link where they can indicate their satisfaction with the outcome.

One goal for this application is ease of use, in order to set it apart from available online survey applications.[1] To enhance ease of use, users will be informed of the default rule that will be used if they do not submit a vote, such as critics' ratings on Rotten Tomatoes. Other desiderata are discussed in the next section.

3 Voting Methods

Desirable properties of the voting method for this application arise from both normative and pragmatic concerns. Anonymity and neutrality ensure that the names of the voters and candidates, respectively, do not influence the outcome. Candidates can be presented to voters in a randomized order to ensure that the format of the list does not bias results. Unanimity requires that if candidate A is preferred over B by all voters, B should not win. The universal domain of potential ballots will be considered in the Monte Carlo simulations, to ensure that the application works with any opinion a voter might entertain about the candidates. Finally, we desire a rule with reinforcement, so that if disjoint sets of voters select the same winner, that candidate should win when the voters are pooled. Practically, this ensures that two small groups of friends who use the app and arrive at the same movie should also have seen that movie if they voted as a single group.

[1] E.g. `http://surveymonkey.com` and `http://doodle.com`.

If there are two candidates, the only social decision method that satisfies neutrality, anonymity, and positive responsiveness (if a candidate is tied for the win and moves up in rankings, it will become the winner) is majority rule [1]. Less strict conditions, such as Pareto optimality, also motivate the use of majority rule even if positive responsiveness is thought to be too strict [2, 3]. If there are more than two candidates, only a scoring rule will satisfy anonymity, neutrality, reinforcement, and continuity (if two subgroups of voters select different winners, then there is some number k such that k copies of the first subgroup plus a single copy of the second subgroup will elect the first group's winner) [4]. Scoring rules have the additional advantage of being computationally easy.

What voting rule should we choose? Borda count chooses the majority alternative (whenever it exists), and satisfies anonymity, neutrality, unanimity, and reinforcement, along with local independence of irrelevant alternatives. A major downside of the Borda rule is that it is easily manipulable [**?**]. However, for a particular type of manipulation (Constructive Coalitional Weighted-Manipulation), manipulating Borda is NP-complete for three candidates, and it is NP-hard for another (Constructive Individual Unweighted-Manipulation) under uncertainty about others' votes [**?**]. This condition should apply for most use cases of the application proposed here. To assess the relative merits of using Borda in this application, Monte Carlo simulations will assess its vulnerability to manipulation.

4 Results and Validation

It is unlikely that sizable groups of users will conduct their group preference aggregation using the proposed application in the near-term. Thus, to assess the vulnerability of Borda count elections to manipulation, a series of Monte Carlo simulations will be conducted with hypothetical voters and candidates. The results will be compared with the Veto and Plurality rules to asses which is most appropriate for this setting.

5 Implications and Further Research

Implementing a web application where users can employ Borda voting to coordinate on a group outcome, such as which movie to attend, will help extend the use of social choice to a popular setting. Soliciting satisfaction ratings after the election will help to indicate whether the application is successful and merits wider use. Monte Carlo simulations will estimate the sensitivity to manipulation relative to other rules.

[1] Kenneth O May. A set of independent necessary and sufficient conditions for simple majority decision. *Econometrica: Journal of the Econometric Society*, pages 680–684, 1952.
[2] Göksel Aşan and M Remzi Sanver. Another characterization of the majority rule. *Economics Letters*, 75(3):409–413, 2002.
[3] Gerhard J Woeginger. A new characterization of the majority rule. *Economics Letters*, 81(1):89–94, 2003.
[4] H Peyton Young. Social choice scoring functions. *SIAM Journal on Applied Mathematics*, 28(4):824–838, 1975.
[5] John G Kemeny. Mathematics without numbers. *Daedalus*, 88(4):577–591, 1959.
[6] H Peyton Young and Arthur Levenglick. A consistent extension of condorcet's election principle. *SIAM Journal on Applied Mathematics*, 35(2):285–300, 1978.
[7] Peyton Young. Optimal voting rules. *Journal of Economic Perspectives*, 9:51–51, 1995.
[8] Vincent Conitzer, Andrew Davenport, and Jayant Kalagnanam. Improved bounds for computing kemeny rankings. In *AAAI*, volume 6, pages 620–626, 2006.
[9] Andrew Davenport and Jayant Kalagnanam. A computational study of the kemeny rule for preference aggregation. In *AAAI*, volume 4, pages 697–702, 2004.