Social choice: locating public facilities & voting in a large electorate

Thesis Summary

Social Choice: Locating Public Facilities & Voting in a Large Electorate

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September 5, 2017

This thesis adds to the theory of social choice. As the name proposes, social choice theory manages decisions of society. A decision of society may concern an extraordinary assortment of things, for example, picking an area to put an open office, picking candidates in an election and so forth. Presently, being normal each person in the public eye needs the aggregate decision to be ideal for herself. Clearly, they express unique preferences about the decision to be made. This makes an issue of amassing these distinctive feelings or inclinations into a solitary social decision. The hidden supposition is that individual inclinations are not known but rather everyone knows the accessible decisions. Social choice theory models this accumulation of individual inclinations to an aggregate decision. A social decision capacity ought to have "good" properties. Being good means distinctive things in various settings. A standout amongst the most imperative properties is that no individual ought to have the capacity to control the aggregate decision, making it ideal to her. This basically ensures each individual is "honestly" announcing her inclinations. Another alluring property is that it considers every single individual inclination. Obviously there are a few different properties thought to be attractive. The most vital inquiry is whether it is conceivable to plan a social decision work that is sensible as in it fulfils a portion of the properties.

In this regard, Arrow (1950), Gibbard (1973), Satterthwaite (1975) have shown that it is generally impossible to find a social choice function satisfying all these desired criteria. These results are called "impossibility results/theorems" in literature. However, there are some remarks concerning the use of these results. Arrow has said, "Most systems are not going to work badly all of the time. All I proved is that all can work badly at times." In his general impossibility result individuals are allowed to have any conceivable preferences. There is a stream of literature showing that it is possible to escape from "impossibility" if we do not assume the individuals to have all conceivable preferences. Specifically, the possibility of having some positive results depends mostly on two things, namely, the set of *admissible preferences* and *properties* of the *social choice function*.

Two noteworthy methods for limiting the arrangement of allowable preferences are considered in this proposition. One path is to limit the arrangement of preferences for each individual to such an extent that every one of them have a similar arrangement of permissible preferences from which they can pick autonomously. Another route is to limit the preference blends of society all in all, as opposed to forcing limitations over every person. In this theory we think about both these sorts of limitations. The previous is examined in Part 1 and the last is contemplated in Part 2 of the Thesis.

Part 1 of the theory elaborates on two area problems, to be specific, Locating an open decent on a sphere and Locating two open products in $\mathbf{R^2}$. Part 2 investigations several Voting strategies.

In chapter 2 the concern is how to locate a public good/bad on a sphere (the earth). We assume that everyone wants the public good to be located at her most preferred point on the sphere called the peak of her preference. For all other points the preference decreases with distance from the peak. Note that because of the Spherical structure, a single-peaked preference can be reformulated as a single-dipped preference. So, results based on single-peaked preferences translate to similar results on single-dipped preferences. Therefore, this research applies to locating global public goods for example global internet servers, storage for all human knowledge etc. Also this work applies to locating global public obnoxious facilities like nuclear power plants, scientific research projects involving nuclear reactions etc.We end up with an "impossibility" result, which means that there is no non-dictatorial social choice rule that satisfies the conditions we imposed. This result stands out in the stream of literature because usually having single-peaked preferences helps achieving possibility results.

In chapter 3, we discuss the location of multiple public goods. Suppose we have to locate two libraries in a town. It is natural to assume that agents prefer to have at least one library close to their homes or some preferred place and preferences for all other locations decrease with the distance from that most preferred locations. Therefore, preference for a single library can be modelled as a single-peaked preference in the two dimensional Euclidean space. As we are deciding on the location of two libraries together, we need to have joint preferences over pairs of locations. These joint preferences are obtained by combining the marginal preferences for a single library. There can be several different types of joint preferences, we use the so called lexmax extension. Here we mainly study this location problem assuming the social choice function to be "non-manipulable" and "uncompromising". Under these conditions we have been able to characterise the class of rules. Specifically, for each location we apply a generalised median voter rule per coordinate.

In the final chapter 4, the issue is on anonymous collective decision making in large electorates. We study frequency distributions over the set of preferences based on the structure on linear orderings induced by the Kemeny distance. We show that at the unimodal preference (frequency) distributions considered here many well-known collective decision rules have the mode as outcome. We therefore consider it to be a natural and appealing collective decision at such distributions. The results found here indicate, that the mode choice of Condorcet consistent, Borda and Plurality rules is

robust to considerable perturbations in the tail part of a single mode distribution. Our analysis includes multimodal distributions resulting from superposing two or more unimodal distributions.