

Contingent Payment Mechanisms for Future Coordination (Doctoral Consortium)

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mechanism design; coordination; assignment; social choice

Abstract

My research is broadly situated at the interface between economics and computer science (especially artificial intelligence) and draws on concepts from multi-agent systems, planning, and game theory. I am particularly interested in mechanism design for coordination when assigning resources or tasks to agents, when choosing a plan for a future event, in the presence of uncertainty, ex-post decisions, self-interest and private information.

Consider assigning time slots for a neighborhood electric vehicle charging station in a way that they are utilized by the residents. At the time of planning, each resident is uncertain about her values and availability of using the station at different times (e.g. they may get stuck in traffic so can't arrive at the station on time, or emergency may happen so they need to drive the cars,) but has private information about their distributions. When the time comes, the values are realized and the assigned residents will then make decisions on whether to use the stations.

Similar coordination problems exist when selecting consumers to prepare for reliable consumption reduction to balance supply and demand in electric power systems, or a group of students choosing a time for a project meeting. In each case, the decision is associated with an intended action (to cut consumption, and to show-up at the meeting) and the mechanism needs to elicit information about uncertain values for different alternatives, make a plan for the future along setting payments that may be contingent on people's future actions.

We seek truthful mechanisms in which people will voluntarily choose to participate. The rich private information (all possible distributions), the possibility of different payments contingent on different actions, the voluntary choice of actions the agents have and the resulting utilities that are non-quasi-linear (NQL) in payments, impose big challenges for information elicitation and incentive alignment. Moreover, the design objective depends on the outcome that is determined by the ex-post actions taken by the agents, which

goes beyond welfare or revenue maximization that are studied in standard mechanism design.

My past research include resource allocation [2] with the objective of maximizing the probability of good outcomes (i.e. resources being utilized), and incentivizing reliable demand-side response in electricity grids [4, 3] where the objective is to guarantee a probabilistic constraint on good outcomes (i.e. sufficient reduction of consumption) without much disturbance of the economy or excessive payment to agents. Normally in social choice setting (such as voting) there is no money. My problem on meeting scheduling is a special case of social choice with payments and NQL utilities. I prove a negative result on the existence of non-dictatorial truthful mechanisms, and characterized NQL utility domains on which mechanisms with VCG properties continue to exist [1]. An ongoing project on bike sharing system addresses the problem of designing a truthful mechanism as a part of a larger optimization problem: how to incentivize riders to help rebalancing the bikes and make plans for truck routes at the same time, in a welfare optimal and cost effective manner.

Looking forward, many challenges remain for the design and implementation of successful coordination mechanisms. Much effort is needed for understanding NQL utilities, e.g. the assignment problem without unit demand and with combinatorial values, and mechanisms for social choice with solution concepts weaker than dominant strategy. To go beyond working with homo economicus, an ongoing project explores the effect of temporal preference and present-bias in the coordination of future events and the design of commitment devices through contingent-payment mechanisms. We also plan on designing experiments to better understand how humans react to future tasks and how the behavior differ under theoretically equivalent mechanisms.

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