In this paper, we investigate an optimal delegation model with multidimensional actions and multidimensional states of the world. The principal is responsible for taking an action, and her payoff is influenced by an unknown state of the world, which represents the agent’s private information. No monetary transfers are available. Since the principal’s and agent’s preferences are not aligned, the agent is unwilling to simply disclose the state. The principal can employ arbitrary mechanisms, including stochastic ones, and her objective is to maximize her expected payoff.

We assume that the agent’s payoff depends affinely on the state and is strictly concave with respect to the action. As a first step, we establish that a mechanism is incentive compatible if and only if its induced indirect utility function is convex and lies below the agent’s first-best payoff, which represents the payoff the agent would receive if she could freely choose her action. This simple characterization provides geometric insights and proves useful even in one-dimensional settings.

Under an assumption about the principal’s payoff—that the curvature of the principal’s payoff is related to the curvature of the agent’s payoff—, we formulate the principal’s problem as a linear program using indirect utilities. By utilizing linear programming duality, we derive necessary and sufficient conditions for any mechanism to maximize the principal’s expected payoff. Earlier results in the literature characterize when a particular interval delegation set is optimal in one-dimensional settings. Our characterization generalizes these results even in one dimension because it applies to any mechanism (not just interval delegation) and notably also applies to multidimensional problems. We show how, in one-dimensional settings, our result recovers existing results on the optimality of interval delegation.

We leverage our main result to examine simpler conditions under which a convex delegation set is optimal. Additionally, for one-dimensional settings, we introduce novel conditions that guarantee the optimality of some interval delegation set. A useful implication is that if the state distribution exhibits a log-concave density and the agent possesses a constant bias, then some interval delegation set is optimal.

Full paper available at: https://arxiv.org/abs/2208.11835

Additional Key Words and Phrases: optimal delegation, multidimensional mechanism design, no transfers

ACM Reference Format:
Andreas Kleiner. 2023. Optimal Delegation in a Multidimensional World. In Proceedings of the 24th ACM Conference on Economics and Computation (EC ‘23), July 9–12, 2023, London, United Kingdom. ACM, New York, NY, USA, 1 page. https://doi.org/10.1145/3580507.3597815