Computing Correlated Equilibria

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- Recall correlated equilibrium: correlating device that each player conditions strategy on. Equilibrium if no incentive to deviate given the strategies of the other agents
- There is always a CE where the random variable can be interpreted as a recommendation of which action each player should take; and in equilibrium all players follow the recommendation

An LP for Computing Correlated Equilibria

- Let a be a pure-strategy profile, a_i denote a pure strategy for player i
- Variables will be *p(a)* the probability that a is the profile recommended to the agents

$$\sum_{a \in A | a_i \in a} p(a) u_i(a) \geq \sum_{a \in A | a_i \in a} p(a) u_i(a'_i, a_{-i}) \quad \forall i \in N, \forall a_i, a'_i \in A_i \qquad (4.52)$$

$$p(a) \geq 0 \quad \forall a \in A \qquad (4.53)$$

$$\sum_{a \in A} p(a) = 1 \qquad (4.54)$$

Adding an Objective Function

- To find specific correlated equilibria, can add an objective to the LP formulation

$$\text{maximize:} \quad \sum_{a \in A} p(a) \sum_{i \in N} u_i(a).$$

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Theorem 4.6.1 *The following problems are in the complexity class P when applied to correlated equilibria:* uniqueness, Pareto optimal, guaranteed payoff, subset inclusion, *and* subset containment.

Compare with NE

- Why can CE be expressed as linear constraint but not NE? Definitions are very similar

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- Why can CE be expressed as linear constraint but not NE? Definitions are very similar
- CE involves single randomization over action profiles. In NE, each agent randomizes independently

$$\sum_{a \in A} u_i(a) \prod_{j \in N} p_j(a_j) \geq \sum_{a \in A} u_i(a'_i, a_{-i}) \prod_{j \in N \setminus \{i\}} p_j(a_j) \quad \forall i \in N, \forall a'_i \in A_i.$$