Computing Correlated Equilibrium

CE finding is to solve a set of linear equations

Two sets of constraints

1
$$\sum_{s_{-i} \in S_{-i}} \pi(s_i, s_{-i}) u_i(s_i, s_{-i}) \geqslant \sum_{s_{-i} \in S_{-i}} \pi(s_i, s_{-i}) u_i(s_i', s_{-i}), \; \forall s_i, s_i' \in S_i, \forall i \in N$$

Total number of inequalities $= O(n m^2)$, assuming $|S_i| = m, \forall i \in N$.

2 $\pi(s) \geqslant 0, \; \forall s \in S$ $\quad m^n$ inequalities

$$\sum_{s \in S} \pi(s) = 1$$

The inequalities together represent a feasibility LP that is easier to compute than MSNE.

MSNE : total number of support profiles $O(2^{mn})$

CE : number of inequalities $O(m^n)$ – exponentially smaller than the above

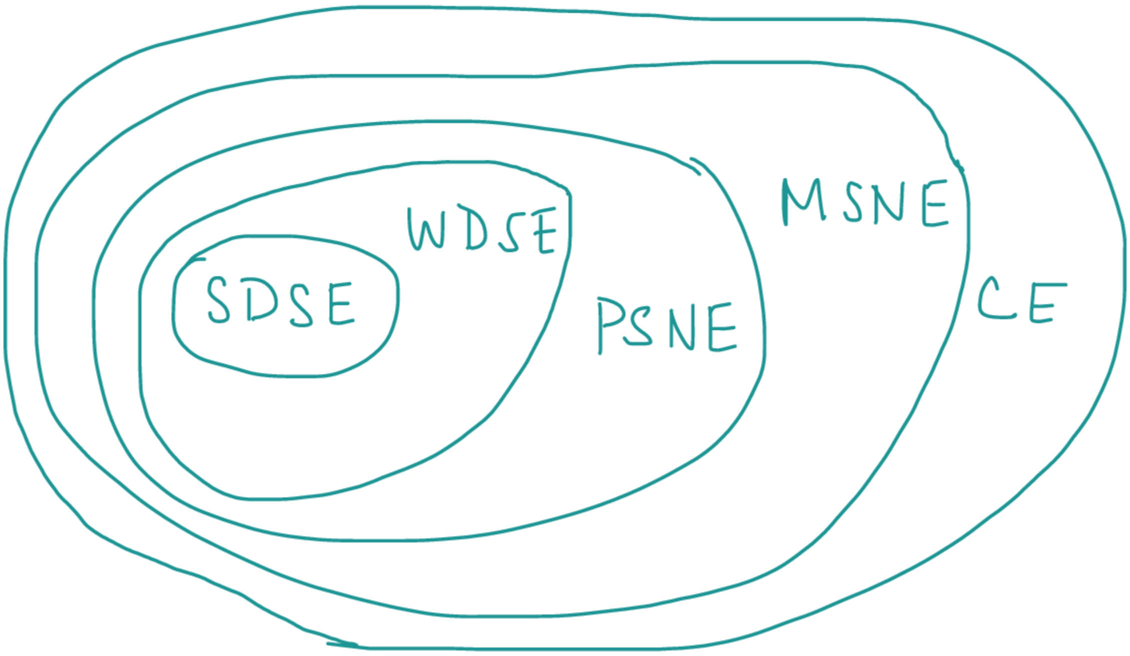
[take log of both quantities to understand this point]

Moreover, this can also be used to optimize some objective function, e.g., maximize utilities of the players

Comparison with the previous equilibrium notions

Theorem : For every MSNE σ^*, there exists a CE π^*.

Proof hint : Use $\pi^*(s_1, \ldots, s_n) = \prod_{i=1}^{n} \sigma_i^*(s_i)$ and the MSNE characterization theorem. [Homework]



Summary so far

- Normal form games
- rationality, intelligence, common knowledge
- strategy and action
- dominance – strict and weak – equilibria : SDSE, WDSE
- unilateral deviation – PSNE, generalization : MSNE, existence (Nash)
- characterization of MSNE – computing, hardness
- trusted mediator – correlated strategies – equilibrium