Department of Data Science, IIT Palakkad

DS5618: Multi-agent systems (Aug-Dec 2025)

08:00 AM-08:50 AM Test 2 (30 October 2025) Marks : 20

Instructions

1. Write your answers neatly in Blue/Black ink. Make sure your answers are legible.
2. If you have to make **any assumptions** about unspecified things, write them clearly with justification.
3. Write the **question number clearly** for each answer.
4. There will be **partial markings** for the questions, so even if you cannot solve the entire problem be sincere with the steps.
5. Be precise. *Best strategy is to not to waste time in writing what is not required.*

1. **Condorcet consistency in single-peaked domain** (2+2+6=10 marks)

   1. A Condorcet winner is the alternative who beats all other alternatives in pairwise elections. Answer *yes* or *no* for the following questions.
      (a) Does a Condorcet winner always exists for any profile of single-peaked preferences?
      (b) Is the median voter rule Condorcet consistent for single-peaked domain? In other words, if there exists a Condorcet winner in single-peaked domain, does median voter rule guarantee to choose that alternative as the winner.
   2. Explain your answer for the question (b) above.

2. **Individual Rationality (IR) and the second-Price auction** (4+6=10 marks)

   Consider a mechanism $M = (f, p)$ which consists of allocation function $f(\cdot)$ and payment functions $p_i(\cdot)$ $\forall i \in N$.
   A mechanism M is *individually rational* if no agent ends up worse off by participating than by abstaining from it. That is, $\forall i \in N$, utility of i when i participates $\geq$ utility of i when i does not participate.
   In other words, if we allow the agents to opt-out of the individually rational mechanism, each agent prefers to participate than to opt-out. In single indivisible goods allocation,

   - if an agent does not participate in the mechanism, then it does not get the object and has to pay nothing, hence gets 0 utility.
   - a mechanism is individually rational, whenever an agent i participate in the mechanism, it guarantees that i's utility is never less than 0 (which is the utility it gets by opting out).

   Note that, Utility of an agent i = the true valuation i gets - the price i pays.

1. Answer *yes* or *no* for the following question. For single indivisible goods allocation, does the second-Price auction mechanism, guarantees *individual rationality*?
2. Explain your answer.

END