Convex elicitation of continuous properties

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Empirical Risk Minimization (ERM)

- In ML, use *Empirical Risk* to form hypothesis $h^* : x \mapsto y$
  
  $$h^* = \arg \min_{h \in \mathcal{H}} \sum_{(x, y) \in \text{data}} L(h(x), y)$$

- Algorithm minimizes empirical risk.
- $h^*$ depends on the design of $L$.
  - Minimum requirement: consistent loss.
A property $\Gamma : \Delta(\mathcal{Y}) \to \mathcal{R}$ maps probability distributions to predictions.

A loss $L : \mathcal{R} \times \mathcal{Y} \to \mathbb{R}$ elicits a property $\Gamma$ if for all $p \in \Delta(\mathcal{Y})$,

$$\Gamma(p) = \arg \min_{r \in \mathcal{R}} \mathbb{E}_{Y \sim p} L(r, Y)$$

When are these loss functions convex?
Main result

Theorem (Informal)

Let $\Gamma$ be a real-valued, continuous property defined over a finite outcome space.*

Then $\Gamma$ is elicitable $\iff$ $\Gamma$ is convex elicitable.

*more assumptions not listed
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- Implications in prediction markets literature
Thank you

Come visit our poster with questions or thoughts!

Right now: 10:45-12:45 Room 210 and 230 AB #73