DS 574 Algorithmic Mechanism Design	**Lecture #10 Worksheet**
Fall 2023	Prof. Kira Goldner

Mechanism Design for Social Good

The Process

For each problem:

1. Learn about the area (from domain experts!)—basic rights that people don't have, inefficiencies in government policies, global harms.
2. Hone in on a high-level problem suitable for our tools.
3. Determine the model (with domain experts!)—what to keep, what to abstract.
4. Solve your theory problem.
5. Circle back **with domain experts** about results.

Regulation in Health Insurance Markets [Essaidi G Weinberg [1]]

Setting: There are a bunch of sellers (e.g. insurance plans) who wish to enter the market and sell their product. Each plan i will simply post a price p_i that consumers can pay to purchase their product (plan).

A consumer has a value for each product which is drawn i.i.d. from some distribution F. Then a specific realization of a consumer has values $(v_1, \dots, v_m)$ for products $1, \dots, m$.

A consumer will purchase the product that maximizes their utility, $i \in \text{argmax} v_i - p_i$. They *must* purchase a product even if their utility is negative for all products. This is motivated by settings where purchase is required by law, or is prohibitively expensive for their utility not to purchase (e.g. health repercussions).

The mechanism designer can choose how best to regulate entry into this market, if at all. In particular, we compare two specific choices:

1. No regulation. This is the "free market" model that is used in markets like medicare where anyone can enter into the market.
2. Allow all but the most expensive seller/product to enter the market. This "limited entry" model corresponds to procurers who negotiate with the sellers and then choose a smaller subset of curated products. We start with the most general case.

Notation. Let X_k^n denote the k^{th} highest value from n i.i.d. draws. That is, if we draw $x_1, x_2, \ldots, x_n$ i.i.d., then $\max\{x_1, \ldots, x_n\} = X_1^n$.

Let V_k^n denote the expected value of the k^{th} highest value from n i.i.d. draws. That is, $V_k^n = \mathbb{E}[X_k^n]$.

Recall that $\varphi_F(v) = v - \frac{1-F(v)}{f(v)}$ is the Myerson virtual value. the inverse of this second term is called the *hazard rate*: $\frac{f(v)}{1-F(v)}$.

We will use $h_2^n(F)$ to denote the expected hazard rate of the second maximum out of n draws from F, that is, $h_2^n(F) = \mathbb{E}\left[\frac{f(X_2^n)}{1-F(X_2^n)}\right]$.

We will use $H_1^n(F)$ to denote the expected inverse of the hazard rate of the maximum out of n draws from F, that is, $H_1^n(F) = \mathbb{E}\left[\frac{1-F(X_1^n)}{f(X_1^n)}\right]$.

The Limited Entry Setting. In this setting, one product is eliminated from the market.

The Free Market Setting. The difficulty here is to try to reason about how a seller will strategize *in response* to the other sellers' strategies. Our key idea will be to just set up the problem pretending that the seller is a monopolist, because we already know how to solve that problem.

Comparing Free Market and Limited Entry. Then the limited entry setting has higher expected utility in equilibrium for consumers over the free market setting precisely when

References

[1] Meryem Essaidi, Kira Goldner, and S. Matthew Weinberg. When to limit market entry under mandatory purchase. *CoRR*, abs/2002.06326, 2020.