Prediction Market Part 1

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Roadmap

1. Breakout room exercise: what's a prediction market?
2. Example prediction markets
3. General Properties
4. Prediction market game
5. LMSR Market Maker
6. Combinatorial Markets

Why prediction markets?

1. Suppose you are Dean Francis Doyle III...
2. You friend Larry asks you to predict whether the new Allston campus will be fully open on September 2021.
3. In breakout rooms: What are some ways you can do this, and what are the benefits / drawbacks of it?

Why prediction markets?

1. Suppose you are Dean Francis Doyle III...
2. You friend Larry asks you to predict whether the new Allston campus will be fully open on September 2021.
3. In breakout rooms: What are some ways you can do this, and what are the benefits / drawbacks of it?
4. Ideas: asking for expert opinion, polling students, etc.

Example Prediction Markets

1. Currently: PredictIt, some contracts on FTX.
2. Betfair for Sports contracts.
3. Intrade before 2013.

The markets above all use a *continuous duoble auction* and a *winner takes all* format.

Why Trade?

Why do people trade in these markets?

1. Speculation. Perhaps you think you know more about the Olympics than other traders.
2. Hedging. POV: you are a coal-mining company, and you think the election results will drastically impact your profit.

General Properties

1. Self organizing.
2. Incentive alignment.
3. Money-weighted aggregation.
4. Real-time feedback.

Empirical Evidence

Common measure: calibration.

Nate Silver: "When we say 70 percent, it really means 70 percent."
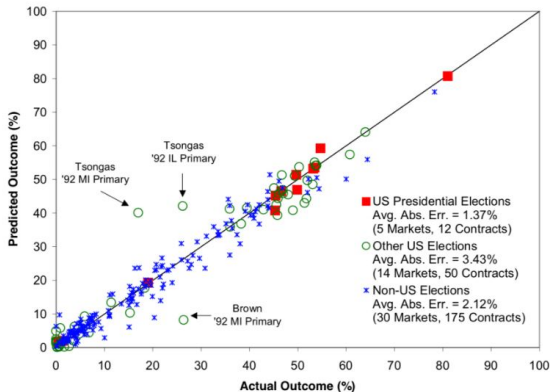

Figure 18.5.: Prices (y-axis) and outcomes in the IEM market. Predictions based on last-trade prices, midnight before each election. Data from 49 elections, 13 countries, 1990-2000, Berg et al. (2003)

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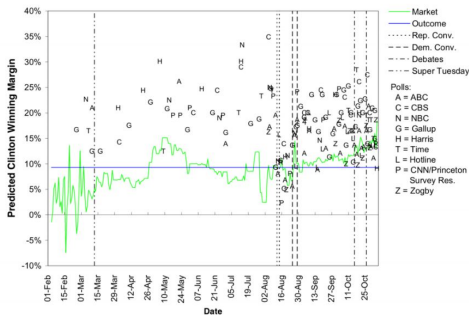

Figure 18.6.: Prices in the IEM market compared with the predictions of opinion polls during the 1996 U.S. presidential election campaign. The y-axis is the normalized margin of victory for Clinton (Clinton outcome minus Dole outcome divided by the sum of the two). Data from 1996. Berg et al. (2003)

Possible Designs for a market

1. Continuous Double Auction: an order book where there are bids (buy orders) and asks (sell orders).

In the market below, what happens if we get a new bid of size 1000 and price 0.768?

		Orderbook	Grouping None ▼
		0.757	0.757
Bid Size (OLYMPICS)	Bid Price (USD)	Ask Price (USD)	Ask Size (OLYMPICS)
4,344.9	0.757	0.768	195.3
10,000.0	0.750	0.769	1,550.0
100.0	0.747	0.770	0.1
473.4	0.743	0.772	677.0
13.5	0.737	0.778	167.0
100.0	0.732	0.780	128.5
2,122.1	0.731	0.782	389.0
133.0	0.730	0.783	229.0
807.7	0.728	0.784	510.0
3,276.7	0.727	0.785	77.0
200.0	0.720	0.786	83.0

Possible Designs for a market

2. Batch Auction: the order book will clear every x seconds. Trading price will be chosen to cause the most number of trades. (Previously used in Taiwan)

Same market as before. During a time interval, we received both a bid of size 1000 and price 0.768 and an ask of size 800 and price 0.754. What trades will happen?

Possible Designs for a market

2. Call market: the order book will clear every x seconds. Trading price will be chosen to cause the most number of trades. (Previously used in Taiwan)

Maximal trade volume occurs when price is at 0.768, so that will be the trading price.

Possible Designs for a market

1. Perimutuel market: there are n outcomes. Put your money in one of the outcome. When an outcome occurs, all the money will be paid out to participants who bet on the given outcome. (Used in HK horse racing)

Other design decisions

Winner takes all vs. continuous settlement.
Example: "Average temperature in Boston during 2021" vs. "2021 is warmer than 2020".

Activity: Prediction Game

We have 2 contracts:

1. Number of books on Richard's bookshelf,
2. A contract that settles to $100 if Richard has gone scuba diving.

You can buy/sell up to 10 contracts total. We will run a call market in both. Try to maximize expected profit!

LMSR Market Maker

This starts the math portion of the lecture – strap in!
A common issue prediction markets face is *liquidity*:

1. How far apart the top bid/offer are,
2. How much more impact I would have on the market if I trade 10 vs. 1000 contracts.

Financial markets tend to have market makers, though they are harder to prove correct.
To the whiteboard!

Combinatorial Markets

Suppose you have belief about a collection of outomes, e.g.

1. Democrats will win 9 of the 10 Northeastern states,
2. OH and FL will go to a single party,
3. Republicans to win the election given that they win PA.

Idea 1: make a market for every possible outcome. Issue: there are 2^{51} outcomes, and expressing "OH and FL will got to the same party" takes 2^{50} outcomes.

Can we do better?

Idea 1.5: find out what people are interested in, and make markets there. (Also how financial markets work.)

Idea 2: Include pairs of outcome, such as "(PA=Dem, FL=Rep)". Can we use AMM's?

A: No, this is #**P**-hard.

Thursday's Lecture Roadmap

Three talks, each $20 + \epsilon$ minutes!

1. Sam, Michael and Zhou on Incentives for decision markets.
2. Abishrant and William on the CMU Gates Market.
3. Max and Daniel on Intrade's 2012 Election Market.

Final Thoughts on Prediction Markets

As a breakout room discussion... What do we think about prediction markets?

Combining Tuesday's lecture, the Perusall reading and the three paper presentations, give 2-3 benefits, drawbacks and concerns about these markets + your final thoughts!