Prediction Markets

Today:

1. Introduction to Prediction Markets

2. Case Study + discussion: Cambrian House
A Typical Contract

Contract payoffs depend on unknown future events

Example: contract pays off $1 if $Y$ occurs by time $T$, 0 otherwise.

Event realizations must be specific.

Good: The Red Sox win the world series

Bad: Daisuke Matsuzaka gets injured in the first 2 months of the season.

Careful - Sometimes well defined contracts can have holes.
Winner Take All Contracts

• Pays out $1 if a specific event occurs, 0 otherwise.

• Market price $p$ for this contract gives the market’s expectation of the probability that this event will occur.

• Why?
Winner Take All Contract: Example

The Saddam Security

- Paid out $100 if Saddam ousted from power by June 2003.
- Traded on website tradesports.com
- Price on Jan 1 2003: $55
- Price on March 1, 2003: $70
Index Contracts

Contracts pay out the value of a specific future event.

Example:

Contract pays $1 for each percentage point of the popular vote won by Ralph Nader.

Market prices of index contracts measure *means*.

Let $y$ be Nader’s percentage of the popular vote.

Market price of contract reveals $E[y]$. 
Spread Contracts

- Amount of bet is fixed.
- Market trades based on cutoffs that determine whether event occurs

Example:

Contract pays even money if Ralph Nader wins more than $y\%$ of the popular vote.

Market trades based on $y$ (I’ll buy 10 units at $y=43$)

Market price reveals median value for $y$. (this is a fair bet if payoff is as likely to occur as not)
More Complicated Contracts

Carefully constructed markets can reveal information about the distribution of an uncertain future event

- Index contract 1 pays $y^2$
- Index contract 2 pays $y$

Market prices reveal $E[y^2]$ and $E[y]$.

In general, contracts can be constructed to provide any desired order statistic about distributions.
Contingent Contracts

Cleverly designed contracts can predict contingent events.

Example: “Electability”

Candidates / Party vote share
How are Contracts Traded?

In most prediction markets, the mechanism used is the *continuous double auction*.

This is the mechanism used on the NYSE.
Market Design Choice: IEM Model

The Iowa Electronic exchange trades contracts that pay off on mutually exclusive events.

A set of mutually exclusive events is called a basket (or a bundle.)

IEM never loses money!

To enter the market, you may either

* Go long on a position
* Exchange $1 for a basket of goods.
Market Design Choice: IEM Model

Drawbacks:

• Two ways to make the same bet. (if you hold positions)
  Arbitrage?

• Hard to take a short position. Must first buy a basket.

• Your cash is held by IEM - no interest.
Tradesports Model

To bet against an event, “short” the asset.

Suppose an asset that pays off $1 if \( y \) occurs is trading at price \( p \).

Shorting gives you \( p \) dollars now, but you are “on the hook” for $1 if \( y \) occurs.

$1 of assets are frozen in your account, to make sure you can cover your bet.

Like margin trading.
Accuracy of Prediction Markets

1. Hollywood stock exchange: Oscar predictions
2. Iowa Electronic Exchange vs Gallup
3. HP Printer Sales vs internal sales prediction methods
Prediction Market Challenge 1: Real vs Play Money

Wolfers et al. “Does Money Matter?”
Prediction Market Challenge 2: Thin Markets

Thin betting on events like

- Who will be the next pope?
- Who will be the next nobel prize winner in economics?

Why is it risky to make a limit order in a thin market?
On tradesports, limit orders are free.
Why is it risky to make any order in a thin market?
Proper Scoring Rules

A proper scoring rule is a method for soliciting a probability distribution from an individual.

Let $X$ be a random variable that takes on $K$ possible states (indexed by $i$).

Let $s_i(\cdot)$ be a mapping that describes a state contingent payoff from a reported probability distribution $r$ for $X$.

$s_i(\cdot)$ is a proper scoring rule if it is incentive compatible for an individual with beliefs $p$ to report beliefs truthfully. That is,

$$p = \arg \max_r \left[ \sum_i p_i s_i(r) \right] \quad \text{and} \quad \left[ \sum_i p_i s_i(p) \right] \geq 0.$$
Examples of Proper Scoring Rules

Quadratic Scoring Rule (Brier, 1950)

\[ s_i(r) = a_i + b \left( 2r_i - \sum_j r_j^2 \right) . \]

Logarithmic Scoring Rule (Good, 1952)

\[ s_i(r) = a_i + b \log(r_i) . \]
Market Scoring Rules

Robin Hanson (2003) insight: Let market participants correct each others probabilities!

Market for variable $X$, $K$ states.

Marketplace ‘sponsor’ begins with distribution $q$.

Market participant may adjust the distribution to $r$.

Each user makes payment to the previous user who has made an adjustment:

$$c_i = s_i(r^t) - s_i(r^{t-1}).$$
Market Scoring Rules

\[ c_i = s_i(r^t) - s_i(r^{t-1}). \]

- Market sponsor subsidizes market
- Subsidy is capped
- Can be operated alongside traditional prediction market, where assets “payout of 1 when state is \( i \)” are traded.
- Probabilities represent prices for very small trades
- For larger trades, calculus used to determine bid ask spreads. (see Hanson 2003 for details)
- Hollywood Exchange uses a version of a scoring rule to generate liquidity.
Applications

1. HP Printer sales
2. Avian Bird flu
3. Google Prediction Markets
4. Cambrian House
Decision Markets

Can Prediction Markets be used to help make decisions?
Example: Versions $A, B$ of software
Cambrian House

Read Case

Suggest Market Design for prediction markets

Discussion