Market Maker Experiments

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1 Motivation

So... LMSR... while great in theory (why?? path independence), sucks in practice (why??). We want to

2 Goals

To test five different market maker mechanisms for their liquidity sensitivity, profit expectation and accuracy.

3 Definitions

We denote time by $t \in \mathbb{R}_+$. We denote money by $m \in \mathbb{R}$.

An **event** has an outcome where we restrict our attention to a binary outcome. The outcome is equal to YES in case the event occurs and NO otherwise. We assume there is a way to unambiguously determine the outcome of an event. The mechanism for making the determination is R.

R is an oracle for mapping an **event** to an outcome.

An **option** is a security that yields a return depending on the outcome of an event. Each **option** has a price, a o_t when $R(o)$ will be evaluated, and an outcome. The **option** will convert to \$1 if $o_{outcome}$ equals $R(o)$ otherwise it converts to \$0.

The function $p(o, t)$ at time t reflects the likelihood of the $o_{outcome}$ being realized at the strike date o_t.

An **agent** $a \in A$ has a belief $v_{at} \in [0, 1]$ at time t. The v_{at} reflects the agent's private belief in the expected likelihood of the $o_{outcome}$ being realized. This belief maps directly to the price that the agent is willing to pay for the o.

A **prediction market** M trades outcomes in an event. Formally, a prediction market is a tuple $\langle o_0, o_1, A, B \rangle$. Each **agent** $a \in A$ purchases some number of o_0 and o_1 paying the price quoted by the **prediction market** at each time t when the **agent** a made the purchases. A prediction market has a **book** B that maps $a \in A$ to a tuple $\langle \mathbb{R}, \mathbb{R} \rangle$ which tracks the number of o_0 and o_1 purchased by that **agent** a.

A **book** $B_{M,t}$ accepts an **agent** a and returns the number of each **option** o that **agent** a has purchased at time t. A **book** B at time t records all the transactions made up to time t.

A **market maker** MM is **predciction market** and strategy for setting prices on each **option** o_0 and o_1 at time t. Each **market maker** has their own function $P(o, t, a, \mathbb{R})$ where the quantity $\mathbb{R}$ is the number of the option desired by the **agent** a, and the output is the money m required by the **market maker** MM from the **agent** a.

We formalize the pricing fnction as$P : \langle o, t, a, \mathbb{R} \rangle \rightarrow m$.

A **market** is defined as a **prediction market**.

4 Market Makers

In these experiments we will test the following five market markers.

4.1 Logarithmic Market Scoring Rule

4.2 Luke's Online Budget Weighted Average

4.3 Yiling and Jen's Expert Weighted Majority

4.4 Luke's Weighted Majority

4.5 Practical Liquidity Sensitive Market Maker

5 Setup

5.1 Types

5.2 Metrics

5.2.1 Liquidity Sensitivity

5.2.2 Market Maker Profit

5.2.3 Social Welfare

5.2.4 Accuracy

Regret

Expectation

Mean Squared Error

5.2.5 Precision