futarchy—a form of government in which elected officials define measures of national welfare and prediction markets are used to determine which policies will have the most positive effect.

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Last time we showed a bunch of dinosaur pictures and discussed a mechanism that only works if you pray.

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You're right! Maybe we should do some rigorous, intense vector calculus to show we're smart.

That's great, and of course I wouldn't change a thing—nothing, really! But if I could make one suggestion? What about just giving the homework answers? It's a crowd pleaser.

No, that’s grossly unethical. No one wants us to do that.

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OK, fair. Let’s just do our usual, clear, concise A-worthy presentation and leave the mathematical details for those interested.

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OK, fair. Let’s just do our usual, clear, concise A-worthy presentation and leave the mathematical details for those interested.

But let’s at least insert some hints that the sharp, participating students will pick up on and appreciate us for?

Victor and Mike present

Victor Shnayder & Mike Ruberry

MARKET SCORING RULE MECHANICS

or

HW 2 Problem 2 hints

Adding ``market'' to ``scoring rule''

HOW IS A RAVEN LIKE A WRITING DESK?

Scoring rules

$$
\begin{aligned}
\text{Quadratic} \quad & s_i = a_i + b r_i - b \sum_j r_j^2/2, \\
\text{Spherical} \quad & s_i = a_i + b\, r_i / (\sum_j r_j^2)^{1/2}, \\
\text{Logarithmic} \quad & s_i = a_i + b \log(r_i), \\
\text{Power Law} \quad & s_i = a_i + b\alpha \int_0^{r_i} \rho_i^{\alpha-2} d\rho_i - b \sum_j r_j^{\alpha}
\end{aligned}
$$

Proper scoring rule

$$\vec{p} = \operatorname{argmax}_{\vec{r}} \sum_i p_i \, x_i = \sum_i p_i \, s_i(\vec{r}) \quad \text{given} \quad \sum_i r_i = 1.$$

Market scoring rule

$$x_i = \sum_{t=1}^{T} x_{it} = \sum_{t=1}^{T} \left(s_i(\vec{r}_t) - s(\vec{r}_{t-1}) \right) = s_i(\vec{r}_T) - s(\vec{r}_0)$$

Agent t's payoff

$$x_i = \sum_{t=1}^{T} x_{it} = \sum_{t=1}^{T} \overbrace{\left(s_i(\vec{r}_t) - s(\vec{r}_{t-1})\right)} = \underbrace{s_i(\vec{r}_T) - s(\vec{r}_0)}$$

- Market maker's payoff

$$a_i + b \log \overrightarrow{r}_0(i)) - a_i - b \log \overrightarrow{r}_T(i)$$

$$b(\log \overrightarrow{r}_0(i) - \log \overrightarrow{r}_T(i))$$

$$\arg\min_{\overrightarrow{r}_0} \arg\max_{\overrightarrow{r}_T} \Sigma_i \ (\log \overrightarrow{r}_0(i) - \log \overrightarrow{r}_T(i))$$

Example

Question: In the year 2525, (what is the probability that) man is still alive?

Example

Question: In the year 2525, (what is the probability that) man is still alive?

.5 .3 .7

Example

Question: In the year 2525, (what is the probability that) man is still alive?

$\log .7 - \log .3$

.5 .3 .7

$\log .3 - \log .5$

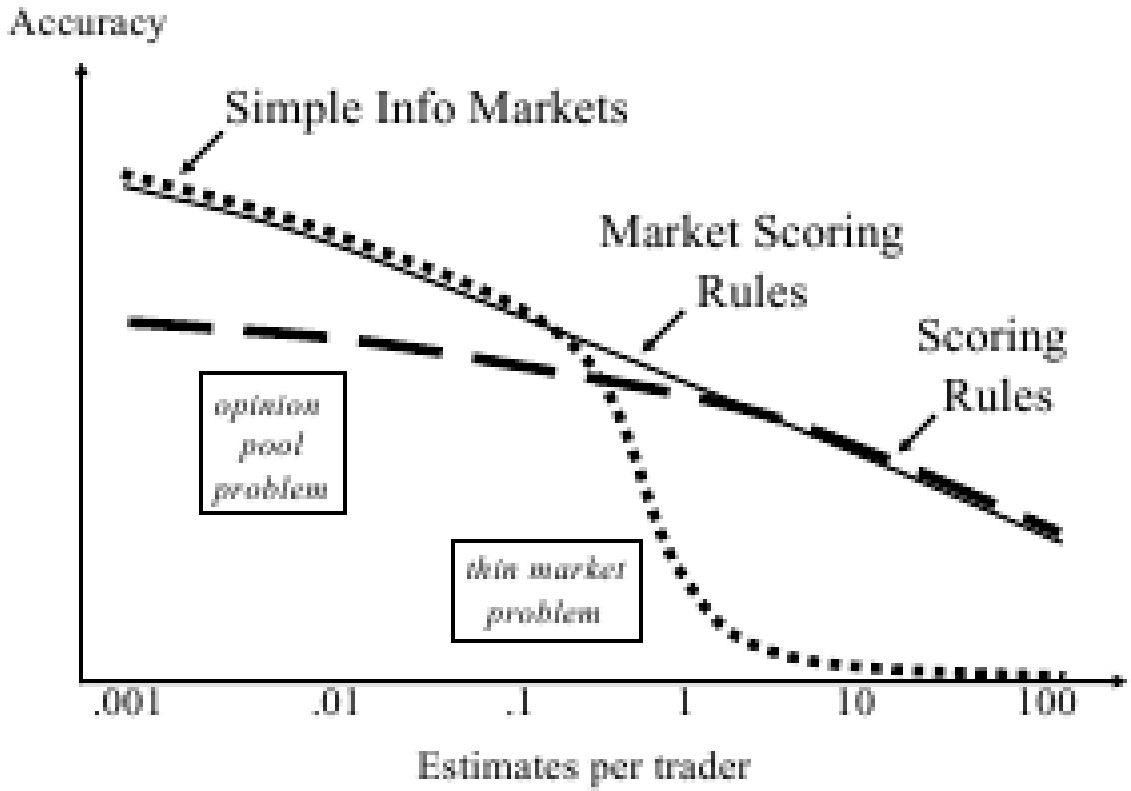
Case 1: Man is still alive

MSR questions

- Is the market maker's loss bounded?
- Is an agent's loss/gain bounded?

MSR questions

- Why is it unreasonable for agents to have unbounded loss or gain in practice?
- What does Hanson predict will lead to convergence?
- What does Hanson's mechanism produce?


Accuracy
Simple Info Markets
Market Scoring Rules
Scoring Rules
opinion pool problem
thin market problem
.001
.01
.1
1
10
100
Estimates per trader

(witty pop culture reference already in name)

THE GREAT AND POWERFUL LOG SCORING RULE

Will you be seated?

THE FRENCH LAUNDRY

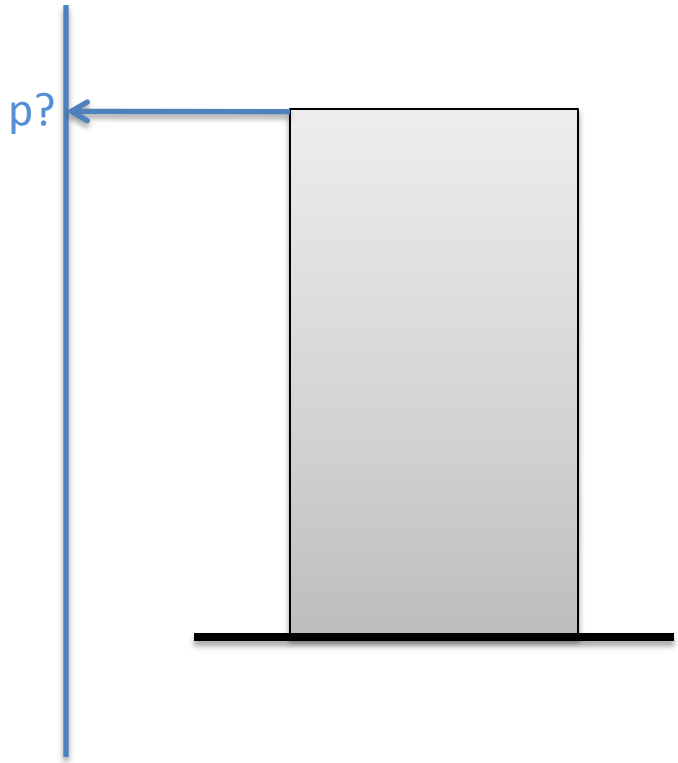
When I was an apprentice traveling through France, I fell in love with the 3-star country restaurants—so fine but also so comfortable. More than a decade later, when I began looking for a space to open a restaurant, a friend suggested I see a property in Yountville, California, north of San Francisco in the Napa Valley. When I stepped under the creeping roses to behold the French Laundry I knew immediately that what I'd seen in France could happen here. And that's how the French Laundry began, a uniquely American restaurant whose inspiration lies in the countryside of France.

OUR STAFF

PHILOSOPHY

HISTORY

Will you be seated?

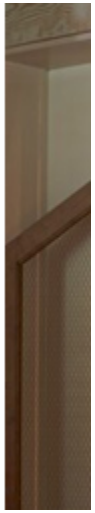


Will you be seated?

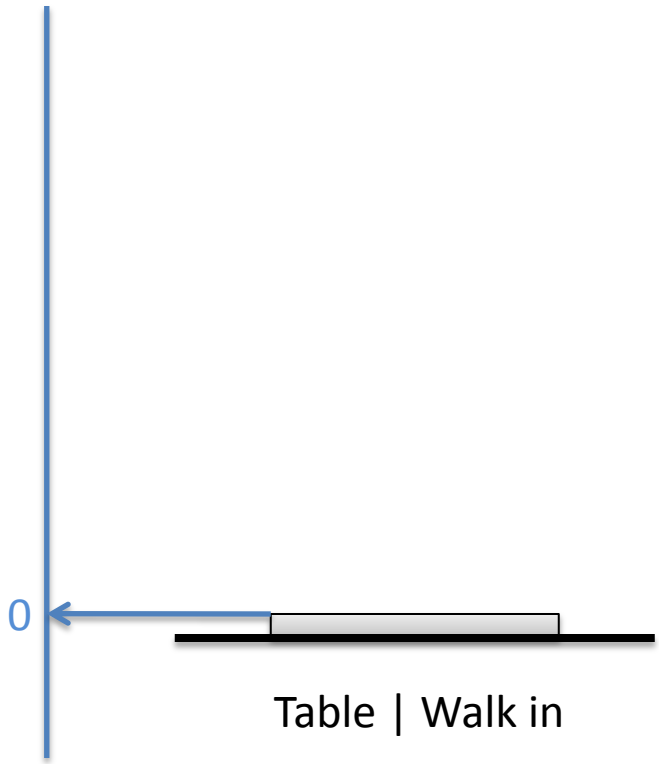
RESERVATIONS

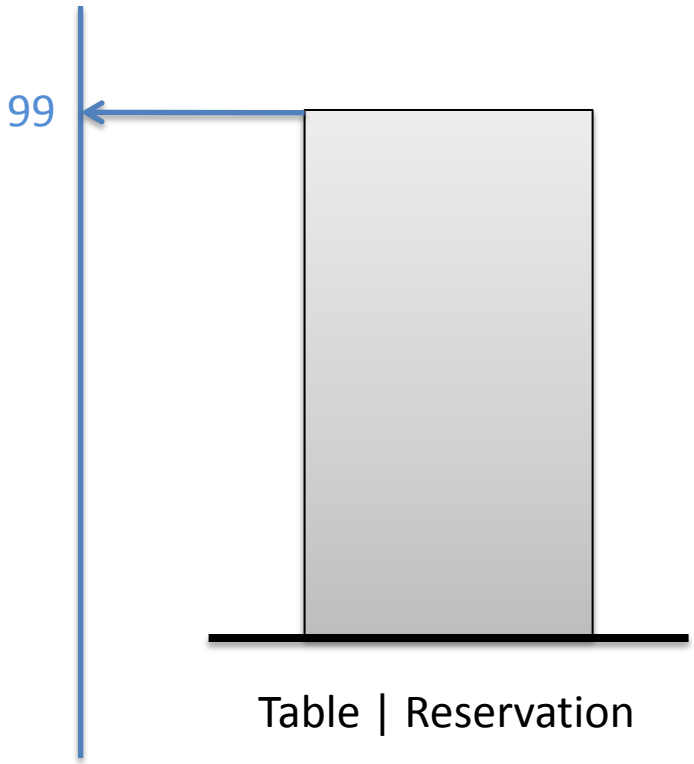
We serve dinner seven nights a week and lunch on Friday, Saturday, and Sunday. Dinner reservations are available from 5:30 p.m. to 9:15 p.m. and lunch reservations from 11:00 a.m. to 1:00 p.m. Reservations are accepted two months to the calendar date by calling 707.944.2380 or online through OpenTable.com.

Reservations for The French Laundry Private Dining Room can be made up to a year in advance. Please visit our "Private Dining" page for more information.



Will you be seated?





Log scoring rule properties

Theorem 1 *Logarithmic rule bets on A given B preserve $p(B)$, and for any event C preserve $p(C|AB)$, $p(C|\bar{A}B)$, and $p(C|\bar{B})$, and thus preserve $I(\mathcal{A},\mathcal{B},\mathcal{C})$, and $I(\mathcal{B},\mathcal{A},\mathcal{C})$.*

Theorem 2 *For $I \geq 3$, if $y_i = 0$ for $i \notin \{j,k\}$ implies $q_i = 0$ for $i \notin \{j,k\}$, the rule is logarithmic.*

MSR questions (2)

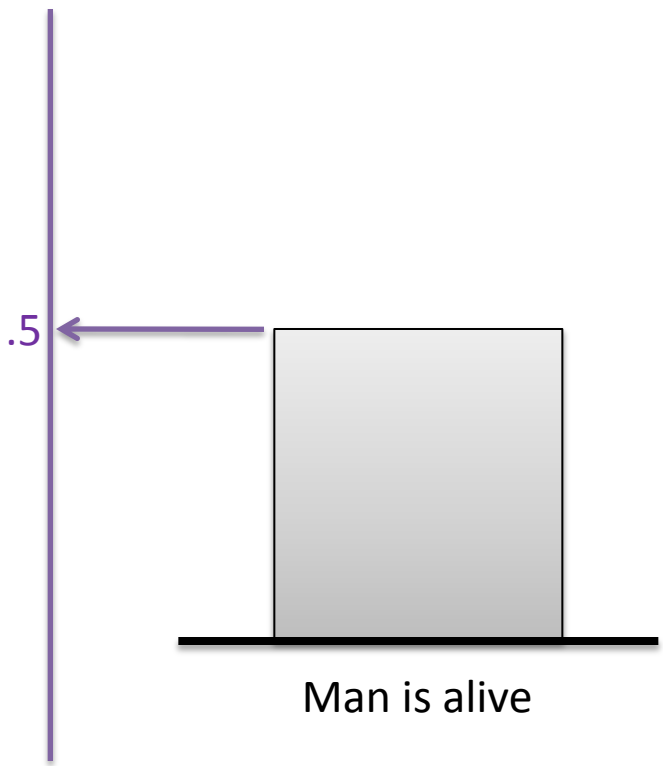
- If we want to support conditional bets on x variables, how many events are there?
- If you only want to change the probability of one event, how would you report that in the mechanism we have so far?

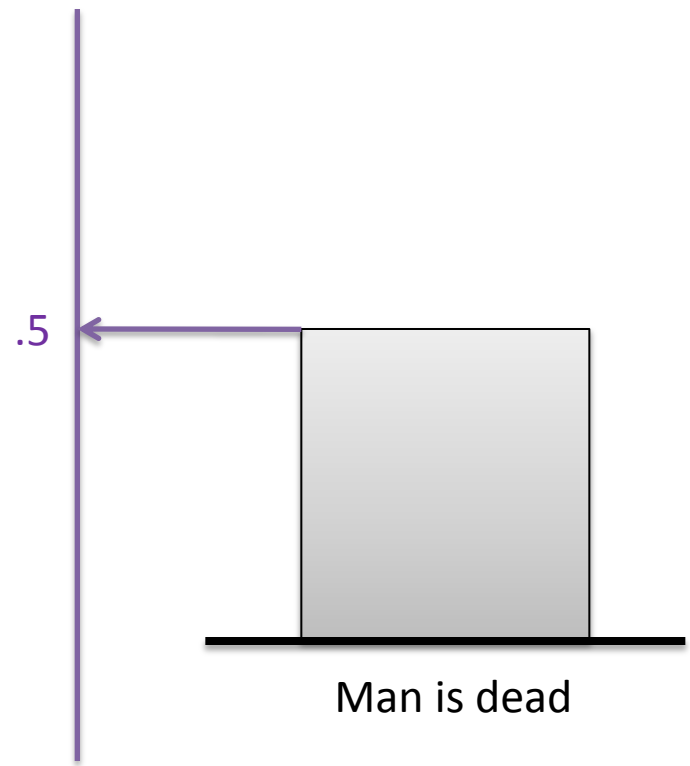
A different perspective

HANSON'S PREDICTION MARKET

Example

Question: In the year 2525, (what is the probability that) man is still alive?





Example

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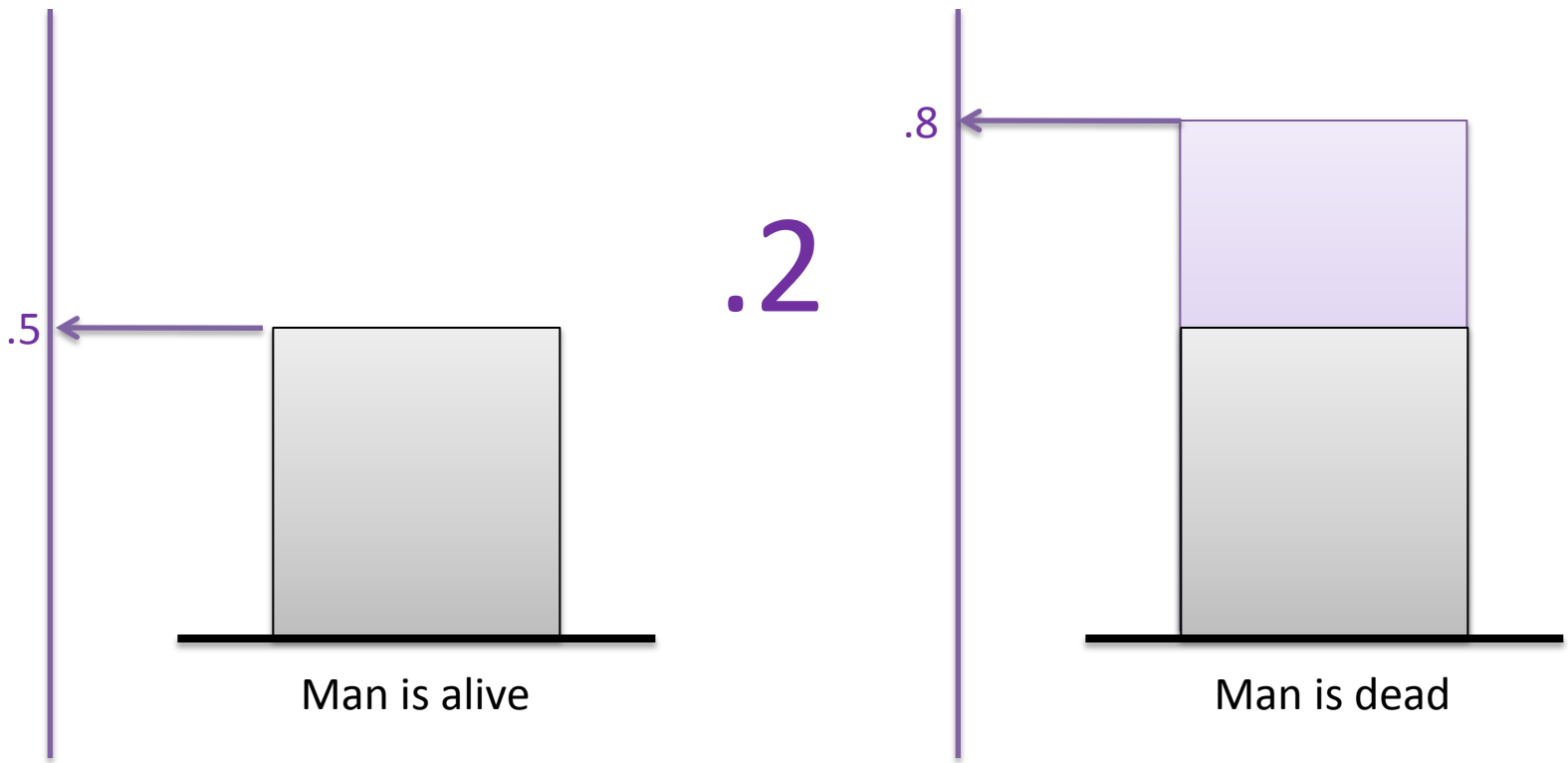

BUY 1.386 “man is dead”

Example

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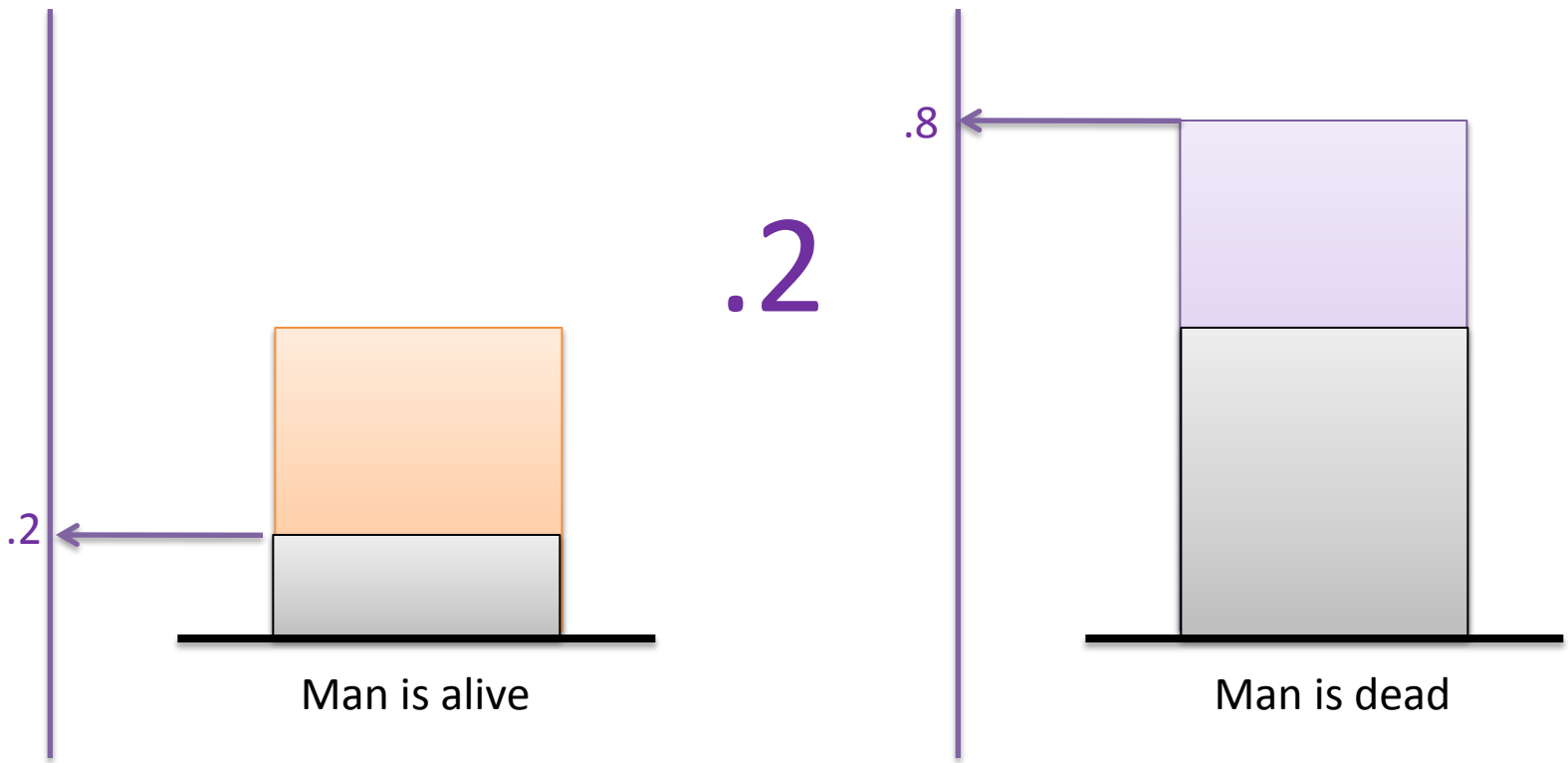

BUY 1.386 “man is dead”

Example

$$q_1 = q_2 = 0, b = 1, C = b\ln(e^{\frac{q_1}{b}} + e^{\frac{q_2}{b}}), P = \frac{e^{\frac{q_1}{b}}}{e^{\frac{q_1}{b}} + e^{\frac{q_2}{b}}}$$

$$p_1 = .2$$

$$q_2' = \ln(\frac{(1-.8)e^{q_1}}{.8})$$

$$C(0, q_2') - C(0, 0) = \ln(1 + e^{q_2'}) - \ln 2 = 1.61 - .693 = .9163$$

$$[C(0,0) - C(x,y)] + [C(q_1,q_2) - C(0,0)] = C(q_1,q_2) - C(x,y)$$

$$s_i(\overrightarrow{r}_T) - s_i(\overrightarrow{r}_{T-1})$$

Questions

- Does a particular probability distribution map to a unique quantity of shares outstanding?
- Does the cost of changing the distribution from p1 to p2 depend on the number of shares outstanding?

Discussion

- In what circumstances might we want to deploy Hanson's MSR?
- Does futarchy seem like a good idea?