

CPS 290.4/590.4

Crowdsourcing Societal Tradeoffs



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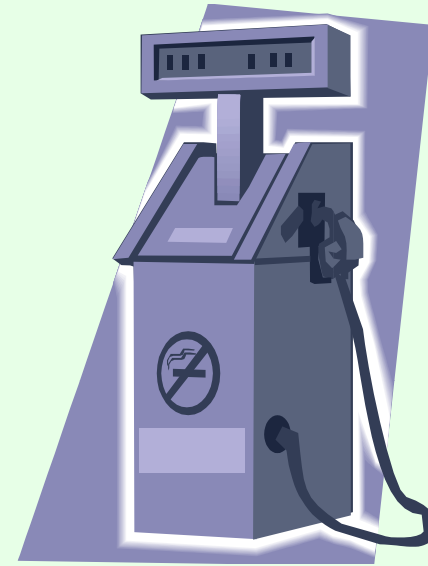


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Motivating question



1 bag of landfill trash *is as bad as* using x gallons of gasoline

How to determine x ?

- Other examples: clearing an acre of forest, fishing a ton of bluefin tuna, causing the average person to sit in front of a screen for another 5 minutes a day, ...

Example decision scenario

- **Benevolent government** would like to get old inefficient cars off the road
- But disposing of a car and building a new car has its own energy and other costs
 - Perhaps also benefits to the economy
- **Which** cars should the government aim to get off the road?
 - Even energy costs are **not directly comparable**, e.g., perhaps gasoline contributes to energy dependence, coal does not



Inconsistent tradeoffs can result in **inefficiency**

- Agent 1: 1 gallon = 3 bags = -1 util
 - I.e., agent 1 feels she should be willing to sacrifice up to 1 util to reduce trash by 3, but no more
- Agent 2: 1.5 gallons = 1.5 bags = -1 util
- Agent 3: 3 gallons = 1 bag = -1 util

- Cost of reducing gasoline by x is x^2 utils for each
- Cost of reducing trash by y is y^2 for each

- What will they do **individually**? (A little calculus...)

- What would be a **better** solution for **all** involved?

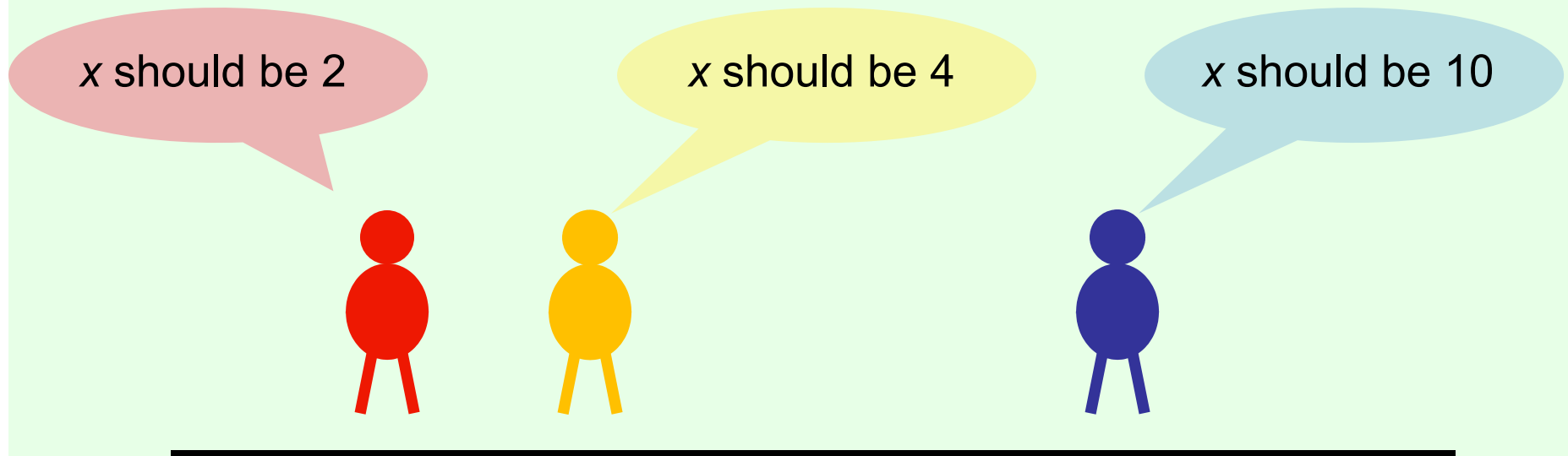
Pigovian taxes

- Taxes intended to discourage undesirable behavior
- More precisely: pay the cost your activity imposes on society (the **externality** of your activity)
- If we decided using 1 gallon of gasoline came at a cost of $\$x$ to society, so we charged a tax of $\$x$ on each gallon...
- ... then people would only use a gallon if they gained at least $\$x$ from doing so (net of purchase cost), which is societally ideal
- Isn't this better than (say) sales tax?
- But where would we get x ?



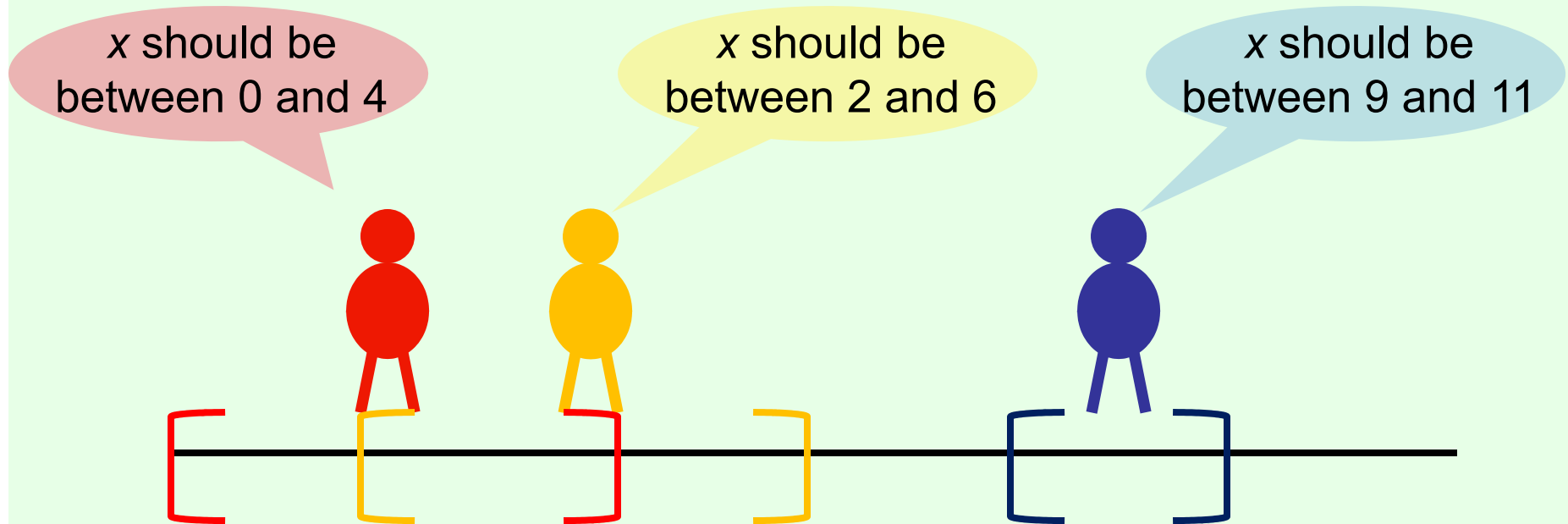
Arthur Cecil Pigou

One approach: let's vote!



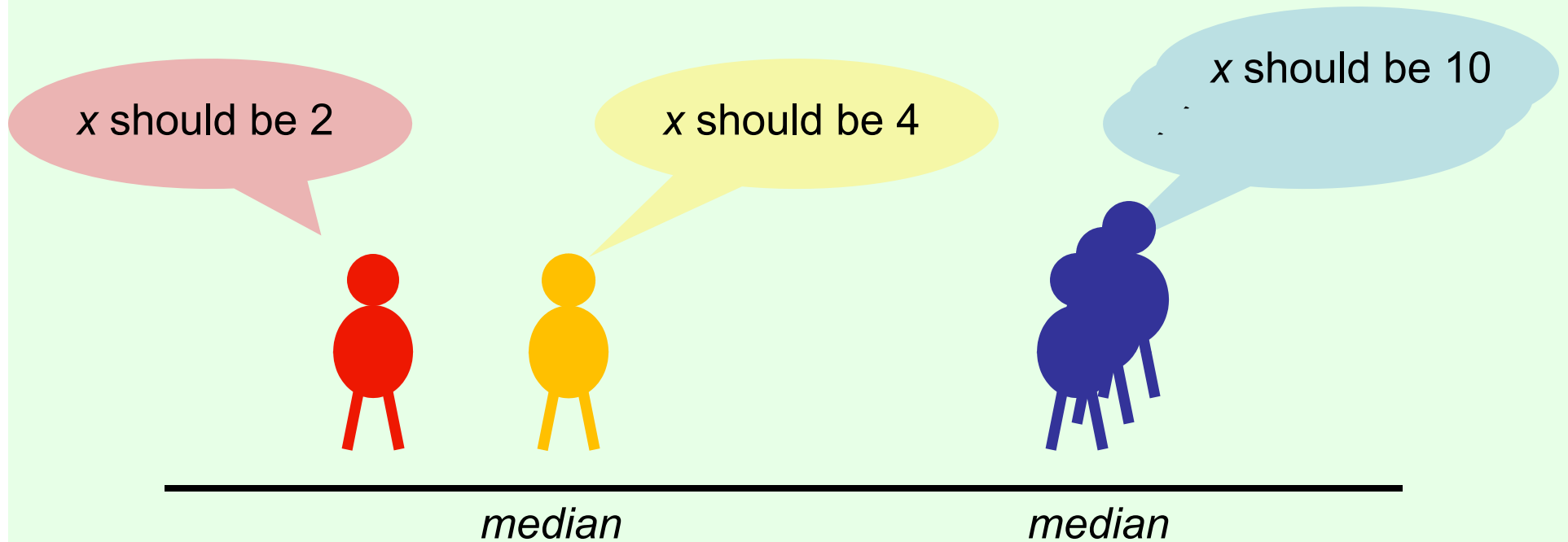
- So what should the outcome be...?
Average? Median?
 - Note $\text{average}(2,4,10)=5.33$ but
 $\text{average}(1/2,1/4,1/10)=.2833$ (not $1/5.33$)
- Is this the right way to vote?
- Who even gets to vote? Where/how?

Perhaps more reasonable...



- E.g., due to **missing information** (what kind of trash?) or plain **uncertainty**
- How should we aggregate these?

Voting more than once...



How to prevent this manipulation?

Consistency (for an individual)

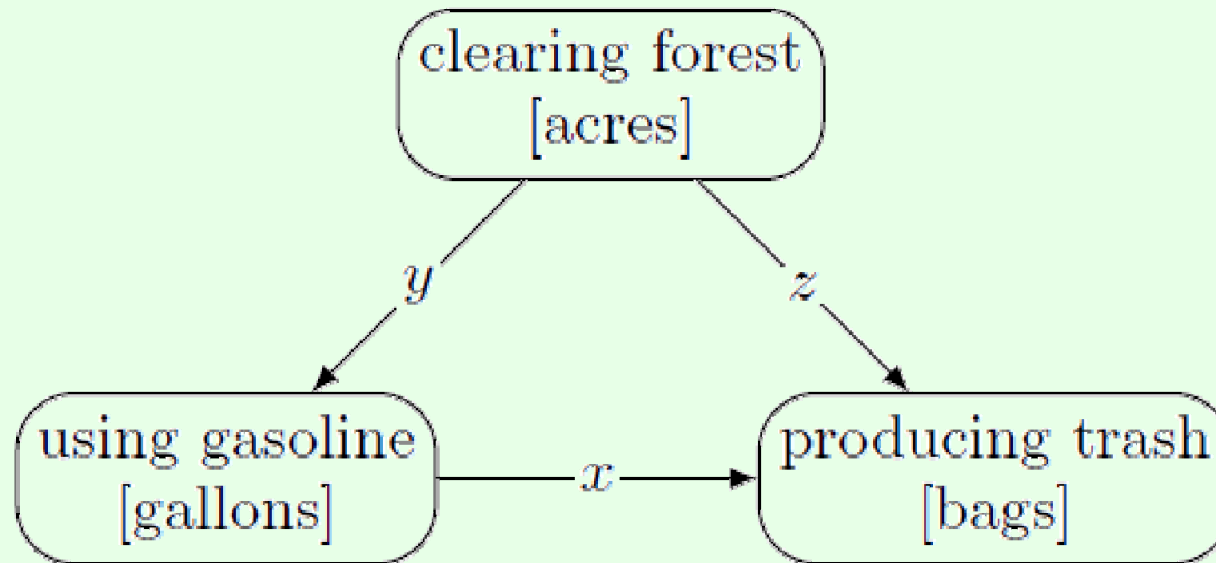


Figure 1: Weighted graph representing the numerical tradeoffs chosen by an individual voter. An arrow from activity A to activity B with weight w represents that one unit of A is considered as bad as w units of B. The tradeoff is consistent if $z = x \cdot y$.

A paradox: individual consistency may lead to societal inconsistency

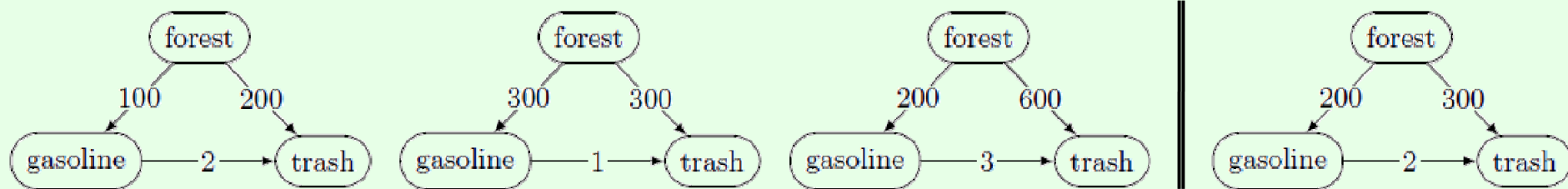
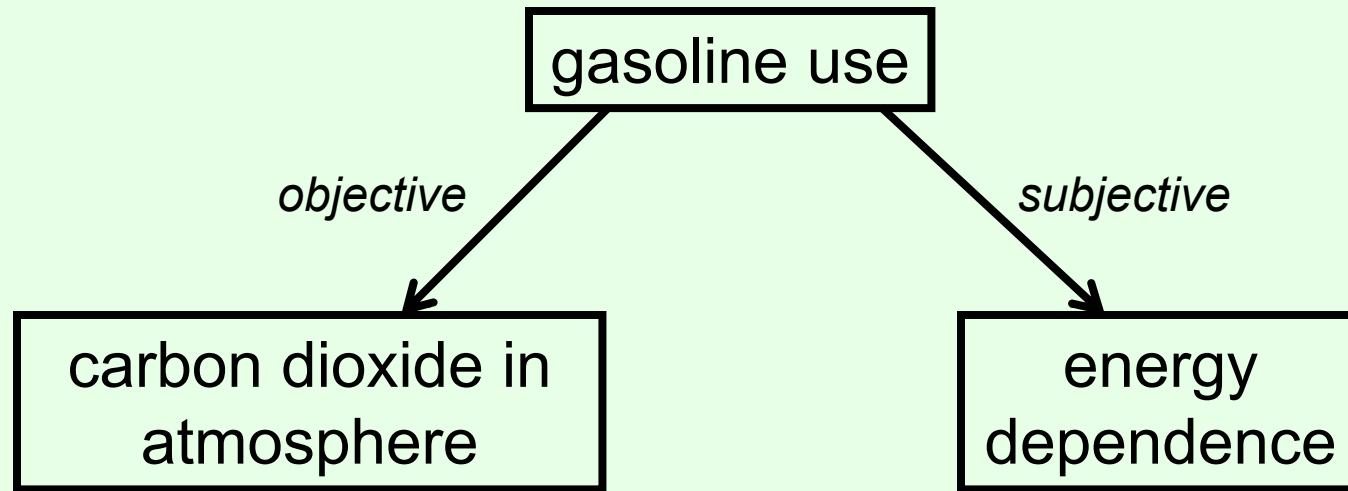


Figure 2: Example illustrating that the pairwise median rule can lead to inconsistent outcomes even when each individual voter is consistent. The left three graphs each illustrate the consistent preferences of a single voter, but the rightmost graph, which is inconsistent because $300 \neq 2 \cdot 200$, results from taking the median on each edge.

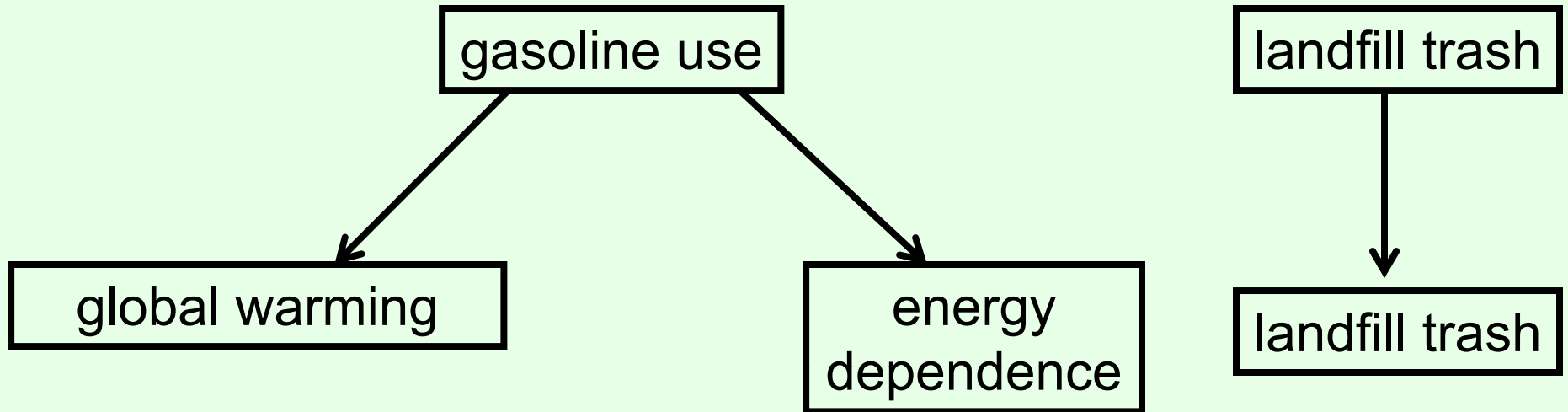
But we want our societal tradeoffs to be consistent...
Otherwise we'll get inefficiency or
incomprehensibility

Decomposition



Maybe we should reason about these components directly... How? How do we determine the components?

Another paradox



- Everyone agrees GU contributes 1 to GW, 1 to ED
- Voter 1: 1 GW = 2 LT, 1 ED = 1 LT (so 1 GU = 3 LT)
- Voter 2: 1 GW = 1 LT, 1 ED = 2 LT (so 1 GU = 3 LT)
- Voter 3: 1 GW = 1 LT, 1 ED = 1 L (so 1 GU = 2 LT)
- Median on attributes would conclude 1 GW = 1 ED = 1 LT (so 1 GU = 2 LT), but median directly gives 1 GU = 3 LT

Objective vs. subjective tradeoffs

- Some tradeoffs seem **objective**...
 - Measuring carbon dioxide emissions
- ... others **subjective**...
 - Global warming vs. energy dependence
- Separate process? Who determines which is which?
- How to bring expert knowledge to bear?

Prediction markets

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Mitt Romney to win the 2012 South Carolina Primary

Last prediction was: **\$7.94** / share

Today's Change: **▲ +\$0.22 (+2.8%)**

79.4%
CHANCE

Event: [South Carolina Primary \(Republican\)](#)

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Step: **1. Buy or Sell** > 2. Select Price > 3. Review & Confirm

1. Choose to buy or sell shares in this market

Tip: Buy if you think it's going to happen, sell if you don't!

Think this event **will** occur?

[Buy Shares](#)

Current best (lowest) price to buy shares is **\$7.94** / share. There are **4** shares available at this price.

Think this event **won't** occur?

[Sell Shares](#)

Current best (highest) price to sell shares is **\$7.66** / share. There are **3** shares available at this price.

Tip: Yes, you can sell shares you don't own!

[Disclaimer](#)

Your Money

Available to spend: Not Logged In

Money currently invested: -

Locality

- Should we always obtain a single global tradeoff?
- Right tradeoff may depend on **where we are**
 - ... though then arguably they're not the same things being traded off
- **Different entities** (say, countries) may wish to reach their tradeoffs independently
- I may care only about the opinions of **my neighbors in my social network**

Some topics to cover

- Social choice theory
 - Voting
 - Judgment aggregation
 - Voting in pursuit of the “truth”
- Strategic agents
 - Game theory
 - Mechanism design
- Prediction markets
- Preference elicitation