

Model Thinking

Scott E Page

Decision Models

Normative: make us
better at deciding

Positive: predict
behavior of others

Normative

School?

Job?

Insurance?

Drive or Fly?

Computer?

Investments?

Wedding?

House?

Positive

Policy choices

Nominations

Platforms

Investments

Technology choice

Multi-Criterion

Probabilistic



<http://www.autoblog.com/>



[/http://maxcdn.fooyoh.com](http://maxcdn.fooyoh.com)

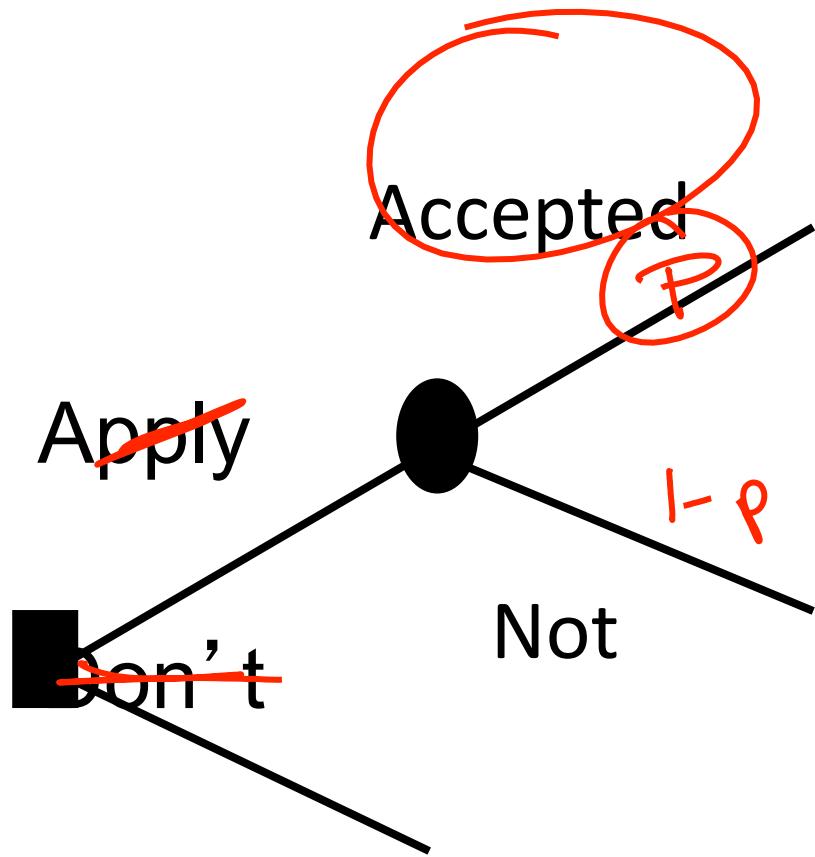
FORD	CHEVY
X	
	X
X	
	X
X	
	X





<http://en.wikipedia.org>





Value of Information



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Multi-Criterion Decisions

Qualitative



Photo: Simon Howden

Criteria

Square feet

Bedrooms

Bathrooms

Lot Size

Location

Condition

Criteria	House 1	House 2
Square Feet	2000	1800
# Bedroom	4	3
# Bathrooms	1½	3
Size	1/4	1/2
Condition	10	15
Lot Size	Ex	Good
Location		
Condition	4	2

DECISION SUPPORT FOR REAL: THE MCRI

We now want to use this same decision support worksheet to help you make a decision on the MCRI. Below, you'll see a list of the six dimensions we discussed. On each of these dimensions, fill in your personal responses—which side has the stronger argument and how important each dimension is to you—that you've already written in this booklet. When finished, you'll have a table like the one above that you can use to help you make an informed and considered decision. We've even included space for additional arguments if, in thinking through this issue, you have come up with new dimensions of your own. We hope that you have.

	SUPPORT MCRI	REJECT MCRI
EQUALITY	1	2
QUALITY OF EDUCATION	1	2
HELP/HARM WOMEN & MINORITIES	1	2
SOCIAL COHESION / ORDER	1	2
Rewarding Merit		
APPROPRIATE LIMIT v. INAPPROPRIATE RESTRICTION	4	2





Photo: Simon Howden

Criteria	House 1	House 2
Square Feet		
# Bedrooms		
# Bathrooms	4	2/3
Lot Size		
Location		
Condition		

?



Quantitative

Criteria	Wgt t	H1	H2
Square Feet	1 2	✓ ✓	✓
# Bedrooms	2 1	✓	✓
# Bathrooms	1 2	✓ ✓	✓
Lot Size			
Location			
Condition			
Possessions			

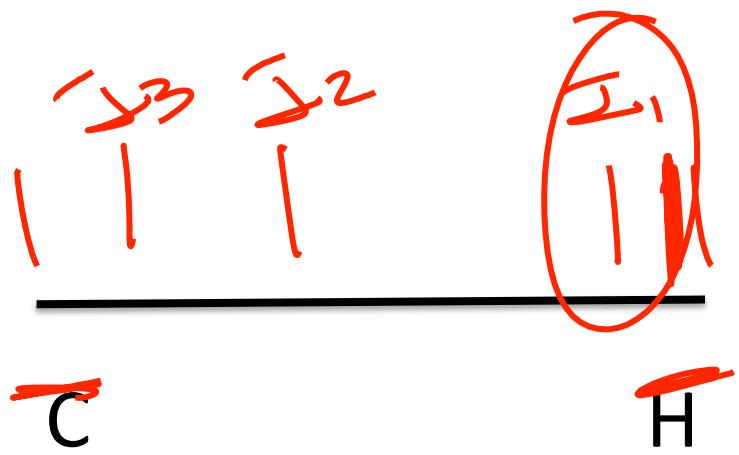
Model Thinking

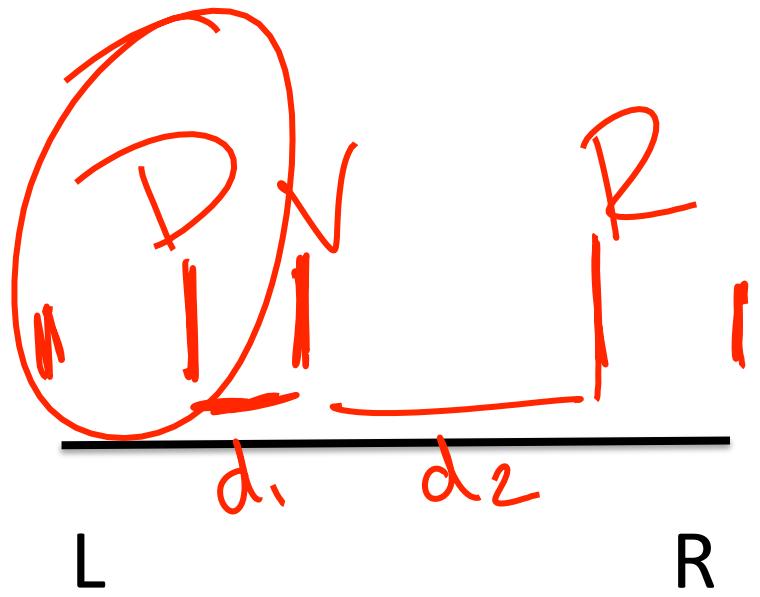
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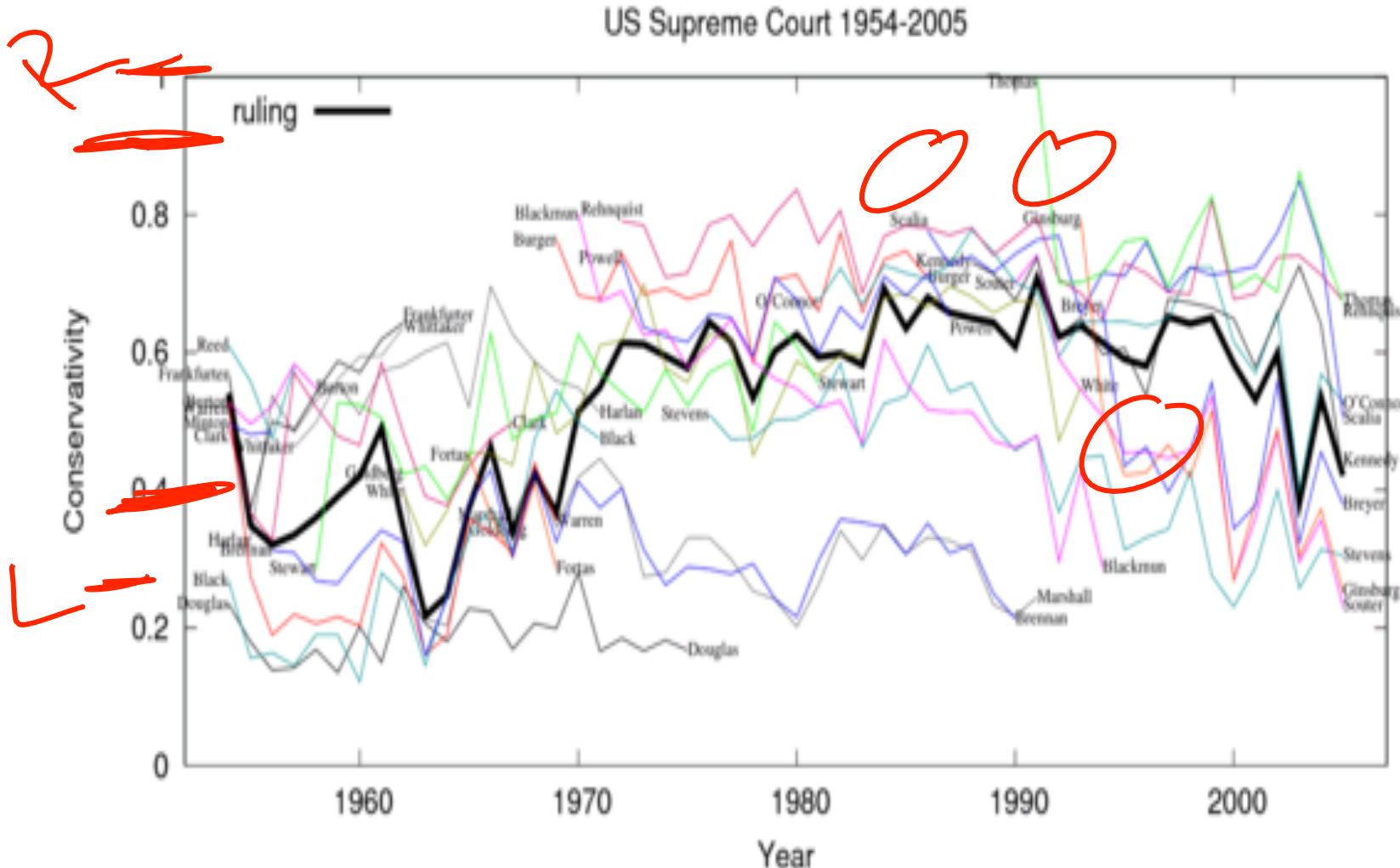
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Spatial Choice Models







Source: Andrew Gelman



CinSif

Speed

Attribute	IDEAL
Cheese Slices	2
Patties	2
Tomatoes	2
Ketchup (TBSP)	4
Mayo (TBSP)	4
Pickles	

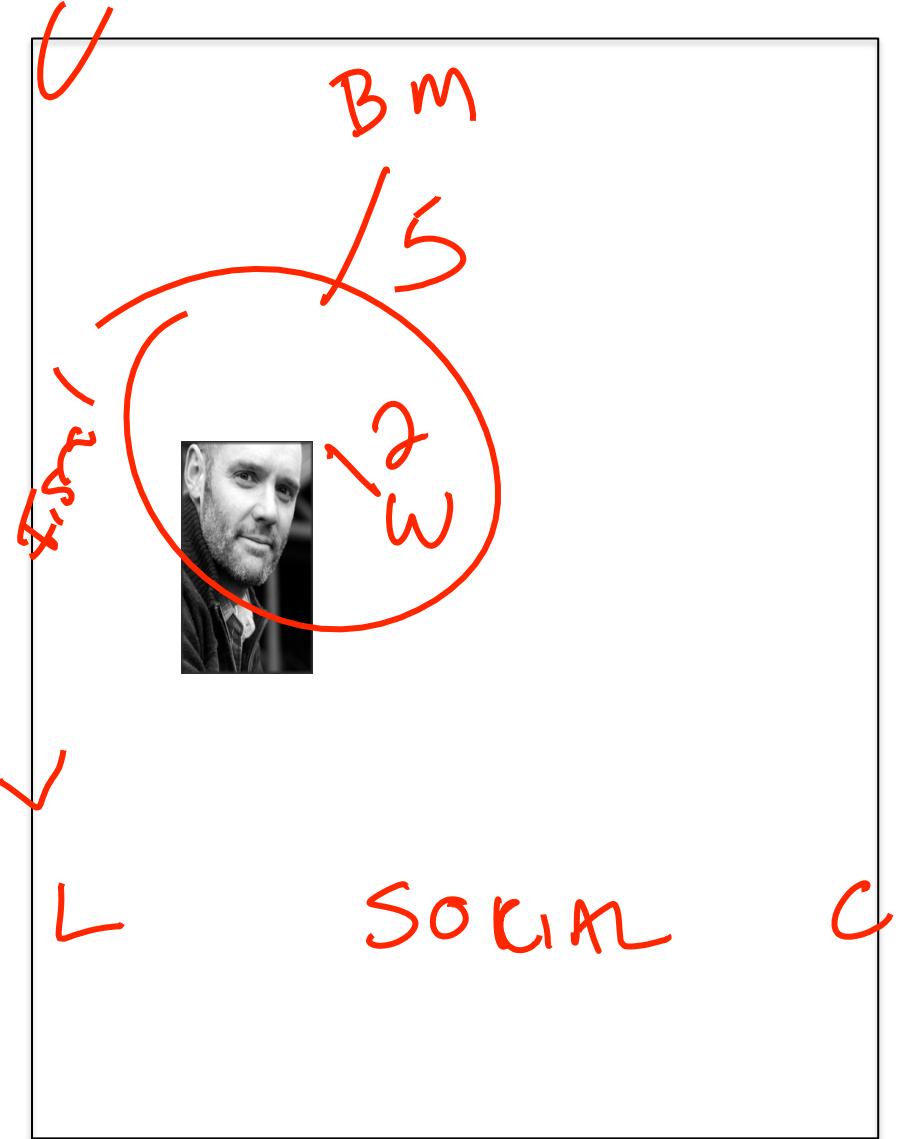
Attribute	IDEAL
Cheese Slices	2
Patties	2
Tomatoes	2
Ketchup (TBSP)	4
Mayo (TBSP)	4
Pickles	4

Y *6 dim*

Attribute	IDEAL	Big Mac
Cheese	2	<u>-2</u>
Patties	2	<u>-2</u>
Tomatoe s	2	<u>-0</u>
Ketchup	4	<u>-3</u>
Mayo	4	3
Pickles	4	6

Attribut e	IDEA L	Big Mac	A I t DIFF
Cheese	2	2	0 0 2
Patties	2	2	1
Tomatoe s	2	0	0 2
Ketchup	4	3	5
Mayo	4	4	
Pickles	4	6	

Attribut e	IDEA L	BKW	I DIFF
Cheese	2	2	1
Patties	2	1	1
Tomatoe s	2	2	0
Ketchup	4	3	2
Mayo	4	4	
Pickles	4	4	



Attribut e	IDEA L	Big Mac	BKW
Cheese	?	2	2
Patties	?	2	1
Tomatoe s	?	0	2
Ketchup	?	3	3
Mayo	?	4	4
Pickles	?	6	4

Big Mac



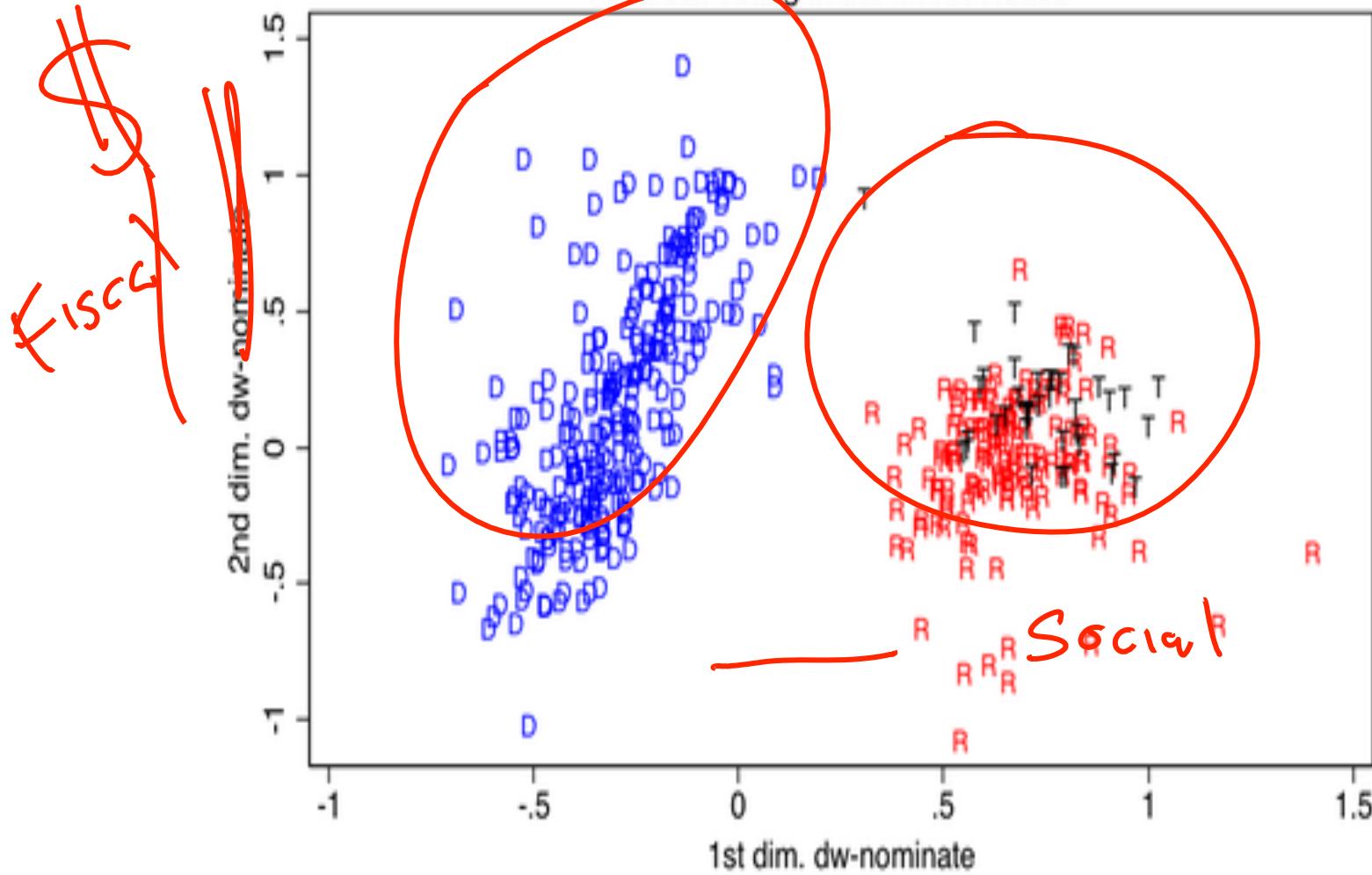
Attribut e	IDEA L	Big Mac	BKW
Patties	?	2	1
Tomatoe s	?	0	2
Pickles	?	6	4

Big Mac



Mapping the Tea Party Caucus

roll call voting in the 111th House



Roll call voting measured with DW-NOMINATE scores from <http://www.voteview.com>

T denotes Tea Party Caucus member.

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Probability

Axiom 1:

Probability of an
outcome in $[0,1]$

Axiom 2:

Sum of all possible outcomes equals 1

$$H \quad T$$
$$\Pr_2 + \Pr_2 = 1$$

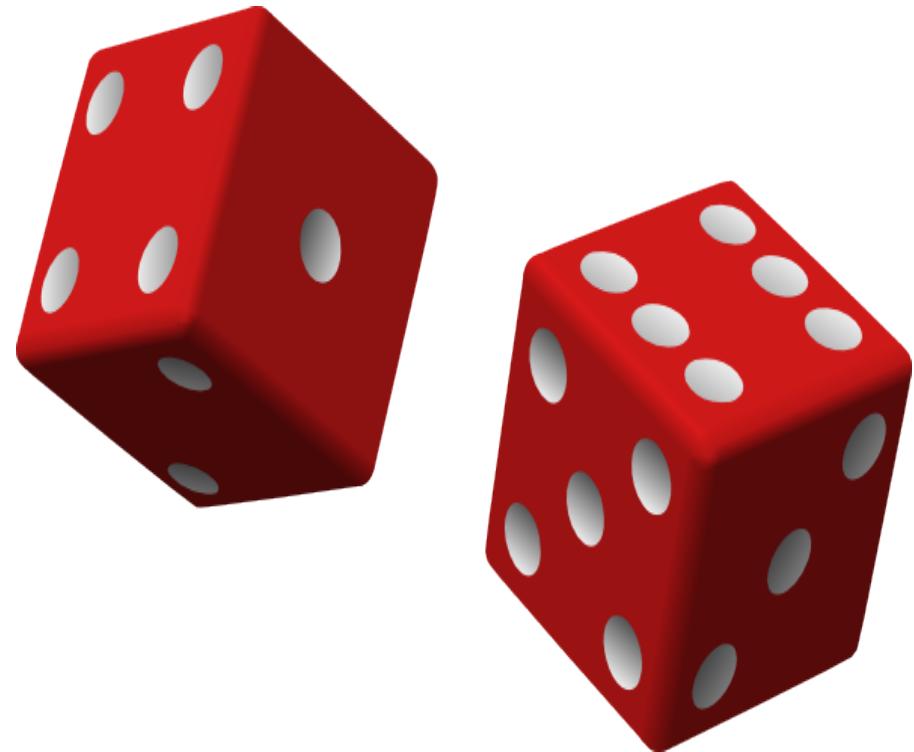
Axiom 3:

A subset of B, then

$$\text{Prob}(B) \geq \text{Prob}(A)$$

$$\mathcal{E}H\mathcal{Z} \subseteq \mathcal{E}H,\mathcal{T}\mathcal{Z}$$

$$\underline{\underline{1}}_2 \leq \underline{\underline{1}}$$



<http://en.wikipedia.org>

Classical

$$\text{Prob}(4) = \frac{1}{6}$$

$$\text{Prob}(\text{Even}) = \frac{1}{2}$$

$$\text{Prob}(\text{Odd}) = \frac{1}{2}$$



Frequency



Do more words
begin with r or
have r as their
third letter?

690

1190

Rain Next June 7th?

100

26 Rain

74 No

26%



Subjective

Shelly majored in political science and was very involved in the college republicans. Write down probabilities for the following events:

- Event A: Flight Attendant *5%*
- Event B. Blogger
- Event C. Flight Attendant while finishing her MBA *10%*
- Event D. Medical Field

Axiom 1? $[0, 1]$

Axiom 2? $\varepsilon = 1$

Axiom 3? $A \subseteq B$

Event A: Flight
Attendant



Event C. Flight
Attendant while
finishing her MBA



$$C \subseteq \underline{A}$$

Will housing
prices go up
this year?

3%

Frequency

Or

Subjective?

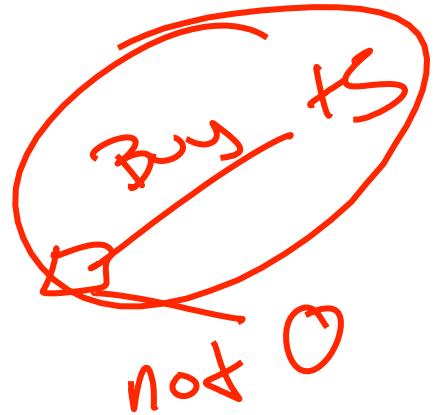
MODEL

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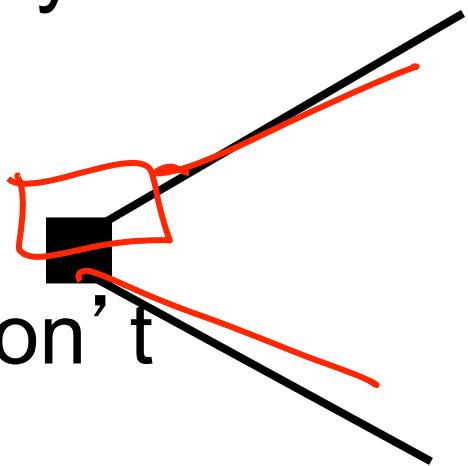
Decision Trees

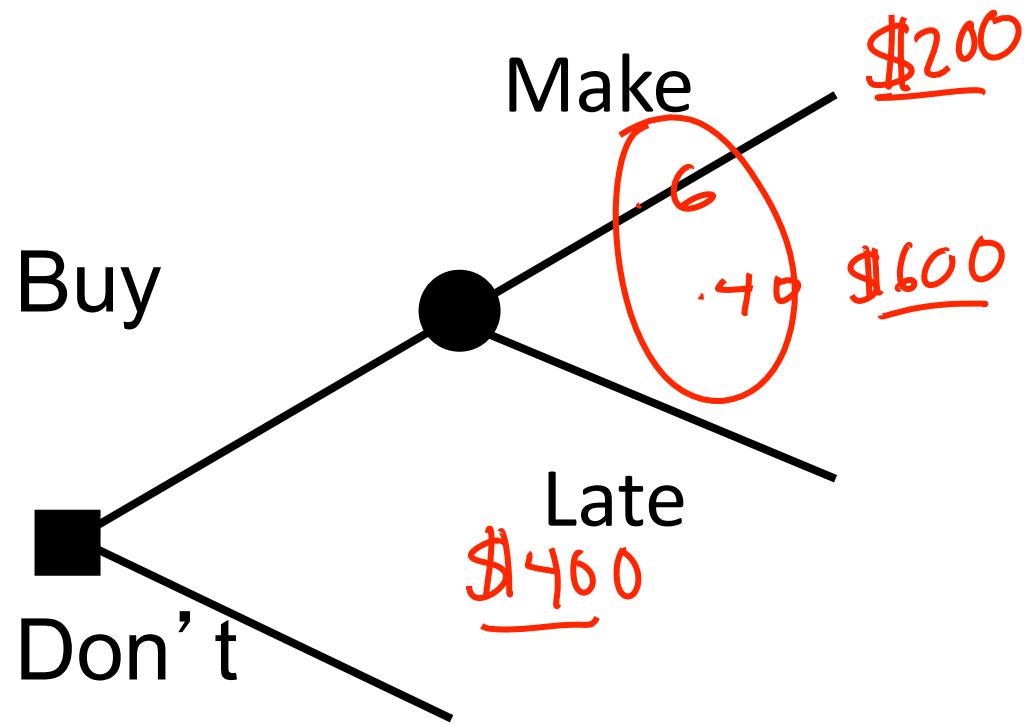
1. Ticket for 3pm: \$200
2. 40% won't make ~~it~~
3. Ticket 4pm: \$400

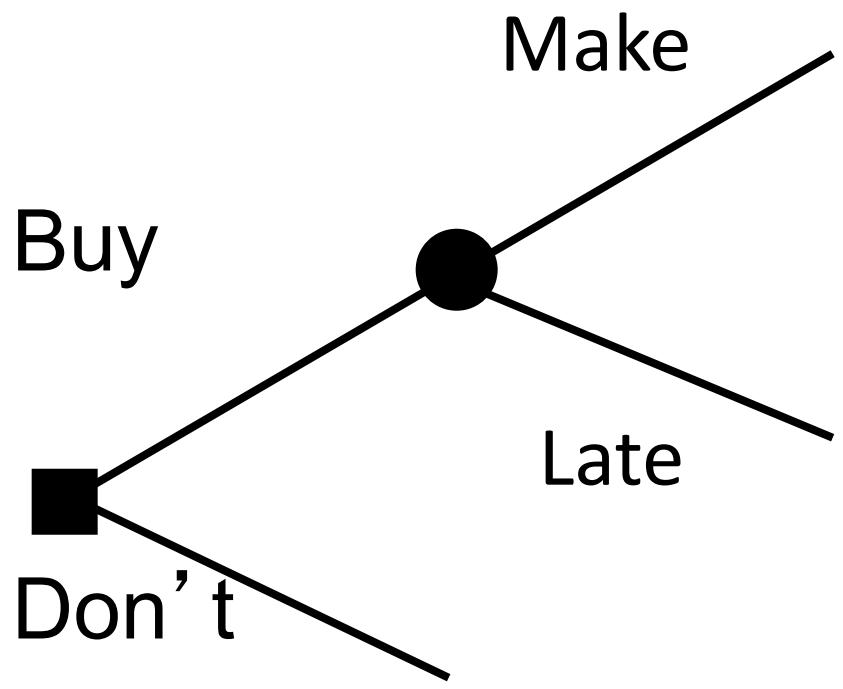
~~Do you buy?~~

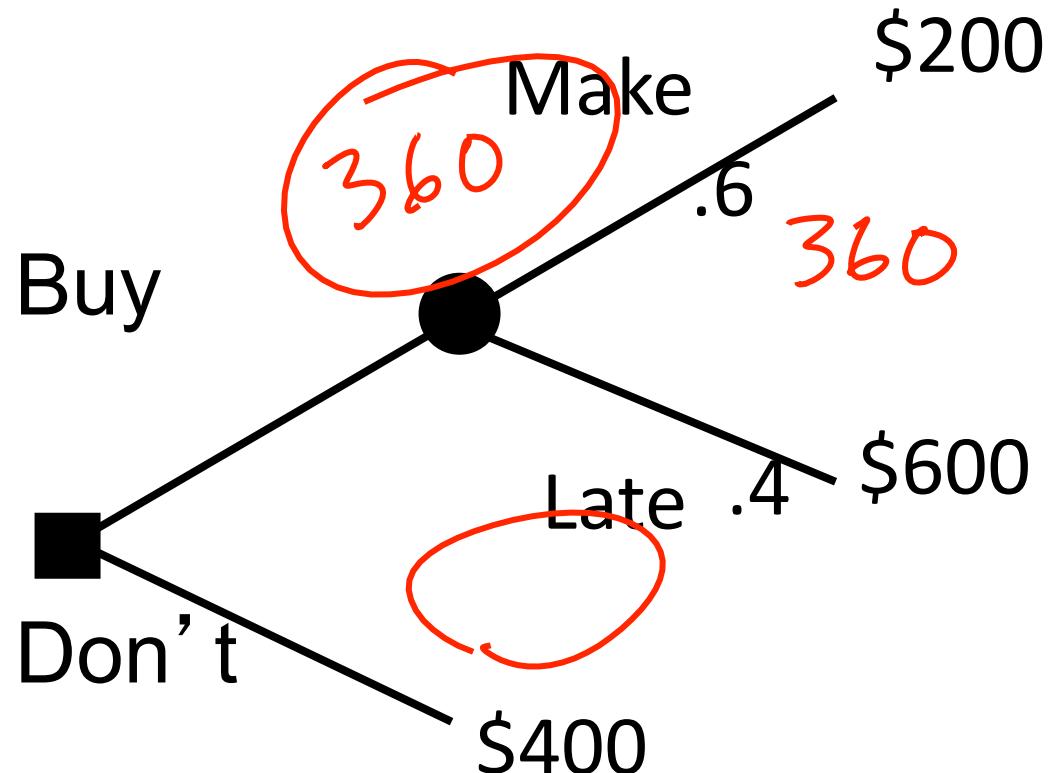
Buy

Don't

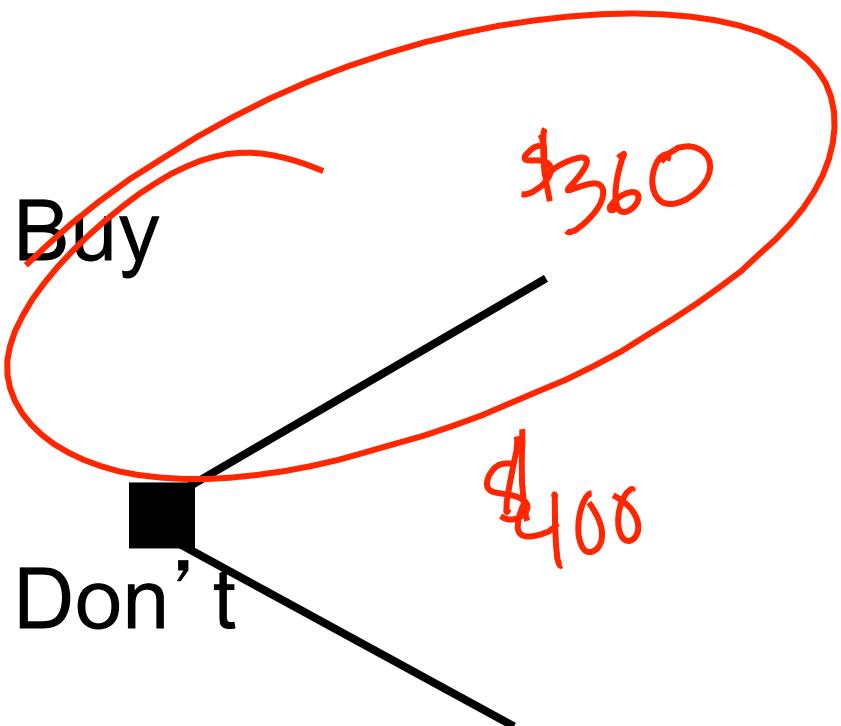








$$(.6)(200) + (.4)(600) = \underline{120 + 240}$$



Scholarship: \$5000

~~\$~~

200 applicants

2 page essay

10 finalists

10 page essay

Cost:

Two page essay: \$20.

Ten page essay: \$40

Step 1: Draw Tree

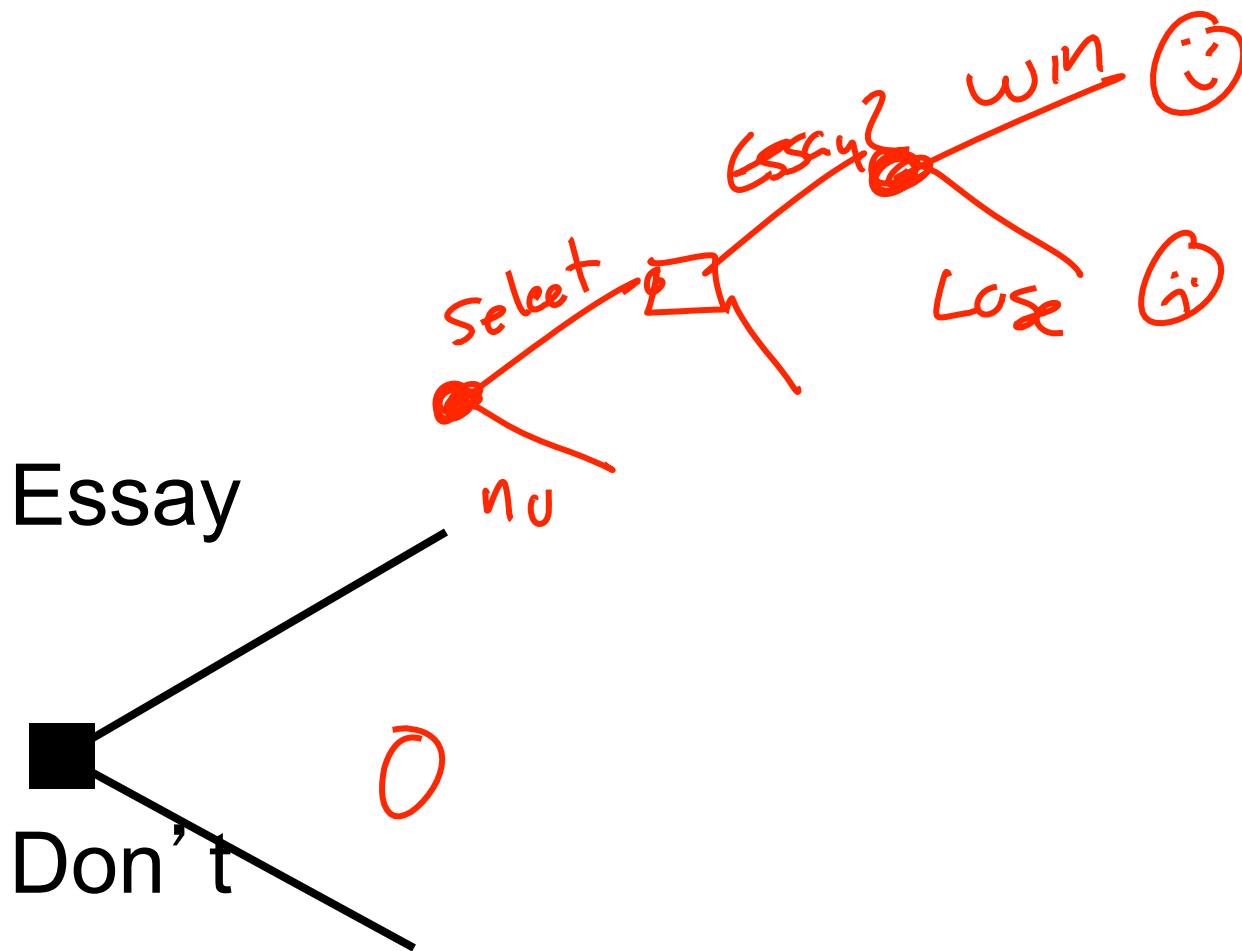


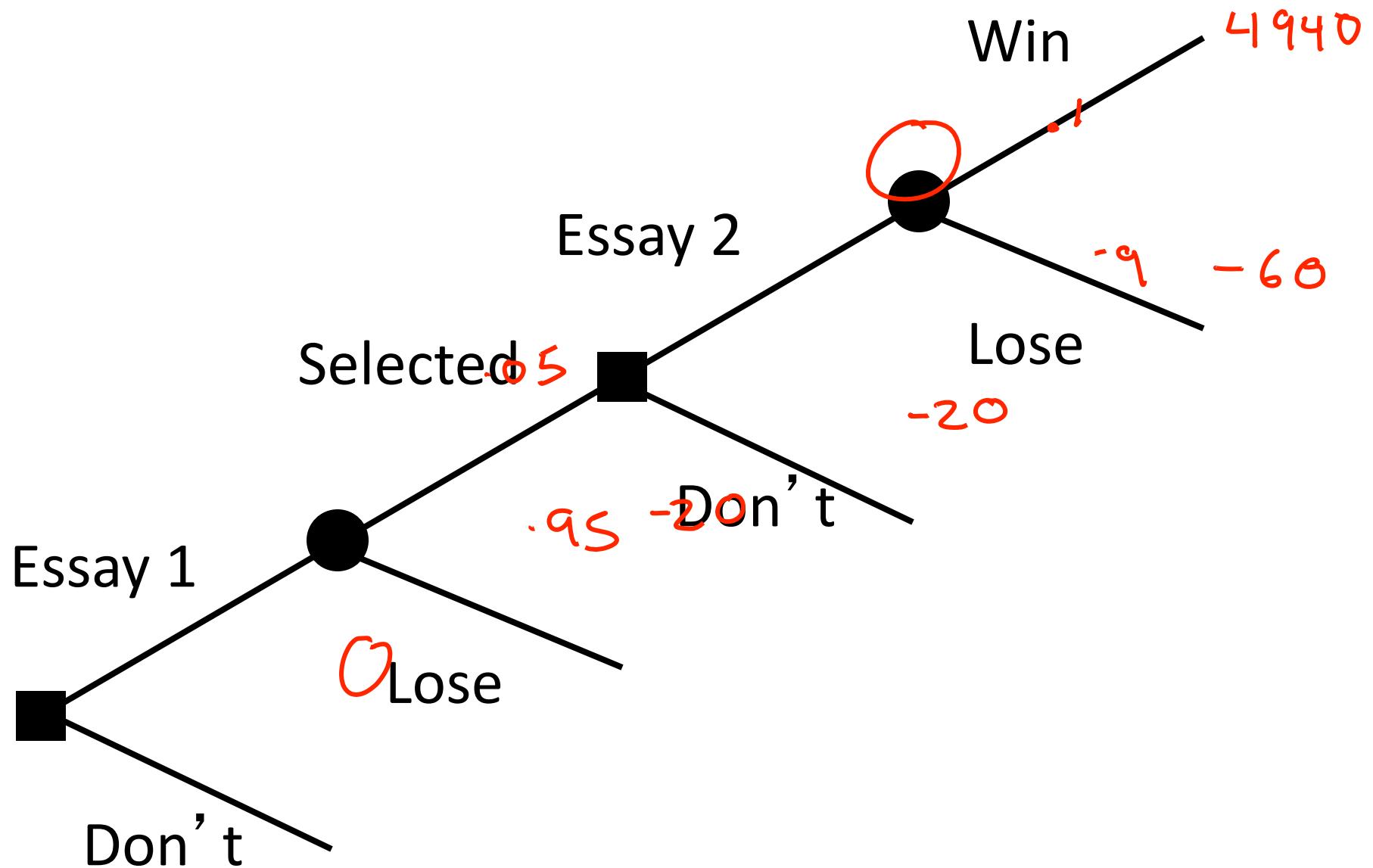
Step 2: Write down payoffs
and probabilities

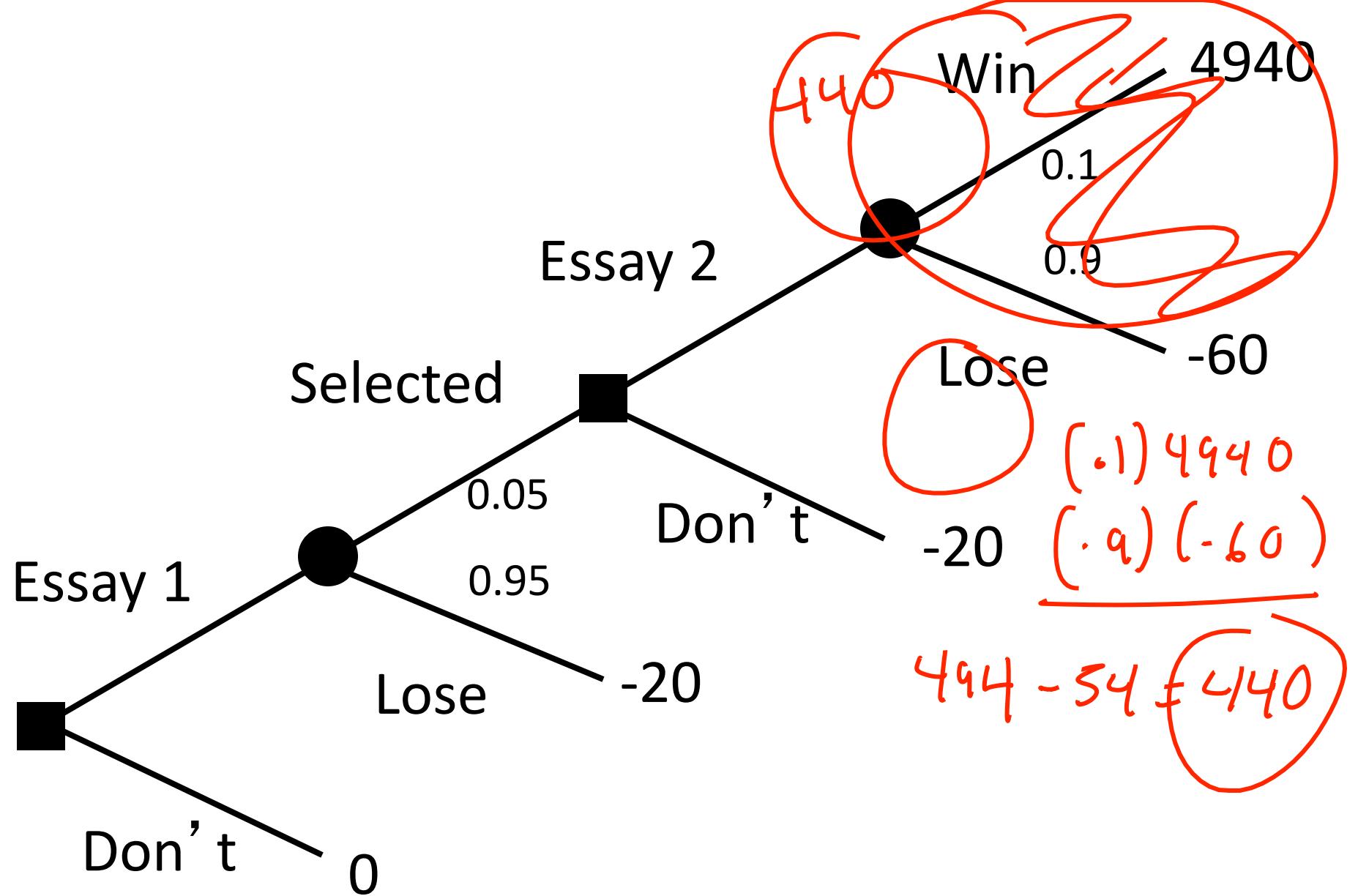


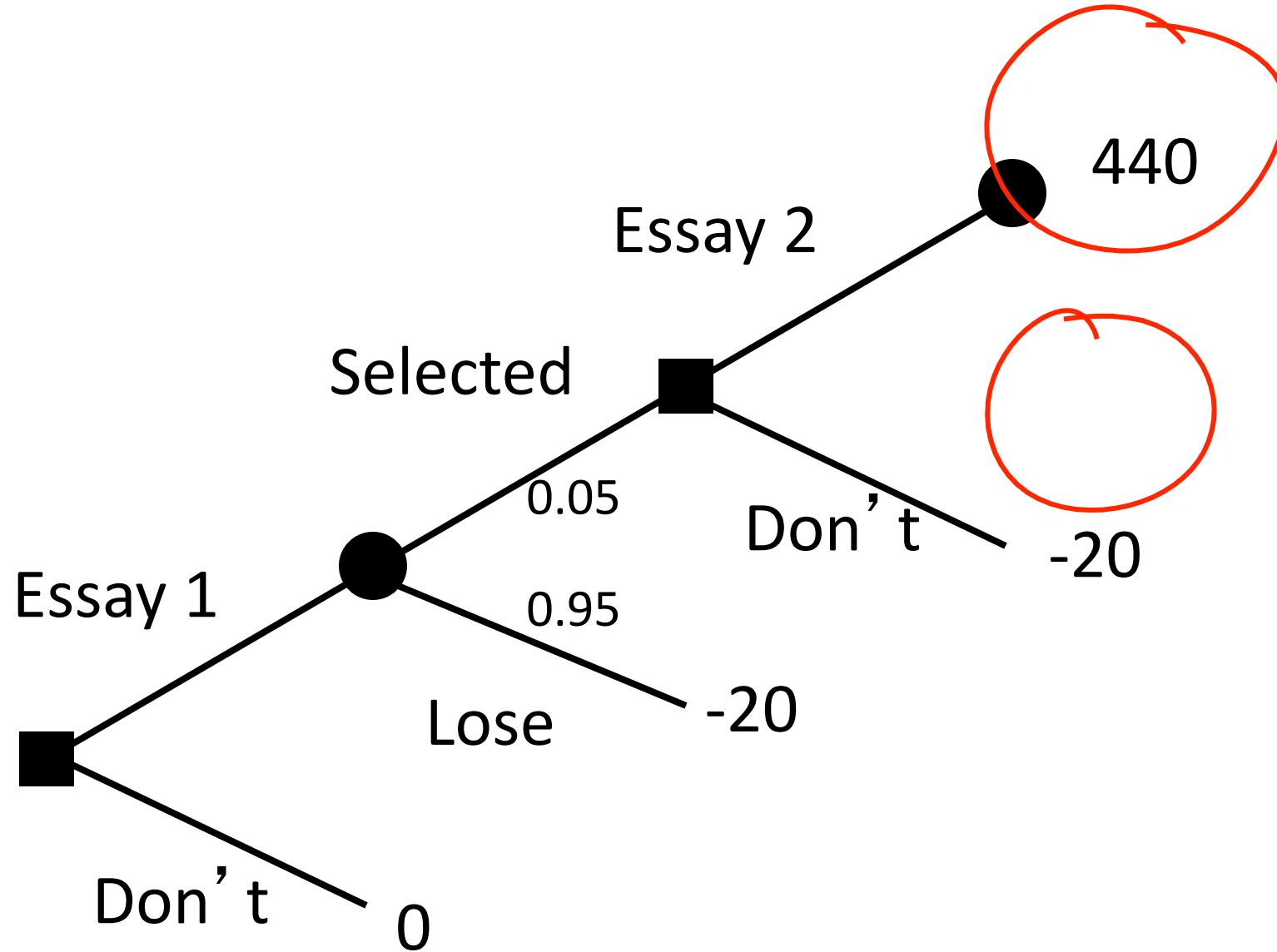
Step 3: Solve Backwards

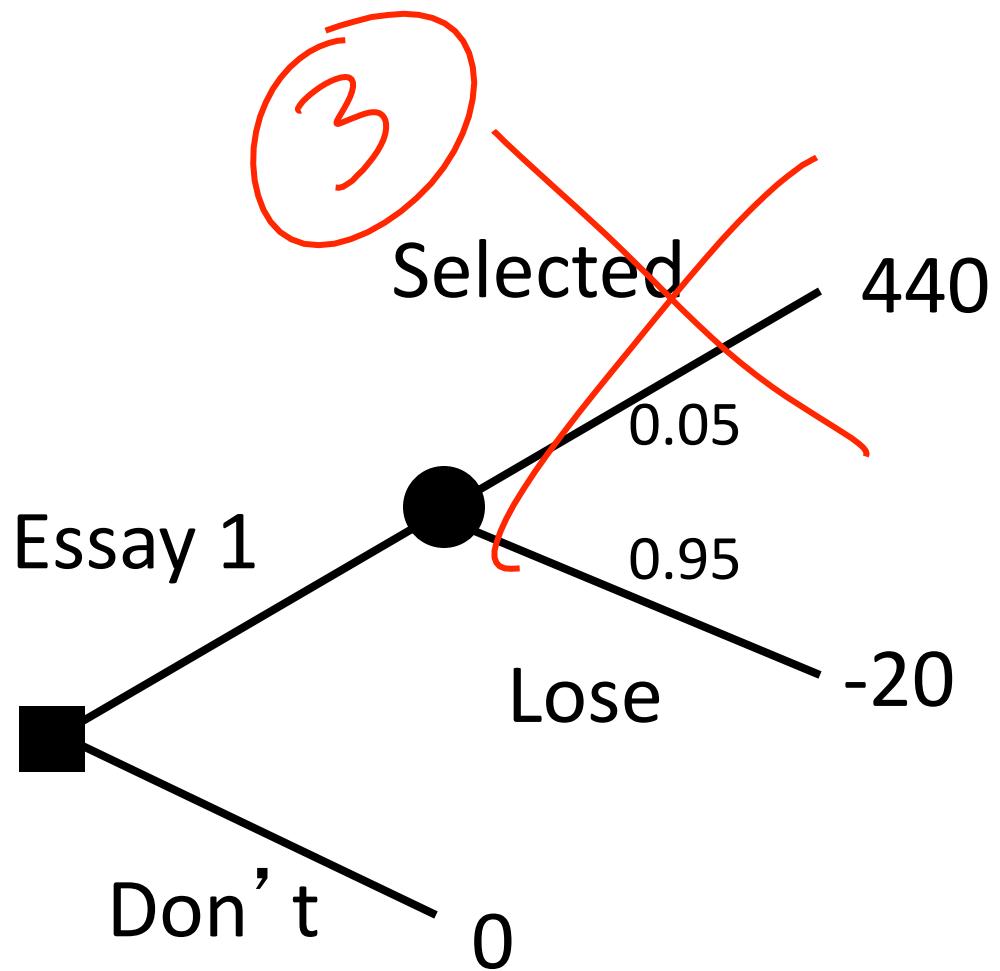




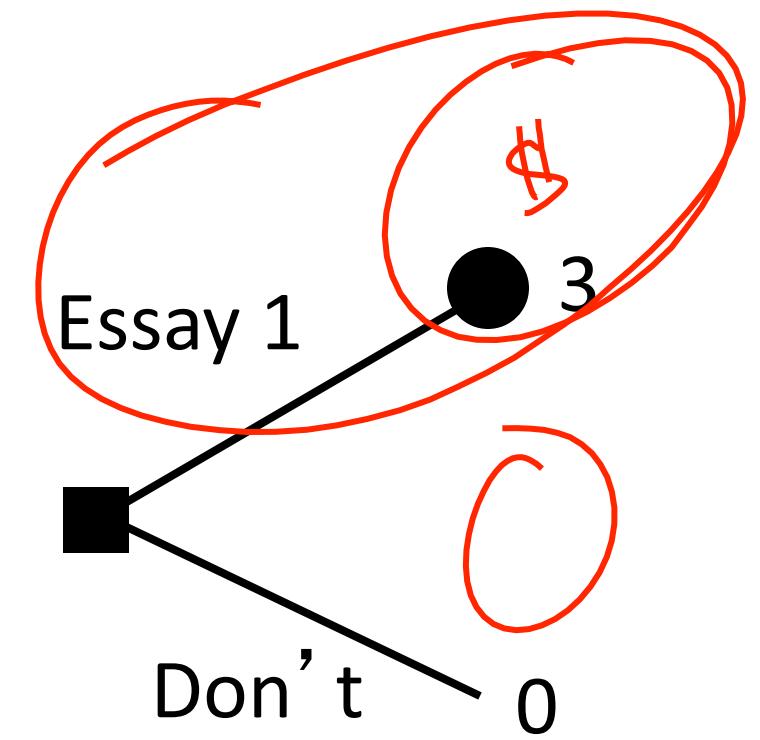








$$\begin{aligned} & (440)(.05) \\ & (-20)(.95) + \\ & \hline \\ & 22 \\ & -19 \\ & \hline \\ & 3 \end{aligned}$$

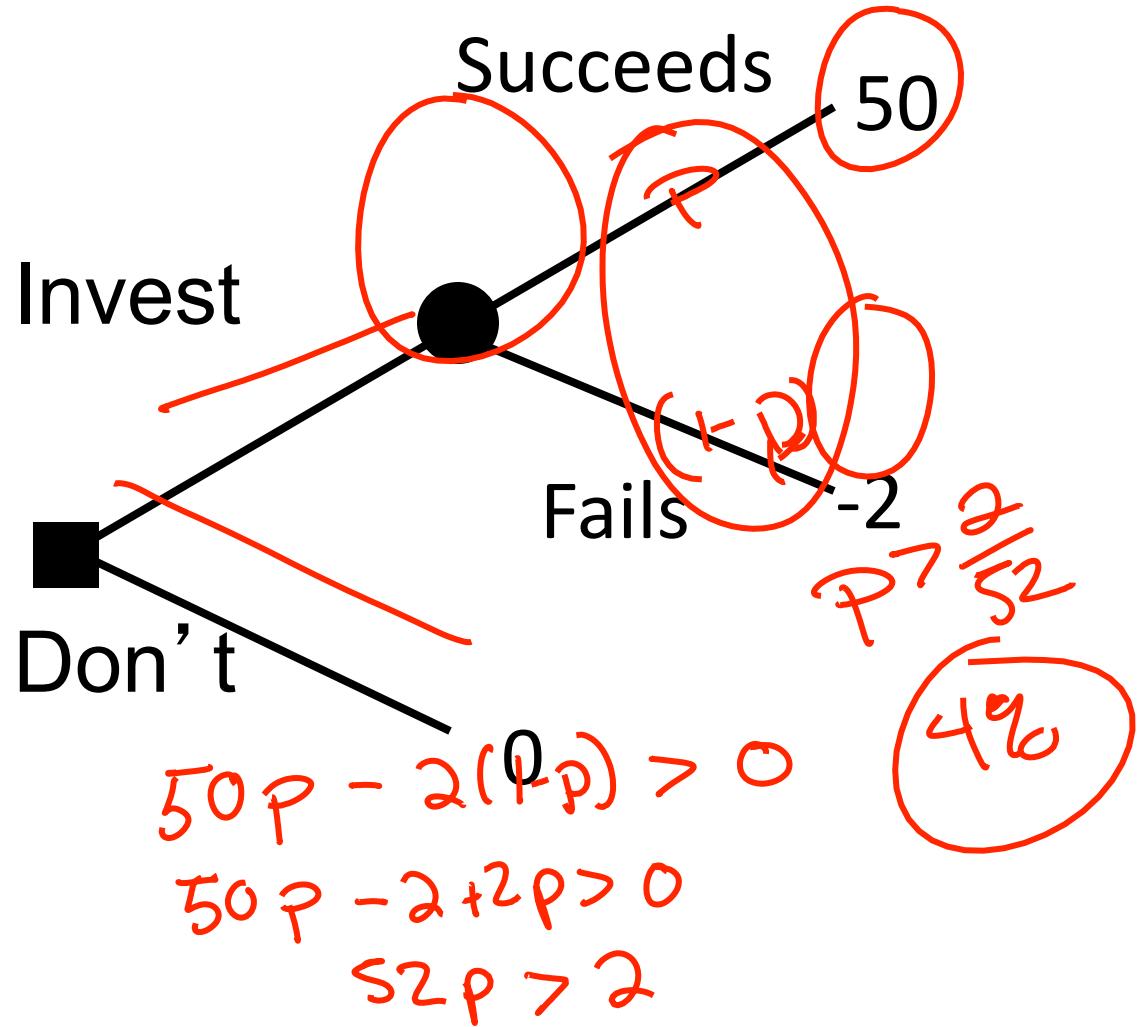


Inferring Probabilities

Your friend tells you
about a risky investment
opportunity that will pay
\$50,000 on a \$2000
investment.



She's in. Do you invest?

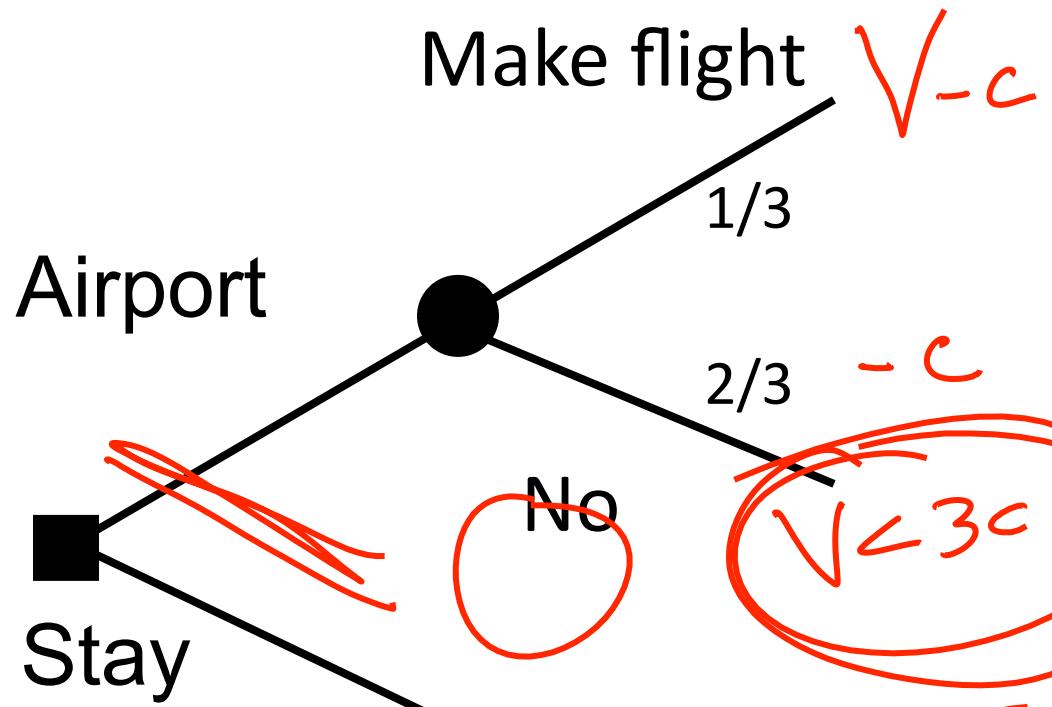


Inferring Payoffs

You have a ~~standby~~ to go visit your parents. The airline says that there is a one third chance that you'll make the flight.

You decide not to go to the airport and to stay on campus.

How much did you want to see your parents?



$$\frac{1}{3}(V - c) + \frac{2}{3}(-c) < 0$$

$$\frac{1}{3}V - c < 0$$

$\sqrt{3}c$

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Value of Information



Photo: Conor Ogle

38

1
38

Value of information of
whether **your** number
won.



Value of information of
the **winning** number.



Option A: buy car now

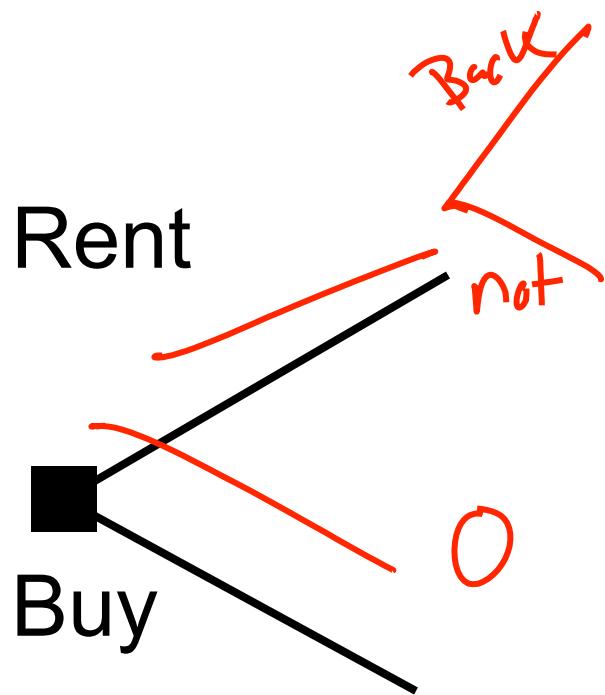
Option B: rent for \$500



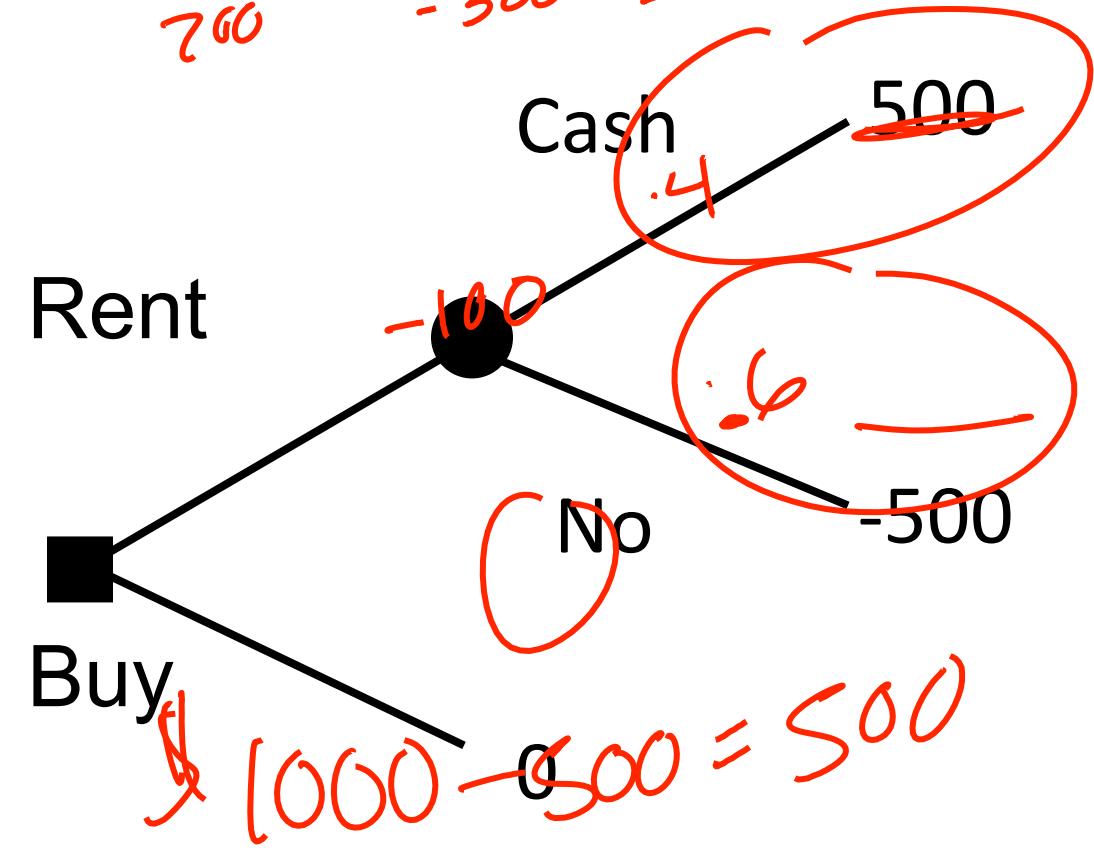
40% chance that the car company offers \$1000 cash back starting next month.

Value of Information

1. Calculate value without the information
2. Calculate value with the information
3. Calculate the difference



$$(.1) 500 + (.6)(-500) \\ 700 - 300 = -100$$



$$1000 - 500 = 500$$

Rent

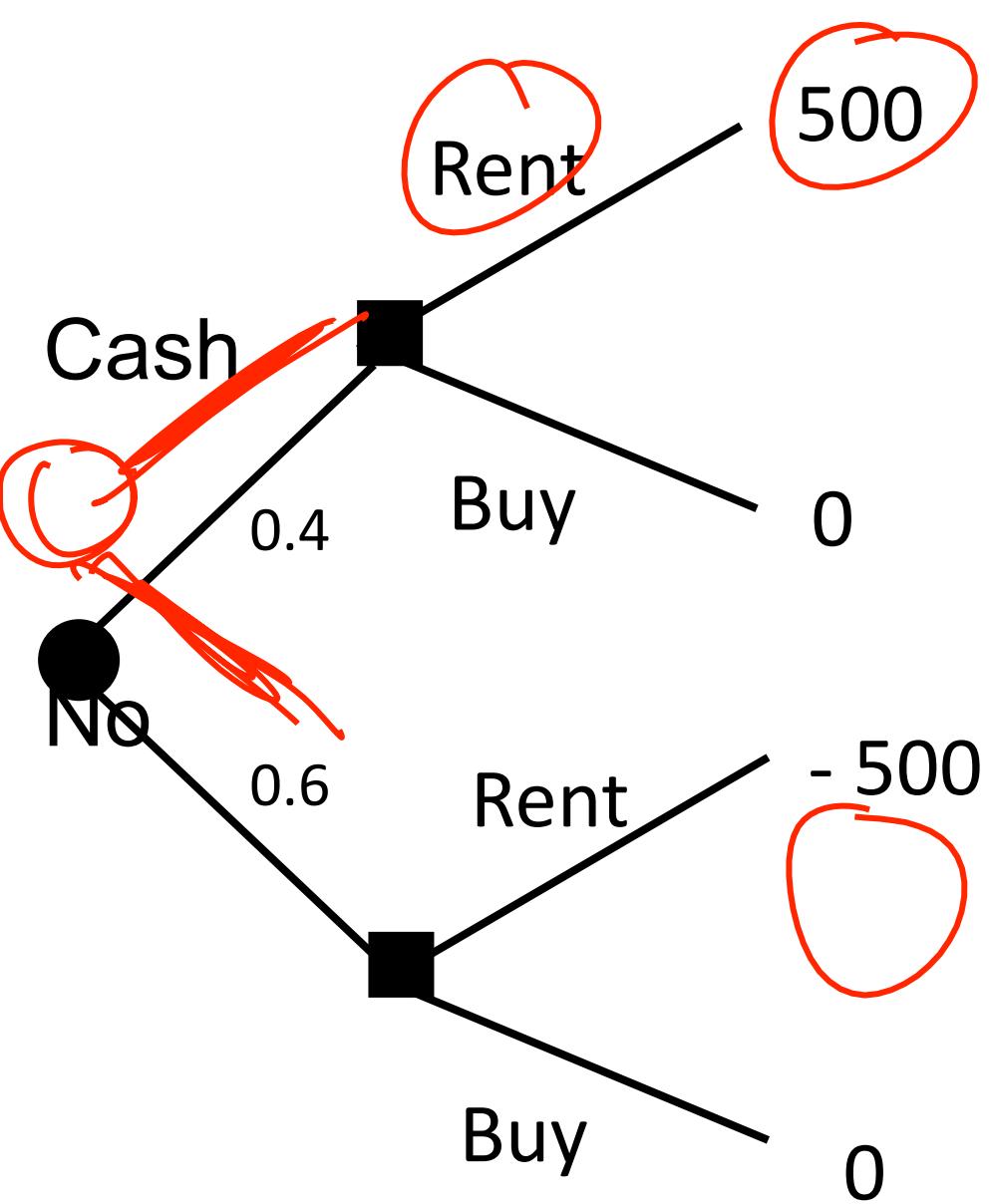
-100

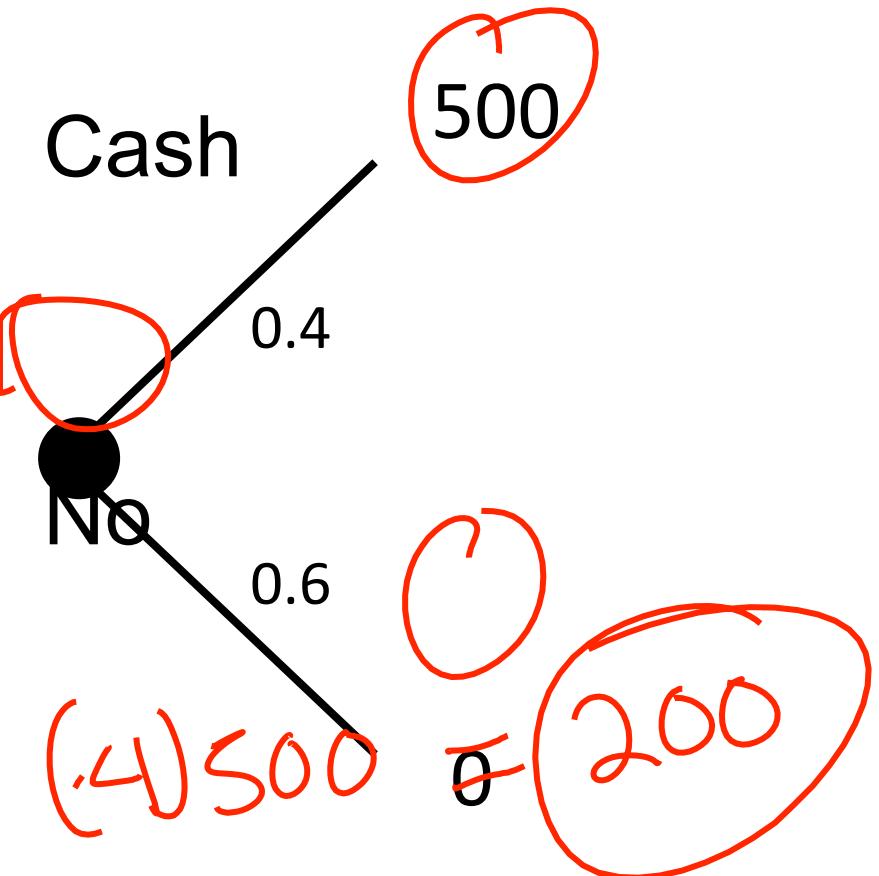
Buy

0

Value of Information

1. Calculate value
without the
information
2. Calculate value
with the information
3. Calculate the
difference





Value of Information

1. Calculate value
without the
information 
2. Calculate value ~~\$200~~
with the information
3. Calculate the ~~\$200~~
difference

The Value of Information

Value with \$200

Value without \$0

Value of Information

\$200

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