Prospect Theory

- Kahneman & Tversky
- Modification of EUT
  - **Utilities not evaluated in absolute sense**
    - **Evaluated wrt reference point**
  - Utilities not multiplied by objective probabilities
    - Multiplied by the π function instead

Framing Effects

Reference Point: 600 deaths

- Imagine the US is preparing for an outbreak of disease which is expected to kill 600 people. 2 programs are proposed:
- Program A: 200 people will be saved
- Program B:
  - 1/3 prob 600 people saved
  - 2/3 prob no people will be saved

Alternative Framing

- Program C: 400 people will die
- Program D: 1/3 probability no people will die, 2/3 probability 600 people will die

Reference Point: status quo (no deaths)

Regret Theory

- People overweight anticipated feelings of regret when the difference between outcomes is large

Allais Paradox

- $1,000 w/probability of 1.0
- $1,000 w/probability of .89
- $5,000 w/probability of .10
- **$0 w/probability of .01**

Focus of anticipated regret

Regret Theory

- People overweight anticipated feelings of regret when the difference between outcomes is large

	Ticket Numbers			
Option	1-9	10-21	22-24	
A	$24	$0	$0	←
B	$0	$16	$0	

Chance of not getting $24 similar to that of not getting $16, and $24 better outcome

	Ticket Numbers			
Option	1-9	10-12	13-24	
C	$24	$0	$0	
D	$16	$16	$0	←

1-9 outcomes fairly similar, so focus on 10-12 and compare winning something vs. nothing

Irrationality

- 2 accounts of irrational decisions
  - Prospect Theory
  - Regret Theory
- Is regret important?
  - Should it be included when calculating utilities?
- Bounded Rationality
  - Limited Processing Resources
  - Huge Amount of Information

Heuristics & Biases

- Heuristics – cognitive shortcuts
- Use of heuristics leads to various judgment biases
- Double-edged sword
  - Used by experts, Usable by novices
  - Can be misleading

Kahneman & Tversky

- Deviations from rational judgment result from use of heuristics
- Anchoring & Adjustment
- Availability
- Representativeness

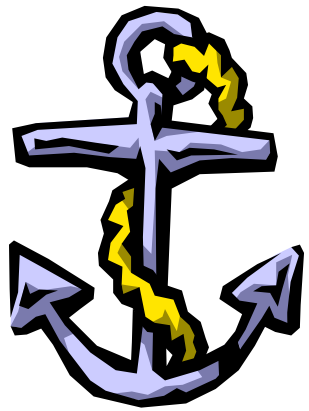
Anchoring & Adjustment

- Strategy in which estimation begins with an initial anchor and adjusts estimate in light of incoming information

1 x 2 x 3 x 4 x 5 x 6 x 7 x 8 = 512

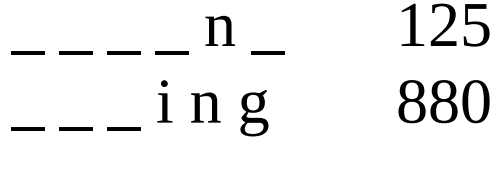
8 x 7 x 6 x 5 x 4 x 3 x 2 x 1 = 2,250

=40,320



Availability Heuristic

- Tendency to form a judgment on the basis of what's readily brought to mind



Tversky & Kahneman (1974)

- If a word of 3 or more letters is taken randomly from an English text, is it more likely that the word starts with r or has r as its 3rd letter?
- Availability reflects effectiveness of search strategy
  - May or may not reflect actual probability

Pros & Cons of Availability

- Availability → Frequency
  - Frequency -> Probability
- Memory distortions
  - Availability not correlated w/Probability
    - Recency
    - Publicity

Von Restorff Effect

- Finding that a single non-category member embedded in a list of items from a category will be the best remembered

- Carrot
- Celery
- Cucumber
- Porsche
- Zuchini
- Eggplant
- Squash

Solo or Token Members

Group A	Tape	Group B
5 Caucasians	6 voices	3 Caucasians
1 African American		3 African Americans

- Statements attributed to African American remembered better in group A than group B
- Statements attributed to the African American were more negatively evaluated in group A than group B

Hindsight Bias

- Tendency to overestimate probability you would have predicted X, once you know X occurred
- Arkes & colleagues
  - 4 Hindsight Groups
  - Assigned 2-3x > probability estimates to the “correct” diagnosis than did the foresight group

Availability & Hindsight

- Availability of correct outcome outweighs other evidence
  - Even when consciously ‘ignoring’ it
- Hindsight Bias can lead outside observers to an inadequate appreciation of original difficulty of a decision
  - Medical Diagnosis
  - Airline Operation

Causal Schema

- Evaluate the probability of an event via the difficulty you have imagining a plausible scenario leading to that outcome
- Good for understanding events and stories
  - The careless man threw a cigarette out the window. The forest won't be restored in our lifetime.
- Use of causal schemas to *estimate probabilities* can be misleading

Down Side of Causal Schemas

- People have limited imaginations
- Overestimate likelihood of events consistent w/causal schemas
  - Predicting daughter's eye color from mother's eye color vs. mother's eye color from daughter's
  - Predicting scores on a short quiz from performance on a 10-hour exam, or vice versa

Representativeness Heuristic

- Evaluate evidence by judging it's similarity to the outcome
  - What's the probability that exemplar E is a member of category C?
    - How many features typical of C does E have?
      - Lots: Probable!
      - Few: Improbable…

Steve

- Steve is very shy and withdrawn, invariably helpful, but with little interest in people, or in the world of reality. A meek tidy soul, he has a need for order and structure and a passion for detail.
- What's the probability that he's a
  - Farmer
  - Pilot
  - Doctor
  - Librarian

Conjunction Fallacy

Which of the following events is the most likely?

1. That a man is under 55 and has a heart attack
2. That a man has a heart attack
3. That a man smokes and has a heart attack
4. That a man is over 55 and has a heart attack

Conjunction Fallacy

Which of the following events is the most likely?

1. That a man is under 55 and has a heart attack
2. **That a man has a heart attack**
3. That a man smokes and has a heart attack
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Representativeness Heuristic and Bayes Theorem

P(O|E)	Probability of Outcome given Evidence
P(O)	Base Rate (Prior Probability of Outcome)
P(~O)	Inverse of Base Rate (1 – P(O))
P(E|O)	Hit Rate (Prob of Evidence given Outcome)
P(E|~O)	False Alarm Rate

$$P(O|E) = \frac{P(E|O)P(O)}{P(O)P(E|O) + P(\sim O)P(E|\sim O)}$$

Bayes' Theorem

An Example

Given that Harold talks to strangers,
how likely is it that he is an extravert?
(What is the probability of the outcome given the evidence?)
Evidence: Harold talks to strangers = T
Outcome: Harold is an extravert = X

Evidence: Harold talks to strangers	= T
Outcome: Harold is an extravert	= X
Assume	
P(Outcome): Base Rate of being an extravert	p(X) = .6
P(Evidence): Probability of talking to strangers	p(T) = .85
P(E&O): Probability of being extraverted and talking to strangers	p(T&X)=.6

Harold

Assume

P(Outcome): Base Rate of being an extravert

p(X) = .6

P(Evidence): Probability of talking to strangers

p(T) = .85

P(E&O): Probability of being extraverted and talking to strangers

p(T&X)=.6

Calculate

Likelihood: Probability of evidence given outcome

p(T|X)=p(T&X)/p(X) =

.6/.6 =

1

p(X|T)

But what is the probability of the outcome given the evidence? p(X|T)

p(X|T) = p(X&T)/p(T)

= .6/.85

= .71

Some people who talk to strangers are not extraverts.

Representativeness Heuristic and Bayes Theorem

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Bayes' Theorem

Probabilities vs. Frequencies

The probability of breast cancer is 1% for a woman at age 40 who participates in routine screening. If a woman has breast cancer, the probability is 80% that she will get a positive mammography. If a woman does not have breast cancer, the probability is 9.6% that she will get a positive mammography. A woman in this age group had a positive mammography in a routine screening. What is the probability that she actually has breast cancer?

High Base Rate

P(Illness)=.10

P(~Illness)=.90

P(E|Illness)=.80

P(E|~Illness)=.20

$$P(\text{Illness}|E)=\frac{.80(.10)}{.10(.80)+.9(.80)}$$

=.01

Low Base Rate

P(Illness)=.01

P(~Illness)=.99

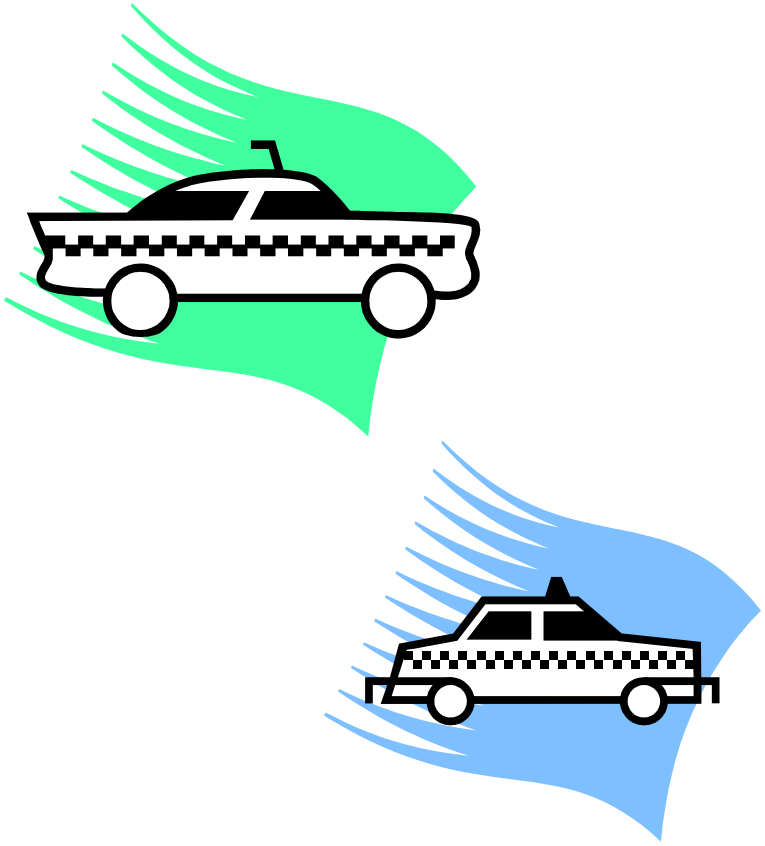
P(E|Illness)=.80

P(E|~Illness)=.20

$$P(\text{Illness}|E)=\frac{.80(.01)}{.01(.80)+.99(.80)}$$

=.004

Base Rate Neglect



- 85% cabs green
- 15% cabs are blue
- Witness: “Cab was blue.”
- Witness: 80% accurate when identifying colors in similar conditions
- What’s the probability that the cab in the accident was blue?
  - Survey Says: 80%
  - Bayes Says: 41%