Historic Studies on the Psychology of Decision Making

Factors that may bias risk assessments and decisions

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Topics

- What influences Risk Preferences?
- Breaking Bayes' Rule
- How Heuristics Can be Misleading
- Anchoring
- Correlation/Covariation
- Implications of classic theory on real-life DA practice

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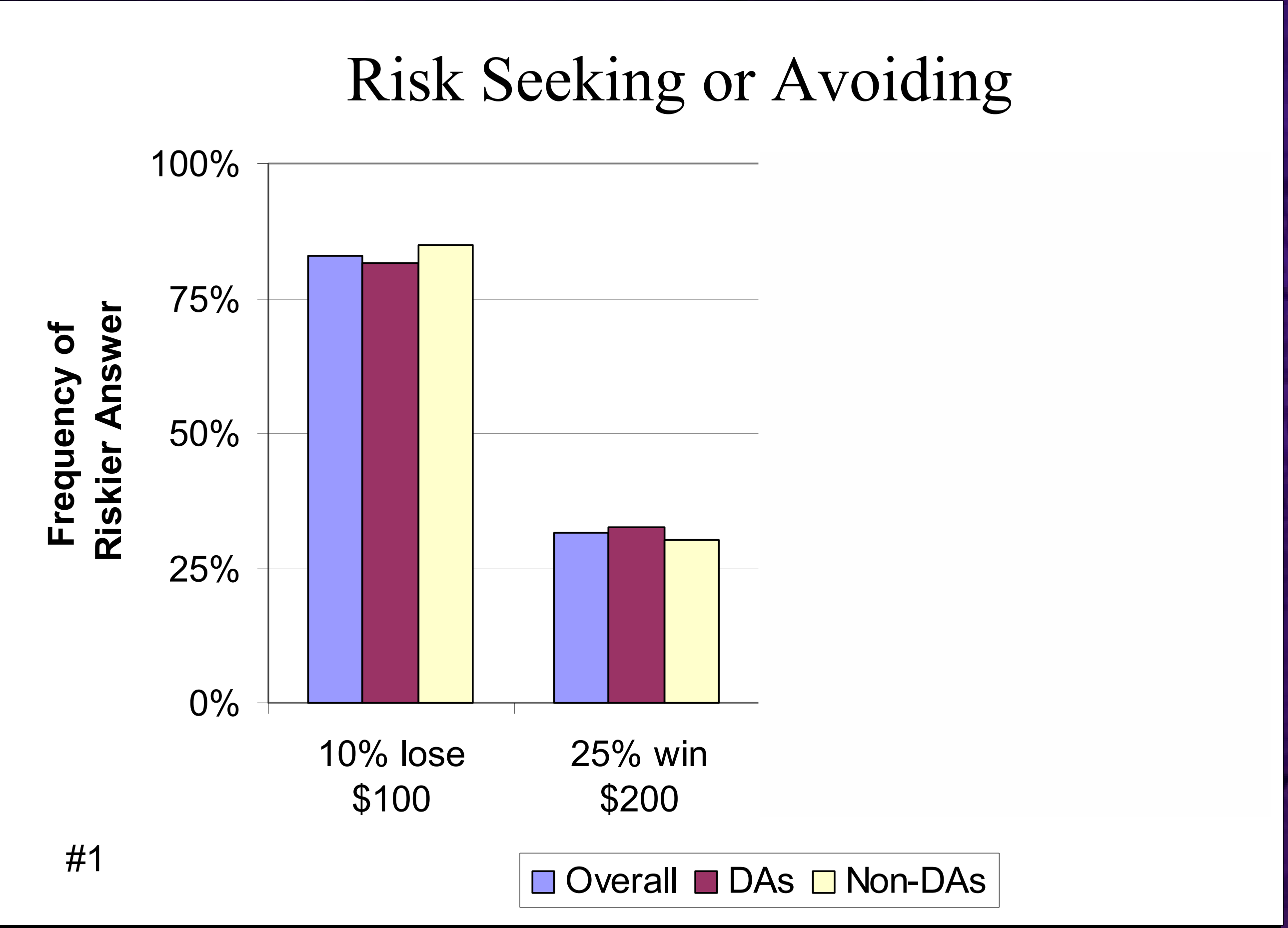
Risk Preferences

Risk Preferences: DAAG Results

- Chose to "bet" if a loss at stake
- Chose sure thing if a gain
- Consistent with Prospect theory



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Risk Preferences: Classical Theory

- Prospect Theory (1st 2 bars)
  - Tversky and Kahneman, 1979
  - Posed questions to 70 people similar to Q1 where in all cases expected value of the choices was the same.
  - 84% of respondents chose a sure gain (Q1B)
    - "Better to have a bird in the hand…"
  - When frame of question was reversed to a loss, nearly 70% chose the risky alternative (Q1A)

Survey Q1

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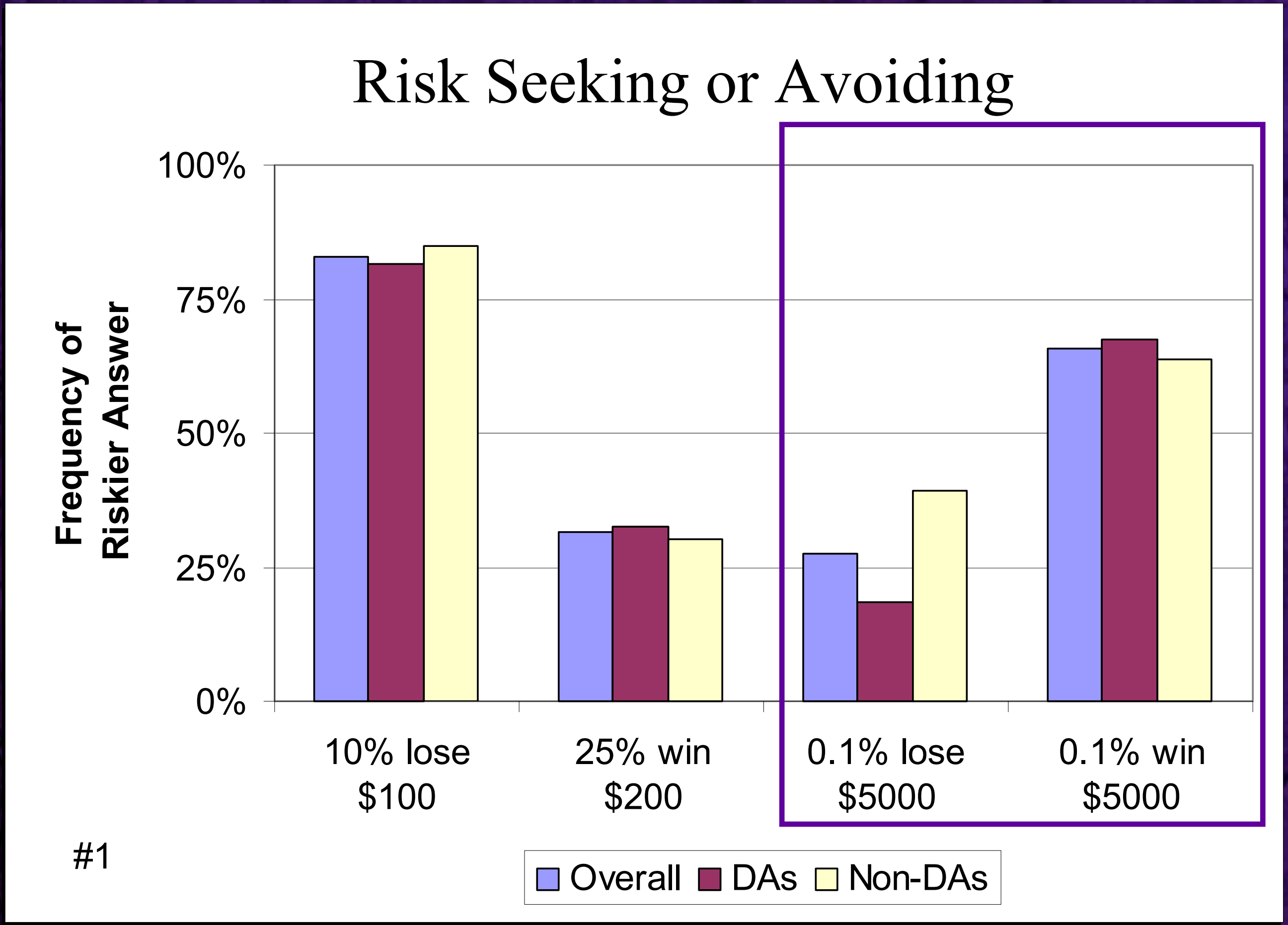
Risk Preferences: DAAG Results

- Willing to risk when a win requires a small bet (lottery)
- Avoid risk if potential for big lose (insurance)

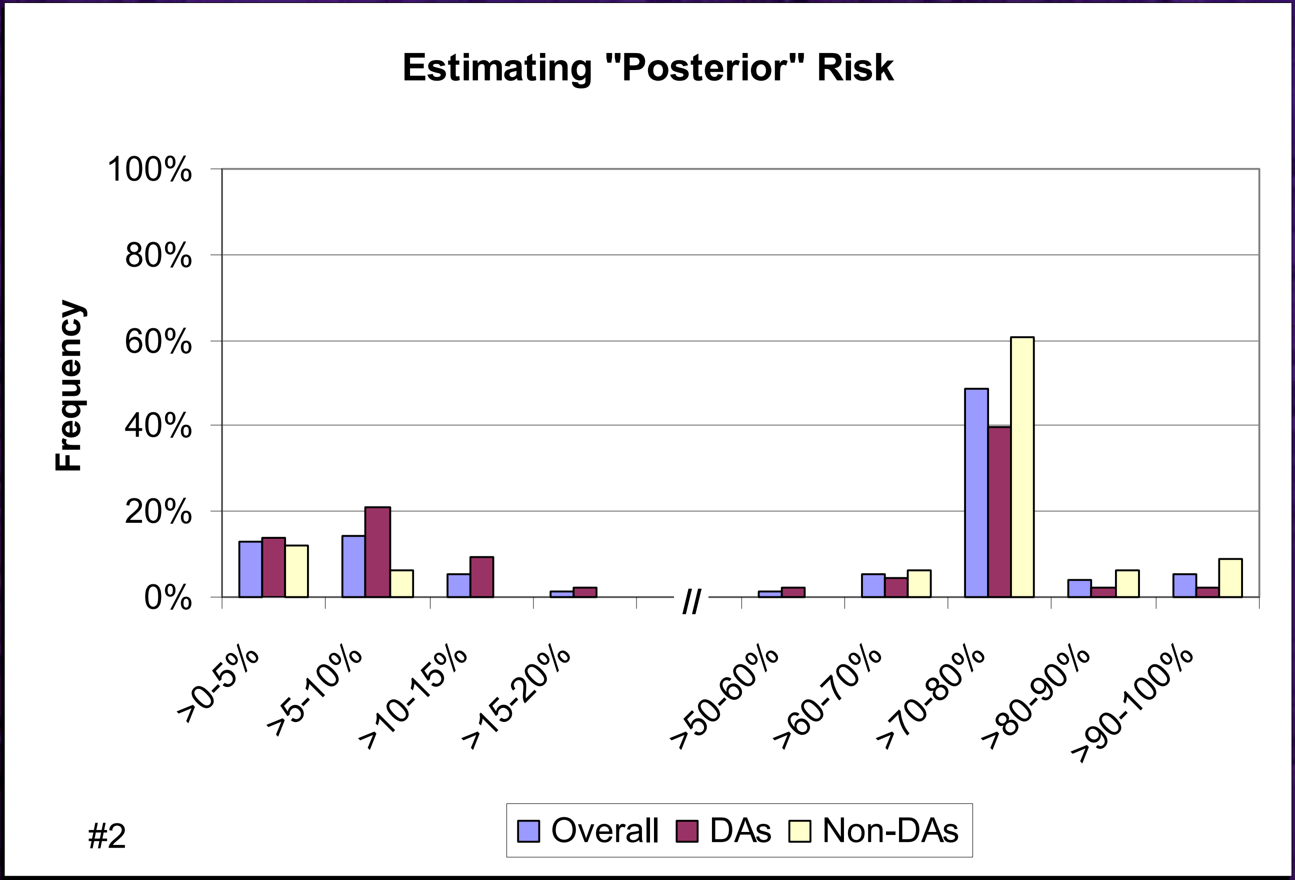


Breaking Bayes' Rule

Q2: How likely is CA given 1% estimate of CA and +test result that identifies 80% of CA as + and 10% of non-CA as +?

How did our sample do at Estimating Posterior Risk?

- Most people chose 80% because it was supplied in the problem as the reliability of mammograms to accurately classify tumors
- People have difficulty understanding the implication of Bayes' Theorem
- DAAG sample consistent with Eddy paper



Confusion of the Inverse

- David Eddy (1982) Asked 100 Physicians to assess the probability of malignancy given a positive mammogram result
  - 95 of them estimated around 75%
  - The correct answer is only 7-8%
  - They confused the chances of cancer given a positive test result with the chance of a positive test result given cancer

Survey Q2

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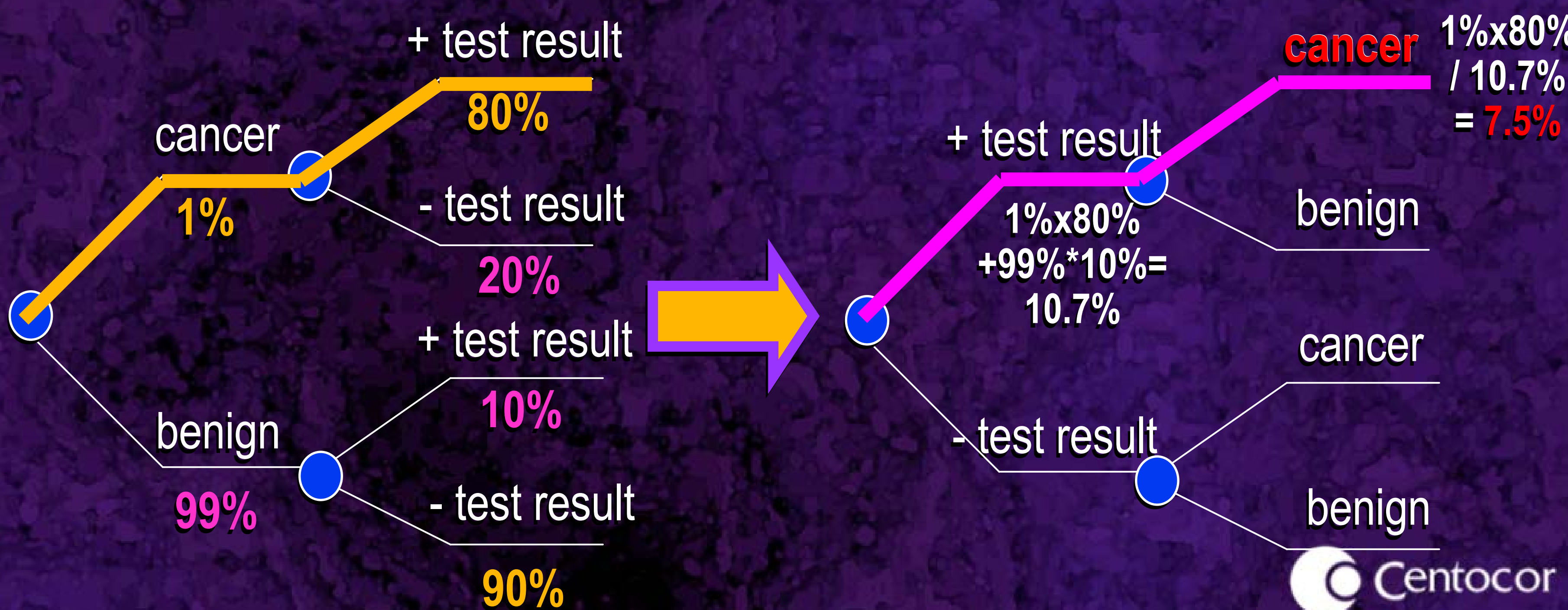
Question 2

- What is the question asking for? p(cancer | positive test result)
- What info did they give us in the problem? p(positive test | cancer)

p(positive test result | cancer) ≠ p(cancer | positive test result)



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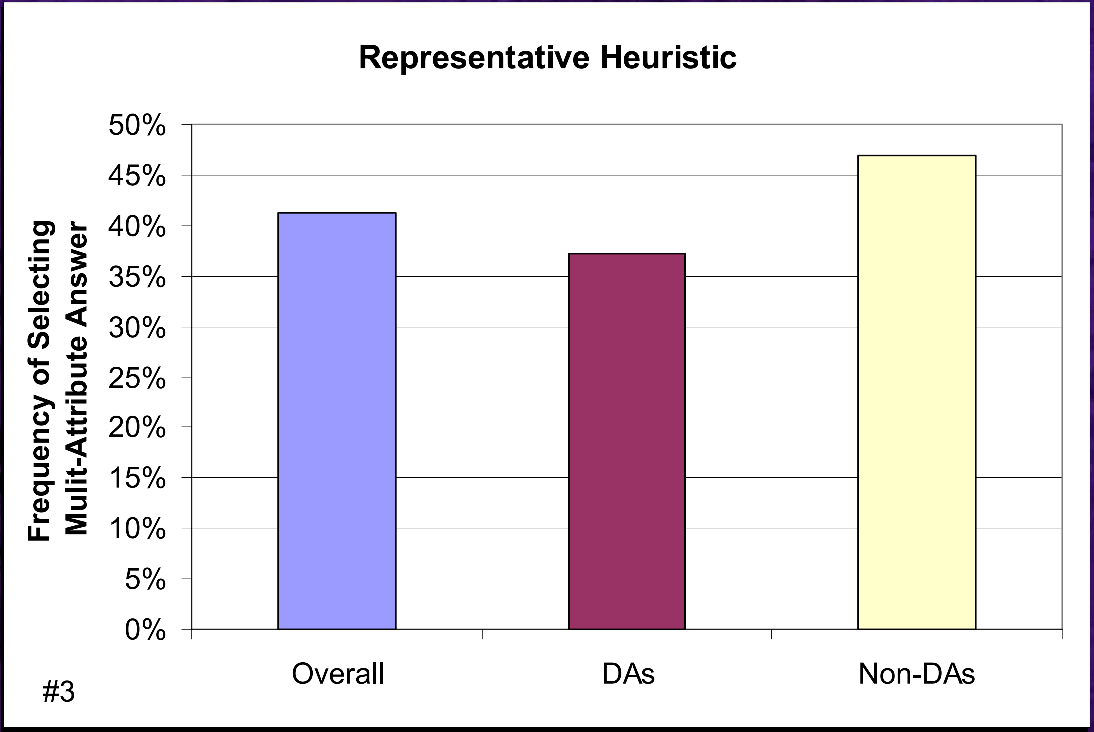
How Heuristics can be misleading

Do people recognize and account for compound "risks"? The DAAG Survey Results

Conjunctive Example

- Estimating the overall probability of multiple events can be difficult and may be "biased" by the setting of the question.



#1=minimal answer, e.g. Bank teller

#2 = Feminist, Bank teller

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Heuristics and Representativeness

- Tversky and Kahneman tested for bias in the way people use their experience (heuristics) to judge probabilities

Survey Q3

- When these researchers posed the question asking whether Linda was more like to be a bank teller/ feminist, or just a bank teller, nearly 90% of respondents answered that Linda was more likely to involved in the feminist movement than to be a bank teller alone
- They concluded that as the amount of detail in a scenario increases, it's apparent likelihood may increase, even though probabilistically, it must decrease

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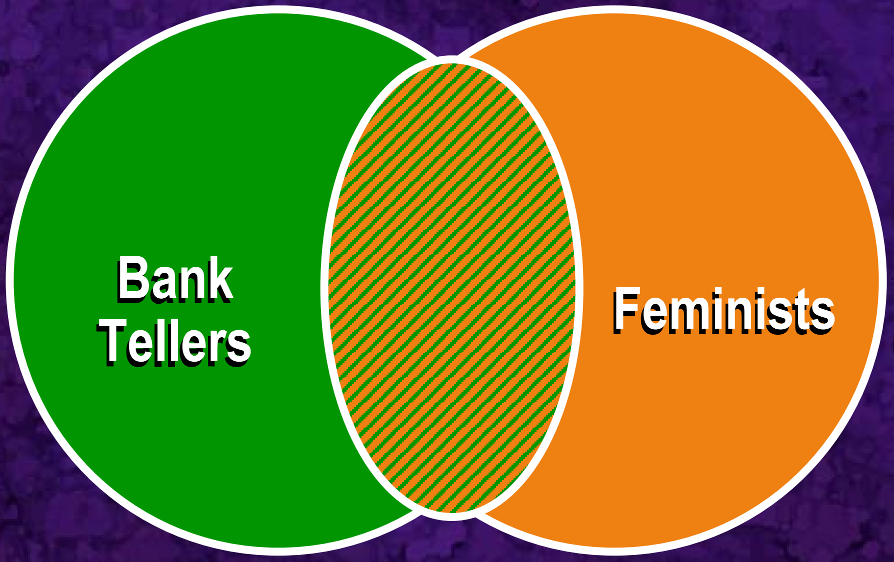
Conjunction Fallacy

The co-occurrence of 2 events cannot be more likely than either event occurring alone



- Compound Events
  - Conjunctive- Probability of A & B occurring
  - Disjunctive- Probability of A or B occurring
- Maya Bar-Hillel (1973) found that subjects had a tendency to systematically overestimate the probability of conjunctive events and underestimate the likelihood of disjunctive events

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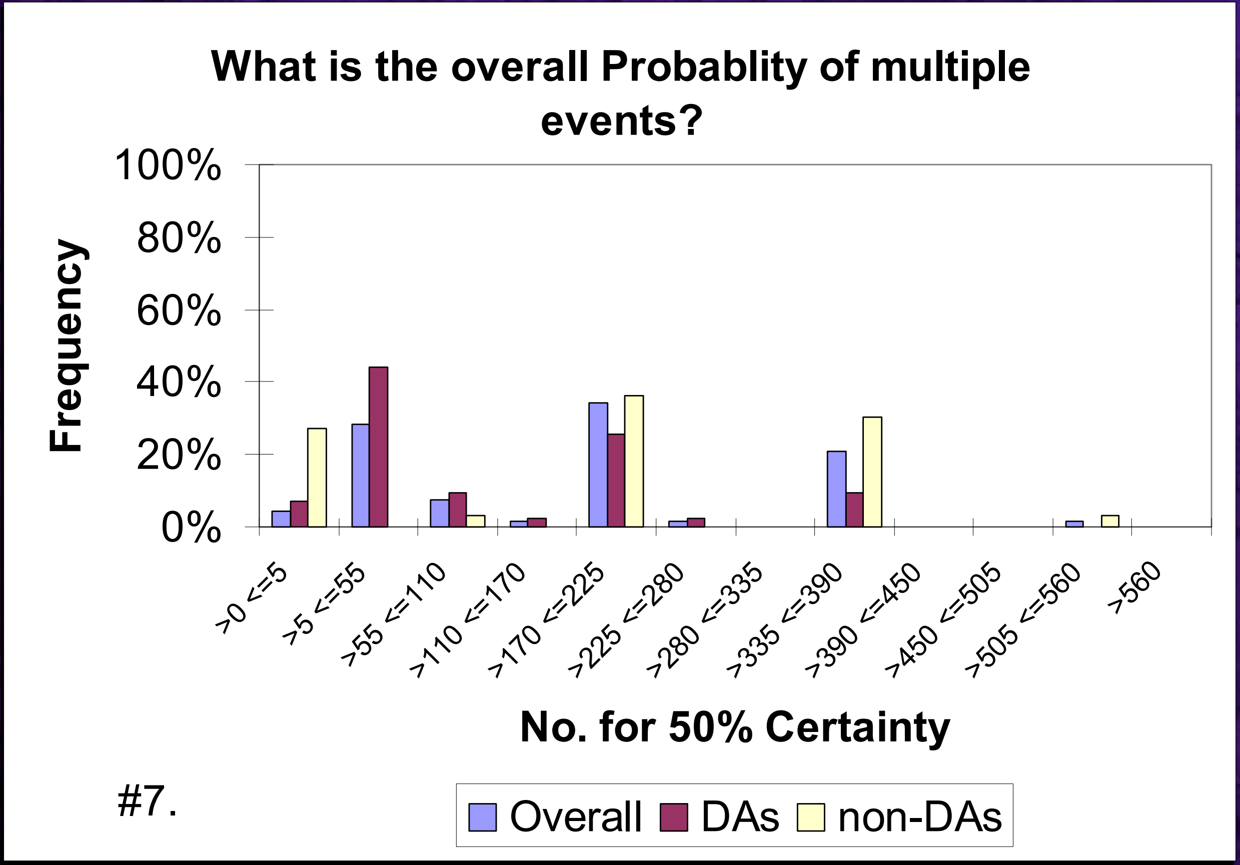
Estimating Overall risk can be a challenge if there are many risks/events

Survey Q7

- Disjunctive events tend to be overestimated
- 366/367 serves as anchor



Coincidences

- Only 23 people are needed to be 50% sure that two of them will share an *unspecified* birthday, but 254 people are necessary to have the same confidence that a single person has a *particular* birthdate
- "The moral… is that some unlikely event is likely to occur, whereas it's much less likely that a particular one will…The paradoxical conclusion is that it would be very unlikely for unlikely events not to occur." Paulos (1988, p.37)

Survey Q7

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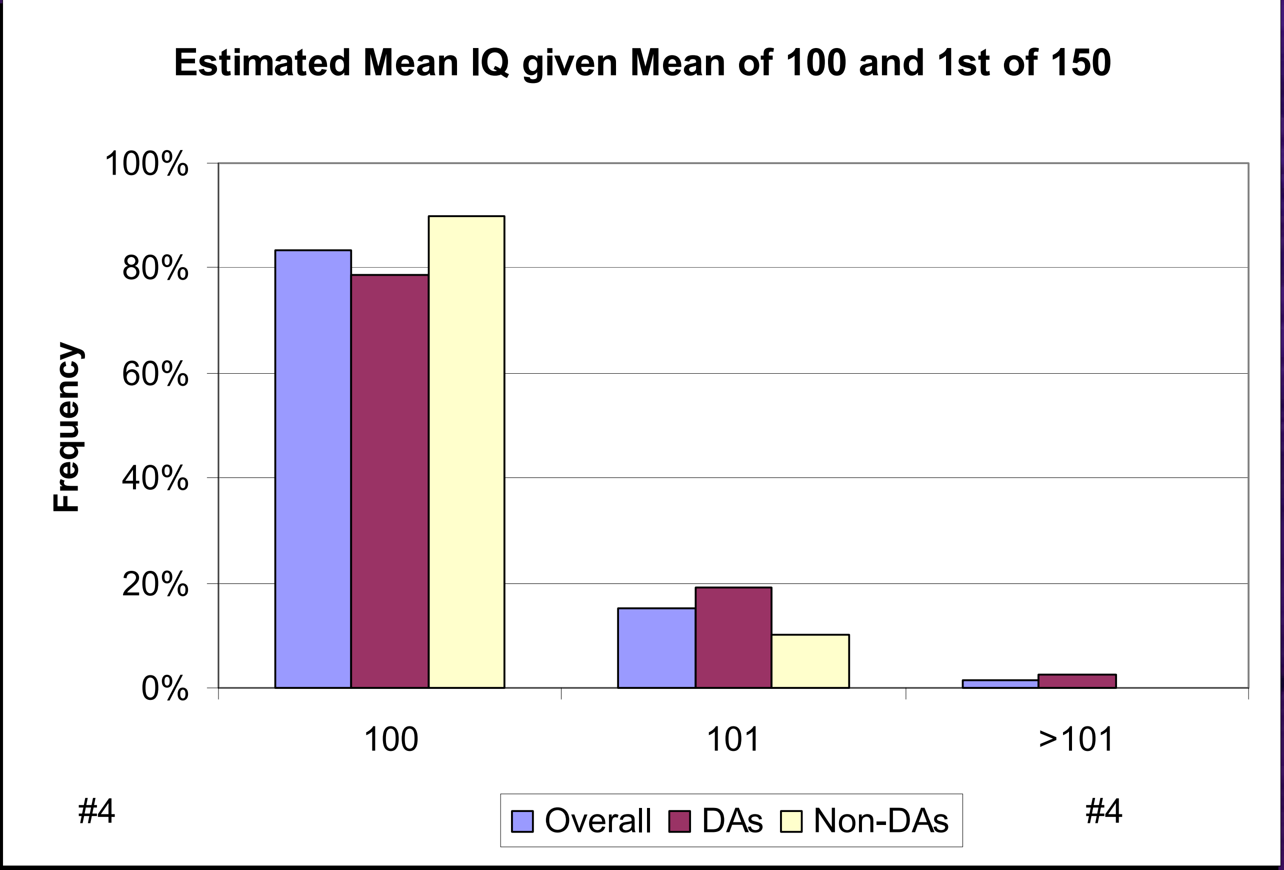
How "representative" is the data?

- The result is "diluted" rather than "balanced"

Survey Q4



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"The Law of Small Numbers"

- The true law in statistics, the Law of Large Numbers, states that the larger a sample you draw from a population, the more representative it will be
  - Tversky and Kanheman coined the phrase the "Law of Small Numbers" in reference to the example of Representativeness in which people overestimate the resemblance between the average of a small sample and of the overall population.

Survey Q4

- This concept is demonstrated in the survey. Most will answer that the mean IQ of the sample should still be 100, because they believe that low scores among the remaining children will balance out the high score
- Tversky and Kahneman (1971) also demonstrated that people tend to believe that chance is self-correcting, hence the "gamblers fallacy", in which people who have had a run of bad luck believe they are due a positive outcome

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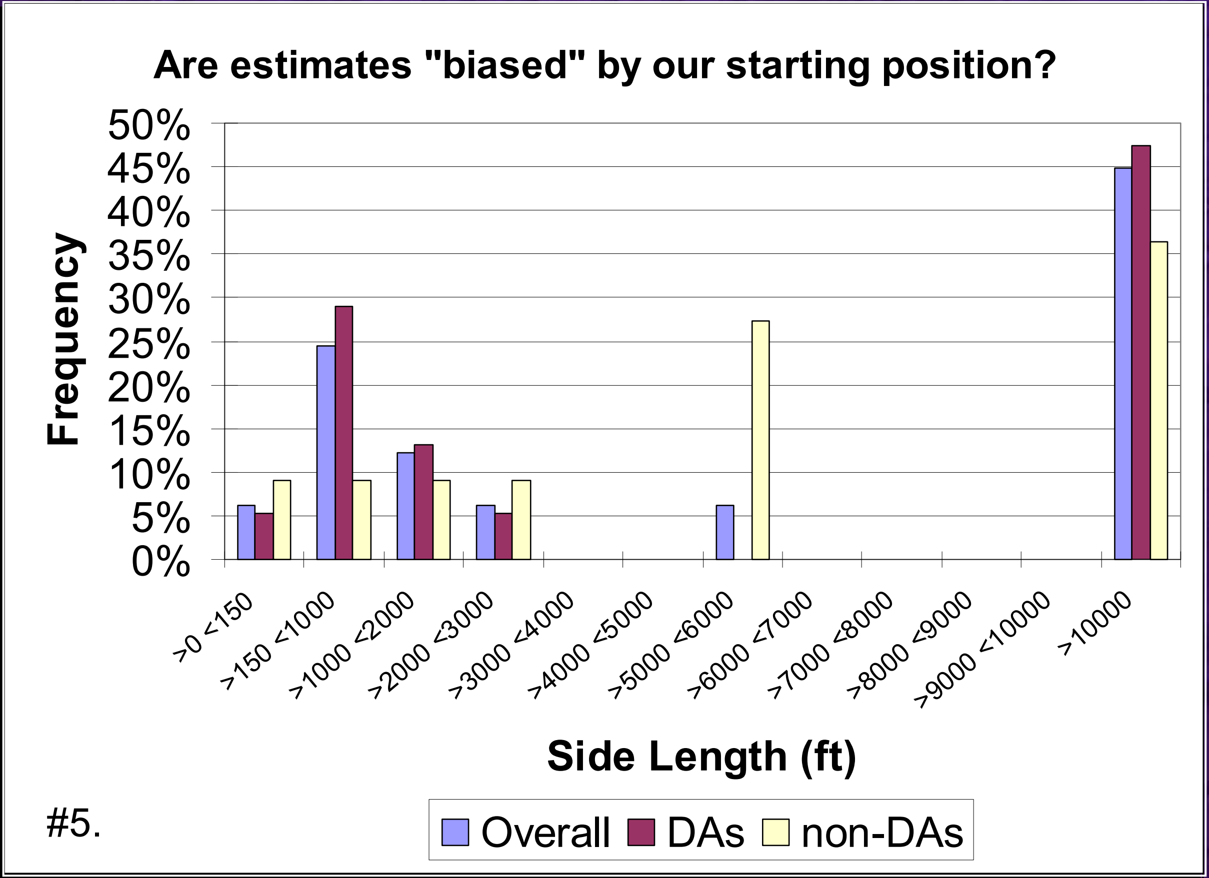
Anchoring

Q6: How big a cube to hold all people's blood?

Anchoring

- The actual answer is ~800 ft and 50% of estimates were >5000 ft
- The starting perception of value can bias an estimate

Survey Q5



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Anchoring and insufficient adjustment

- When we use a starting point for estimation, our final judgment often remains too close to the starting point
- "The More You Ask For, The More You Get"- Chapman and Bornstein (1996) demonstrated that anchoring plays a role in the judgments awarded in civil tort lawsuits
- Northcraft and Neale (1987) asked real estate agents to do an independent appraisal of residential property values, a common aspect of their jobs.
  - Agents toured the homes and were given a 10-page fact sheet in which the only value that the researchers manipulated was the original listing price of the home (+/- 12% of fair market value).
  - The researchers found that this anchor had a major impact on the realtors assessment, shifting appraisals by > $10,000, although the agents did not admit that listing price impacted their assessments

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Covariants

Q6		Brain Tumor	
		Present	Absent
Dizziness	Present	160	40
	Absent	40	10

Determining "Correlation"

- Assessing how to determine correlation and whether data are correlated can be a challenge
- <10% chose No correlation using the correct facts

Survey Q6

Overall		All 4 Data Points		
		Required	Not	Frequency
Correlated	Yes	27%	29%	56%
	No	19%	12%	31%
	Unknown	11%	3%	13%
	Frequency	56%	44%	

- DAAG results consistent with original (Nisbett and Ross)

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Determining "Correlation"

Non-DAs		All 4 Data Points		
		Required	Not	Freguency
Correlated	Yes	28%	44%	72%
	No	6%	9%	16%
	Unknown	9%	3%	13%
	Freguency	44%	56%	

DAs		All 4 Data Points		
		Required	Not	Freguency
Correlated	Yes	26%	19%	44%
	No	28%	14%	42%
	Unknown	12%	2%	14%
	Freguency	65%	35%	

Survey Q6

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Covariation and Correlation

- Nisbett & Ross (1980) tested peoples' ability to assess whether two variables (brain tumor and dizziness) are related

Survey Q6

- People tend to rely on positive occurrences of both events
- Many people report that there is an association between dizziness and brain tumor because they fail to analyze all four pieces of information

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Applying the lessons learned from the classics to real-life DA

How to avoid Pitfalls of bias or poor data?

- How to frame questions so as to avoid bias (“anchoring”)?
  - How to use ‘Benchmark’ values?
- How to collect/assess complex risks?
  - Don’t ask for overall PTRS, break into manageable units
- How to ask questions about correlation and “posterior” probabilities?
  - Bayes- given success, given failure; discuss both
- How confident should a small “study” make a team?
  - Be careful of small phase IIA study results.

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References

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Hastie, R. and Dawes, R. (2001). *Rational Choice in an Uncertain World.* Thousand Oaks: Sage Publications, Inc.

Plous, S. (1993). *The Psychology of Judgement and Decision Making.* New York: McGraw-Hill, Inc.

Russo, J. and Schoemaker, P. (2002). *Winning Decisions.* New York: Random House, Inc.

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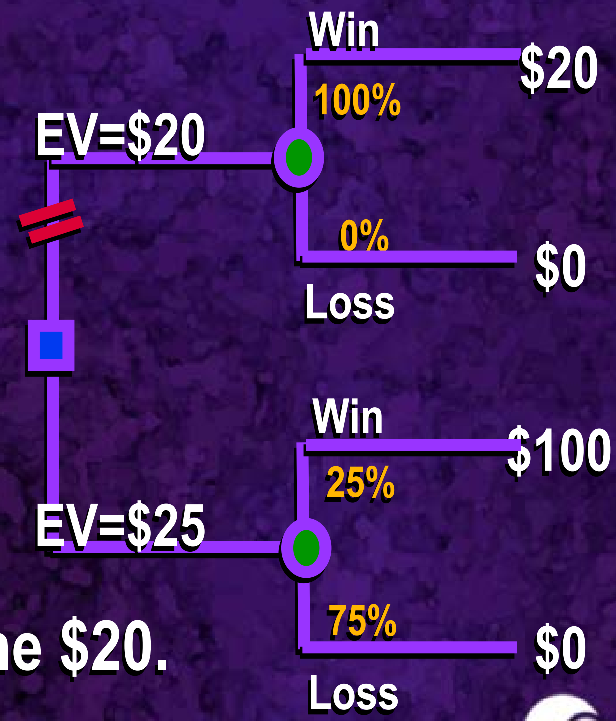
Backup slides

Survey Answers

Question 1

- There is no correct answer, this is a matter of risk preference
- However, for part 5, the riskier option has a greater expected value. Therefore, if you are risk-neutral, 25% chance of $100 would be a higher-value answer than a sure $20



- Some people still prefer a "bird in the hand" and choose the $20.

Question 2

- **Bayes Theorem:**

$$p(\text{cancer} \mid \text{positive}) = \frac{p(\text{positive} \mid \text{cancer})\ p(\text{cancer})}{p(\text{positive} \mid \text{cancer})\ p(\text{cancer}) + p(\text{positive} \mid \text{benign})\ p(\text{cancer})}$$

$$= \frac{(.80)\ p(.01)}{(.80)\ p(.01) + (.10)(.99)}$$

$$= 7.5\%$$

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Question 3

- The correct answer is the first choice, “Linda is a bank teller”
- The laws of probability explain why the 2nd choice is not correct (see slide #14)

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Question 4

- The most common answer is that the mean of the sample is still 100
- This answer illustrates the common assumption that the remaining children will have some low scores that balance out the high score we already know about
- The assumption above is in error. The correct answer is to assume that the remaining 49 children have an average score of 100, and add the known score, and divide by the total
  - (150+100(49))/50 = 5050/50 = 101

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Question 5

- Assume world population of 5 Billion
- Assume 1 gallon of blood per person
- 1 cubic foot holds $\cong$ 7.5 gallons
- Thus, 670 million cubic feet of blood in the world
- The cube-root of 670 million is a mere 870, therefore **the length, width and height of the cube is 870 feet.**

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Question 6

- All four cells of the table are necessary
- The Ratio of dizziness present to Absent is 4:1 regardless of Brain tumor, therefore there is no evidence in this data to suggested that the 2 are correlated

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Question 7

- Need to consider the probability that any 2 randomly selected people will *not* share the same birthday = 365/366= 98.37%

- (365/366)(364/366)(363/366)…

- (365*364*363* … *344)/$(366)^{22}$ = 49%

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