Decision Theory and Business Analytics ISQS 5330 Spring 2021

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Introduction

- Managers and executives make important decisions every day
  - "Making decisions is the most important job of any executive." Hammond, Keeney, and Raiffa, *Smart Choices*.
  - "There's a funny paradox with decision making. Almost everyone realizes how important it is, yet very few people practice. Why don't we drill young students on decision making? How come so few professionals--executives, doctors, lawyers, government officials--are versed in these big ideas?" Michael J. Mauboussin, *Think Twice*.

Perspectives on Decision Making

- Normative (Prescriptive) and Behavioral (Descriptive) Views of Decision Making
- Normative Decision Making
  - Specifies how decisions *should be made* in a rational or economic sense
  - Assumes that people have perfect information, can specify their preferences clearly and consistently, generate all reasonable alternatives, seek optimal solutions, and are not subject to inconsistencies or systematic errors in reasoning or judgment

Perspectives on Decision Making

- Behavioral Decision Making
  - Describes how decisions are actually made
  - Assumes that people almost never have complete information, are inconsistent in their specification of preferences, do not generate all reasonable alternatives, make systematic errors in reasoning and judgment, and seek only satisfactory solutions to problems and decisions

Decision Making

- Data/Experience → Perfect Decisions
- Looks simple, but if it were, life on earth would be much more rational than it is
- Where are the problems/bottlenecks?

Decision Making

- What is decision making?
  - Decision making is a process
    - "The fact is, decision making is not an event. It's a process, one that unfolds over weeks, months, or even years." Garvin and Roberto, p. 1.
    - Typically is faster, but it's still a process with a number of steps

Decision Making

- Making Good Decisions – Three Keys

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Decision Making

- Making Good Decisions – Much of the answer involves recognizing that outcomes are not all within our control or due to our own actions. *What we mainly control is the process.* This is key.
- Success = Talent + Luck

--Daniel Kahneman (Nobel Prize-winning psychologist), in *Thinking, Fast and Slow*

- "Chance favors only the prepared mind"

--Louis Pasteur

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Models of Decision Making

- Models of decision making
  - It's important to use a framework or model of decision making if we want to make smart and consistent decisions
  - Decision making is like any other professional activity—it's best to have a methodology

Process Model of Decision Making

- Process models of decision making generally show the steps that *should* be taken in an ideal situation
- Often the time needed to perform every step will be lacking, and process models thus represent an upper bound (that is, the *best practice*) on how decisions should be made

Process Model of Decision Making

(adapted in part from Bazerman and Moore 2013)

- Identify and define the problem
- Gather information
- Identify the criteria
- Weight the criteria
- Generate alternatives
- Evaluate each alternative on each criterion
- Compute the best choice
- Implement the decision
- Use feedback to improve the process next time

Process Model of Decision Making

- 1. Identify and Define the Problem

- Be sure you understand the problem and can state it clearly.

- How can we identify problems?

  - a. Line employees, customers, or suppliers may notice problems with products or processes. This is sometimes termed finding "pain points."

  - b. Strategic planning may allow problems or opportunities to be identified, e.g., through benchmarking or best practices discussion.

  - Note: This stage of decision making is nearly always how projects are started. A problem or opportunity is identified.

Process Model of Decision Making

- 2. Gather Information

- What information do we need to make the decision?

- a. In many ways, we are awash in information. How so?
- We collect terabytes of information about our customers, and our business intelligence software finds patterns and trends in the data that we did not know were there. Further, information about our business performance and about our competitors, our industry, and the economy in general is abundant.

- b. However, in other ways, we have a paucity of information. How so?
- The information we have is often not organized or filtered into a useful form. This can cause us to miss many opportunities and problems. E.g., many experts believe the 9/11/01 attacks could have been prevented had our information been better organized.

- In 1597, Francis Bacon said "Knowledge is power." That is still the key. However, in many cases, we have information but it is not organized into useful knowledge.

Process Model of Decision Making

- c. As managers and executives, how do we find useful information and filter it to make decisions? Where do we find it, and what problems are associated with it?

- i. Some information is easily located, such as that in databases and that readily available using search engines (although reliability is always an issue).
- ii. However, much information is gathered from human sources via interviews, informal conversations, rumors, etc. Human sources can lead to:
  - Cognitive problems – e.g., forgetting, biased reporting of information
  - Motivational problems – e.g., decision rights, data hoarding, fear of offending, biases
  - Reliability problems – e.g., much of the information provided is simply inaccurate or untrue
- iii. Time must be given and taken to organize and reflect upon information and to follow the remaining steps in the decision-making process.

Process Model of Decision Making

- 3. Identify the Criteria

- Identify the relevant attributes or criteria that are important in making the decision. That is, what attributes are important to you in making the decision? What factors or metrics might you use?

- You might consider "critical success factors" (CSFs) or various organizational metrics such as profit or return on investment.

Process Model of Decision Making

- 4. Weight the criteria
- How important is each criterion to our decision? How do we assess this?
- Assign weights to the relevant criteria that reflect their relative importance to you in making the decision.
- The weights you assign ideally tie into organizational goals and strategies or personal preferences. The weights should reflect the relative importance of each CSF or metric.
- The weights can add to one, or can be on a scale of 10 or 100.

Process Model of Decision Making

- 5. Generate alternatives

- Identify the possible courses of action or choices available. How do we do this?

  - Use past experience, creativity, analogies or metaphors, etc. Note that it is usually smart to generate more alternatives than occur to one initially.
  - Ask experts, suppliers, or customers, or look at competitors

- 6. Rate each alternative on each criterion

- Assign ratings to the alternatives for each criterion that reflect each alternative's relative amount on that criterion.

- Use objective numbers if they are available, e.g., dollar amounts. Otherwise, use ratings rather than rankings. These ratings require judgments reflecting personal preferences or values.

Process Model of Decision Making

- 7. Compute the best choice
- Select the alternative with the highest weighted average or expected value.
- 8. Implement the decision
- Take actions in the organization based on the choice made.
- 9. Use feedback to improve the process
- Collect and analyze data to improve the decision-making process the next time. Use both process and outcome feedback if available.
- Most difficult steps – generally 1, 2, 8, and 9

Levels of Decision Making

- Levels of decision making
  - Individual, group, and organizational
    - We will look at individual and group decision making in this course.
    - "Organizational" decision making is really individual, group, or a combination of the two.
  - Operational, tactical, and strategic

Levels of Decision Making

- Operational Level Decisions
  - E.g., What is the best way to arrange our products on shelves to maximize revenue per square foot?
- Tactical (Managerial) Level Decisions
  - E.g., Which vendors should we use for data management in our company?
- Strategic Level Decisions
  - E.g., What information architecture should we pursue to enable new business opportunities?
- All levels are addressed by concepts in this course

Business Analytics and Data Science

- Why is a decision making course a critical component of a curriculum in Data Science?

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Normative Decision Making

- Specifies how decisions should be made in a rational or economic sense
- Scope of Normative Decision Making
  - Decision making under certainty and uncertainty, decision tables, decision trees, game theory, signal detection theory, linear models (e.g., regression), calibration, economic value of information, linear programming, simulation, algorithmic decision making, the prisoner's dilemma, Bayesian revision, et al.

Normative Decision Making

- Used extensively in economic and statistical models underlying both manufacturing and service industries

Normative Decision Making

- Scope here – A few desktop decision tools
  - Decision making under certainty and under uncertainty
  - Decision tables and decision trees
  - Bayes' Theorem
  - Algorithms and linear models
- Goal is to provide a basic understanding of how normative decision making works so you can apply it yourself and also understand when other people are using it

Decision Making Under Certainty

- A decision is to be made among alternatives, and the outcomes from choosing each alternative are known in advance
- Examples:

- Task is to choose the alternative that best reflects our preferences for outcomes

Decision Making Under Certainty

- Identify and define the problem 
- Gather information 
- Identify the criteria
- Weight the criteria
- Generate alternatives
- Evaluate each alternative on each criterion
- Compute the best choice
- Implement the decision 
- Use feedback to improve process next time 

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Decision Making Under Certainty

- Problem: Where should we locate our new regional office?
- Criteria
  - Natural Beauty and Environmental Quality
  - Strength of Local Economy
  - Quality of Local Transportation System
  - Quality of Public Services
  - Availability of Affordable Housing
  - Parks and Recreation
- Weights
  - .20, .10, .15, .20, .25, and .10, respectively
- Alternatives
  - A, B, C, and D
- Evaluate each alternative on each criterion
- How should we set up this problem?

Decision Making Under Certainty

- Problem: Where should we locate our new regional office?
- We can use a ***decision table*** to set up the problem and calculate the best choice
- Ratings are on a scale of 1-10, with 10 being best

Criteria	Natural Beauty and Environmental Quality	Strength of Local Economy	Quality of Local Transportation System	Quality of Public Services	Availability of Affordable Housing	Parks and Recreation	W.A.
Weights	.20	.10	.15	.20	.25	.10	
Alt. A	8	7	7	9	5	9	
Alt. B	7	7	7	9	6	10	
Alt. C	3	8	6	5	9	6	
Alt. D	4	9	8	7	3	7	

Decision Making Under Uncertainty

- Making decisions about the future when the outcomes of events are probabilistic
- Concept of "expected value"

- Changes in process model for decision making under uncertainty

Decision Making Under Uncertainty

- Identify and define the problem
- Gather information
- Identify the most important event and "states of nature"
  - States of nature are uncontrollable states of the environment that partition the event, and are mutually exclusive and collectively exhaustive
- Assess probabilities of occurrence for the states of nature
- Generate alternatives
- Specify outcomes for each alternative under each state of nature
- Compute the best choice
- Implement the decision
- Use feedback to improve process next time

Decision Making Under Uncertainty

- Problem: What types of stocks should I invest in this year?
- Critical event: Growth of the U.S. economy this year
- States of Nature
  - Strong Growth, Moderate Growth, No Growth, Recession
- Probabilities
  - .20, .40, .30, .10, respectively
- Alternatives
  - Large-cap growth stocks, large-cap value stocks, mid and small-cap stocks
- Outcomes

Decision Making Under Uncertainty

- Problem: What types of stocks should I invest in this year?
- Critical event: Growth of the U.S. economy this year
- Outcomes are predicted returns on investment

States of Nature	Strong Growth	Moderate Growth	No Growth	Recession	Expected Value
P(X)	.20	.40	.30	.10	
Large-Cap Growth Stocks	30%	10%	-5%	-25%	
Large-Cap Value Stocks	20%	8%	0%	-10%	
Mid and Small-Cap Stocks	40%	15%	-10%	-35%	

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Decision Making and Utilities

- Do people make decisions based only on monetary value?

- Utilities

Decision Making and Risk

- What is risk?

- Attitudes toward risk

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Decision Making and Risk

- Example

Decision Making and Risk

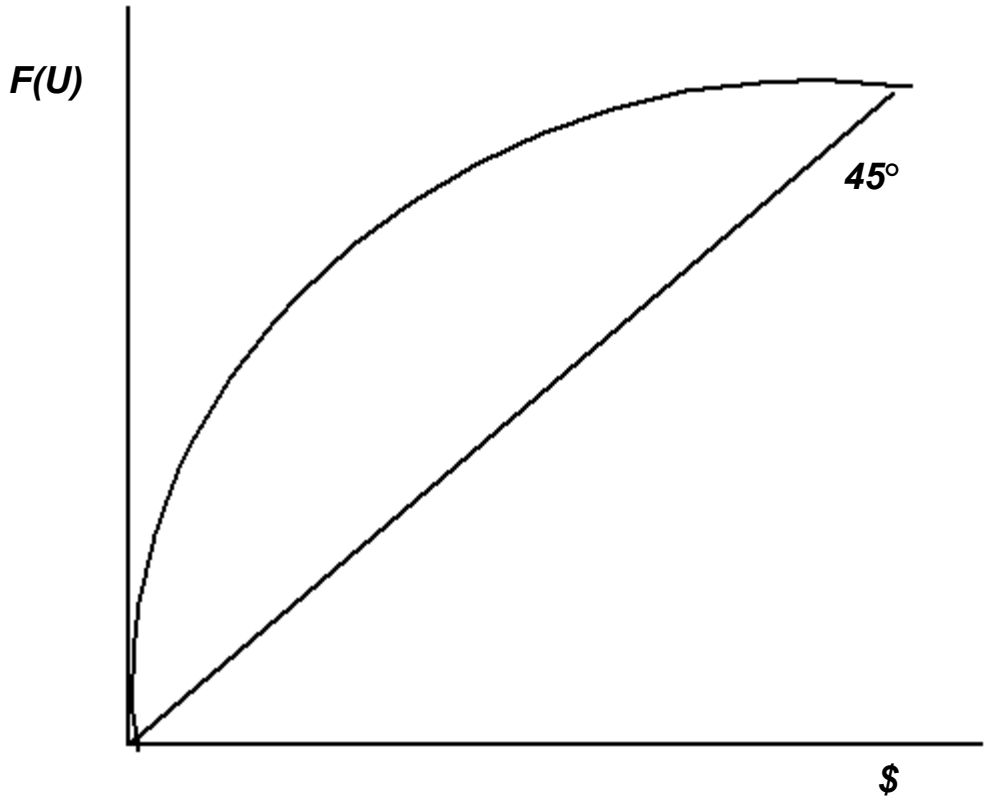
- Example

Decision Making and Risk

- Each of these choices says something about how you view risk. We can use "utility curves" to illustrate attitudes toward risk.
- For example,

Decision Making and Risk

Risk Averse Utility Curve

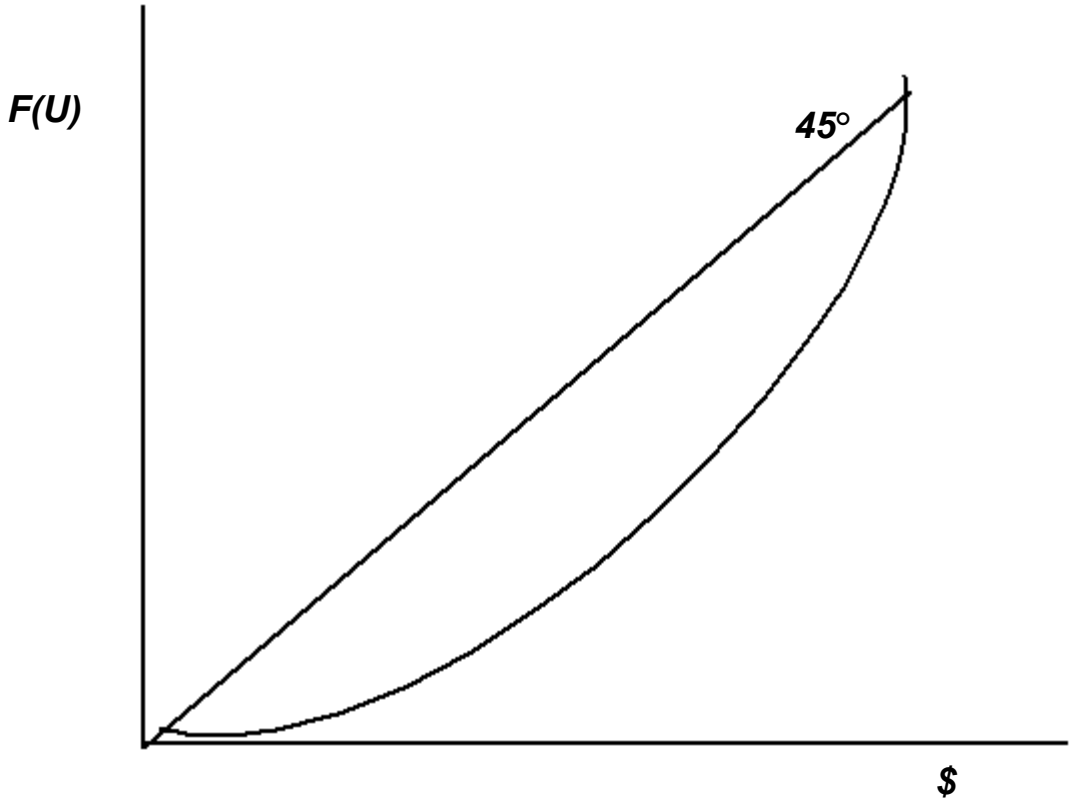


Decision Making and Risk

- For example,

Decision Making and Risk

Risk Seeking Utility Curve

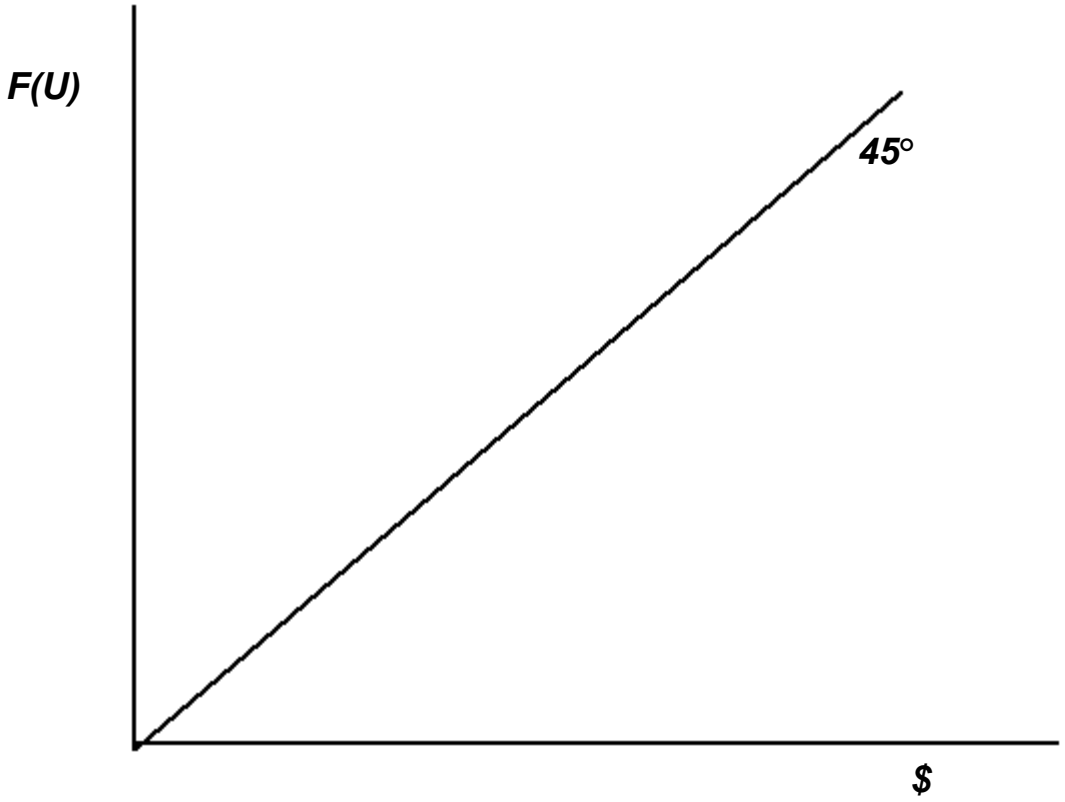


Decision Making and Risk

- For example,

Decision Making and Risk

Risk Neutral Utility Curve



Decision Making and Risk

- Conclusion

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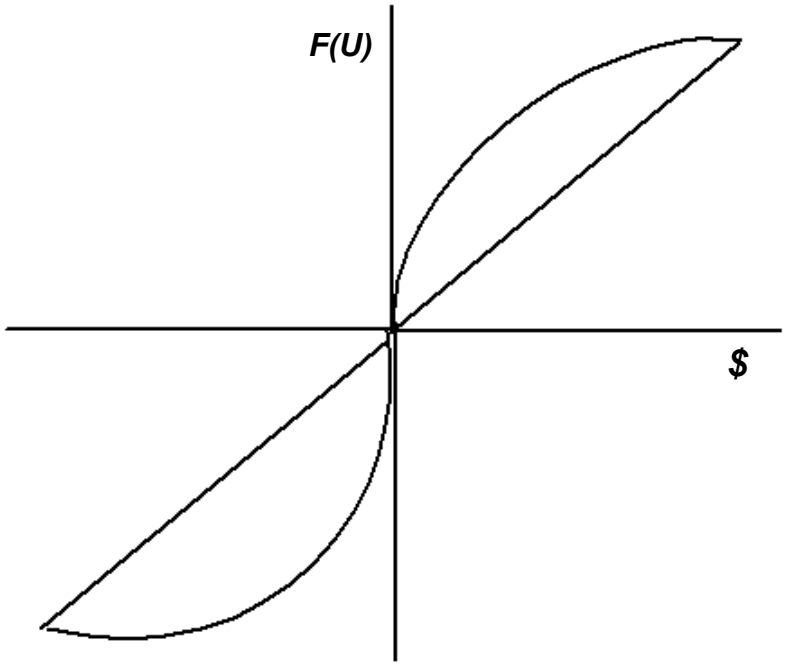
Decision Making and Risk

- Most people



Decision Making and Risk

- How does this impact our utilities for outcomes?
- How does this impact our assessments of risk?
- How does this impact our decision making?

Prospect Theory

- Prospect Theory is a descriptive theory of decision making under uncertainty developed by Daniel Kahneman and Amos Tversky in the late 1970s and early 1980s. It explains people's actual behavior and reveals fatal flaws in classical economic theory (as a descriptive theory). Kahneman won the Nobel Prize for this theory.
- The function shown several slides previously is referred to as the "S-shaped curve of Prospect Theory"

Prospect Theory

- Example

Prospect Theory

- Prospect Theory, it turns out, may be a fundamental behavioral principle of much of life on earth

- https://itunes.apple.com/us/podcast/ted-radio-hour/id523121474?mt=2&i=327972947

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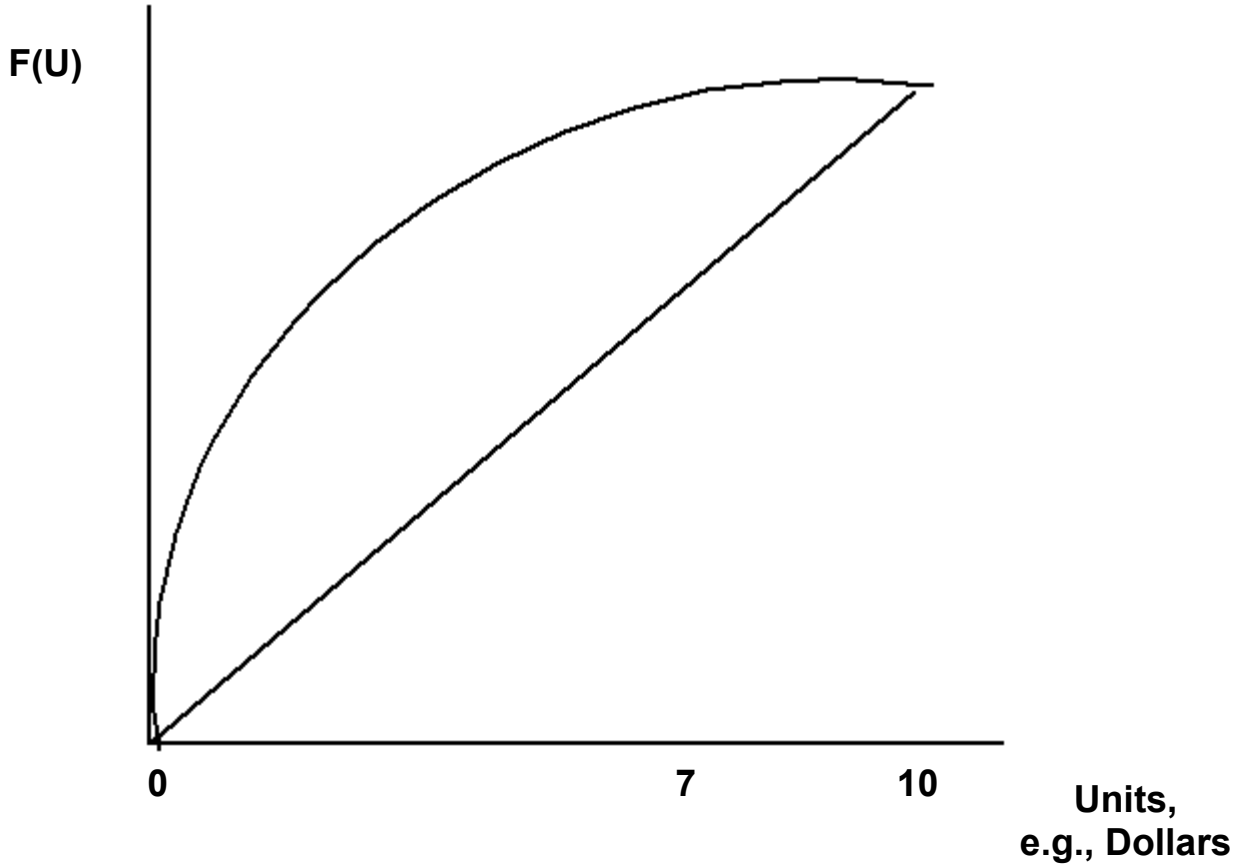
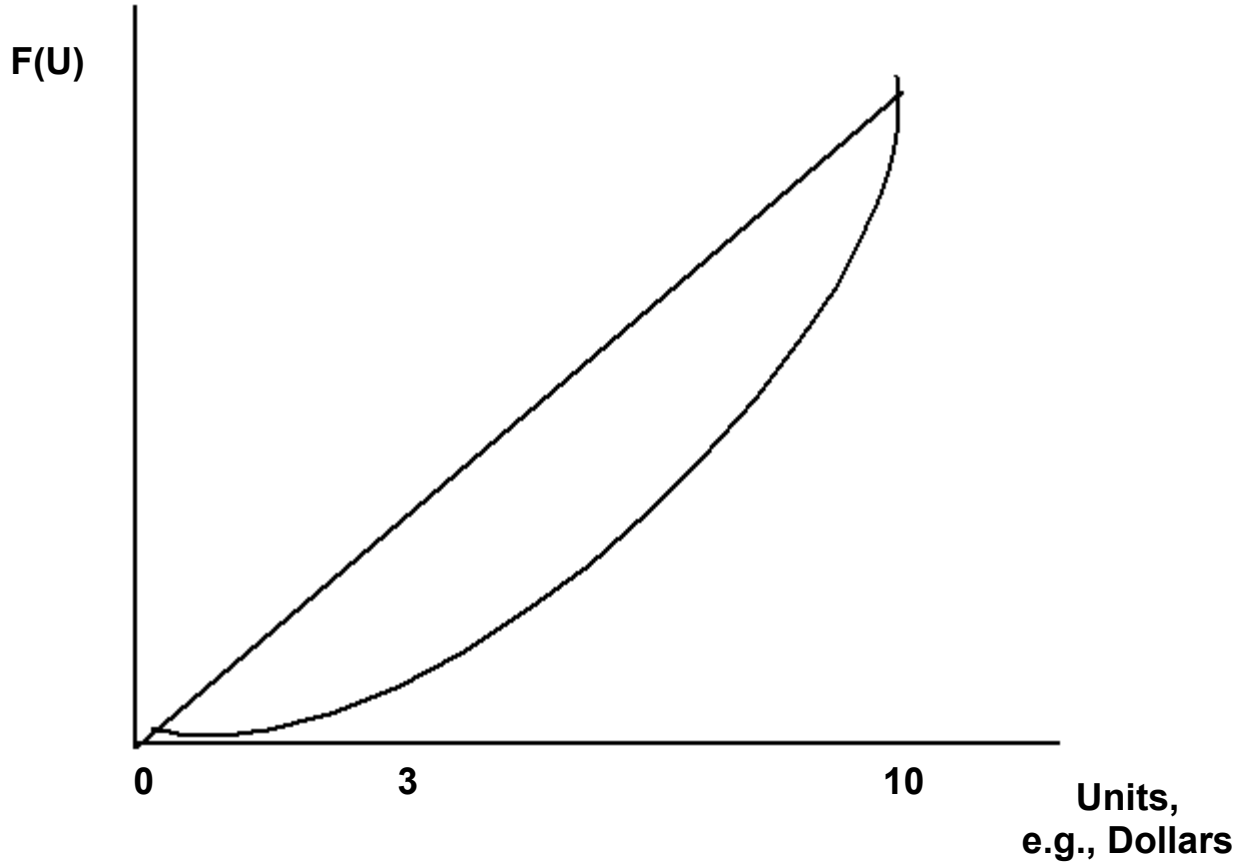
Certainty Equivalents and Risk Premiums

- There are several ways to define a certainty equivalent and a risk premium. We will use the following definitions.
- Certainty Equivalent – the sure payoff a person needs to receive to be indifferent between that payoff and a lottery with the same expected value
- Risk Premium – the amount of expected value a person will sacrifice to avoid playing a lottery, i.e., to take a sure payoff

Certainty Equivalents and Risk Premiums



Certainty Equivalents and Risk Premiums



Exercises

- Practice Exercises

Decision Making Under Uncertainty (cont.)

- Problem
  - What do we do if we have multi-stage decisions involving uncertainty?
- Decision Trees
  - Constructing decision trees - A simple example
  - Should we play tennis tomorrow?

Decision Trees

- Example - Should we play tennis tomorrow?
  - Most important event - Will it rain?
  - States of Nature - Rain, No Rain
  - Probabilities - Rain = , No Rain =
  - Alternatives - Play, Don't Play
  - Outcomes (Note: Utility is on a scale of 0 to 1)
    - Play and Rain =
    - Play and No Rain =
    - Don't Play and Rain =
    - Don't Play and No Rain =
  - Note that this is a single-stage decision and is used only to illustrate the structure of the tree

Decision Tree Example

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Decision Trees

- Note that because it was a single-stage decision, the previous problem could have been set up as a decision table

Decision Trees

- Practice Exercise
  - See handout

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Simpson's Paradox

- Simpson's Paradox
  - "When Combined Data . . ." article

Simpson's Paradox

- Simpson's Paradox Example
- Derek Jeter 1995 1996
  - At-Bats 48 582
  - Hits 12 183
  - Average .250 .314

- David Justice 1995 1996
  - At-Bats 411 140
  - Hits 104 45
  - Average .253 .321

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Simpson's Paradox

▪ Derek Jeter	1995	1996
• At-Bats	48	582
• Hits	12	183
• Average	.250	.314
• Weights		

Simpson's Paradox

- David Justice 1995 1996
  - At-Bats 411 140
  - Hits 104 45
  - Average .253 .321
  - Weights

- Summary – Derek Jeter =

  David Justice =

Simpson's Paradox

- Which level of analysis *should* we use?

- If you are interested in an academic treatment of Simpson's Paradox, you can see
  - Curley, Shawn P. and Glenn J. Browne. "Normative and Descriptive Analyses of Simpson's Paradox in Decision Making." *Organizational Behavior and Human Decision Processes*, 84, 2001, pp. 308-333.

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Bayes' Theorem

- Bayes' Theorem is a normative method for updating one's prior belief (or prior probability) concerning an outcome given new information
- Bayes' Theorem: $P(A/B) = \dfrac{P(A)\,P(B/A)}{P(A)\,P(B/A) + P(\text{Not } A)\,P(B/\text{Not } A)}$
- Where P(A) is known as the prior probability and P(B/A) is the conditional probability of "B" given "A". P(B/A) is also often known as "sample data." P(B) is often measured as a positive result of a test.

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Bayes' Theorem

- Example: (from B&M p. 38)
- "Lisa is 33 and is pregnant for the first time. She is worried about birth defects such as Down syndrome. Her doctor tells her that she need not worry too much because there is only a 1 in 1,000 chance that a woman her age will have a baby with Down syndrome. Nevertheless, Lisa remains anxious about this possibility and decides to obtain a test, known as the Triple Screen, that can detect Down syndrome. The test is moderately accurate: When a baby has Down syndrome the test delivers a positive result 86% of the time. There is, however, a small 'false positive' rate: 5% of babies produce a positive result despite not having Down syndrome. Lisa takes the Triple Screen and obtains a positive result for Down syndrome. Given this result, what are the chances that her baby has Down syndrome?"

Bayes' Theorem

- $$\frac{P(A)\,P(B/A)}{P(A)\,P(B/A) + P(\text{Not } A)\,P(B/\text{Not } A)}$$

Bayes' Theorem

- Practice Examples

Bayes' Theorem

- Example #1

Bayes' Theorem

- Example #2

Algorithms and Linear Models

- Linear Models and Linear Combinations
  - $y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \varepsilon$
  - $y = b_1x_1 + b_2x_2 + b_3x_3$
- Example (a linear combination)
  - Who will be successful in graduate school?

Algorithms and Linear Models

- Advantages of Linear Models

- Disadvantages of Linear Models

Algorithms and Linear Models

- Used extensively in both manufacturing and service industries

- Please look at the readings for algorithms

Normative Decision Making

- Bottom line on normative decision making
  - As noted, we want to use it whenever we can
  - However, the assumptions underlying normative rules mean that they are rarely usable in their pure form in everyday managerial problems
  - Exceptions include algorithms and Bayes' Rule, which can be used occasionally to good advantage
  - Nonetheless, we can use the tools as guides to help us structure decisions—e.g., decision trees and decision tables—even if the assumptions are violated

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Decision Making

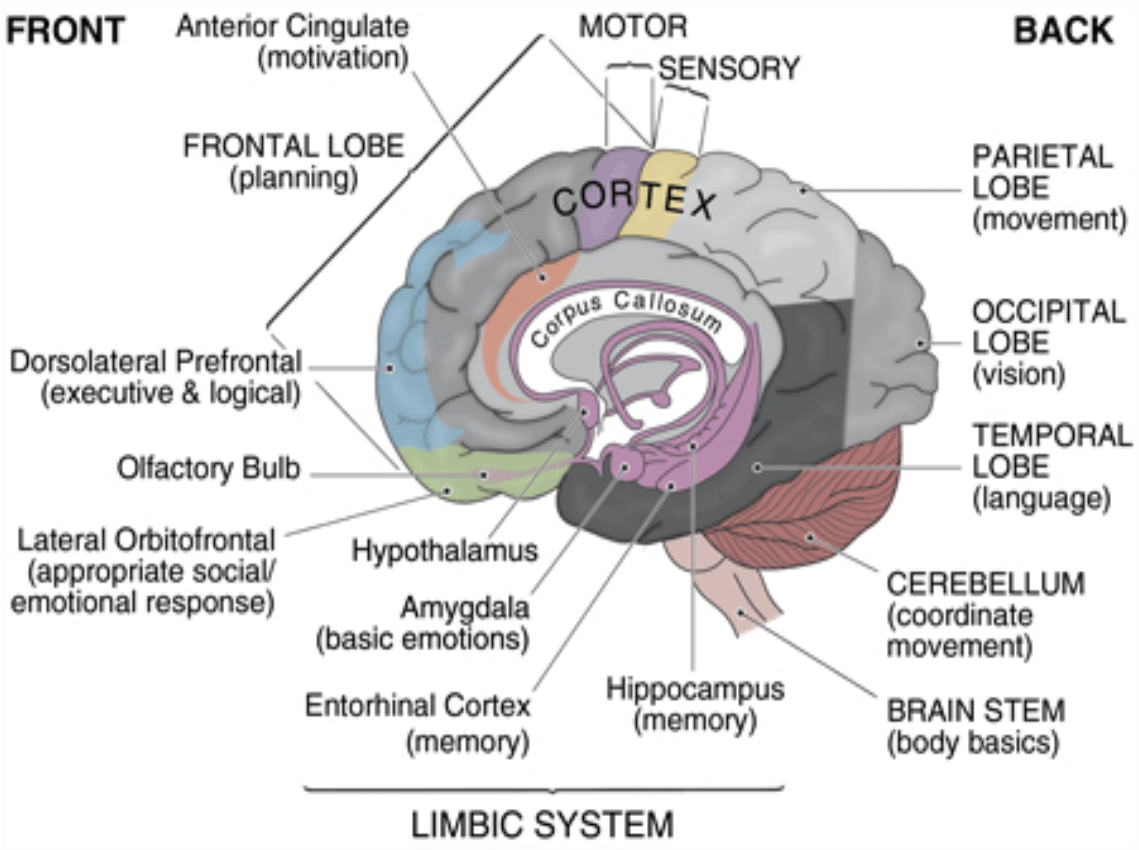
- How do people make decisions?
  - We will look at human information processing as a starting point

Information Processing

- Human information processing – the architecture of cognition
- Motivational influences on decisions
- This background underlies the material we will discuss for the remainder of the course

Information Processing

- Information Processing and the Brain
  - Image is from brainwaves.com, ©2010 Allen D. Bragdon Publishers



Information Processing

- Neural Level - Knowledge of how the brain processes information at this level increases daily
- For the foreseeable future, however, we will not have adequate explanatory models for describing information processing in layman's terms at the neural level

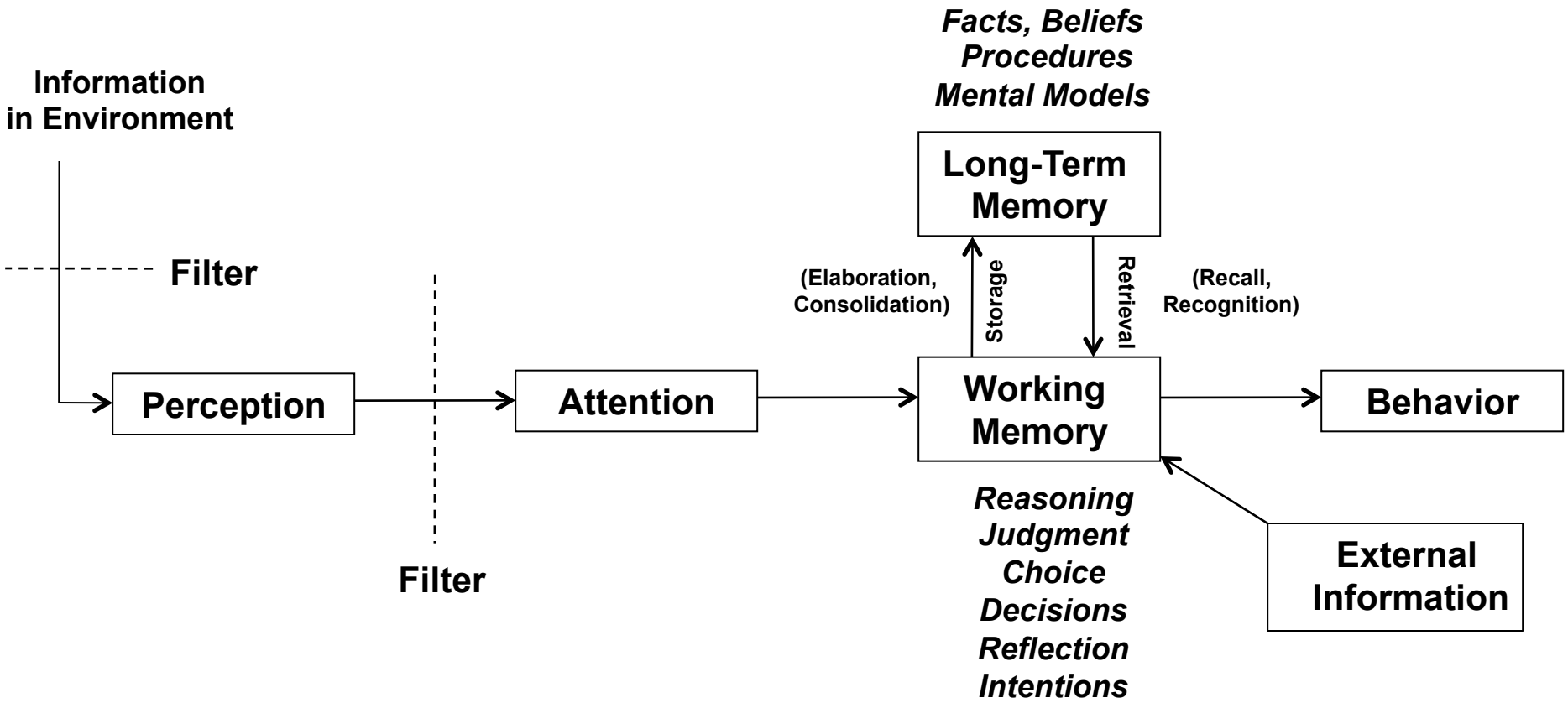
Information Processing

- "[The] uncertainty flows from a profound ignorance about how brains actually work. Neuroscientists understand how nerve cells work. They also know which bits of the brain deal with vision, locomotion, language, memory and suchlike. But between these two anatomical levels all is darkness." *The Economist*, May 18, 2013, p. 14.

Information Processing

- A Simple Conceptual Model of Human Information Processing

Information Processing



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Information Processing

- Limitations on Cognition
  - Perception

Information Processing

- Limitations (cont.)
  - Attention

Information Processing

- Limitations (cont.)
  - Working Memory

Information Processing

- Limitations (cont.)
  - Long-Term Memory

Information Processing

- Limitations (cont.)
  - Long-Term Memory (cont.)

- Conclusion

Information Processing

- The abundance

- Now and in the future,

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Motivation and Affect

- Motivation and Affect

- We will discuss the impact of motivation and affect on decision making much more later in the course

Summary

- Why This Matters
  - We have very sophisticated information technology, professional processes and methods, mathematical models, and other means to support decision making
  - IT, for example, can take us a long way. It can perform calculations far better and faster than we can and organize information for us in ways that we can use directly for decision making.

Cognitive Management of Information

- Given our limitations on information processing, how do we manage information to make decisions?

Cognitive Management of Information

- Two Systems of Thought – We all have them
- System 1 Thinking

- Examples of System 1 Thinking (from Kahneman 2011)
  - Detect that one object is more distant than another
  - Orient to the source of a sudden sound
  - Complete the phrase “bread and . . .”
  - Detect hostility (or friendliness) in a voice
  - Drive a car on an empty road
  - Answer to 2 + 2 = ?

Cognitive Management of Information

- System 2 Thinking

- Examples of System 2 Thinking (from Kahneman 2011)
  - Search memory for the identity of a surprising sound
  - Count the occurrences of the letter “a” on a page of text
  - Park your car in a narrow space
  - Compare two washing machines for overall value
  - Complete your tax return
  - Answer to 17 x 24 = ?

Cognitive Management of Information

- System 1 Thinking
  - Can it be turned off?

- System 1
- "System 1 does not keep track of alternatives that it rejects, or even of the fact that there were alternatives."
- "System 1 runs ahead of the facts in constructing a rich image on the basis of scraps of evidence."
- "System 1 is not prone to doubt. It suppresses ambiguity and spontaneously constructs stories that are as coherent as possible." --D. Kahneman (2011), p. 80, p. 114.

Cognitive Management of Information

- System 2 is doubting and suspicious

- Only System 2

- System 2

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Cognitive Management of Information

- Generally speaking, System 1 and System 2 operate efficiently and effectively together
- What happens when System 2 is busy?

Heuristics

- Heuristics –

- Examples

Heuristics

- Common Heuristics We All Employ
  - Availability
  - Representativeness
  - Anchoring
  - Affect
  - Confirmation
- You will read about these heuristics in the Bazerman and Moore book

Heuristics

- Most processes we perform and judgments and decisions we make every day utilize heuristics. Most heuristics are idiosyncratic.
- Idiosyncratic examples

Heuristics

- Bottom line:

Behavioral Decision Making

- Limitations on human information processing, e.g., working memory limitations, limitations on perception and attention, and retrieval limitations from long-term memory, lead people to be sub-optimal (that is, non-normative) decision makers
- Behavioral decision making attempts to describe how people *actually make* decisions. These decisions are nearly always sub-optimal in complex decision-making contexts.

Behavioral Decision Making

- Examples
  - Cognition Exercise
  - Please do this exercise on your own with no external assistance

Behavioral Decision Making

- Cognitive Biases
  - Defined: Biases in reasoning or judgment caused by the ways in which people process information

Behavioral Decision Making

- Cognitive Biases (cont.)

Behavioral Decision Making

- Cognitive Biases (cont.)

Disjunctive Events Bias

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Behavioral Decision Making

- Cognitive Biases (cont.)

Conjunctive Events Bias

Behavioral Decision Making

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Behavioral Decision Making

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Behavioral Decision Making

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Behavioral Decision Making

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Behavioral Decision Making

- Example (cont.)

Behavioral Decision Making

- Other Examples

Behavioral Decision Making

- Example

Behavioral Decision Making

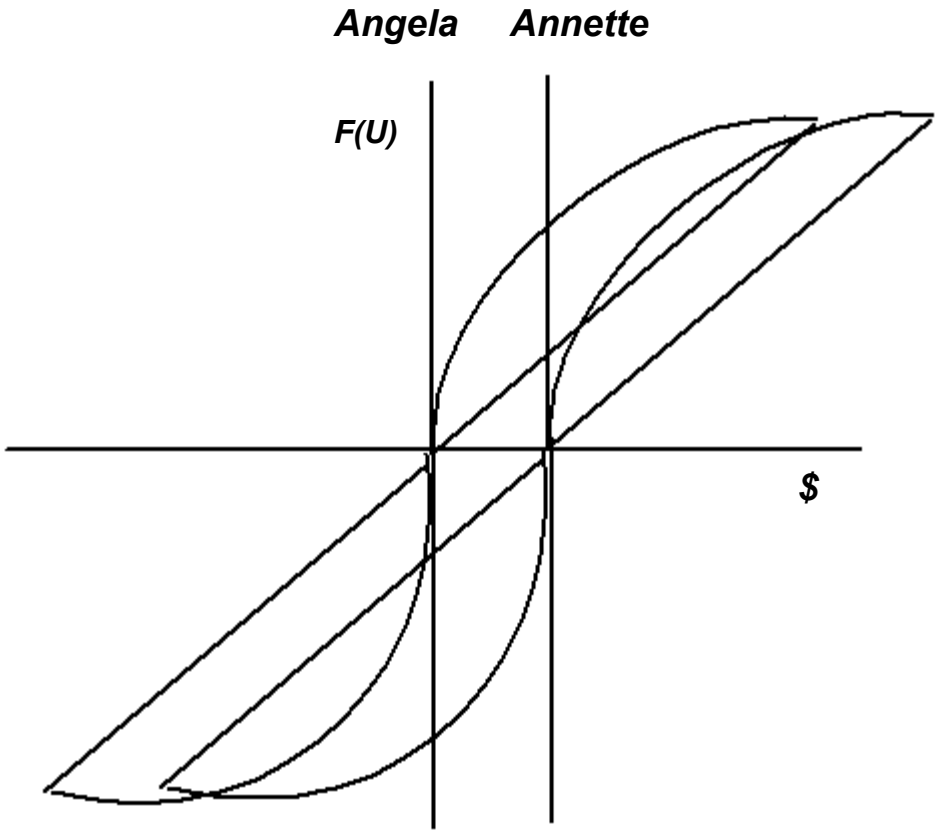
- Example

Behavioral Decision Making

- Example: Recently, Annette, a vice-president for a large corporation, was given the following choice:
  - A. Win $1,000 for sure, or
  - B. Participate in a coin flip: If it's heads, she wins $2000. If it's tails, she wins nothing.

- Later, Angela, a poor college student, was given the same choice as Annette

Behavioral Decision Making



Behavioral Decision Making

- Example:

Behavioral Decision Making

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Behavioral Decision Making

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Behavioral Decision Making

- Confirmation Bias

  - This is our second most pervasive bias

Judgmental Accuracy

- Example
  - Please do the exercise before we continue. Please do the exercise without any reference to outside sources, i.e., using only your own knowledge.
  - General Knowledge Exercise

Judgmental Accuracy

- I will now provide the answers to the questions. For each question, please mark whether you answered it correctly or incorrectly.
- Now please use the second handout to calculate your proportions correct and plot them on the graph according to the instructions
  - Calibration Graph

*****

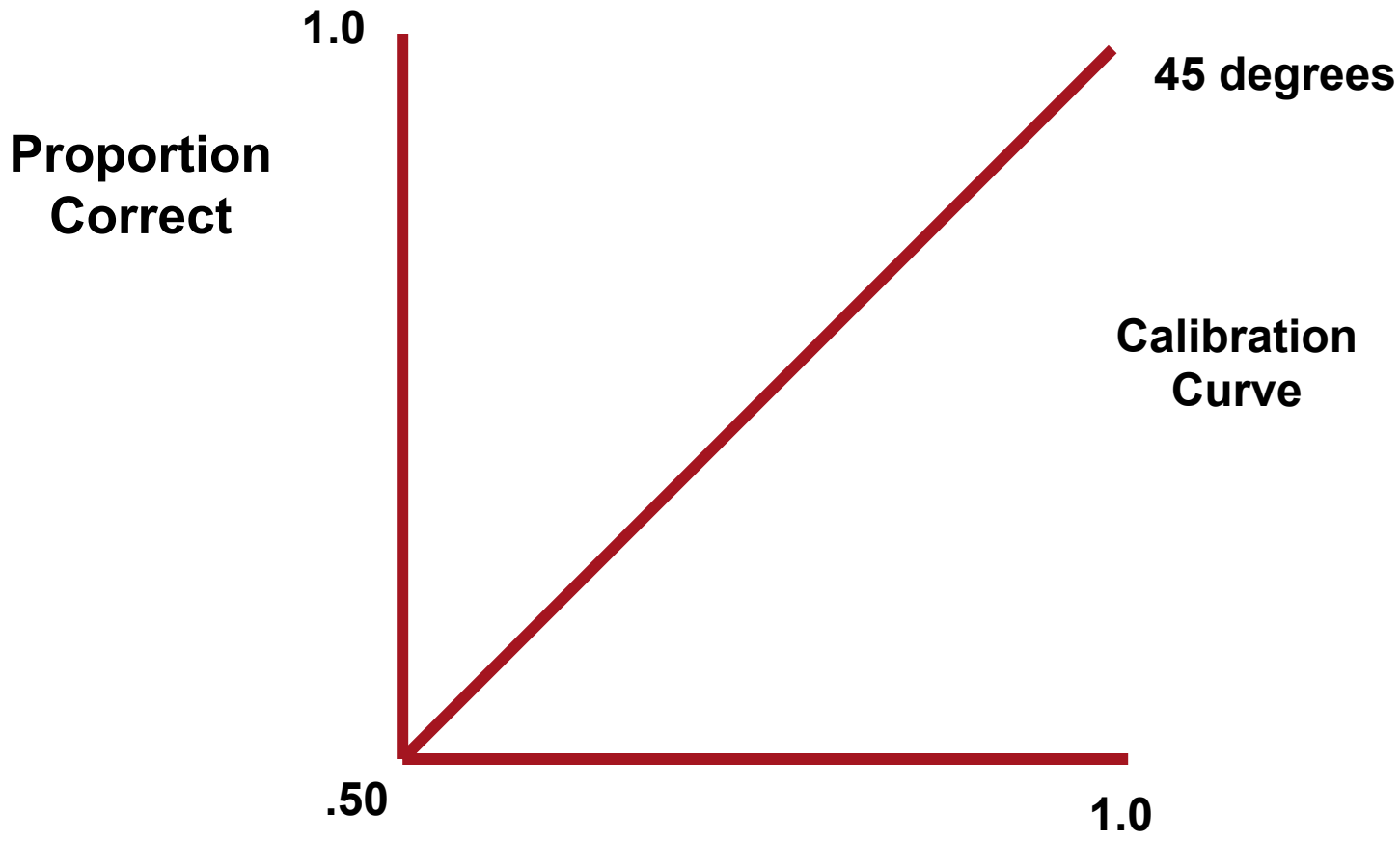
Judgmental Accuracy

- Overall Accuracy – Three components
  - Domain Knowledge
  - Discrimination

Judgmental Accuracy

- Calibration

Typical Calibration Curve



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Overconfidence Summary

- "Overconfidence is the mother of all biases." B&M.
- "Subjective confidence in a judgment is not a reasoned evaluation of the probability that this judgment is correct. Confidence is a feeling, which reflects the coherence of the information and the cognitive ease of processing it. . . . Declarations of high confidence mainly tell you that an individual has constructed a coherent story in his mind, not necessarily that the story is true." Kahneman 2011, p. 212.

*****

Behavioral Decision Making

- Examples
  - Motivation Exercise

Behavioral Decision Making

- Affective and Motivational Biases
  - Defined - Biases in decision making caused by real or perceived incentives in the external environment or by internal desires, preferences, or fears

Behavioral Decision Making

- Affective and Motivational Biases (cont.)

Behavioral Decision Making

- Affective and Motivational Biases (cont.)

Behavioral Decision Making

- Affective and Motivational Biases (cont.)

Behavioral Decision Making

- Affective and Motivational Biases (cont.)

Behavioral Decision Making

- Sunk Costs
  - Money, time, resources, and/or effort that are spent and not recoverable. Since these costs are "sunk," they should not be considered further in the decision-making process.
  - "When you find yourself in a hole, the best thing you can do is stop digging."

    –Warren Buffett,

    quoted in Hammond, Keeney, and Raiffa

Behavioral Decision Making

- Non-Rational Escalation of Commitment

Behavioral Decision Making

- Causes of Escalation

Business Analytics

- Behavioral Issues in Business Analytics
  - Cognitive biases
  - Change management

- See Guszcza and Lucker (2014) for a good discussion of much of this material

Business Analytics

- "'Switching from simple intuitions to careful assessments of evidence' is not a bad working definition of business analytics. With its fundamental postulate of the perfectly rational homo economicus, classical economics has long abetted the belief that real-life markets are efficient. The recent discoveries of scientists like Simon, Kahneman, Tversky, and Thaler teach us 'it ain't necessarily so.' The implication is that those organizations early to adopt predictive analytics can profit from market inefficiencies resulting from traditional decision-making practices that are infused with cognitive biases." Guszcza and Lucker, p. 41.

Business Analytics

- What cognitive biases may be present in the use of business analytics techniques?

Business Analytics

- Cognitive Biases (cont.)

Business Analytics

- Business analytics can also help in overcoming cognitive biases

Business Analytics

- Change Management
  - The use of business analytics to improve decision making requires change on the part of executives, managers, and line employees. Change is never easy and is resisted by almost everyone in organizations.
  - Two quotes illustrate the problems

Business Analytics

- "Resistance to change is part of human nature. Therefore, especially for organizations steeped in traditions of intuition-based decision making, . . . it takes time and effort . . . to switch from a culture of intuition-based to evidence-based decision making." Guszcza and Lucker, p. 42.

Business Analytics

- "Two other principles of behavioral economics are relevant . . . *Status quo bias* (the tendency to stick with the current situation even when better ones are available) and *optimism bias* (the tendency to be overly optimistic about one's own abilities and the outcomes of one's actions). Such cognitive biases . . . are major reasons why organizations' traditional, intuitive decision-making cultures often resist analytics initiatives." Guszcza and Lucker, pp. 42-43.

Business Analytics

- Big Data and the Search for Correlation
  - Traditionally, decision makers and scientists have searched for causation. Determining causation allows us to explain and to predict, the two primary pillars of decision making.

Business Analytics

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Fairness

- Fairness in Decision Making
  - Perceptions of Fairness
    - – Example –

Fairness

- Fairness in Decision Making
  - Example

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Fairness

- Fairness considerations

- "Employers who violate rules of fairness are punished by reduced productivity, and merchants who follow unfair pricing policies can expect to lose sales." Kahneman 2011, p. 308.

Fairness

- Resisting Unfair Ultimatums
  - Example –

Choice

- "Choice" defined
  - Making a selection among alternatives
- How do people make choices?

Choice

- Examples of Heuristic (Rule-Based) Choice Rules

States of Nature	Strong Growth	Moderate Growth	No Growth	Recession	Expected Value
P(X)	.20	.40	.30	.10	
Large-Cap Growth Stocks	30%	10%	-5%	-25%	6.0%
Large-Cap Value Stocks	20%	8%	0%	-10%	6.2%
Mid and Small-Cap Stocks	40%	15%	-10%	-35%	7.5%

Choice

- Examples of Heuristic (Rule-Based) Choice Rules

Criteria	Natural Beauty and Environmental Quality	Strength of Local Economy	Quality of Local Transportation System	Quality of Public Services	Availability of Affordable Housing	Parks and Recreation
Alt. A	8	7	7	9	5	9
Alt. B	7	7	7	9	6	10
Alt. C	3	8	6	5	9	6
Alt. D	4	9	8	7	3	7

Choice

- Problems in Choice

Naturalistic Decision Making

- Understanding human cognitive performance under several conditions:

- Examples

Naturalistic Decision Making

- What do these decision situations have in common?

- How do people make decisions in these types of situations?

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Naturalistic Decision Making

- Numerous models have been proposed. Perhaps the best known is the "Recognition-Primed Decision" model, developed by Gary Klein.
- "In the RPD model . . . the performance of experts involves both an automatic process [System 1] that brings promising solutions to mind and a deliberate activity [System 2] in which the execution of the candidate solution is mentally simulated in a process of progressive deepening." Kahneman and Klein, 2009, p. 519.
- RPD model on next page from Klein and Klinger, 1991

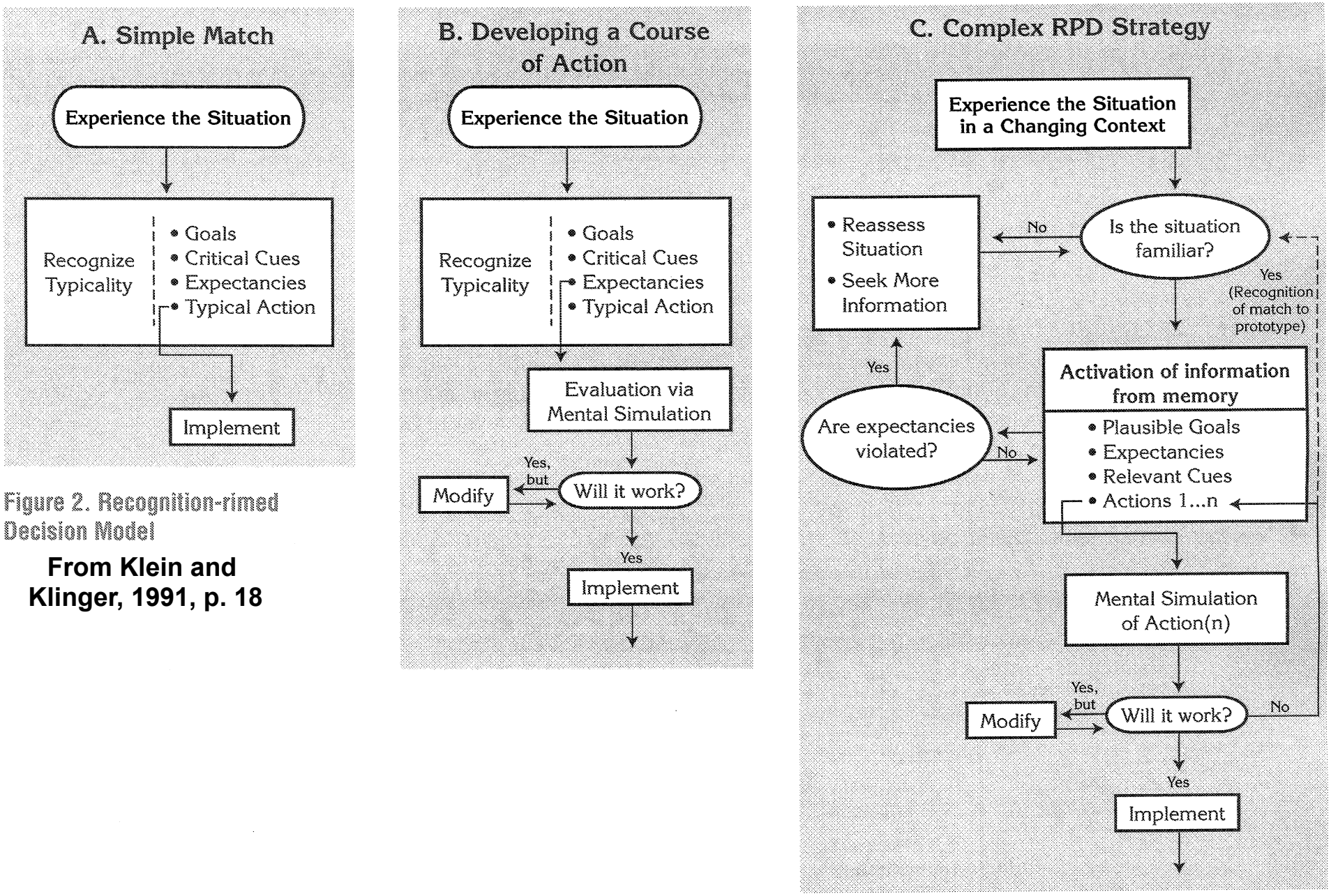

Figure 2. Recognition-rimed Decision Model

From Klein and Klinger, 1991, p. 18

Naturalistic Decision Making

- Naturalistic decision making occurs in many more contexts than those that have been studied

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"Intuition" vs. Deliberative Analysis

- What is "intuition"?

- System 1 vs. System 2 Thinking
- Should decision makers rely on their intuition, or "gut feel," when making important decisions?

"Intuition" vs. Deliberative Analysis

- What are the principal dangers of relying on intuition?

"Intuition" vs. Deliberative Analysis

- Are there circumstances in which using "intuition" is reasonable?

- These are examples of "naturalistic decision making." These people have to train and rehearse, and they require good and frequent feedback, because they typically rely on System 1 thinking.

"Intuition" vs. Deliberative Analysis

- When can "intuition" (that is, experience) be trusted?
  - "If the environment is sufficiently regular and the judge has had a chance to learn its regularities, the [judge] will recognize situations and generate quick and accurate predictions and decisions. You can trust someone's intuition if these conditions are met." Kahneman 2011, p. 243.

Negotiation

- Defined – A type of collective decision making typically involving both competition and cooperation. Negotiation usually implies competition for scarce resources.
- Decision Analytic Approach to Negotiation
  - Involves assessing three sets of information:

Negotiation

- Two Primary Tasks of Negotiation

Negotiation

- Consider the following example (after Bazerman and Moore, 2013):
- A student about to receive an MBA from the Rawls College of Business is being recruited for a specialized position at a consulting firm. The company and the prospective employee have begun to negotiate the starting salary. The company has offered $72,000 per year and the employee has counteroffered at $82,000. Both sides believe they have made fair offers. However, both sides would very much like to see an agreement reached. The prospective employee, while not verbalizing this information, would be willing to take any offer over $75,000 rather than lose the position. The company, while not verbalizing this information, would be willing to pay up to $79,000 rather than lose the recruit.

Negotiation

- Example – Negotiation and Distribution

Is there any room to bargain?

Negotiation

- Strategies for Integration

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Negotiation

- Integration Graphically Described

Negotiation

- Negotiator Cognition
  - We won't discuss these today, but please familiarize yourself with them (from the book)
  - The mythical fixed pie
  - Biases
    - Framing Effects
    - Overconfidence
    - Self-serving attributions
    - Anchoring

*****

Group Decision Making

- Benefits of group decision making

Group Decision Making

- Issues in Group Decision Making
  - Brainstorming – Is it good or bad?
  - Aggregation of Views – When should it occur?
    - "It's much better to . . . consider the evidence as we pick it up, each of us from his own point of view. Pooling our views simply means losing the advantage of three different view-points."

      --J.J. Connington, *Mystery at Lynden Sands*

    Connington's point:

Group Decision Making

- Collective rationalization and group polarization

- Social loafing

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Group Decision Making

- Overconfidence

- Non-Rational Escalation of Commitment

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Group Decision Making

- Groupthink

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Group Decision Making

- Abilene Paradox (Illusions of agreement)
  - "Abilene Paradox" article

Group Decision Making

- Group Decision Rules
  - If you are a team leader or project manager, how would you like to make decisions? On what should it depend?

Group Decision Making

- What types of group decision rules can be used?

Crowdsourcing

- Seeking the "wisdom of crowds" to help in making decisions
  - What is meant by the "wisdom of crowds"?
  - What are potential advantages of decision making by collectives?

Crowdsourcing

- What factors need to be present?
  1. People must have different experiences
  2. Decision making must be decentralized, with no one at the top of a hierarchy making decisions
  3. There must be an unbiased way of aggregating individual decision makers' judgments (e.g., a fair market or a pre-specified decision rule)
  4. People must choose independently
  5. The decision cannot rely on *consensus*. The "average" opinion, rating, vote, bet, etc. must be used, but not one that everyone can agree with. That is, you have to accept the conflict and find the "average" choice.

Crowdsourcing

- What are potential *disadvantages* of decision making by collectives?

Crowdsourcing

- Examples of crowdsourcing

Crowdsourcing

- Most executives are more interested in finding an expert than they are in relying on the wisdom of crowds
- This helps explain the multi-billion dollar consulting industry

*****

Improving Decision Making

- We have discussed the strengths and weaknesses of human decision making in this course
- We do many things well and we do many things poorly. We focus now on strategies we can use to improve our decision making.

Best Practices

- Best practices for identifying biases
- Best practices for avoiding biases
- Agile decision making in a fast-paced and uncertain world

Bias Analysis

- Am I relying on a heuristic process? If so,
  - Am I relying too much on recall?
  - Have I considered base rates, sample size, chance outcomes, and long-run averages of events? (Distributional assumptions)
  - Am I anchored on an answer or a position? If so, am I adjusting adequately from that anchor? Is the anchor appropriate?
  - Have I considered the way the problem is framed? What is my reference point?
  - Have I looked for disconfirming evidence?
  - Am I over-emphasizing the value of the status quo?
  - Am I overconfident?

Bias Analysis (cont.)

- Do I have motivations that are preventing me from performing a rational analysis?
  - Am I appropriately calibrated? Am I attempting to deflect blame from myself? Am I taking too much or too little credit?
  - Am I trying to control events that are random or beyond my control?
  - Am I letting anticipated regret control my behavior inappropriately?
  - Am I considering sunk costs? Am I escalating commitment to an action irrationally?
  - Do I care too much about what others think?

Predicting Biases

- If you observe any of the elements discussed in the bias analysis in yourself or others, biases are likely to be present. In addition . . .
- Whenever (many) people are rushing to take actions without articulating reasons, there are usually problems. (In such cases, ask yourself which has a higher potential cost, false positives or false negatives?)
- Whenever you feel that you are being "herded" into actions, without being allowed to think about your decisions independently, there is probably at least a short-term disequilibrium, and you will probably end up losing
- E.g.,

Everyday Decision Making

- How can we make decisions in fast environments with lean information? What can we realistically do in everyday settings?

Improving Decision Making

- Use a structured decision-making process whenever practical
- Use algorithms (e.g., linear models) whenever appropriate
- Build in structural aids to promote constructive conflict, such as devil's advocates, rotations on and off decision-making committees, and portfolios of skills, backgrounds, training, and personalities

Improving Decision Making

- Use technology when available and appropriate, but be aware that decision-making activities require human reasoning, judgment, and preferences
- Be aware of cognitive and motivational biases. Perform a bias analysis before making important decisions.
- Seek different perspectives and others' opinions on problems

Improving Decision Making

- Understand when costs are sunk, and don't consider them in future planning
- Generate between three and seven alternatives for decisions (note that this is generally more than you think you need, but far fewer than are available)
- Be aware of how a decision is being framed. What other frames are possible?

Improving Decision Making

- If your intuition "speaks" during important decisions, ignore it or return to the data
- Use feedback to calibrate yourself

The End

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