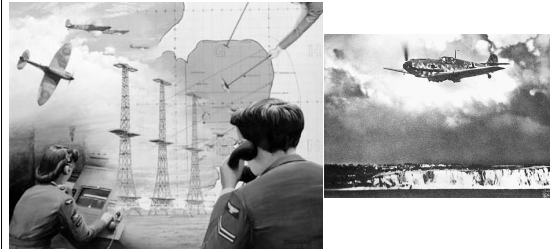


Introduction to Decision Analysis for Public Policy Decision-Making



Ross D. Shachter
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British Decision to Develop Radar During WWII



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British Decision to Develop Radar During WWII

- ☞ Choice between Infrared and Radar to detect German bombers
- ☞ Churchill protégé advocated infrared, which would have been ineffective
- ☞ Consequence: infrared would not have prevented a German invasion
- ☞ Right decision by chance



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The Serenity Prayer



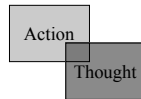
- ☞ God grant me
 - the **serenity to accept** the things I cannot change, **Uncertainties**
 - the **courage to change** the things I can, and **Decisions**
 - the **wisdom to know** the difference. **Decision Analysis**

Reinhold Niebuhr (1892-1971)
 Inspired by Friedrich Oetinger and Boethius.

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Actional Thought

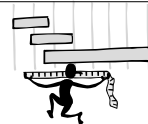


- ☞ Some of our actions merit thought and reflection.
- ☞ Not all of our thoughts are focused on interventions we can make in our world.
- ☞ Decision analysis lets us think clearly about a complex problem so that we can choose those actions that yield our preferred prospect.
- ☞ The quality of a decision is determined by the process we use, not by the eventual outcome.
- ☞ A good decision can lead to a bad outcome.

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Bayesian Perspective



- ☞ We measure our beliefs about those uncertain possibilities we care about using probabilities.
- ☞ Those probabilities are based on our current state of information, &, from life experience, expert opinions, and observation.
 (There are no “objective” probabilities.)
- ☞ The possibilities are distinctions we impose on the world. We define them with enough clarity that the uncertainty arises from our lack of knowledge, rather than from ambiguity.

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Decision Analysis for Public Policy

Individual Decision Maker

- Identify single “rational” decision maker for public decision, such as President, Governor, etc.
- Many stakeholders are affected by public policy decisions and process should engage them

Normative Approach

- How we would want choices made rather than how choices might otherwise be made in a political process
- Adds transparency and defensibility to a public process

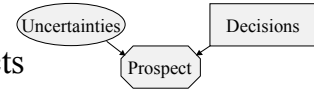


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Decisions and Prospects



- A decision is an irrevocable allocation of resources, completely under the decision maker’s control.
 - Doing nothing can be a decision.
- The decision to act or intervene in the world can have multiple possible effects.
- A prospect is the future the decision maker faces with a particular set of choices. It can be a deal, made up of multiple possible prospects.
- The decision maker should choose those actions and interventions that yield his/her preferred prospect.

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Decision Basis

To build a model, we address the following questions:

- Who makes the final commitment?
 - Decision Maker
- What do you want?
 - Preferences
- What do you know?
 - Information
- What can you do?
 - Alternatives
- What is your real problem/opportunity?
 - Frame
- Do we have a process?
 - Logical Reasoning
 - Decision Analysis!**
- And afterwards?
 - Commitment to Action



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\$20 Auction



- We will conduct an auction
 - The highest bidder will receive a \$20 bill
 - The top **TWO** bidders have to pay
 - I reserve the right to back out of the deal

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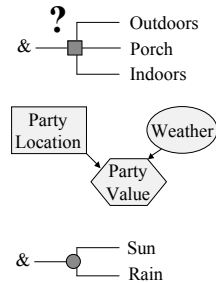
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Jane’s Party Problem

Jane wants to decide where to have her party but she is not prepared to compare the prospects of each location.

She recognizes that the party value depends on the weather.

She considers the uncertain possibilities for the weather to be *Sun* or *Rain*.



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The Normative Rules of Actional Thought

Lead to a logically consistent normative analysis for a rational decision maker:

1. Given your observations and choices, you can recognize each possibility that you care about and you can assign a probability to it.
2. You can think about the prospect of each of those possibilities, and you can identify a best prospect *b* and a worst prospect *w*. (These do not have to be unique.)

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Rules of Actional Thought (Continued)

- 3. For any prospect x , there is a number $u(x)$, $0 \leq u(x) \leq 1$, such that: $x \sim \left\langle \frac{u(x)}{1-u(x)} \frac{b}{w} \right\rangle$
- 4. You prefer prospect x to prospect y if and only if $u(x) > u(y)$.
- 5. If you are indifferent between prospects x and y then you are indifferent between two deals if one can be formed from the other by substituting x for y .

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Normative Analysis of Jane's Party Problem

$\& \left\langle \frac{0.4}{0.6} \frac{\text{Sun}}{\text{Rain}} \right\rangle$ for any party location

Party Values	Outdoors	Porch	Indoors
Sun	\$100 _b	\$90	\$40
Rain	\$0 _w	\$20	\$50

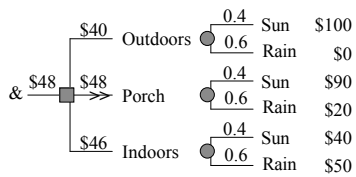
For Jane, $u(x) = x/\$100$ for any prospect value x .

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Normative Analysis of Jane's Party Problem (Continued)



To determine the prospect value of Jane's decision opportunity, we must determine

- her prospect value for each party location
- her preferred choice for party location

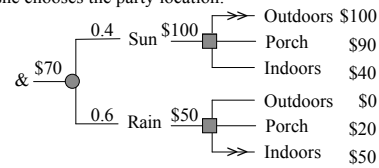
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Value of Clairvoyance

Suppose Jane knows the weather (clairvoyance) before she chooses the party location:



The prospect value of Jane's decision opportunity with clairvoyance is \$70. (It cannot decrease!)

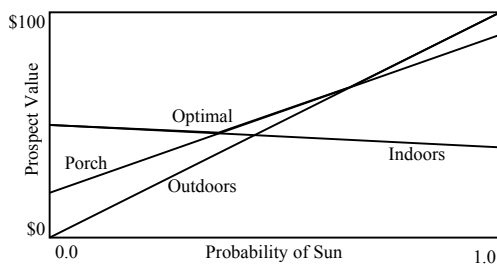
- Thus, she is willing to pay up to \$22 = 70 - 48 for clairvoyance.
- This is the most she would pay for any information.

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Sensitivity Analysis



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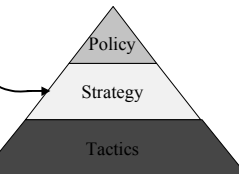
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Decision Hierarchy

Frame determines the level at which this decision is made

- Assuming levels above
- Setting assumptions for the levels below

It is impractical to relate each decision to the fundamental values



Or to relate it to the detailed prospects

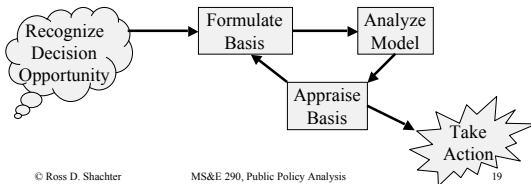
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Decision Analysis Cycle

- Continue to improve the modeled basis -- uncertainties, alternatives, preferences -- until there is clarity of thought about action.



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US/Soviet Decisions during Cuban Missile Crisis

- Both sides had “facts” that were not correct and did not understand each other
- Consequence: closest we ever came to a nuclear war
- Right decisions and good process, but wrong information



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Important Extensions

Value Models within the DA Framework

- Multiple objectives
- Risk aversion
- Time value of money
 - capital expenditures
 - deferred benefits
- Multiple decision makers

Information Models

- Representing relationships in graphical models
- Probability assessment
- Using experimental evidence

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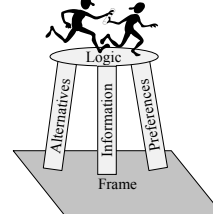
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Decision Quality



Commitment to Action



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- Determined by the decision process, not by the eventual outcome.
- Appropriate Frame:** solving the correct problem;
- Creative Alternatives:** taking full advantage of the decision opportunity;
- Information:** accurate modeling of possibilities, relationships, probabilities, and observations;
- Values:** capturing the important features of the decision maker's preferences;
- Logical Reasoning:** applying clear thinking to the entire decision situation; and
- Commitment to Action:** implementation of the decision-maker's insights.

In Closing



- A good decision can lead to a bad outcome.
- The quality of information available at the time of the actual decision is critical.
- You are always better off if you have
 - More alternatives or
 - More information

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