Decision Analysis

- **Objective**
  - To introduce a particular, effective technique for evaluating alternatives in uncertain situations

- **3 conclusions brought out by Decision Analysis:**
  1. **Strategies for altering choices** as unknowns become known, rather than optimal choices against a set of specifications
  2. **Second best choices** which offer
     - insurance against downside
     - opportunity to exploit upside
  3. **Education of client** especially about range and distribution of possible results (Value at Risk)

Motivation

- **People, when acting on intuition, deal poorly with complex, uncertain situations**
  - They process probabilistic information poorly
  - They simplify complexity in ways which alter reality
    - Focus on extremes
    - Focus on end states rather than process
    - Example: Mexico City Airports

- **Need for structured, efficient means to deal with situation**

- **Decision Analysis is the way**
General Features

- Simple way of defining the wide range of choices
- Over several Periods
- Includes Uncertainties
- Standard Method
- Can Include Levels of Consumer Satisfaction

Identifying Issues

- What’s the Important Uncertainty for Situation?
- What Factors Define this Uncertainty?
- What Management Decisions Relate to it?
- How do we represent the
  - Range of possible decisions,
  - Uncertainties, and
  - Outcomes?
Decision Tree

- Representing the Analysis -- Decision Tree
  - Shows Wide Range of Choices
  - Several Periods
  - Permits Identification of Plans that
    - Exploit Opportunities
    - Avoid Losses

- Components of Decision Tree
  - Structure
    - Choices; Possible Outcomes
  - Data
    - Uncertainties; Value of Each Possible Outcome

Constructing Decision Tree (1)

- Structure
  - The Decision Tree as an organized, disciplined means to present alternatives and possible states of nature

- Two graphical elements
  1. Decision Points
  2. Chance Points (after each decision)
Constructing Decision Tree (2)

- Two data elements
  1. Probability
  2. Value of each outcome

When does it become a “messy bush”?

Decision Analysis -- 1 stage

- Calculation
  - Maximize Expected Value of Outcomes
- For each set of alternatives
  - Calculate Expect Value
  - Choose alternative with maximum EV

\[
\begin{align*}
\text{EV (raincoat)} & = 2.0 - 1.2 = 0.8 \\
\text{EV (no raincoat)} & = - 4.0 + 2.4 = -1.6
\end{align*}
\]
In Excel Layout

<table>
<thead>
<tr>
<th>First Decision</th>
<th>Expected Value</th>
<th>Chance Event</th>
<th>Probability</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raincoat</td>
<td>0.80</td>
<td>Rain</td>
<td>0.40</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Rain</td>
<td>0.60</td>
<td>-2.00</td>
</tr>
<tr>
<td>No Raincoat</td>
<td>-1.60</td>
<td>Rain</td>
<td>0.40</td>
<td>-10.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Rain</td>
<td>0.60</td>
<td>4.00</td>
</tr>
</tbody>
</table>

EV (raincoat) = 2.0 - 1.2 = 0.8
EV (no raincoat) = -4.0 + 2.4 = -1.6

To show Sequence of Alternatives

- We repeat basic block (changing entries)

Notice: Data seen in early stages
=> changes later probabilities, results
Analysis of Two or More Stages

- Subject of Next Presentation
- Two main ideas
  - Look Forward: Early observations change prior estimates of events => changes in decisions you might have made without information
  - Look Back: Analysis from last stages going toward front => “folding back”

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Results of Decision Analysis

- NOT a Simple Plan
  - Do A in Period 1; Do B in Period 2; etc.

- A DYNAMIC PLAN
  - Do A in Period 1,
  - BUT in Period 2:
    - If Growth, do B
    - If Stagnation, do C
    - If Loss, do D
Decision Analysis Consequences

- Education of client, discipline of decision tree encourages perception of possibilities
  - A strategy as a preferred solution
  - NOT a single sequence or a Master Plan

- In general, Second Best strategies not optimal for any one outcome, but preferable because they offer flexibility to do well in a range of outcomes

In short: It is best to buy insurance!

It’s can be best to buy insurance

- You can choose
  - Drive a car
  - Don’t drive

- You may have an accident - or not
  - If accident
    - Drive: Worst
    - Don’t Drive: Best
  - If no accident
    - Drive: Best
    - Don’t Drive: Worst

- Optimal Solution: Drive with insurance
  Never best - but never worst