

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

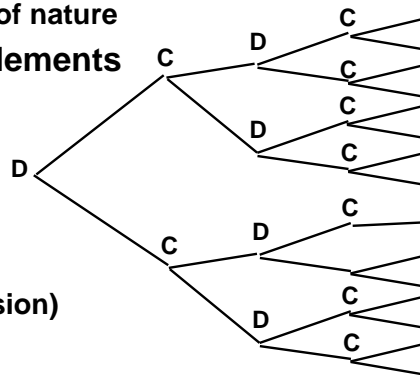
Constructing Decision Tree (1)

- **Structure**

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

- **Two graphical elements**

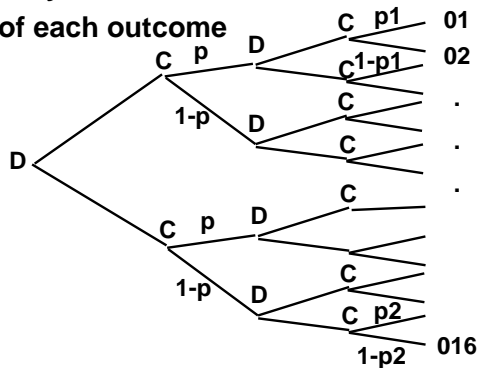
- 1. **Decision Points**



- 2. **Chance Points
(after each decision)**

Constructing Decision Tree (2)

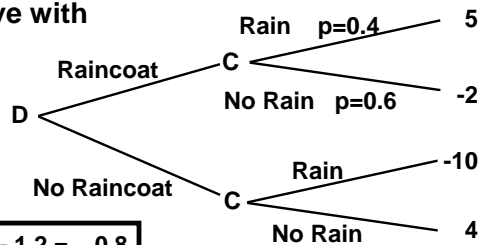
- Two data elements
 1. Probability
 2. Value of each outcome



- 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



$$EV(\text{raincoat}) = 2.0 - 1.2 = 0.8$$

$$EV(\text{no raincoat}) = -4.0 + 2.4 = -1.6$$

... In Excel Layout

	First Decision	Expected Value	Chance Event	Probability	Outcome
Start	Raincoat	0.80	Rain	0.40	5.00
			No Rain	0.60	-2.00
	No Raincoat	-1.60	Rain	0.40	-10.00
			No Rain	0.60	4.00

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)

	First Decision	Expected Value	Chance Event	Probability	Outcome	Second Decision	Expected Value	Chance Event	Probability	Outcome
Start	Weather Channel	??	Rain Forecast	p	??	Raincoat	??	Rain	??	5.00
						No Raincoat	??	No Rain	??	-2.00
	No Rain Forecast	1-p	??	Raincoat	??	Rain	??	5.00		
				No Raincoat	??	No Rain	??	-2.00		
No News	0.80				Start etc					

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”

Results of Decision Analysis

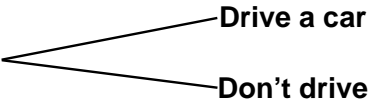
- **NOT a Simple Plan**
 - Do A in Period 1; Do B in Period 2; etc.
- **A DYNAMIC PLAN**
 - Do A in Period 1,
 - BUT in Period 2:
 - ◆ If Growth, do B
 - ◆ If Stagnation, do C
 - ◆ If Loss, do D

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