Dynamic Strategic Planning

Primitive Models
Risk Recognition
Decision Trees
Dynamic Strategic Plans

Primitive Decision Models

- Still widely used
- Illustrate problems with intuitive approach
- Provide base for appreciating advantages of decision analysis

Primitive Decision Models

BASIS: Payoff Matrix

Alternative	State of "nature" S1 S2 . . . Sm
A1	Value of outcomes
A2	
An	Onm

Primitive Model: Laplace

- Decision Rule:

  a) Assume each state of nature equally probable => $p_m = 1/m$

  b) Use these probabilities to calculate an "expected" value for each alternative

  c) Maximize "expected" value

Primitive Model: Laplace (cont'd)

- Example

	S1	S2
A1	100	40
A2	70	80

"expected" value
70
75

Primitive Model: Laplace (cont'd)

- Problem: Sensitivity to framing
  ==> "irrelevant alternatives

	S1a	S1b	S2
A1	100	100	40
A2	70	70	80

"expected" value
80
73.3

Primitive Model: Maximin or Maximax

- Decision Rule:
  - a) Identify minimum or maximum outcomes for each alternative
  - b) Choose alternative that maximizes the global minimum or maximum

Primitive Model: Maximin or Maximax (cont'd)

- Example:

	S1	S2	S3
A1	100	40	30
A2	70	80	20
A3	0	0	110

maximin	maximax
√	2
2	3
3	√

- **Problems**
  - discards most information
  - focuses in extremes

Primitive Model: Regret

- **Decision Rule**

  a) Regret = (max outcome for state i) - (value for that alternative)

  b) Rewrite payoff matrix in terms of regret

  c) Minimize maximum regret (minimax)

Primitive Model: Regret (cont’d)

- **Example:**

	S1	S2	S3
A1	100	40	30
A2	70	80	20
A3	0	0	110

→

0	40	80
30	0	90
100	80	0

Primitive Model: Regret (cont’d)

- **Problem: Sensitivity to Irrelevant Alternatives**

A1	100	40	30
A2	70	80	20

0	40	0
30	0	10

NOTE: Reversal of evaluation if alternative dropped
Problem: Potential Intransitivities

Primitive Model: Weighted Index

- **Decision Rule**

  a) Portray each choice with its deterministic attributed different from payoff matrix e.g.

Material	Cost	Density
A	$50	11
B	$60	9

Primitive Model: Weighted Index (cont'd)

b) Normalize table entries on some standard, to reduce the effect of differences in units. This could be a material (A or B); an average or extreme value, etc.

Material	Cost	Density
A	1.00	1.000
B	1.20	0.818

c) Decide according to weighted average of normalized attributes.

Primitive Model: Weighted Index (cont'd)

- Problem 1: Sensitivity to Framing
  "irrelevant attributes" similar to Laplace criterion (or any other using weights)
- Problem 2: Sensitivity to Normalization

Example:

Norm on A			Norm on B	
Matl	$	Dens	$	Dens
~~A~~	~~1.00~~	~~1.000~~	~~0.83~~	~~1.22~~
B	1.20	0.818	1.00	1.00

Weighting both equally, we have
A > B (2.00 vs. 2.018) B > A (2.00 vs. 2.05)

Primitive Model: Weighted Index (cont'd)

- **Problem 3: Sensitivity to Irrelevant Alternatives**

  As above, evident when introducing a new alternative, and thus, new normalization standards.

Need for a Decision Analysis Approach

- Avoid the problems associated with "primitive models"
- Appropriate analytical treatment
  – Range of business choices
  – Uncertainty of future events
- Provides planning flexibility
  – Incorporates new market information as it comes available
  – Decisions made only as needed

Typical Decision Making Problem: Inflexible Planning

- **The Usual Error**
  - **Choice of a Fixed "Strategy" ; A Master Plan**
  - **"Here we are...There we'll be"**
  - **Management and Company commitment to plan -- leading to resistance to change when needed**
- **The Resulting Problem**
  - **Inflexibility and Inability to respond to actual market conditions**
  - **Losses and Lost Opportunities**

Traditional Approach is a Master Plan

- **No flexibility included in master plans**
- **The development of a Master Plan involves**
  - Defining the Forecast (pick one)
  - Examining alternatives for THAT FORECAST only
  - Selecting a SINGLE SEQUENCE OF DEVELOPMENT with no examination of alternative scenarios
- **Does not anticipate RISK of possible changes in market conditions**
  - Does not provide insurance against those real risks,
  - Is inflexible, and inherently unresponsive to the risks.

Examples of Inflexible Planning

- **New Denver International Airport**
  - Management could not reduce initial size... Even when airlines not committed => unnecessary passenger building
  - No back-up for failure of new technology (Bag System)
- **Dallas / Fort Worth Airport**
  - Gate Arrival Master Plan: No Provision for transfer passengers, and huge unnecessary costs
  - No provision for failure of technological leap
- **Nuclear Power in USA**
  - Fix on technology
  - Uneconomic Plants
  - Bankrupt Companies

Decision Analysis Approach

- **PHASE 1: Recognition of Risk and Complexity Reality**
- **PHASE 2: Analysis/Decision Trees**
- **PHASE 3: Developing a Dynamic Strategic Plan**

Recognition of Risk and Complexity

- Risk
  - Fundamental uncertainty inherent in all business decisions
  - Impossible to eliminate uncertainty or risk. Can only make contingency plans to be able to react to unexpected events
- Complexity
  - Wide range of choices
  - Hybrid choices
  - Choices distributed over time

Analysis/Decision Trees

- Structured Method to Analyze Decisions
  - Organizes the large number of choices available
  - Explicitly considers uncertain situations
- Organization of basic elements of all decision problems
  - Decision variables
  - Uncertain events
  - Business outcomes

The Solution: Dynamic Strategic Planning

- Dynamic Strategic Planning involves
  - Looking ahead many periods, appreciating the many scenarios with their opportunities and threats
  - Choosing Actions to create flexibility,so you can respond to opportunities and avoid bad situations
  - Committing to Actions only one period at a time.
    - Maintaining the flexibility to adjust to conditions as they actually develop

Recognition of Risk and Complexity Reality

- Risk: Wide Range of Futures
  - The forecast is "always wrong"
- Complexity: Wide Range of Choices
  - Number of Choices is Enormous
    - “Pure” solutions only 1 or 2% of possibilities
    - Most possibilities are “hybrid”, that combine elements of “pure” solutions
    - “Hybrid” choices provide most flexibility

Recognition Of Risk

- The usual error
  - Search for correct forecast
- However: the forecast is "always wrong"
  - What actually happens is quite far, in practically every case, from what is forecast
  - Examples: costs, demands, revenues and production
- Need to start with a distribution of possible outcomes to any choice or decision

Surprises Lead to Underestimating Risk

- All forecasts are extensions of past
  - Past trends always interrupted by surprises, by discontinuities:
    - Major political changes
    - Economic booms and recessions
    - New industrial alliances or cartels
- The exact details of these surprises cannot be anticipated, but it is sure surprises will exist!

Data Ambiguity Also Leads to Uncertainty

- Many extrapolations possible from any set of historical data
  - Different explanations (independent variables*)*
  - Different forms of explanations (equations)
  - Different number of periods examined
- Many of these extrapolations will be "good" to the extent that they satisfy usual statistical tests
- Yet these extrapolations will give quite different forecasts!

Underestimating Risk Leads to Poor Planning

- Wrong Size of Plant, of Facility
  - Denver Airport
    - Oversized, poor baggage handling, etc.
  - Boston Water Treatment Plant
    - Far greater capacity than needed
- Wrong type of Facility
  - Although "forecast" may be "reached"…
  - Components that make up the forecast generally not as anticipated, thus requiring
  - Quite different facilities or operations than anticipated

Complexity

- More Choices Available than Usually Anticipated
- The Usual Error
  - Polarized Concept
  - Choices Narrowly Defined around simple ideas,
    on a continuous path of development

Range Of Choices

- The Correct View
  - All Possibilities must be considered
  - The Number of Possible Developments, considering all the ways design elements can combine, is very large
- The general rule for locations, warehouses
  - Possible Sizes, S
  - Possible Locations, L
  - Possible Periods of Time, T
  - Number of Combinations: {S exponent L} exponent T
- Practical Example: Mexico City Airport
  - Polarized View: "Texcoco" or "Zumpango"
  - All Combinations: {2 exp 4}exp 3 = 4000+ !!!

Considering Limited Set of Choices Can Lead to Poor Decisions

- The Resulting Problem
  - Blindness to "98%" of possible plans of action
    - These are the "combination" (or "hybrid") possibilities that combine different tendencies
    - The "combination" designs allow greatest flexibility -- because they combine different tendencies
  - Blindness to many possible developments
    - those that permit a variety of futures
    - because they do not shut off options
  - Inability to adapt to risks and opportunities
  - Significant losses or lost opportunities

Practical Example: Mexico City Airport

- Large Set of Choices
  - Most of the possible developments are combinations of operations at 2 sites (instead of only 1)
  - The simultaneous development at 2 sites allows the mix and the level of operations to be varied over time
  - The development can thus follow the many possible patterns of development that may occur
  - There is thus great flexibility
  - Also ability to act economically and efficiently
- Recommended Action
  - Option on Zumpango Site
  - Wait 6 years
  - Then decide next step

Decision Analysis

- Objective
  - To present a particular, effective technique for evaluating alternatives to risky situations
- Three Principal conclusions brought out by Decision Analysis. Think in terms of:
  1. Strategies for altering choices as unknowns become known, rather than optimal choices
  2. Second best choices which offer insurance against extremes
  3. Education of client especially about range of alternatives

Motivation

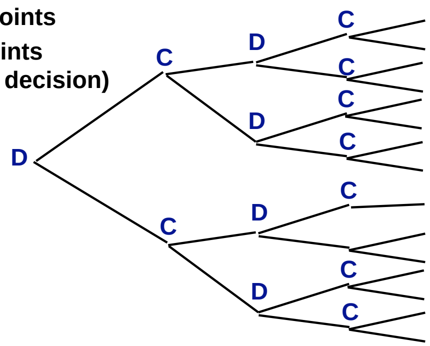
- People, when acting on intuition, deal poorly with complex, uncertain situations
  - They process probabilistic information poorly
  - They simplify complexity in ways which alter reality
    - Focus on extremes
    - Focus on end states rather than process
    - Example: Mexico City Airports
- Need for structured, efficient means to deal with situation
- Decision Analysis is the way

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
    - Risks; Value of Each Possible Outcome

Decision Analysis

- 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)

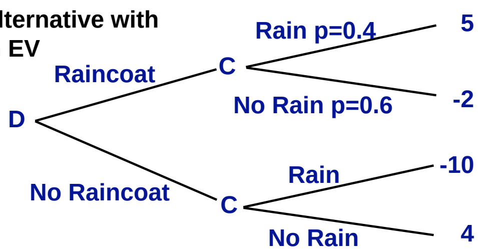


Rain Coat Problem

- Weather Forecast: 40% Chance of Rain
- Outcomes:
  If it rains and you don't take a raincoat = -10
  If it rains and you take a raincoat = +5
  If it does not rain and you don't take a coat = +4
  If it does not rain and you take a coat = -2
- Question: Should you take your raincoat given the weather forecast (40% chance of rain)?

Decision Analysis

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



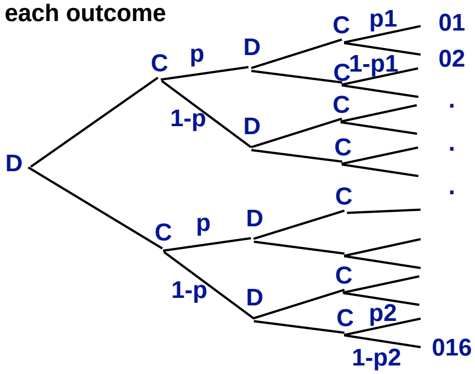
EV (raincoat)	=	2.0 - 1.2 =	0.8
EV (no raincoat	=	- 4.0 + 2.4 =	- 1.6

For Sequence of Alternatives

- Start at end of tree (rightmost edge)
- Calculate Expected Value for last (right hand side) alternatives
- Identify Best
  - This is the value of that decision point, and is the outcome at the end of the chance point for the next alternatives
- This is also the best choice, if you ever, by chance, reach that point
- Repeat, proceeding leftward until end of tree is reached
- Result: A sequence of optimal choices based upon and responsive to chance outcomes - "A Strategy"

Structure (continued)

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



- When does it become a “messy bush”?

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

  I.E., It is best to buy insurance!

Dynamic Strategic Planning

- The Choice
  - Preferred Choice depends on Satisfaction of Decision-Makers, or Customers
  - Not a technical absolute
- The Dynamic Strategic Plan
  - Buys Insurance -- by building in flexibility
  - Commits only to immediate First Period Decisions
  - Balances level of Insurance to Feelings for Risk
  - Maintains Understanding of Need for Flexibility

The Choice

- Any Choice is a PORTFOLIO OF RISKS
  - Nothing can be guaranteed
- Choices differ in two important ways
  - The "Average" Returns (Most Likely, Median, Expected)
  - Their Performance over a Range of Scenarios
- In General, they either
  - Perform well over many scenarios (they "fail gracefully" because they lose performance gradually)
  - Give good returns only for specified circumstances, otherwise they do not
- A Choice is for First Period Only
  - New Choices available later

The Best Choice

- Permit good performance over a range of scenarios
- They achieve overall best performance by
  - Building in Flexibility, to adjust plan to situation in later periods -- this costs money
  - Sacrificing Maximum Performance under some circumstances
- "Buy Insurance" in the form of flexibility, the capability to adjust rapidly and easily to future situations

Final Dynamic Strategic Plan

- 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