Primitive Decision Models

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

Payoff Matrix as Basic Framework

BASIS: Payoff Matrix

Alternative	State of "nature" S_1 S_2 . . . S_M
A_1	
A_2	Value of outcomes
A_N	O_{NM}

Primitive Model: Laplace (1)

- **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 (2)

- **Example**

	S_1	S_2	"expected" value
A_1	100	40	70
A_2	70	80	75

Primitive Model: Laplace (3)

- **Problem: Sensitivity to framing**
  ==> “irrelevant alternatives

	S_{1A}	S_{1A}	S_2	“expected” value
A_1	100	100	40	80
A_2	70	70	80	73.3

Maximin or Maximax Rules (1)

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

Maximin or Maximax Rules (2)

- **Example:**

	S_1	S_2	S_3	maximin	maximax
A_1	100	40	30	☑	2
A_2	70	80	20	2	3
A_3	0	0	110	3	☑

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

Regret (1)

- **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)**

Regret (2)

- **Example:**

	S_1	S_2	S_3
A_1	100	40	30
A_2	70	80	20
A_3	0	0	110

→

0	40	80	☑
30	0	90	
100	80	0	

Regret (3)

- **Problem: Sensitivity to Irrelevant Alternatives**

A_1	100	40	30
A_2	70	80	20

0	40	0	
30	0	10	☑

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

Weighted Index Approach (1)

- **Decision Rule**

  a) Portray each choice with its deterministic attribute -- different from payoff matrix

For example:

Material	Cost	Density
A	$50	11
B	$60	9

Weighted Index Approach (2)

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.

For example:

Material	Cost	Density
A	1.00	1.000
B	1.20	0.818

c) Decide according to weighted average of normalized attributes.

Weighted Index Approach (3)

- **Problem 1: Sensitivity to Normalization**

Example:

Matl	Normalize on A: $	Normalize on A: Dens	Normalize on B: $	Normalize on B: 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)

Weighted Index Approach (4)

- **Problem 2: Sensitivity to Irrelevant Alternatives**

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

- **Problem 3: Sensitivity to Framing "irrelevant attributes" similar to Laplace criterion (or any other using weights)**

Example from Practice

- Sydney Environmental Impact Statement
- 10 potential sites for Second Airport
- About 80 characteristics

- The choice from first solution
- … not chosen when poor choices dropped
- … best choices depended on aggregation of attributes
- Procedure a mess -- totally dropped

Summary

- Primitive Models are full of problems

- Yet they are popular because
  - people have complex spreadsheet data
  - they seem to provide simple answers

- Now you should know why to avoid them!