



Decision Making under Uncertainty

When several states of nature exist and a decision maker *cannot* assess the outcome probability with *confidence*



Criteria for Decision Making under Uncertainty

- Computed directly from the decision table
 - Optimistic (maximax)
 - Pessimistic (maximin)
 - Criterion of Realism (Hurwicz Criterion)
 - Equally Likely (Laplace)
- Use the opportunity loss table
 - Minimax Regret

Example: Thompson Lumber Company

Alternatives	State of Nature	
	Favorable Market	Unfavorable Market
Construct a large plant	200,000	- 180, 000
Construct a small plant	100,000	- 20, 000
Do Nothing	0	0

Optimistic (Maximax Criterion)

- The best (maximum) payoff for each alternative is considered and the alternative with the best (maximum) of these is selected.

Alternatives	State of Nature		Maximum in a Row
	Favorable Market	Unfavorable Market	
Construct a large plant	200,000	- 180,000	200,000
Construct a small plant	100,000	- 20,000	100,000
Do nothing	0	0	0

← Maximax

Pessimistic (Maximin Criterion)

- The worst (minimum) payoff for each alternative is considered and the alternative with the best (maximum) of these is selected.

Alternatives	State of Nature		Minimum in a Row
	Favorable Market	Unfavorable Market	
Construct a large plant	200,000	- 180,000	- 180,000
Construct a small plant	100,000	- 20,000	- 20,000
Do nothing	0	0	0

← Maximin



Criterion of Realism

Hurwicz Criterion

- Weighted average
- Compromise between an optimistic and a pessimistic decision
- To begin, select a **coefficient of realism, α**
 - this measures the degree of optimism of the decision maker
 - $0 \leq \alpha \leq 1$
 - If $\alpha = 1$, the decision maker is 100% optimistic about the future
 - If $\alpha = 0$, the decision maker is 100% pessimistic about the future
- This allows the decision maker to build personal feelings about relative optimism and pessimism

Criterion of Realism

Hurwicz Criterion

$$\text{Weighted Average} = \alpha(\text{best in row}) + (1 - \alpha)(\text{worst in row})$$

Let $\alpha = 0.80$

Alternatives	State of Nature		Criterion of Realism or Weighted Average
	Favorable Market	Unfavorable Market	
Construct a large plant	200,000	- 180, 000	124,000
Construct a small plant	100,000	- 20, 000	76,000
Do Nothing	0	0	0

Realism



Equally Likely Laplace Decision Criterion

- Uses all the payoffs for each alternative
- Finding the average payoff for each alternative, and selecting the alternative with the best or highest average
- All probabilities of occurrence for the states of nature are equal, thus each state of nature is **equally likely**

Equally Likely Laplace Decision Criterion

Alternatives	State of Nature		Row Average
	Favorable Market	Unfavorable Market	
Construct a large plant	200,000	- 180, 000	10,000
Construct a small plant	100,000	- 20, 000	40,000
Do Nothing	0	0	0

Equally
Likely



Minimax Regret

- Based on opportunity loss or regret
- Opportunity loss refers to the difference between the optimal profit of a payoff for a given state of nature and the actual payoff received for a particular decision.

Example: Thompson Lumber Company

Alternatives	State of Nature	
	Favorable Market	Unfavorable Market
Construct a large plant	200,000	- 180, 000
Construct a small plant	100,000	- 20, 000
Do Nothing	0	0
Optimal Profit	200,000	0

Minimax Decision using Opportunity Loss

Alternatives	State of Nature		Maximum in a Row
	Favorable Market	Unfavorable Market	
Construct a large plant	0	180,000	180,000
Construct a small plant	100,000	20,000	100,000
Do nothing	200,000	0	200,000

Minimax