SATISFICING: INTEGRATING TWO TRADITIONS

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“[D]ecision makers can satisfice either by finding optimal solutions for a simplified world, or by finding satisfactory solutions for a more realistic world. Neither approach, in general, dominates the other, and both have continued to co-exist in the world of management science.”

– Simon (1979)

Motivation

- In 1955, Simon proposed that agents do not maximise their utility, but rather they "satisfice" due to bounded rationality – they make a decision that is good enough
  - *"Bounded rationality is not irrationality." (Simon, 1985, p.297)*
- Two (largely unconnected) streams of research has emerged from Simon's (1955) work over the last 60+ years
  - *Economics, Psychology and Management: satisficing is sub-optimal*
  - *Computer Science: satisficing can be optimal*
- Why is there a divergence?
  - *Key difference: it depends on the environment in which the agent makes a decision*

Decision Environments

Risk, Ambiguity, Uncertainty

Choice under	Baseline Certainty	Risk	Ambiguity	Uncertainty
	State 1 (s_1)			
Prob.	1	p_1	?	?
Action 1 (a_1)	$c_{1,1}$	$c_{1,1}$	$c_{1,1}$	$c_{1,1}$/?
Action 2 (a_2)		$c_{1,2}$	$c_{1,2}$	?

Choice under	*Baseline* Certainty	Risk	Ambiguity	Uncertainty
No. of alternatives (actions)	Known	Known	Known	Unknown
No. of states of the world	Known	Known	Known	Unknown
No. of outcomes	Known	Known	Known	Unknown
State to Outcome Mapping	Known	Known	Known	Unknown
Probability of each state of the world	Known	Known	Unknown	Unknown
Problem	Well-defined	Well-defined	Well-defined	Ill-defined

- Expected utility theory assumes the problem is well-defined and tractable, and thus can't be used for decisions under uncertainty (Savage, 1954)

Definition

What is Satisficing?

- Three definitions in this paper:

1. *"The observation that agents make choices with the help of aspiration levels that do not necessarily coincide with utility maximization" (p.598)*

2. *"The alternative chosen is the 'best so far'" (p.604)*
   - *Better summary than "an alternative is good enough"*

3. *"The antithesis of optimization, without imposing additional constraints on the decision model" (p.605)*

Model

How does one Satisfice?

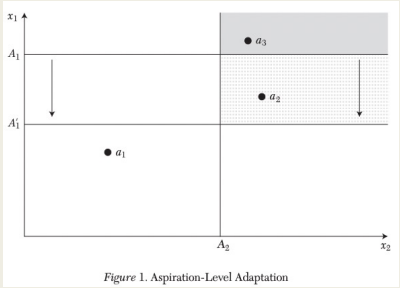


Figure 1. Aspiration-Level Adaptation

Step 1: Set an aspiration level.

Step 2: Continue search until finding the first alternative that meets or exceeds the aspiration level.

Step 3: If no alternative meets the aspiration level within a fixed period, adapt it by a particular value and return to Step 2.

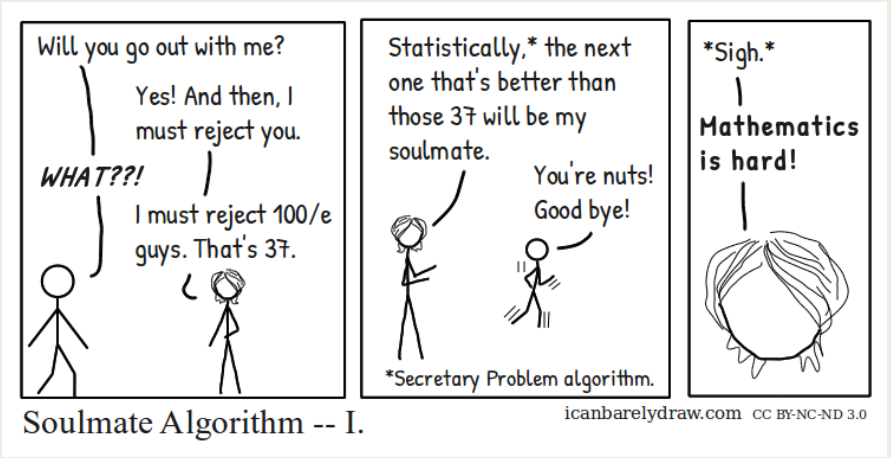
- Satisficing is based on two elements:

1. **Aspiration level**
   - *A simplified value function that adapts to environment over time*
   - *There can be multiple aspiration levels - one for each attribute*
     - They need not to be commensurable and can be valued separately
2. **Information Search**
   - *This leads to sequential decision-making*
   - *Note that in expected utility theory, agents have complete information and there is no search cost*

- Aspiration level determines the quality of choice and duration of search

Problems are well-defined and tractable

Decision under Risk



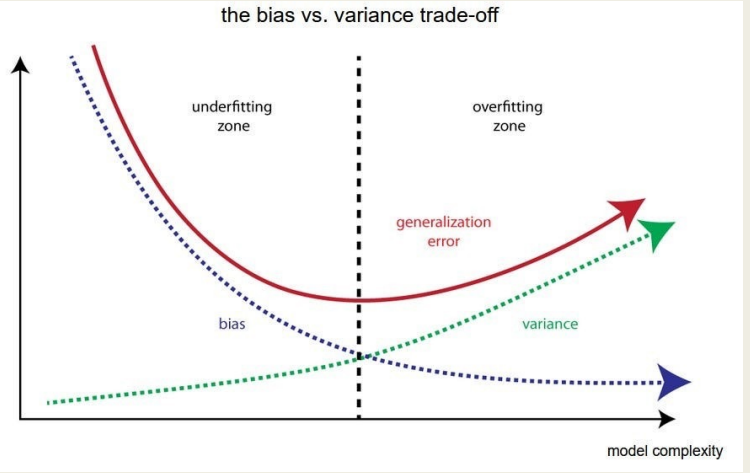
- No search (static) vs. With search (sequential)
- Start with expected utility theory (rational choice)
- Modify the model by including aspiration levels to account for behavioral deviations
  - *No search: Prospect Theory (reference point = aspiration level)*
  - *With search: Marriage/Secretary problem (optimal stopping rule is choose the best after observing ~37% of options)*
- **Satisficing and Rational Choice**
  - *Without search: sub-optimal to satisfice – deviation from rational choice*
  - *With search: optimal to satisfice – choose the "best so far"*
    - Cost-benefit trade-off in information acquisition/processing to determine optimal stopping point

Problems are either ill-defined or intractable

Decision under Uncertainty & Intractability

- Heuristic: "*to find out or discover*" in Greek
- Empirically derivate strategies that can adapt to the environment over time
  - *Aspiration-level adaption: choose alternative based on a single attribute that meets a minimum level that changes over time*
  - *Tallying: choose alternative if x number of attributes meets the minimum levels*
- Develop multiple candidate decision models and use bias-variance trade-off to choose the best one
- **Satisficing and Rational Choice**
  - *Satisficing can be optimal as long as it offers good bias-variance trade-off*
    - Heuristics have fewer parameters/lower model complexity

“Because optimization strategies are only optimal relative to their assumptions or the sample they were estimated in, there is no guarantee that the decisions they yield are indeed optimal.” (p.625)



Integrating Two Traditions

- Satisficing and Bias-Variance trade-off
  - *Decision under Risk (no search) = mistake is only due to bias given complete information (no variance)*
  - *Decision under Uncertainty = bias and variance exist given incomplete information*

- Theory formulation should follow two principles (Friedman, 1953)

1. **Out-of-sample testing** = test how well the theory predicts, not how well it fits the data
2. **Theory comparison** = compare how well the theory predicts relative to alternative theories/models

Future Research

1. Out-of-sample testing for research in both traditions

2. Theoretical research in satisficing under uncertainty & intractability

3. Research in the processes (rather than outcomes) of satisficing under risk

4. Research in decision under uncertainty (in general)

Appendix

Constructivist Rationality	Ecological Rationality
Equilibrium	Behavioural
Normative (”as-if”)	Positive
Aggregative	Individual
Theoretical	Empirical
Derives from a well-defined incentive structure (simplified/stylised representation of the world)	Derives from the strategies an agent use to adapt to the environment
Static environment	Dynamic environment
One-shot game (without search) Sequential (with search)	Sequential game