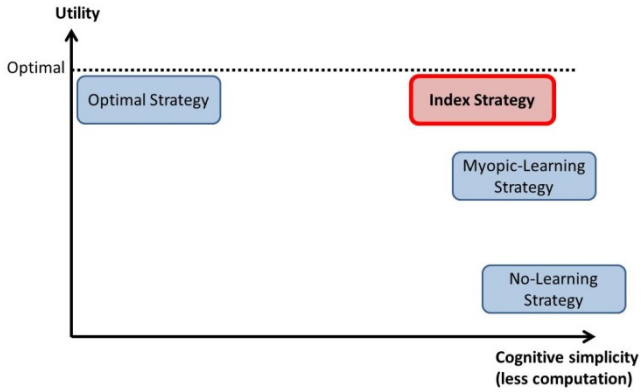
Some problems are just hard

- Realistic empirical problems require tradeoffs between complexity and completeness
- With today's data, often need to "scale" to large numbers of consumers, transactions, firms, phenomena
- Tradeoffs usually involve heuristics
  - NP-hard – cannot be solved in polynomial time
  - PSPACE-hard – cannot be solved in polynomial memory
  - But, heuristics are often extremely close to optimal
    - for description, estimation, and/or prescription

Some Examples



- Consumer decision heuristics
  - Cognitive simplicity
  - Greedoid dynamic program – *n!* to $2^n \Leftrightarrow$ millennia vs. seconds
- Forward-looking consumers
  - standard dynamic program – $(D^2)^J \Leftrightarrow$ 300 years for $J = 6$, $D = 10$
  - vs. index strategies – $D^{2 \cdot} J \Leftrightarrow$ 6 seconds
  - likely to be a realistic description of consumer's decision process
- Matching banners (or websites) to consumer segments
  - intrusive measures and full (or fractional) factorial experiment
  - vs. optimal experimentation in real time (Expected Gittins' Indices)