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 ⇔ millennia vs. seconds

- Forward-looking consumers
  - standard dynamic program – $(D^2)^J$ ⇔ 300 years for $J = 6$, $D = 10$
  - vs. index strategies – $D^2 \cdot J$ ⇔ 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)