

Engineering and the Service Sector: Common Elements, Challenges and Opportunities

John Birge
Northwestern University

Common Elements

- Characterizing Service
 - Performing tasks for another **individual**
- Emphasis
 - **Customized** to the individual
- Requirements
 - Knowledge of individual needs/desires
 - Direct (often repeated) involvement with individual (personal)
 - Tools for organizations to manage, design, and improve these functions

Challenges

- Recognizing individual preferences
 - Examples: financial planning, health care planning, retail, education, entertainment
 - How to structure choices to find preferences?
 - How to do so implicitly?
 - How to accomplish on large scale?
 - How to incorporate into design of the service and pricing of the service?

Challenges (2)

- Interpreting data from large populations
 - Examples: Scanner data in retail, investor choices and tick-level price movements, medical procedures, monitor results and outcomes, learning in large organizations (and within individual)
 - How to use these datasets to design, improve decisions?
 - How to measure effects of different treatments, protocols, algorithms?

Challenges (3)

- Effects of organizational interactions
 - Examples: limited markets in finance, pricing in retail, multiple diseases in healthcare, limited audience attention in entertainment
 - How to incorporate many multiple agents with individual preferences (not necessarily observed) into decision system?
 - How to combine individual actions and choices on a large scale?

Challenges (4)

- Combining real-time, continuous actions with discrete changes in policies and preferences
 - Examples: Continuous trading in finance, continuous monitoring and control in healthcare
 - How to incorporate other techniques such as finite-element methods and continuous control with discrete preferences?
 - How to use learning in online processing?

Challenges (5)

- Nature of multiple interactions on model form: non-convexity and discontinuity
 - Examples: combinations of pricing and capacity decisions, multiple equilibria in markets, discontinuous learning outcomes, non-convex and complex physiological responses
 - How to optimize systems with multiple possible states?
 - How to model complex and chaotic transitions and responses (e.g., with gene mutations)?

Summary of Service Sector Opportunities

- Key on eliciting, addressing, and satisfying the needs of individuals
 - Identify preferences
 - Interpret massive amounts of data
 - Incorporate organizational interactions
 - Combine continuous and discrete
 - Explore multiple alternative states and complex interactions