How do humans behave (collectively)?

Much attention paid by social sciences to individual decision making / behavior

- Neoclassical economics asserts individual attributes (e.g. preferences and rationality)
- Behavioral economics identifies "real" attributes
- Organizational economics extends (game theoretic) notion of individual agent to firms/divisions
- Social psychology / sociology / anthropology embed individuals in an environment (e.g. group, firm, institutional framework, culture, etc.)

But Many (Most?) Problems are Collective

- "Collective Capabilities"
  - Maximizing production of firms / industries
  - Innovation
  - Catastrophe Survival
- "Collective Decisions"
  - Market share of product
  - Success of an innovation
  - Change in corporate culture
- "Other"
  - Effects of tax cut on economy

Micro-Macro Problem

- Given micro mechanics
  - Some set of individuals, specified by some set of attributes / preferences; and
  - Some environment, which in turn specifies some set of incentives / payoffs
- Predict / explain macro outcomes

Implicit in most social science:

- Notion that individual / micro-level behavior is the problem of greatest interest
  - Optimization vs. Satisficing
  - Preferences vs. Norms
- At most, individuals "play" against a single other actor or "react" to some environment
- Once individual behavior settled, macro / collective behavior is "merely" a matter of aggregation
  - Walrasian auctioneer centralizes supply and demand
  - Many player games as collection of two-player games
- Assumption shared by other sciences too (so called "mean field" theories, linear algebra, linear differential equations, linear regressions)

In Reality
Aggregation is Problematic

- In general "complex systems" characterized by
  - Many components (not just one or two)
  - Components interact (decisions interdependent)
  - Interactions Nonlinear (whole not sum of parts)
  - Interactions Decentralized (no maestro)
  - Collective behavior dynamic (unfolds in time)
- All these criteria apply to the systems of sociology and economics

“More is Different”

- “Emergence” of new collective behavior not reducible to individual rules/attributes, in sense that:
- Link between (distributional) properties of individuals and collective outcomes deeply unclear (e.g. cascades)
- Importance of time scales (e.g. catastrophes)
- Historical dependence and lock-in
- Sensitive dependence on initial conditions derived from multiple equilibria and fractal basins of attraction
- Oscillations, Bifurcations, and Chaos
- Skewed distributions, and rare but significant events

Examples

- Organizational Robustness can vary immensely depending on the global arrangement of connections (with the same individuals)
- Information Cascades can be triggered in populations that are indistinguishable from populations in which cascades do not occur, and by shocks that are a-priori indistinguishable from other shocks.

What to do?

- If collective outcomes only weakly related to individual attributes /preferences /capabilities and even their environments
- Then modeling focus needs to shift from more accurate representation of individuals to more accurate representation of
  - Interactions between individuals (networks)
  - Evolution of decisions / interactions (dynamics)

Inherently Multi-Disciplinary

- Individual rules still matter (psychology)
- Incentives still matter (economics)
- Institutions / Identity matter (sociology)
- Networks matter (math / physics)
- Computations matter (computer science)
- Dynamics matter (math / physics)