Agent-Based Models and Human Subject Experiments

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Three Approaches

- Three different classes of agent-based models have been developed to characterize or understand data from human subject experiments.

- From least to most sophisticated/complicated.
  - Zero Intelligence Agents
  - Reinforcement and Belief Learning
 - Evolutionary Algorithms

Zero Intelligence Agents

- Gode and Sunder (1993, 1997ab): is the rapid convergence of prices and quantities to competitive equilibrium in laboratory double auction experiments, e.g. Smith (1962), due to human cognitive abilities or to the double auction mechanism and the enforcement of budget constraints?

- Replacing human subjects with zero-intelligence (no memory), unconstrained or budget constrained robot traders they found that the budget constrained robot traders did as well or better than the human subject traders in terms of extracting gains from trade.

Gode and Sunder's Approach:

- Unconstrained ZI implementation: Buyer bids and seller asks are random draws from U[0,B]

- Budget constrained ZI implementation:
  - Buyer i's bid for unit j is a random draw from $[0, v_{ij}]$, where v_{ij}, is i's valuation for the jth unit.
  - Seller i's ask for unit j is a random draw from $[c_{ij}, B]$, where c_{ij} is j's cost of producing the jth unit.

- Bids and asks must satisfy standard double auction improvement rules.

- Once a unit is exchanged it cannot be bought or sold again in the same trading period.

ZI Agents and Human Subjects

ZI Traders without Budget Constraint

ZI Traders with Budget Constraint

Human Traders

PERIODS
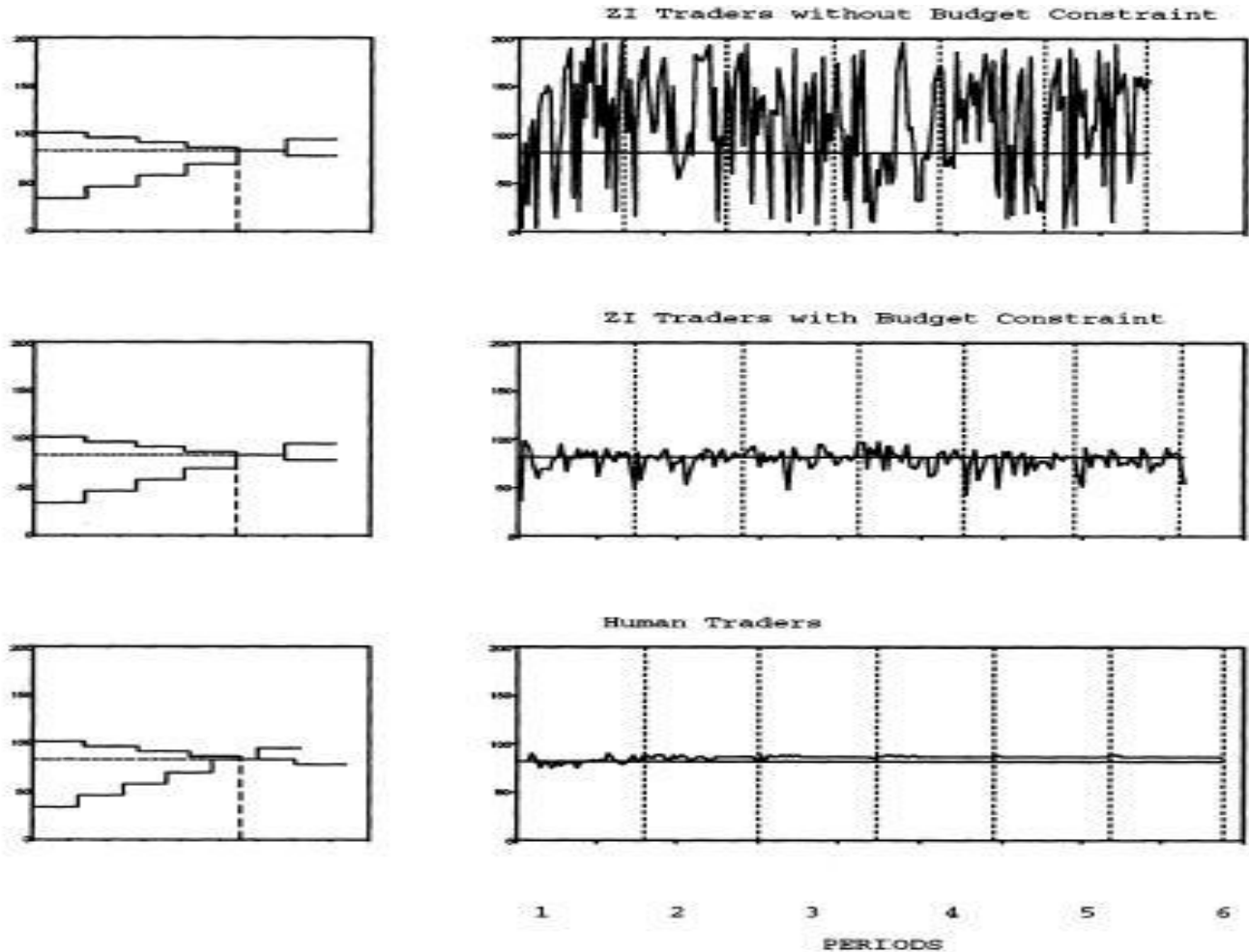
Reaction

- Experimentalists emphasize what human subjects can do that ZI agents cannot do.
  - Avoidable costs (Van Boening and Wilcox 1996)
  - Continually refreshed demand and supply (Brewer et al. 2002).
- Computer scientists provide challenging test environments in which ZI agent perform poorly, e.g. Cliff (1997), Cliff and Bruten (1997).
- Both reactions miss the point: Random, ZI traders *are* a useful benchmark, but may not be the whole story.
  - Good building block for further ACE model construction (satisfies KISS principle, bottom of bottom-up processes)

Summary

- ZI is a useful benchmark for assessing the marginal contribution of institutional features and human cognition in experimental settings.

- ZI is perhaps best suited to competitive environments where agents have no strategic power.

- Starting from ZI (directed random search) *and adding additional structure as needed* seems a reasonable approach to agent-based modeling.

- More work being done, e.g. ZI agents in general equilibrium endowment economies, (Gode et al. (2000), Crockett et al. 2005).