Social Learning

- Learning from experience
  - learning in games
  - optimal experimentation
- Combining learning and externalities
- Pure informational externalities
  - ad hoc learning
  - Bayesian learning

Bikhchandani,Hirshleifer, Welch (1992)

- An ordered infinite set of individuals $i = 1, 2 \ldots.$

- Each agent decides to adopt or reject some behavior.

- Benefit V of adopting behavior: $V \in \{v_1, \ldots, v_s\}$.

- Cost of adoption is $v_1 < C < v_s$, $C \neq v_\ell$ for all ℓ.

- All agents start with identical prior probability Prob $\{V = v_l\} = \mu_l$

- Individual i also gets private signal $X_i \in \{x_1 < x_2 < \cdots < x_R\}$.

- Signal observed by each agent is (conditional on V) independent and identically distributed across agents.

- $p_{q,\ell} = \text{Prob}\{X_i = x_q \mid V = v_\ell\}$.

- Monotone likelihood ratio ordering: For each $\ell < S$
$$\frac{p_{q,\ell}}{p_{q+1,\ell}} \geq \frac{p_{q,\ell+1}}{p_{q+1,\ell+1}}$$

- Agent $i > 1$ observes action (*not signal*) of agents $1, \ldots, i-1$.

- Agents choose action that yields highest expected value conditional on the information they have (own signal plus observed actions)

- Cascade: i's action is independent of X_i

Example

- $V \in \{0, 1\}$.

- $X_i \in L, H$.

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	Prob $X_i = H$	Prob $X_i = L$
$V = 1$	p	$1 - p$
$V = 0$	$1 - p$	p

- $C = 1/2 + \epsilon$, where ϵ is small

- $p = 1/2 + 2\epsilon$

- $\mu_1 = \mu_2 = 1/2$

- Agent 1 adopts if and only if $X_1 = H$.

- If agent 1 adopts, agent 2 adopts if and only if $X_2 = H$

- If agents 1, 2 adopt, agent 3 knows H, H occurred and adopts independent of X_3.

- If $V = 0$, this happens with prob. $(1 - p)^2$.

- *Fragility:* if there exists small probability that an agent receives two independent signals and he receives $\{L, L\}$, cascade stops.

- If $C \neq v_\ell$ for each ℓ, consistency of Bayesian estimation implies cascade with probability one.

- Discrete *versus* continuous actions.

- More complex graphs.

- Financial markets: C price of a traded asset

- (weak form) efficiency: C reflects all public information.

- $C_t = E[V|a_1, \dots a_{t-1}]$, where a_i is action by agent i.

- Hence $V_t = E[V|a_1, \dots, a_{t-1}, X_t] > C_t$ if and only if $X_t = H$.

- No cascade.

- May introduce noise traders.

- Event uncertainty and non-monotonicity.

Endogenous sequencing

- Two agents and two periods.
- Agents receives at time 1 signals θ^i, $i = 1, 2$ that are $i.i.d.$ and uniformly distributed in $[-1, 1]$.
- If investment is made in period 1 it produces $\theta^1 + \theta^2$.
- If made in period 2 it produces $\delta(\theta^1 + \theta^2)$.
- C=0.

Equilibrium

- If $\theta^i > 0$, agent 1 delays decision only if his decision to invest in period 2 depends on whether agent 2 invested or not. If agent 1 delays and then invest in period 2, agent 2 invested in period 1.

- a $\bar{\theta} \geq 0$ such that such that investment by i in first period if and only if $\theta^i > \bar{\theta}$.

- $\bar{\theta} + E[\theta^i | \theta^i < \bar{\theta}] < 0$.

- $$\bar{\theta} = \delta(1 - \text{Prob}\,[\theta^i < \bar{\theta}])(\bar{\theta} + E[\theta^i | \theta^i > \bar{\theta}])$$

- Only one $\bar{\theta} > 0$.

- Number of periods is irrelevant.

- If $0 < \theta^i < \bar{\theta}$, $i = 1, 2$, no investment ever takes place.

- Continuous time.

- Individuals differ on quality of information
  - Better informed individuals choose first.
  - Time of choice may signal quality of information.
  - Other individuals ignore their own information.