Econ Lab: Network Paper Summary

The effect of network density on asymptotic information and welfare in regular random networks

Agent i observes her own and her neighbors' past successes(i->j)
Before tau: both social learn and private experiment?
After tau: only social learn
Get optimal cutoff time tau by solving phi_tau=0

If tau increase by eps: +payoff from a private success p_t(x+y)eps
=belief P(high quality)(payoff)eps
-expected benefit of future social learning p_t(b/r+b)y*eps,
Where b=neighbor success arrival rate, r=welfare discount
-marginal effort cost c*eps

Asymptotic information B = total information created by society
Asymptotic learning='B=inf'=probability that all agents perfectly learn is equal to 1='agents learn the state'=an agent learn the successes of all agents?

Second-best benchmark? to provide an upper bound on the equilibrium utility

Top Figure

Theorem 1(a)=B decrease, network density increases(lambda>=1/sigma*?)

- sigma*=the time when an agent perfectly learns and is indifferent about their private experiment at t=0(phi_0=0)(pessimistic priors p0<p_bar)(optimistic priors p0>=p_bar, sigma*=0, experimentation incentives are higher and the asymptotic learning obtains as long as p=0?)
- 1/lambda=lim(logI/n^I)=lim(log #of agents/# of links)=network's time-diameter=the time for social information to travel between two random agents in the network(continuous)
- Why tau_bar comparable to B(on y-axis)?
- Why use v, lambda, p sequentially to describe increasing network density?

Middle Figure

Theorem 1(b)=V rises in v, attains V* iff x=inf and p=0, falls in p

- v=# of links
- p=# of links/# of agents=proportion of connection among all
- Welfare V=V*: min(perfect learn immediately=p_0y, some other agent generate the social info=V(0,0)=p_0(x+y)-c)
- When 0<lambda<1/sigma*(time diameter 1/lambda>=sigma*=perfectly learn time), network sparse enough to accommodate asymptotic learning and dense enough to fully crowd out pre-cutoff social learning(no experiment? Or no neighbor learn before cutoff?) so attain V*
- Intuitivly v=inf and p=0?

Bottom Figure

B*? Relationship to inf?

Spare networks: v is finite
- Contagion phase accelerates over time(convex)
- Info B=inf: each agent experiments time>0 ensure asymptotic learning?

Intermediate networks: information spreads in finite time=finite>lambda>1/sigma*
- As v->inf, individual experiment vanish tau->0, convex cumulative learning curve B converges to a step function, constant equal to 0 below sigma*, and inf above?
- Denser, time diameter 1/lambda<=sigma*=perfectly learn time, social learning is faster than perfect learning, agents are exposed before perfect learning and eq information B<inf(asymptotic learning fails), but V* still attains
- As lambda grows, the corner of the stepfunction slides along the dashes line?

Dense networks: proportion of links is finite=0<p<1
- Analogous to the clique: given total info B, agents learn pB before stopping and (1-p)B immediately after stopping
- As p->1, we approach the clique and B->tau_bar=maximized cutoff time=agent receive all their social info before stopping, speed of diffusion crowd off discovery

Lemma 1: higher social learning B increases value V and decreases the cutoff tau(stop earlier)
Lemma 2: the agent's value=V(optimal cutoff tau, <u>pre-cutoff learning B_tau</u>), which decreases(post-cutoff learning decreases) when B_tau increase if fix optimal stopping time tau
So V(tau=0,B_tau0)=no private experiment and no pre-cutoff learning > V(tau>0, B_tau>=0)
Lemma 4: assume v=inf. Agent i gets exposed at time sigma or never.
(All agents observe the first success at the same deterministic time?)

p_0=all agents hare a common prior P(high quality) at t=0
c=cost of an agent's private efforts to generate successes with arrival rate
x=the payoff received by agent's own successes(discounted at rate r in welfare calculation)
y=future benefit of success=(x-c)/r
A agent receive x+y when she succeeds, receive y when a neighbor succeeds

p_bar=c/x=myopic threshold belief=when agent stop if it ignore the future benefit of success y
An agent's prior

is optimistic if p_0>p_bar(always experiment, no mater social learning curve)
is pessimistic if p_0<=p_bar

phi_t=an agent's experimentation incentives at time t

Get optimal cutoff time tau by solving phi_tau=0 if phi_0(initial experiment incentive)>0
tau=0 if phi_0(initial experiment incentive)<=0

tau_bar=maximized cutoff time in the absence of social learning(B=0)=single-agent solution

1. Fsolve vs vpasolve

fsolve is part of the Optimization Toolbox, and it uses a trust-region algorithm to find the roots of a nonlinear system of equations. It is more robust than vpasolve and is generally the preferred method when the problem is well-behaved, i.e., has unique solutions and is not too ill-conditioned. fsolve requires an initial guess and can be slower than vpasolve for simple problems, but it is more reliable for complex problems.

vpasolve, on the other hand, is part of the Symbolic Math Toolbox, and it uses a variant of the Newton-Raphson method to find the roots of a symbolic equation. It is faster than fsolve for simple problems, but it is less robust and can fail to find solutions for more complex problems. vpasolve does not require an initial guess, but it can only solve for a single variable at a time.

In general, you should use fsolve when you have a well-behaved problem and are confident that the initial guess is close to the solution. You should use vpasolve when you have a simple problem and do not have an initial guess, or when you need to solve for a single symbolic variable.