

CHAOS LAB

A FIELD GUIDE TO RULES, FEEDBACK AND UNCERTAINTY

Sahil Tayal / Sahilverse • 2026

This guide accompanies the interactive experiments at chaos.sahilverse.online. It is a learning resource, not a prediction system. Try the models, write down your assumptions, and treat surprising outputs as invitations to investigate.

1. Three different ideas

Deterministic chaos: rule-governed behaviour can be extremely sensitive to initial conditions.

Cascades: local adoption rules can propagate across a network. Multistability: a system can settle into different persistent states under the same external forcing. These are related ideas, not synonyms.

2. The logistic map

Equation: $x[n+1] = r \times x[n] \times (1 - x[n])$. Each new value depends on the previous one. The model is dimensionless. Try $r = 3.2$ and $r = 3.9$ with the same initial difference. Record whether two paths separate, how quickly, and whether they sometimes approach each other again.

3. A careful experiment

Hypothesis: a larger growth parameter always produces more separation after 65 iterations. Test at $r = 3.2, 3.5, 3.7, 3.9, 4.0$ with the same starting difference. Export CSV for each run. Is final separation monotonic? Do not infer global chaos from one pair of paths or one final point.

4. Threshold cascades

A ring of 60 nodes uses four neighbours per node. Each non-adopter switches when the fraction of adopting neighbours reaches the threshold. Adoption is irreversible. Vary seed size and threshold separately. Ask how results might change with hubs, unequal influence, reversibility or random connections.

5. Feedback and multiple stable states

Equation: $x[n+1] = \tanh(k \times x[n] + f)$. k controls reinforcement and f represents external forcing. Start from -0.9 and $+0.9$. Under some parameters, paths converge; under others they remain apart. The presence of two persistent outcomes in a toy model does not establish a real-world tipping point.

6. Four interpretation traps

(a) Not every small cause becomes a large effect. (b) A model is not the territory. (c) An analogy does not prove a social or clinical claim. (d) A single simulation run does not establish reliability, causality or policy effectiveness.

7. Worked reasoning: a viral message

Suppose a toy network reaches 90% adoption. A correct statement is: “Under this network topology, seed configuration, irreversible-adoption assumption and threshold, 90% of model nodes adopted.” An incorrect statement is: “A real campaign will reach 90% of people.” To test a real campaign, you would need observed network data, behavioural measurement and out-of-sample validation.

8. Worked reasoning: weather

Small differences in estimated initial atmospheric conditions can grow under nonlinear dynamics, limiting forecast horizons. But weather prediction also depends on measurement quality, model structure, computing resources and probabilistic ensemble forecasts. “Butterfly effect” is a useful metaphor, not a licence to claim that any action determines a particular storm.

9. Field exercises

EXERCISE A — Choose one parameter, make three predictions, then run and revise them.

EXERCISE B — Find a parameter setting where two trajectories converge; explain why sensitivity is conditional. EXERCISE C — Draw a network with a hub and hypothesize how adoption would change.

EXERCISE D — Identify one real-world analogy that the model cannot justify. EXERCISE E — Write a rival explanation for an observed pattern.

10. Your experiment log

Question: _____

Assumption: _____

Parameter changed: _____

Observation: _____

Alternative explanation: _____

What would falsify my interpretation? _____

11. Further reading

Encyclopaedia Britannica, “Chaos theory” — [britannica.com/science/chaos-theory](https://www.britannica.com/science/chaos-theory)

Wolfram MathWorld, “Logistic Map” — mathworld.wolfram.com/LogisticMap.html

American Mathematical Society, “Iterated Maps” — ams.org/publicoutreach/feature-column/fcarc-iterated-maps

Santa Fe Institute, “Complex Systems” — santafe.edu/research/themes/complex-systems

These are starting points; consult original mathematical literature for deeper proofs.

12. Connect the worlds

World Engine: worldengine.sahiltayal.com — how rules and components create emergent worlds.

Madness: madness.sahiltayal.com — how categories and models shape judgments. Main atlas:

sahiltayal.com — research, writing and experiments. Check current availability before relying on any external site.