EnpRisk - Lecture Notes Week 7

Ruben Schenk, ruben.schenk@inf.ethz.ch

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0.0.1 More on Chaos

It can be shown that the logistic maps is equivalent to the **tent map:**

$$y(n+1) = 2y(n) \mod 1,$$

with $x_n = \sin^2(2\pi y_n)$.

This explains the origin of the chaotic behavior as fundamentally embedded the mathematical properties of the digits of irrational numbers, which are of measure 1 among the real numbers.

Chaos is not random, but due to a *deterministic* map $x : A \to B$, satisfying the following properties:

- x is low dimensional, i.e. x is only dependent on a "small" number of variables
- x is deterministic, i.e. the next value can always be predicted exactly
- x is sensitive to initial values, i.e. slight changes in the initial value can drastically change the output
- trajectories of x are reinjected, i.e. although slight differences in initial values can lead to trajectories arbitrarily far apart from each other, there will be a point at which the two trajectories are again arbitrarily close to each other.

0.1 The Diffusion of Innovation

0.1.1 Introduction

The *diffusion of innovation* describes a game of personal preference versus social trends. It answers questions such as "How does a new technology spread?" and "How are new products adopted by people in society?".

Five different categories of adopters can be defined:

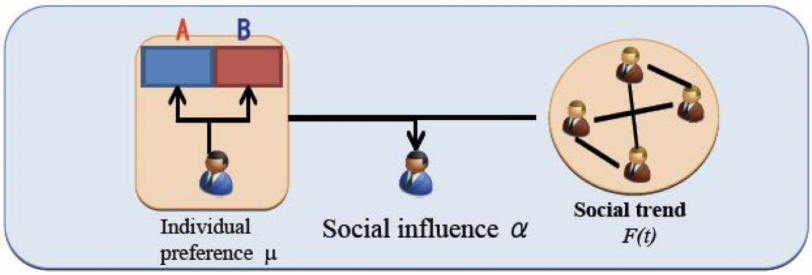
1. Innovators (2.5%) are risk-takers
2. Early adopters (13.5%) are selective
3. Early majority (34%) take their time
4. Late majority (34%) adopt in reaction to peer pressure
5. Laggards (16%) are traditional

The **penetration rate** is like the population size as discussed in Part 1, it follows an S-shaped curve and saturates at 100% when the full population has adopted a new technology. The **penetration speed** is comparable to the production rate, it follows a Gaussian shaped curve.

0.1.2 The Agent Based Model

Let us introduce some definitions:

- $F(t)$ is the **penetration rate,** it is the fraction of population that has adopted new technology, it follows an S-shaped curved and is cumulative
- $F(t+1) - F(t)$ is the **penetration rate,** it is the fraction of the population that adopts the new technology in the following time-step, it follows a Gaussian-shaped curve
- $p(t+1)$ gives the probability that an agent will adopt the new technology in the next time-step



Probability of choosing A at time t

$$p(t+1) = (1-\alpha)\mu + \alpha F(t) \qquad F(t) = A(t)/\{A(t)+B(t)\}$$

preference social trend

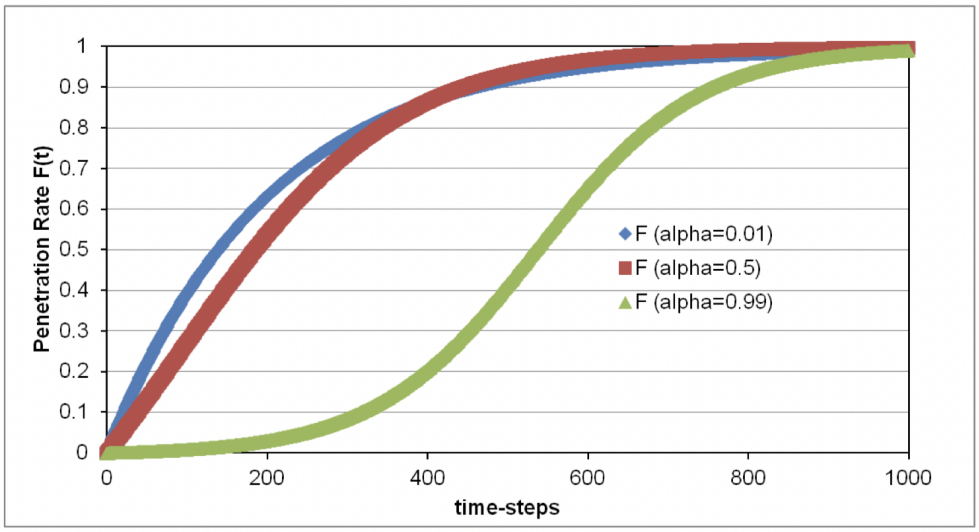
F(t): the proportion of the agents to choose A

$\alpha \in [0, 1]$: social influence factor

More intuitively:

- No personal preference and only social interaction: $\mu = 0$, $F(t+1) = F(t) + \alpha \cdot F(t) \cdot (1 - F(t))$
- Only personal preference and no social interaction: $\alpha = 0$, $F(t+1) = F(t) + \mu \cdot (1 - F(t))$

The following figure shows an example with $\mu = 0.5$:



0.2 Case Study: Valuation of Facebook

The methodology works as follows:

- We model the Monthly Active Users: $MAU(t)$
- We model the revenues per user: $r(t)$
- We define a profit margin: p
- *Profits at time:* $r(t) \cdot MAU(t) \cdot p$
- We define the value of the company as the sum of all the discounted future profits using a discount rate d

In the end, we have:

$$valuation = \sum_{t=1}^{end} \frac{r(t)MAU(t)p}{(1+d)^t} = \sum_{t=1}^{end} \frac{profits(t)}{(1+d)^t}$$

In conclusion, we have developed a new methodology to compute the fundamental value of social networking companies based on the dynamics of their users and revenues per user:

	user's dynamics	rev/user dynamics
Facebook	logistic function	logistic function
Zynga	more complex	more complex

Based on that, we can compute the intrinsic value of social networking companies.
The three *important laws of valuation and investment are:*

- Prediction is no extrapolation, but understanding the underlying process.
- Understand the technicalities of the market and of investment banking.
- Always **RTFM - Read The Fucking Manual!**