MODELING THE SOCIAL GAME OF SCIENCE

when time matters

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What is expected from a scientist?

We don't know, we can only conjecture. Popper, 1934.

A scientist, let him be a theorist or an experimentalist, proposes some statements and test them step-by-step. Popper, 1934.

Few questions:

- How much time do you spend testing your results before publication (adequacy of your model to data, simulation regularities, etc.) (modeled as stopping time for publication - $\lambda$),
- How hard do you test the results or the theories you rely on? (modeled as stopping time for refutation - $\lambda'$),
- What is your propensity to test other's theories rather than going for a new theory? (modeled as a probability to go for new research $\nu$).

Modeling research strategies by ($\nu, \lambda, \lambda'$)
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Modeling research strategies by $(\nu, \lambda, \lambda')$
Theories as items that can be tested empirically

The simplest model of theories landscape: a distribution of Bernoulli variables. Agents have to discover items with $p = 1$. 

*Testing relativity theory by A. Einstein*

Number of successful tests so far: 14

Result of your last test on the theory: √

Number of failures so far: 0

"Publish now, it's a hot topic!"

"Published at Christmas, falsified at Easter."
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**GENERIC PROBLEM : EXPLORATION/EXPLOITATION DILEMMA**
The social game of science

Exploration/exploitation dilemma is influenced by science policies

Model parameters:
The social game of science

Exploration/exploitation dilemma is influenced by science policies

Model parameters:

- **P**: Rewards for a publication

  - **R**: Rewards for a refutation
  - **L**: Loss for being refuted

Nobels are the players with highest payoffs.

Three approaches to agents behaviors

- **Evolutionary game theory**: rational agents. Finding the Nash equilibrium in evolving environment,
- **Multi-agents modeling**: adaptive agents. Mimetic agents updating their strategies when not satisfied: [http://chavalarias.com/Nobel Simulation](http://chavalarias.com/Nobel Simulation)
- **Experimental economics**: humans in games. Multi-players online game: [http://nobelgame.org](http://nobelgame.org)
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Nobel prizes are the players with highest payoffs.

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What are the expected collective dynamics of science?

- **FALSIFIED THEORIES**
  - Theories that have been tested and found to be incorrect.

- **PUBLISHED THEORIES**
  - Theories that have been tested at least λ times to try to falsify them.
  - Examples:
    - Make at most λ tests to try to falsify.
    - Publish if λ tests are successful.

- **THEORIES TO DISCOVER**
  - Theories that have not yet been tested but have a probability of ν being true theories.
  - Examples:
    - ν of true theories.
    - (1-ν) of true theories.
What are the expected collective dynamics of science?

How the individual exploration/exploitation dilemmas translates into a collective exploration/exploitation dilemma?
Stylized facts from modeling approaches

- **Stylized fact 1**: Bigger communities discover slower and publish less (normalized in person/month) but have a highest mean quality for the set of published theories.
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Stylized facts from modeling approaches

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• **Stylized fact 2**: In finite research spaces situations, there is a trade-off between the speed of the discovery and quality of published theories,

• **Stylized fact 3**: An increase in the incentive for publication leads to a decrease in the mean quality of the set of accepted theories.
How to test these predictions empirically?

Be nobel at ISSI 2015!

Play to the Nobel Game at http://nobelgame.org
David CHAVALARIA AND Jean-Baptiste Leenart AND Maziyar Panahi

THANKS FOR YOUR ATTENTION

And please falsify ...

Scientific papers can be found on http://chavalarias.com