Models of Science: An Overview

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Mathematical Approaches

Process characteristics o	Agents interact	Group inte	Proces	Agents	Agents	Interactions
Stochastic processes	Agent-rule bas modelling	Population models (stochastic	Systen dynam Growth	Social analys	Complex network models	
Distributions, Gr	Growth Distributions	Growth Competitio	Compe	Structu perforn	Evolving structures	
Lotka, Price, Egghe/Rousseau Glänzel/Schubert Rogers….	*Gilbert, Grim, Kutcher, …*	*Goffman, Yablonsky, et al. ,…*	*Sterma*	…..	*Barabasi, Newman, Fronczak ….*	

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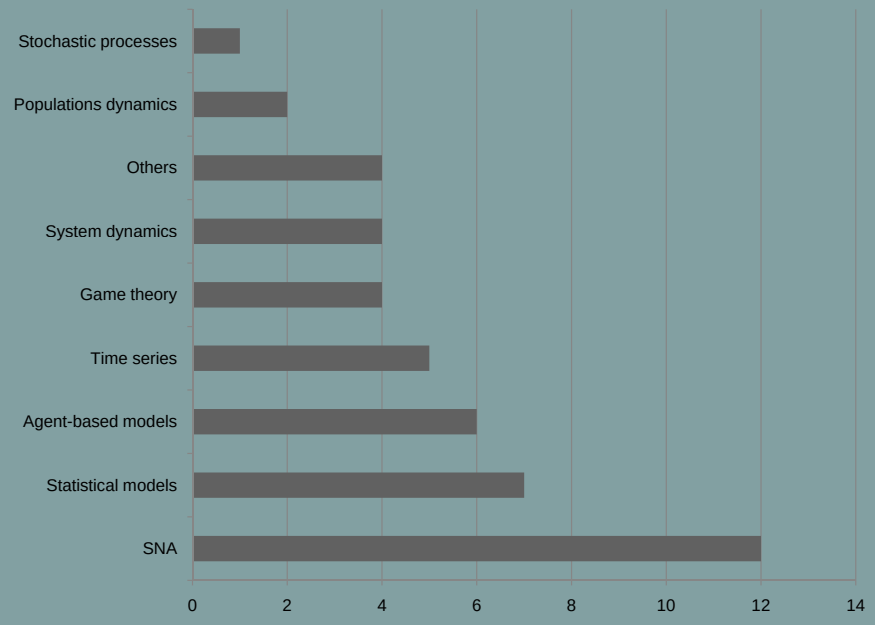
PR^2: Which type of models do you use (mathematical approach)?



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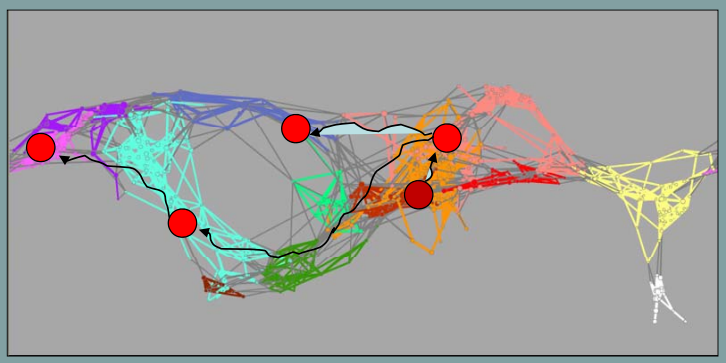
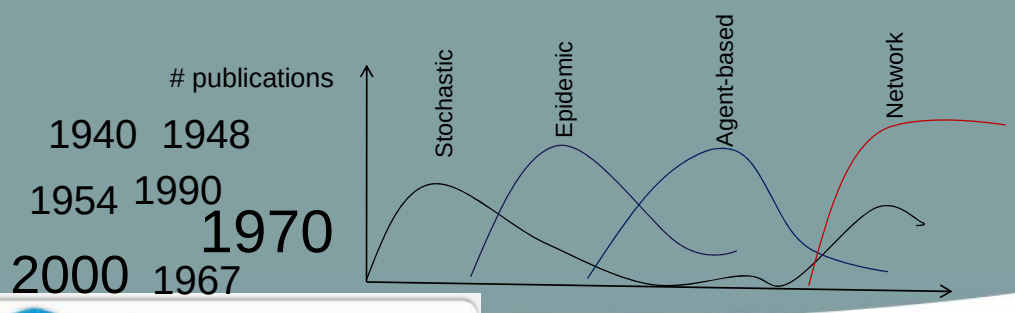
Mathematical Approaches: Origins and Prevalence





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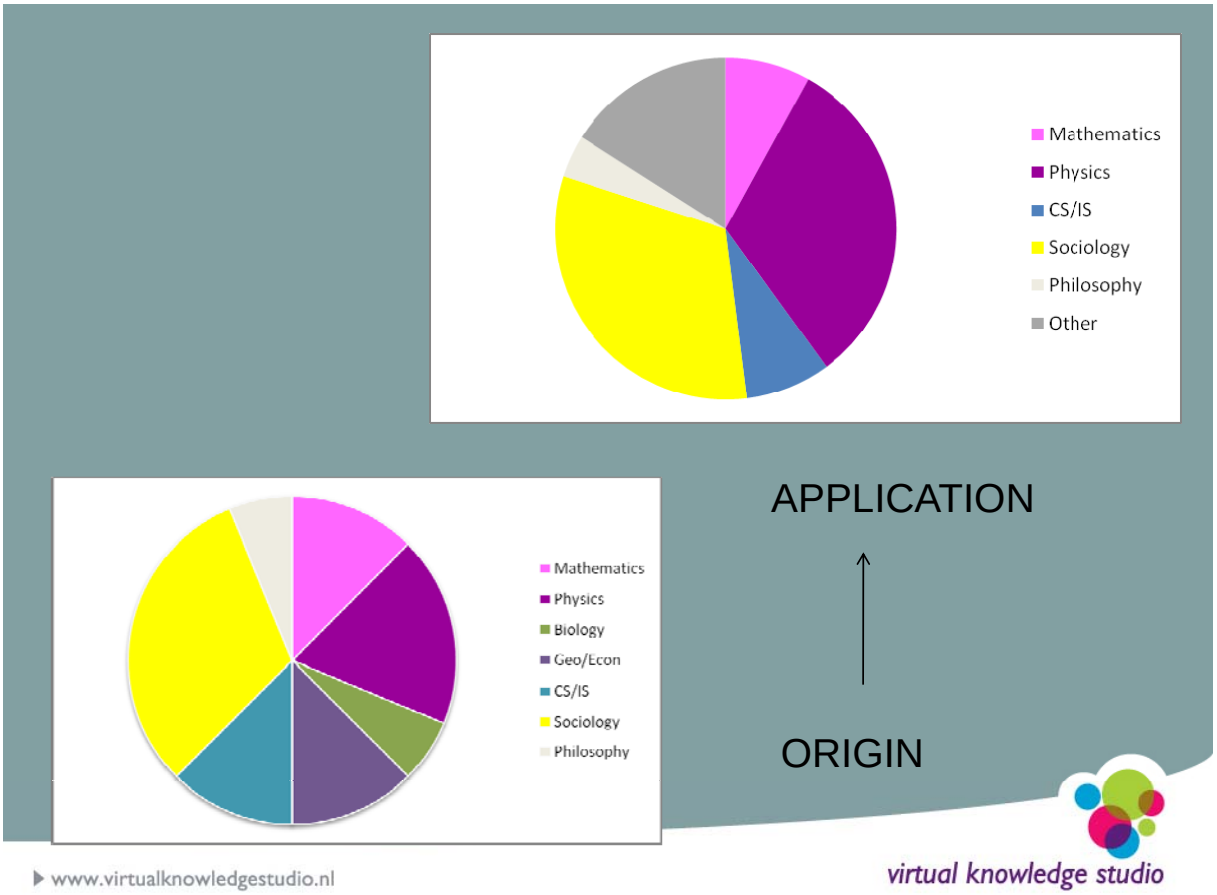


Science of Science Conceptualization(s)

Identify and define major terms and concepts.

Describe science studies/ models in a uniform, replicable way.

See Special Issue of *Journal of Informetrics,*

Science of Science: Conceptualizations and Models of Science

Guest Editors: Katy Börner, Indiana University & Andrea Scharnhorst, Royal Netherlands Academy of Arts and Sciences

This special issue of the journal *Informetrics* aims to improve our understanding of the structure and evolution of science by reviewing and advancing existing conceptualizations and models of scholarly activity.

Existing conceptualizations and models of science have been created by scholars from very different disciplines and backgrounds. They have the form of

- philosophical concepts (Bernal, Kuhn, Popper),
- (utopian) stories (Wells, Lem),
- visual drawings (Otlet),
- empirical measurements (Price, Garfield), or
- mathematical theories (Goffman, Yablonski)

among others.

It is our belief that a theoretically grounded and practically useful shared conceptualization of science can provide the intellectual framework to interlink and puzzle together the hundreds of science models in existence today. This is analogous to how meteorologists or seismologists integrate rather different local weather models or seismic hazard predictions into a global coherent model that has higher predictive value and broader coverage. With this issue we aim to start an interdisciplinary discourse towards a science of science models.

The design of such a conceptualization requires the identification of the

- Boundaries of the system or object.
- Basic building blocks of science, e.g., units of analysis or key actors.
- Interactions of building blocks, e.g., via coupled networks.
- Basic mechanisms of growth and change.
- Existing laws (static and dynamic).

Ideally, the conceptualizations can be also presented in a visual form so that disciplinary and cultural boundaries can be bridged more easily.

Editorial is available at http://ivl.slis.indiana.edu/km/pub/2009-borner-scharnhorst-joi-sos-intro.pdf

Toward a Model Type Taxonomy: PR^2s

Which phenomena/question/effect does your model describe?

- *Phenomena*

Which type of models do you use? Where these models used otherwise, what is their disciplinary origin?

- *Type of models / class of models*

What are the building blocks of your model? What are the main entities/subjects/objects? Which kinds of interaction does the model cover?

- *Operationalization*

How you would characterize your model: as a thought experiment, as an explanation for a measured effect, ...

- *Epistemic purpose*

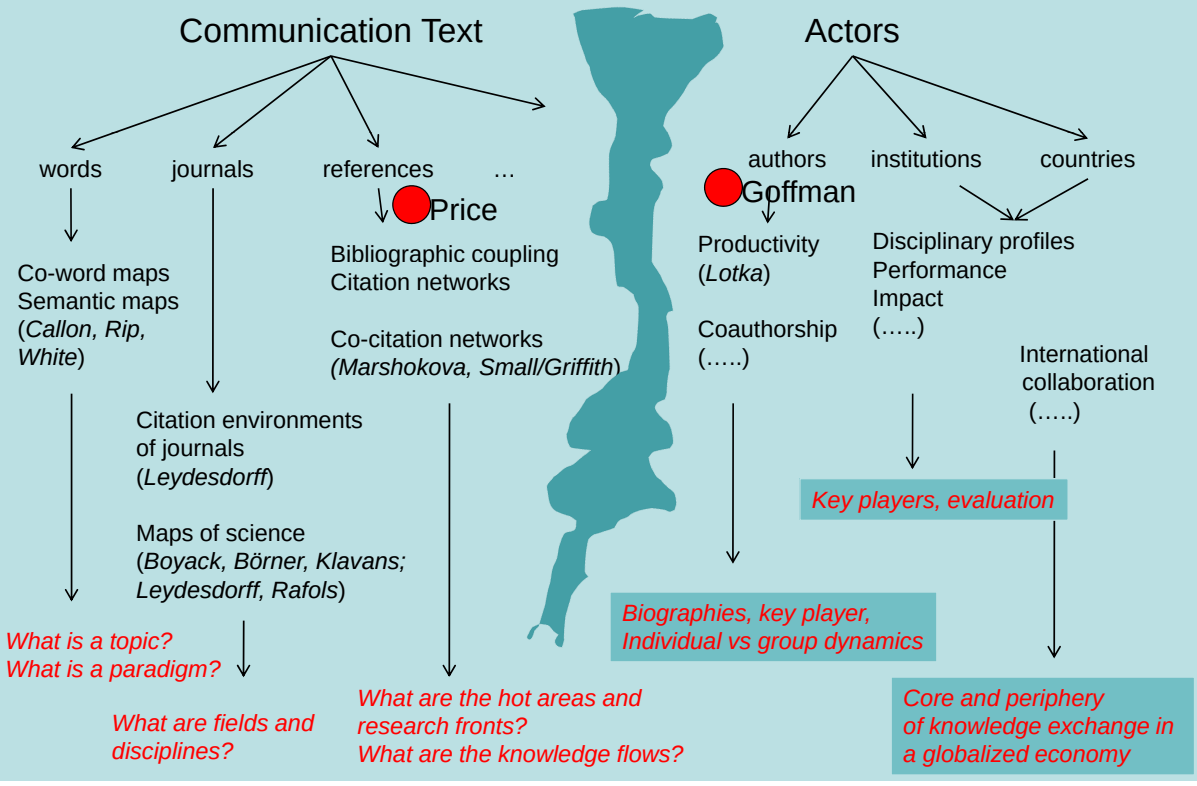
How did you validate your model? (Common sense, theoretical insights, observations, data)

- *Validation approach*

Which visualization you used in the analysis of the phenomena AND the presentation of your model results?

- *Visualization*

Example: Modeled Phenomena/Question/Effect



Scholarly Marketplaces / Inventories of Science Studies/Models

http://dev.epic.slis.indiana.edu

The Quest for a Science Models Inventory

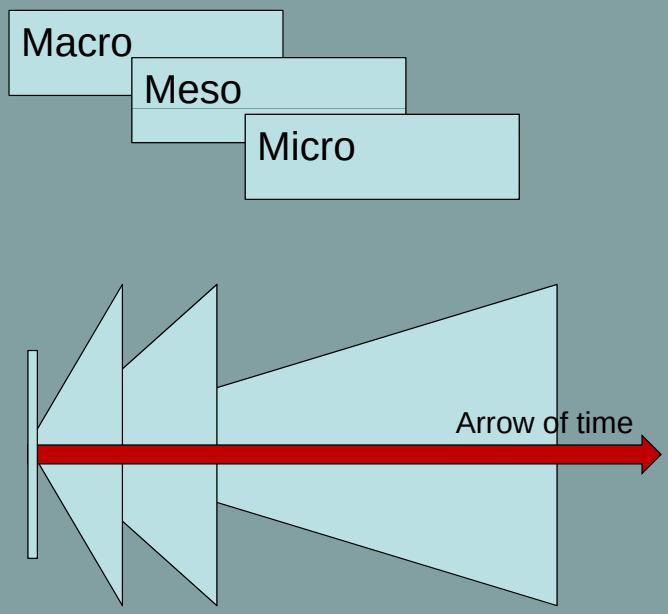
Please download and complete xls form linked from
http://sci.slis.indiana.edu/amsterdam.xls

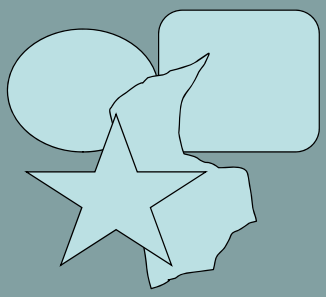
Every morning, we will generate new networks from

- Co-author
- Author-model
- Author-insitution
- Author-software
- Author-data.

THANK YOU!

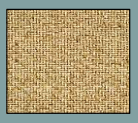
The perspective of scale, time and “specimen”

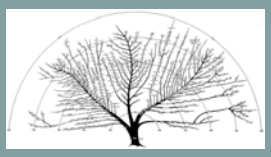




… and many other perspectives

Substrates





Visualizations

Data bases

Software tools