# Models of Science: An Overview

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## Mathematical Approaches

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<th>Process characteristics of Stochastic processes</th>
<th>Agents interacting</th>
<th>Group interaction</th>
<th>Agents Social analysis</th>
<th>Agents Complex models</th>
<th>Interactions Evolving network structures</th>
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<td>Stochastic processes</td>
<td>Agent-rule based modelling</td>
<td>Population models (stochastic)</td>
<td>System dynamics</td>
<td>Growth Competition</td>
<td>Goffman, Yablonsky, et al., ……</td>
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<td>Distributions, Growth Distributions</td>
<td>Growth Distributions</td>
<td>Competition</td>
<td>Structures perform</td>
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<td>Barabasi, Newman, Fronczak, ……</td>
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<td>Lotka, Price, Gilbert, Grim, Kutcher, ……</td>
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<td>Egghe/Rousseau, Glänzel/Schube, Rogers, ……</td>
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</table>
PR^2: Which type of models do you use (mathematical approach)?

**Mathematical Approaches: Origins and Prevalence**

- Stochastic processes
- Populations dynamics
- System dynamics
- Game theory
- Time series
- Agent-based models
- Statistical models
- SNA

# publications
- 1940
- 1948
- 1954
- 1990
- 2000
- 1967
- 1970

[Diagram showing the spread of publications over time and different types of models.]
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*,

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

**Communication Text**
- words
- journals
- references ... Price
- Co-word maps
  - Semantic maps (Callon, Rip, White)
- Bibliographic coupling
  - Citation networks
- Co-citation networks
  - (Marshokova, Small/Griffith)
- Citation environments of journals (Leydesdorff)
- Maps of science
  - (Boyack, Börner, Klavans; Leydesdorff, Rafols)

**Actors**
- authors
  - Price
  - Goffman
  - Productivity (Lotka)
  - Coauthorship (.....)
  - Disciplinary profiles
    - Performance Impact (.....)
  - International collaboration (.....)
- institutions
- countries

**Visualization**
- Key players, evaluation
- Biographies, key player, individual vs group dynamics
- Core and periphery of knowledge exchange in a globalized economy

What is a topic? What is a paradigm? What are fields and disciplines?
- What are the hot areas and research fronts?
- What are the knowledge flows?
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-institution
- Author-software
- Author-data.
The perspective of scale, time and “specimen”
... and many other perspectives

Substrates → Visualizations → Data bases → Software tools

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