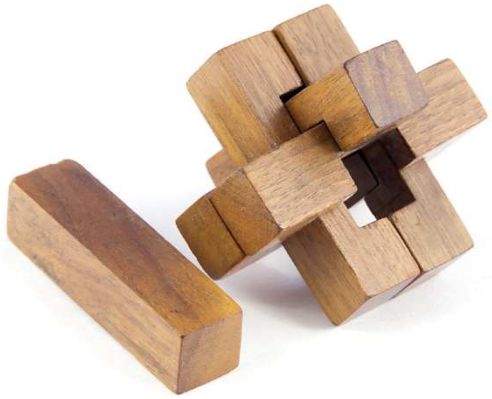

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on Research Impact Assessment

Methodological issues related to the application of bibliometric analyses supporting research management

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RAND EUROPE
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Learning objectives and key messages of the lecture

- Introduce you to bibliometrics in a general manner.
- Show you the basic requirements for conducting bibliometric analyses.
- You will learn about invalid bibliometric measures around.
- ***Build up expertise in bibliometrics before using it !***
- ***Use bibliometrics wisely, and in context !***

Contents of the lecture

- Introduction of bibliometrics and data systems.
- Basic requirements for bibliometric analysis.
- Validity of research assessment, in relation to coverage issues.
- Bibliometric indicators.
- Some conclusions.

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BIBLIOMETRICS AND BIBLIOMETRIC DATA SYSTEMS

Introduction of bibliometrics

- Bibliometrics can be defined as the quantitative analysis of science and technology (development), and the study of cognitive and organizational structures in science and technology.
- Basic for these analyses is the scientific communication between scientists through (mainly) journal publications.
- Key concepts in bibliometrics are ***output*** and ***impact***, as measured through publications and citations.
- Important starting hypothesis in bibliometrics: scientists express, through citations in their scientific publications, a certain degree of ***influence*** of others on their own work.
- By large scale quantification, citations indicate (inter)national ***influence*** or (inter)national ***visibility*** of scientific activity, but should not be interpreted as synonym for 'quality'.

Bibliographic/bibliometric data systems

- In the field we work with three bibliographic databases:
  - Web of Science by Thomson Reuters;
  - Scopus by Elsevier Science;
  - Google Scholar by Google.
- Our WoS database covers the period 1981-2012.
- Some characteristics:
  - Over 39.000.000 publications.
  - Over 470.000.000 citation relations between source papers.
  - Author disambiguation tools, based upon acquired experience.
  - Address cleaning tools, related to the Leiden Ranking.
  - Contains reference sets for journal and field citation data.

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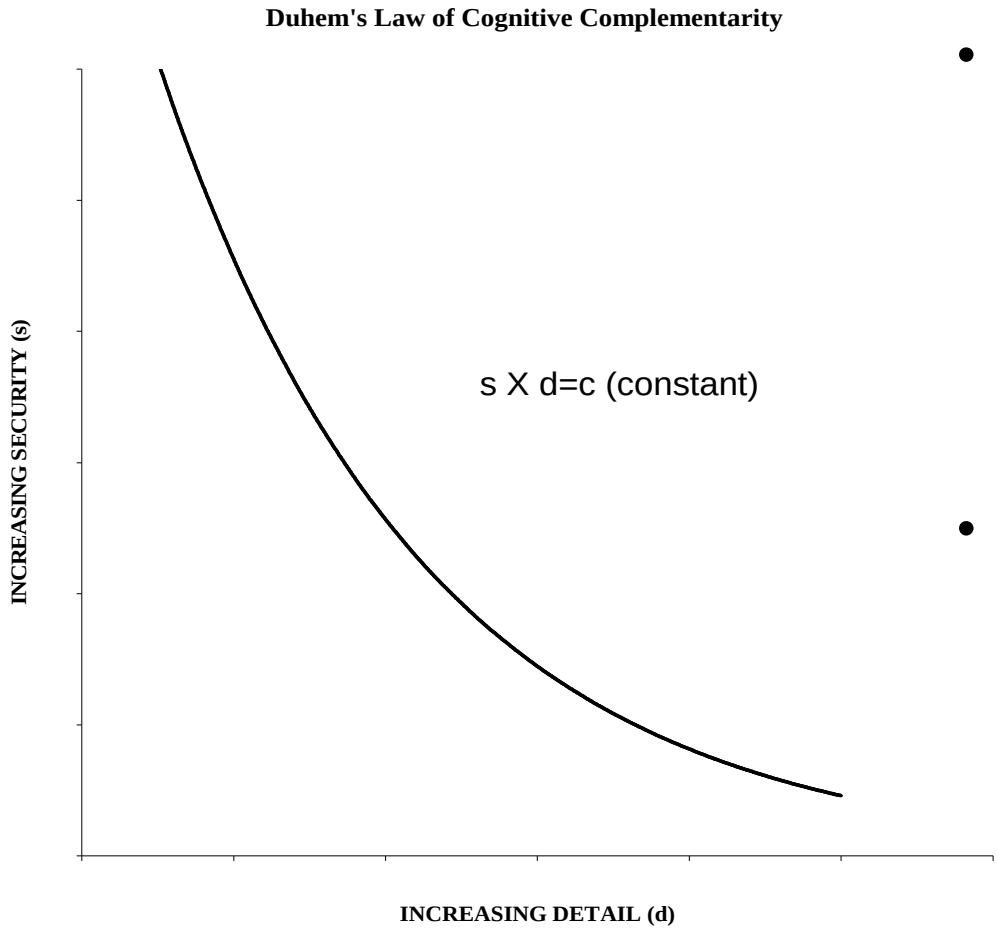
BASIC REQUIREMENTS FOR BIBLIOMETRIC ANALYSIS

As a very first basic requirement !

- Bibliometrics are best embedded in a procedure that also covers peer review (“Informed peer review”).
- Do not apply bibliometrics as a stand-alone tool, without any context.
- As bibliometrics and peer review can reinforce one another, this contextualization is important !

- We estimate the size of the tree at *around* 8 mtr
- We are *quite sure* that the tree is between 6-12 mtr high.
- We are *virtually certain* that ist height is between 3-18 mtr.
- But we can be *completely and absolutely sure* that its height is between 1 mtr and 56 mtr.

Tension between detail and accuracy:
Duhem's *'Law of Cognitive Complementarity'*



- An inverse relationship exists between the precision of our information and its substantiation: detail and security/accuracy stand in a competing relationship !
- Obtained from '*Epistemetrics*' by Nicolas Rescher (2006)

Levels of analysis in bibliometrics

- We distinguish three levels of analysis:
  - ***Macro-level***, e.g. country and region comparison for the EU, Dutch Observatory of S&T.
  - ***Meso-level***, e.g. research organizations, universities, institutes.
  - ***Micro-level***, e.g. analysis of programs, groups, or individual researchers.

Data collection

- Roughly, we can distinguish three methods of the collection of a set of publications
  - ***1) Based on a list of names of researchers***
    (verification through a website creates a valid dataset)
  - ***2) Based on a list of publications of a unit***
    (the supplied lists forms the authorized/verified dataset)
  - ***3) Based on the address of a country or an institute***
    (this approach does not allow lower level insights)

For research assessment purposes, we work most with both the first and the second method.

Various additional types of analysis focus on …

- ***Research profiles****: a break down of the output over various fields of science.*
- ***Scientific cooperation analysis:*** *a break down of the output over various types of scientific collaboration.*
- ***Knowledge user analysis:*** *a break down of the 'responding' output into citing fields, countries or institutions.*
- ***Highly cited paper analysis:*** *which publications are among the most highly cited output (top 10%, 5%, 1%) of the global literature in that same field(s).*
- ***Network analysis:*** *how is the network of partners composed, based on scientific cooperation?*

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VALIDITY OF RESEARCH ASSESSMENT, IN RELATION TO COVERAGE ISSUES

How to define adequate coverage ?

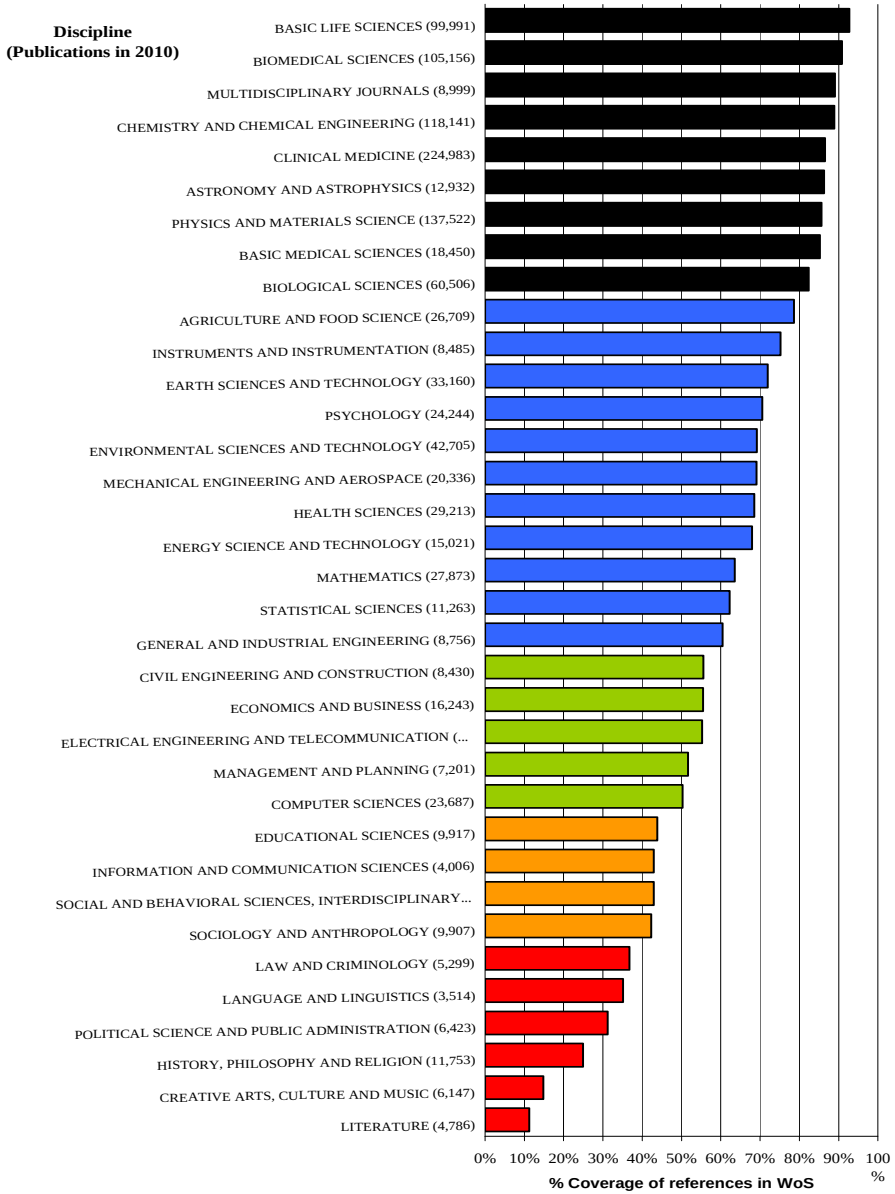
- In order to determine whether metrics applied in assessments are meaningful, one needs to know what is represented through the metrics.

- We distinguish two types of coverage:
  - *Internal* (from inside the perspective of the WoS)
  - *External* (from the perspective of a total output set)

		in WOS
AU	Moed, HF; Garfield, E.	
TI	In basic science the percentage of 'authoritative' references decreases as bibliographies become shorter	
SO	SCIENTOMETRICS 60 (3): 295-303, 2004	Y
RF	ABT HA, J AM SOC INF SCI T, v 53, p 1106, 2004	Y
	GARFIELD, E ING, 1979 (BOOK!)	N
	GARFIELD E, ATION S, v 8, p 403, 1985	N
	GILBERT GN, SOC STUDIES SCI, v 7, p 113, 1977	Y
	MERT	Y
	ROU , 1998	Y
	ZUCKE , p 329, 1987	Y

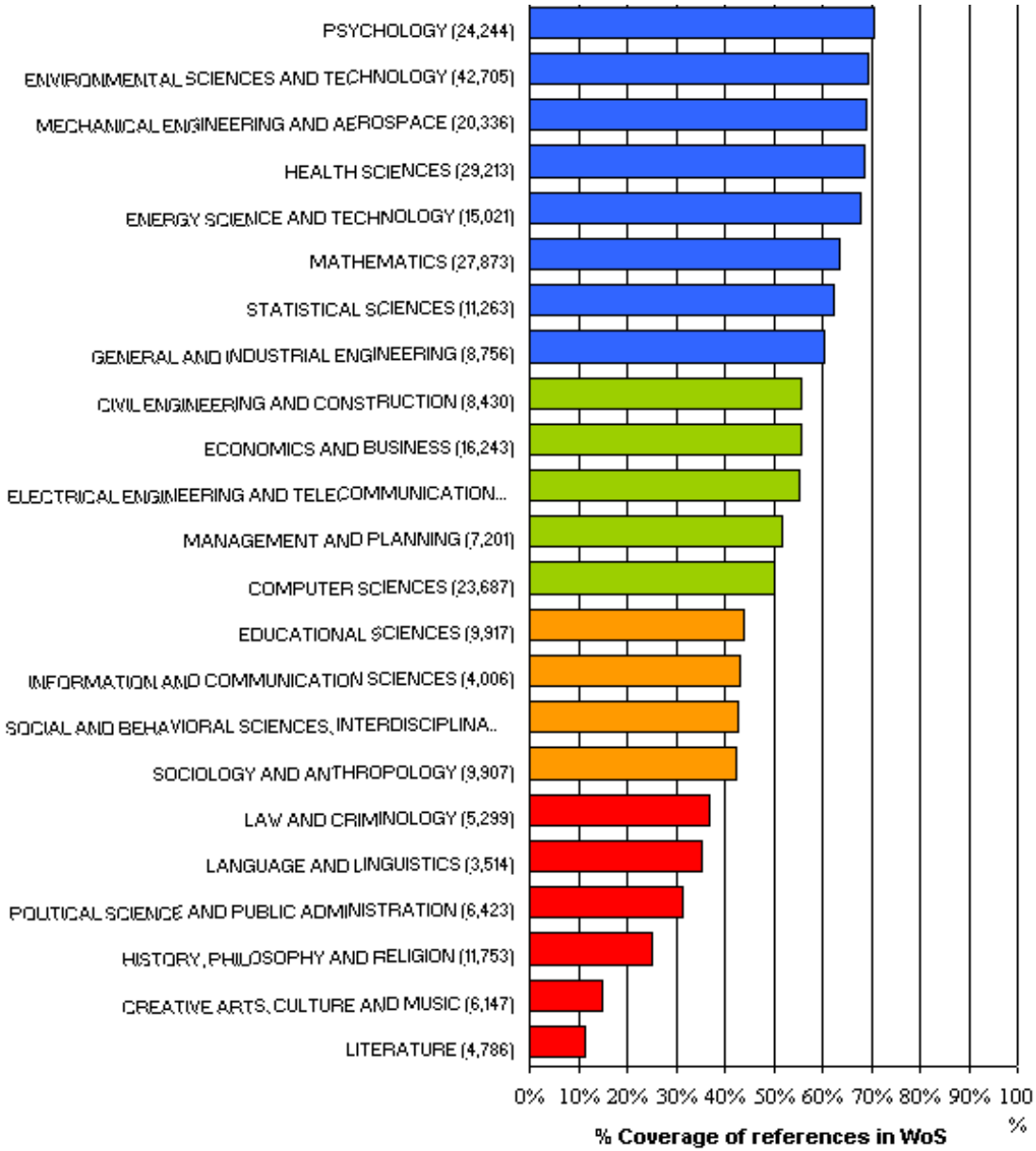
Not in WoS

WoS Coverage = 5/7 = 71%

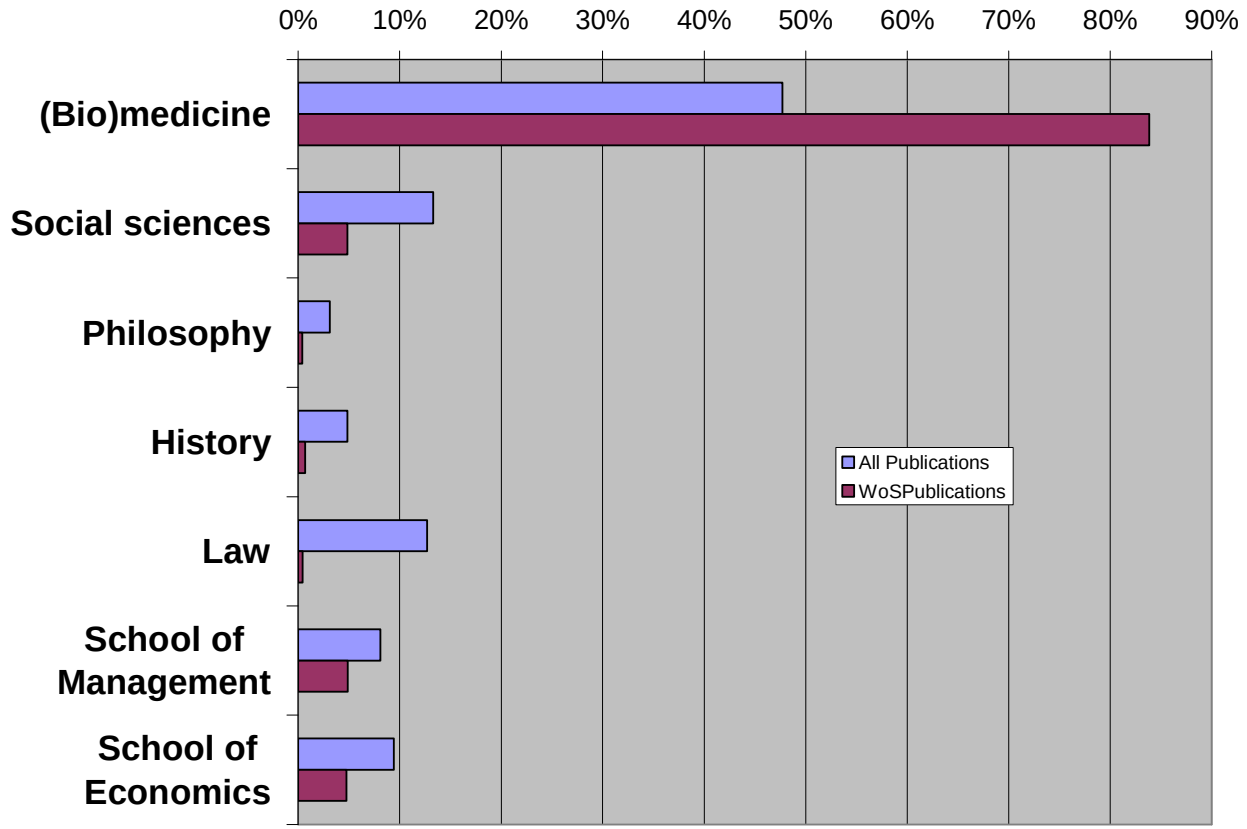


WoS Coverage in 2010 across disciplines

- **Black=Excellent coverage** (>80%)
- **Blue= Good coverage** (between 60-80%)
- **Green= Moderate coverage** (but above 50%)
- **Orange= Moderate coverage** (below 50%, but above 40%)
- **Red= Poor coverage** (highly problematic, below 40%)

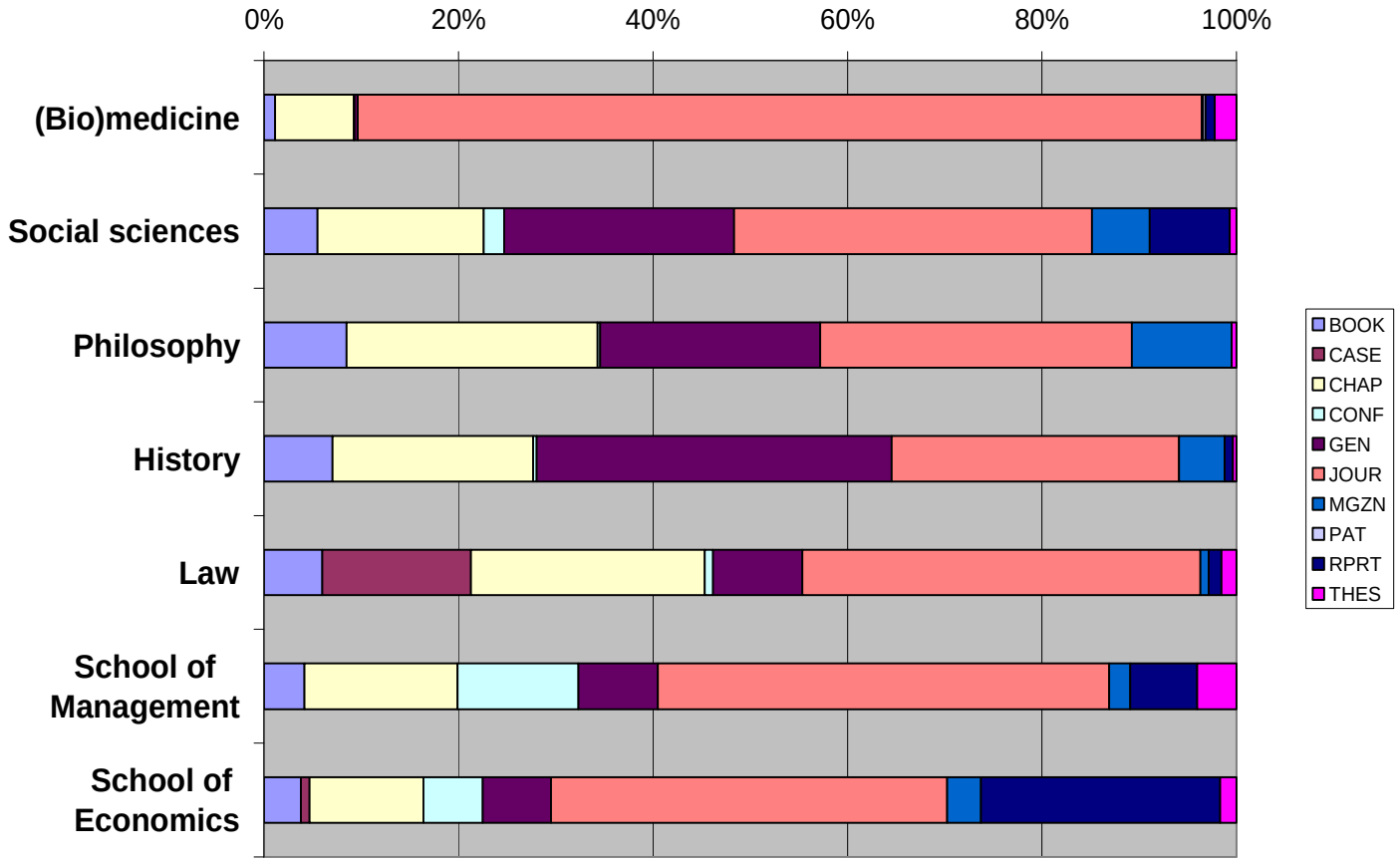

PSYCHOLOGY (24,244)
ENVIRONMENTAL SCIENCES AND TECHNOLOGY (42,705)
MECHANICAL ENGINEERING AND AEROSPACE (20,336)
HEALTH SCIENCES (29,213)
ENERGY SCIENCE AND TECHNOLOGY (15,021)
MATHEMATICS (27,873)
STATISTICAL SCIENCES (11,263)
GENERAL AND INDUSTRIAL ENGINEERING (8,756)
CIVIL ENGINEERING AND CONSTRUCTION (8,430)
ECONOMICS AND BUSINESS (16,243)
ELECTRICAL ENGINEERING AND TELECOMMUNICATION...
MANAGEMENT AND PLANNING (7,201)
COMPUTER SCIENCES (23,687)
EDUCATIONAL SCIENCES (9,917)
INFORMATION AND COMMUNICATION SCIENCES (4,006)
SOCIAL AND BEHAVIORAL SCIENCES, INTERDISCIPLINA...
SOCIOLOGY AND ANTHROPOLOGY (9,907)
LAW AND CRIMINOLOGY (5,299)
LANGUAGE AND LINGUISTICS (3,514)
POLITICAL SCIENCE AND PUBLIC ADMINISTRATION (6,423)
HISTORY, PHILOSOPHY AND RELIGION (11,753)
CREATIVE ARTS, CULTURE AND MUSIC (6,147)
LITERATURE (4,786)
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100 %
% Coverage of references in WoS

External coverage &journal literature



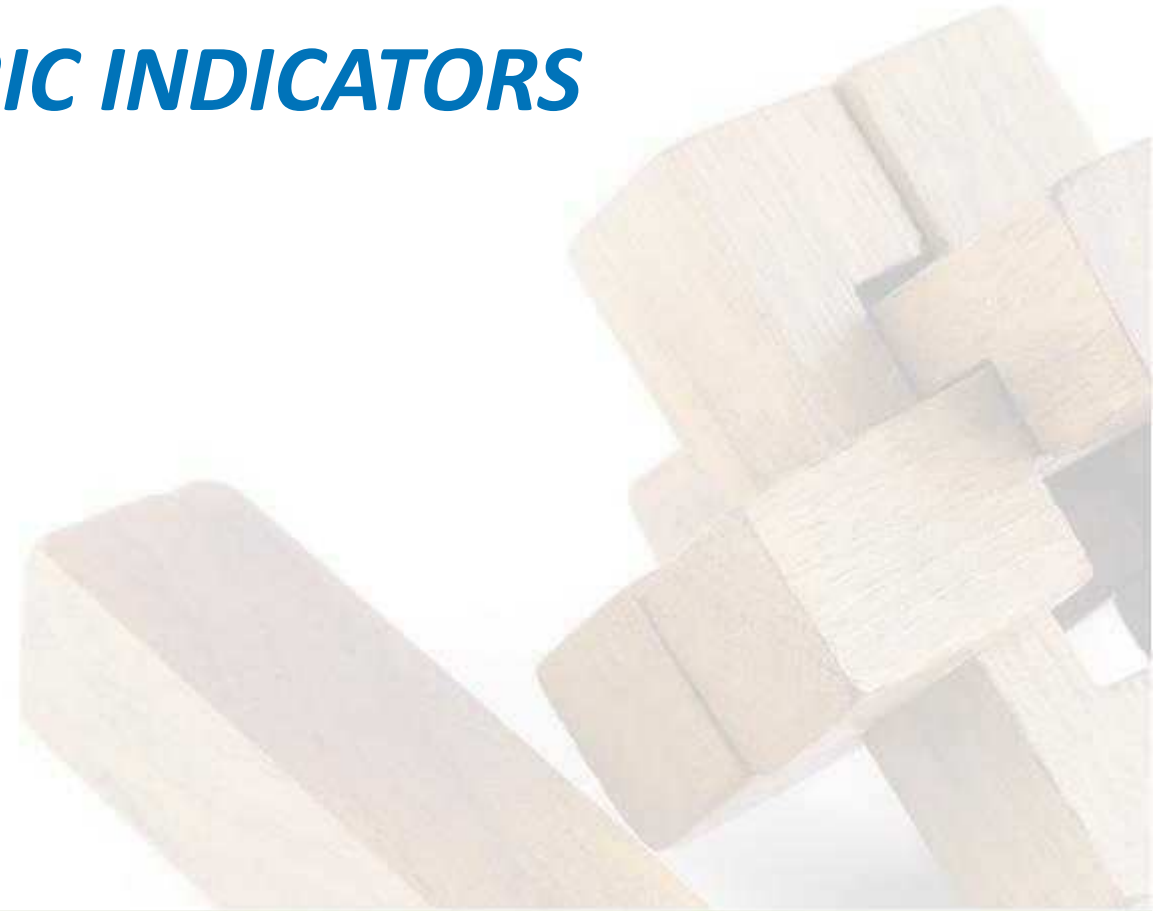
- Production is spread across disciplines.
- In Web of Science, Biomedicine is dominant !

External coverage & journal literature



- We observe a variety of types of output.
- Journal publishing is important in all disciplines !

BIBLIOMETRIC INDICATORS



Definitions of JIF and Hirsch Index

- Definition of JIF:
  - The mean citation score of a journal, determined by dividing all citations in year T by all citable documents in years T-1 and T-2.
- Definition of h-index:
  - The ‘impact’ of a researcher, determined by the number of received citations of an oeuvre, sorted by descending order, where the number of citations equals the rank position.

Problems with JIF

- Some methodological problems of JIF:
  - Was/is calculated erroneously.
  - Not field normalized.
  - Not document type normalized.
  - Underlying citation distributions are highly skewed

- Some conceptual problems of JIF:
  - Inflates the impact of **all** researchers publishing in the journal.
  - Promotes journal publishing, as JIF is easily measured.
  - Stimulates one-indicator thinking.
  - Is based on expected values only, does not relate to reality.
  - Ignores other scholarly virtues.

Problems with H-index

- Some bibliometric-mathematical problems of H-index:
  - Is mathematically inconsistent in its' behavior.
  - Tends to rise only, no decrease possible, and thus conservative by nature.
  - Not field normalized.
- Some bibliometric-methodological problems of H-index:
  - How to define an author?
  - In which bibliographic/metric environment?
- Some conceptual problems of H-index:
  - Is biased against youth, and favors age and experience.
  - Is biased against selective researchers, and favors highly productive scientists.
  - No relationship between H-index and research quality.
  - Ignores other elements of scholarly activity.
  - Promotes one-indicator thinking.

Preferred indicators

- Bibliometric indicators could best reflect actual impact of a unit under study.
- Therefore, compare ***actual*** versus ***expected*** impact.
- Take into account the field, age , and types of document you are dealing with.
- Stay away from “One-Indicator” thinking: preferably use a variety of indicators.

What do we use ?

- MNCS, the Mean Normalized Citation Score, which:
  - Compares ***Actual*** and ***Expected*** impact;
  - Takes into account ***Field*** / ***Age*** / ***Document type***
- We also use MNJS, the Mean Normalized Journal Score.
  - Indicates the impact of a journal in the field(s) to which it belongs.
  - Covers similar characteristics as MNCS

'… and look at other indicators, as P ("total production"), C ("all received citations"), and MCS ("mean impact score").

Some conclusions

- Bibliometrics can play an important role in research performance monitoring and evaluation processes, and particularly in benchmarking of institutions.
- The process of data collection and handling plays a crucial role in obtaining valid data.
- One has to be very careful in the selection of bibliometric indicators, against the light of the purpose they are going to be used for.
- Finally, bibliometric indicators can best be used in an ‘informed peer review’ context, in which experts make final judgments.

We haven't talked about ….

- Field delineation, and the consequences for bibliometric studies.
- The various ways to apply field normalization.
- The phenomenon of document types, and the effects in bibliometric studies.
- Mapping of science.
- Network analyses on scientific communication.

End of the lecture

For further questions regarding the contents of the presentation, mail to:
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