The Signal and the Noise: Separating Genuine Mathematical Influence from Artificially Inflated Metrics.

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Outline of the talk

- ✓ The indicators we trust (and why we shouldn't)
- ✓ From signal to noise: the rise of fake Top 1% institutions
- ✓ Citation fraud: two blatant examples
- ✓ JIRC: a reputation-based correction

Some bibliometrics indicators of research performance.

Top 1%: A field-normalized indicator that measures the number or percentage of a research unit's publications that rank among the top 1% most cited papers in the world. It compares a publication's citation count to similar publications within the same scientific field, publication year, and document type.

Category Normalized Citation Impact (CNCI): Citation impact of a research output relative to the world average, also adjusted for subject field, document type, and publication year. A CNCI of 1.0 represents performance equal to the world average, while values above 1.0 indicate above-average performance.

%Q1: percentage of a research unit's publications in the JCR's first Quartile. It enables comparisons across fields.

h-index: measures productivity and citation impact of a research unit's body of work. A unit has an h-index of h if h is the maximum number of its papers that have at least h citations each. Using it across scientific fields is misguiding.

Institutions by number of Top 1% papers 2000-2004

Affiliations	COUNTRY	2000-2004
Stanford University	USA	42
University of California Berkeley	USA	29
University of California Los Angeles	USA	29
Harvard University	USA	27
University of Minnesota Twin Cities	USA	26
University of Washington Seattle	USA	26
Sorbonne Universite	FRANCE	24
Universite Paris Saclay	FRANCE	22
University of Michigan	USA	21
Princeton University	USA	20
Pennsylvania State University	USA	19
Chinese Academy of Sciences	CHINA MAINLAND	18
Purdue University	USA	17
University of Cambridge	UK	17
Massachusetts Institute of Technology	USA	16
University of Wisconsin Madison	USA	16
Universite PSL	FRANCE	16
Columbia University	USA	15
University of Toronto	CANADA	15
CNRS InstItitute for Mathematical Sciences	FRANCE	15
University of Oxford	UK	15

Institutions by number of Top 1% papers 2010-2014

Affiliations	COUNTRY	2010-2014	2000-2004
Stanford University	USA	60	42
Princeton University	USA	51	20
Massachusetts Institute of Technology	USA	43	16
King Abdulaziz University	**SAUDI ARABIA**	**41**	**0**
Universite Paris Cite	FRANCE	41	7
CNRS InstItitute for Mathematical Sciences	FRANCE	40	15
University of California Berkeley	USA	36	29
University of Texas Austin	USA	35	9
Chinese Academy of Sciences	CHINA MAINLAND	35	18
New York University	USA	34	13
Sorbonne Universite	FRANCE	34	24
University of California Los Angeles	USA	33	29
Harvard University	USA	32	27
University of Minnesota Twin Cities	USA	30	26
Institut Polytechnique de Paris	FRANCE	29	12
University of Oxford	UK	28	15
Duke University	USA	26	14
University of Michigan	USA	25	21
University of Pennsylvania	USA	25	9
Universite PSL	FRANCE	25	16
ETH Zurich	SWITZERLAND	24	10

Institutions by number of Top 1% papers 2020-2024

Affiliations	COUNTRY	2020-2024	2010-2014	2000-2004
China Medical University Taiwan	CHINA TAIWAN	124	0	0
Huzhou University	CHINA MAINLAND	60	0	0
Prince Sattam Bin Abdulaziz University	SAUDI ARABIA	43	0	0
Princess Nourah bint Abdulrahman University	SAUDI ARABIA	39	0	0
Xi'an University of Architecture & Technology	CHINA MAINLAND	33	0	0
University of Craiova	ROMANIA	30	0	0
King Khalid University	SAUDI ARABIA	34	1	0
Changsha University of Science & Technology	CHINA MAINLAND	45	2	0
Henan Polytechnic University	CHINA MAINLAND	41	2	0
Prince Sultan University	SAUDI ARABIA	37	2	0
Hangzhou Normal University	CHINA MAINLAND	67	3	0
Zhejiang Normal University	CHINA MAINLAND	51	3	0
University of Electronic Sci Tech China	CHINA MAINLAND	30	4	0
Central South University	CHINA MAINLAND	38	5	0
Beijing Normal University	CHINA MAINLAND	30	5	0
Cankaya University	TURKEY	46	8	0
Hong Kong Polytechnic University	CHINA HONG KONG	29	9	0
King Abdulaziz University	SAUDI ARABIA	84	41	0
Shanghai Jiao Tong University	**CHINA MAINLAND**	**34**	**13**	**3**
Chinese Academy of Sciences	**CHINA MAINLAND**	**37**	**35**	**18**
Stanford University	**USA**	**35**	**60**	**42**

Institutions by number of Top 1% papers 2023-2025

Numerical Analysis	TOP 1%	Statistics & Probability	TOP 1%
LEBANESE AMERICAN UNIVERSITY	26	QUAID I AZAM UNIVERSITY	14
CHINA MEDICAL UNIVERSITY TAIWAN	26	HUNAN UNIV TECH BUSINESS	14
PRINCE SULTAN UNIVERSITY	24	KING SAUD UNIVERSITY	12
NEAR EAST UNIVERSITY	21	HANGZHOU NORMAL UNIVERSITY	11
HUNAN UNIVERSITY OF TECHNOLOGY	16	STANFORD UNIVERSITY	11
QASSIM UNIVERSITY	16	UNIVERSITY OF CRAIOVA	10
KYUNG HEE UNIVERSITY	15	CENTRAL SOUTH UNIVERSITY	9
PRINCE SATTAM BIN ABDULAZIZ UNIV	15	BEIJING NORMAL UNIVERSITY	9
GUIZHOU UNIV FIN ECON	14	PRINCESS NOURAH BINT ABD UNIV	9
CAIRO UNIVERSITY	14	ZHEJIANG NORMAL UNIVERSITY	9

Functional Analysis	TOP 1%	Pure Mathematics (2020-2025)	TOP 1%
UNIVERSITE 8 MAI 1945 DE GUELMA	11	UNIVERSITE DE MONASTIR	7
CHANDIGARH UNIVERSITY	10	JILIN UNIVERSITY	4
KOHSAR UNIV MURREE	9	NORTHWEST UNIVERSITY XI AN	4
CHINA THREE GORGES UNIVERSITY	7	PRINCETON UNIVERSITY	4
COMSATS UNIVERSITY ISLAMABAD CUI	7	UNIVERSITY OF CALIFORNIA BERKELEY	4
YUZUNCU YIL UNIVERSITY	7	COLUMBIA UNIVERSITY	3
DUZCE UNIVERSITY	6	MAX PLANCK SOCIETY	3
NATL HIGHER SCH TECHNOL ENGN	6	RUTGERS UNIVERSITY NEW BRUNSWICK	3
QASSIM UNIVERSITY	6	UNIVERSITY OF MICHIGAN	3
UNIVERSITY OF JORDAN	5	UNIVERSITY OF OXFORD	3

Bibliometric information in some fields is no longer reliable

- ✓ International league tables create perverse incentives for researchers and institutions.
- ✓ Benchmarking of institutional performance is severely compromised.
- ✓ Individual evaluation using just bibliometric information will end up rewarding misconduct.

Only the Top 1% is compromised?

- ✓ All citation-based metrics are vulnerable. The Top 1% is just the most visible victim.
- ✓ However, the manipulation does not stop there. It trickles down to the rest of the bibliometric indicators.

Best performers %Q1

Name	Country	PUB	%Q1	MDPI	%MDPI
Ajman University	UNITED ARAB EMIRATES	141	85.2	75	53%
University of Malakand	PAKISTAN	139	82.4	44	32%
Alexandria University	EGYPT	117	80.9	64	55%
Near East University	TURKIYE	155	80.6	60	39%
Asia University Taiwan	TAIWAN	106	80.2	41	39%
University Ha'il	SAUDI ARABIA	337	77.4	254	75%
University of Salamanca	SPAIN	187	77.3	82	44%
Menofia University	EGYPT	157	77.3	104	66%
Prince Sultan University	SAUDI ARABIA	533	76.9	198	37%
Sejong University	SOUTH KOREA	279	76.8	208	75%
Princeton University	USA	570	48.3	3	1%
University College London	ENGLAND	426	46.6	16	4%
New York University	USA	391	45.3	1	0%
UC Berkeley	USA	651	45.1	11	2%
Stanford University	USA	611	44.3	10	2%
BCAM	SPAIN	168	43.8	2	1%
Imperial College London	ENGLAND	508	40.6	14	3%
University of Cambridge	ENGLAND	621	40.4	8	1%
MIT	USA	760	40.4	6	1%
University of Oxford	ENGLAND	929	36.1	8	1%
Universite PSL	FRANCE	476	36.0	8	2%

Suspicious citation patterns: citations per citing paper: some anonymized examples from “top” institutions

Institution	Pub	Top 1%	Citations	Citing Art	Ratio
Quaid I Azam Univ	23	6	316	57	5.54
IIT Patna	24	23	1654	348	4.75
Beijing Normal Univ	259	15	4656	1274	3.65
Hangzhou Normal Univ	99	11	1717	473	3.63
Univ Paderborn	164	40	7785	2175	3.58
Jiangsu Univ Sci Tech	55	9	717	206	3.48
Univ Monastir	92	6	1052	309	3.40
Huzhou Univ	224	53	12064	3619	3.33
Hangzhou Normal Univ	33	15	3118	965	3.23
Hangzhou Normal Univ	34	15	3165	1012	3.13
Tiangong Univ	103	24	2869	941	3.05

Range for 80% of mathematicians with more than 20 papers in the period 2015-2024: (**1.1,1.6)**

How to artificially increase the number of citations?

Chu, Yu-Ming	Huzhou Univ	3.33
Zhao, Tie-Hong	Hangzhou Normal Univ	3.23

Citing paper: A review of recent advances in carbon dioxide absorption–stripping by employing a gas–liquid hollow fiber polymeric membrane contactor. December 2022 Polymer Bulletin 80(4).

It cites Zhao's work 20 times and Chu's work 35 times. It also carries 13 citations to Li, C (more later).

HCPs by Zhao and Chu are all in Functional Analysis.
Some examples:

A sharp double inequality involving generalized complete elliptic integral of the first kind. AIMS Math

On some refinements for inequalities involving zero-balanced hypergeometric function. AIMS Math

Sharp bounds for the weighted Holder mean of the zero-balanced generalized complete elliptic integrals. Comput Methods Funct Theory

The citations

1. “the gas–liquid membrane contactor system can be a suitable choice for the absorption and disposal of carbon dioxide gas [213–216]”
2. “large-scale Inorganic membranes are difficult and costly to construct [212, 213, 272–276]”
3. “The gas passes through the shell or tube and the absorbing liquid in the opposite direction through the tube (fiber) or shell [217–219]”
4. “This technology is in the transition stage from laboratories and pilots and transfer to industrial and semi-industrial applications [220–223]”
5. “Due to the independent flow of gas and liquid, there are no problems of dripping, flooding and foaming [224–228]”
6. “The use of membrane contactors has attracted much attention in recent years. In general, the most important advantages of hollow fiber membrane contactors over other traditional contact devices are [229–236]”

Outside the Mathematical Realm

Investigation of Microbial Biofilms during COVID-19 Pandemic: A Bibliometric Analysis, by Ali Salehinasab, et al. 2023 **17 References to Li C**

"The prevalence of K. pneumoniae resistant to carbapenem in patients with COVID-19 was determined to be 0.35–53%, according to the findings by Mędrzycka-Dąbrowska et al. (23)"

[23] Yang M, Li C, et al. Predictive model of convective heat transfer coefficient in bone micro-grinding using nanofluid aerosol cooling. Int Commun Heat Mass Transf., 2021.

Table 2. Most cited global documents based on total citations (TC) per year		
Paper(Author, Year, Source)	Title	Ref
HUAN Y, 2020, FRONT MICROBIOL	Antimicrobial peptides: classification, design, application and research progress in multiple fields	[35]
BALASUBRAMANIAM B, 2021, ACS PHARM TRANSL SCI	Antibacterial and Antiviral Functional Materials: Chemistry and Biological Activity toward Tackling COVID-19-like Pandemics	[36]
NAYAK V, 2021, NEW J CHEM	Potentialities of selenium nanoparticles in biomedical science	[37]
Citations 35-37 from the paper's reference list		
Cui X, Li C, et al., 2023, Tribol Int.	Enhanced grindability and mechanism in the magnetic traction nanolubricant grinding of Ti-6Al-4 V.	[35]
Liu M, Li C, et al., 2023, , Tribol Int.	Mechanism and enhanced grindability of cryogenic air combined with biolubricant grinding titanium alloy.	[36]
Zhang X, Li C, et al. 2023, CCJME	Vegetable oil-based nanolubricants in machining: from physicochemical properties to application.	[37]

The value of the MDPI currency: number of articles published per year

Journal	PUB	YEAR	PUB	Journal
Mathematics	84	2017	40	Annals of Mathematics
	331	2018	33	
	1234	2019	36	
	2241	2020	37	
	3319	2021	34	
	4789	2022	26	
	4954	2023	28	
	4016	2024	38	
	4150	2025	25	

Assessing journal and institution influence through reputation recirculation via citations
Docampo D., Cram. L. (work in progress)

Traditional citation-based metrics are vulnerable to manipulation and fail to account for the prestige of the citing source. Spectral methods (e.g., Pinski-Narin) address this issue for journals.

To screen papers' influence, our algorithm (JIRC) recirculates reputation between journals and institutions through two citation matrices: from institutions to journals (A) and back (B).

The algorithm solves for the dominant eigenvector of the combined system $v = B^T A^T v$, where v is the institutional influence vector, and derives the journal influence vector w, as $w = A^T v$.

20 TOP JOURNALS (JIRC ALGORITHM)

journal	score
ACTA NUMERICA	20.0
PUBLICATIONS MATHEMATIQUES DE L IHES	17.1
ANNALS OF MATHEMATICS	16.6
JOURNAL OF THE AMERICAN MATHEMATICAL SOCIETY	13.1
ACTA MATHEMATICA	11.8
INVENTIONES MATHEMATICAE	11.4
COMMUNICATIONS ON PURE AND APPLIED MATHEMATICS	8.8
DUKE MATHEMATICAL JOURNAL	8.6
PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA	8.2
JOURNAL OF THE EUROPEAN MATHEMATICAL SOCIETY	8.2
SIAM REVIEW	7.8
FORUM OF MATHEMATICS PI	7.4
ANNALS OF PDE	7.3
JOURNAL OF THE ROYAL STATISTICAL SOCIETY SERIES B-STATISTICAL METHODOLOGY	7.3
GEOMETRIC AND FUNCTIONAL ANALYSIS	7.0
ANNALS OF STATISTICS	6.6
CAMBRIDGE JOURNAL OF MATHEMATICS	6.5
ARCHIVE FOR RATIONAL MECHANICS AND ANALYSIS	6.2
ANNALS OF PROBABILITY	6.0
JOURNAL FUR DIE REINE UND ANGEWANDTE MATHEMATIK	5.9

20 TOP INSTITUTIONS (JIRC ALGORITHM)

Institution	score
Institute for Advanced Study - USA	8
Institut Universitaire de France	7.6
Princeton University	7.4
University of Chicago	6.8
Stanford University	6.3
Columbia University	6.2
Scuola Normale Superiore di Pisa	6.2
University of Zurich	6.1
Massachusetts Institute of Technology (MIT)	6
University of Bonn	5.9
University of Basel	5.9
Northwestern University	5.8
Imperial College London	5.7
Brown University	5.7
Leipzig University	5.6
University of Southern California	5.5
University of California Berkeley	5.5
New York University	5.5
California Institute of Technology	5.5
Universite PSL	5.5

2023-2025: Top journals by number of TOP 1% articles

JOURNAL	top 1%	Publisher	JIRC_SCORE
MATHEMATICS	229	MDPI	0.33
FRACTAL AND FRACTIONAL	117	MDPI	0.63
AIMS MATHEMATICS	91	AIMS	0.36
FRACTALS-COMPLEX GEOMETRY PATTERNS AND SCALING...	53	WORLD SCIENTIFIC PUBL	0.24
APPLIED MATHEMATICS AND COMPUTATION	44	ELSEVIER	0.76
MATHEMATICAL METHODS IN THE APPLIED SCIENCES	41	WILEY	0.59
QUALITATIVE THEORY OF DYNAMICAL SYSTEMS	38	SPRINGER	0.41
APPLIED MATHEMATICS LETTERS	37	ELSEVIER	1.18
JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS	34	ELSEVIER	1.16
JOURNAL OF APPLIED MATHEMATICS AND COMPUTING	32	SPRINGER	0.52
AXIOMS	32	MDPI	0.32
COMPUTATIONAL & APPLIED MATHEMATICS	32	SPRINGER	0.51
SYMMETRY-BASEL	30	MDPI	0.47
ACTA NUMERICA	6	CAMBRIDGE UNIV PRESS	20.00
PUBLICATIONS MATHEMATIQUES DE L IHES	0	IHES Univ Paris-Saclay	17.07
ANNALS OF MATHEMATICS	10	Princeton Univ	16.64
JOURNAL OF THE AMERICAN MATHEMATICAL SOCIETY	2	AMER MATH SOC	13.12
ACTA MATHEMATICA	2	INT PRESS BOSTON, INC	11.78
INVENTIONES MATHEMATICAE	6	SPRINGER	11.42

2023-2025: Top institutions by number of TOP 1% articles

Institution	top 1%	Country	JIRC_SCORE
China Medical University Taiwan	41	TAIWAN	1.5
Zhejiang Normal University	36	CHINA MAINLAND	2.1
King Abdulaziz University	36	SAUDI ARABIA	1.5
King Saud University	35	SAUDI ARABIA	1.3
Prince Sultan University	35	SAUDI ARABIA	1.6
Lebanese American University	33	LEBANON	1.2
Qassim University	33	SAUDI ARABIA	1.1
Quaid I Azam University	27	PAKISTAN	1.1
Imam Mohammad Ibn Saud Islamic University (IMSIU)	27	SAUDI ARABIA	1.2
Prince Sattam Bin Abdulaziz University	26	SAUDI ARABIA	1.3
Cairo University	25	EGYPT	1.7
Princess Nourah bint Abdulrahman University	25	SAUDI ARABIA	1.5
Near East University	25	TURKIYE	1.3
Institute for Advanced Study - USA	3	USA	8.00
Institut Universitaire de France	0	FRANCE	7.60
Princeton University	9	USA	7.40
University of Chicago	4	USA	6.80
Stanford University	13	USA	6.30
Columbia University	6	USA	6.20
Scuola Normale Superiore di Pisa	0	ITALY	6.20

JIRC screening results

- Weigh the citations by quality of journal and institution.
- In-field influence: only citations from math journals count.
- Control: 150 Fields, Abel, other prizes, ERC grant holders.
  Test: 150 researchers showing more than 10 HCPs.

Number of researchers per group and tier		
Groups: Control (Green), Test (Blue)		
First Tier (1-100)	Third Tier (201-300)	Group
88	5	C
12	95	T

What can we do?

- ✓ First thing first: acknowledge the problem.
- ✓ Do whatever it takes to prevent this malaise to spread in our scientific community. At least:
  - ✓ Report suspicious citation patterns in peer review, and demand action from editors and publishers.
  - ✓ Penalize substantial MDPI and similar publishers' article counts when hiring and promoting.
- ✓ Look for ways to restore trust in bibliometric information.