CWTS Meaningful metrics

CWTS Leiden Ranking 2013

Methodology

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Data collection

The CWTS Leiden Ranking 2013 is based on data from the Web of Science bibliographic database produced by Thomson Reuters. The ranking includes the 500 universities worldwide with the largest publication output in the Web of Science database. Although the ranking is limited to universities, it does include organizations directly related to universities, in particular hospitals associated with universities. Changes in the organizational structures of universities up to 2012 have been taken into account.

Below, a summary of the data collection methodology of the CWTS Leiden Ranking 2013 is provided. It should be emphasized that in general publications have been assigned to universities on the basis of the institutional affiliations of authors as indicated in their publications. For most universities, the results of the data collection have not been verified by the university itself.

The procedure for assigning publications to universities consists of two rounds. These two rounds are discussed below.

First round

In the first round of the publication assignment procedure, addresses have been identified that explicitly mention the name of a university or one of its components. Abbreviations, (non-English) name variants, and spelling variations have been taken into account. A key challenge is the handling of publications originating from research institutes and hospitals associated with universities. Many researchers who are formally employed by a university work in an affiliated hospital or research institute. In publications, they therefore may provide only their institute's or hospital's address, without mentioning the university's name. However, as these researchers are formally employed by the university, their publications should be attributed to the university.

Second round

Relations between universities and hospitals vary among national academic systems. In some countries, an academic hospital is an integral part of a university. In others, hospitals can be autonomous organizations that may collaborate with one or more universities in differing degrees and modalities. In these cases, plainly assigning all

hospital publications to universities would be a misrepresentation of the complex research practice and could have serious effects on international comparisons.

In the second round of the publication assignment procedure, publications from hospitals with university affiliations have been partly assigned to universities, based on an author affiliation analysis. A publication from an academic hospital has been assigned to a university if one or more authors of the publication exhibit a strong collaboration link with the university, that is, if the name of the university is mentioned in at least half of the author's publications.

Data quality

The assignment of publications to universities is not free of errors, because it has been done partly by hand and also because the second round of affiliation analysis can involve inaccuracies. There are generally two types of errors: 'false positives', which are publications that have been assigned to a university while in fact they do not belong to this university, and 'false negatives', which are publications that have not been assigned to a university while in fact they should have been. Considerably more false negatives than false positives should be expected, especially since the 5% least frequently occurring addresses in the database may not have been manually checked. This can be considered a reasonable upper bound for errors, since the majority of these probably are non-university addresses.

Fields of science

Five broad fields of science are distinguished in the CWTS Leiden Ranking 2013:

1. Biomedical and health sciences
2. Life and earth sciences
3. Mathematics and computer science
4. Natural sciences and engineering
5. Social sciences and humanities

Each of the above fields is defined as a collection of journal subject categories in the Web of Science database. A publication is assigned to a field based on the subject category (or categories) of the journal in which the publication has appeared. For instance, a publication in the *American Economic Review* is assigned to the *Social sciences and humanities* field because the *American Economic Review* belongs to the *Economics* subject category and this subject category in turn has been assigned to the *Social sciences and humanities* field. Some publications belong to more than one field. This is the case if a publication has appeared in a journal that belongs to multiple subject categories and if these subject categories do not belong to the same field. Publications belonging to more than one field are assigned fractionally to fields. This for instance means that a publication belonging to two fields may be counted as half a publication in each field. Publications in general multidisciplinary journals such as *Nature*, *PNAS*, and *Science* are assigned to a field based on their referencing behavior. For instance, if most of the references in a publication in Science point to publications in the *Economics* subject category, the publication is considered to also belong to this subject category and is therefore assigned to the *Social sciences and humanities* field.

The assignment of Web of Science journal subject categories to the above five broad fields of science is shown in the table below.

Field	Journal subject category
Biomedical and health sciences	allergy
Biomedical and health sciences	anatomy & morphology
Biomedical and health sciences	andrology
Biomedical and health sciences	anesthesiology
Biomedical and health sciences	audiology & speech-language pathology
Biomedical and health sciences	biochemical research methods

Biomedical and health sciences	biochemistry & molecular biology
Biomedical and health sciences	biophysics
Biomedical and health sciences	cardiac & cardiovascular systems
Biomedical and health sciences	cell & tissue engineering
Biomedical and health sciences	cell biology
Biomedical and health sciences	chemistry, medicinal
Biomedical and health sciences	clinical neurology
Biomedical and health sciences	critical care medicine
Biomedical and health sciences	dentistry/oral surgery & medicine
Biomedical and health sciences	dermatology
Biomedical and health sciences	developmental biology
Biomedical and health sciences	emergency medicine
Biomedical and health sciences	endocrinology & metabolism
Biomedical and health sciences	engineering, biomedical
Biomedical and health sciences	gastroenterology & hepatology
Biomedical and health sciences	genetics & heredity
Biomedical and health sciences	geriatrics & gerontology
Biomedical and health sciences	health care sciences & services
Biomedical and health sciences	hematology
Biomedical and health sciences	immunology
Biomedical and health sciences	infectious diseases
Biomedical and health sciences	integrative & complementary medicine
Biomedical and health sciences	materials science, biomaterials
Biomedical and health sciences	medical informatics
Biomedical and health sciences	medical laboratory technology
Biomedical and health sciences	medicine, general & internal
Biomedical and health sciences	medicine, legal
Biomedical and health sciences	medicine, research & experimental
Biomedical and health sciences	neuroimaging
Biomedical and health sciences	neurosciences
Biomedical and health sciences	nursing
Biomedical and health sciences	nutrition & dietetics
Biomedical and health sciences	obstetrics & gynecology
Biomedical and health sciences	oncology
Biomedical and health sciences	ophthalmology
Biomedical and health sciences	orthopedics
Biomedical and health sciences	otorhinolaryngology
Biomedical and health sciences	pathology
Biomedical and health sciences	pediatrics
Biomedical and health sciences	peripheral vascular disease

Biomedical and health sciences	pharmacology & pharmacy
Biomedical and health sciences	physiology
Biomedical and health sciences	primary health care
Biomedical and health sciences	psychiatry
Biomedical and health sciences	public, environmental & occupational health
Biomedical and health sciences	radiology, nuclear medicine & medical imaging
Biomedical and health sciences	rehabilitation
Biomedical and health sciences	reproductive biology
Biomedical and health sciences	respiratory system
Biomedical and health sciences	rheumatology
Biomedical and health sciences	sport sciences
Biomedical and health sciences	substance abuse
Biomedical and health sciences	surgery
Biomedical and health sciences	toxicology
Biomedical and health sciences	transplantation
Biomedical and health sciences	tropical medicine
Biomedical and health sciences	urology & nephrology
Biomedical and health sciences	virology
Life and earth sciences	agricultural engineering
Life and earth sciences	agriculture, dairy & animal science
Life and earth sciences	agriculture, multidisciplinary
Life and earth sciences	agronomy
Life and earth sciences	behavioral sciences
Life and earth sciences	biodiversity conservation
Life and earth sciences	biology
Life and earth sciences	biotechnology & applied microbiology
Life and earth sciences	ecology
Life and earth sciences	engineering, environmental
Life and earth sciences	entomology
Life and earth sciences	environmental sciences
Life and earth sciences	evolutionary biology
Life and earth sciences	fisheries
Life and earth sciences	food science & technology
Life and earth sciences	forestry
Life and earth sciences	geochemistry & geophysics
Life and earth sciences	geography, physical
Life and earth sciences	geology
Life and earth sciences	geosciences, multidisciplinary
Life and earth sciences	horticulture
Life and earth sciences	imaging science & photographic technology

Life and earth sciences	limnology
Life and earth sciences	marine & freshwater biology
Life and earth sciences	mathematical & computational biology
Life and earth sciences	meteorology & atmospheric sciences
Life and earth sciences	microbiology
Life and earth sciences	mineralogy
Life and earth sciences	mycology
Life and earth sciences	oceanography
Life and earth sciences	ornithology
Life and earth sciences	paleontology
Life and earth sciences	parasitology
Life and earth sciences	plant sciences
Life and earth sciences	remote sensing
Life and earth sciences	soil science
Life and earth sciences	veterinary sciences
Life and earth sciences	water resources
Life and earth sciences	zoology
Mathematics and computer science	automation & control systems
Mathematics and computer science	computer science, artificial intelligence
Mathematics and computer science	computer science, cybernetics
Mathematics and computer science	computer science, hardware & architecture
Mathematics and computer science	computer science, information systems
Mathematics and computer science	computer science, interdisciplinary applications
Mathematics and computer science	computer science, software engineering
Mathematics and computer science	computer science, theory & methods
Mathematics and computer science	engineering, electrical & electronic
Mathematics and computer science	engineering, industrial
Mathematics and computer science	engineering, manufacturing
Mathematics and computer science	logic
Mathematics and computer science	mathematics
Mathematics and computer science	mathematics, applied
Mathematics and computer science	mathematics, interdisciplinary applications
Mathematics and computer science	operations research & management science
Mathematics and computer science	robotics
Mathematics and computer science	statistics & probability
Mathematics and computer science	telecommunications
Mathematics and computer science	transportation science & technology
Natural sciences and engineering	acoustics
Natural sciences and engineering	astronomy & astrophysics
Natural sciences and engineering	chemistry, analytical

Natural sciences and engineering	chemistry, applied
Natural sciences and engineering	chemistry, inorganic & nuclear
Natural sciences and engineering	chemistry, multidisciplinary
Natural sciences and engineering	chemistry, organic
Natural sciences and engineering	chemistry, physical
Natural sciences and engineering	construction & building technology
Natural sciences and engineering	crystallography
Natural sciences and engineering	electrochemistry
Natural sciences and engineering	energy & fuels
Natural sciences and engineering	engineering, aerospace
Natural sciences and engineering	engineering, chemical
Natural sciences and engineering	engineering, civil
Natural sciences and engineering	engineering, geological
Natural sciences and engineering	engineering, marine
Natural sciences and engineering	engineering, mechanical
Natural sciences and engineering	engineering, multidisciplinary
Natural sciences and engineering	engineering, ocean
Natural sciences and engineering	engineering, petroleum
Natural sciences and engineering	instruments & instrumentation
Natural sciences and engineering	materials science, ceramics
Natural sciences and engineering	materials science, characterization & testing
Natural sciences and engineering	materials science, coatings & films
Natural sciences and engineering	materials science, composites
Natural sciences and engineering	materials science, multidisciplinary
Natural sciences and engineering	materials science, paper & wood
Natural sciences and engineering	materials science, textiles
Natural sciences and engineering	mechanics
Natural sciences and engineering	metallurgy & metallurgical engineering
Natural sciences and engineering	microscopy
Natural sciences and engineering	mining & mineral processing
Natural sciences and engineering	nanoscience & nanotechnology
Natural sciences and engineering	nuclear science & technology
Natural sciences and engineering	optics
Natural sciences and engineering	physics, applied
Natural sciences and engineering	physics, atomic, molecular & chemical
Natural sciences and engineering	physics, condensed matter
Natural sciences and engineering	physics, fluids & plasmas
Natural sciences and engineering	physics, mathematical
Natural sciences and engineering	physics, multidisciplinary
Natural sciences and engineering	physics, nuclear

Natural sciences and engineering	physics, particles & fields
Natural sciences and engineering	polymer science
Natural sciences and engineering	spectroscopy
Natural sciences and engineering	thermodynamics
Social sciences and humanities	agricultural economics & policy
Social sciences and humanities	anthropology
Social sciences and humanities	archaeology
Social sciences and humanities	architecture
Social sciences and humanities	area studies
Social sciences and humanities	art
Social sciences and humanities	asian studies
Social sciences and humanities	business
Social sciences and humanities	business, finance
Social sciences and humanities	classics
Social sciences and humanities	communication
Social sciences and humanities	criminology & penology
Social sciences and humanities	cultural studies
Social sciences and humanities	dance
Social sciences and humanities	demography
Social sciences and humanities	economics
Social sciences and humanities	education & educational research
Social sciences and humanities	education, scientific disciplines
Social sciences and humanities	education, special
Social sciences and humanities	environmental studies
Social sciences and humanities	ergonomics
Social sciences and humanities	ethics
Social sciences and humanities	ethnic studies
Social sciences and humanities	family studies
Social sciences and humanities	film, radio, television
Social sciences and humanities	folklore
Social sciences and humanities	geography
Social sciences and humanities	gerontology
Social sciences and humanities	health policy & services
Social sciences and humanities	history
Social sciences and humanities	history & philosophy of science
Social sciences and humanities	history of social sciences
Social sciences and humanities	hospitality, leisure, sport & tourism
Social sciences and humanities	humanities, multidisciplinary
Social sciences and humanities	industrial relations & labor
Social sciences and humanities	information science & library science

Social sciences and humanities	international relations
Social sciences and humanities	language & linguistics theory
Social sciences and humanities	law
Social sciences and humanities	linguistics
Social sciences and humanities	literary reviews
Social sciences and humanities	literary theory & criticism
Social sciences and humanities	literature
Social sciences and humanities	literature, african, australian, canadian
Social sciences and humanities	literature, american
Social sciences and humanities	literature, british isles
Social sciences and humanities	literature, german, dutch, scandinavian
Social sciences and humanities	literature, romance
Social sciences and humanities	literature, slavic
Social sciences and humanities	management
Social sciences and humanities	medical ethics
Social sciences and humanities	medieval & renaissance studies
Social sciences and humanities	music
Social sciences and humanities	philosophy
Social sciences and humanities	planning & development
Social sciences and humanities	poetry
Social sciences and humanities	political science
Social sciences and humanities	psychology, applied
Social sciences and humanities	psychology, biological
Social sciences and humanities	psychology, clinical
Social sciences and humanities	psychology, developmental
Social sciences and humanities	psychology, educational
Social sciences and humanities	psychology, experimental
Social sciences and humanities	psychology, mathematical
Social sciences and humanities	psychology, multidisciplinary
Social sciences and humanities	psychology, psychoanalysis
Social sciences and humanities	psychology, social
Social sciences and humanities	public administration
Social sciences and humanities	religion
Social sciences and humanities	social issues
Social sciences and humanities	social sciences, biomedical
Social sciences and humanities	social sciences, interdisciplinary
Social sciences and humanities	social sciences, mathematical methods
Social sciences and humanities	social work
Social sciences and humanities	sociology
Social sciences and humanities	theater

Social sciences and humanities	transportation
Social sciences and humanities	urban studies
Social sciences and humanities	women's studies

Indicators

The CWTS Leiden Ranking 2013 is based on publications in Thomson Reuters' Web of Science database in the period 2008–2011. Book publications, publications in conference proceedings, and publications in journals not indexed in the Web of Science database are not included. Only publications of the Web of Science document types *article* and *review* are considered in the Leiden Ranking.

Impact indicators

The Leiden Ranking offers the following indicators of the scientific impact of a university:

- *MCS (mean citation score)*. The average number of citations of the publications of a university.
- *MNCS (mean normalized citation score)*. The average number of citations of the publications of a university, normalized for field differences and publication year. An MNCS value of two for instance means that the publications of a university have been cited twice above world average.
- *PP(top 10%) (proportion of top 10% publications)*. The proportion of the publications of a university that, compared with other publications in the same field and in the same year, belong to the top 10% most frequently cited.

Citations are counted until the end of 2012 in the above indicators. Author self citations are excluded. The PP(top 10%) indicator is more stable than the MNCS indicator, and we therefore regard the PP(top 10%) indicator as the most important impact indicator of the Leiden Ranking.

Collaboration indicators

The following indicators of scientific collaboration are provided in the Leiden Ranking:

- *PP(collab) (proportion of interinstitutional collaborative publications).* The proportion of the publications of a university that have been co-authored with one or more other organizations.
- *PP(int collab) (proportion of international collaborative publications).* The proportion of the publications of a university that have been co-authored by two or more countries.

- *PP(UI collab) (proportion of collaborative publications with industry).* The proportion of the publications of a university that have been co-authored with one or more industrial partners.
- *MGCD (mean geographical collaboration distance).* The average geographical collaboration distance (in km) of the publications of a university, where the geographical collaboration distance of a publication equals the largest geographical distance between two addresses mentioned in the publication's address list.

Special types of journals

A journal is considered special if it meets at least one of the following two conditions:

- The journal does not publish in English or it does publish in English but authors are concentrated in one or a few countries, indicating that the journal does not have a strong international scope.
- The journal has only a small number of references to other journals in the Web of Science database, indicating that in terms of citation traffic the journal is only weakly connected to these other journals. This is the case for many journals in the humanities, but also for trade journals and popular magazines.

The Leiden Ranking offers the possibility of excluding publications in special types of journals from the calculation of the indicators. The MNCS and PP(top 10%) indicators become significantly more accurate by excluding publications in special types of journals. By default, publications in special types of journals are excluded.

Size-dependent vs. size-independent indicators

The Leiden Ranking by default reports size-independent indicators. These indicators provide average statistics per publication, such as a university's average number of citations per publication. The advantage of size-independent indicators is that they enable comparisons between smaller and larger universities. As an alternative to size-independent indicators, the Leiden Ranking can also report size-dependent indicators, which provide overall statistics of the publications of a university. An example is the total (rather than the average) number of citations of the publications of a university. Size-dependent indicators are strongly influenced by the size of a

university (i.e., a university's total publication output) and therefore tend to be less useful for comparison purposes.

Counting method

The impact indicators included in the Leiden Ranking can be calculated using either a full counting method or a fractional counting method. The full counting method gives equal weight to all publications of a university. The fractional counting method gives less weight to collaborative publications than to non-collaborative ones. For instance, if the address list of a publication contains five addresses and two of these addresses belong to a particular university, then the publication has a weight of 2 / 5 = 0.4 in the calculation of the indicators for this university. The fractional counting method leads to a more proper field normalization of impact indicators and to fairer comparisons between universities active in different fields. Fractional counting is therefore regarded as the preferred counting method in the Leiden Ranking. Collaboration indicators are always calculated using the full counting method.

Stability intervals

A stability interval indicates a range of values of an indicator that are likely to be observed when the underlying set of publications changes. For instance, the MNCS indicator may be equal to 1.50 for a particular university, with a stability interval from 1.40 to 1.65. This means that the true value of the MNCS indicator equals 1.50 for this university, but that changes in the set of publications of the university may relatively easily lead to MNCS values in the range from 1.40 to 1.65. The Leiden Ranking employs 95% stability intervals constructed using a statistical technique known as bootstrapping.