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Options for Defining Normalisation Fields

A report to HEFCE by RAND Europe

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Options for Defining Normalisation Fields

Background

In response to a request from HEFCE, this discussion paper examines options for defining journal sets for disciplines which can then be used to develop discipline-specific benchmarks. It will describe and assess the classification schemes of the two main commercial data suppliers – Scopus and Web of Science (WoS), and will also describe the process followed in Australia to develop discipline-specific journal sets. The paper will outline options available for pilot testing bibliometrics in the short-term, and for long-term approaches to the issue.

The information presented here draws on my experience in using bibliometric techniques to assess research performance for Australian institutions and government agencies over the last 20 years, and also my role in assisting the Australian Research Council undertake an extensive journal rankings exercise.

After preliminary discussions with HEFCE, it became clear that the sector does not, at this point in time, have a preferred fine-grained field of research classification scheme. The implications of this scenario have been incorporated into the discussion paper.

Web of Science

Thomson Reuters currently uses two different subject classification schemes – one for their Web of Science product, and the other for Current Contents. In discussions about the two classification schemes with a Sydney representative of Thomson Reuters, Geeho Liu, on 11 June 2008, it emerged that the company is in the process of fully integrating all its databases and in the future will be moving to a single subject classification scheme – the WoS subject category scheme. This paper therefore focuses on a description and assessment of their WoS scheme.

Description

The development and maintenance of subject categories in WoS is the responsibility of the editors who oversee the various subject areas of the database. It is a flat classification scheme, not a hierarchical one; and journals may appear in more than one category. Journals are classified to categories based on an assessment of the scope of articles covered by the journal, and an analysis of the journals citing those articles. The latter data enables editors to calculate the statistical relevance of a journal to a particular category. There are about 250 different categories in the sciences, social sciences and arts & humanities (see Appendix A).

Assessment

The extent of multiple assignment of journals in WoS subject categories was analysed, and the findings are shown in Table 1.

Table 1: Extent of journal assignment to more than one category in WoS

<i># categories in which a journal is found</i>	<i># journals</i>	<i>%</i>
1	3999	56
2	2050	29
3	754	11
4	241	3
5	72	1
6	12	0
7	4	0
Total	7132	100

With over 40% of all journals appearing in more than one journal set, using the ISI subject classification scheme means there will be considerable overlap between some categories. It makes it virtually impossible to conduct clear assessments of performance in discrete disciplines, based on these categories. However, it is unlikely that assessment will be done at this fine-grained level.

In Australia, institutions and agencies commissioning bibliometric studies expect to see it based on the country's standard research classification scheme – the Australian Bureau of Statistics' Research Fields, Courses and Disciplines (RFCD) codes. To enable analyses to be undertaken on this basis, REPP¹ has

¹ REPP is the Research Evaluation and Policy Project in the Research School of Social Sciences at the Australian National University.

translated the WoS categories into this classification scheme. The translation table is shown in Appendix B.

When collapsing the WoS subject categories into the RFCD fields², some of the duplication disappears as closely related subject categories were often combined into one RFCD field. Table 2 analyses the extent of overlap using this schema.

Table 2: Extent of journal assignment to more than one Australian field of research (4 digit)

<i># fields (4 digit) in which a journal is found</i>	<i>Total</i>	<i>%</i>
1	4489	63
2	1896	27
3	539	8
4	150	2
5	52	1
6	6	0
Total	7132	100

The multiple assignment of journals was reduced after translation to RFCD disciplines, but it was a relatively small adjustment. The effect of aggregating journal sets up further from the four digit level to the two digit level is shown in Table 3.

² The RFCD classification scheme has a hierarchical structure. 2-digit codes cover broad fields of research (e.g. Mathematical Sciences, Studies in Human Society), while 4-digit codes are at the discipline level (e.g. statistics, demography). The classification system also has 6-digit codes, but it is considered impossible to obtain and assess indicators at this fine-grained level, as the analysis is likely to rest on too few publications.

Table 3: Extent of journal assignment to more than one Australian major field of research (2 digit)

<i># fields (2 digit) in which a journal is found</i>	<i>Total</i>	<i>%</i>
1	5220	73
2	1648	23
3	239	3
4	20	0
5	5	0
Total	7132	100

Clearly, collapsing journal lists into larger sets at higher levels of aggregation considerably reduces the extent of overlap, but it also reduces the usefulness of the journal sets for fine-grained analysis.

In addition to the multiple category assignment issue, the other concern with the WoS classification is whether an acceptable translation can be performed to the field of research classification scheme being used. The WoS scheme presented us with major problems in the Australian context. WoS subject categories often make little distinction between research that focuses on humans as opposed to that focussing on plants and/or animals, while in the RFCD scheme, this distinction is quite explicit. There were many examples of WOS subject categories that crossed this divide e.g. Virology, Mycology, Reproductive biology, etc.

In undertaking the translation, REPP followed the rule of thumb that if a clear majority of research carried by the journals in the set appeared related to a particular 4 digit RFCD code, it was classified to that code. This was not an ideal solution, though short of examining every journal this was all that could be accomplished at the time this translation was initially undertaken. The Australian outlets ranking exercise (described below) allows this shortcoming to be overcome, as in that exercise discipline experts will be assessing the relevance of individual journals to their field of research.

Scopus

Description

Scopus has developed an All Science Journal Classification (ASJC). Their list of journals can be downloaded from their website³. In discussions with Scopus developers in early June 2008, we were advised that journals are allocated to journal sets on the advice of the Scopus subject editorial teams, and that no systematic assessment is made of citation patterns to journals (unlike WoS). It is our clear impression that the process of journal classification is not yet complete. Details of their hierarchical classification scheme are given in Appendix C.

Assessment

There appears to be even more duplication in the ASJC than WoS, with a single journal classified in up to 14 different sets. One example of this is the *Journal of Geophysical Research* which is classified to: Physical Sciences, Earth and Planetary Sciences (all), Palaeontology, Water Science and Technology, Oceanography, Forestry, Aquatic Science, Engineering (all), Atmospheric Science, Space and Planetary Science, Ecology, Environmental Science (all), Earth and Planetary Sciences (miscellaneous), Soil Science, and Geochemistry and Petrology. Even allowing for the hierarchical nature of the classification scheme, and deleting the higher level journal sets (denoted by "... (all)'), this journal is still classified to 11 categories. Table 4 describes the extent of multiple journal assignment within Scopus.

Table 4: Extent of journal assignment to more than one category in Scopus

<i># categories in which a journal is found</i>	<i># journals</i>	<i>%</i>
1	6550	30
2	4389	20
3	2512	11
4	1413	6
5	790	4
6	530	2
7	303	1
8	155	1
9	81	0
10	22	0
11	10	0
12	6	0
13	4	0
Multi/interdisc set	5263	24

³ <http://www.info.scopus.com/detail/what/titles.asp>

In addition to the amount of multiple assignment, it is important to note that 24% of journals are only classified to interdisciplinary or multidisciplinary journal sets. It is anticipated that this proportion will decline as the classification process is completed. It is also anticipated that the extent of multiple assignment may decline as the classification process is refined, however it is likely to remain a significant cause for concern.

Custom Journal Sets Constructed for the Australian ERA

When metrics were incorporated into the assessment process for the Australian Research Quality Framework (RQF), work commenced on developing robust outlet rankings across all types of publications (journals, conferences, publishers, venues, etc). When the RQF was replaced by the Excellence for Research in Australia (ERA) program, the process continued, concentrating in the first instance on journal rankings. As well as providing the data to produce a performance indicator in its own right (the distribution of publications across ranks), this process also produced journal sets that are much more tightly aligned to Australia's research classification schemes (the RFCD, and the Field of Research (FOR) that replaced it in March 2008⁴).

The following section describes how the journal lists were established and the way in which they were subsequently refined. I won't, for this discussion paper, go into detail on the ranking process itself, which is tangential to the issues covered by this paper.

Developing and refining journal lists

The starting point for constructing the lists was the publication data that universities collect annually to report to government, and which is fed into a formula for the distribution of research funding (the Research Quantum). Twenty universities were approached and they provided details of the journals their staff published between 2001 and 2006. They supplied a single record for each publication, gave details of the department(s) to which their author(s) were attached and, in some instances, the RFCD code to which they had coded it in their internal information systems.

The departments were coded to the RFCD classification scheme as far as possible, and then analysed which departments were publishing in a

⁴ Throughout 2007 and early 2008, the Australian Bureau of Statistics, together with its New Zealand counterpart, updated the RFCD classification scheme. Many parts of the classification scheme remained unchanged, though areas of increasing activity e.g. nanotechnology were identified, and areas of declining activity were merged with other disciplines. The structure remained the same – hierarchical with 2, 4 and 6 digit codes – though the codes themselves were changed.

particular journal. If universities had coded a publication to an RFCD code, this coding took precedence over the departmental code. Journals were deleted from a discipline's list where only a small proportion of publications came from the relevant department (and most were to be found in the list of another discipline). There was a desire to reduce the amount of double-counting significantly (compared to WoS or Scopus), but an acknowledgement that some journals would quite legitimately fall within two journal sets. The aim was to construct journal sets at the 4-digit level, but it was always acknowledged that for most fields there would be a number of journals that covered all or most disciplines within the field. Therefore overarching 2-digit journal sets were constructed in many fields.

Additional journals that were identified in Ulrich's database of journals, and the Web of Science master journal list, were added to the lists using their subject classifications as a guide to which journal set they should be included in. Additional journals for humanities disciplines were identified from comprehensive European Science Foundation lists. The need to go beyond the initial data supplied by universities acknowledged that this method of identifying journals would not pick up all relevant journals as there were many that Australians did not publish in. However, it was necessary to be as comprehensive as possible – Australians might well publish in these in the future and they therefore needed to be included; and comprehensive lists were needed for use in constructing citation benchmarks.

The four Learned Academies in Australia volunteered to co-ordinate the fine-tuning of the journal lists (and also undertake an initial ranking for each). For a small number of disciplines not well covered by the Academies, umbrella organisations undertook the task. In addition to ranking journals, they were asked to ensure that the listed journals were indeed 'core' to the discipline(s) they were listed against, and to advise on any journals that required to be moved into a different list. They were also asked to add additional journals that our development process had not identified.

After the draft rankings were completed, the journal lists were translated from the RFCD coding scheme under which they were originally constructed, into the new scheme that had recently replaced it – the Australian and New Zealand Standard Research Classification Field of Research (FoR) which was published in March 2008, towards the end of this process. The FoR scheme, listing both 2digit and 4-digit codes, is shown in Appendix D.

These lists were published on the ARC's website⁵ and were open for one final round of consultation through the sector. University Research Offices were asked to coordinate responses from their staff, and the ARC's expert panels will adjudicate on these responses (both changes in ranking, and the movement of journals between FoR lists).

Assessment

The journal sets developed for ERA align much more closely to the FoR classification scheme that will form the basis of assessment under ERA than was possible using translated WoS or Scopus classification schemes. The level of duplication across fields has been reduced to approximately 10%. Problems still remain for a small number of disciplines that have two very closely related FoR codes (e.g. 0605 Microbiology and 1108 Medical Microbiology). However, the responses from the Academies imply that the majority of journals fit quite clearly into one or two categories. These journal sets are also, importantly, independent of the data source used in citation analysis.

I was asked to assess whether this very long, labour-intensive process resulted in lists that were significantly different to those created by merging WoS subject categories. I have surveyed the changes that occurred in the initial phases of the project (the modified lists resulting from the final round of sector consultations have not yet been published) and found: for 43 journal sets (28%), the alignment between FoR and WoS subject category (or combination of categories) was very good, at 90% or better (i.e. there was a difference of only 10% or less between the two lists); for 35 journal sets (23%), the alignment between FoR and WoS sets was between 50 and 60%; for a further 25 (another 23%), the overlap was only between 40 and 49%. While this analysis is not complete, it is clear that the methodology did result in significant changes to the journal sets, rather than small changes at the margins.

Advice for the REF

Relying on either WoS subject categories journal sets, or the Scopus AJSC classification scheme, to delineate fields of research could result in some problems in regards to the validity and robustness of any bibliometric measures used. There are significant levels of overlap between journal lists in both schemes, which means it is unlikely that it will be possible to create journal sets that align closely with any REF field classification scheme.

The work already undertaken in Australia to develop lists of journals (for subsequent ranking) for the ERA exercise that align closely, and tightly, to its

⁵ <http://www.arc.gov.au/era/indicators.htm>

FoR classification scheme may provide a much better starting point for the REF. In the short-term, I recommend that these journal sets be used in the pilot tests. These lists have been constructed at a sufficiently low level of aggregation (4-digit FoR code, rather than 2-digit FoR code) that they are sensitive to different citation practices across academic disciplines. They have been constructed by experts in the disciplines who are knowledgeable about the content of individual journals. Going down to even finer levels of aggregation (such as the 6-digit FoR codes) is likely to result in problems caused by lists constructed from a very small number of journals.

I anticipate that the pilot tests would demonstrate that the ERA journal lists provide a nuanced tool for calculating citation benchmarks. This is because the FoR classification scheme on which the lists are based uses a conceptual framework that classifies activities “according to the field in which the research is undertaken and based on the processes and techniques used in the R&D”⁶. It is therefore highly likely that research activities that are classified to the same code will exhibit similar citation levels. HEFCE may find that the ERA lists can also provide the long-term solution to their field benchmarking needs.

Alternatively, the ERA lists could be used as the starting point for a more UK-specific set of journals. It is likely that the FoR lists will map on to any proposed classification scheme for most fields, though some additional work may be required by local experts to split and/or combine lists to take account of any differences between schemes. The extent of reworking of the Australian FoR journal lists that is needed is dependant on the classification scheme finally chosen for the REF.

Once the classification scheme for use in the REF is determined, it would be possible to undertake a translation between this and the FoR journal lists, identifying where the translation can be done automatically, and where some additional work would be required by UK discipline experts.

⁶ Australian Bureau of Statistics and Statistics New Zealand, *Australian and New Zealand Standard Research Classification (ANZSRC)*, ABS Catalogue No. 1297.0, 2008 (also available online from www.abs.gov.au)

APPENDICES

Appendix A: Web of Science Subject Categories

Acoustics
Aerospace engineering & technology
Agricultural economics and policy
Agricultural engineering
Agriculture, dairy & animal science
Agriculture, multidisciplinary
Agriculture, soil science
Agronomy
Allergy
Anatomy and morphology
Andrology
Anaesthesiology
Anthropology
Applied linguistics
Archaeology
Architecture (ah)
Area Studies
Art
Arts & humanities, general
Asian Studies
Astronomy & Astrophysics
Automation & control systems
Behavioural sciences
Biochemical research methods
Biochemistry and molecular biology
Biodiversity conservation
Biology
Biology, miscellaneous
Biophysics
Biotechnology and applied microbiology
Business
Business, finance
Cardiac & cardiovascular systems
Cell biology
Chemistry, analytical
Chemistry, applied
Chemistry, inorganic & nuclear
Chemistry, medicinal
Chemistry, multidisciplinary
Chemistry, organic
Chemistry, physical
Classics
Clinical neurology
Communication
Computer science, information systems
Computer science, artificial intelligence
Computer science, cybernetics
Computer science, hardware & architecture
Computer science, interdisciplinary applications
Computer science, software, graphics, programming
Computer science, theory & methods
Construction & building technology
Criminology & Penology
Critical care medicine
Crystallography
Dance
Demography
Dentistry, oral surgery & medicine
Dermatology & venereal diseases
Developmental biology
Ecology
Economics
Education & educational research
Education, scientific disciplines
Education, special
Electrochemistry
Emergency medicine
Endocrinology & metabolism
Energy & fuels
Engineering, biomedical
Engineering, chemical
Engineering, civil
Engineering, electrical and electronic
Engineering, environmental
Engineering, geological
Engineering, industrial
Engineering, manufacturing
Engineering, mechanical
Engineering, multidisciplinary
Engineering, ocean
Engineering, petroleum
Entomology
Environmental sciences
Environmental studies (ss)

Ergonomics
 Ethnic studies
 Evolutionary biology
 Family studies
 Film, radio, television
 Fisheries
 Folklore
 Food science and technology
 Forestry
 Gastroenterology & hepatology
 Genetics & heredity
 Geochemistry & Geophysics
 Geography
 Geology
 Geosciences, interdisciplinary
 Geriatrics & gerontology
 Health care sciences & services
 Health policy and services
 Haematology
 History
 History
 History and philosophy of science
 History and philosophy of science (ah)
 History and philosophy of science
 History of social sciences
 Horticulture
 Imaging Science & photographic technology
 Immunology
 Industrial relations and labour
 Infectious diseases
 Information science & library science
 Instruments & instrumentation
 International relations
 Language & linguistics
 Law
 Limnology
 Literary reviews
 Literary Theory and Criticism
 Literature
 Literature, African, Australian, Canadian
 Literature, American
 Literature, British Isles
 Literature, German, Netherlandic,
 Scandinavian
 Literature, Romance
 Literature, Slavic
 Management
 Marine & freshwater biology
 Materials science, characterization & testing
 Materials science, biomaterials
 Materials science, ceramics
 Materials science, coatings & films
 Materials science, composites
 Materials science, multidisciplinary
 Materials science, paper & wood
 Materials science, textiles
 Mathematics
 Mathematics, applied
 Mathematics, miscellaneous
 Mechanics Thermodynamics
 Medical informatics
 Medical laboratory technology
 Medicine, general & internal
 Medicine, legal
 Medicine, research and experimental
 Metallurgy & metallurgical engineering
 Meteorology & Atmospheric Sciences
 Microbiology
 Microscopy
 Mineralogy
 Mining & mineral processing
 Multidisciplinary sciences
 Music
 Mycology
 Neuroimaging
 Neurosciences
 Nuclear science & technology
 Nursing
 Nutrition & dietetics
 Obstetrics & gynaecology
 Oceanography
 Oncology
 Operations research and management science
 Ophthalmology
 Optics
 Ornithology
 Orthopaedics
 Otorhinolaryngology
 Palaeontology
 Parasitology
 Pathology
 Paediatrics
 Peripheral vascular disease
 Pharmacology and pharmacy
 Philosophy
 Physics, applied
 Physics, atomic, molecular & chemical
 Physics, condensed matter
 Physics, fluids & plasmas
 Physics, mathematical
 Physics, multidisciplinary
 Physics, nuclear
 Physics, particles & fields
 Physiology
 Planning & development
 Plant sciences
 Poetry
 Political science
 Polymer science
 Psychiatry
 Psychiatry
 Psychology
 Psychology (SCI only)
 Psychology, applied
 Psychology, biological
 Psychology, clinical

Psychology, developmental
Psychology, educational
Psychology, experimental
Psychology, mathematical
Psychology, psychoanalysis
Psychology, social
Public administration
Public, environmental & occupational health
Radiology, nuclear medicine & medical
imaging
Rehabilitation
Religion
Remote sensing
Reproductive biology
Respiratory system
Rheumatology
Robotics
Social issues
Social sciences, biomedical
Social sciences, interdisciplinary
Social sciences, mathematical methods
Social work
Sociology
Spectroscopy
Sport sciences

Statistics & probability
Substance abuse
Surgery
Telecommunications
Theatre
Toxicology
Transplantation
Transportation
Tropical medicine
Urban studies (ss)
Urology & nephrology
Veterinary sciences
Virology
Water Resources
Women's studies
Zoology
Zoology (ss)

Abbreviations

ah = Arts and Humanities Citation Index
SCI only = Science Citation Index only
ss = Social Sciences Citation Index

Appendix B: Translation of ISI subject categories to RFCD sub-fields (2005)

PRIMARILY SCIENCE CITATION INDEX

210000	SCIENCE GENERAL		
21000X	Multidisciplinary		
	Multidisciplinary sciences	Acoustics	
21000Y	Interdisciplinary life sciences		
	Marine & freshwater biology		Developmental biology
	Virology		Mycology
	Reproductive biology		
230000	MATHEMATICAL SCIENCES		
230100	Mathematics		
	Mathematics	Mathematics, applied	
	Operations research and management science		
230200	Statistics		
	Statistics & probability		
239900	Other mathematical sciences		
	Mathematics, miscellaneous		
240000	PHYSICAL SCIENCES		
240100	Astronomical sciences		
	Astronomy & Astrophysics		
240200	Theoretical and condensed matter physics		
	Physics, condensed matter		
240300	Atomic and molecular physics; Nuclear and particle physics; Plasma physics		
	Physics, atomic, molecular & chemical	Physics, nuclear	
	Physics, particles & fields		
240400	Optical physics		
	Optics		
240500	Classical physics		
	No corresponding ISI category		
249900	Other physical sciences		
	Biophysics	Instruments & instrumentation	
	Microscopy		
24X000	General physical sciences		
	Physics, multidisciplinary	Physics, applied	
	Physics, fluids & plasmas	Nuclear science & technology	
	Physics, mathematical		
250000	CHEMICAL SCIENCES		
250100	Physical chemistry (incl. structural)		
	Chemistry, physical	Electrochemistry	
250200	Inorganic chemistry		
	Chemistry, inorganic & nuclear	Crystallography	
250300	Organic chemistry		
	Chemistry, organic		
250400	Analytical chemistry		
	Chemistry, analytical	Spectroscopy	
250500	Macromolecular chemistry		
	Polymer science		
250600	Theoretical and computational chemistry		
	No corresponding ISI category		
259900	Other chemical sciences		

25X000	Chemistry, applied General chemical sciences Chemistry, multidisciplinary	
260000	EARTH SCIENCES	
260100	Geology	
	Geology	Mineralogy
	Palaeontology	
260200	Geophysics & 260300	Geochemistry
		Geochemistry & Geophysics
260400	Oceanography	
	Oceanography	
260500	Hydrology	
	No corresponding ISI category	
260600	Atmospheric sciences	
	Meteorology & Atmospheric Sciences	
269900	Other earth sciences	
	Geography	
26X000	General earth sciences	
	Geosciences, interdisciplinary	
270000	BIOLOGICAL SCIENCES	
270100	Biochemistry and cell biology	
	Biochemistry and molecular biology	Cell biology
270200	Genetics	
	Genetics & heredity	
270300	Microbiology	
	Microbiology	
270400	Botany	
	Plant sciences	
270500	Zoology	
	Entomology	Ornithology
	Zoology	Zoology (ss)
270600	Physiology	
	No corresponding ISI category	
270700	Ecology and evolution	
	Biodiversity conservation	Ecology
	Evolutionary biology	
270800	Biotechnology	
	Biotechnology and applied microbiology	Biochemical research methods
279900	Other biological sciences	
	Biology, miscellaneous	
27X000	General biological sciences	
	Biology	
280000	INFORMATION, COMPUTING AND COMMUNICATION SCIENCE	
280100	Information systems	
	Computer science, cybernetics	Computer science, information systems
280200	Artificial intelligence and signal and image processing	
	Computer science, artificial intelligence	
280300	Computer software	
	Computer science, software, graphics, programming	
280400	Computation theory and mathematics	
	Computer science, theory & methods	
280500	Data format	
	No corresponding ISI category	
289900	Other information, computing and communication sciences	
	Computer science, interdisciplinary applications	
290000	ENGINEERING AND TECHNOLOGY	
290100	Industrial biotechnology and food sciences	

	Food science and technology		
290200	Aerospace engineering		
	Aerospace engineering & technology		
290300	Manufacturing engineering		
	Automation & control systems	Engineering, manufacturing	
	Robotics	Materials science, textiles	
290400	Automotive engineering		
	No corresponding ISI category		
290500	Mechanical and industrial engineering		
	Engineering, mechanical	Engineering, industrial	
290600	Chemical engineering		
	Engineering, chemical		
290700	Resources engineering		
	Mining & mineral processing	Engineering, petroleum	
	Energy & fuels	Engineering, geological	
290800	Civil engineering		
	Engineering, civil	Transportation	
	Water Resources	Construction & building technology	
290900	Electrical and electronic engineering		
	Engineering, electrical and electronic		
291000	Geomatic engineering		
	Imaging Science & photographic technology	Remote sensing	
291100	Environmental engineering		
	Engineering, environmental		
291200	Maritime engineering		
	Engineering, ocean		
291300	Metallurgy		
	Metallurgy & metallurgical engineering		
291400	Materials engineering		
	Materials science, multidisciplinary	Materials science, ceramics	
	Materials science, characterization & testing	Materials science, coatings &	
	films		
	Materials science, composites	Materials science, paper & wood	
291500	Biomedical engineering		
	Engineering, biomedical	Materials science, biomaterials	
291600	Computer hardware		
	Computer science, hardware & architecture		
291700	Communications technologies		
	Telecommunications		
291800	Interdisciplinary engineering		
	Mechanics	Thermodynamics	
299900	Other engineering and technology		
	Agricultural engineering		
27X000	General engineering		
	Engineering, multidisciplinary		
300000	AGRICULTURAL, VETERINARY AND ENVIRONMENTAL SCIENCES		
300100	Soil and water sciences		
	Agriculture, soil science		
300200	Crop and pasture production		
	Agronomy		
300300	Horticulture		
	Horticulture		
300400	Animal production		
	Agriculture, dairy & animal science		
300500	Veterinary sciences		
	Veterinary sciences	Parasitology	
300600	Forestry sciences		
	Forestry		
300700	Fisheries sciences		
	Fisheries	Limnology	

300800 Environmental sciences
Environmental sciences Environmental studies (ss)

300900 Land, parks, and agriculture management
No corresponding ISI category

309900 Other agricultural, veterinary and environmental sciences
No corresponding ISI category

30X000 General agricultural, veterinary and environmental sciences
Agriculture, multidisciplinary

310000 ARCHITECTURE, URBAN ENVIRONMENT AND BUILDING

310100 Architecture, urban environment and building
Urban studies (ss) Architecture (ah)

310200 Building
No corresponding ISI category

319900 Other architecture, urban environment and building
No corresponding ISI category

320000 MEDICAL AND HEALTH SCIENCES

320200 Immunology
Allergy Immunology

320300 Medical biochemistry and clinical chemistry
Chemistry, medicinal

320400 Medical microbiology
No corresponding ISI category

320500 Pharmacology and pharmaceutical sciences
Pharmacology and pharmacy Toxicology

320600 Medical physiology
Anatomy and morphology Physiology

320700 Neurosciences
Neurosciences

320800 Dentistry
Dentistry, oral surgery & medicine

320900 Optometry
No corresponding ISI category

321000 Clinical Sciences
Andrology Anaesthesiology
Cardiac & cardiovascular systems Clinical neurology
Critical care medicine Dermatology & venereal diseases
Emergency medicine Endocrinology & metabolism
Gastroenterology & hepatology Geriatrics & gerontology
Geriatrics & gerontology (SSCI) Haematology
Infectious diseases Medicine, general & internal
Neuroimaging
Obstetrics & gynaecology Oncology
Ophthalmology Orthopaedics
Otorhinolaryngology Pathology
Paediatrics Peripheral vascular disease
Psychiatry Psychiatry (SSCI)
Psychology (SCI only) Radiology, nuclear medicine & medical imaging
Rehabilitation Rehabilitation (SSCI)
Rheumatology Respiratory system
Transplantation Surgery
Urology & nephrology Tropical medicine

321100 Nursing
Nursing (SSCI)

321200 Public health & health services
Ergonomics (SSCI)
Health care sciences & services Health policy and services (SSCI)
Medical informatics Nutrition & dietetics
Public, environmental & occupational health Public, environmental &
occupational health (SSCI)
Substance abuse Substance abuse (SSCI)

- 321300 Complementary/alternative medicine
 - Integrative and complementary medicine
- 321400 Human movements and sports science
 - Sport sciences
- 329900 Other medical and health sciences
 - Medical laboratory technology
- 32X000 General medical & health science
 - Medicine, research and experimental

PRIMARYLY SOCIAL SCIENCES CITATION INDEX

- 330000 EDUCATION
- 330100 Education studies
 - Education, special Psychology, educational
- 330200 Curriculum studies
 - Education, scientific disciplines (sci)
- 330300 Professional development of teachers
 - No corresponding ISI category
- 339900 Other education
 - No corresponding ISI category
- 33X000 General education
 - Education & educational research

- 340000 ECONOMICS
- 340100 Economic Theory
 - No corresponding ISI category
- 340200 Applied economics
 - Agricultural economics and policy (sci)
- 340300 Economic history and history of economic thought
 - No corresponding ISI category
- 340400 Econometrics
 - Social sciences, mathematical methods
- 340500 Other economics
 - No corresponding ISI category
- 340X00 General economics
 - Economics

- 350000 COMMERCE, MANAGEMENT, TOURSIM AND SERVICES
- 350100 Accounting, auditing and accountability
 - No corresponding ISI category
- 350200 Business and management
 - Business Industrial relations and labour
 - Management
- 350300 Banking, finance and investment
 - Business, finance
- 350400 Transportation
 - Transportation
- 350500 Tourism
 - No corresponding ISI category
- 350600 Services
 - No corresponding ISI category
- 359900 Other commerce, management, tourism and services
 - No corresponding ISI category

- 360000 POLICY AND POLITICAL SCIENCE
- 360100 Political science
 - International relations Political science
- 360200 Policy and administration
 - Public administration
- 369900 Other policy and political science
 - No corresponding ISI category

370000 STUDIES IN HUMAN SOCIETY
370100 Sociology
Ethnic studies Sociology
Social issues
370200 Social work
Social work
370300 Anthropology
Anthropology
370400 Human geography
Geography
370500 Demography
Demography Family studies
370600 History and philosophy of science and medicine
History and philosophy of science History and philosophy of science (sci)
History and philosophy of science (ah)
379900 Other studies in human society
Women's studies

380000 BEHAVIOURAL AND COGNITIVE SCIENCES
380100 Psychology
Psychology Psychology, biological
Psychology, applied Psychology, developmental
Psychology, experimental Psychology, mathematical
Psychology, social Psychology, psychoanalysis
Psychology, clinical

380200 Linguistics
Language & linguistics (art) Applied linguistics
380300 Cognitive science
No corresponding ISI category
389900 Other behavioural and cognitive sciences
No corresponding ISI category
380X00 General behavioural and cognitive sciences
Behavioural sciences (sci)

390100 LAW, JUSTICE AND LAW ENFORCEMENT
390100 Law
Law
390200 Professional development of law practitioners
No corresponding ISI category
390300 Justice and legal studies
No corresponding ISI category
390400 Law enforcement
Criminology & Penology
399900 Other law, justice and law enforcement
No corresponding ISI category
390X00 General law, justice and law enforcement
Medicine, legal (sci)

400000 JOURNALISM, LIBRARIANSHIP AND CURATORIAL STUDIES
400100 Journalism, communication and media
Communication
400200 Librarianship
Information science & library science
400300 Curatorial studies
No corresponding ISI category
409900 Other journalism, librarianship and curatorial studies
No corresponding ISI category

PRIMARILY ARTS & HUMANITIES CITATION INDEX

410000 THE ARTS

410100	Performing arts		
	Dance		Music
410200	Visual arts and crafts		
	Art		
410300	Cinema, electronic arts and media		
	Film, radio, television		Theatre
410400	Design studies		
	No corresponding ISI category		
410500	Other arts		
	No corresponding ISI category		
420000	LANGUAGE AND CULTURE		
420100	Language studies		
	No corresponding ISI category		
420200	Literature studies		
	Literary reviews	Literature	
	Literature, African, Australian, Canadian		Literature, American
	Literature, British Isles	Literature, German, Netherlandic, Scandinavian	
	Literature, Romance	Literature, Slavic	
	Literary Theory and Criticism		Poetry
420300	Cultural studies		
	Folklore		
429900	Other language and culture		
	No corresponding ISI category		
430000	HISTORY AND ARCHAEOLOGY		
430100	Historical studies		
	Classics		History
	History (ssci)		
430200	Archaeology and prehistory		
	Archaeology		
439900	Other history and archaeology		
	No corresponding ISI category		
440000	PHILOSOPHY AND RELIGION		
440100	Philosophy		
	Philosophy		
440200	Religion and religious traditions		
	Religion		
449900	Other philosophy and religion		
	No corresponding ISI category		
4X0000	HUMANITIES AND SOCIAL SCIENCES GENERAL		
4X0100	Area Studies		
	Asian Studies		Area Studies (ssci)
4X9900	General humanities and social sciences		
	History of social sciences (ssci)		Planning & development (ssci)
	Arts & humanities, general Social sciences, interdisciplinary (ssci)		
	Social sciences, biomedical (ssci)		

Abbreviations

ah = Arts and Humanities Citation Index

SCI only= Science Citation Index only

ss = Social Sciences Citation Index

SSCI = Social Sciences Citation Index

sci = Science Citation Index

Appendix C: Scopus ASJC = All Science Journal Classification

Description	New code		
General	1000	Accounting	1402
Agricultural and Biological Sciences (all)	1100	Business and International Management	1403
Agricultural and Biological Sciences (misc)	1101	Management Information Systems	1404
Agronomy and Crop Science	1102	Management of Technology and Innovation	1405
Animal Science and Zoology	1103	Marketing	1406
Aquatic Science	1104	Organizational Behaviour and Human Resource Management	1407
Ecology, Evolution, Behaviour and Systematics	1105	Strategy and Management	1408
Food Science	1106	Tourism, Leisure and Hospitality Management	1409
Forestry	1107	Industrial relations	1410
Horticulture	1108	Chemical Engineering (all)	1500
Insect Science	1109	Chemical Engineering (misc)	1501
Plant Science	1110	Bioengineering	1502
Soil Science	1111	Catalysis	1503
Arts and Humanities (all)	1200	Chemical Health and Safety	1504
Arts and Humanities (misc)	1201	Colloid and Surface Chemistry	1505
History	1202	Filtration and Separation	1506
Language and Linguistics	1203	Fluid Flow and Transfer Processes	1507
Archaeology	1204	Process Chemistry and Technology	1508
Classics	1205	Chemistry (all)	1600
Conservation	1206	Chemistry (misc)	1601
History and Philosophy of Science	1207	Analytical Chemistry	1602
Literature and Literary Theory	1208	Electrochemistry	1603
Museology	1209	Inorganic Chemistry	1604
Music	1210	Organic Chemistry	1605
Philosophy	1211	Physical and Theoretical Chemistry	1606
Religious studies	1212	Spectroscopy	1607
Visual Arts and Performing Arts	1213	Computer Science (all)	1700
Biochemistry, Genetics and Molecular Biology (all)	1300	Computer Science (misc)	1701
Biochemistry, Genetics and Molecular Biology (misc)	1301	Artificial Intelligence	1702
Ageing	1302	Computational Theory and Mathematics	1703
Biochemistry	1303	Computer Graphics and Computer-Aided Design	1704
Biophysics	1304	Computer Networks and Communications	1705
Biotechnology	1305	Computer Science Applications	1706
Cancer Research	1306	Computer Vision and Pattern Recognition	1707
Cell Biology	1307	Hardware and Architecture	1708
Clinical Biochemistry	1308	Human-Computer Interaction	1709
Developmental Biology	1309	Information Systems	1710
Endocrinology	1310	Signal Processing	1711
Genetics	1311	Software	1712
Molecular Biology	1312	Decision Sciences (all)	1800
Molecular Medicine	1313	Decision Sciences (misc)	1801
Physiology	1314	Information Systems and Management	1802
Structural Biology	1315	Management Science and Operations Research	1803
Business, Management and Accounting (all)	1400	Statistics, Probability and Uncertainty	1804
Business, Management and Accounting (misc)	1401	Earth and Planetary Sciences (all)	1900
		Earth and Planetary Sciences (misc)	1901
		Atmospheric Science	1902

Computers in Earth Sciences	1903	Parasitology	2405
Earth-Surface Processes	1904	Virology	2406
Economic Geology	1905	Materials Science (all)	2500
Geochemistry and Petrology	1906	Materials Science (misc)	2501
Geology	1907	Biomaterials	2502
Geophysics	1908	Ceramics and Composites	2503
Geotechnical Engineering and Engineering		Electronic, Optical and Magnetic Materials	2504
Geology	1909	Materials Chemistry	2505
Oceanography	1910	Metals and Alloys	2506
Palaeontology	1911	Polymers and Plastics	2507
Space and Planetary Science	1912	Surfaces, Coatings and Films	2508
Stratigraphy	1913		
Economics, Econometrics and		Mathematics (all)	2600
Finance (all)	2000	Mathematics (misc)	2601
Economics, Econometrics and Finance		Algebra and Number Theory	2602
(misc)	2001	Analysis	2603
Economics and Econometrics	2002	Applied Mathematics	2604
Finance	2003	Computational Mathematics	2605
Energy (all)	2100	Control and Optimization	2606
Energy (misc)	2101	Discrete Mathematics and Combinatorics	2607
Energy Engineering and Power Technology	2102	Geometry and Topology	2608
Fuel Technology	2103	Logic	2609
Nuclear Energy and Engineering	2104	Mathematical Physics	2610
Renewable Energy, Sustainability and the		Modelling and Simulation	2611
Environment	2105	Numerical Analysis	2612
		Statistics and Probability	2613
		Theoretical Computer Science	2614
Engineering (all)	2200	Medicine (all)	2700
Engineering (misc)	2201	Medicine (misc)	2701
Aerospace Engineering	2202	Anatomy	2702
Automotive Engineering	2203	Anaesthesiology and Pain Medicine	2703
Biomedical Engineering	2204	Biochemistry, medical	2704
Civil and Structural Engineering	2205	Cardiology and Cardiovascular Medicine	2705
Computational Mechanics	2206	Critical Care and Intensive Care Medicine	2706
Control and Systems Engineering	2207	Complementary and alternative medicine	2707
Electrical and Electronic Engineering	2208	Dermatology	2708
Industrial and Manufacturing Engineering	2209	Drug guides	2709
Mechanical Engineering	2210	Embryology	2710
Mechanics of Materials	2211	Emergency Medicine	2711
Ocean Engineering	2212	Endocrinology, Diabetes and Metabolism	2712
Safety, Risk, Reliability and Quality	2213	Epidemiology	2713
Media Technology (NEW)	2214	Family Practice	2714
Building and Construction (NEW)	2215	Gastroenterology	2715
Architecture (NEW)	2216	Genetics (clinical)	2716
		Geriatrics and Gerontology	2717
Environmental Science (all)	2300	Health Informatics	2718
Environmental Science (misc)	2301	Health Policy	2719
Ecological Modelling	2302	Haematology	2720
Ecology	2303	Hepatology	2721
Environmental Chemistry	2304	Histology	2722
Environmental Engineering	2305	Immunology and Allergy	2723
Global and Planetary Change	2306	Internal Medicine	2724
Health, Toxicology and Mutagenesis	2307	Infectious Diseases	2725
Management, Monitoring, Policy and Law	2308	Microbiology (medical)	2726
Nature and Landscape Conservation	2309	Nephrology	2727
Pollution	2310	Clinical Neurology	2728
Waste Management and Disposal	2311	Obstetrics and Gynaecology	2729
Water Science and Technology	2312	Oncology	2730
		Ophthalmology	2731
Immunology and Microbiology (all)	2400	Orthopaedics and Sports Medicine	2732
Immunology and Microbiology (misc)	2401	Otorhinolaryngology	2733
Applied Microbiology and Biotechnology	2402	Pathology and Forensic Medicine	2734
Immunology	2403	Paediatrics, Perinatology, and Child Health	2735
Microbiology	2404		

Pharmacology (medical)	2736	Instrumentation	3105
Physiology (medical)	2737	Nuclear and High Energy Physics	3106
Psychiatry and Mental health	2738	Atomic and Molecular Physics, and Optics	3107
Public Health, Environmental and Occupational Health	2739	Radiation	3108
Pulmonary and Respiratory Medicine	2740	Statistical and Nonlinear Physics	3109
Radiology Nuclear Medicine and imaging	2741	Surfaces and Interfaces	3110
Rehabilitation	2742	Psychology (all)	3200
Reproductive Medicine	2743	Psychology (misc)	3201
Reviews and References, Medical	2744	Applied Psychology	3202
Rheumatology	2745	Clinical Psychology	3203
Surgery	2746	Developmental and Educational Psychology	3204
Transplantation	2747	Experimental and Cognitive Psychology	3205
Urology	2748	Neuropsychology and Physiological Psychology	3206
Neuroscience (all)	2800	Social Psychology	3207
Neuroscience (misc)	2801	Social Sciences (all)	3300
Behavioural Neuroscience	2802	Social Sciences (misc)	3301
Biological Psychiatry	2803	Archaeology	3302
Cellular and Molecular Neuroscience	2804	Development	3303
Cognitive Neuroscience	2805	Education	3304
Developmental Neuroscience	2806	Geography, Planning and Development	3305
Endocrine and Autonomic Systems	2807	Health (social science)	3306
Neurology	2808	Human Factors and Ergonomics	3307
Sensory Systems	2809	Law	3308
Nursing (all)	2900	Library and Information Sciences	3309
Nursing (misc)	2901	Linguistics and Language	3310
Advanced and Specialised Nursing	2902	Safety Research	3311
Assessment and Diagnosis	2903	Sociology and Political Science	3312
Care Planning	2904	Transportation	3313
Community and Home Care	2905	Anthropology	3314
Critical Care	2906	Communication	3315
Emergency	2907	Cultural Studies	3316
Fundamentals and skills	2908	Demography	3317
Gerontology	2909	Gender Studies	3318
Issues, ethics and legal aspects	2910	Life-span and Life-course Studies	3319
Leadership and Management	2911	Political Science and International Relations	3320
LPN and LVN	2912	Public Administration	3321
Maternity and Midwifery	2913	Urban Studies	3322
Medical–Surgical	2914	Veterinary (all)	3400
Nurse Assisting	2915	Veterinary (miscellaneous)	3401
Nutrition and Dietetics	2916	Equine	3402
Oncology (nursing)	2917	Food Animals	3403
Pathophysiology	2918	Small Animals	3404
Paediatrics	2919	Dentistry (all)	3500
Pharmacology (nursing)	2920	Dentistry (misc)	3501
Psychiatric Mental Health	2921	Dental Assisting	3502
Research and Theory	2922	Dental Hygiene	3503
Review and Exam Preparation	2923	Oral Surgery	3504
Pharmacology, Toxicology and Pharmaceutics (all)	3000	Orthodontics	3505
Pharmacology, Toxicology and Pharmaceutics (misc)	3001	Periodontics	3506
Drug Discovery	3002	Health Professions (all)	3600
Pharmaceutical Science	3003	Health Professions (misc)	3601
Pharmacology	3004	Chiropractics	3602
Toxicology	3005	Complementary and Manual Therapy	3603
Physics and Astronomy (all)	3100	Emergency Medical Services	3604
Physics and Astronomy (misc)	3101	Health Information Management	3605
Acoustics and Ultrasonics	3102	Medical Assisting and Transcription	3606
Astronomy and Astrophysics	3103	Medical Laboratory Technology	3607
Condensed Matter Physics	3104	Medical Terminology	3608

Occupational Therapy	3609
Optometry	3610
Pharmacy	3611
Physical Therapy, Sports Therapy and Rehabilitation	3612
Podiatry	3613
Radiological and Ultrasound Technology	3614
Respiratory Care	3615
Speech and Hearing	3616

Appendix D: ANZ Field of Research Classification Scheme (2 and 4 digit levels)

01	MATHEMATICAL SCIENCES	0599	Other Environmental Sciences
0101	Pure Mathematics	06	BIOLOGICAL SCIENCES
0102	Applied Mathematics	0601	Biochemistry and Cell Biology
0103	Numerical and Computational Mathematics	0602	Ecology
0104	Statistics	0603	Evolutionary Biology
0105	Mathematical Physics	0604	Genetics
0199	Other Mathematical Sciences	0605	Microbiology
02	PHYSICAL SCIENCES	0606	Physiology
0201	Astronomical and Space Sciences	0607	Plant Biology
0202	Atomic, Molecular, Nuclear, Particle and Plasma Physics	0608	Zoology
0203	Classical Physics	0699	Other Biological Sciences
0204	Condensed Matter Physics	07	AGRICULTURAL AND VETERINARY SCIENCES
0205	Optical Physics	0701	Agriculture, Land and Farm Management
0206	Quantum Physics	0702	Animal Production
0299	Other Physical Sciences	0703	Crop and Pasture Production
03	CHEMICAL SCIENCES	0704	Fisheries Sciences
0301	Analytical Chemistry	0705	Forestry Sciences
0302	Inorganic Chemistry	0706	Horticultural Production
0303	Macromolecular and Materials Chemistry	0707	Veterinary Sciences
0304	Medicinal and Biomolecular Chemistry	0799	Other Agricultural and Veterinary Sciences
0305	Organic Chemistry	08	INFORMATION AND COMPUTING SCIENCES
0306	Physical Chemistry (incl. Structural)	0801	Artificial Intelligence and Image Processing
0307	Theoretical and Computational Chemistry	0802	Computation Theory and Mathematics
0399	Other Chemical Sciences	0803	Computer Software
04	EARTH SCIENCES	0804	Data Format
0401	Atmospheric Sciences	0805	Distributed Computing
0402	Geochemistry	0806	Information Systems
0403	Geology	0807	Library and Information Studies
0404	Geophysics	0899	Other Information and Computing Sciences
0405	Oceanography	09	ENGINEERING
0406	Physical Geography and Environmental Geoscience	0901	Aerospace Engineering
0499	Other Earth Sciences	0902	Automotive Engineering
05	ENVIRONMENTAL SCIENCES	0903	Biomedical Engineering
0501	Ecological Applications	0904	Chemical Engineering
0502	Environmental Science and Management		
0503	Soil Sciences		

0905	Civil Engineering		
0906	Electrical and Electronic Engineering	14	ECONOMICS
0907	Environmental Engineering	1401	Economic Theory
0908	Food Sciences	1402	Applied Economics
0909	Geomatic Engineering	1403	Econometrics
0910	Manufacturing Engineering	1499	Other Economics
0911	Maritime Engineering		
0912	Materials Engineering	15	COMMERCE, MANAGEMENT, TOURISM AND SERVICES
0913	Mechanical Engineering		
0914	Resources Engineering and Extractive Metallurgy	1501	Accounting, Auditing and Accountability
0915	Interdisciplinary Engineering	1502	Banking, Finance and Investment
0999	Other Engineering	1503	Business and Management
		1504	Commercial Services
		1505	Marketing
10	TECHNOLOGY	1506	Tourism
1001	Agricultural Biotechnology	1507	Transportation and Freight Services
1002	Environmental Biotechnology	1599	Other Commerce, Management, Tourism and Services
1003	Industrial Biotechnology		
1004	Medical Biotechnology		
1005	Communications Technologies	16	STUDIES IN HUMAN SOCIETY
1006	Computer Hardware	1601	Anthropology
1007	Nanotechnology	1602	Criminology
1099	Other Technology	1603	Demography
		1604	Human Geography
11	MEDICAL AND HEALTH SCIENCES	1605	Policy and Administration
1101	Medical Biochemistry and Metabolomics	1606	Political Science
1102	Cardiovascular Medicine and Haematology	1607	Social Work
1103	Clinical Sciences	1608	Sociology
1104	Complementary and Alternative Medicine	1699	Other Studies in Human Society
1105	Dentistry		
1106	Human Movement and Sports Science	17	PSYCHOLOGY AND COGNITIVE SCIENCES
1107	Immunology	1701	Psychology
1108	Medical Microbiology	1702	Cognitive Science
1109	Neurosciences	1799	Other Psychology and Cognitive Sciences
1110	Nursing		
1111	Nutrition and Dietetics	18	LAW AND LEGAL STUDIES
1112	Oncology and Carcinogenesis	1801	Law
1113	Optometry and Ophthalmology	1802	Maori Law
1114	Paediatrics and Reproductive Medicine	1899	Other Law and Legal Studies
1115	Pharmacology and Pharmaceutical Sciences		
1116	Medical Physiology	19	STUDIES IN CREATIVE ARTS AND WRITING
1117	Public Health and Health Services	1901	Art Theory and Criticism
1199	Other Medical and Health Sciences	1902	Film, Television and Digital Media
		1903	Journalism and Professional Writing
12	BUILT ENVIRONMENT AND DESIGN	1904	Performing Arts and Creative Writing
1201	Architecture	1905	Visual Arts and Crafts
1202	Building	1999	Other Studies in Creative Arts and Writing
1203	Design Practice and Management		
1204	Engineering Design		
1205	Urban and Regional Planning	20	LANGUAGE, COMMUNICATION AND CULTURE
1299	Other Built Environment and Design		
		2001	Communication and Media Studies
13	EDUCATION	2002	Cultural Studies
1301	Education Systems	2003	Language Studies
1302	Curriculum and Pedagogy	2004	Linguistics
1303	Specialist Studies in Education	2005	Literary Studies
1399	Other Education		

2099 Other Language, Communication and Culture

21 HISTORY AND ARCHAEOLOGY

2101 Archaeology

2102 Curatorial and Related Studies

2103 Historical Studies

2104 Other History and Archaeology

22 PHILOSOPHY AND RELIGIOUS STUDIES

2201 Applied Ethics

2202 History and Philosophy of Specific Fields

2203 Philosophy

2204 Religion and Religious Traditions

2299 Other Philosophy and Religious Studies