Disciplinary trends in graduate degree program proposals, 1999-00 to 2018-19

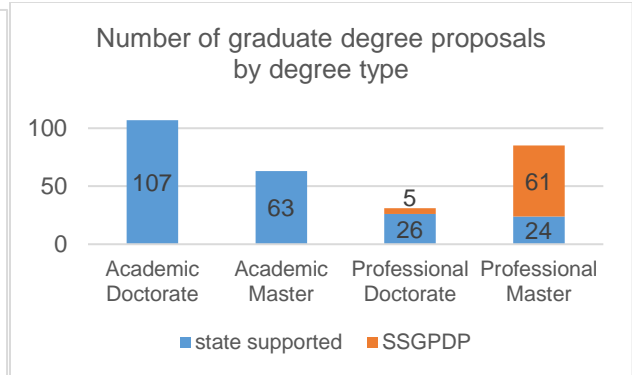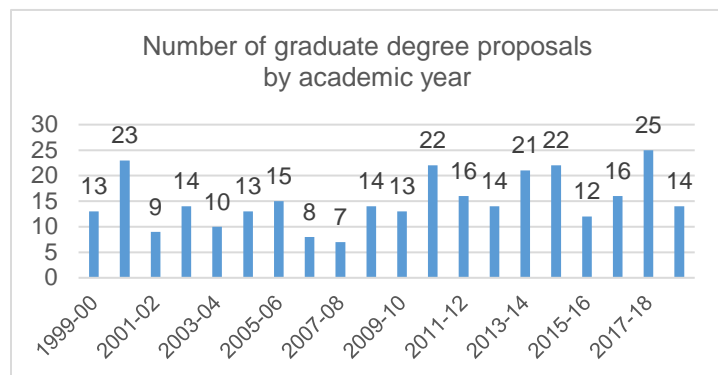As detailed in the _Compendium: Universitywide Review Processes for Academic Programs, Academic Units, & Research Units_, the establishment of new graduate degree programs is a multi-step process involving the Academic Senate and UC administrators at both the campus and system levels. At the system level the review and approval process is initially coordinated by the Senate's Coordinating Committee on Graduate Affairs (CCGA). This topic brief explores trends—disciplinary tends in particular—from academic years 1999-2000 to 2018-2019 in proposals to CCGA to establish new graduate degree programs.

In this nineteen-year period, 301 proposals to establish graduate degree programs, including hybrid undergraduate-graduate degree programs, were submitted to CCGA. An average of 15 proposals were submitted each year. This average differs slightly in the pre- and post-Great Recession periods, with an annual average of 13 proposals from 1999-00 to 2009-10 compared to an average of 18 per year from 2010-11 to 2018-19. The number of proposals peaked in 2017-18 at 25.
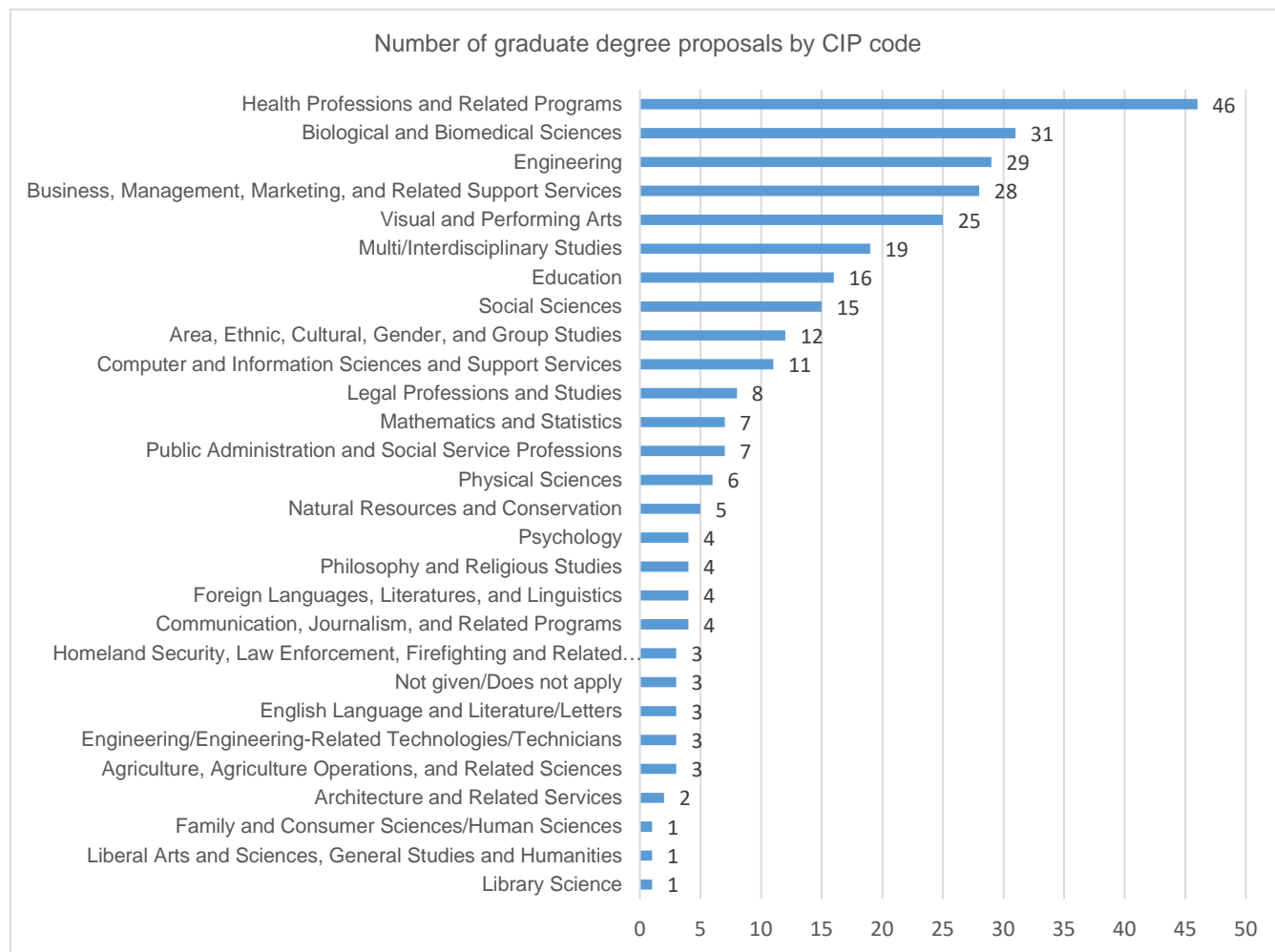
Over half (56%) of these proposals were for graduate academic programs while 40% were for graduate professional programs. The majority of total proposals, 36%, were for academic doctoral programs. Twenty-eight percent of proposals were for professional masters programs, 21% were for academic masters programs, and 10% were for professional doctoral programs. Sixty-six proposals, or 22% of the total, were for self-supporting graduate professional degree programs (SSGPDP's) with nearly all of these programs falling into the professional master's category.

KEY FINDINGS

- From 1999-00 to 2018-19, 301 proposals to establish a graduate degree program were submitted to the Coordinating Committee on Graduate Affairs, with an average of 15 proposals received each year.

- Over half of these proposals were for graduate academic programs while 40% were for graduate professional programs.

- Among all disciplinary categories, the largest number of proposals were in: Health Professions and Related Programs; Biological and Biomedical Sciences; Engineering; Business, Management, Marketing, and Related Support Services; Visual and Performing Arts; and Multi/Interdisciplinary Studies.

- Programs in the health professions exerted the most influence during this period with public health and nursing programs being the primary driving forces.

- Most of the program proposals not based in long-standing disciplines were in computational and data science, confirming UC planning data that these fields will expand in the future.

Number of graduate degree proposals by academic year

Number of graduate degree proposals by degree type

state supported   SSGPDP

UNIVERSITY OF CALIFORNIA   Institutional Research and Academic Planning

The ten disciplinary categories most represented (based on the federal Department of Education's Classification of Instructional Programs [CIP] system) were: Health Professions and Related Programs (15% of total); Biological and Biomedical Sciences (10%); Engineering (10%); Business, Management, Marketing, and Related Support Services (9%); Visual and Performing Arts (8%); Multi/Interdisciplinary Studies (6%); Education (5%); Social Sciences (5%); Computer and Information Sciences and Support Services (4%); and Area, Ethnic, Cultural, Gender, and Group Studies (4%). Remaining categories accounted for 3% or less of total proposals submitted.

Number of graduate degree proposals by CIP code

Category	Count
Health Professions and Related Programs	46
Biological and Biomedical Sciences	31
Engineering	29
Business, Management, Marketing, and Related Support Services	28
Visual and Performing Arts	25
Multi/Interdisciplinary Studies	19
Education	16
Social Sciences	15
Area, Ethnic, Cultural, Gender, and Group Studies	12
Computer and Information Sciences and Support Services	11
Legal Professions and Studies	8
Mathematics and Statistics	7
Public Administration and Social Service Professions	7
Physical Sciences	6
Natural Resources and Conservation	5
Psychology	4
Philosophy and Religious Studies	4
Foreign Languages, Literatures, and Linguistics	4
Communication, Journalism, and Related Programs	4
Homeland Security, Law Enforcement, Firefighting and Related…	3
Not given/Does not apply	3
English Language and Literature/Letters	3
Engineering/Engineering-Related Technologies/Technicians	3
Agriculture, Agriculture Operations, and Related Sciences	3
Architecture and Related Services	2
Family and Consumer Sciences/Human Sciences	1
Liberal Arts and Sciences, General Studies and Humanities	1
Library Science	1

The appendix shows the number of proposals for disciplines accounting for 5% or more of total proposals submitted based on the CIP codes one step below the broadest classification level. Using these more-specific codes, the subdisciplinary driving forces within each broad discipline become clear:

- For health-related programs, Public Health and Nursing.
- For biology-based programs, Biomathematics, Bioinformatics, and Computational Biology; Ecology, Evolution, Systematics, and Population Biology; and Pharmacology and Toxicology.
- For engineering programs, Biomedical/Medical Engineering; Engineering, General; and Materials Engineering.
- For business-related programs, Business Administration, Management and Operations; Accounting and Related Services; and Management Sciences and Quantitative Methods.
- For visual and performing arts programs, Music; Fine and Studio Arts; and Design & Applied Arts.

- For multi/interdisciplinary programs, Computational Science; Data Science; and International/Globalization Studies.
- For education programs, Education, General.
- For social science programs, Economics, followed by Criminology, Sociology, and International Relations and National Security Studies.

While disciplines outside of the health professions have played an important role, programs based in the health professions exerted the most influence between 1999-00 and 2018-19. This can be seen not only in proposals to establish graduate degree programs but in proposals to establish schools or colleges across the system. Seven out of the twelve proposals for a new school or college (58%) were in the Health Professions and Related Programs category during this period. This included two schools of public health, two schools of nursing, two schools of pharmacy, and one school of medicine.
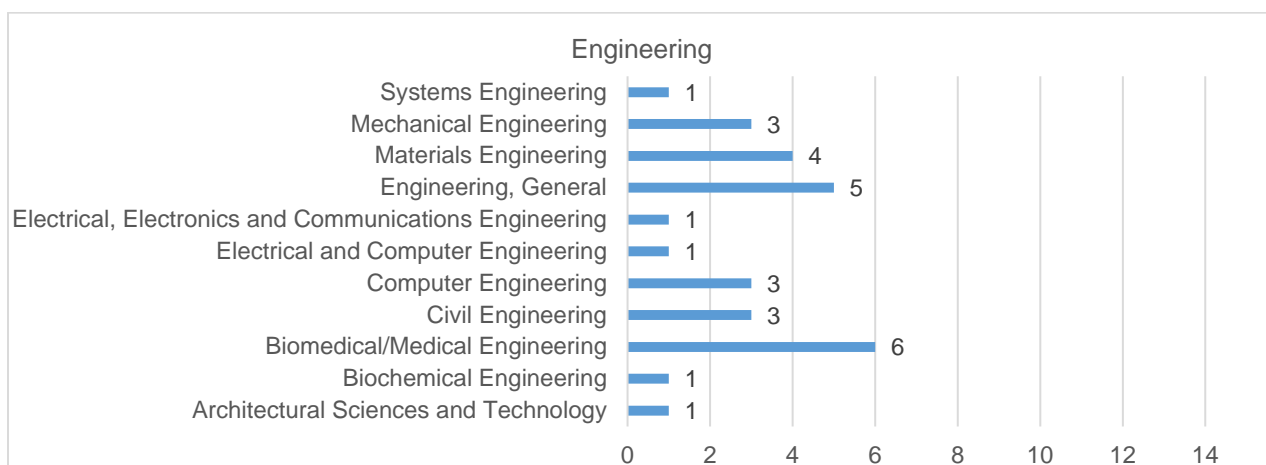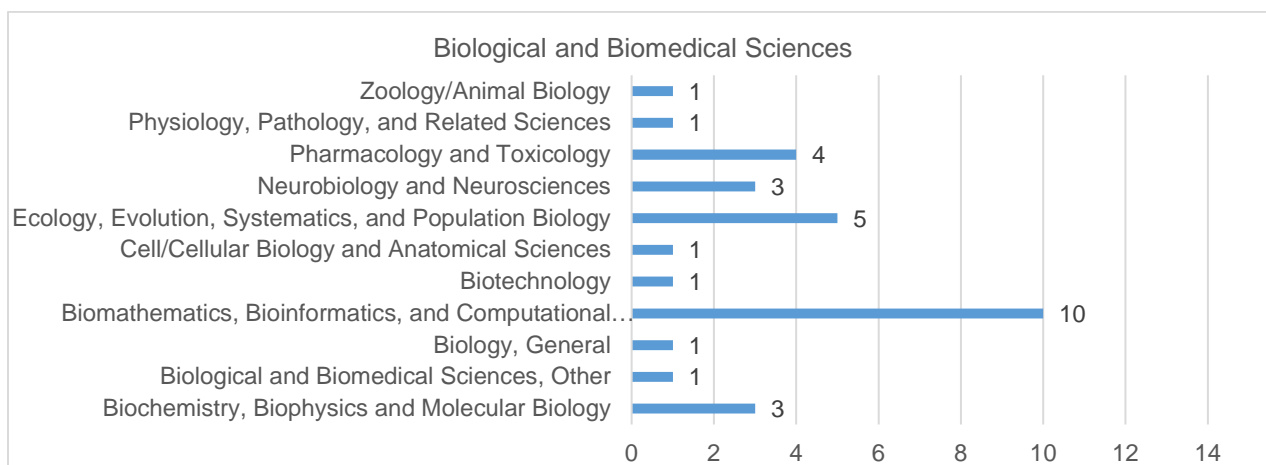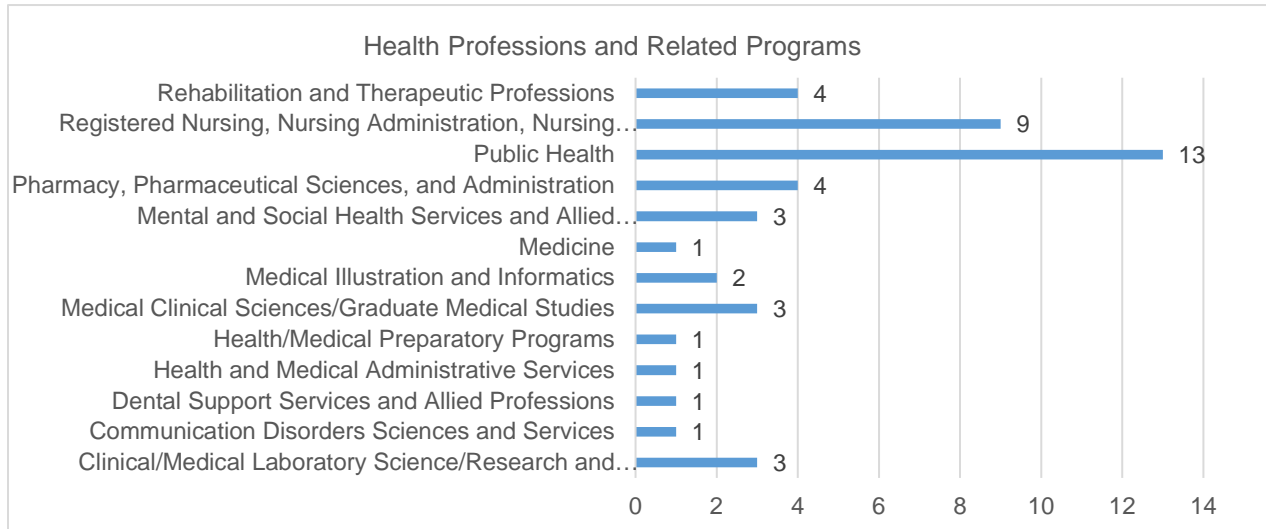
The underlying curricula for these health-related programs and schools are based on long-standing disciplinary work. If we were to look at which proposed programs are based on disciplines at earlier stages of development, results cluster around computational science and data science. In the Biological and Biomedical Sciences, for example, programs in Biomathematics, Bioinformatics, and Computational Biology made up about a third of program establishment proposals and included three programs in bioinformatics, three programs in biostatistics, and singular programs in biomathematics, computational biology, quantitative and systems biology, and mathematical, computational, and systems biology. In Business and Management programs, four business analytics programs were proposed under Management Sciences and Quantitative Methods. One program in Computer and Information Sciences and Support Services was proposed. Finally, in Multi/Interdisciplinary Studies, programs in data science and computational science accounted for about a third of proposed programs.
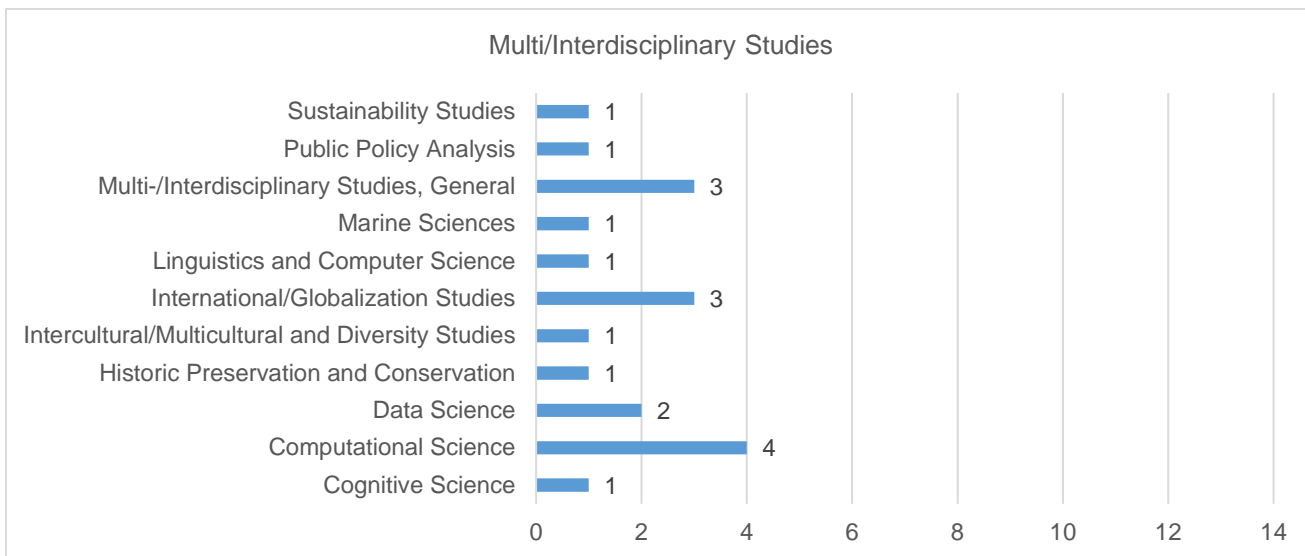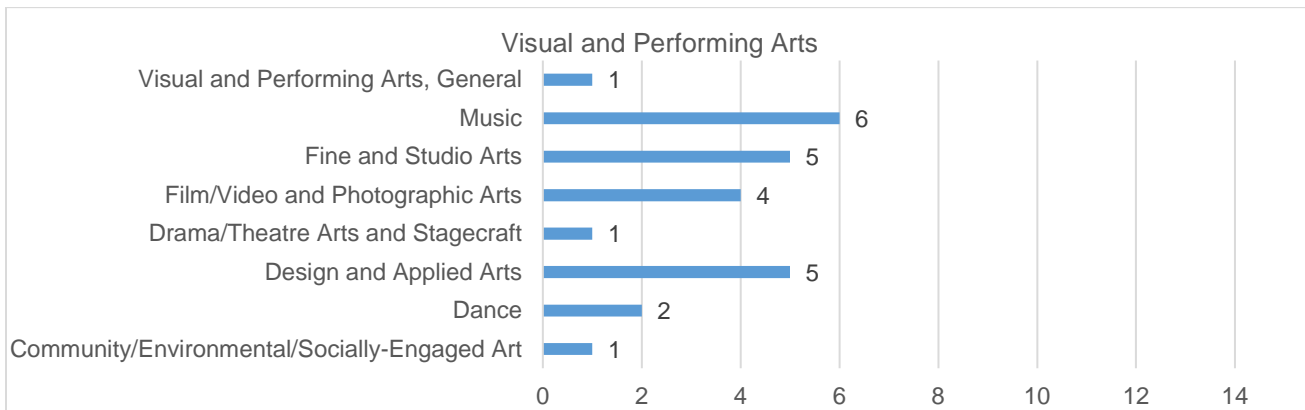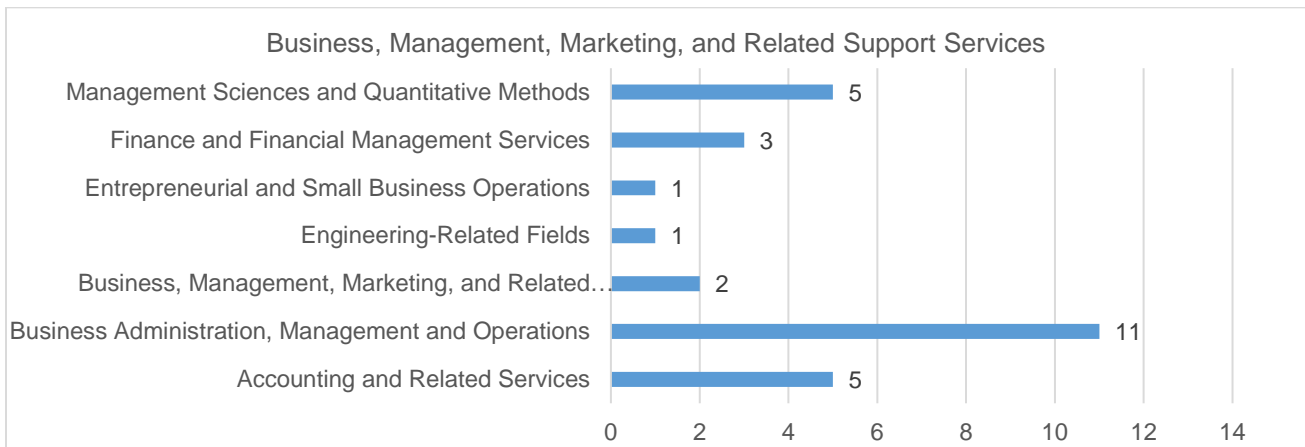
Academic Year	Campus	Program Name	Degree	Classification of Instructional Programs category
2000-01	San Diego	Bioinformatics	M.A./Ph.D.	Biomathematics, Bioinformatics, and Computational Biology
2000-01	Davis	Biostatistics	M.S./Ph.D.	Biomathematics, Bioinformatics, and Computational Biology
2000-01	Los Angeles	Biomathematics (clinical training)	M.S.	Biomathematics, Bioinformatics, and Computational Biology
2002-03	Santa Cruz	Bioinformatics	M.S./Ph.D.	Biomathematics, Bioinformatics, and Computational Biology
2007-08	Los Angeles	Bioinformatics	M.S./Ph.D.	Biomathematics, Bioinformatics, and Computational Biology
2008-09	San Diego	Computational Science	M.S.	Computational Science
2009-10	Merced	Quantitative and Systems Biology	M.S./Ph.D.	Biomathematics, Bioinformatics, and Computational Biology
2011-12	Berkeley	Computational Biology	M.S./Ph.D.	Biomathematics, Bioinformatics, and Computational Biology
2012-13	Berkeley	Information and Data Science	Master	Computer and Information Sciences and Support Services
2013-14	Irvine	Mathematical, Computational, and Systems Biology	M.S./Ph.D.	Biomathematics, Bioinformatics, and Computational Biology
2013-14	San Diego	Data Science and Engineering	Master of Advanced Study	Computational Science
2014-15	San Diego	Biostatistics	Ph.D.	Biomathematics, Bioinformatics, and Computational Biology
2014-15	San Diego	Business Analytics	M.S.	Management Sciences and Quantitative Methods
2014-15	Davis	Business Analytics	M.S.	Management Sciences and Quantitative Methods
2015-16	Irvine	Business Analytics	M.S.	Management Sciences and Quantitative Methods
2015-16	Los Angeles	Business Analytics	M.S.	Management Sciences and Quantitative Methods
2015-16	Santa Cruz	Computational Media	M.S./Ph.D.	Computational Science
2016-17	Irvine	Computational Science	Ph.D.	Computational Science
2017-18	San Diego	Biostatistics	M.S.	Biomathematics, Bioinformatics, and Computational Biology
2018-19	Irvine	Data Science	Master	Data Science
2018-19	Santa Barbara	Environmental Data Science	Master	Data Science

Of the above, the four Business Analytics programs, UC Berkeley's Master of Information and Data Science, and UC San Diego's Master of Advanced Study in Data Science and Engineering were self-supporting graduate professional degree programs (together making up 29% of the total). The remaining were state-supported programs.

This trend towards computational science and data sciences is reflected in the most recent Five-Year Planning Perspectives, which list the anticipated actions to establish, transfer, consolidate, disestablish, or discontinue undergraduate and graduate degree programs, schools, and colleges across the UC system. In the 2018-23 Five-Year Planning Perspectives, plans to establish data science programs were submitted by several campuses. UC Berkeley planned for a Division of Data Science with bachelor's and undergraduate minors programs in data science, UCLA planned for a data science bachelor's program and a M.S. in Data Science Engineering, and UC campuses at Merced, Davis, Santa Cruz, Irvine, and San Diego each planned for a master's programs in data science.

Appendix A: Number of proposals for the disciplines accounting for 5% or more of the total while using the Classification of Instructional Programs' subdisciplinary categories.

Health Professions and Related Programs

Discipline	Count
Rehabilitation and Therapeutic Professions	4
Registered Nursing, Nursing Administration, Nursing…	9
Public Health	13
Pharmacy, Pharmaceutical Sciences, and Administration	4
Mental and Social Health Services and Allied…	3
Medicine	1
Medical Illustration and Informatics	2
Medical Clinical Sciences/Graduate Medical Studies	3
Health/Medical Preparatory Programs	1
Health and Medical Administrative Services	1
Dental Support Services and Allied Professions	1
Communication Disorders Sciences and Services	1
Clinical/Medical Laboratory Science/Research and…	3

Biological and Biomedical Sciences

Discipline	Count
Zoology/Animal Biology	1
Physiology, Pathology, and Related Sciences	1
Pharmacology and Toxicology	4
Neurobiology and Neurosciences	3
Ecology, Evolution, Systematics, and Population Biology	5
Cell/Cellular Biology and Anatomical Sciences	1
Biotechnology	1
Biomathematics, Bioinformatics, and Computational…	10
Biology, General	1
Biological and Biomedical Sciences, Other	1
Biochemistry, Biophysics and Molecular Biology	3

Engineering

Discipline	Count
Systems Engineering	1
Mechanical Engineering	3
Materials Engineering	4
Engineering, General	5
Electrical, Electronics and Communications Engineering	1
Electrical and Computer Engineering	1
Computer Engineering	3
Civil Engineering	3
Biomedical/Medical Engineering	6
Biochemical Engineering	1
Architectural Sciences and Technology	1

Business, Management, Marketing, and Related Support Services

Program	Count
Management Sciences and Quantitative Methods	5
Finance and Financial Management Services	3
Entrepreneurial and Small Business Operations	1
Engineering-Related Fields	1
Business, Management, Marketing, and Related…	2
Business Administration, Management and Operations	11
Accounting and Related Services	5

Visual and Performing Arts

Program	Count
Visual and Performing Arts, General	1
Music	6
Fine and Studio Arts	5
Film/Video and Photographic Arts	4
Drama/Theatre Arts and Stagecraft	1
Design and Applied Arts	5
Dance	2
Community/Environmental/Socially-Engaged Art	1

Multi/Interdisciplinary Studies

Program	Count
Sustainability Studies	1
Public Policy Analysis	1
Multi-/Interdisciplinary Studies, General	3
Marine Sciences	1
Linguistics and Computer Science	1
International/Globalization Studies	3
Intercultural/Multicultural and Diversity Studies	1
Historic Preservation and Conservation	1
Data Science	2
Computational Science	4
Cognitive Science	1

UNIVERSITY OF CALIFORNIA

Institutional
Research and
Academic Planning

Academic Planning
Academic Program Review

Education

Category	Value
Teacher Education and Professional Development, Specific Subject Areas	1
Teacher Education and Professional Development, Specific Levels and Methods	1
Educational/Instructional Media Design	1
Educational Administration and Supervision	2
Education, General	11

Social Sciences

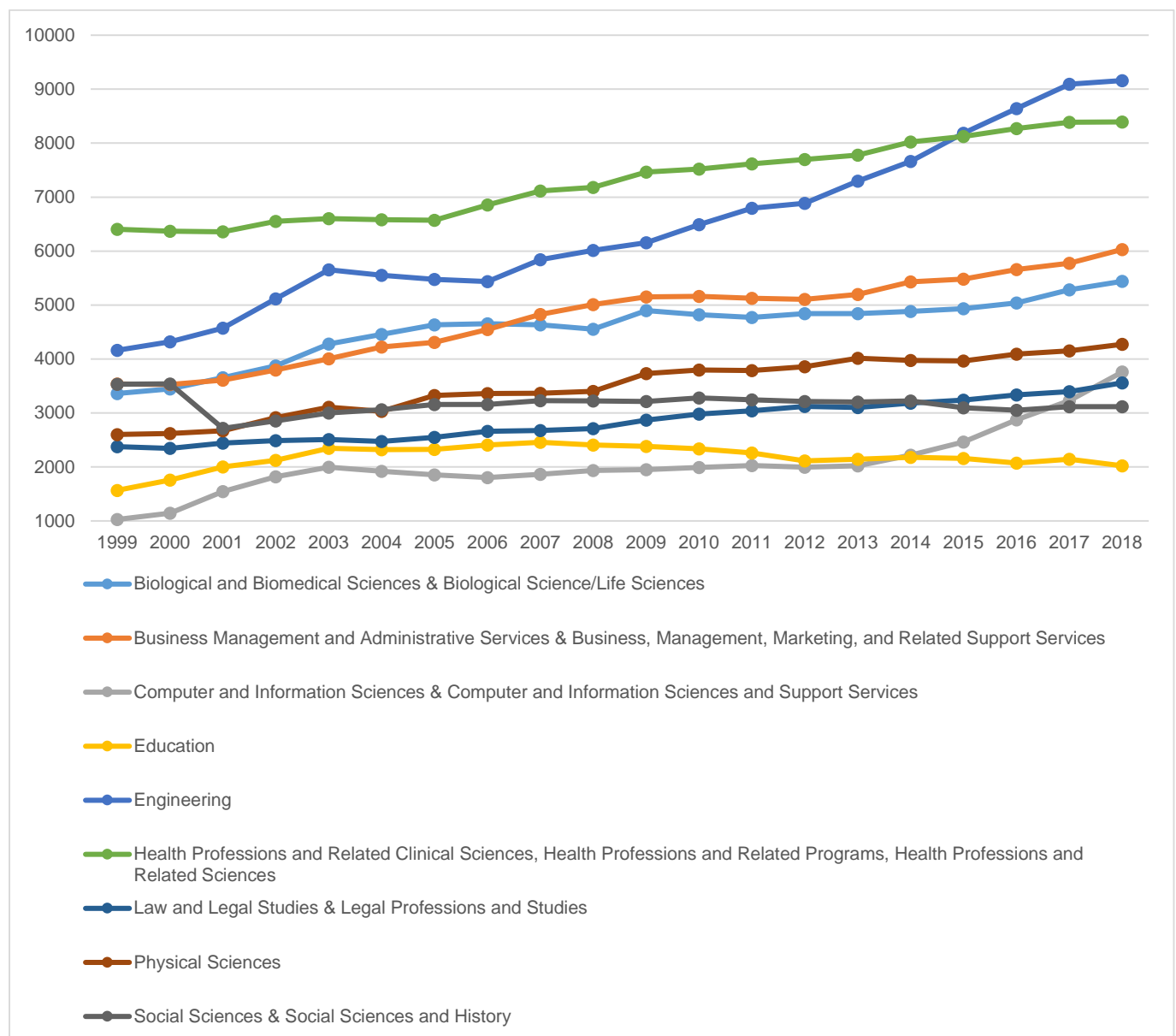| Category	Value
Sociology	2
Social Sciences, General	1
Political Science and Government	1
International Relations and National Security Studies	2
Geographic Information Science and Cartography	1
Economics	3
Demography and Population Studies	1
Criminology	2
Archeology	1
Anthropology	1

Appendix B: Disciplinary trends in graduate enrollment, 1999 to 2018

While the number of graduate degree program proposals is a primary measure for understanding disciplinary trends, complementary data, such as enrollment data, enhances our understanding in that it verifies the above findings and illuminates new trends.

All graduate enrollment data, including academic doctorate, academic masters, and professional masters enrollment, from 1999 to 2018 were used to examine disciplinary trends in graduate programs. Nine disciplines (CIP categories) exceeded 2,000 FTE in student enrollment in this 19-year period: Health Professions and Related Programs; Engineering; Business Management and Related Services; Biological and Biomedical Sciences; Physical Sciences; Computer and Information Sciences; Law and Legal Studies; Social Sciences; and Education. Six of these nine disciplines accounted for 5% or more of total program proposals.

Legend:
- Biological and Biomedical Sciences & Biological Science/Life Sciences
- Business Management and Administrative Services & Business, Management, Marketing, and Related Support Services
- Computer and Information Sciences & Computer and Information Sciences and Support Services
- Education
- Engineering
- Health Professions and Related Clinical Sciences, Health Professions and Related Programs, Health Professions and Related Sciences
- Law and Legal Studies & Legal Professions and Studies
- Physical Sciences
- Social Sciences & Social Sciences and History

The rank order of enrollment disciplinary trends is similar to the order of program proposal disciplinary trends. Historically, Health Professions and Related Programs has had the highest enrollment. In 1999, Health Professions had 6,400 enrollees; in 2009, 7,400 enrollees; and in 2017 and 2018, 8,400 enrollees. Health Professions enrollment was surpassed by Engineering in 2015, the first time another discipline exceeded Health Professions enrollment. Engineering enrollment was 8,100 in 2015 and 9,100 in 2018, the highest number of enrollments for a single year in the chart. Enrollment in Business Management and Related Services and in Biological and Biomedical Sciences have been similar—between 5,000 and 6,000 for the last three years, and around 5,000 from 2009 to 2013. Physical Science was the only discipline other than the ones above to break past 4,000 enrollees in this period; Computer and Information Sciences, Law and Legal Studies, Social Sciences, and Education all had enrollments between 1,000 and 4,000 throughout this period. Worth noting is the rise of Computer and Information Sciences. In 1999, this discipline had the lowest enrollment, about 1,000 students. In 2003, enrollment jumped to about 2,000 and began a sharp upward trend after 2013. By 2018, Computer and Information Sciences had surpassed Law and Legal Studies, Social Sciences, and Education to reach 3,700 enrollees.
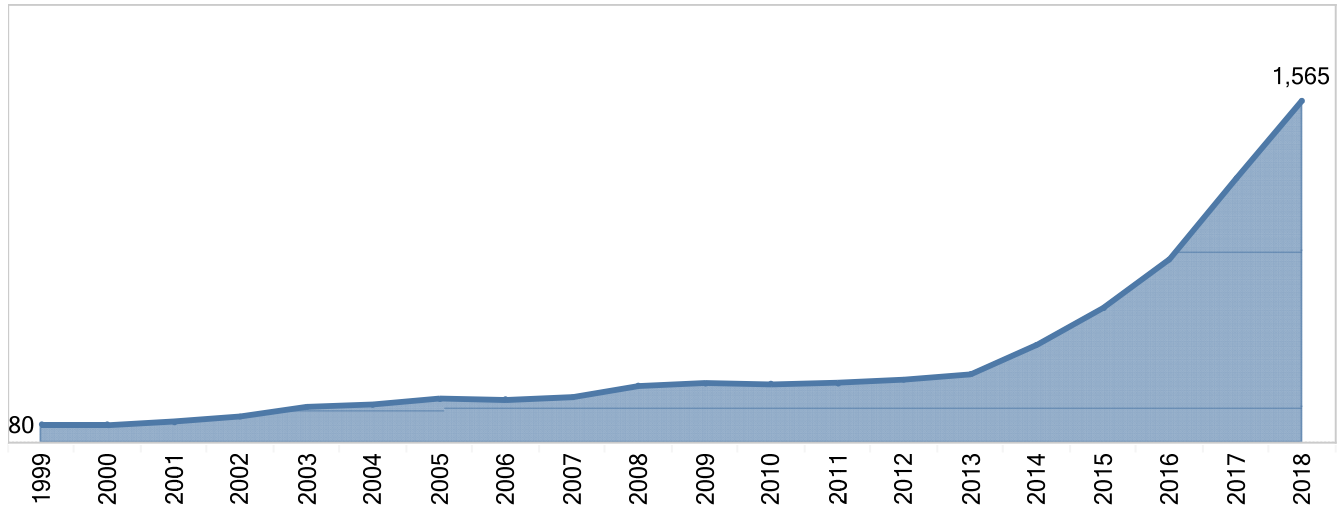
For Health Professions and Related Programs, Engineering, Business Management and Related Services, and Biological and Biomedical Sciences, subdisciplinary trends paralleled trends found in the program proposal analysis in some cases but not others:

- In Health Professions and Related Programs, Medicine had the most enrollees, between 2,500 and 3,000, followed by Public Health and Nursing. Public Health enrollment peaked at 1,200 in 2017; Nursing enrollment peaked at 1,000 in 2009.
- In Engineering, although the Biomedical/Medical Engineering subdiscipline had proposed the most degree programs during this period, Engineering enrollment was highest for Electrical Engineering. Electrical Engineering had between 1,200 and 2,300 enrollees during this period compared to Mechanical Engineering's peak of 1,500 enrollees in 2018, Biomedical/Medical Engineering's peak of 1,200 in 2018, and Civil Engineering's high mark of 1,200 in 2017.
- In Business Management and Related Services, virtually all enrollment were in Business Administration, and Management & Operations, as reflected in the program proposal analysis.
- In Biological and Biomedical Sciences, Biology, General; Ecology, Evolution, Systematics, and Population Biology; Biochemistry, Biophysics and Molecular Biology; and Cellular Biology and Anatomical Sciences all had the highest enrollments, between 600 and 1,000 during most of this period. Compared to these disciplines, Biomathematics, Bioinformatics, and Computational Biology was low but rising quickly. Enrollment in this subdiscipline was 33 in 2001 and 480 in 2018.

Finally, graduate enrollment in data science-related programs has accelerated, particularly since 2013. In 1999, only 80 students were enrolled in these programs and in 2013, enrollment was 312. By 2016, enrollment was 839 then reached past 1,500 by 2018. Following is a graph showing total enrollment for data science-related programs and enrollment by program type and name.

UNIVERSITY OF CALIFORNIA | Institutional Research and Academic Planning

Graduate enrollment growth in data science-related programs:

Annual Graduate Enrollments

1,565

80

1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

Students Ever Enrolled by Program

Program Type	Program Name	Graduate Academic	Graduate Professional
Data Science, Machine Learning, and Computational Science	MASTER OF INFORMATION AND DATA SCIENCE	4	1,070
	DATA SCIENCE AND ENGINEERING		149
	COMPUTATIONAL SCIENCE	100	
	ELEC. ENGINEERING (MACHINE LEARNING AND DATA SCIEN..	42	
	COMPUTATIONAL MEDIA	38	
Biostatisics, Bioinformatiics, and Computational Biology	BIOSTATISTICS	768	
	BIOINFORMATICS	360	
	QUANTITATIVE AND SYSTEMS BIOLOGY	219	
	MATHEMATICAL AND COMPUTATIONAL BIOLOGY	89	
	BIOMATHEMATICS	72	
	MATHEMATICAL, COMPUTATIONAL AND SYSTEMS BIOLOGY	46	
	COMPUTATIONAL BIOLOGY	29	
	BIOINFORMATICS & SYSTEMS BIOLOGY	6	
Business Analytics	BUSINESS ANALYTICS		327
	MASTERS OF SCIENCE IN BUSINESS ANALYTICS		85
Grand Total		1,754	1,630