Undergraduate Mathematics Student Pathways: Data and Tools

TPSE Department Chairs Conversations

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National Science Foundation

Overview

Context and Definitions
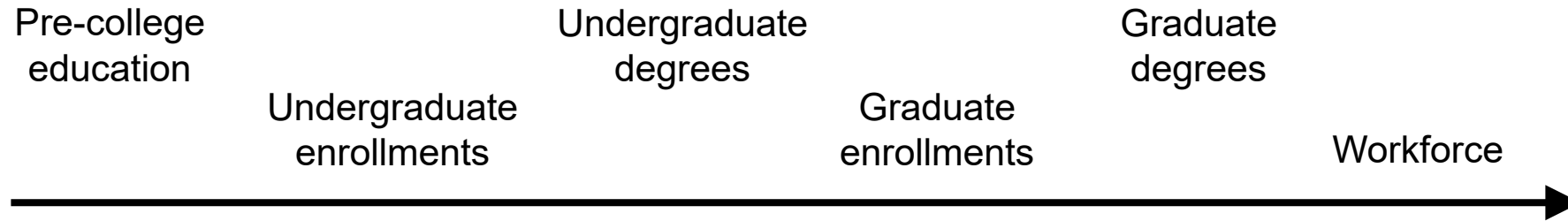
Major Trends

Pe-college achievement

Undergraduate Indicators

Workforce Characteristics

Tools to Explore the Data

Human Resources Data Continuum

Pre-college education   Undergraduate degrees   Graduate degrees

Undergraduate enrollments   Graduate enrollments   Workforce

———————————————————————————→

At each stage in this continuum, we are trying to understand:

- How many people are in this stage?

- What are their demographic characteristics?

- What are the short-term and long-term trends at that stage?

- How does performance at one stage relate to other stages?

STEM Higher Education: Then and Now

1960s

- Disciplinary focus

- U.S. a world leader in higher education

- Students predominantly white and majority male

- Predominantly U.S. citizen students and postdocs

- Public and private non-profit campus-based degree programs

2020s

- Greater interdisciplinary focus

- Growth in higher education abroad

- Greater racial/ethnic and gender diversity

- Increase in foreign students and foreign postdocs

- Growth of for-profit institutions and online programs

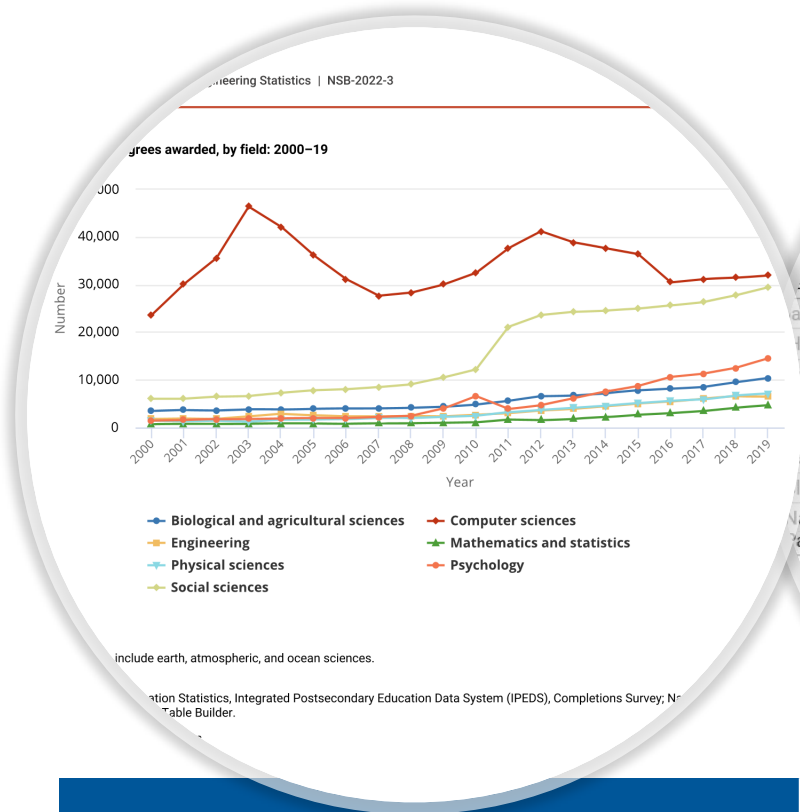# STEM Workforce: Then and Now

1960s

- Workers in S&E occupations a small proportion of total workforce

- Individuals with STEM degrees and skills primarily work in STEM occupations

- Individuals primarily work within a single discipline

- STEM workforce primary U.S.-born/white/male

- U.S. a leader in attracting STEM talent from all over the world

- Mobility of STEM workers (across sectors, jobs, economies) is limited

2020s

- Workers in S&E occupations larger proportion of total workforce

- Those with S&E degrees and skills work in a wide variety of STEM and non-STEM occupations

- Great increase in collaborative and multi-disciplinary work

- Increase in proportion of foreign-born/minority/female workers

- Greater competition from other countries in attracting STEM talent

- STEM workers making frequent moves across sectors, jobs, economies

What are the trends in bachelor's degree attainment in math?

Compiled Data and Analysis

Compiled, Disaggregated Data

Custom Tables

Example #1:

Trends in Bachelor's Degrees in Math

Compiled Data and Analysis

Figure HED-8

S&E bachelor's degrees awarded, by field: 2000−19
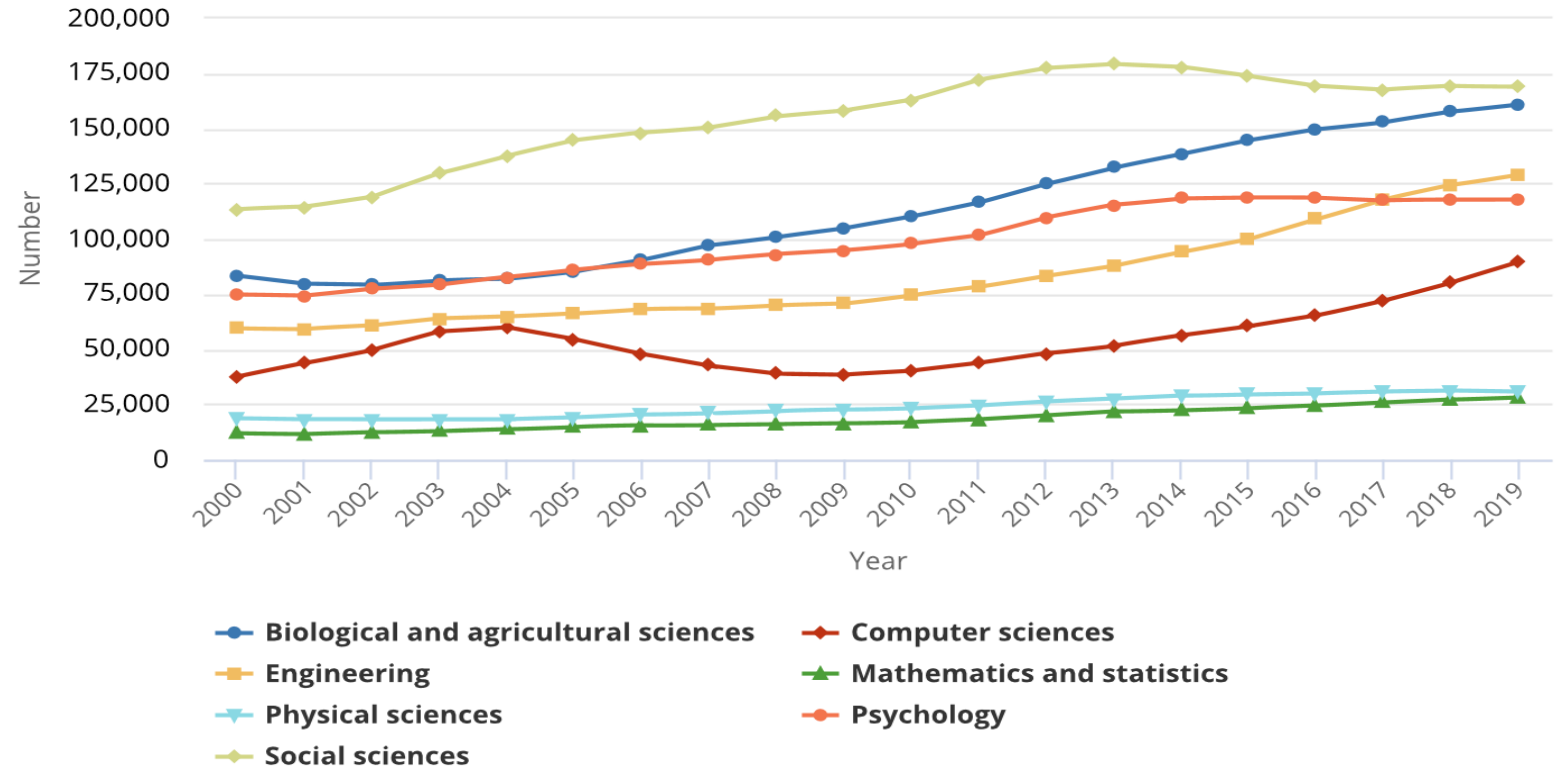
Note(s):
Physical sciences include earth, atmospheric, and ocean sciences.

Source(s):
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completions Survey; National Center for Science and Engineering Statistics, Table Builder.

Science and Engineering Indicators

Example #1: Trends in Bachelor's Degrees in Math Compiled Data and Analysis

- Science and Engineering Indicators

  A general starting point for access to S&T data and analysis

  - Biennial summary report produced for the President and Congress to report on the state of S&E in the United States

  - Produced by the National Center for Science and Engineering Statistics

    A federal statistical agency with accessible tools

- Supplemented with in-depth topical reports

  A biennial report focused on trends in STEM higher ed

  - Higher Education in Science and Engineering

    - Undergraduate Degree Awards

      Specific section on undergraduate degree trends

Example #2:

Trends in Bachelor's Degrees in Math

Compiled Disaggregated Data

Table 5-3

Bachelor's degrees awarded, by sex, field, citizenship, ethnicity, and race: 2008–18

(Number)

Sex, field, citizenship, ethnicity, and race	2008			2018			2008 - 2018 Change Female	
	Total	Female	Male	Total	Female	Male	Number	Chng in %
Mathematics and statistics	15,841	6,957	8,884	27,161	11,490	15,671	4,533	-2%
U.S. citizen and permanent resident	15,079	6,646	8,433	22,356	9,286	13,070	2,640	-3%
Hispanic or Latino[a]	924	421	503	2,556	1,077	1,479	656	-3%
Not Hispanic or Latino	14,155	6,225	7,930	19,800	8,209	11,591	1,984	-3%
American Indian or Alaska Native	73	25	48	61	31	30	6	17%
Asian or Pacific Islander[b]	1,512	652	860	3,227	1,318	1,909	666	-2%
Black or African American	796	399	397	1,089	517	572	118	-3%
White	10,875	4,806	6,069	13,876	5,710	8,166	904	-3%
More than one race[c]	na	na	na	823	349	474	na	na
Other or unknown race and ethnicity	899	343	556	724	284	440	-59	1%
Temporary resident	762	311	451	4,805	2,204	2,601	1,893	5%

Source(s):

Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, unrevised provisional release data, accessed 14 January 2020.

Example #2: Trends in Bachelor's Degrees in Math Compiled, Disaggregated Data

A general starting point for STEM diversity data trends

- **Women, Minorities and Persons with Disabilities in Science and Engineering** (WMPD)

  - Biennial summary report on the status of underrepresented groups in STEM

  - Produced by the National Center for Science and Engineering Statistics

  - Understanding Diversity in STEM Webinar

  A tutorial on using the WPMD

- Analysis

  Analysis and data on all parts of the continuum: US population, enrollments, degrees, postdocs, employment

- Detailed data tables

  - Degrees, Institutions, Sources of Support

  Specific section on undergraduate degree trends by demographic characteristics

Example #3:

Trends in Bachelor's Degrees in Math

Custom Tables

Mathematics and statistics bachelor's degrees awarded at UCLA, by sex, field, citizenship, ethnicity, and race: 2008 and 2018

(Number)

Sex, field, citizenship, ethnicity, and race	2008			2018			2008 - 2018 Change Female	
	Total	Female	Male	Total	Female	Male	Number	% Change
Mathematics and statistics	219	89	130	546	237	309	148	3%
U.S. citizen and permanent resident	196	80	116	342	139	203	59	0%
Hispanic or Latino[a]	23	9	14	40	15	25	6	-2%
Not Hispanic or Latino	173	71	102	302	124	178	53	0%
American Indian or Alaska Native	0	0	0	0	0	0	na	na
Asian	96	43	53	177	80	97	37	0%
Black or African American	5	2	3	4	1	3	-1	-15%
White	61	25	36	94	36	58	11	-3%
More than one race[c]	na	na	na	18	5	13	na	na
Other or unknown race and ethnicity	11	1	10	9	2	7	1	13%
Temporary resident	23	9	14	204	98	106	89	9%

Example #3: Trends in Bachelor's Degrees in Math Custom Tables

- National Center for Science and Engineering Statistics

- Explore Data

  Multiple tools for different types of data

  - Table Builder

    Custom table builder

  - NCSES Data Tools Media Archive

    Online tutorial for table builder and chart builder

    - IPEDS Completions

      Dept. of Ed database with institutional data

What are the AP Calculus outcomes of US students?
How does that that vary geographically?

Interactive Compiled Data

Example #4:

AP Calculus Outcomes

Interactive Compiled Data

Public High School Students Scoring 3 or Higher on the Advanced Placement Calculus AB Exam
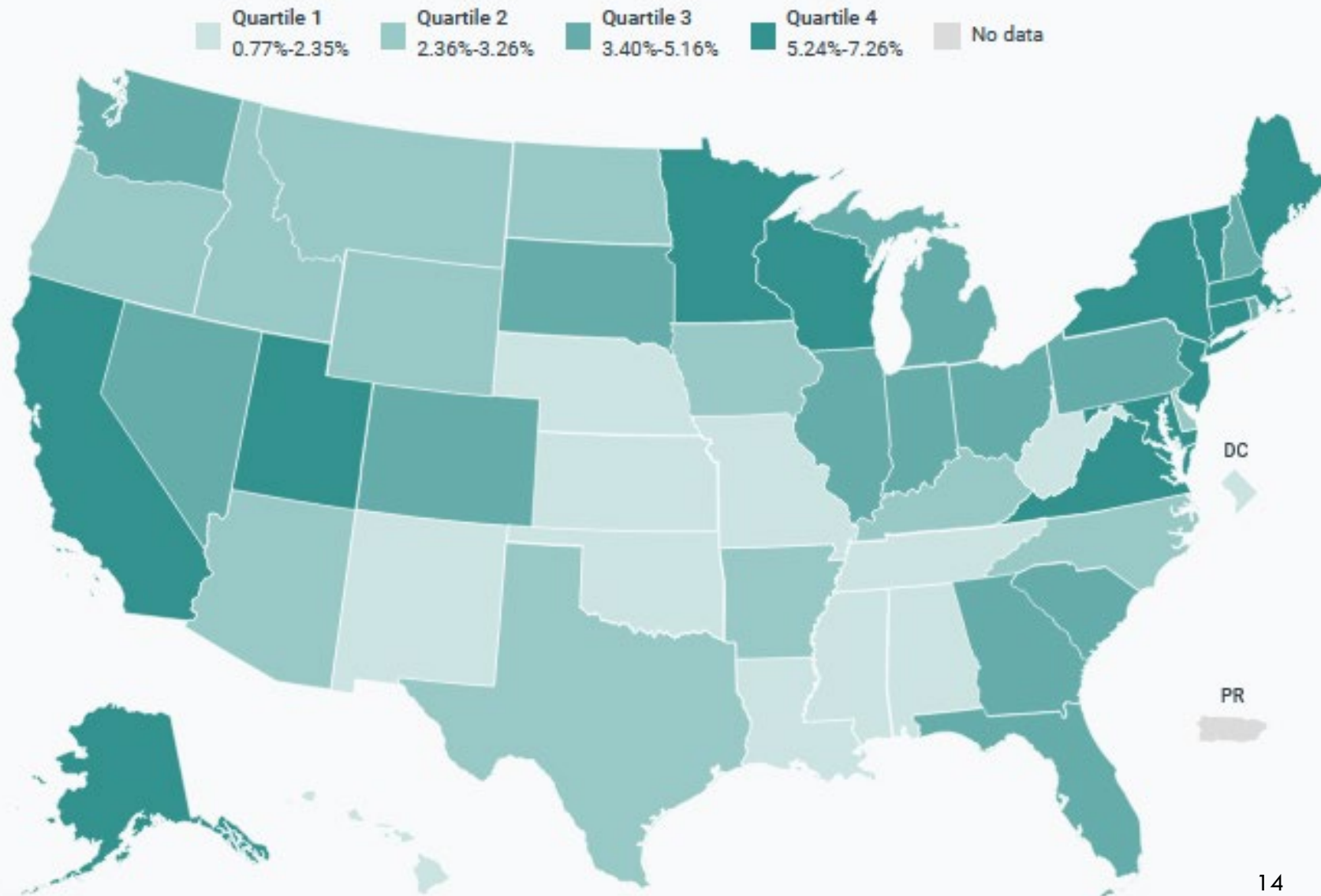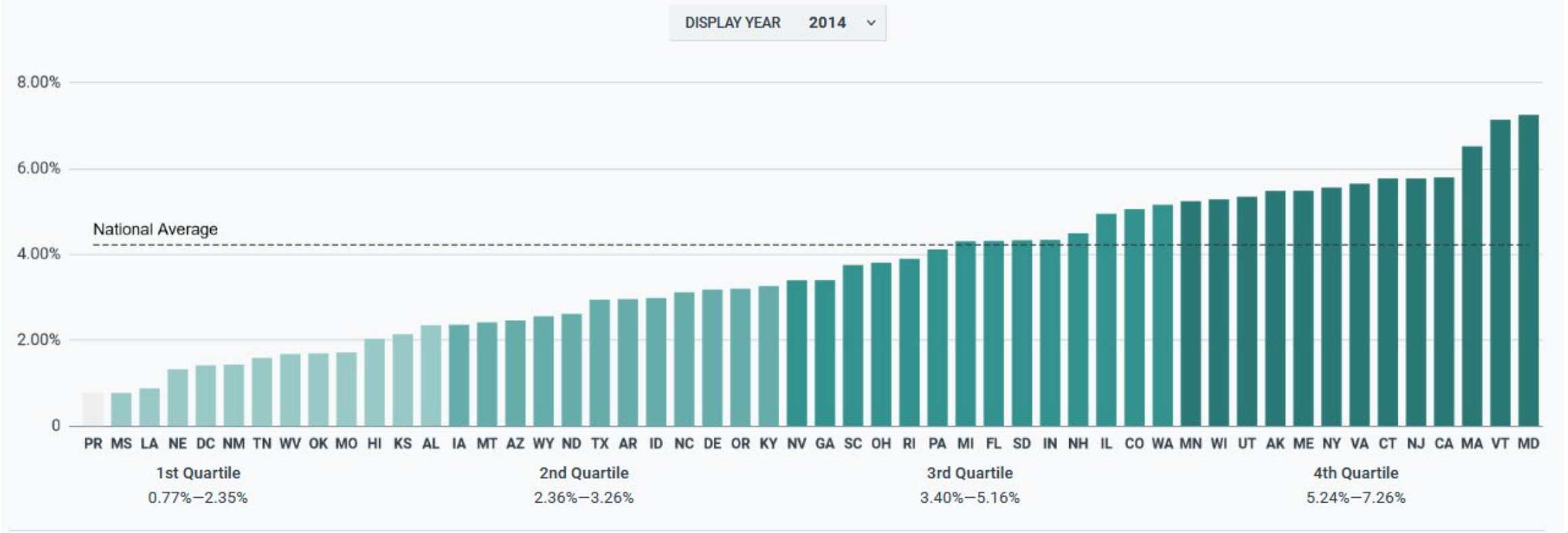
Example #5: AP Calculus Outcomes
Interactive Compiled Data

Public High School Students Scoring 3 or Higher on the Advanced Placement Calculus AB Exam

DISPLAY YEAR 2014

Examples #5 and #6: AP Calculus Outcomes Interactive Compiled Data

- Science and Engineering Indicators

Interactive Data Tool

- State Data Tool

Two ways of comparing the data

  - Compare Indicators or Compare States

  - Compare Indicators

One of multiple types of people and R&D indicators

    - Elementary and Secondary Education

      - Public High School Students Scoring 3 or Higher on the Advanced Placement Calculus AB Exam

National comparison of achievement, by state

What are the characteristics of incoming freshman, with respect to math preparation or intention to major in math?

The American Freshman: National Norms Fall 2019

ELLEN BARA STOLZENBERG | MELISSA C. ARAGON | EDGAR ROMO | VICTORIA COUCH | DESTINY MCLENNAN | M. KEVIN EAGAN | NATHANIEL KANG

Annual Pulse Survey
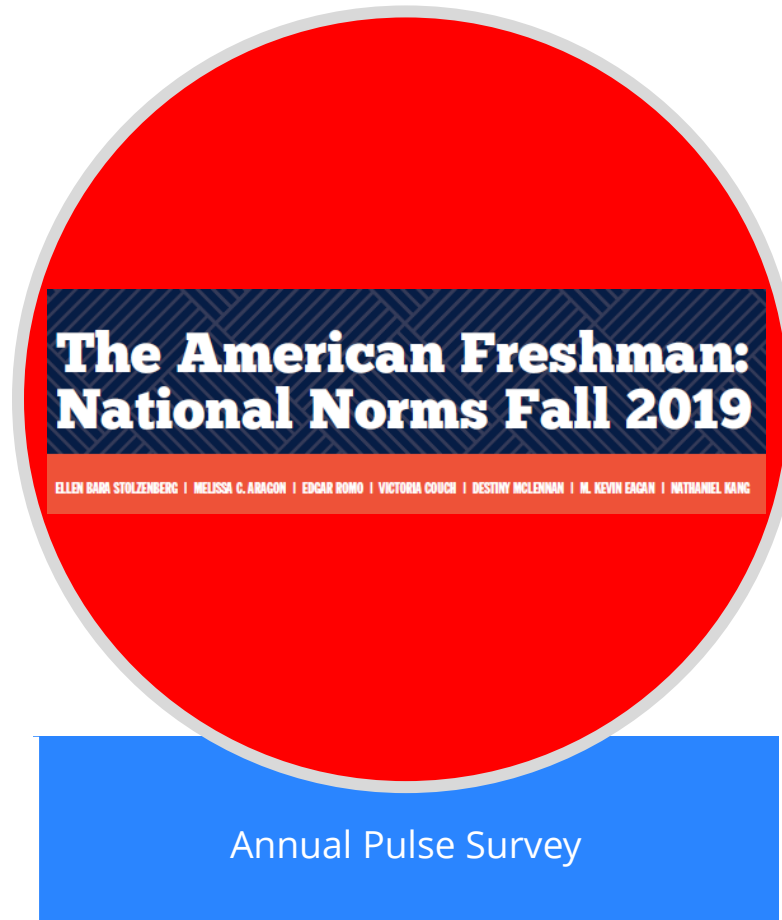
Example #6: Selected Statistics from Freshmen National Norms (2019)

Figure 3. Importance of Academic Reputation of Intended Major in College Choice, by Major Field
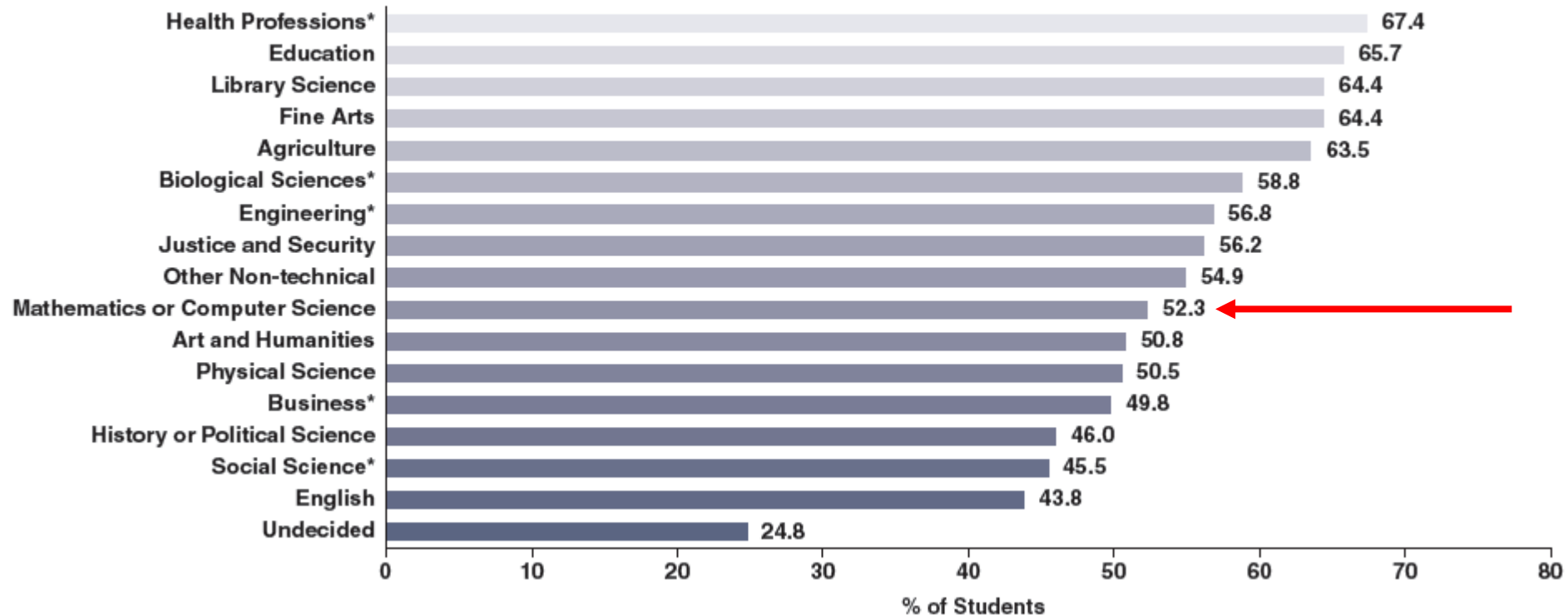(% Very important)

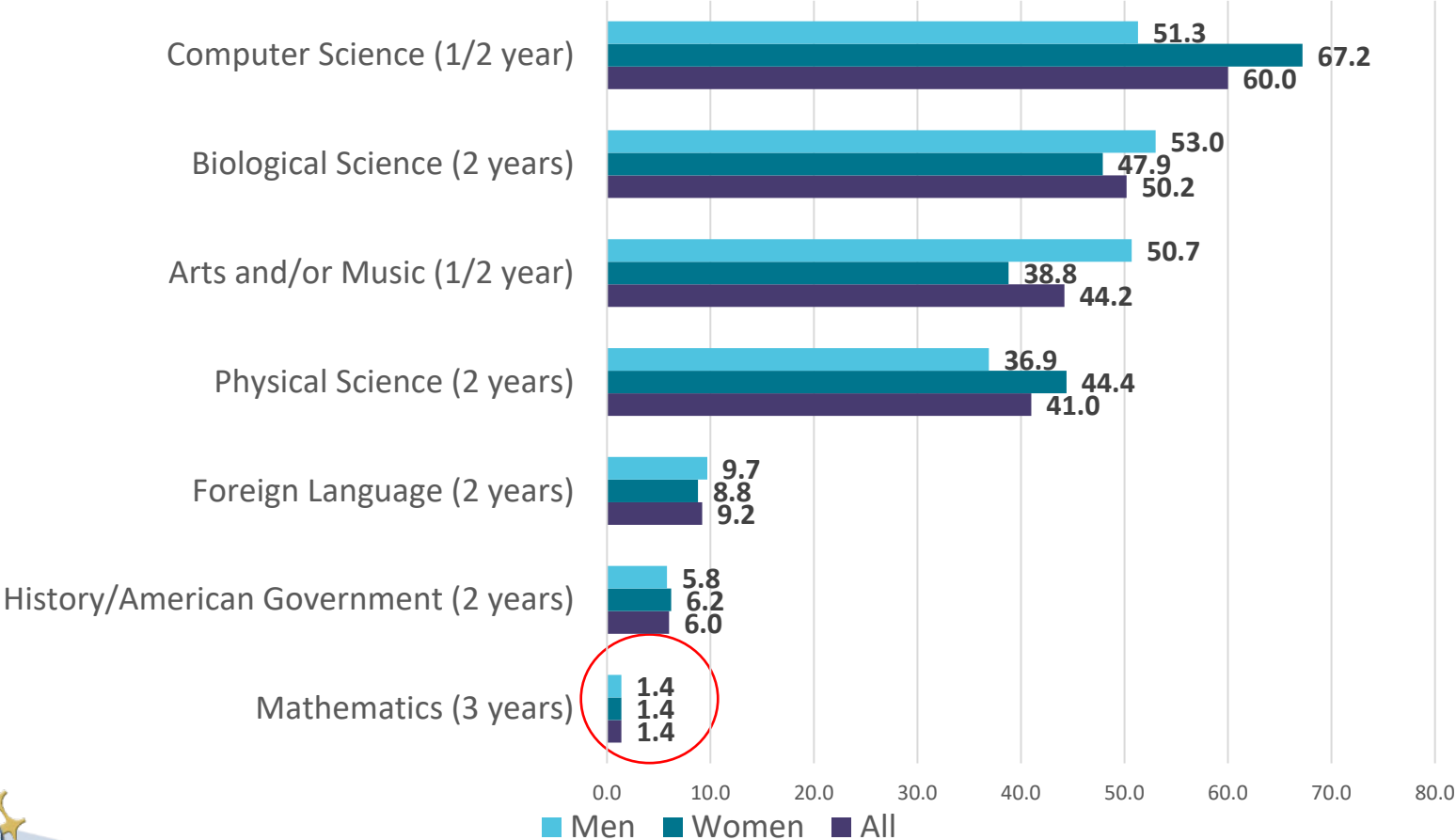| Major Field	% of Students
Health Professions*	67.4
Education	65.7
Library Science	64.4
Fine Arts	64.4
Agriculture	63.5
Biological Sciences*	58.8
Engineering*	56.8
Justice and Security	56.2
Other Non-technical	54.9
Mathematics or Computer Science	52.3
Art and Humanities	50.8
Physical Science	50.5
Business*	49.8
History or Political Science	46.0
Social Science*	45.5
English	43.8
Undecided	24.8

*Most common fields for incoming freshmen

Example #7: Selected Statistics from Freshmen National Norms (2019)

During high school (grades 9-12) how many years did you study each of the following subjects?

Chart categories (Men, Women, All):

- **Computer Science (1/2 year)** — Men: 51.3, Women: 67.2, All: 60.0
- **Biological Science (2 years)** — Men: 53.0, Women: 47.9, All: 50.2
- **Arts and/or Music (1/2 year)** — Men: 50.7, Women: 38.8, All: 44.2
- **Physical Science (2 years)** — Men: 36.9, Women: 44.4, All: 41.0
- **Foreign Language (2 years)** — Men: 9.7, Women: 8.8, All: 9.2
- **History/American Government (2 years)** — Men: 5.8, Women: 6.2, All: 6.0
- **Mathematics (3 years)** — Men: 1.4, Women: 1.4, All: 1.4

Legend: Men, Women, All

Intending to Major in Math

Men: 1.2%
Women: 1.0%

Self-assessment – I am in the "highest 10%" or "above average" in mathematical ability among my peers

Men: 53.9%
Women: 36.4%

Examples #6 and #7: Annual national data from the Freshman National Norms Survey

- The Freshman Survey – National Norms *(Annual pulse survey)*

  - UCLA – Higher Education Research Institute

  - Annual pulse survey of incoming, first-time, first-year students

  - Request data or custom reports *(Institutional data is available)*

- Demographics of Incoming Students

- Math-related Data *(Specific data about all students' preparedness)*

  - Pre-college math course-taking
  - Intention to major in math, compared to other fields
  - Importance of choice of school, by major
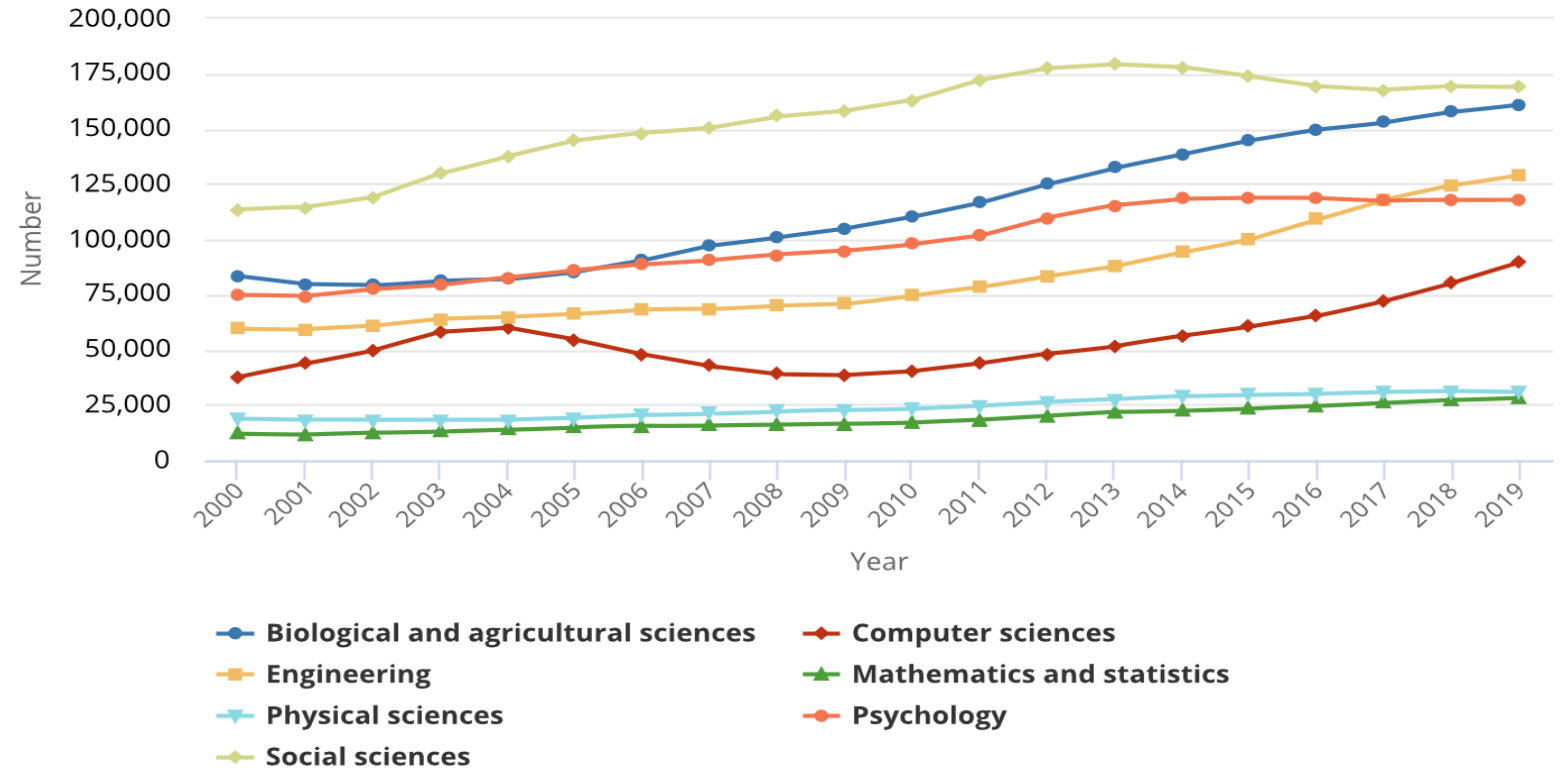 - Importance of engagement with professors

Example #1:

Trends in Bachelor's Degrees in Math

Compiled Data and Analysis

Figure HED-8

S&E bachelor's degrees awarded, by field: 2000–19

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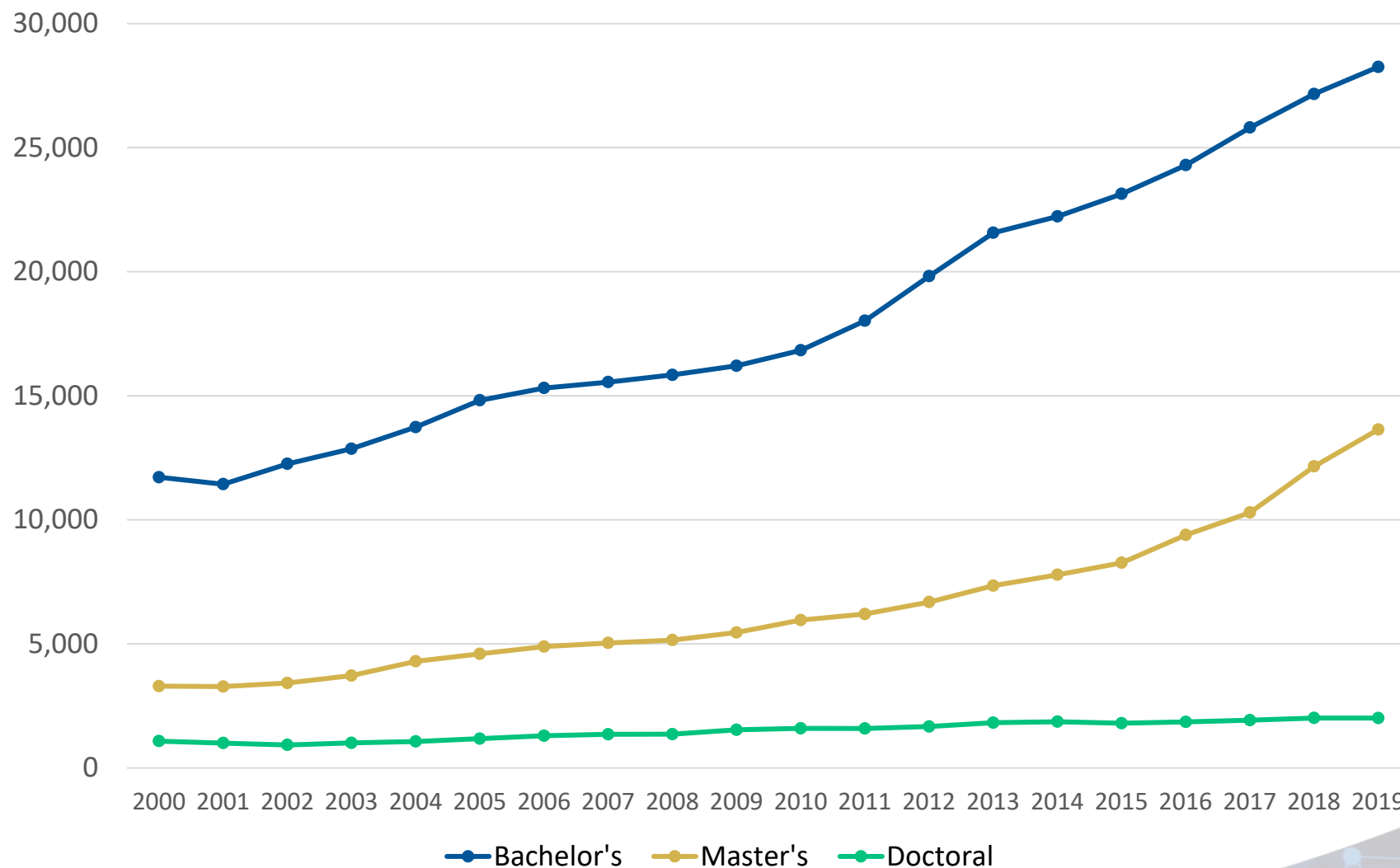
Science and Engineering Indicators

Example #8:

Trends in Degrees in Math/Stat

Combining Data

Mathematics and Statistics Degrees Awarded at U.S. Institutions, by level: 2000-2019

What are the workforce characteristics of recent bachelor's degree holders in math?
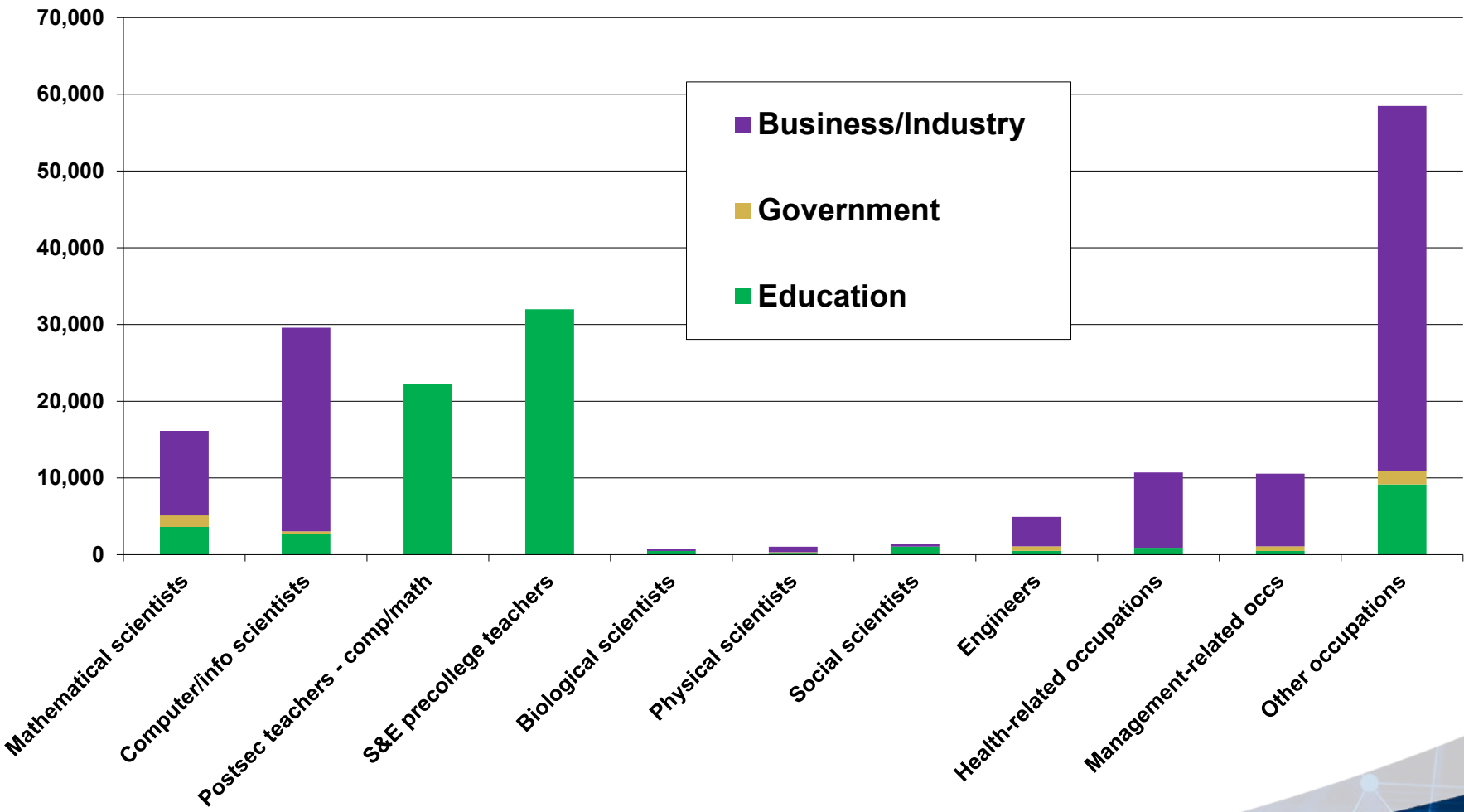

Custom Tables

Example #9:

Young Math Degree Holders by Sector and Occupation

Advanced Custom Tables

Math Degree Holders (35 yrs or younger) by occupation and sector: 2019

Legend:
- Business/Industry
- Government
- Education

Example #9: Workforce Characteristics of Recent Math Degree Holders
Custom Tables

- National Center for Science and Engineering Statistics

- Explore Data

  Multiple tools for different types of data

  - SESTAT – Scientists and Engineers Statistical Data System

    Custom table builder

    - SESTAT Tutorial

      Online help for table builder

    - National Survey of College Graduates

      Biennial survey of all college graduates in the U.S.

    - Detailed Statistical Tables

      Compiled data

Questions?

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Thank You!