Undergraduate Mathematics Student Pathways: Data and Tools

TPSE Department Chairs Conversations
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Office of the Director
National Science Foundation
Overview

Context and Definitions

Major Trends

Pe-college achievement

Undergraduate Indicators

Workforce Characteristics

Tools to Explore the Data
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?
<table>
<thead>
<tr>
<th><strong>1960s</strong></th>
<th><strong>2020s</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Disciplinary focus</td>
<td>Greater interdisciplinary focus</td>
</tr>
<tr>
<td>U.S. a world leader in higher education</td>
<td>Growth in higher education abroad</td>
</tr>
<tr>
<td>Students predominantly white and majority male</td>
<td>Greater racial/ethnic and gender diversity</td>
</tr>
<tr>
<td>Predominantly U.S. citizen students and postdocs</td>
<td>Increase in foreign students and foreign postdocs</td>
</tr>
<tr>
<td>Public and private non-profit campus-based degree programs</td>
<td>Growth of for-profit institutions and online programs</td>
</tr>
</tbody>
</table>
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?
Example #1:

Trends in Bachelor’s Degrees in Math

Compiled Data and Analysis

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**
  - 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](https://www.nationalcenter.org)

- Supplemented with in-depth topical reports
  - **Higher Education in Science and Engineering**
  - **Undergraduate Degree Awards**
    - Specific section on undergraduate degree trends

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

A federal statistical agency with accessible tools

A biennial report focused on trends in STEM higher ed
### Table 5-3
Bachelor’s degrees awarded, by sex, field, citizenship, ethnicity, and race: 2008–18

<table>
<thead>
<tr>
<th>Sex, field, citizenship, ethnicity, and race</th>
<th>2008</th>
<th>2018</th>
<th>2008 - 2018</th>
<th>Change Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Female</td>
<td>Male</td>
<td>Total</td>
</tr>
<tr>
<td>Mathematics and statistics</td>
<td>15,841</td>
<td>6,957</td>
<td>8,884</td>
<td>27,161</td>
</tr>
<tr>
<td>U.S. citizen and permanent resident</td>
<td>15,079</td>
<td>6,646</td>
<td>8,433</td>
<td>22,356</td>
</tr>
<tr>
<td>Hispanic or Latinoa</td>
<td>924</td>
<td>421</td>
<td>503</td>
<td>2,556</td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
<td>14,155</td>
<td>6,225</td>
<td>7,930</td>
<td>19,800</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td>73</td>
<td>25</td>
<td>48</td>
<td>61</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>1,512</td>
<td>652</td>
<td>860</td>
<td>3,227</td>
</tr>
<tr>
<td>Black or African American</td>
<td>796</td>
<td>399</td>
<td>397</td>
<td>1,089</td>
</tr>
<tr>
<td>White</td>
<td>10,875</td>
<td>4,806</td>
<td>6,069</td>
<td>13,876</td>
</tr>
<tr>
<td>More than one racec</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>823</td>
</tr>
<tr>
<td>Other or unknown race and ethnicity</td>
<td>899</td>
<td>343</td>
<td>556</td>
<td>724</td>
</tr>
<tr>
<td>Temporary resident</td>
<td>762</td>
<td>311</td>
<td>451</td>
<td>4,805</td>
</tr>
</tbody>
</table>

Source(s):
Example #2: Trends in Bachelor’s Degrees in Math Compiled, Disaggregated Data

- 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
    - Analysis
      - Detailed data tables
        - Degrees, Institutions, Sources of Support
          - Analysis and data on all parts of the continuum: US population, enrollments, degrees, postdocs, employment
          - Specific section on undergraduate degree trends by demographic characteristics
          - A tutorial on using the WPMD

A general starting point for STEM diversity data trends
### 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

<table>
<thead>
<tr>
<th>Sex, field, citizenship, ethnicity, and race</th>
<th>2008</th>
<th>2018</th>
<th>2008 - 2018 Change Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Mathematics and statistics</td>
<td>219</td>
<td>89</td>
<td>130</td>
</tr>
<tr>
<td>U.S. citizen and permanent resident</td>
<td>196</td>
<td>80</td>
<td>116</td>
</tr>
<tr>
<td>Hispanic or Latinoa</td>
<td>23</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
<td>173</td>
<td>71</td>
<td>102</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Asian</td>
<td>96</td>
<td>43</td>
<td>53</td>
</tr>
<tr>
<td>Black or African American</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>White</td>
<td>61</td>
<td>25</td>
<td>36</td>
</tr>
<tr>
<td>More than one racec</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Other or unknown race and ethnicity</td>
<td>11</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Temporary resident</td>
<td>23</td>
<td>9</td>
<td>14</td>
</tr>
</tbody>
</table>

Example #3: Trends in Bachelor’s Degrees in Math

Custom Tables

• National Center for Science and Engineering Statistics

• Explore Data

  • Table Builder

  • NCSES Data Tools Media Archive

  • IPEDS Completions

Multiple tools for different types of data

Dept. of Ed database with institutional data

Custom table builder

Online tutorial for table builder and chart builder
What are the AP Calculus outcomes of US students? How does that vary geographically?
Example #4:

AP Calculus Outcomes

Interactive Compiled Data
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

National Average

1st Quartile
0.77%–2.35%

2nd Quartile
2.36%–3.26%

3rd Quartile
3.40%–5.16%

4th Quartile
5.24%–7.26%
Examples #5 and #6: AP Calculus Outcomes

Interactive Compiled Data

• Science and Engineering Indicators

• State Data Tool
  • Compare Indicators or Compare States

• Compare Indicators
  • Elementary and Secondary Education
    • Public High School Students Scoring 3 or Higher on the Advanced Placement Calculus AB Exam
What are the characteristics of incoming freshman, with respect to math preparation or intention to major in math?
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)

*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?

- Computer Science (1/2 year)
- Biological Science (2 years)
- Arts and/or Music (1/2 year)
- Physical Science (2 years)
- Foreign Language (2 years)
- History/American Government (2 years)
- Mathematics (3 years)

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
  • UCLA – Higher Education Research Institute
  • Annual pulse survey of incoming, first-time, first-year students
  • Request data or custom reports

• Demographics of Incoming Students

• Math-related Data
  • 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

National Center for Science and Engineering Statistics | NSB-2022-3

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 #8: Trends in Degrees in Math/Stat Combining Data


- Bachelor's
- Master's
- Doctoral

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

- Business/Industry
- Government
- Education
Example #9: Workforce Characteristics of Recent Math Degree Holders
Custom Tables

• National Center for Science and Engineering Statistics
  • Explore Data
    • SESTAT – Scientists and Engineers Statistical Data System
    • SESTAT Tutorial
    • National Survey of College Graduates
    • Detailed Statistical Tables

  Custom table builder
  Multiple tools for different types of data
  Online help for table builder
  Biennial survey of all college graduates in the U.S.

Compiled data
Questions?

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Thank You!