Data Science in K12
Summary

1. The world is newly awash in data
2. Everyone needs data-related skills to navigate this new world
   • Decisions that used to be simple are now complex
   • Most jobs, and nearly all the good jobs, require these skills
3. We are not preparing our kids well for this change
4. Reshaping what we emphasize in math is critical
5. We want to work with you to make this change possible
Every Second of Every Day the World Creates Enough Data to Fill Fifty New Libraries of Congress

Source: Center of RISC Analysis, Domo https://www.domo.com/learn/data-never-sleeps-6
The Internet is Feeding This Phenomenon

More than 4 billion people are now on the Internet

Source: Internet Live Stats: http://www.internetlivestats.com/
So is the Proliferation of Smartphones

5 billion smartphones in the world in 2017

Immensely Powerful Computers in Our Pockets

Today’s iPhone 8 has a thousand times more storage capacity than a multi-million dollar mainframe computer in the 1970s.

Feeding a Data Explosion – 90% of the World’s Data Have Been Created in the Last Two Years

This New, Data-Intensive World can be Difficult to Navigate
Decisions That Used to be Straightforward are Now More Complex
Separating Fact from Fiction is Getting Harder
Data are Changing the Nature of Our Work. Fixing a Car Used to be Simpler
Today’s Mechanics are Immersed in Data
Teachers Have Had to Adapt Too
Today’s Teachers Work with Data Daily
Employers are Desperate to Find People with Data-Related Skills

Source: https://www.brookings.edu/interactives/still-searching-job-vacancies-and-stem-skills/

**Top 10 Emerging Jobs**

- Machine Learning Engineer: 9.6x
- Data Scientist: 6.5x
- Sales Development Representative: 5.7x
- Customer Success Manager: 5.6x
- Big Data Developer: 5.5x
- Full Stack Engineer: 5.5x
- Unity Developer: 5.1x
- Director of Data Science: 4.9x
- Brand Partner: 4.5x
- Full Stack Developer: 4.5x

College Students are Responding by Changing Their Majors

Top Majors at Stanford in 2015

1. Computer Science
2. Human Biology
3. Engineering
4. Mechanical Engineering
5. Science, Technology & Society

Student Majors at Harvard

Source: https://stanfordmag.org/contents/the-five-most-popular-majors-at-stanford
But What About Our High School Students? Data Science is Absent from the Curriculum.
**Racial disparities**

Black and Hispanic Adults Underrepresented across most STEM job clusters

<table>
<thead>
<tr>
<th>Occupation Group</th>
<th>White</th>
<th>Asian</th>
<th>Black</th>
<th>Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>All employed</td>
<td>65%</td>
<td>61%</td>
<td>11%</td>
<td>16%</td>
</tr>
<tr>
<td>STEM jobs</td>
<td>68%</td>
<td>13%</td>
<td>9%</td>
<td>7%</td>
</tr>
<tr>
<td>Among those who work in ___ jobs…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
<td>73%</td>
<td>12%</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>Health-related</td>
<td>70%</td>
<td>11%</td>
<td>9%</td>
<td></td>
</tr>
<tr>
<td>Physical sciences</td>
<td>67%</td>
<td>19%</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>Math</td>
<td>68%</td>
<td>19%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Life sciences</td>
<td>67%</td>
<td>19%</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td>71%</td>
<td>19%</td>
<td>9%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Note: Based on employed adults age 25 and older. Whites, African-Americans, and Asians include only non-Hispanic adults. Hispanics are of any race. Engineering includes architects. STEM stands for science, technology, engineering and Math. Source: Pew Research Center analysis of 2014-2016 American Community Survey (IPUMS).

“Women and Men in STEM Often at Odds Over Workplace Equity”

**Socioeconomic disparities**

Low-income students are less likely to take statistics courses

| Percentage of 12th-graders who have taken at least one statistics course, 2015 |
|-----------------------------|-----------------------------|
| Higher Income | Lower Income |
| Any statistics course* | 26% | 19% |
| AP Statistics course* | 10% | 5% |


Source: http://blogs.edweek.org/edweek/curriculum/2016/09/1_in_4_high_school_seniors_take_statistics.html
Even the Most Privileged Students with the Most Opportunities, Learn Little About Data

* Includes statistics, computer science, research-focused courses
** includes algebra, geometry, algebra II, and calculus
Source: Representative sample of transcript data from 250 applicants to the University of Chicago
Our High School Math Curriculum was Born During the Space Race

- 1957: Sputnik Launched
- 1959: College Board develops 9-part program to prep students for calculus and geometry
When Calculus was King and Engineers were Needed to Build Our Rockets
When Computers and Data were Far Less Important to Our Success

• The Apollo Guidance Control computer had less computing power than a classic Nintendo GAME BOY (first introduced in 1989)

“Very Few People Actually Use Calculus in a Conscious, Meaningful Way in Their Day-to-Day Lives”

Arthur T. Benjamin
Professor of Mathematics
Harvey Mudd College
A Tiny Fraction of Today’s Workers Use Traditional High School Math, But They Do Use Data Frequently

Source: Survey distributed via Freakonomics tweets and web site; respondents not representative—skewed male, higher income, higher education
Many of Today’s Workers Wish They Had Learned Different Math

Source: Survey distributed via Freakonomics tweets and web site; respondents not representative—skewed male, higher income, higher education
Today’s World Requires We Know How to:

• Find information and sort the good from the bad
• Interpret data from tables and charts
• Analyze data to discover hidden insights
• Visualize and present data to make an argument
• Use common analytical software (e.g. Excel, Google Spreadsheets)
So We Need to Teach Our High School Children How to . . .

**Ask Questions**
- Generate hypotheses

**Consider Data**
- Understand how data are used to address real-world problems and are used in all facets of modern life

**Analyze Data**
- Analyze statistical graphics to identify patterns in data and to connect these patterns back to the real world

**Interpret Data**
- Critically evaluate shortcomings and strengths in the data and the data collection process
And Help Students...

• Develop computational and statistical thinking skills
• Interpret categorical and quantitative data
• Make inferences and justify conclusions
• Seek data to answer questions or support/undermine claims
• Understand conditional probability and the rules of probability
• Evaluate and fit models to data
• Interpret analyses of data and communicate findings
Helping Students Become Data Fluent Will Better Prepare Them for College and the Workforce and Also Boost High-stakes Test Scores
Over Time, the SAT Has Changed to Reflect a Data-driven World
And Not Just in Math! Data Fluency is Throughout the SAT

12% of the SAT Reading sections and 7% of the Writing and Language sections require data skills
For the ACT, Data Analysis and Interpretation Are an Even Bigger Component

Join us and Make the Necessary Change
Data Science is Not a Subject for Some. It is a Set of Skills for All.