Data Science at Two-Year Colleges: Moving Forward

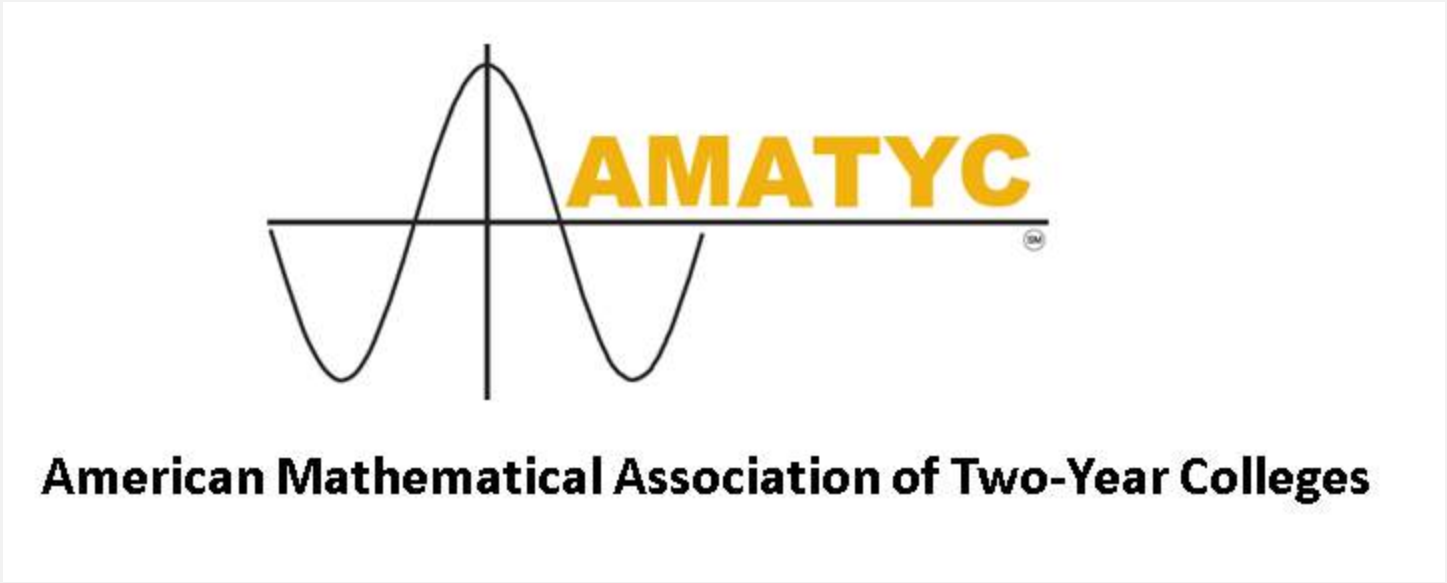
A Panel Discussion for eCOTS
May 22, 2018

Randy Kochevar
Brian Kotz
Manju Shah
Cara Tang

Why Create a Two-Year College Certificate Program in Data Science?

Brian Kotz,
Montgomery College
Professor, Mathematics and Statistics
Chair, AMATYC Data Science Subcommittee
brian.kotz@montgomerycollege.edu

A two-year college in
Montgomery County, Maryland



Data Science Subcommittee

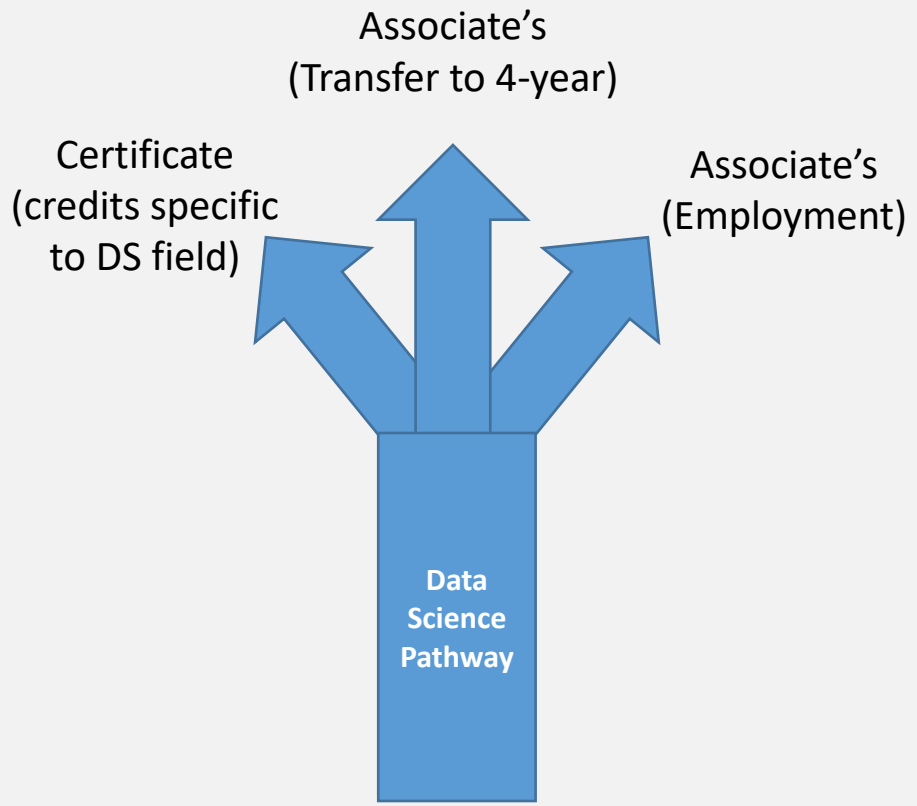
Discussion of levels of data science engagement in curriculum…

Four levels of credit bearing data science curriculum at TYCs:

- Infusing data science in STAT101
- Offering DATA101 (single course)
- **Offering a Certificate**
- Offering an Associate's Degree

AMATYC

American Mathematical Association of Two-Year Colleges



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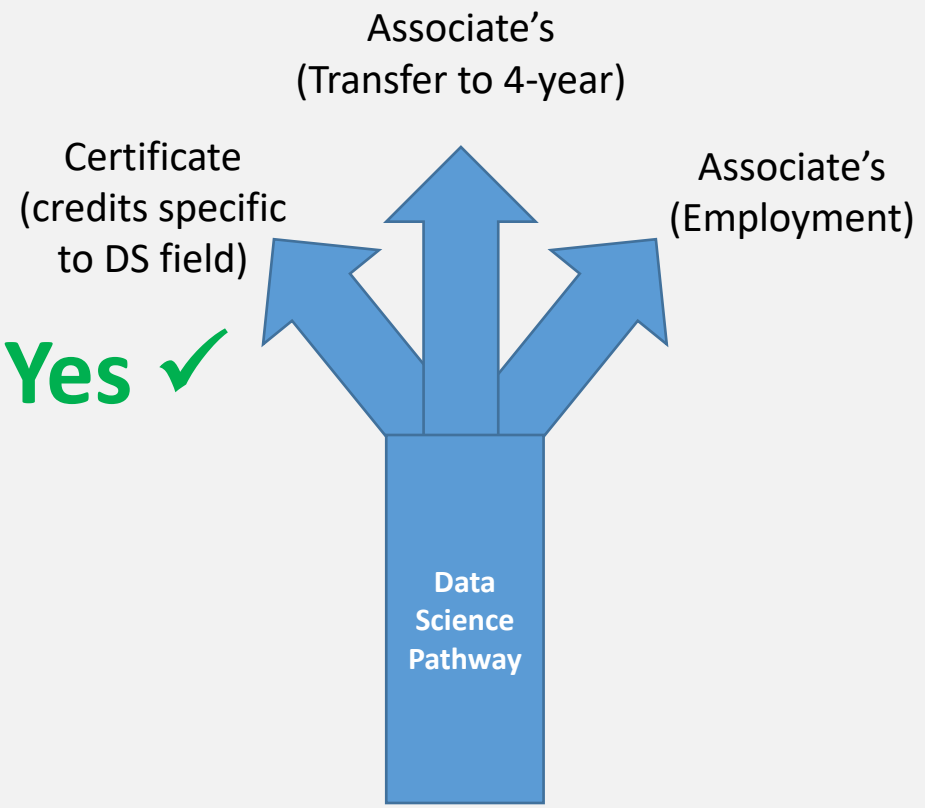
Examples:

Student would like a credit certificate (or coursework) from an accredited state college to supplement career, research, CV, etc. (might already have a degree)

Current student or “Visiting” 2-year or 4-year college student with room in schedule and interest

- *Just graduated high school*
- *Master’s in psychology*
- *Return to workforce*
- *Career advancement*



Why pursue this?

(Enough going on: completion, redesign, remediation, etc.)

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Teaching!

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Dr. DJ Patil

"I'm the U.S. Chief Data Scientist — and I got my start in community college."

https://obamawhitehouse.archives.gov/blog/2015/05/06/email-dj-patil-how-i-became-chief-data-scientist

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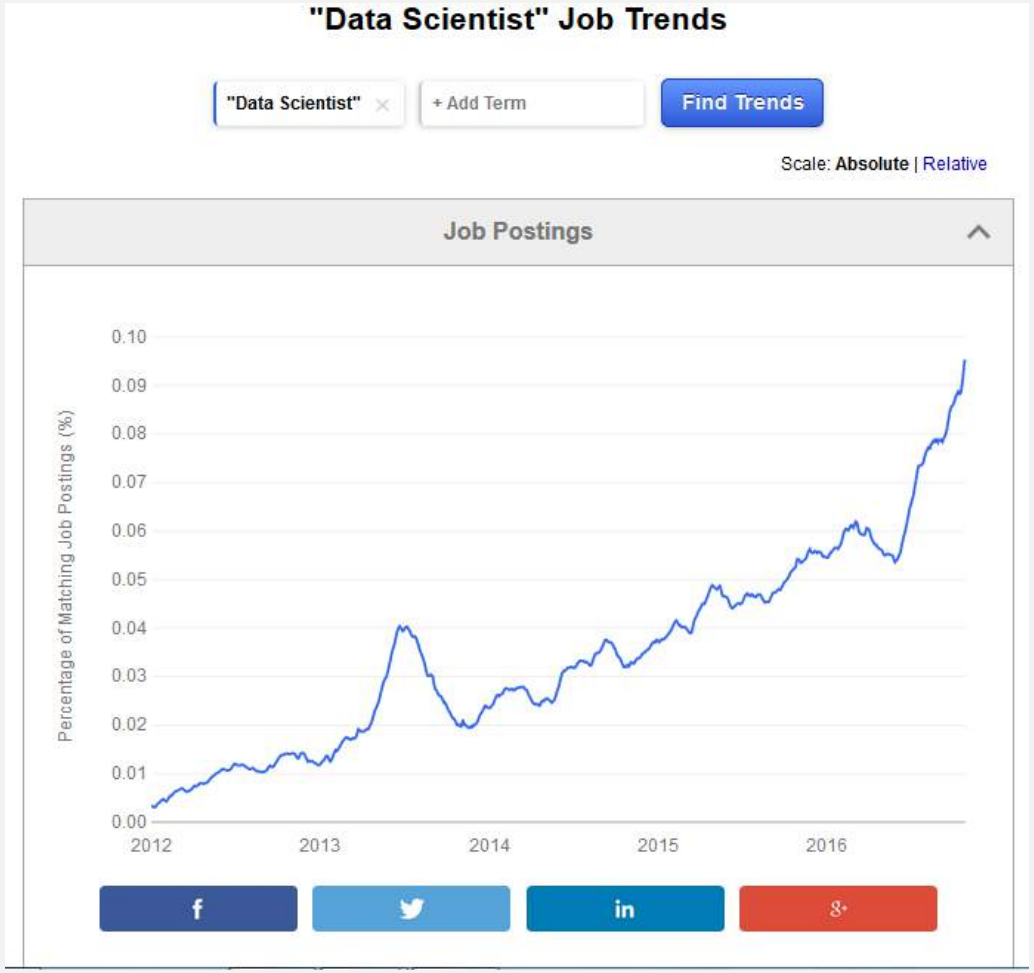
"The Certificate in Practical Data Science is designed for undergraduate students…"

Great Bay ***Community College***



AMSTATNEWS

The Membership Magazine of the American Statistical Association

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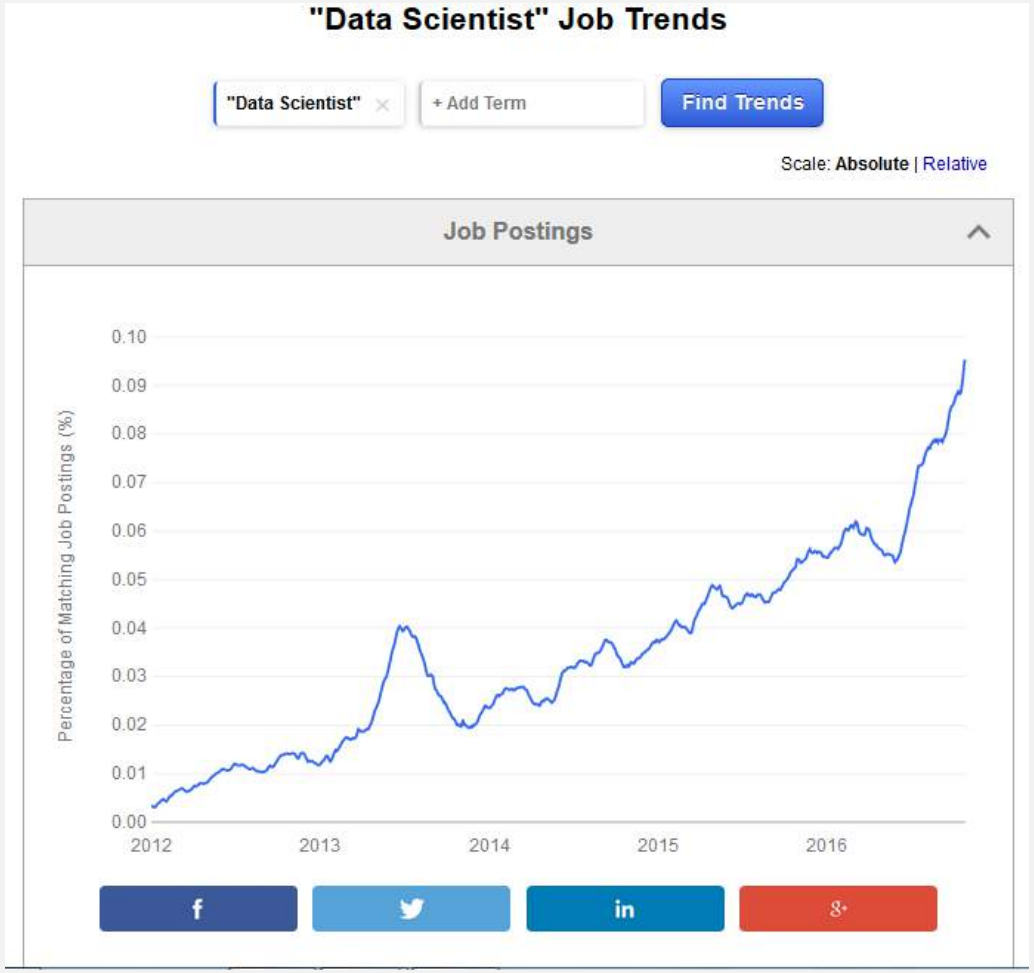
Home » Featured

ASA Statement on the Role of Statistics in Data Science

1 OCTOBER 2015 8,606 VIEWS 13 COMMENTS

https://www.indeed.com/jobtrends/q-%22Data-Scientist%22.html (accessed January 3, 2017)



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Better get involved!


DANA-FARBER
CANCER INSTITUTE
Lock Ad - Final- 30

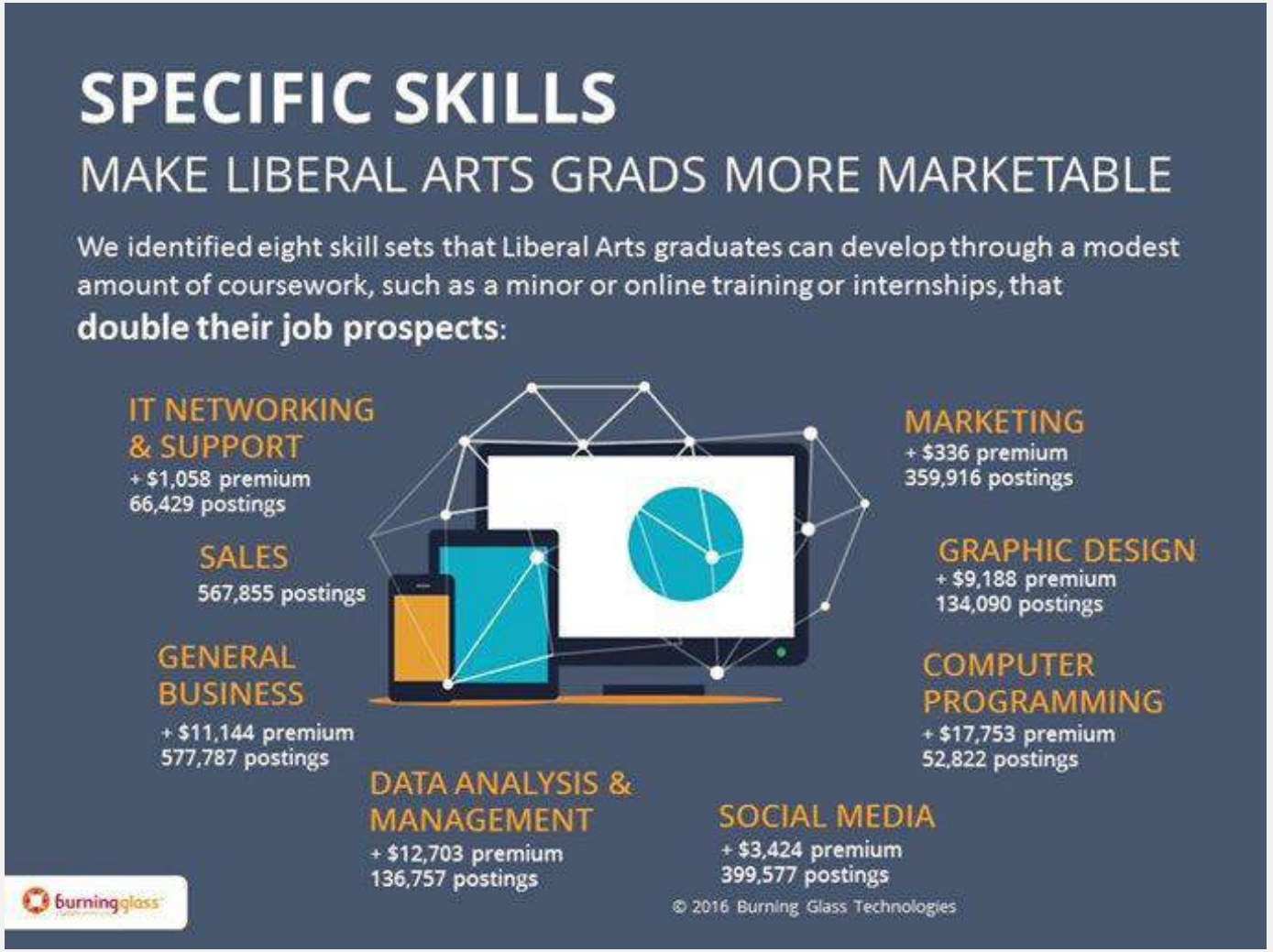

DANA-FARBER
CANCER INSTITUTE


BRCA
WIFE
IDH1


FLT3
DNA
KRAS

“By constantly using information in completely new ways, we’re cracking the cancer code.”

Dana-Farber Cancer Institute, discovercarebelieve.org



THE CHRONICLE OF HIGHER EDUCATION

http://www.chronicle.com/img/photos/biz/liberal-arts-skills_683x512.jpeg

Why have a “statistics lead”?

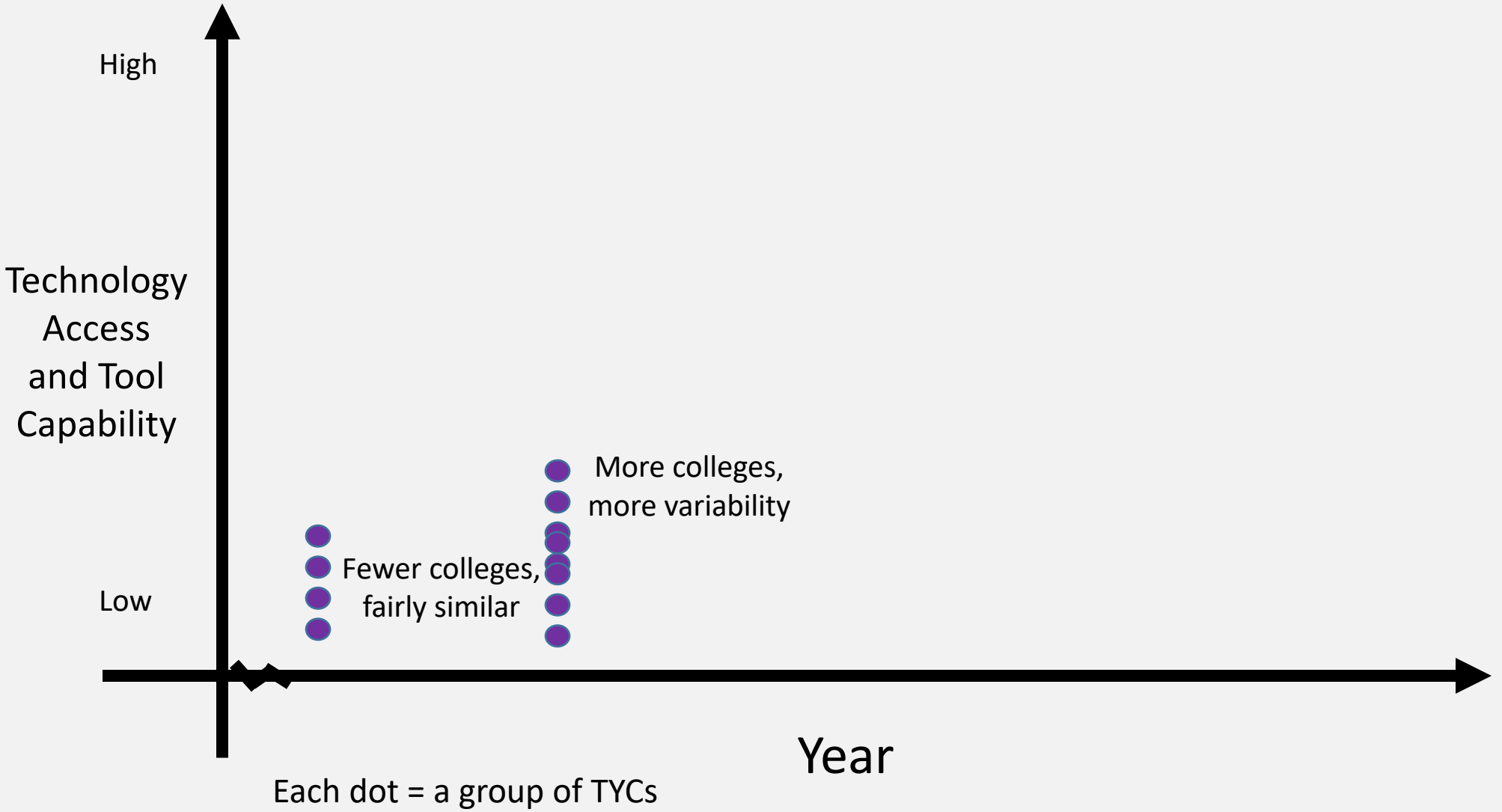
(vs. other disciplines: Business, Computer Science)

Why have a “statistics lead”?

(vs. other disciplines: Business, Computer Science)

Students asked: “Will you have data science classes soon?”

History of Two-Year College Statistics Instruction (in my opinion)



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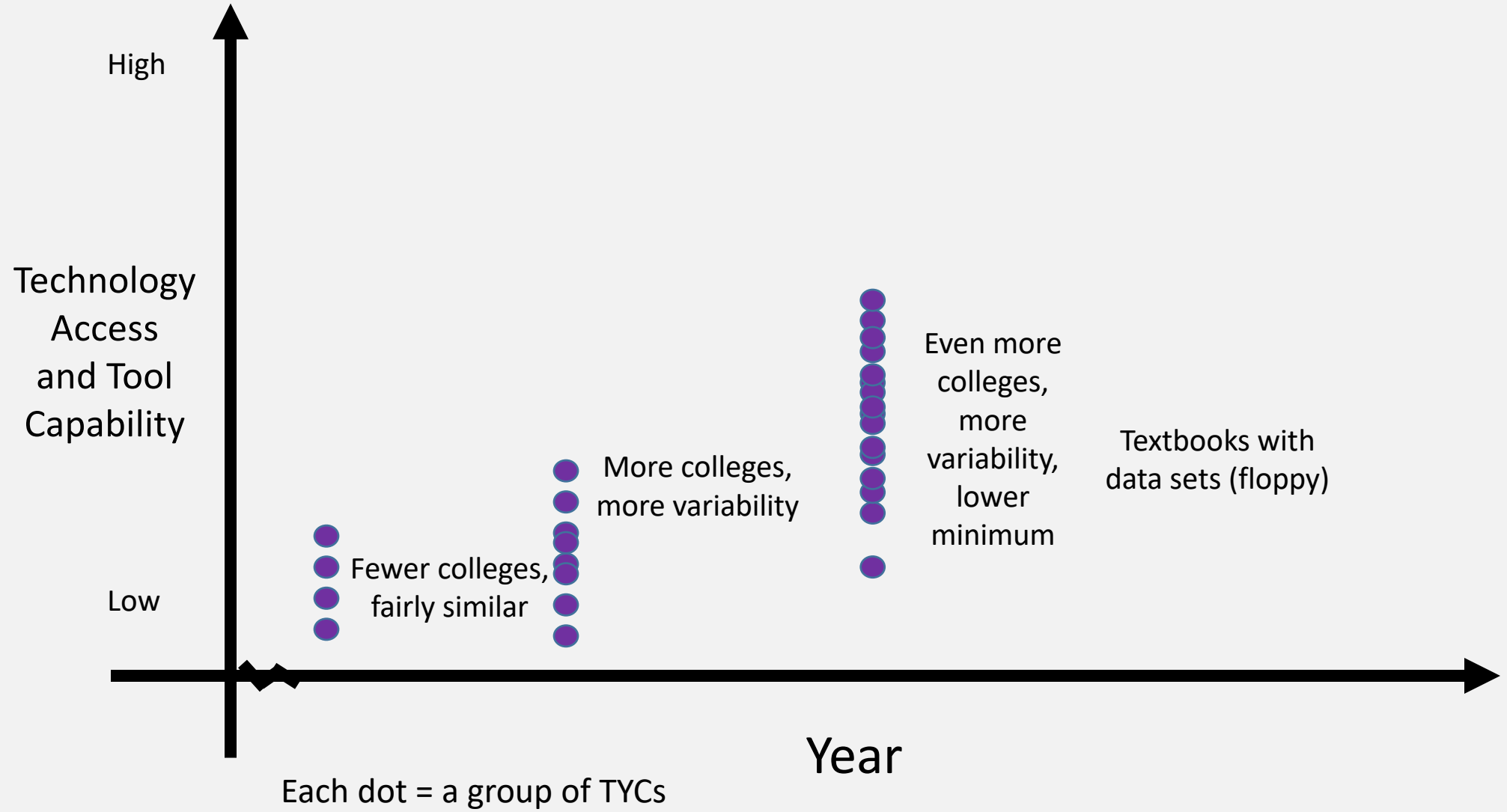

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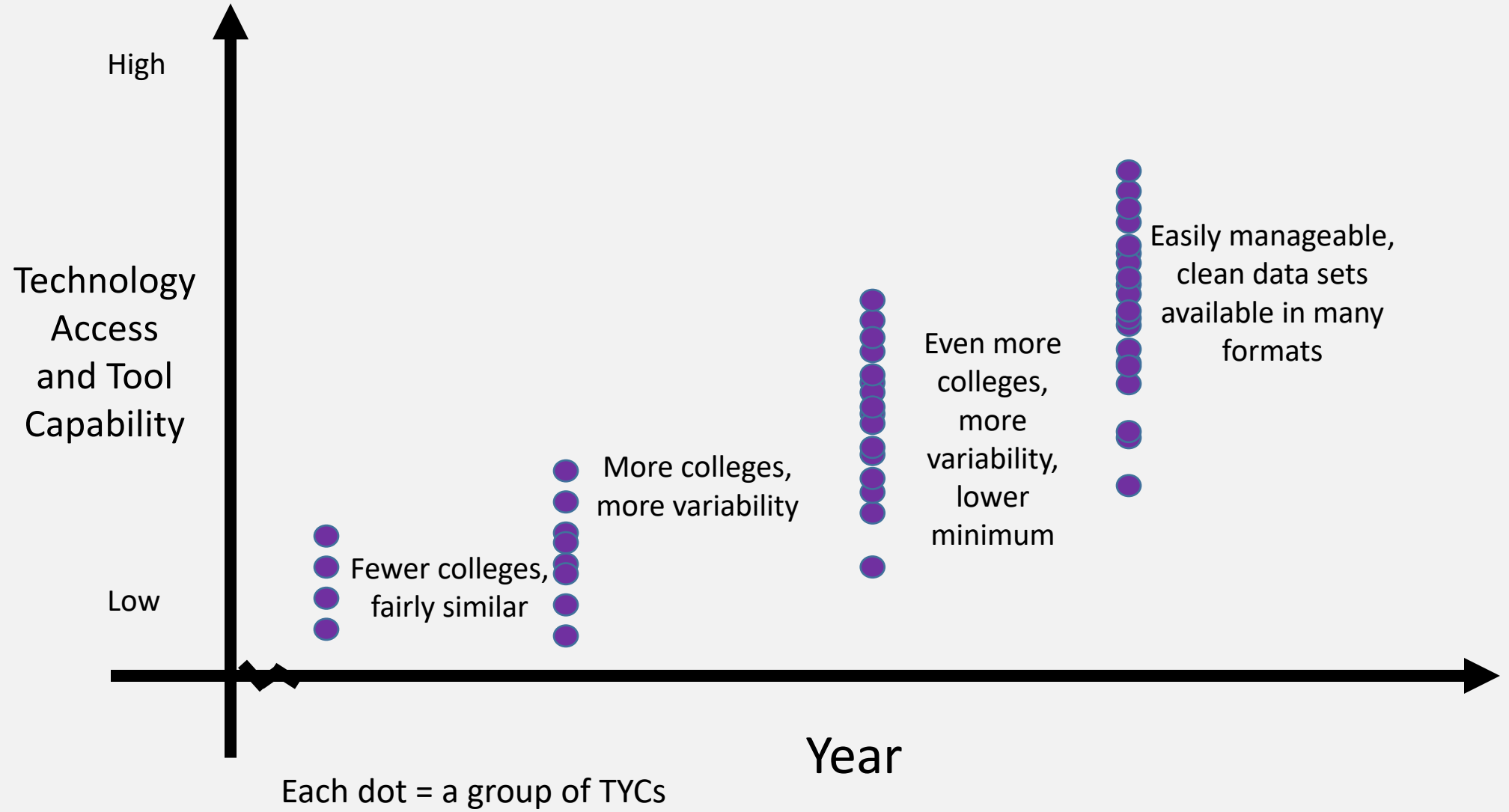

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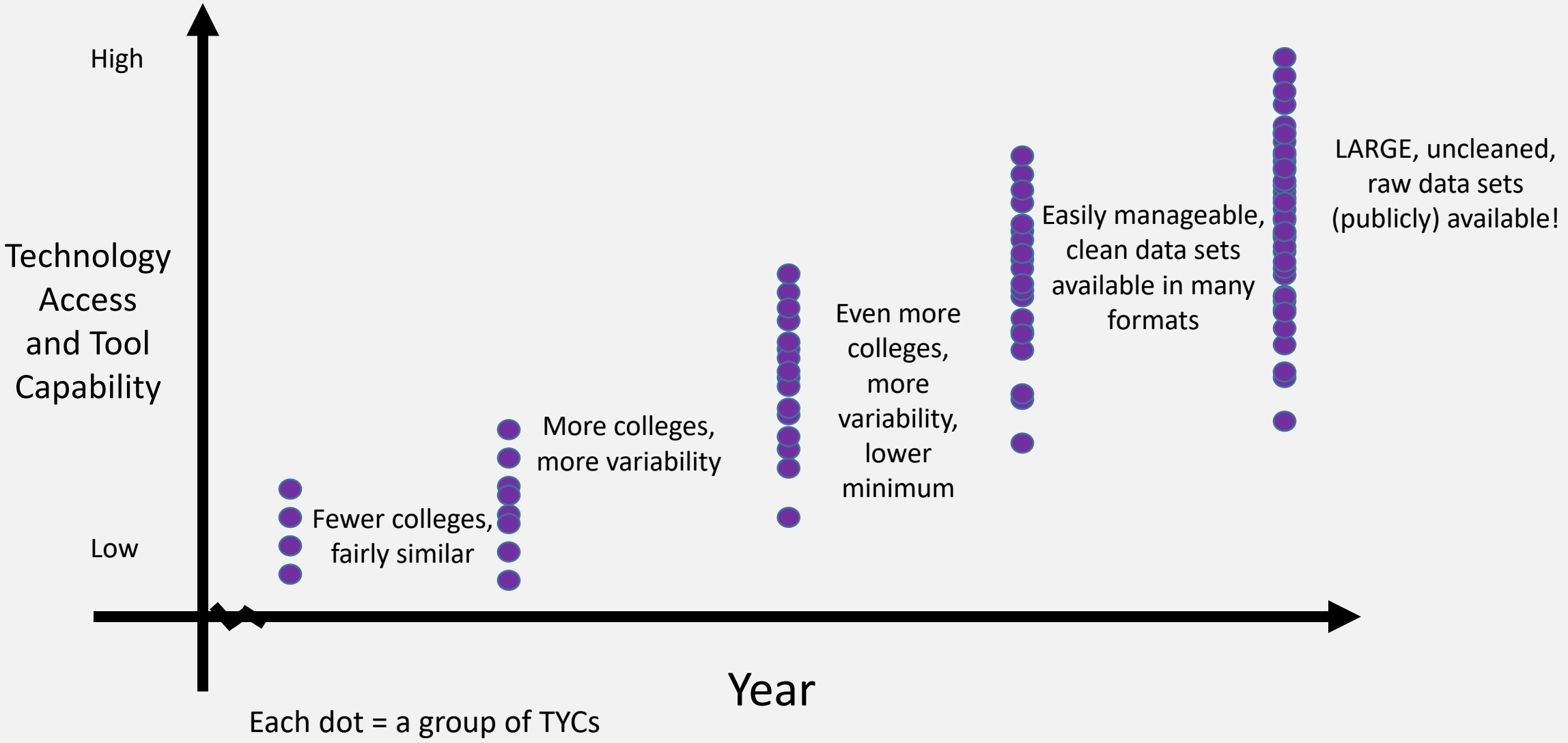

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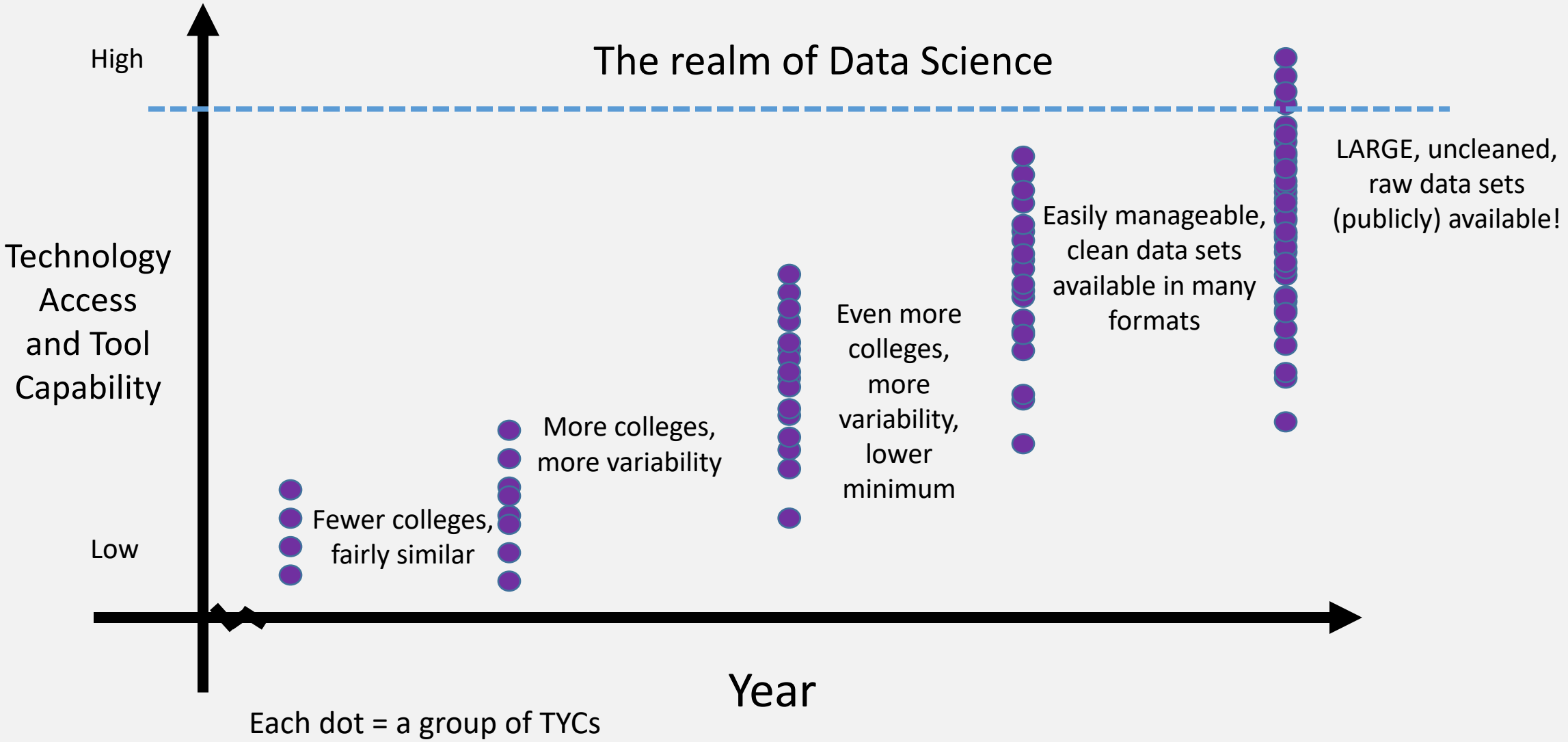

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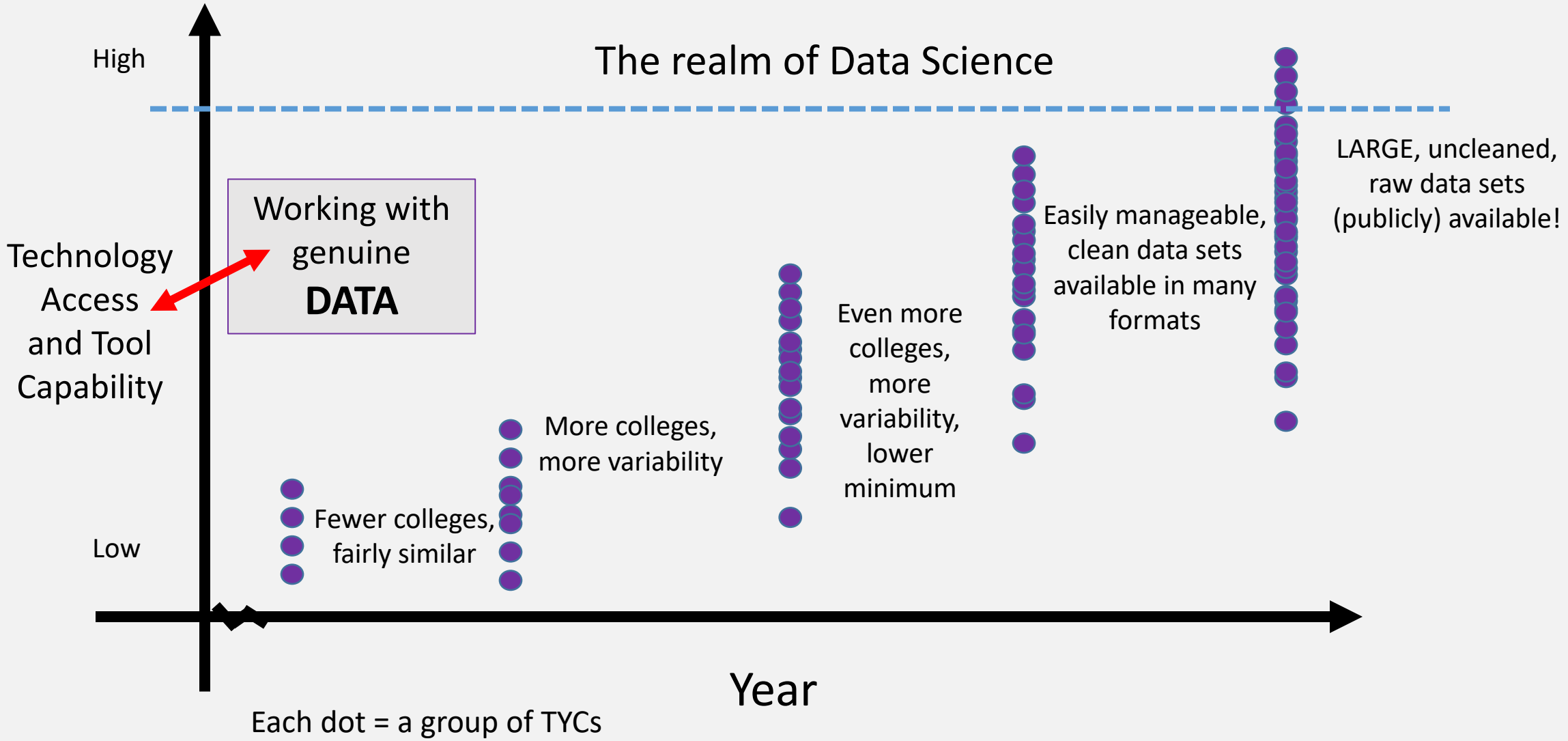
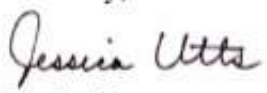


PROPOSALS….

- **Forms, Forms, and More Forms**
- **Support from ASA**

As president of the American Statistical Association, I write in support of your effort to initiate a data science curriculum with an "Introduction to Data Science" course at Montgomery College.

Sincerely,



Jessica Utts
President, American Statistical Association

- **Support from local businesses** ***(such as DataFest sponsors)***

summit

Letter of Support for a Data Science Curriculum at Montgomery College

- **Show data for local market demand, opportunities, and many 4-year programs**
- **Mention DataFest students and Chief Data Scientist**

Our Certificate (16 Credits)

MATH 117 – Elements of Statistics*

DATA 101 – Introduction to Data Science

DATA 110 – Writing and Communication in Data Science

DATA 201 – Statistical Methods in Data Science

DATA 205 – Capstone Experience in Data Science

(all materials at no cost)

www.montgomerycollege.edu/datascience

* - Students may also take MATH 217 – Biostatistics or BSAD 210 – Statistics for Business and Economics

Program started
Fall 2017

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www.montgomerycollege.edu/datascience

We are all uniquely responsive to our communities.

Dr. Manju Shah,
Wake Technical Community College
Lead Instructor, Business Analytics
Cary, North Carolina
mkshah@waketech.edu


WELCOME
Business Analytics
Wake Tech

What makes us different

- First Associate in Applied Science degree in the country.

- Flexible course offerings including online, hybrid and seated formats.

- Fast track certificate options through accelerated learning.

- In demand skills with several high demand software and programming packages.

- Lab facilities available equipped with software and weekly open lab sessions hosted by instructors.

What Makes us Different?

Our Students!

- 30% of our students come in with a Master's degree or higher
- 85% have a Bachelor's degree
- Median age is 42, with a large range between 18 and 75!
- Students come in with diverse backgrounds: history, music, plant biology, computer science, business, anthropology- it's the entire gamut!
- Success in our program is not predicted by student background- anyone can succeed in analytics!

Available Programs

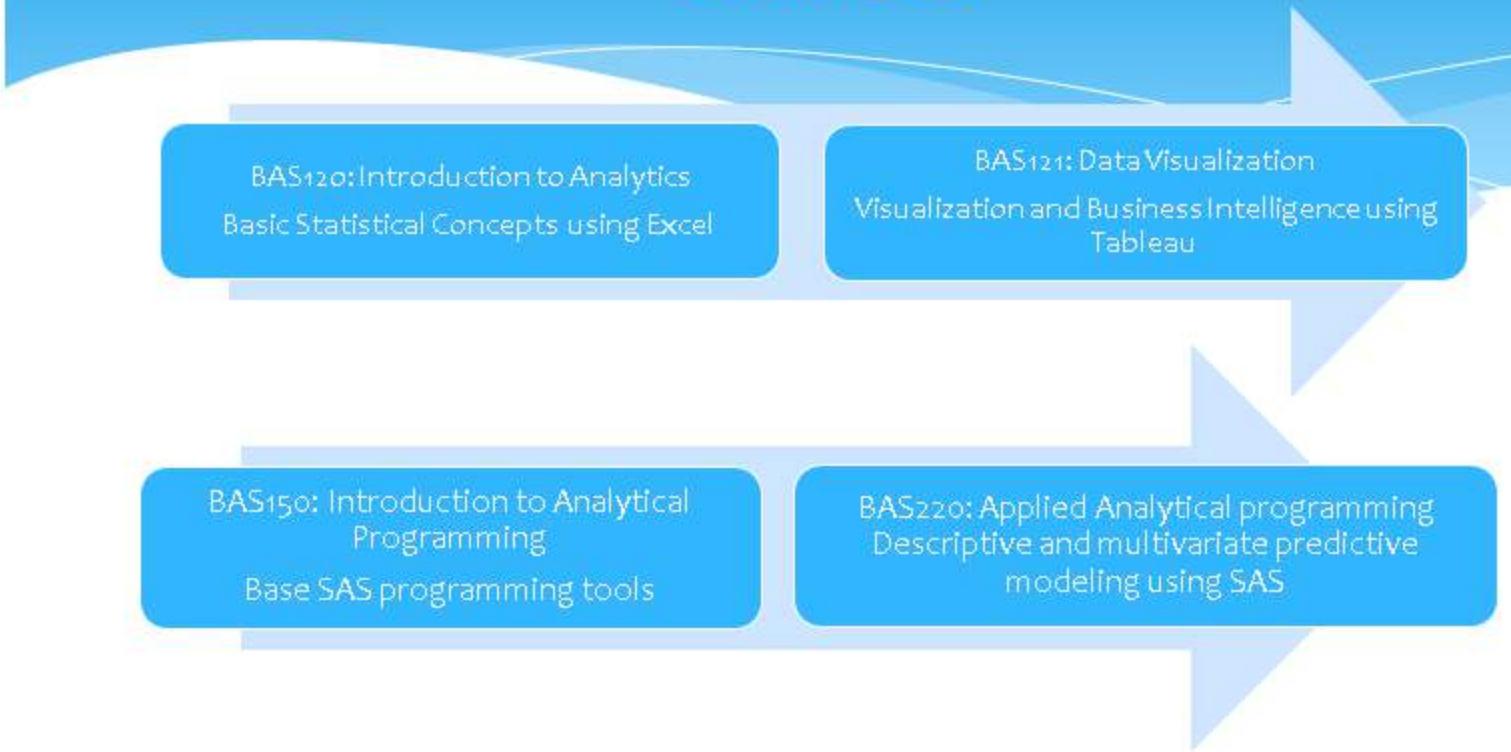
Associate in Applied Science (A.A.S)
65 Credit Hours

Business Analytics
(includes certificates as stackable credentials)

Core Certificates
(includes 9 new courses developed for the program)
Business Intelligence (BI)
Business Analytics (BA)

Other Certificates
(4 courses that include 2 new courses and two existing ones)
Marketing Analytics
Finance Analytics
Logistics Analytics

Business Intelligence Certificate Courses

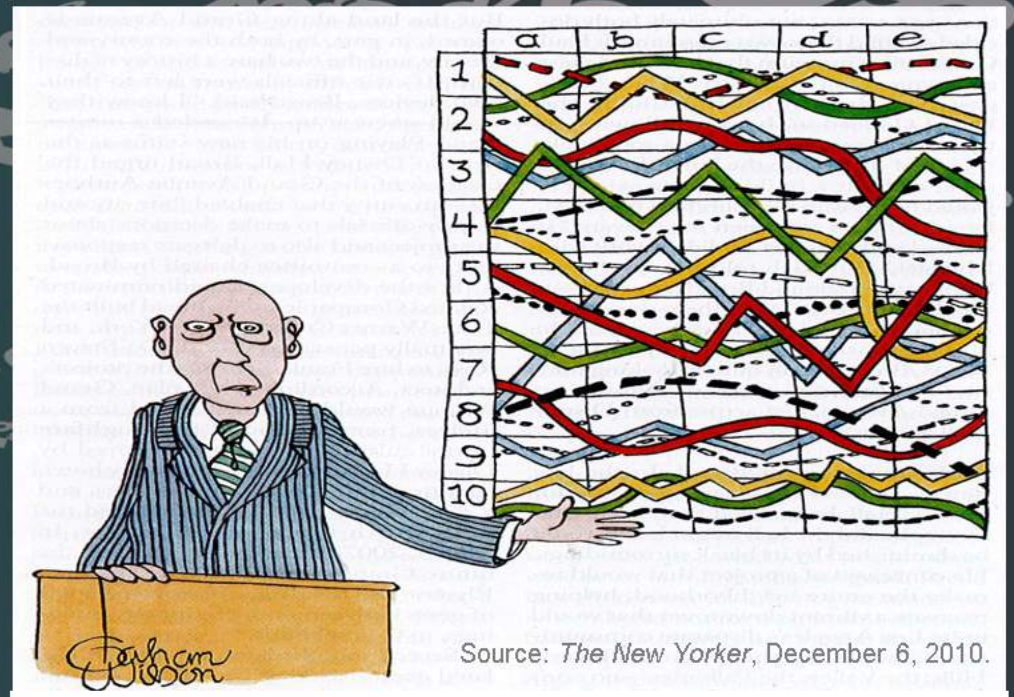



Business Analyst
Certificate Courses
BAS221: Introduction to Predictive Analytics
Basic Machine Learning Concepts with Open Source software (currently using Python)
BAS230 : Applied Predictive Modeling
Applications of Machine Learning Methods
With Python
BAS250: Advanced Analytical Tools and Methods
Data Mining Using Rapid Miner
BAS270 : Analytics Practicum
Capstone Project
BAS240: Data Structures for Analytics
Connecting to Relational and Non-Relational Databases, Joins and data extraction for Analytics (SQL)

What does it mean to be data-literate in the age of "big data"?

Randy Kochevar, *Director*
Oceans of Data Institute
Education Development Center, Inc.

eCOTS Panel
22 May, 2018



"I'll pause for a moment so you can let this information sink in."

EDC OCEANS of DATA INSTITUTE

Oceans of Data Institute:

Preparing students for life in a data-intensive world

Build a research-based learning progression

EDC OCEANS of DATA INSTITUTE

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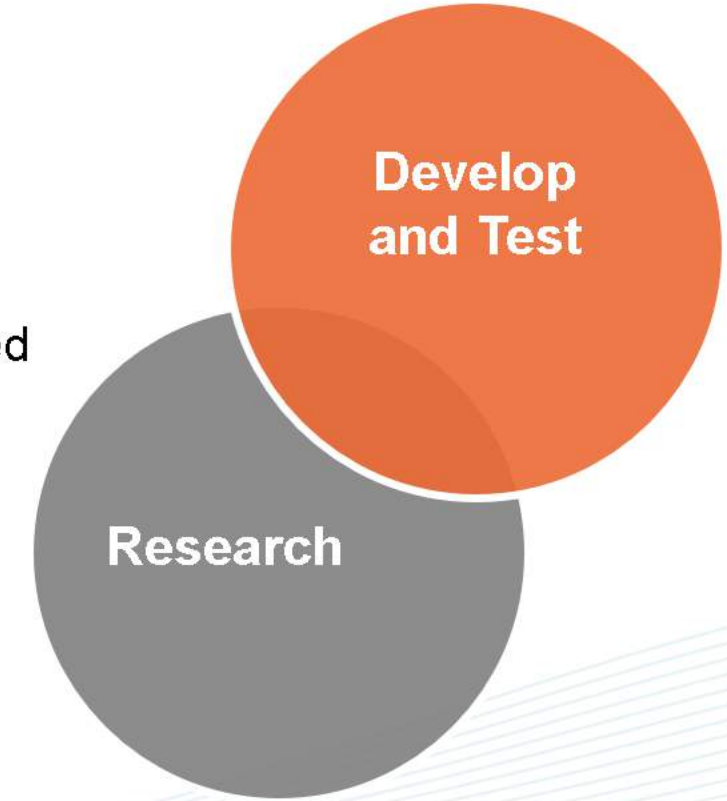

Develop and test curricula and tools

Build a research-based learning progression

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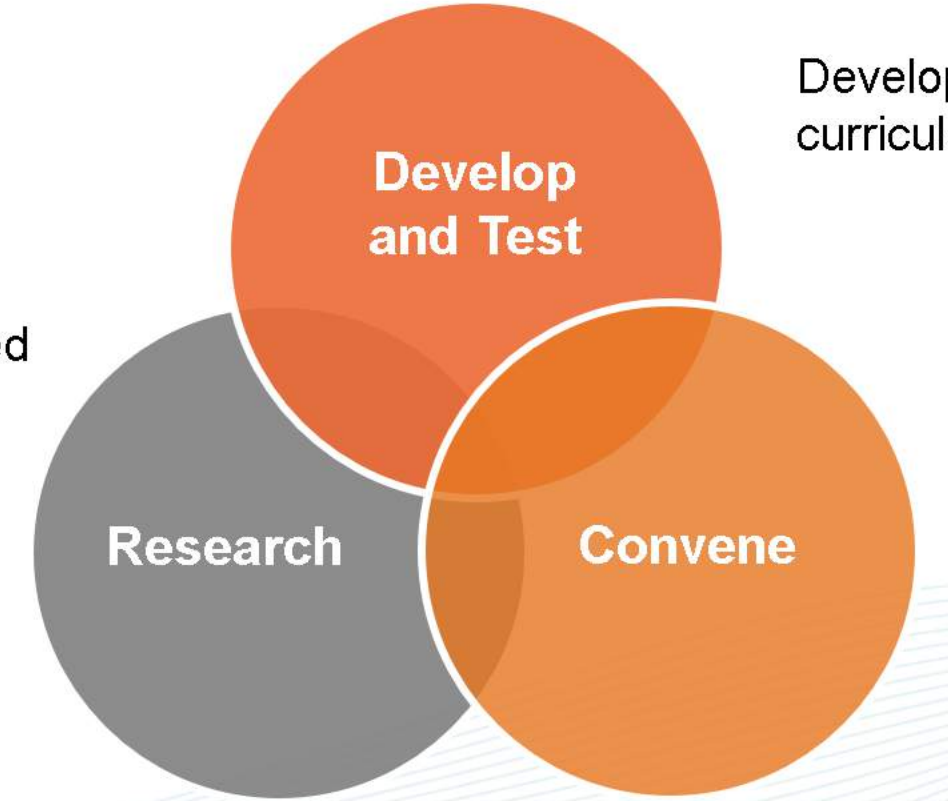

Develop and test curricula and tools

Build a research-based learning progression

Act as a hub for diverse stakeholders

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Defining data literacy in the age of “big data”

The data literate individual understands, explains and documents the utility and limitations of data by becoming a critical consumer of data, controlling his/her personal data trail, finding meaning and taking action based on data. S/he can identify, collect, evaluate, analyze, interpret, present and protect data.

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Creating Pathways to Big Data Careers

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Creating Pathways to Big Data Careers

Panel

Kirk Borne
Professor of Astrophysics and Computational Science
George Mason University
Fairfax, Virginia

Randy Bucciarelli
Programmer/Analyst
Scripps Institution of Oceanography
UC San Diego
La Jolla, California

Tim Chadwick
Principal Engineer
Dynamic Network Services, Inc.
Manchester, New Hampshire

Benjamin Davizon
Quantitative User Experience Researcher
Google
Boston, Massachusetts

Lucy Drotning
Associate Provost of Planning and Institutional Research
Columbia University
New York, New York

Ryan Kapaun
Law Enforcement Analyst
Eden Prairie Police Department
Eden Prairie, Minnesota

Juan Miguel Lavista Ferres
Principal Data Scientist
Bing/Microsoft
Seattle, Washington

Shannon McWeeney
Head of Division of Bioinformatics and Computational Biology
Oregon Health & Science University
Portland, Oregon

Jay Parker
Earth Scientist
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Steve Ross
Consultant on Data Quality Control
Corporate Editor
Broadband Communities Magazine
Revere, Massachusetts

Kartik Shah
Principal Consultant
Strategix Solutions
Toronto, Canada

Oceans of Data Institute

Ruth Krumhansl
Director

Profile Facilitators

Joseph Ippolito

Joyce Malyn-Smith

Suggested Citation:
Oceans of Data Institute. (2014). *Profile of a big-data-enabled specialist*. Waltham, MA: Education Development Center, Inc.

Profile of a Big-Data-Enabled Specialist

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http://oceansofdata.org | Email: oceansofdata@edc.org

PANEL

Daniel Boisvert – Biotechnology
Biogen
Cambridge, Massachusetts

Mike DeFabbo – Education/ Nonprofit
OneGoal
Chicago, Illinois

Rebecca Hailey – Marine Science
Virginia Institute of Marine Science
Gloucester, Virginia

Paul Hansford – Business Consulting
SimpleSoft Solutions, Inc.
Dayton, Ohio

Tony Joy – Financial Services
Global Audit Management & Consulting
Urbana, Ohio

Ryan Kapaun – Law Enforcement
Eden Prairie Police Department
Eden Prairie, Minnesota

Sean Larson –
Medical Device Manufacturing
Medtronic
Minneapolis, Minnesota

Andy Ramlatchan – Health Care
Patient Advocate Foundation
Virginia Beach, Virginia

Greg Reisz – Agriculture
E-4 Crop Intelligence
Woodbine, Iowa

Joel Wright – Public Policy
Wright Consulting Services
Strawberry, Arizona

PROFILE FACILITATORS

Joseph Ippolito
Education Development Center
Cleveland, Ohio

Joyce Malyn Smith, Ed. D.
Education Development Center
Boston, Massachusetts

Profile of the Data Practitioner

April 15-16, 2016
oceansofdata.org
oceansofdata@edc.org

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Creating Pathways to Big Data Careers

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Creating Pathways to Big Data Careers

- Creating occupational profile of "middle skills" data practitioners
- Partnering with community colleges to create stackable credential program:
  - Bunker Hill Community College (MA),
  - Normandale Community College (MN),
  - Johnson County Community College (KS) and
  - Sinclair Community College (OH)

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SKILLS AND KNOWLEDGE

Skills in:

Analytical Thinking
Applying Statistical Methods
Basic GIS
Basic Security
Chart/ Visualizations
Coding Languages
Communication
Critical Thinking
Data Entry (to server)
Data Manipulation
Data Structure of Organization
Design
Documentation
ETL
Multi-tasking
Operating Systems
Pattern identification/ analysis
Presenting
Oracle, Prioritizing
Problem Solving
Project Management
Research Methods
Statistics (Basic)
Time Management
Writing

Knowledge of:

Business Acumen
Communication
Computer Modeling
Critical Thinking
Customer Relations
Databases
Data Discovery
Data Modeling
Data Organization
Data Quality
Data Stewardship
Data Structures
Design
Domain Knowledge
Ethics
IT
Project Management
RDBMS (SQL Server, No SQL)
Research Methods
Software
Statistics

BEHAVIORS

A successful Data Practitioner is…

Able to manage time
Able to multi-task
Able to problem solve
Able to work independently
Collaborative
Competent
Courageous
Creative
Curious
Diligent
Effective serving customers
Effective executing work
Ethical
Focused
Inquisitive
Intellectually humble
Open to/ provides feedback
Organized
Patient
Persistent
Self-Confident

EQUIPMENT/TOOLS/SUPPLIES

Data/ Database Tools (e.g., Excel, Access, SQL Server, Oracle)
Data Mining Tools (e.g., Microsoft SQLServer Data Tools including SSRS, SSAS, SSIS)
Data Visualization Software (e.g., Tableau Software, QlikTech Qlikview, TIBCO Spotfire, Microsoft Power BI)
GIS (e.g., ArcGIS for Desktop Basic)
Mobile Devices
Online communities/ discussion groups/ forums
Open Source Tools
PowerPoint/ Prezi
Project Management Software
Python
Reporting Tools (e.g., SAP Crystal Reports, MicroStrategy, Inc.)
Statistics Packages (e.g., SPSS, R, SAS, SASJMP)
Tablet
Word Processing

FUTURE TRENDS

- Growing concern about the role of individual privacy in a world in which data is heavily collected and shared
- Growing expectation that people will use and/ or create data in their work
- Growing need for data literacy by all
- Increasing automation of the analytic process
- Increasing capacity of data to solve specific and complex problems (e.g. Genomics - 23andme)
- Increasing number of individuals with limited data analysis skills utilizing machine learning, applications, visualization tools and platforms as a means to analyze data
- Increasing speed and volume of data sources (IoT) outpaces application of the findings

INDUSTRY CONCERNS

- Costs needed to staff data practitioners
- Need to educate consumers of data to ensure they know its limitations
- Need to establish standardization of data within industries
- Ongoing necessity to question data for reliability: data quality, consistency, completeness, bias, sourcing, transparency, data security
- Possibility of AI eliminating human jobs in Data Analysis
- The need for clarity regarding marketplace and organizational strategic imperatives which drive priorities
- Too many academic programs teaching software that employers do not use

PANEL

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Learning Occupation: The Data Practitioner, in service of an organization and/or stakeholders, supports the data life cycle by collecting, transforming, and analyzing data, and communicating results in order to inform and guide decision-making.

DUTIES	TASKS										
1. Initiates the Project	1A. Translates business problems into analytic needs.	1B. Interviews stakeholders.	1C. Refines stakeholder needs.	1D. Identifies appropriate data.	1E. Identifies whether data exists or not.	1F. Performs gap analysis of the data.	1G. Determines resource needs (e.g., SMEs, tools, timelines).	1H. Determines feasibility of analysis to be done.	1I. Creates statement of work.		
2. Sources the Data	2A. Determines data source(s).	2B. Determines target structure.	2C. Collects data.	2D. Exercises quality control (e.g., randomizes selection).	2E. Extracts data (e.g., writes SQL, API code).	2F. Cleans data (e.g., identifies outliers/errors).	2G. Tests data.	2H. Creates data dictionary.	2I. Complies with business, ethical and legal standards.		
3. Transforms the Data	3A. Merges data.	3B. Splits data.	3C. Derives new variables.	3D. Creates new data.	3E. Augments data.	3F. Applies meta-data.	3G. Purges data.	3H. Changes data structure.	3I. Changes data types.	3J. Normalizes data.	3K. Interpolates data.
	3L. Finalizes data dictionary.	3M. Stores data for analytics.									
4. Analyzes the Data	4A. Determines what analysis to run.	4B. Applies the research method and tools.	4C. Identifies dependent and independent variables.	4D. Defines appropriate algorithms.	4E. Performs data mining.	4F. Separates any anomalies.	4G. Interprets the results.	4H. Runs additional tests as needed.	4I. Performs reasonableness tests of results.	4J. Compares results to previous findings.	4K. Confirms results.
	4L. Conducts causality testing.	4M. Creates data visualizations (e.g., dashboards, reports, charts, graphs, videos, animation).									
5. Closes Out the Project	5A. Selects documentation media.	5B. Describes problem, method and analysis.	5C. Articulates conclusions.	5D. Compiles reports.	5E. Presents information to stakeholders.	5F. Integrates feedback from stakeholders.	5G. Defends analysis as needed.	5H. Reworks analysis as needed.	5I. Prepares final report.	5J. Archives work products.	5K. Communicates future processes, improvements and opportunities.
6. Engages in Professional Development	6A. Maintains professional qualifications.	6B. Stays current on emerging technologies, methods and tools.	6C. Seeks out mentors.	6D. Shares best practices.	6E. Contributes new knowledge to the field.	6F. Attends relevant conferences and seminars.	6G. Mentors others.	6H. Participates in professional organizations.	6I. Suggests future projects.		

Thank you!

Materials available at http://Oceansofdata.org

Randy Kochevar, *Director*
Oceans of Data Institute
Education Development Center, Inc.

eCOTS Panel
22 May, 2018

Source: *The New Yorker*, December 6, 2010.

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ACM CCECC & Data Science Reflections

Cara Tang, Panelist

Data Science at Two-Year Colleges: Moving Forward

eCOTS 2018 May 22

Outline

- ACM Curriculum Guidelines
- ACM CCECC & Curriculum Guidelines for 2-year Programs
- Reflections from 2-Year College Data Science Summit

ACM Curriculum Guidelines

- ACM – Association for Computing Machinery, acm.org
- Computing Curricula 2005 (CC2005) *being revised as CC2020*
  - Computer Engineering – CE2016
  - Computer Science – CS2013
  - Information Systems – IS2010
  - Information Technology – IT2017
  - Software Engineering – SE2014
- New ACM-recognized Disciplines
  - Cybersecurity – CSEC2017
  - Data Science – in progress

ACM Data Science Curriculum Guidelines

- Task Force
  - Chaired by Andrea Danyluk, Williams College & Paul Leidig, Grand Valley State University
  - Representatives from industry; UK, China
  - Community College representative: Christian Servin, CCECC member
- Purpose / Scope
  - Computing programs in Data Science
- Timeline
  - Final report by Summer 2019

ACM CCECC

- CCECC – Committee for Computing Education in Community Colleges
  - Over 40 years of service to computing education
  - Standing committee of the ACM Education Board for 25+ years

Global Mission: Serve and support community and technical college educators in all aspects of computing education.

- Produce curriculum guidelines for 2-year programs
- Support community among educators

ccecc.acm.org

ACM Curriculum Guidelines for 2-Year Programs

- 2014: **Information Technology** Competency Model of Core Learning Outcomes and Assessment for Associate-Degree Curriculum
- 2017: **Computer Science** Curricular Guidance for Associate-Degree **Transfer** Programs with Infused Cybersecurity (**CSTransfer2017**)
- In progress: CSEC2Y – guidelines for 2-year programs in **Cybersecurity**, based on CSEC2017
- In progress: IT Transfer – guidelines for 2-year **Information Technology Transfer** programs, based on IT2017

Two-Year College Data Science Summit

- 2018 May 10-11, Washington D.C.
- ~80 participants from 2- & 4-year schools, government, & industry
- Goal: Recommendations for 2-year college Data Science programs
  - Career-oriented Associate's Degree
  - Transfer Associate's Degree
  - Professional Certificate
- Reflections
  - Variety of students at community colleges
  - Variety of communities served
  - Variety of "home" departments for Data Science

Summary: Moving Forward

eCOTS from Monday:

- “Accessibility,” “low cost” (Jeff Leek)
- “Pathways”
- “re-envisioned intro stats course for data science”
- “Beyond started”
- “Are CS courses data-centric?”
- National Academies – December 10

Summary: Moving Forward

eCOTS from Monday:

- “Accessibility,” “low cost” (Jeff Leek)
- “Pathways”
- “re-envisioned intro stats course for data science”
- “Beyond started”
- “Are CS courses data-centric?”
- National Academies – December 10

Who’s working with TYCs in data science?

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Who’s working with TYCs in data science?

StatPREP

teach data-centric stats!

MAA

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Data science at two-year colleges

StatPREP leaders Kate Kozak (Coconino Community College and AMATYC), Doug Ensley (MAA), and Danny Kaplan (Macalester College), represented StatPREP at last week's "Two-Year College Data Science Summit". The purpose of the summit

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Summary: Moving Forward

- At least 12 TYC programs in data science
  (check www.amatyc.org/?page=DataResources)
- At least 5 NSF funded projects involving TYC data science education
- TYC participants and reviewers for the National Academies of Sciences *Envisioning the Data Science Discipline* reports
- ASA/NSF Sponsored *Two-Year College Data Science Summit*
- *Journal of Statistics Education* coverage

Summary: Moving Forward

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People want to work with two-year colleges in data science!

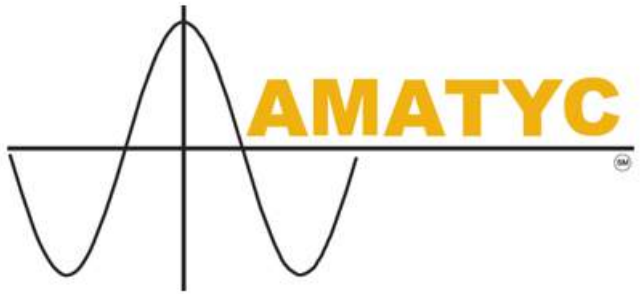
And many two-year colleges want to work with these organizations and four-year colleges!

Conference Board of the Mathematical Sciences

The 2015 CBMS Survey Report stated that there were an estimated ***280,000*** statistics enrollments in two-year colleges in Fall 2015
(http://www.ams.org/profession/data/cbms-survey/cbms2015-work – Chapter 1 Discussion Text and Tables)

From the same report, that means that as of fall 2015, two-year colleges now account for almost ***45%*** of introductory statistics enrollments at the college level.

Personal: I think it is possible that two-year colleges may serve as the inspiration and starting point to more **data scientists** than statisticians in the coming years.



American Mathematical Association of Two-Year Colleges

Data Science Subcommittee

Join as an AMATYC member or as a "Friend of AMATYC"

Data Science Resource Page

Subcommittee Goals; List of TYC programs
Links of Interest: NSF, National Academies, Park City

www.amatyc.org/?page=DataResources

ASA
AMERICAN STATISTICAL ASSOCIATION
Promoting the Practice and Profession of Statistics®

www.amstat.org and www.amstat.org/education

2YC Educator Membership, $54 (70% Discount)

Section on Statistics Education; "This is Statistics"

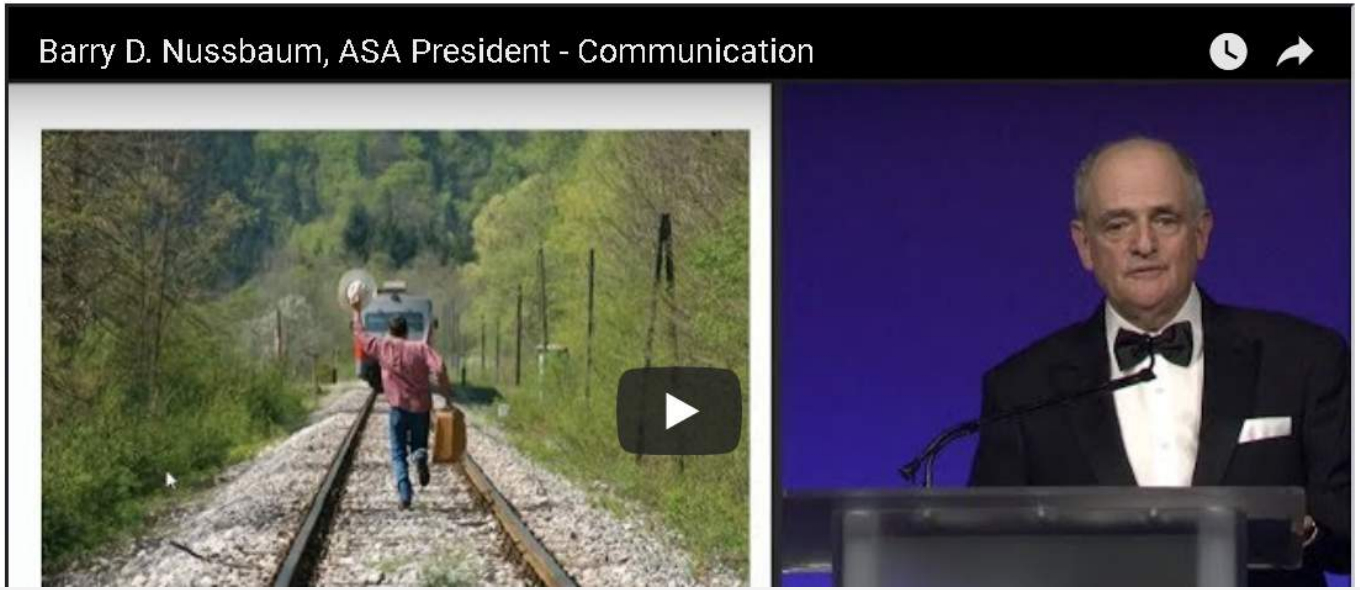
Interest Group: Business Analytics/Statistics Education (open to Non-ASA Members)

NEW Interest Group: Undergraduate Data Science Education (very soon!) (open to Non-ASA Members)

The Analytics Train Has Already Left the Station!

With all the data around these days, and abundant software tools, data analysis is open to people who may not have all the necessary statistical background. There is a sense among some that the statistics profession has been left behind. But in his address at JSM, ASA President Barry Nussbaum said this is the best of times for statistics. He encouraged us to be active, collaborate, get to the table early, and learn new skills to ensure a bright future for the statistics profession.

Below is a clip from Barry's address in which he talks about what we—as statisticians—should and shouldn't do. Watch the full address online.



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…including two-year colleges

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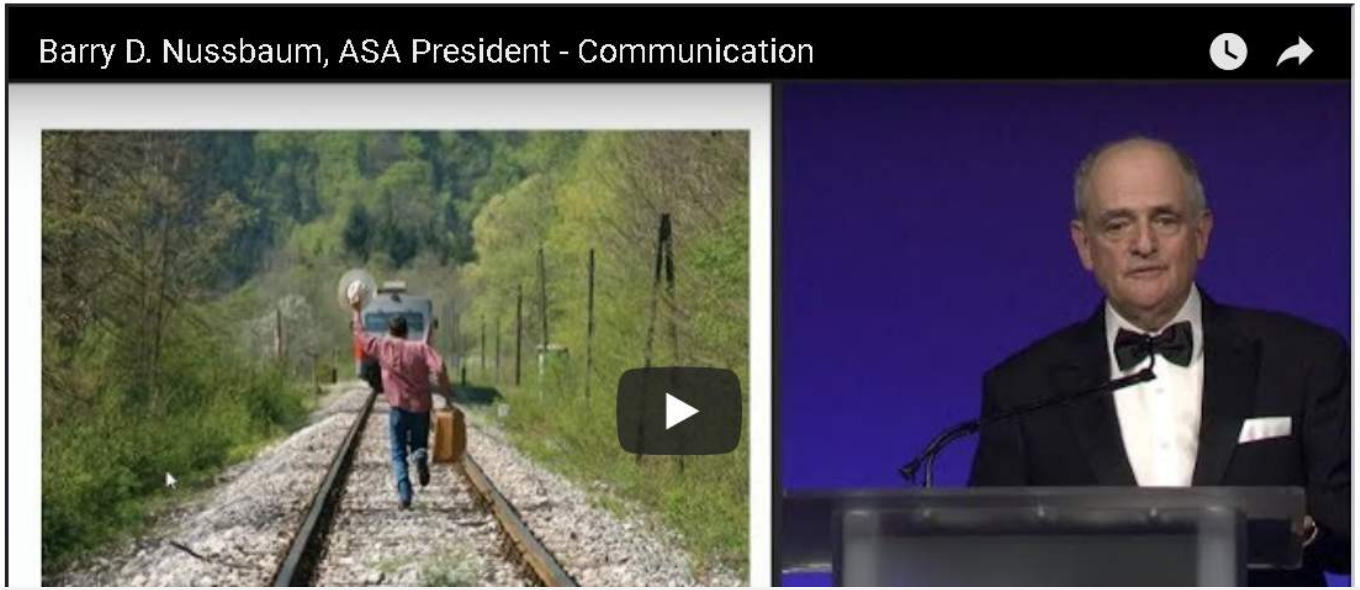

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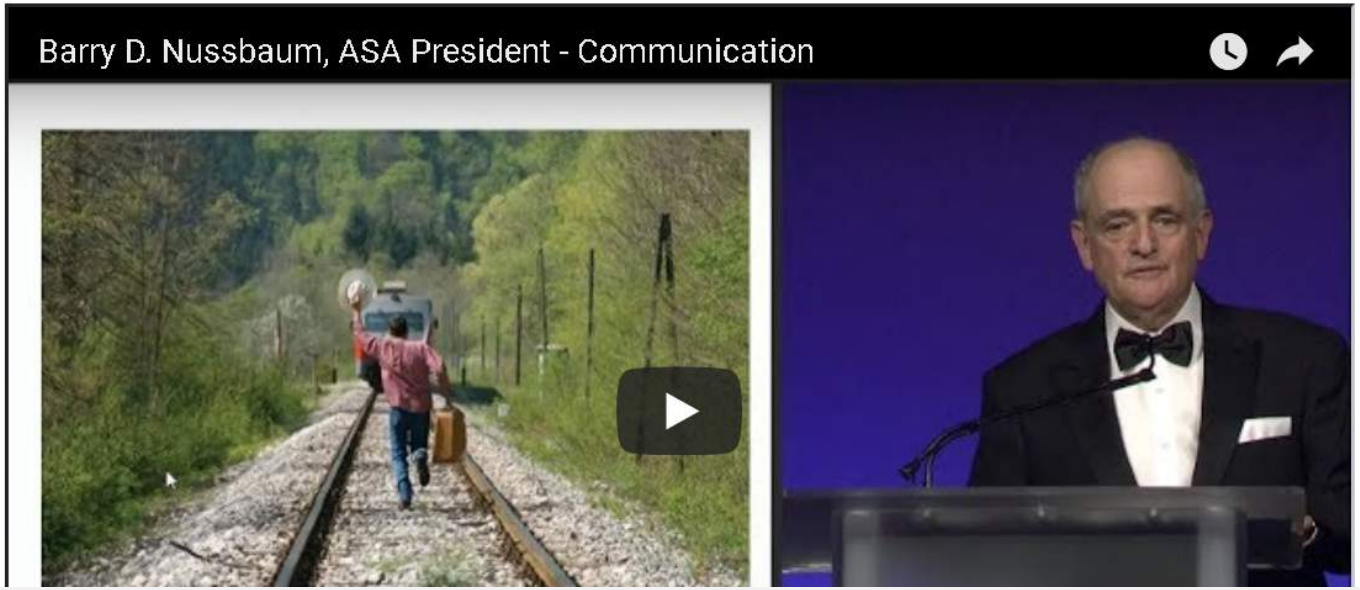

Audience Questions

Thank You!

Data Science at Two-Year Colleges: Moving Forward

Tuesday, May 22nd 1:00 pm – 2:00 pm

With Brian Kotz (Montgomery College); Manju Shah (Wake Technical Community College); Randy Kochevar (Oceans of Data Institute); Dr. Cara Tang (Portland Community College)