NC STATE UNIVERSITY
College of Education
Friday Institute for Educational Innovation

Preparing Teachers to Teach Modern Mathematics Curriculum: The Role of Mathematics Teacher Educators in Teaching and Learning About Data

Hollylynne S. Lee
Judith Jacobs Lecture, AMTE 2026

I am honored and humbled to be here

Thank you to my advisor, Joe Garofalo

For introducing me to the AMTE community

About Me

- I went to 8 different schools in 4 different cities and 2 states
- I am a Wife, Mother, Daughter, Sister, Niece, Cousin, Aunt, Great Aunt, & Friend
- Former middle and high school math teacher
- Wife of a mathematician (Todd), mother to Delta, 20 and Jonah, 17
- Since 2000, faculty in STEM Education with ties with Statistics
- Visiting Professor at Baylor University in 2023
- Serve on National Academies' Mathematical Sciences Education Board.

All grants from 2004-current discussed in this presentation were funded by the National Science Foundation, Institute of Educational Sciences, William and Flora Hewlett Foundation, or RTI International to NC State University.

The findings and opinions expressed are those of the presenter and not the funding agencies.

Thank You for Contributing to the Survey!

n=169, +32 partially completed

Where are our home institutions or organizations?

Tell us where you traveled from!
ALASKA
HAWAII
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
WYOMING
IDAHO
NEVADA
UTAH
KANSAS
TEXAS
NEW MEXICO
MAINE
NEW YORK
PENNSYLVANIA
OHIO
KENTUCKY
VIRGINIA
TENNESSEE
CELEBRATING 30 YEARS
AMTE
PORTLAND

What makes a K-12 mathematics curriculum more modern?

Share Characteristics of a Modern Math Curriculum

PollEv.com/hslee

Send a text message to 37607
Body of text
hslee and your response

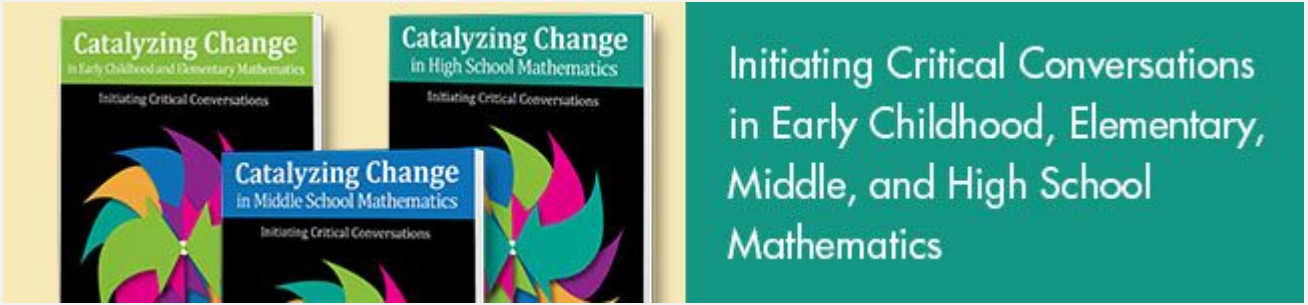
What makes a K-12 mathematics curriculum more modern? Write a brief phrase to describe a characteristic (1-3 words). You can contribute more than once to enter additional characteristics.

Nobody has responded yet.

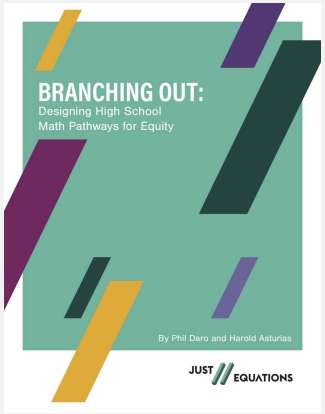
Hang tight! Responses are coming in.

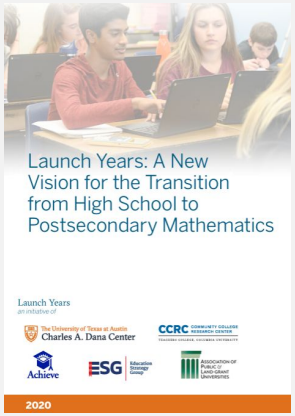
Start the presentation to see live content. For screen share software, share the entire screen. Get help at **pollev.com/app**

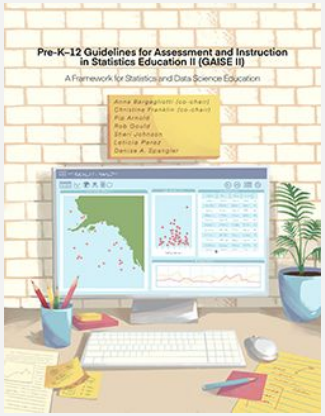
Major Efforts to Fuel Modern Math in K-12

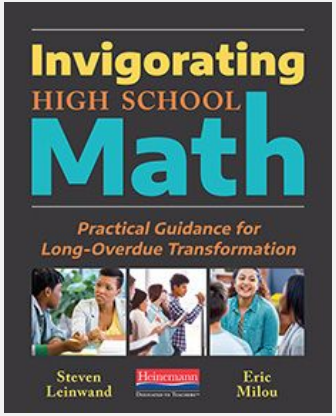


2018 - 2020

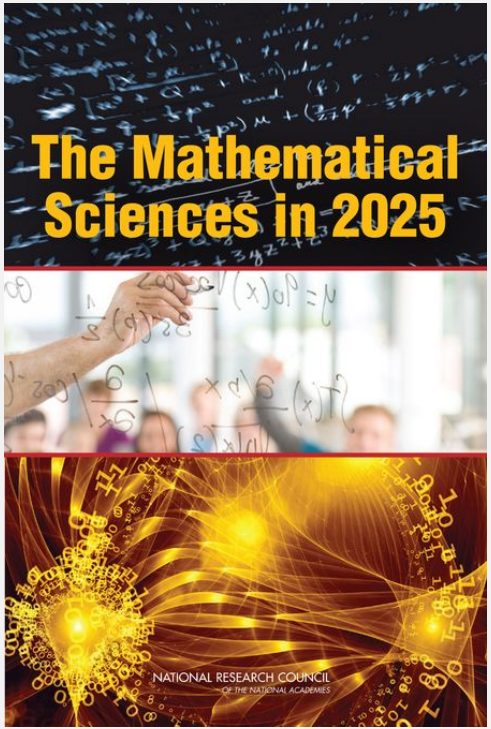








From the National Academies



Published in 2013

Currently reviewing nominations for a new consensus study in 2026-27

Modernizing Mathematics Education for Grades 9-14

The Mathematical Education of Teachers III

The Statistical Education of Teachers II

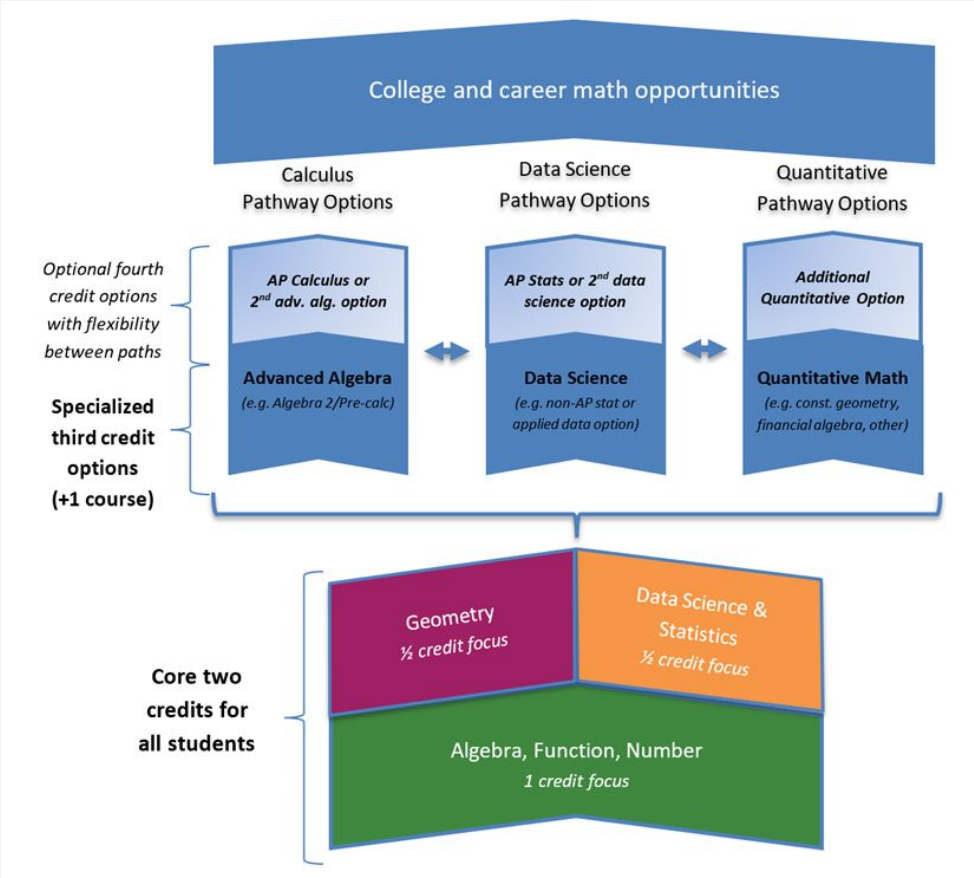
ASA AMERICAN STATISTICAL ASSOCIATION
Promoting the Practice and Profession of Statistics®

To Be Published in 2026

The Movement

Oregon has been leading the way!

- Introduced a K-12 strand on data reasoning
- Created a 2+1 model for math pathways in high school
- Finalized 2021, first implemented 2023-24



Oregon Data Reasoning Strand K-12

FIRST GRADE

1.DR.A.1 Generate questions to investigate situations within the classroom. Collect or consider data that can naturally answer questions by representing data visually.

1.DR.B.2 Analyze data sets with up to three categories by representing data visually, such as with graphs and charts, and interpret information presented to answer investigative questions.

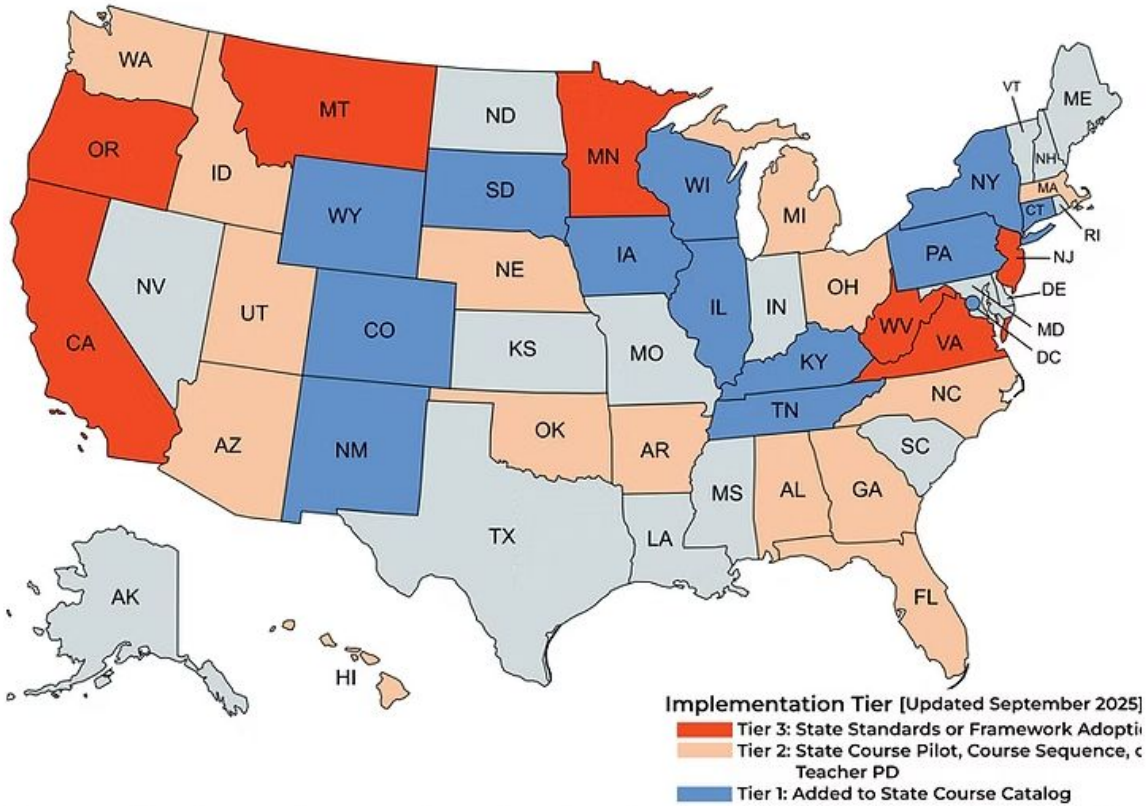
HIGH SCHOOL

HS.DR.D.12 Articulate what it means for an outcome or an estimate of a population characteristic to be plausible or not plausible compared to chance variation.

HS.DR.D.13 Use multivariate thinking to articulate how variables impact one another, and measure the strength of association using correlation coefficients for regression curves.

Have You Heard of

Data science is spreading across the country...



State-wide data science education implementation (September 2025)

datascience4everyone.org

NCTM | NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

Teaching Data Science in High Schools

Position statement --March 2024

Data science is a rigorous, engaging, and practical field of study and can be a significant part of a high school student's mathematical experience. Knowledge of data science is important, and a data science course should be accepted as a high school mathematics course that can be used for credit towards graduation...

All students should have the opportunity to take four years of high school mathematics, and data science content should be available to all students in order to complete their high school mathematics graduation requirement.

Data Science in K-12 Education

Data Science in K-12 Education -- April 2024

Data science bridges disciplines and thus should be introduced and taught across the curriculum in K-12 schools to help develop informed users of data....

All subjects in school should recognize the contribution of data to their discipline and take curricular approaches that integrate data with disciplinary lessons where appropriate.

NCTM NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

nsta National Science Teaching Association

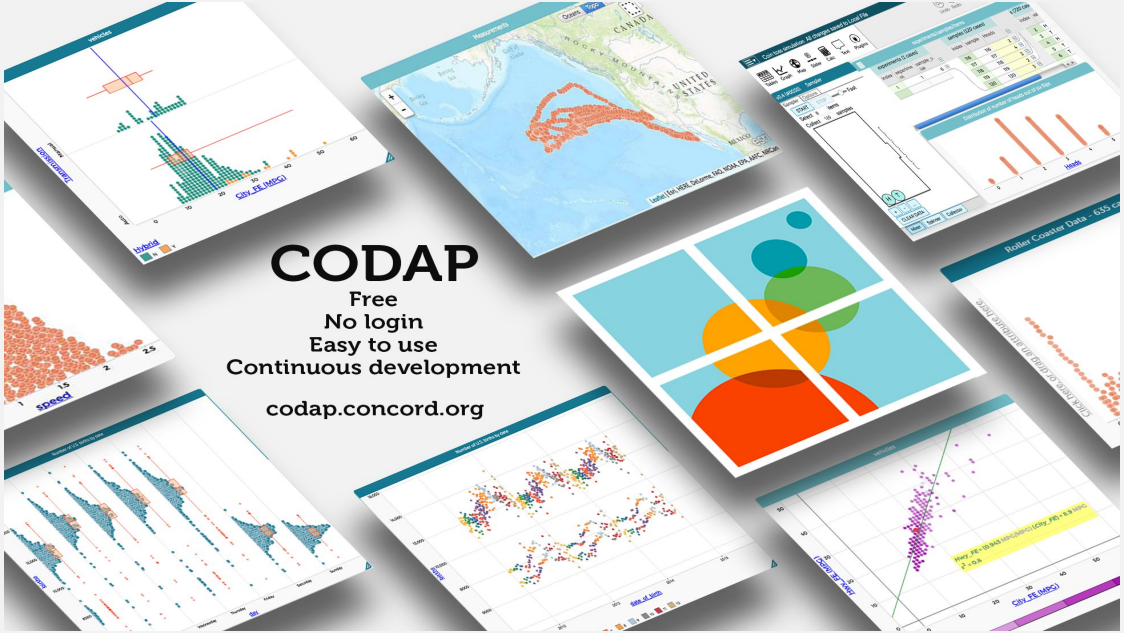
CSTA

National Council for the Social Studies

ASA AMERICAN STATISTICAL ASSOCIATION Promoting the Practice and Profession of Statistics

Love of Statistics

View Data in CODAP

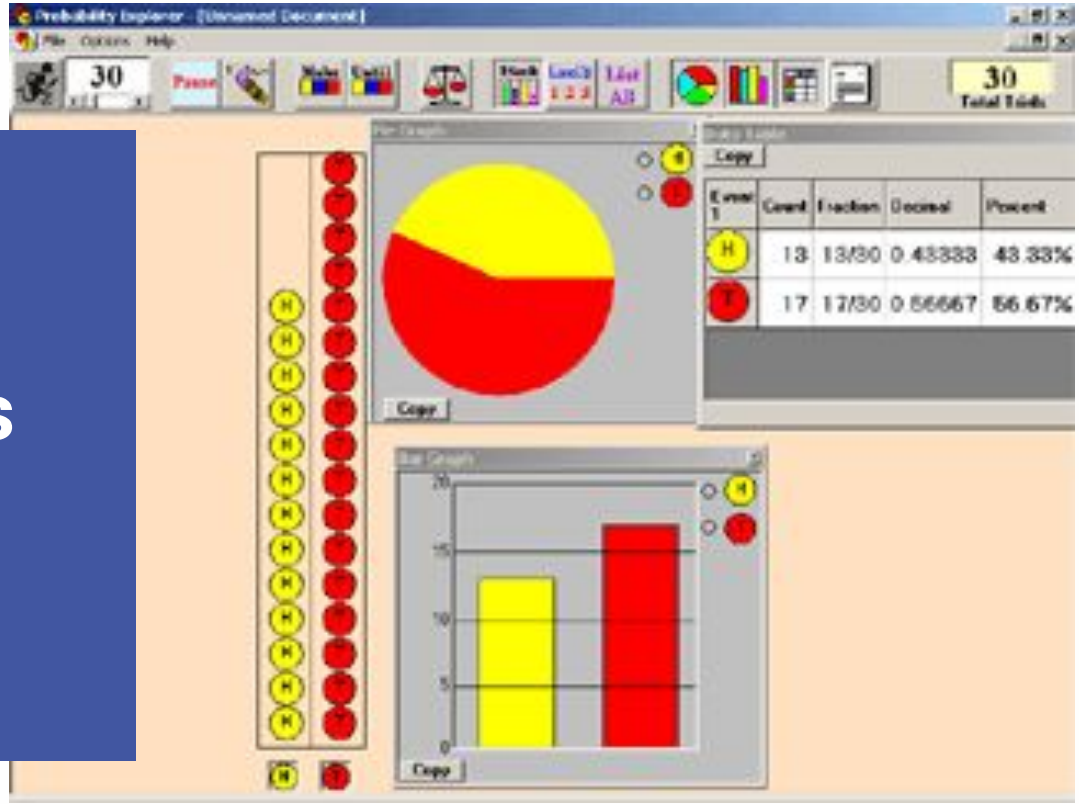


My Statistics and Data Science Education Research Origin Story

1997
Doctoral Internship
First Grade Classroom

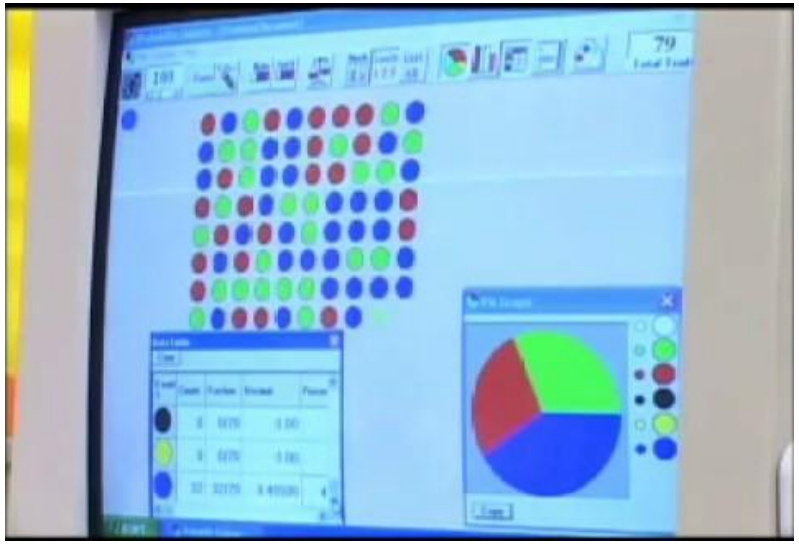
Probability Explorer

Simulation Approach and Dynamic Graphs
1999 v1.0
2002 v2.0

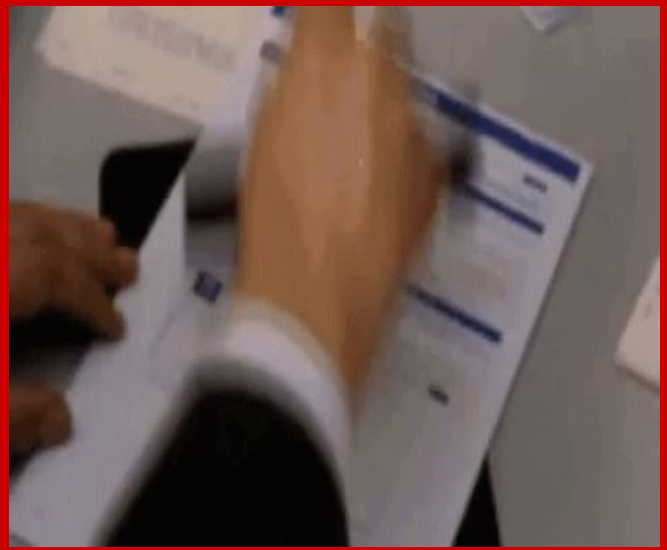


Early Studies

1. Case Study Teaching Experiment-Dissertation
2. Classroom Teaching Experiment for 3 weeks
3. Summer Informal Learning with Rutgers Partners



In 2004, 2005, and 2006, NSF reviewers said no need to research MS/HS students' learning about a simulation approach to probability and statistics--the focus should be on algebra



And JRME rejected the research after 3 years and 2 rounds of revise and submit!

Know *your* impact goals and the *context* in which you can work towards the goals

My Impact Goals

Reach More Students Through Reaching Teachers

and

Provide *Research-Informed* Tools and Learning Experiences for Teachers and Students

Three examples of how to be a change agent for more modern math *through teacher education*

Start Local with a Good Friend

...

But Bring in Others and Share Broadly

Preparing to Teach
Mathematics
with Technology

Preparing to Teach Mathematics with Technology funded 2004-current

PTMT has impacted teaching and learning of mathematics through

500+ College Faculty

8000+ Prospective Teachers

50 States

NSF

NC STATE UNIVERSITY

MIDDLE TENNESSEE STATE UNIVERSITY

UNIVERSITY OF NORTH CAROLINA CHARLOTTE

ECU

ptmtproject.com

NSF

PTMT Materials Related to Teaching Data, Probability & Statistics

Examining Students' Practices in Algebra and Function

These materials connect with the Teaching Algebra materials to support teachers' development of pedagogical skills related to professional noticing of student thinking and engaging in productive discussions in technology-mediated learning environments. Teachers engage in tasks and analyze videos of students' work.

Teaching Algebra

The Teaching Algebra materials consist of 7 chapters that provide strategies for teaching algebra with dynamic technology explorations of important topics such as variables, equality, rate of change, and functions.

Teaching Statistics Investigations

This set of materials includes four chapters that prepare teachers to use large multivariate data and a new free online tool, CODAP, to engage in similar investigations as in Chapters 1-4 of the Teaching Data Analysis and Probability materials.

Teaching Data Analysis and Probability

This set of materials includes 6 chapters that utilize tools such as TinkerPlots, Fathom, Excel, and graphing calculators to engage teachers in statistics investigations using multivariate data. Topics include learning to teach distributions, variability, bivariate relationships, probability, and simulations.

New Teaching Geometry

Coming Soon.....

Teaching Geometry

The 7 chapters in the Teaching Geometry materials engage teachers with how dynamic approaches to geometry can change students' understanding of concepts such as polygon properties, transformations, similarity, and symmetry.

Voices from the Field

A collection of video clips representing how real teachers use technology in their mathematics classrooms. Some clips illustrate how teachers and students use technology in lessons. Other clips show teachers and experts discussing issues related to their planning and implementation of technology.

Forging Connections Between Geometry and Functions

A collection of materials on an ***external site*** that were developed through a PTMT-related project. Activities use web-based Sketchpad activities to develop deeper understandings of functions through a geometric approach.

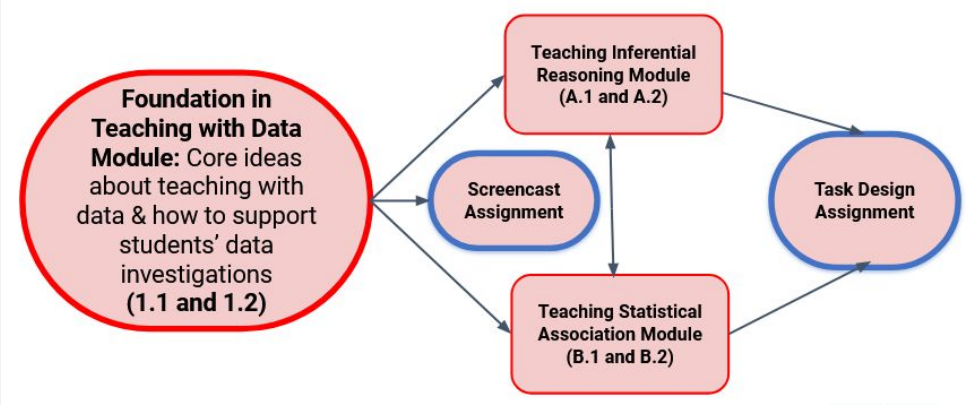
ptmtproject.com

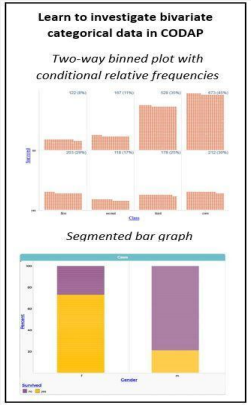
Build Online Modules to Support Teacher Preparation for Teaching Statistics

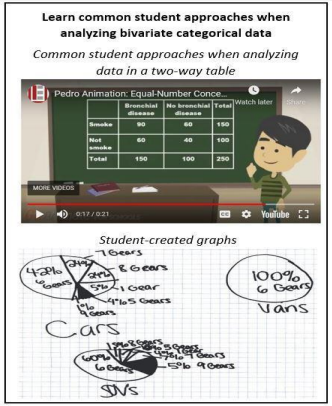
2016 - 2021

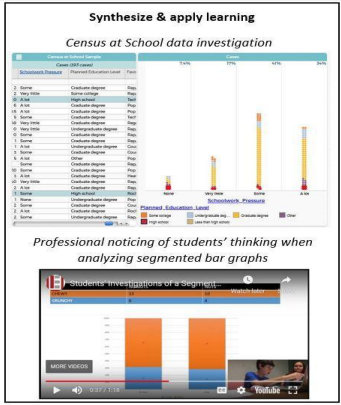
ESTEEM
ENHANCING STATISTICS TEACHER EDUCATION WITH E-MODULES

Enhancing Statistics Teacher Education Through E-Modules





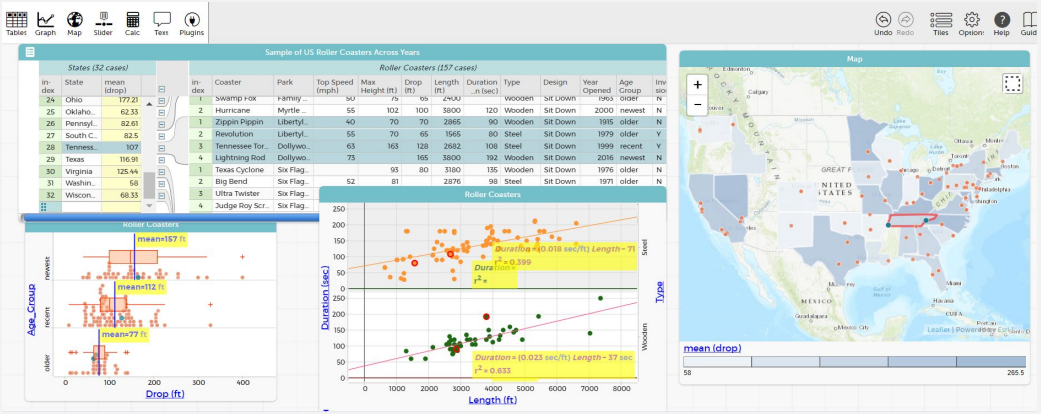


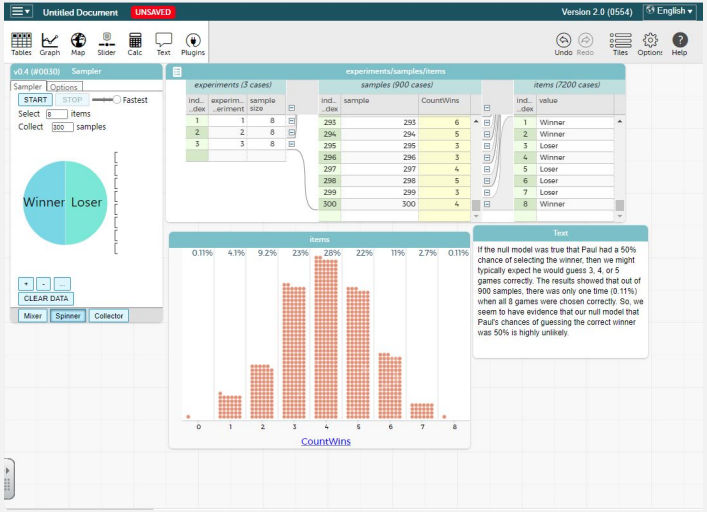


40+ hrs of multimedia material
Data Investigations in CODAP
8 In-Person and Web-based Faculty Workshops
500+ registered users

Contribute to Design of an Online Data Tool

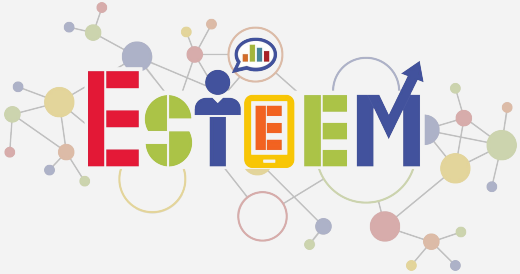
CODAP: Common Online Data Analysis Platform





codap.concord.org

Enhancing Statistics and Data Science Teacher Education: Transforming & Building Community



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Emily Thrasher (Senior Researcher)
Rachel Abel (GRA)
Adrian Kuhlman (GRA)

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Stephanie Casey (PI)

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Rick Hudson (PI)

The Concord Consortium
Bill Finzer (Co-PI)

Began 2022

NC STATE UNIVERSITY

EASTERN MICHIGAN UNIVERSITY

UNIVERSITY OF SOUTHERN INDIANA

The Concord Consortium

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Broad ESTEEM II Goal 2022-2028

Transform

undergraduate teacher preparation

to support developing teachers who are knowledgeable and confident in teaching Data Science & Statistics (DS&S)

ESTEEM Network: Sample of Key Partners

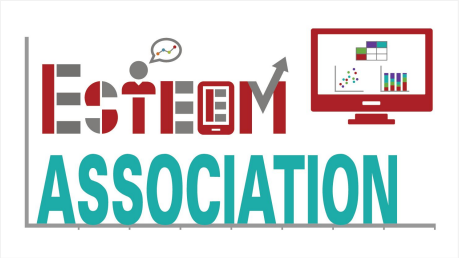
CODAP

MODULE(S²)

Mathematics Of Doing, Understanding, Learning and Educating for Secondary Schools

Revised Curriculum Materials

Available Now!



Available Now!

To be released Summer 2026

Professional Growth for Teacher Educators

Webinars

Facilitator's Guides

Conferences & Convening

Online Resource Hub

Slack Community

In-Person Workshops

research.ced.ncsu.edu/esteemhub

go.ncsu.edu/esteemhub

Learn Something New to Build Something New

MOOC-Ed

MASSIVE OPEN ONLINE COURSES FOR EDUCATORS

Scaling-Up for Online Teacher Learning

NC STATE Friday Institute for Educational Innovation

fi.ncsu.edu

2015-2025

place.fi.ncsu.edu

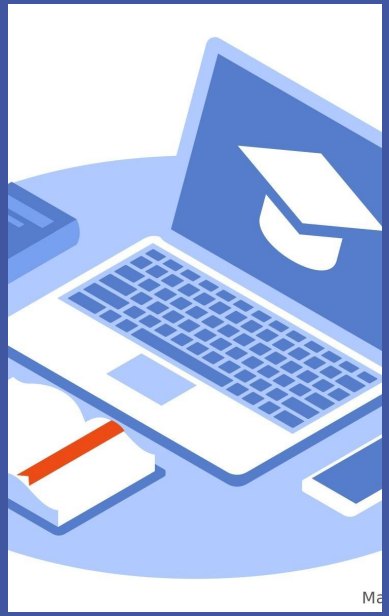
Free Online Courses for Practicing Teachers

50 states, 106 countries, 8500+ enrolled

	Course Title	Sections	Enrolled
	Teaching Statistics Through Data Investigations	7	3,128
	Teaching Statistics Through Inferential Reasoning	3	789
	Teaching Mathematics with Technology	5	3,644
	Amplifying Statistics and Data Science in Classrooms *(summer 2021)*	1	940 (5/1/2025)

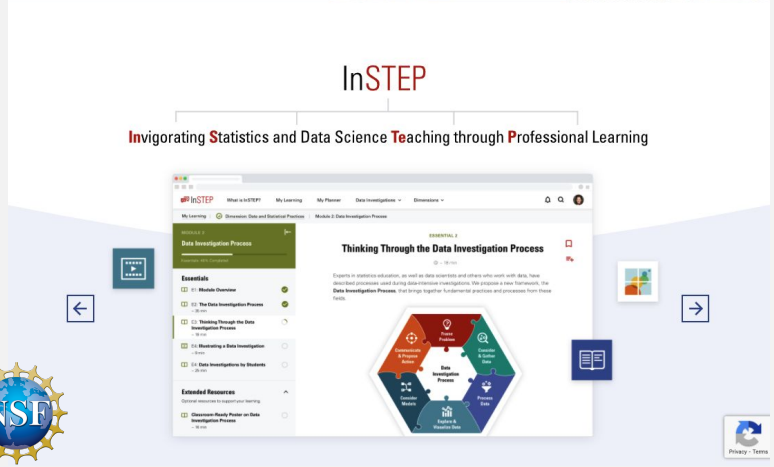
WILLIAM + FLORA Hewlett Foundation

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



Taking Online Professional Learning for Teachers to the Next Level

Personalized Learning for Teaching Statistics and Data Science in grades 6-12+



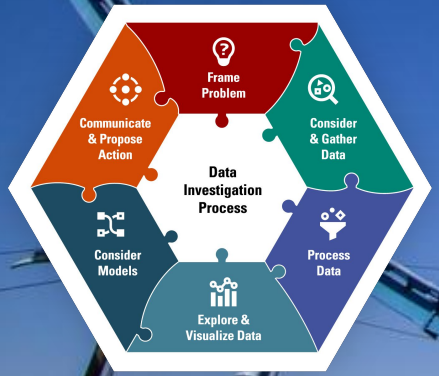
InSTEP

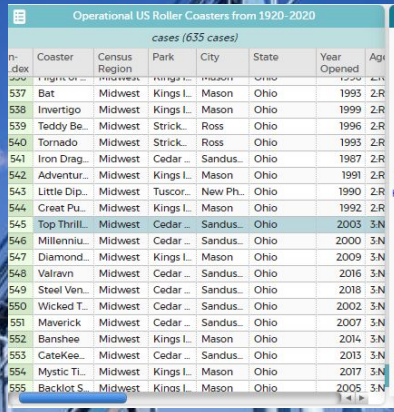
instepwithdata.org

FREE for All!

Learning Experience 1:

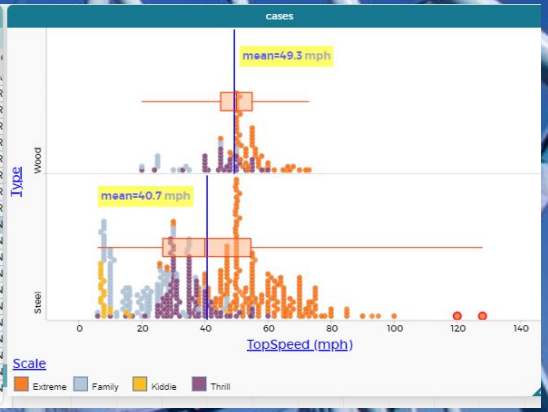
Data Investigations with “Big” Multivariate Data




Operational US Roller Coasters from 1920-2020

cases (635 cases)

n- dex	Coaster	Census Region	Park	City	State	Year Opened	Ag
537	Bat	Midwest	Kings I...	Mason	Ohio	1993	2.R
538	Invertigo	Midwest	Kings I...	Mason	Ohio	1999	2.R
539	Teddy Be...	Midwest	Strick...	Ross	Ohio	1996	2.R
540	Tornado	Midwest	Strick...	Ross	Ohio	1993	2.R
541	Iron Drag...	Midwest	Cedar ...	Sandus...	Ohio	1987	2.R
542	Adventur...	Midwest	Kings I...	Mason	Ohio	1991	2.R
543	Little Dip...	Midwest	Tuscor...	New Ph...	Ohio	1990	2.R
544	Creat Pu...	Midwest	Kings I...	Mason	Ohio	1992	2.R
545	Top Thrill...	Midwest	Cedar ...	Sandus...	Ohio	2003	3.N
546	Millenniu...	Midwest	Cedar ...	Sandus...	Ohio	2000	3.N
547	Diamond...	Midwest	Kings I...	Mason	Ohio	2009	3.N
548	Valravn	Midwest	Cedar ...	Sandus...	Ohio	2016	3.N
549	Steel Ven...	Midwest	Cedar ...	Sandus...	Ohio	2018	3.N
550	Wicked T...	Midwest	Cedar ...	Sandus...	Ohio	2002	3.N
551	Maverick	Midwest	Cedar ...	Sandus...	Ohio	2007	3.N
552	Banshee	Midwest	Kings I...	Mason	Ohio	2014	3.N
553	CateKee...	Midwest	Cedar ...	Sandus...	Ohio	2013	3.N
554	Mystic Ti...	Midwest	Kings I...	Mason	Ohio	2017	3.N
555	Backlot S...	Midwest	Kings I...	Mason	Ohio	2005	3.N



Learn to Do Data Investigations with CODAP

DATA INVESTIGATION 1

US Roller Coasters

Engage in a data investigation to compare, contrast and examine trends in US roller coasters using a technology tool, CODAP.

100% Completed

DATA INVESTIGATION 2

Census at School

In this data investigation you have an opportunity to feel awash in a bigger, messy dataset through sampling student-generated data from the Census at School Project.

63% Completed

DATA INVESTIGATION 3

Popular Cereals

Engage in a data investigation to examine trends in nutritional characteristics of over 200 popular cereals in a multivariate dataset using CODAP, a technology tool.

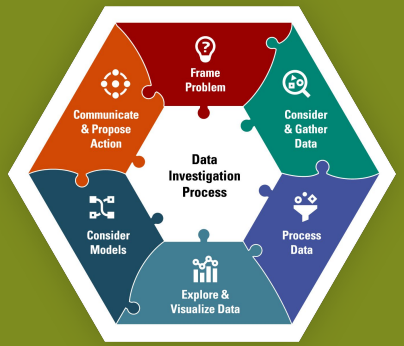
100% Completed

DATA INVESTIGATION 4

Fish Catch Data

Through investigating fish catch data from the NOAA, you will learn how to use linear regression to model relationship between length and weight of different species of fish.

100% Completed



DATA INVESTIGATION 5

Democratic Representation Part 1

In this data investigation, explore what it means to be representative using data from the 117th US Congress and the US Census.

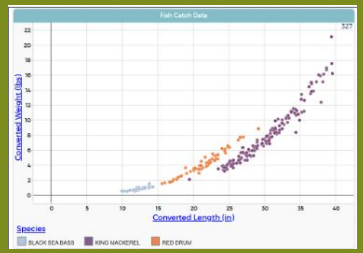
Not Started

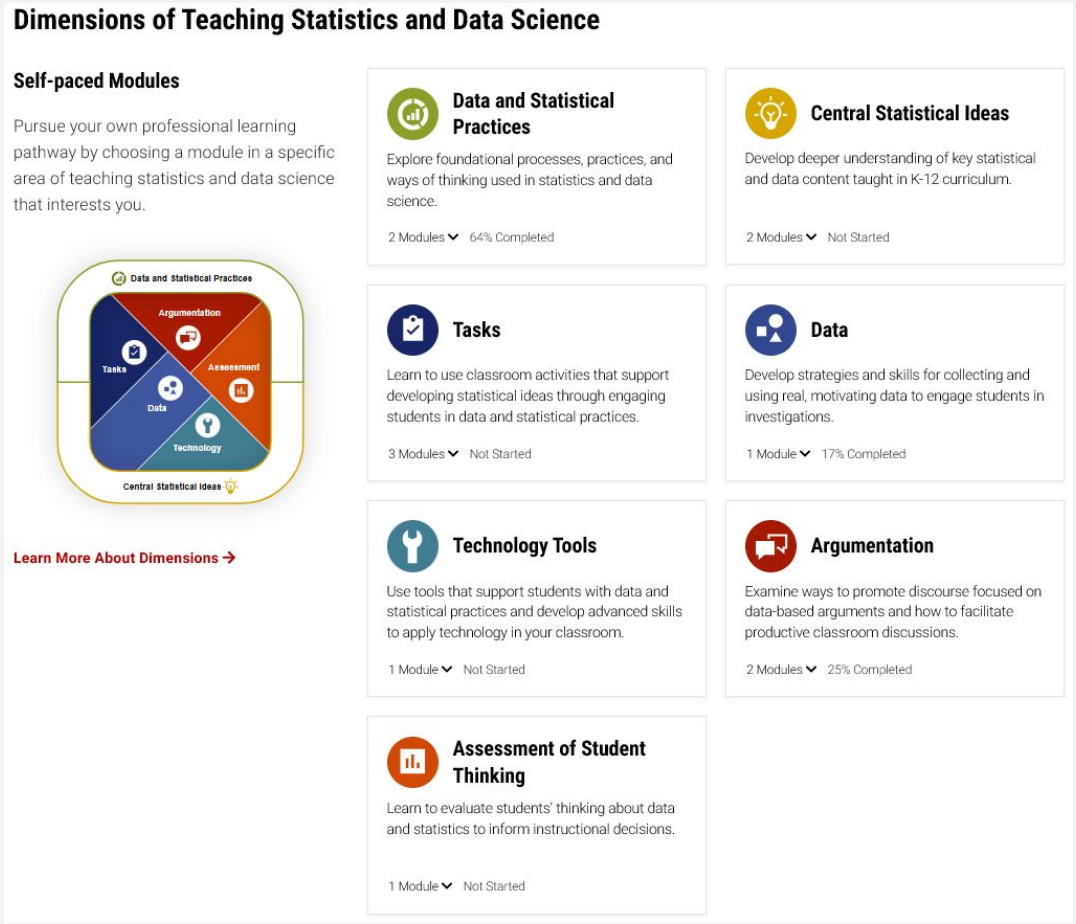
DATA INVESTIGATION 6

Democratic Representation Part 2

In this data investigation, use simulations & sampling distributions to determine whether the 117th US House of Representatives is representative of the Asian population.

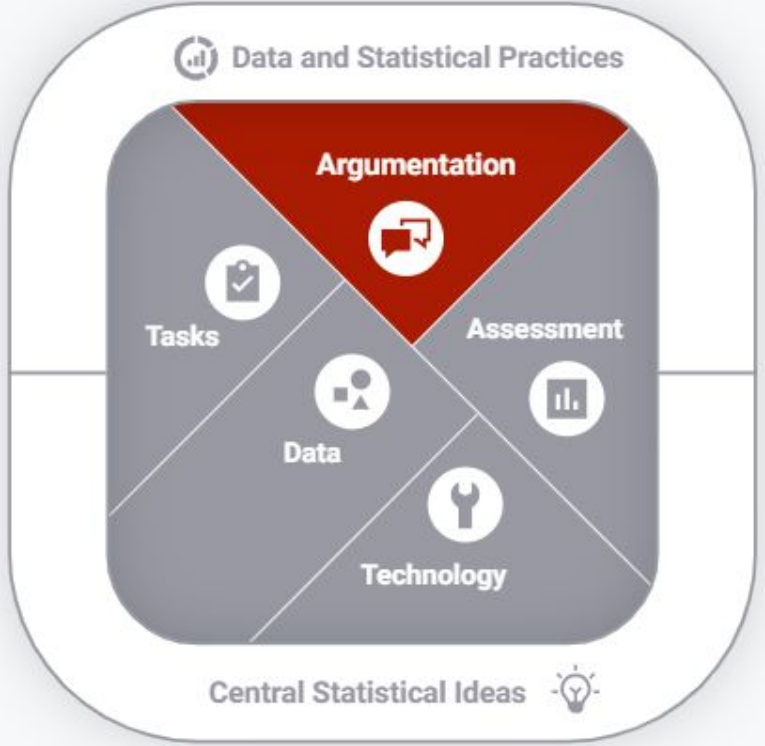
10% Completed





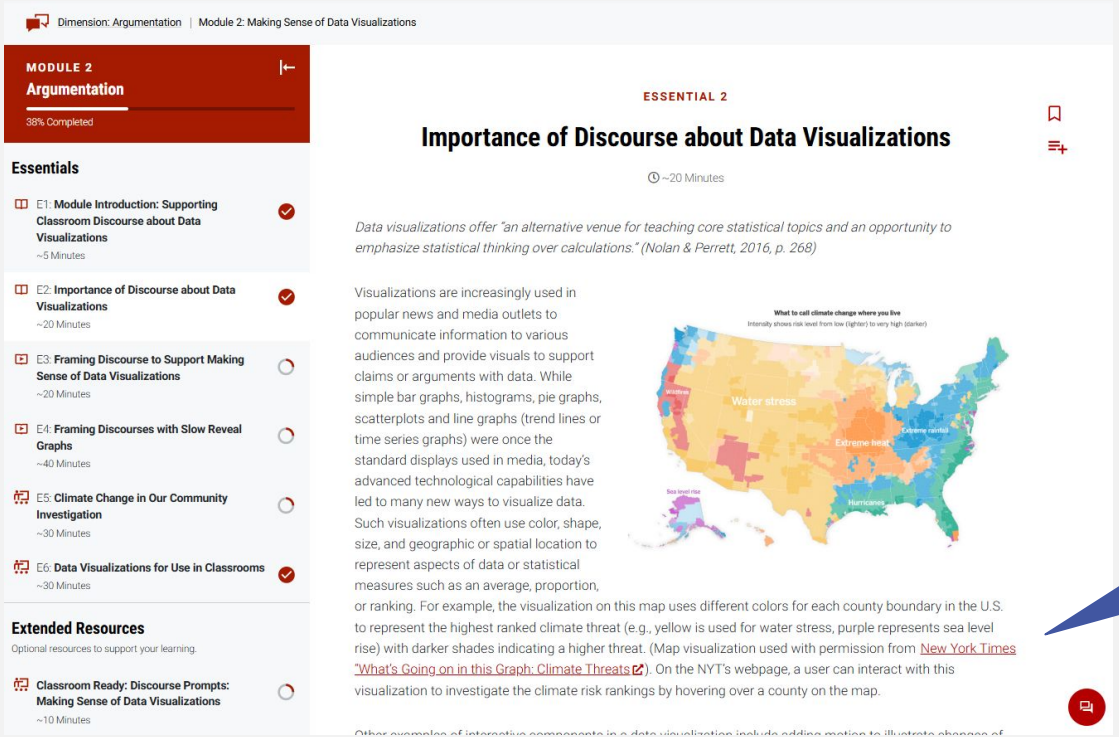
Learning Experience 2: Self-Paced Multimedia Modules

Learn to orchestrate discussions with and about data



Argumentation Module 2: Making Sense of Data Visualizations

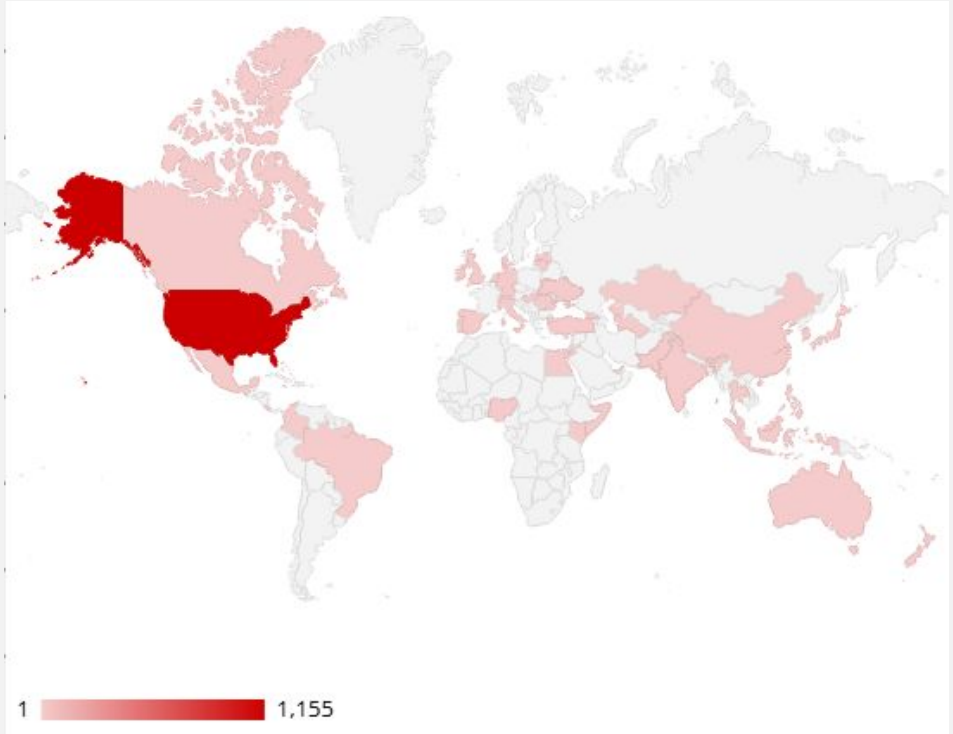
Completion Does Not Need to be Linear and is Tracked

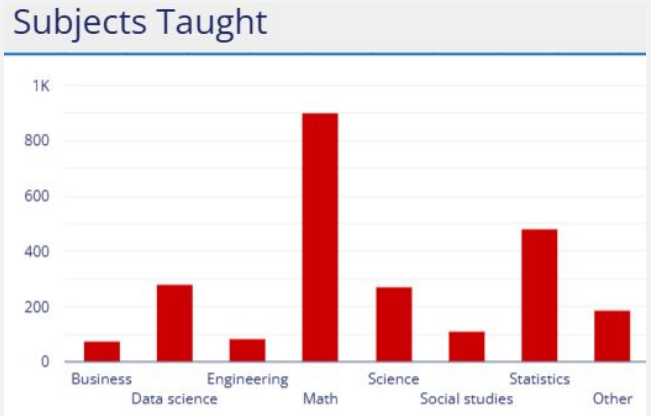


Links to Many External Resources

Who is Getting InSTEP with Data?

1500+ registered users



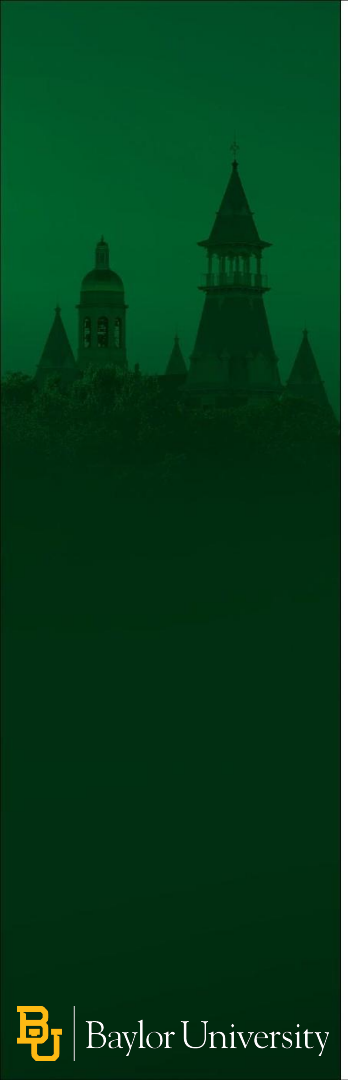


As of January 2026

InSTEP

instepwithdata.org

Don’t Forget How Powerful and Fun Local Impact Can Be!



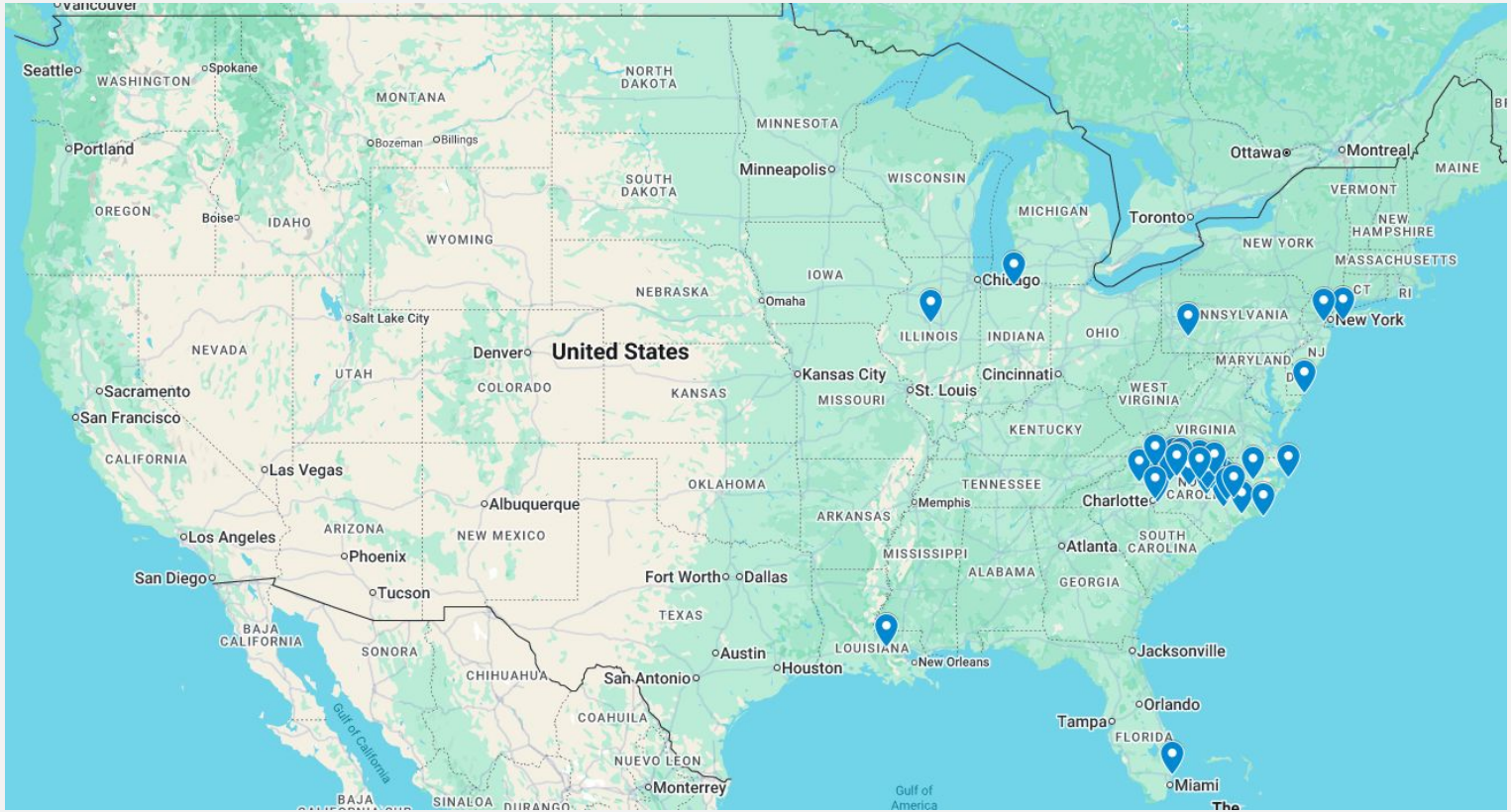
Baylor University

Give future K-8 teachers a better data and statistics experience to inspire their future data teaching

MTH 3318 Data & Chance

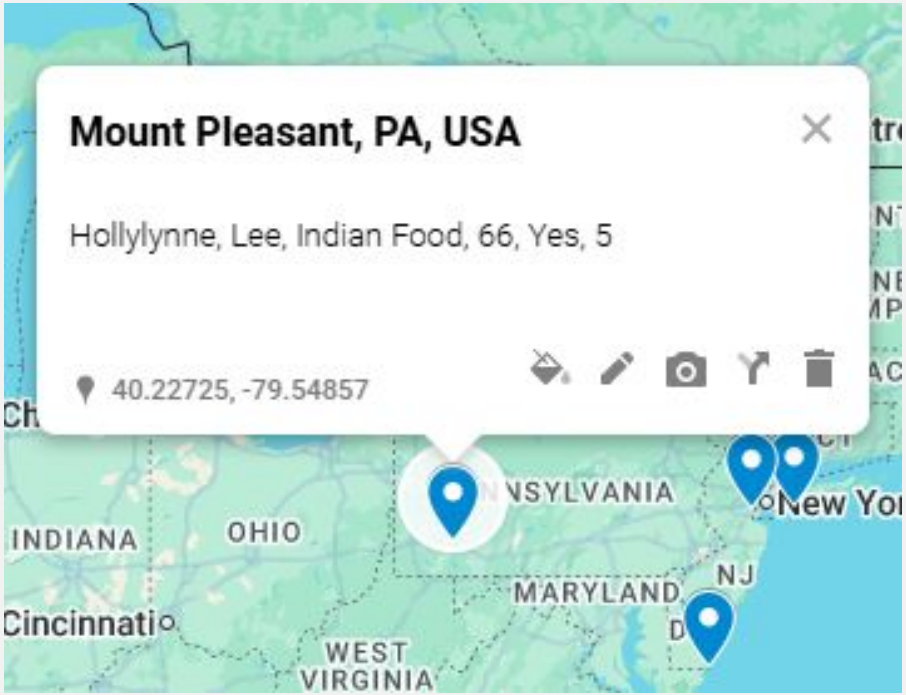
ST 101 Statistics by Example for K-8 Teachers

Day 1: Where are our Hometowns?



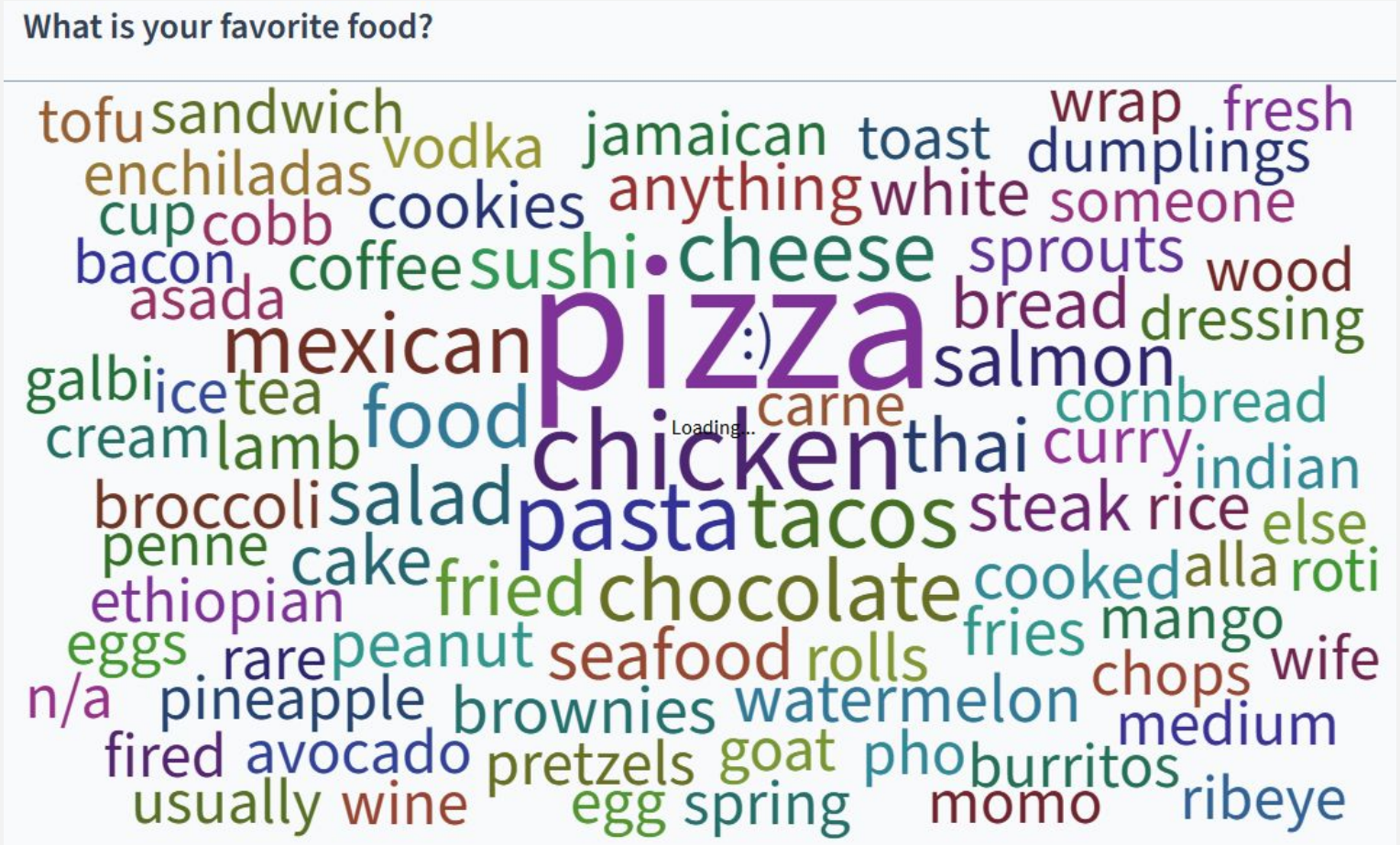
Day 1: Collecting Multivariate Data About Us

Latitude
Longitude
Hometown City
Hometown State
Hometown Country
First Name
Last Name
Favorite Food
Height (in inches)
Are you the First Born (Yes, No)
What is Your Current Love of Statistics? (1-Low to 5-High)

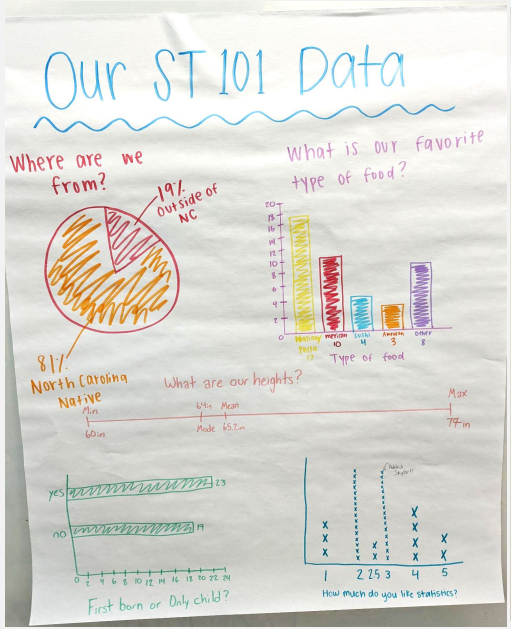


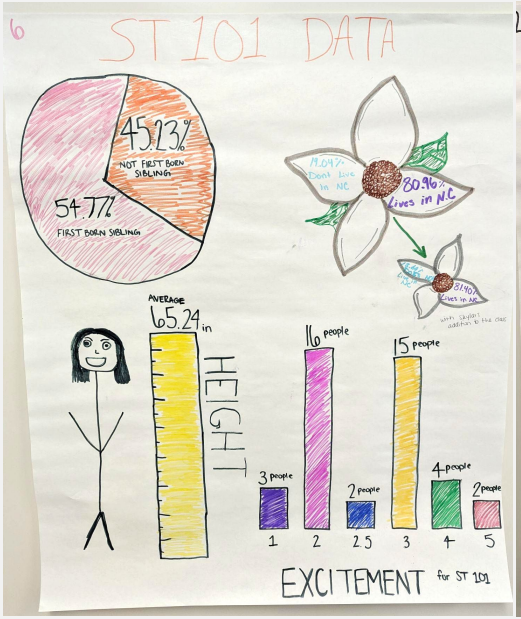
Download csv file, open in spreadsheet

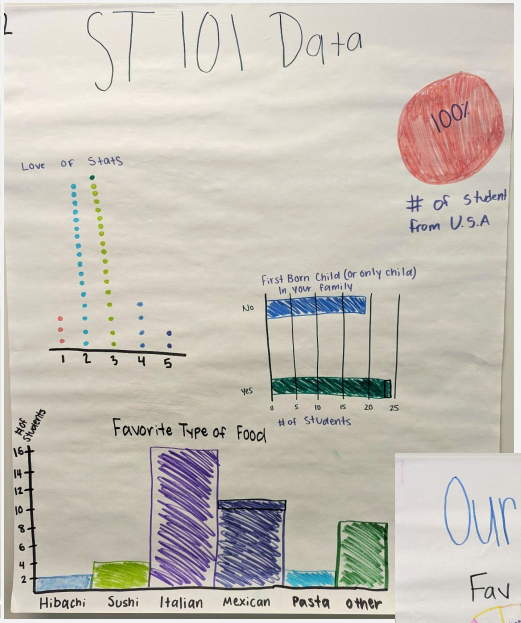
AMTE Survey asked about Favorite Food

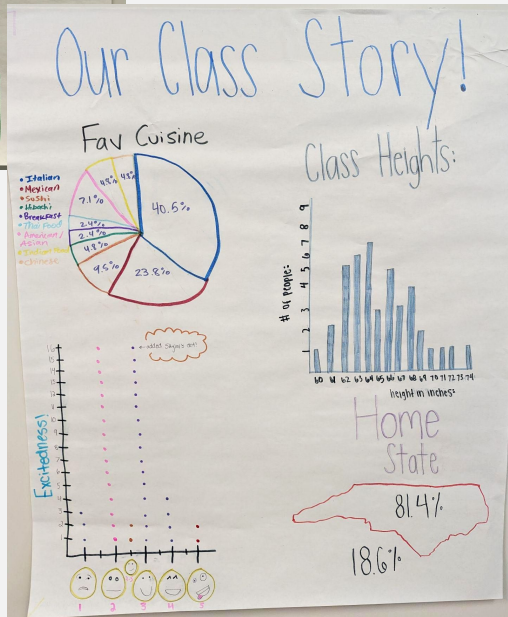


Pizza	Lamb chops	Broccoli	cheese	Massaman Curry	Pasta	Muffins	Seafood
Cookies	Dark chocolate	Burger	Pizza	Bean and plantain	Chicken	Galbi	Lobster
Pizza	MoMo	Bread	Pasta	Turkish Food :)	Carne Asada Tacos	Steak and salad	Cobb salad
Cornbread dressing	N/A	indian food	Pasta	Eggs	Salmon	Pizza	Salmon
Chocolate	Thai	Udon	Pizza	Pizza	Smoked mussels	Coffee cake	Mango
Xiaolongbao	Tacos	Blueberries	Brussel sprouts	Sushi	Chocolate	Steakhouse	Pizza
French fries	Nachos!	Fresh baked bread	Cheese cake	Any seafood	Salsa	Pizza	Anything someone else cooked for me.
Berries	Wood fired pizza	Pizza	Curry chicken roti	Pizza	Seafood	Salad	Ice cream
Penne alla vodka	Chicken	Tacos	Salad	Goat cheese	Pasta	Chicken and pasta	Avocado toast
Pizza	Coffee	Thai	Pizza	Pasta	Jamaican food	Pretzels	Brussels sprouts
Peanut Thai	Gyros	Mexican	Burritos	Desserts (cake, brownies, cookies)	Mexican	Cheese	Pancakes!!!
chocolate	Brownies	Pizza	Steak	Watermelon	Cake	Pizza	Fried chicken
Thai	Fries	Bubble tea	Chicken Enchiladas	Medium rare ribeye	Ethiopian	Wine	Dumplings
Pasta	Chicken	Pike mackerel kimchi stew with a steaming bowl of white short grain rice and a cup of barley tea.	Cookies	Cheese	Pizza	Pizza	Tofu
Watermelon	Salmon	Smothered Turkey Wings	Bacon egg and cheese sandwich	Pineapple	Lamb biryani....usually cooked by my wife!	Tacos	
Fried chicken	Steak	Taco	Pizza	Pizza	Pizza	Sushi	
Spring Rolls	Anything with steamed white rice!!	Fried chicken	Pizza	Mexican	Chicken and waffles	Roasted broccoli	
Pizza	Sushi	Mexican	Tacos	Raspberry sorbet	Banana bread	Mexican Food	
Yellow food	Carrots	Pizza	Tacos	Chocolate and peanut butter	Cinnamon Rolls	Vegetable tikki masala	
Pizza	Chicken shawarma wrap	Fried Shrimp	Pickled green beans	Pho	Pizza	Salad	
Olives	Chocolate	Sushi	Salmon	Pasta	Mexican food	Tacos	









Still Day 1...and into Day 2

Tell a Data Story .... Then Gallery Walk with Notice and Wonder

CleanedData_St101Sp2026 Data About Us UNSAVED Version 2.

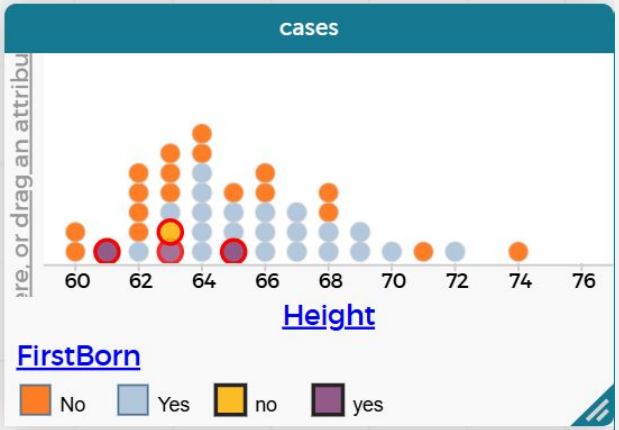
Tables Graph Map Slider Calc Text Plugins Undo Redo

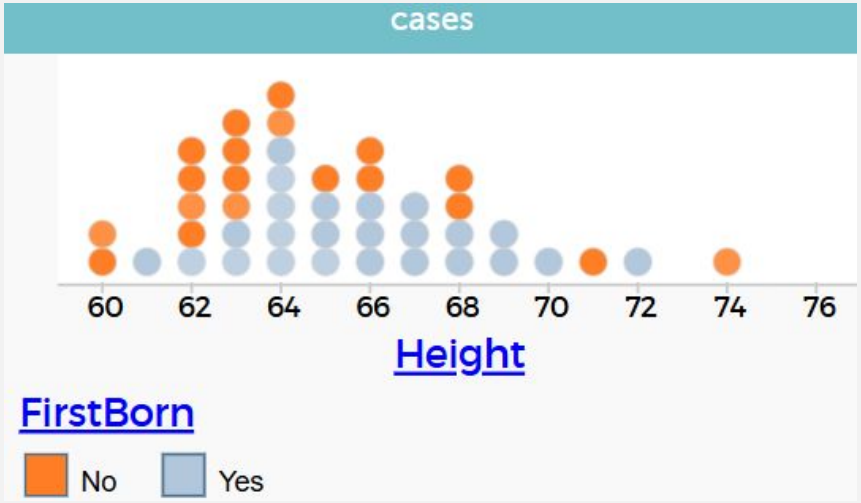
clipboard data

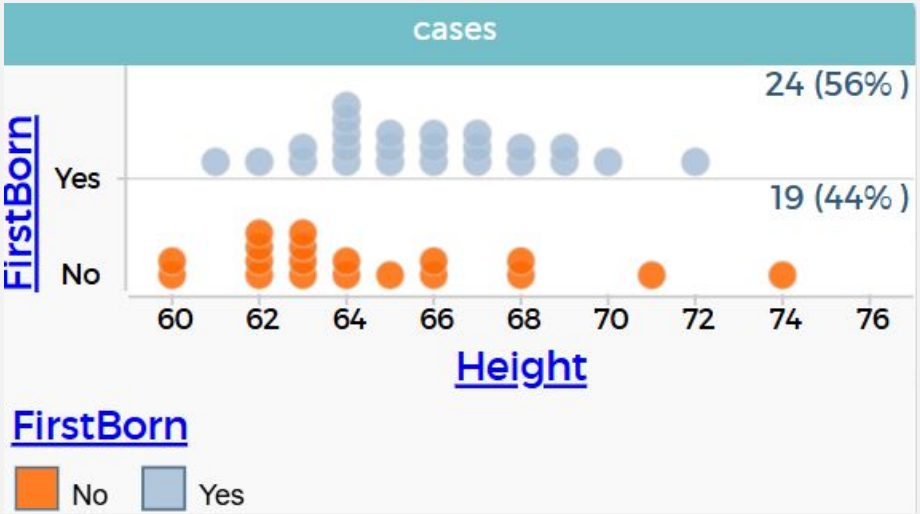
cases (43 cases)

dex	Longitude	Latitude	Town	State	Country	FirstName	LastName	FavoriteFood	Height	FirstBorn	StatsLove	Le...
28	-75.06	38.52	Betha...	DE	USA	[illegible]	[illegible]	Italia...	69	Yes	2	
29	-75.68	35.91	Manteo	NC	USA	[illegible]	[illegible]	Mexi...	68	Yes	3	
30	-80.14	26.13	Ft. Lau...	FL	USA	[illegible]	[illegible]	Italia...	64	No	2	
31	-78.78	35.79	Cary	NC	USA	[illegible]	[illegible]	Italia...	65	Yes	2	
32	-79.5	35.67	Bear C...	NC	USA	[illegible]	[illegible]	Mexi...	64	Yes	1	
33	-78.66	35.56	Willlo...	NC	USA	[illegible]	[illegible]	Italia...	67	Yes	4	
34	-79.94	35.99	Jamest...	NC	USA	[illegible]	[illegible]	Hiba...	64	No	2	
35	-78.8	35.58	Fuqua...	NC	USA	[illegible]	[illegible]	Sushi	64	Yes	3	
36	-80	35.96	High P...	NC	USA	[illegible]	[illegible]	Hiba...	66	Yes	3	
37	-79.55	40.23	Mount ...	PA	USA	[illegible]	[illegible]	India...	66	Yes	5	
38	-78.51	35.98	Wake F...	NC	USA	[illegible]	[illegible]	Ame...	64	Yes	2	
39	-79.08	35.86	Chapel...	NC	USA	[illegible]	[illegible]	Mexi...	63	no	3	
40	-91.18	30.45	Baton ...	LA	USA	[illegible]	[illegible]	Sushi	68	Yes	4	
41	-86.25	41.69	South ...	IN	USA	[illegible]	[illegible]	India...	72	Yes	5	
42	-78.07	35.2	Mount ...	NC	USA	[illegible]	[illegible]	Italian	67	Yes	3	
43	-77.8	35.3	La Gra...	NC	USA	[illegible]	[illegible]	Mexi...	65	yes	3	

cases




cases
60
62
64
66
68
70
72
74
76
Height
FirstBorn
No
Yes


cases
24 (56%)
19 (44%)
FirstBorn
Yes
No
60
62
64
66
68
70
72
74
76
Height
FirstBorn
No
Yes

cases (43 cases)

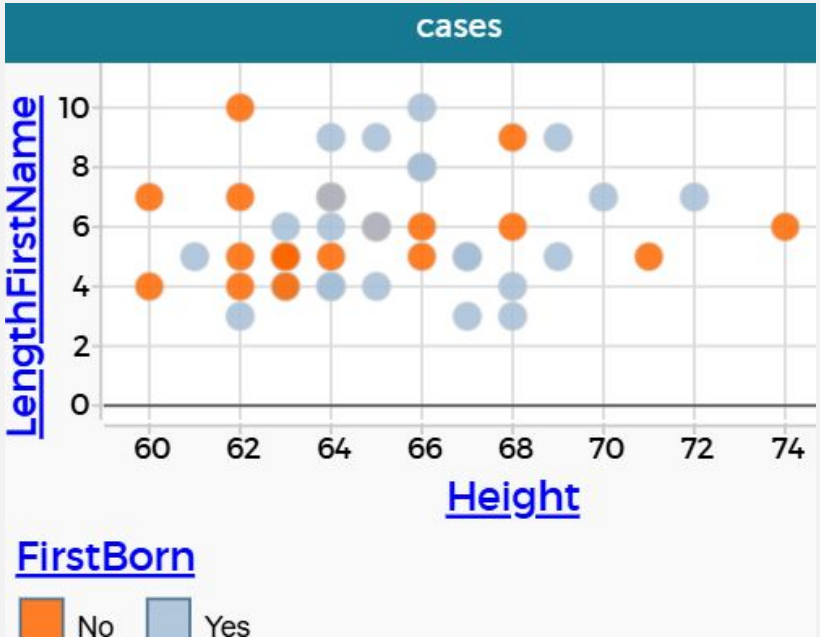
...t	FirstBorn	StatsLove	Lengt...ame)	FirstLe...ame	LengthLa...stName	Lengt...ame	FirstLe...ame
71	No	1	9	C	9	5	M
52	No	2	5	G	5	5	K
50	No	2	10	S	10	4	M
61	Yes	3	7	N	7	5	S
55	Yes	3	9	E	9	4	C
59	Yes	2	6	C	6	9	T
56	No	2	7	R	7	6	G
74	No	2.5	4	S	4	6	W
56	No	3	4	M	4	5	H
53	No	2	7	A	7	5	P
70	Yes	2	5	B	5	7	R
58	No	4	5	E	5	9	C
55	No	4	7	S	7	6	S
54	Yes	3	8	L	8	4	W
56	Yes	2	5	C	5	8	S
53	No	3	8	E	8	5	C
53	No	1	6	S	6	5	B

Attribute Name: FirstLetterFirstName

Formula: charAt(FirstName, 1)

Attribute Name: LengthLastName

Formula: stringLength(LastName)



Data Investigation Process

Holistic, Dynamic and Nonlinear

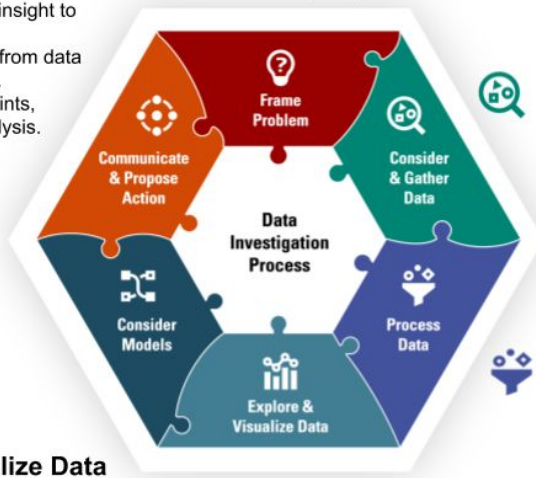
InSTEP

Frame Problem

- Consider real-world phenomena & broader issues related to problem.
- Pose investigative question(s).
- Anticipate potential data and strategies.

Communicate & Propose Action

- Craft a data story to convey insight to stakeholder audiences.
- Justify claims with evidence from data and propose possible action.
- Address uncertainty, constraints, and potential bias in the analysis.



Consider & Gather Data

- Understand possible attributes, measurements, and data collection methods needed for the problem.
- Evaluate and use appropriate design and techniques to collect or source data.
- Consider sample size, access, storage, and trustworthiness of data.

Consider Models

- Analyze and identify models that address the problem.
- Consider assumptions and purpose of the models.
- Recognize possible limitations.

Process Data

- Organize, structure, clean, merge, and transform data in efficient and useful ways.
- Consider additional data cases or attributes.

Explore & Visualize Data

- Construct meaningful visualizations, static or dynamic.
- Compute meaningful statistical measures.
- Explore and analyze data for potential relationships or patterns that address the problem.

Key Considerations & Dispositions

Make sense of data with respect to context	Take advantage of technology	Attend to variability & uncertainty	Seek expertise & information	Communicate & collaborate	Be curious creative, & intuitive	Persist & be resilient	Consider ethical issues & biases	Be a skeptic

Gemma Mojica, Hollylynne Lee, Emily Thrasher, Zachary Vaskalis, and Greg Ray. (2021). The data investigation process classroom poster. In Invigorating Statistics Teacher Education through Professional Online Learning, Friday Institute for Educational Innovation: NC State University. Available at: http://cdn.instepwithdata.org/DataInvestigationProcessPoster.pdf

Lee et al., 2022 SERJ

How Can We Help The Next Generation Experience Modern Math and See the World Through Data?

How have we engaged in our state towards a more modern curriculum?

EVERYONE Needs to Make Sense of Data to Inform Decisions

“By asking questions such as, “**Who produced this research? How were the data collected and analyzed? How do the context and conditions under which the data were collected shape the findings?**” and “**What perspectives or interests might influence the conclusions?**” mathematics leaders can make better-informed decisions and, as a result, better support the teaching and learning of mathematics in their own context. “

(p. 9, NCSM, 2025 Position Statement “Strengthening Research-informed Decision Making for Mathematics Education”)

Mathematics Teacher Educators make a difference every day in the lived mathematical experiences of teachers and students.

Together we can grow a new generation that uses the mathematical sciences to solve tomorrow’s problems, understand the impact of data and statistics to inform decisions and understand our world in ways that can lead to better neighbors.

Bonus Advice

- Great research does not have to be funded
- Impact and dissemination is NOT just publishing
- About 1/3 of your papers will never be finished and published
- Be nice. Others will want to play with you
- Take time to play
- Family first

Get the Slide Deck

go.ncsu.edu/jacobs2026

Stay Connected

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