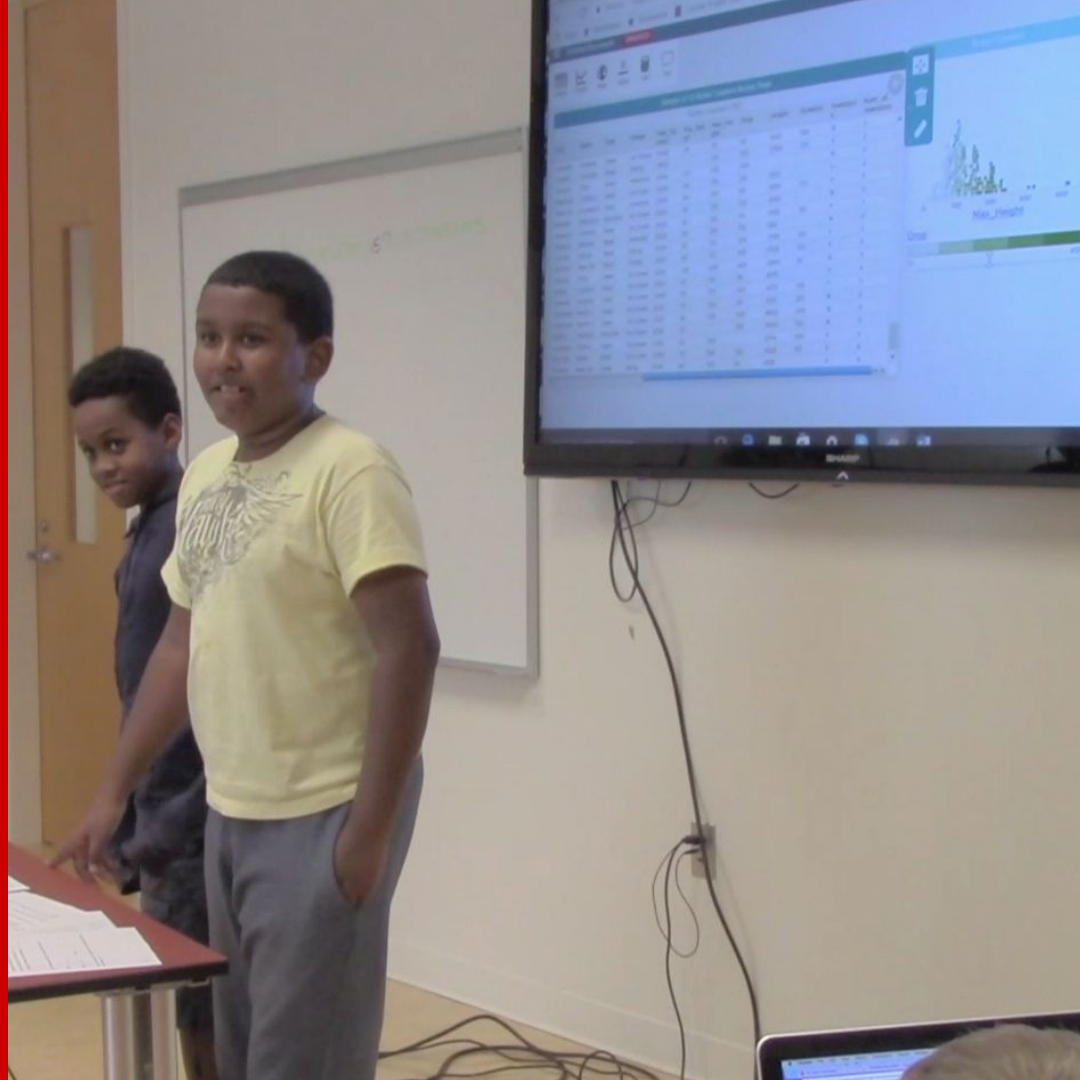
Exemplar of Data-Empowered Teaching and Learning

Hollylynne S. Lee

September 28, 2023
NC Data Science Education Summit

NC STATE UNIVERSITY
College of Education
Friday Institute for Educational Innovation



Director:
Hollylynne
Lee

Co-Director:
Gemma
Mojica

ESTEEM

Data Stories

fi.ncsu.edu/teams/hi-rise/

Coming Soon
Amplifying Statistics and Data Science in Classrooms

Teaching Statistics Through Inferential Reasoning

Teaching Statistics Through Data Investigations

InSTEP
Invigorating Statistics and Data Science Teaching through Professional Learning

DICE

NC STATE Friday Institute for Educational Innovation

fi.ncsu.edu

Acknowledgments

Materials used in this presentation were partially funded by the 2018-19 University Scholars program through RTI International and the National Science Foundation under Grant No. DRL **1908760,** **1900606** and DUE **1625713** and **2141727** awarded to NC State University. Any opinions, findings, and conclusions or recommendations expressed herein are those of the presenters and do not necessarily reflect the views of the NSF or RTI.

Work of Data Scientists: An Ethnographic Study

Immersed in workplace for 9 months:

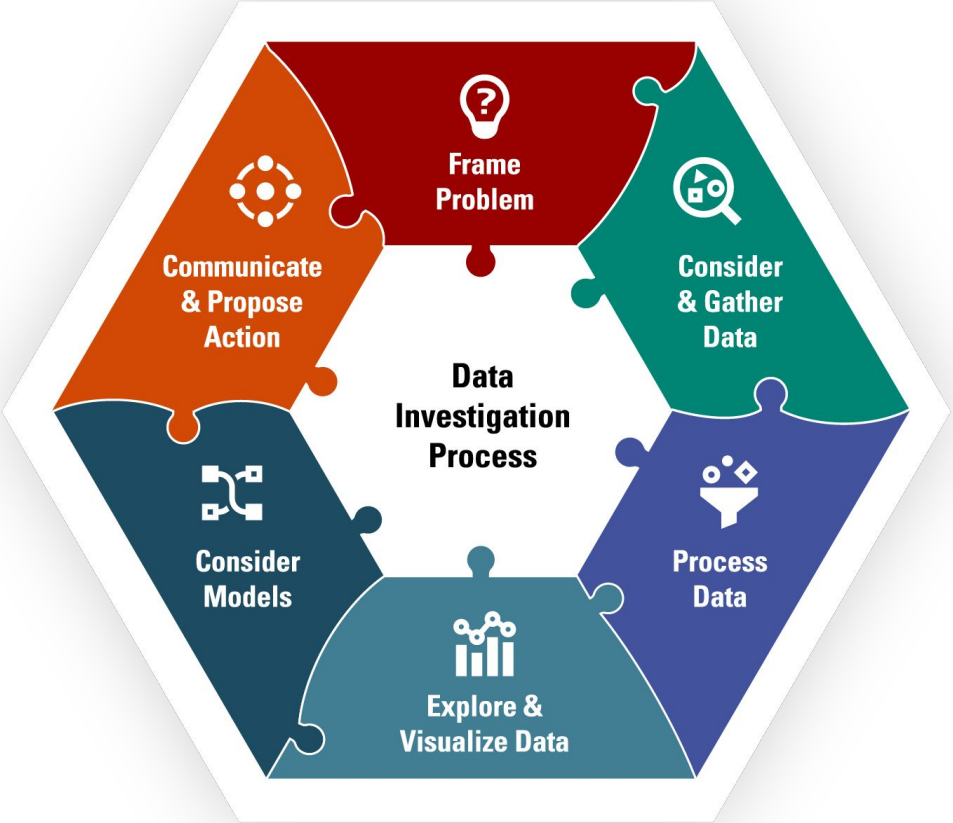
- observations of group meetings, presentations, informal conversations
- interviews with 5
- interviews posted on public sites

Key Practices, Processes and Dispositions of Data Scientist

Data Investigation Process

More holistic, nonlinear, and reflective of data science practices

Lee, Mojica, Thrasher, & Baumgartner, 2022



NC STATE
College of Education
Friday Institute
for Educational Innovation

Data Investigation Process

Holistic, Dynamic and Nonlinear

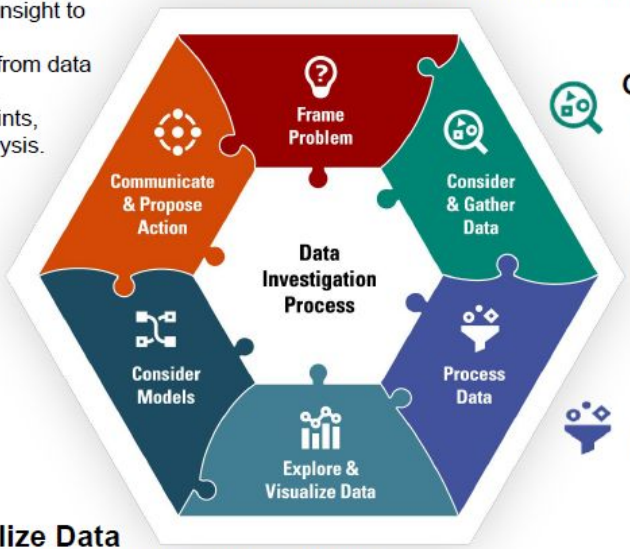
InSTEP

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

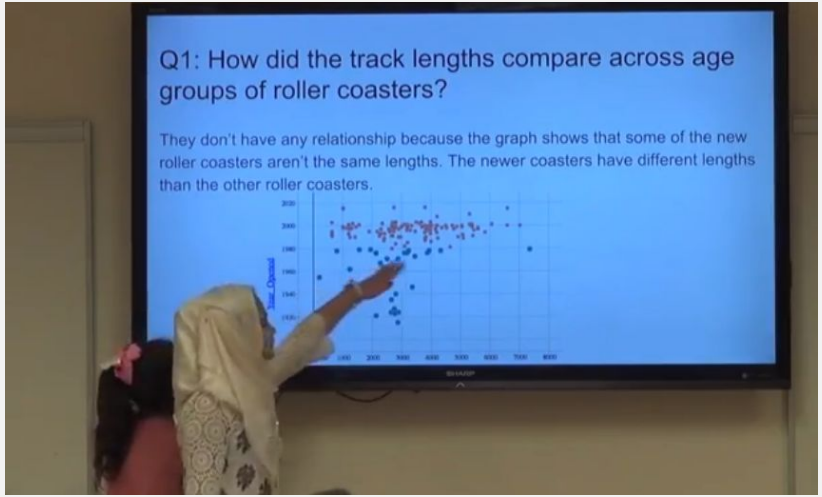
- Construct meaningful visualizations, static or dynamic.
- Compute meaningful statistical measures.
- Explore and analyze data for potential relationships or patterns that address the problem.

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

Big(ger) Data

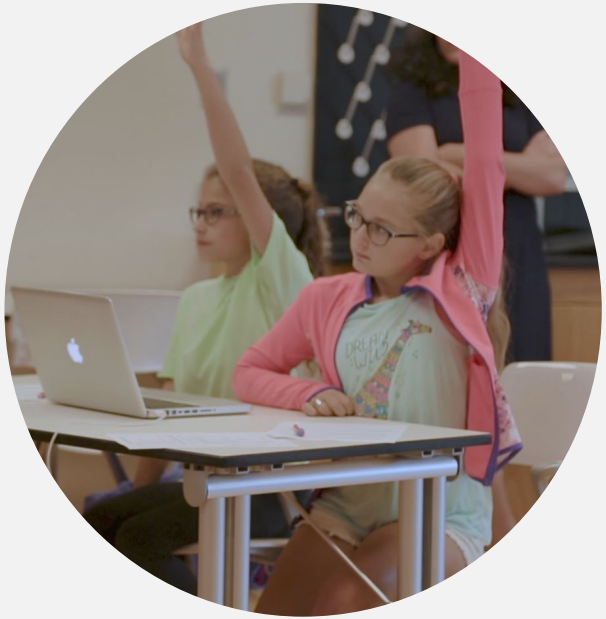
(multivariate with different types of attributes, messy, many cases)



Use of visualization and analysis tools that link representations and facilitate data moves and simple coding

Data Intensive Approach

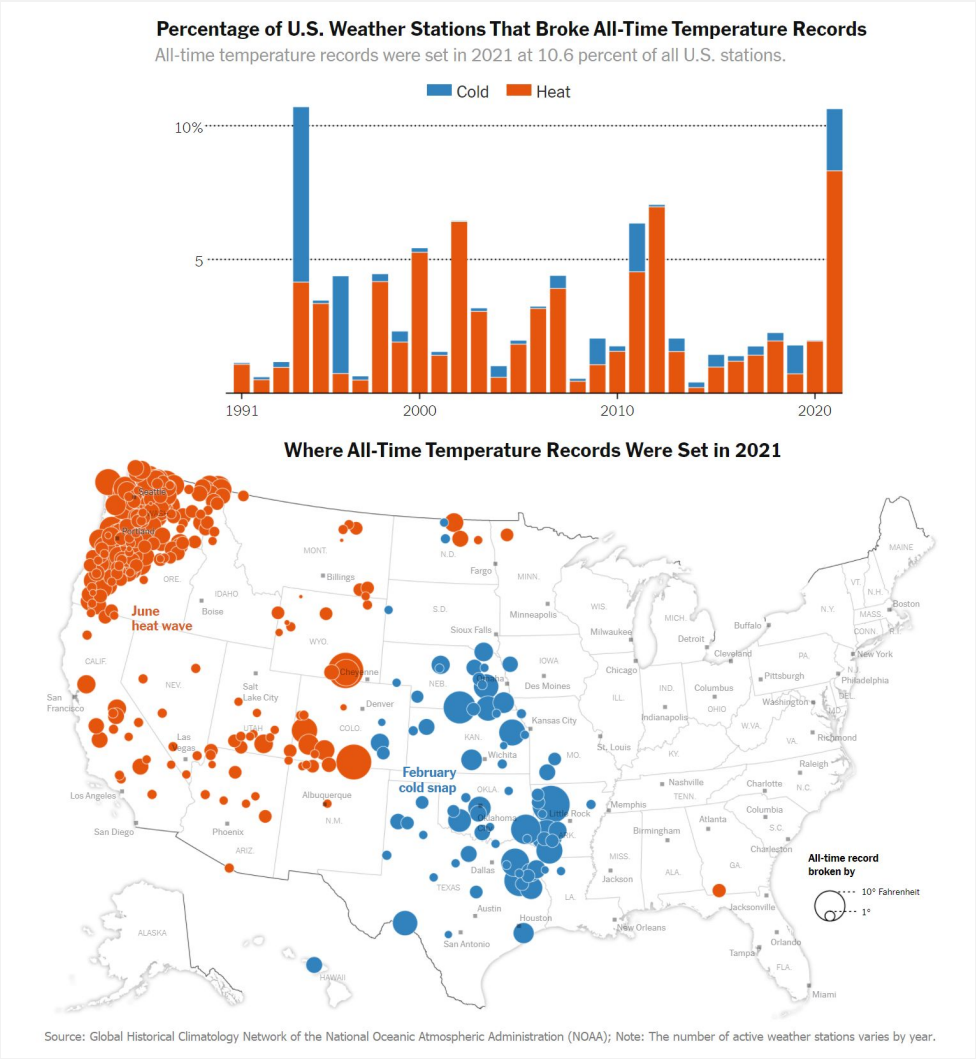
Engage with real contexts



Every Subject Matter

All learners

Aspects of Data Science should be Everywhere and for Everyone



Data in the News

What do you notice?

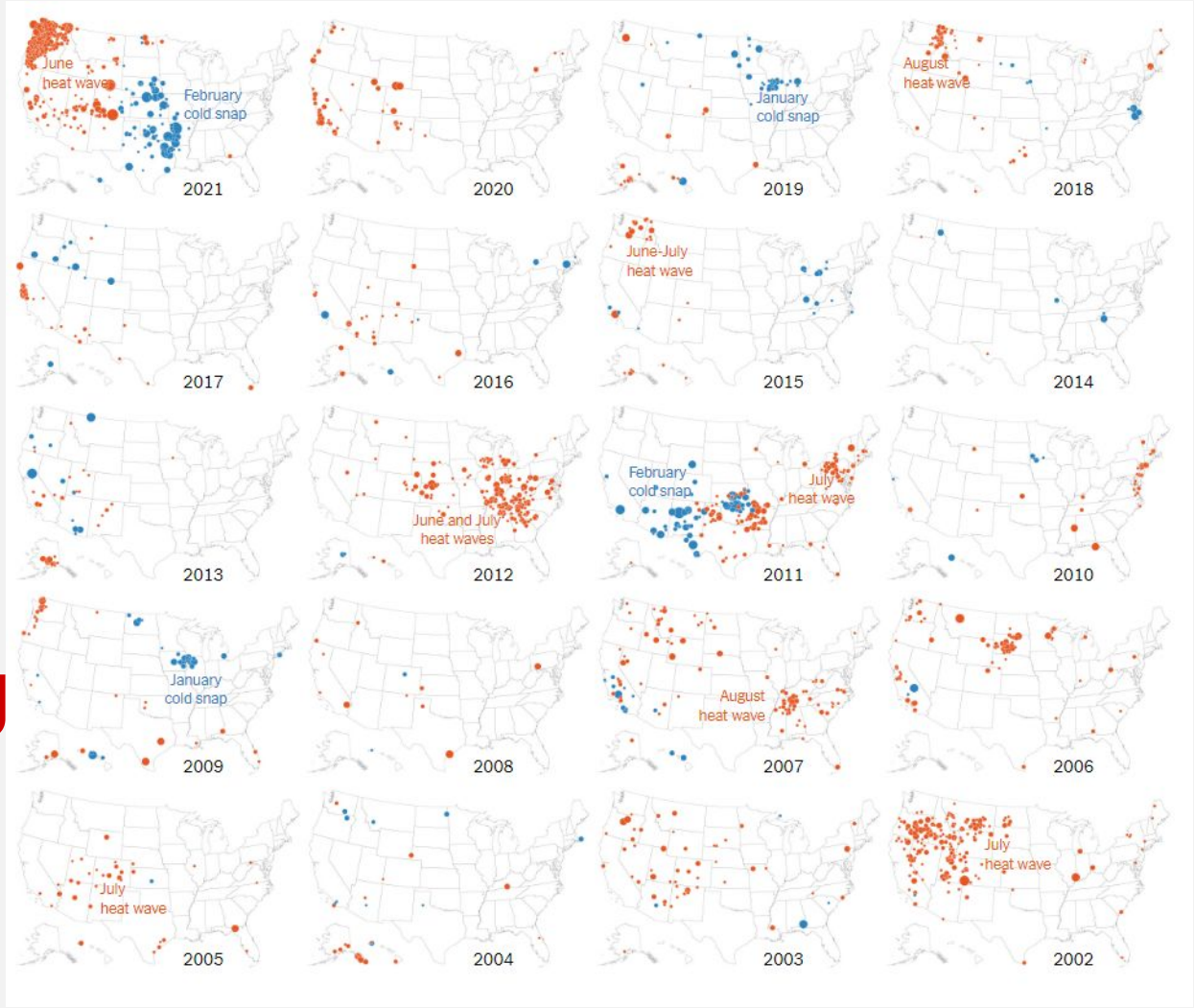
What do you wonder?

https://www.nytimes.com/2022/03/10/learning/whats-going-on-in-this-graph-march-16-2022.html

Original Article: *A Vivid View of Extreme Weather: Temperature Records in the U.S. in 2021*

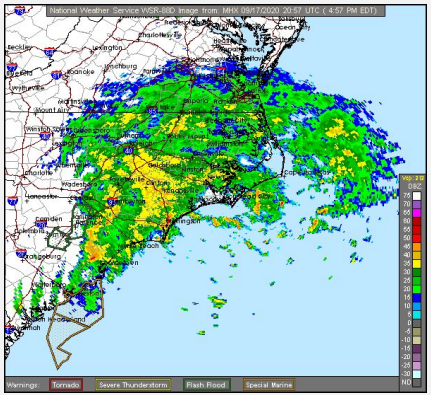
By Krishna Karra and Tim Wallace, Jan. 11, 2022

20 years of record setting

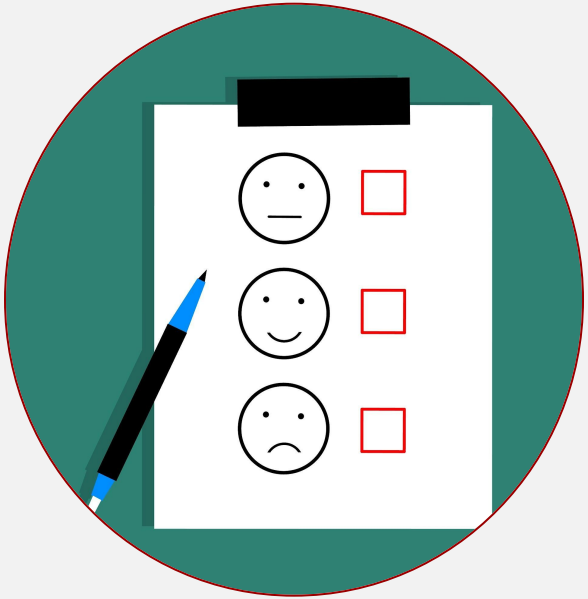


What about NC?

Let’s Think About Weather in Raleigh Durham Area



YES, you may use your device!

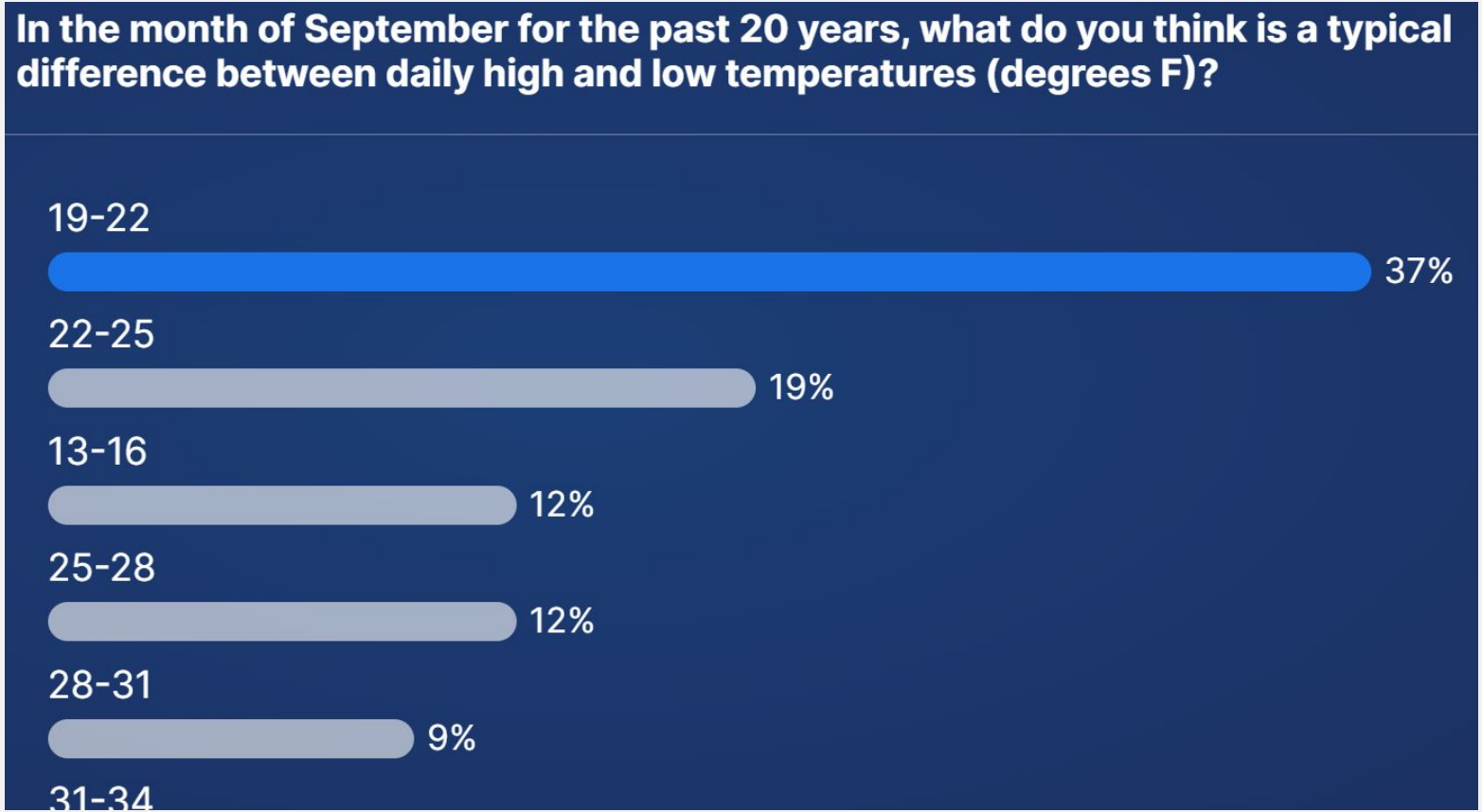


Time for a Poll

Our Poll Results

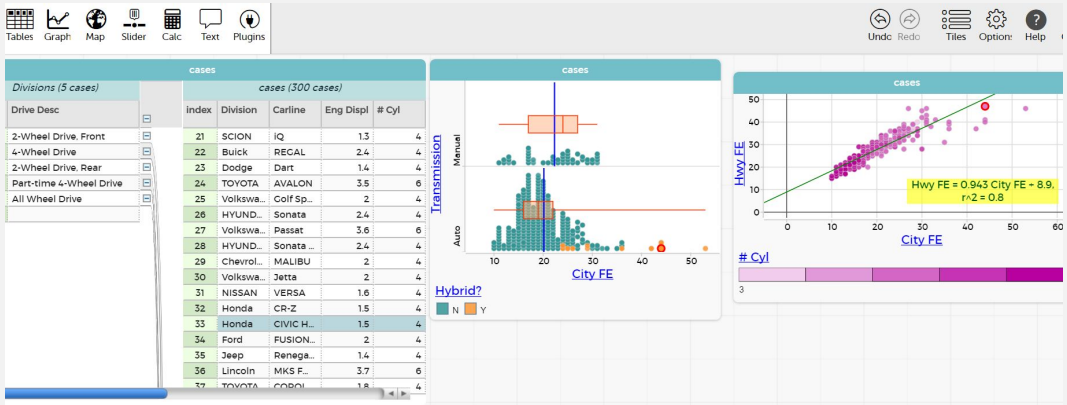
BEST GUESS: What was the lowest minimum daily temperature in RDU in past 20 years?

BEST GUESS: What was the highest maximum daily temperature in RDU in past 20 years?


In the month of September for the past 20 years, what do you think is a typical difference between daily high and low temperatures (degrees F)?
19-22
37%
22-25
19%
13-16
12%
25-28
12%
28-31
9%
31-34

codap.concord.org

Free
Web-based
No login required
Easy to use
Under continual development



Works best in Chrome or FireFox

Optimal on computer or chromebook or large tablet

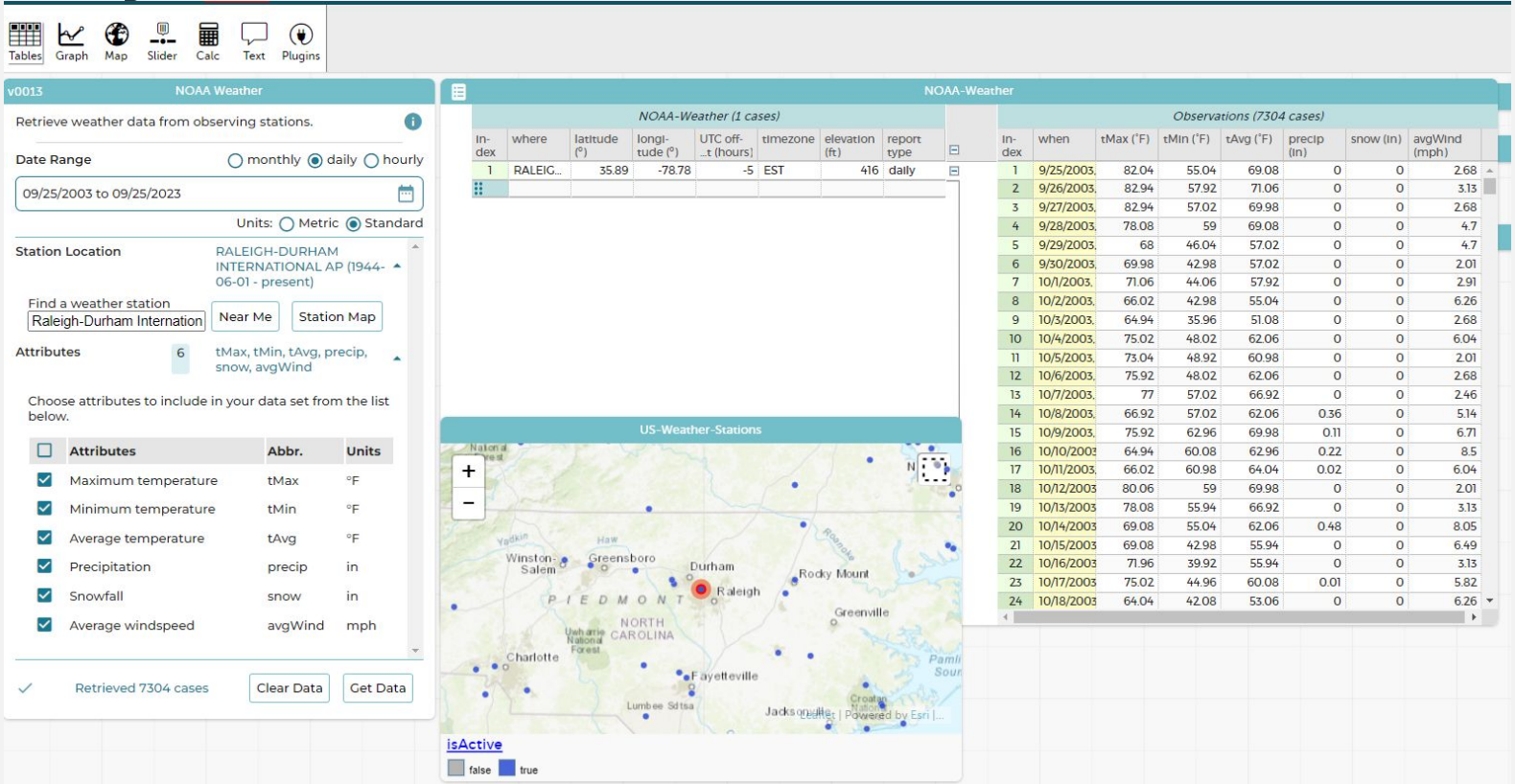
Includes “Plugins” that expand capability. TWO of these are data portals connected to NOAA and US Census!

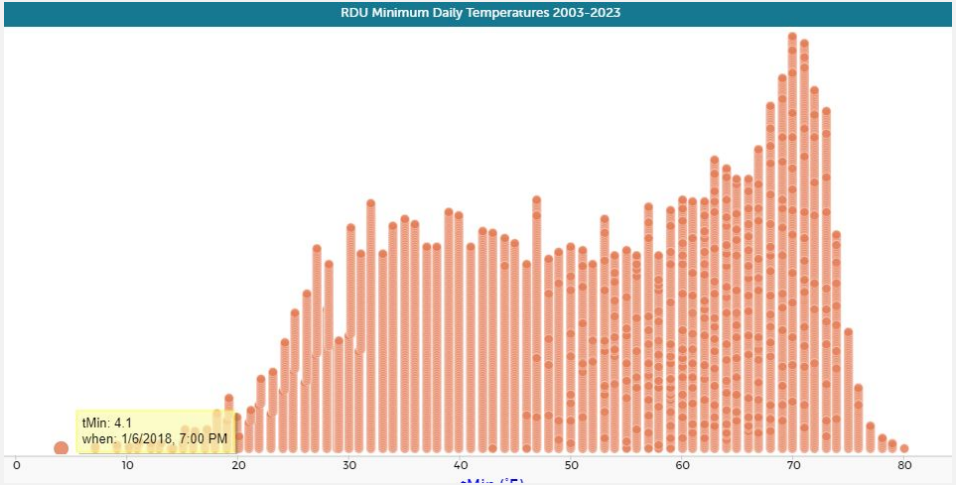
Let’s Collect Weather Data

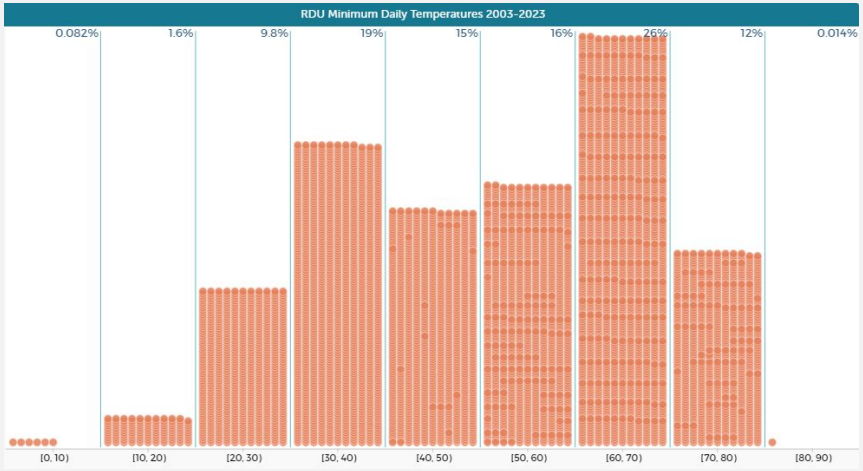
codap.concord.org/app

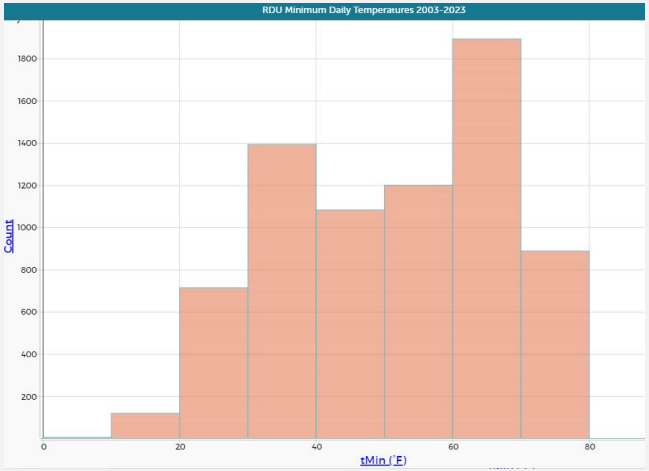
Backup CODAP Document

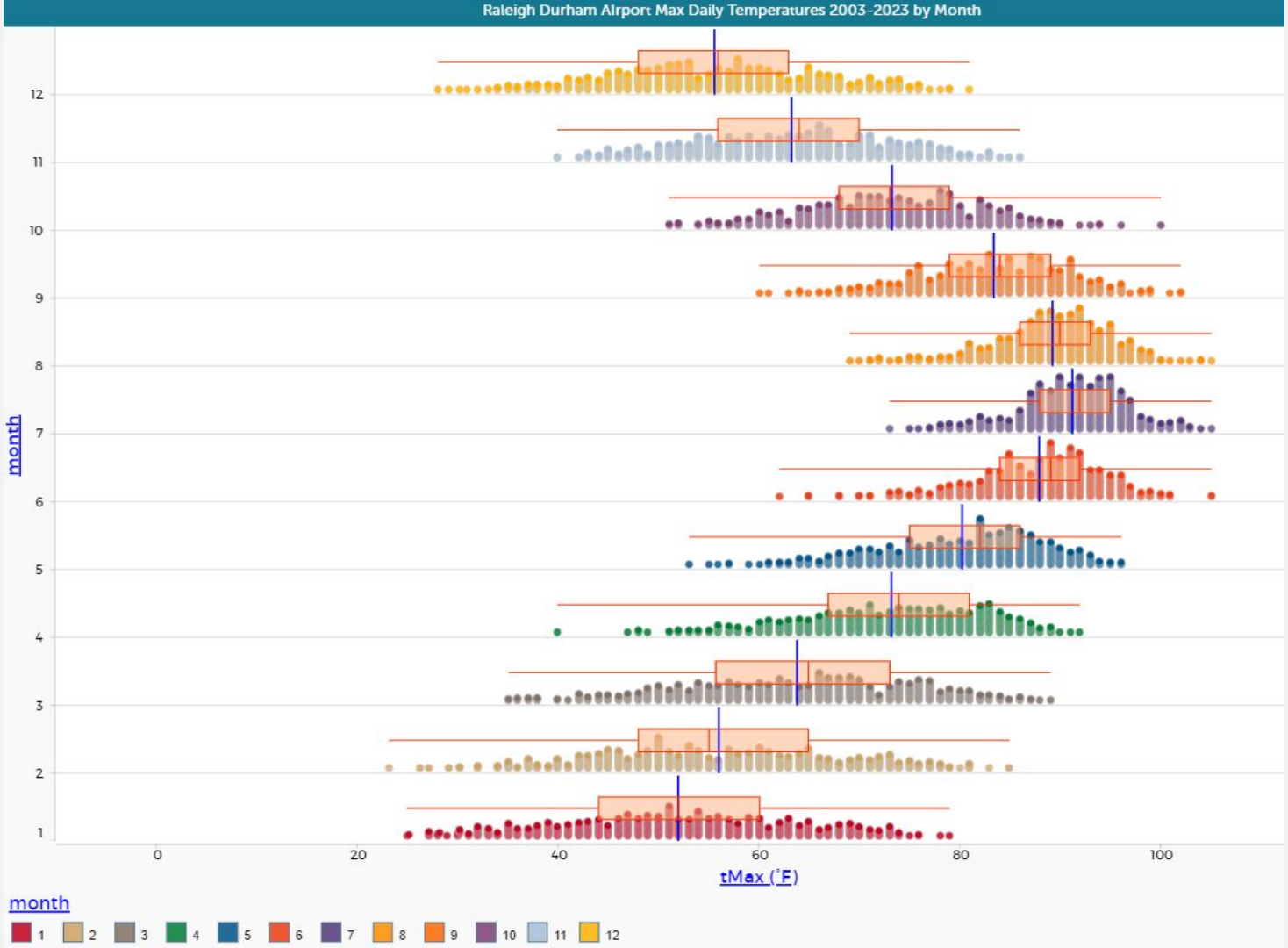
Used the Plugin NOAA Weather to collect 20 years of daily measurements from RDU weather station

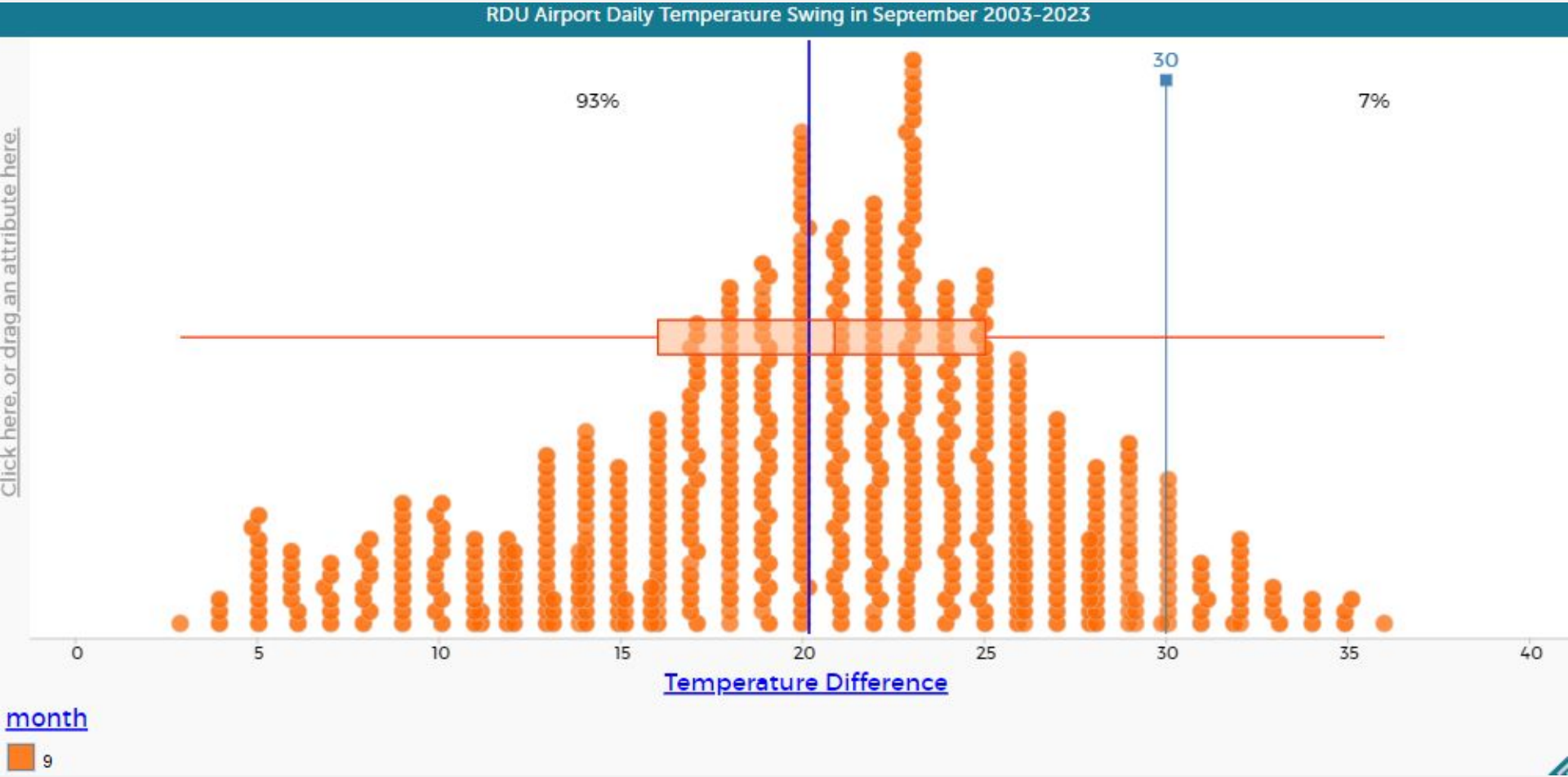



RDU Minimum Daily Temperatures 2003-2023
tMin: 4.1
when: 1/6/2018, 7:00 PM
0
10
20
30
40
50
60
70
80


RDU Minimum Daily Temperatures 2003-2023
0.082%
1.6%
9.8%
19%
15%
16%
26%
12%
0.014%
[0, 10)
[10, 20)
[20, 30)
[30, 40)
[40, 50)
[50, 60)
[60, 70)
[70, 80)
[80, 90)

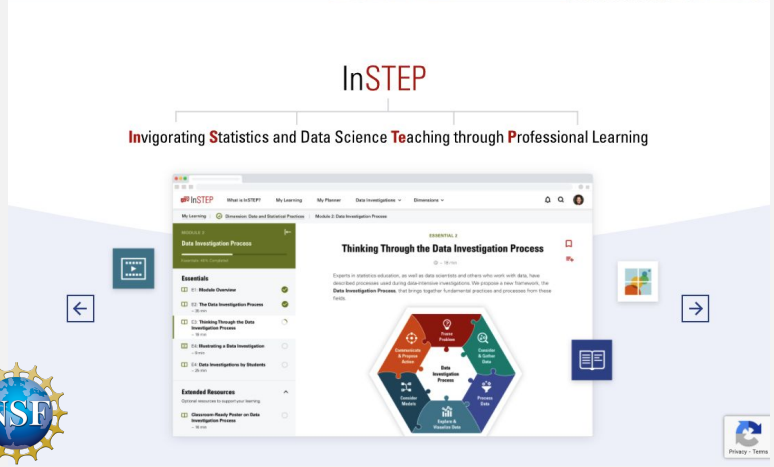

RDU Minimum Daily Temperatures 2003-2023
Count
1800
1600
1400
1200
1000
800
600
400
200
0
20
40
60
80
tMin (°F)


Raleigh Durham Airport Max Daily Temperatures 2003-2023 by Month
month
12
11
10
9
8
7
6
5
4
3
2
1
0
20
40
60
80
100
tMax (°F)
month
1
2
3
4
5
6
7
8
9
10
11
12


RDU Airport Daily Temperature Swing in September 2003-2023
30
93%
7%
Click here, or drag an attribute here.
0
5
10
15
20
25
30
35
40
Temperature Difference
month
9

Support for Teachers’ Professional Learning

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

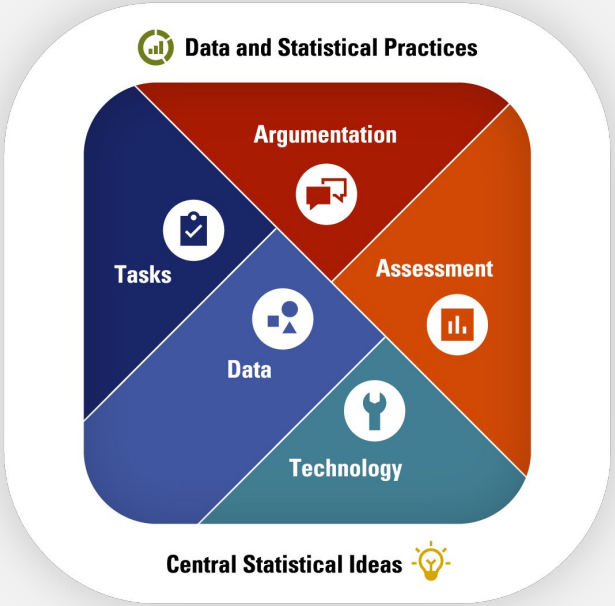


InSTEP

instepwithdata.org

FREE for All!

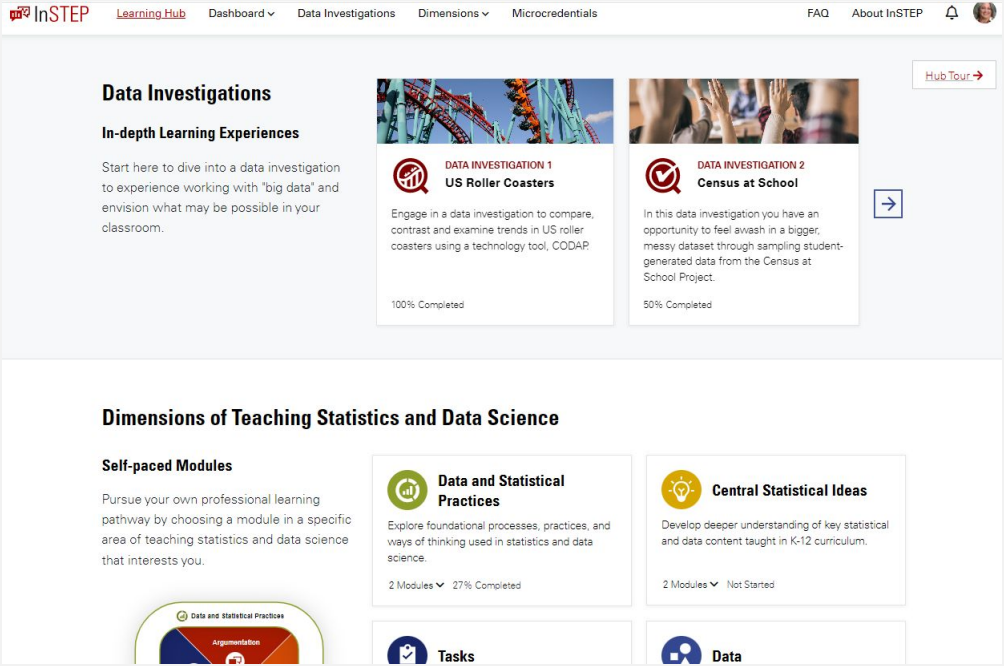
InSTEP is organized by anchoring professional learning in **Seven Dimensions of Teaching Statistics and Data Science** which describe important aspects that support teaching and learning environments for statistics and data science.



Effective Learning Environments for Statistics and Data Science

Two Primary Pathways: Data Investigations & Self-Paced Modules

Use Variety of Tech Tools, but primarily CODAP



Two Open Access Papers to Learn More About Data Investigations

Digging into Data: Illustrating a Data Investigation Process

2022

Statistics Teacher

statisticsteacher.org/2022/03/23/diggingdata/

Investigating Data like a Data Scientist: Key Practices and Processes

2022

Statistics Education Research Journal

iase-web.org/ojs/SERJ/article/view/41

Contact Information

Hollylynne S. Lee

hollylynne@ncsu.edu

fi.ncsu.edu/teams/hirise

Sample Research to Support Examples

Haldar, L. C., Wong, N., Heller, J. I., & Konold, C. (2018). Students making sense of multi-level data. *Technology Innovations in Statistics Education*, *11*(1). https://escholarship.org/content/qt7x28z96b/qt7x28z96b.pdf

Jiang, S., & Kahn, J. (2020). Data wrangling practices and collaborative interactions with aggregated data. *International Journal of Computer-Supported Collaborative Learning, 15*, 257–281. https://doi.org/10.1007/s11412-020-09327-1

Kahn, J. B., Peralta, L. M., Rubel, L. H., Lim, V. Y., Jiang, S., & Herbel-Eisenmann, B. (2022). Notice, wonder, feel, act, and reimagine as a path toward social justice in data science education. *Educational technology & society*, *25*(4), 80-92. https://www.jstor.org/stable/48695983

Konold, C., Finzer, W., & Kreetong, K. (2017). Modeling as a core component of structuring data. *Statistics Education Research Journal*, *16*(2), 191-212.

Konold, C., Higgins, T., Russell, S. J., & Khalil, K. (2015). Data seen through different lenses. *Educational Studies in Mathematics*, *88*(3), 305-325.

Lee, H. S., Kersaint, G., Harper, S. R., Driskell, S. O., Jones, D. L., Leatham, K. R., Angotti, R. L., & Adu-Gyamfi, K. (2014), Teachers' Use of Transnumeration in Solving Statistical Tasks With Dynamic Statistical Software, *Statistics Education Research Journal, 13*, 25–52. https://doi.org/10.52041/serj.v13i1.297

Lee, H. S., Mojica, G., Thrasher, E., & Baumgartner, P. (2022). Investigating data like a data scientist: Key practices and processes. *Statistics Education Research Journal, 21*(2), 3–3. iase-web.org/ojs/SERJ/article/view/41

Lee, V. R., Wilkerson, M. H., & Lanouette, K. (2021). A Call for a Humanistic Stance Toward K-12 Data Science Education. *Educational Researcher, 50*(9), 664-672.

Mojica, G. F., Barker, H., & Azmy, C. N. (2019). Instrumented learning in a CODAP-enabled learning environment. En J. M. Contreras, M. M. Gea, M. M. López-Martín y E. Molina-Portillo (Eds.), *Actas del Tercer Congreso Internacional Virtual de Educación Estadística*. Disponible en www.ugr.es/local/fqm126/civeest.html

Rubel, L. H., Nicol, C., & Chronaki, A. (2021). A critical mathematics perspective on reading data visualizations: reimagining through reformatting, reframing, and renarrating. *Educational Studies in Mathematics*, *108*(1-2), 249-268.

Shapiro, B. W., Meng, A., Rothschild, A., Gilliam, S., Garrett, C., DiSalvo, C., & DiSalvo, B. (2022). "Bettering Data": The Role of Everyday Language and Visualization in Critical Novice Data Work. *Educational Technology & Society*, *25*(4), 109-125. https://www.jstor.org/stable/48695985

Wilkerson, M. H., Lanouette, K.^, & Shareff, R. L. (2021). Exploring variability during data preparation: A way to connect data, chance, and context when working with complex public datasets. *Mathematical Thinking and Learning.* doi: 10.1080/10986065.2021.1922838