Solving Problems with Data: Tasks and Technology to Support Evidence-Based Decision-Making with Data

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NCTM Annual Meeting 2023

InSTEP

Invigorating Statistics and Data Science Teaching through Professional Learning

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Materials used in this presentation were funded by the National Science Foundation under Grant No. DRL 1908760 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.

Access links we will use today

https://bit.ly/NCTM2023DSStasks

NC STATE Friday Institute for Educational Innovation

Mathematics vs. Statistics

How is statistics different from mathematics?

Think: 1 minute

Pair: 2 minutes

Share!

Data Investigation Process

Holistic, Dynamic and Nonlinear

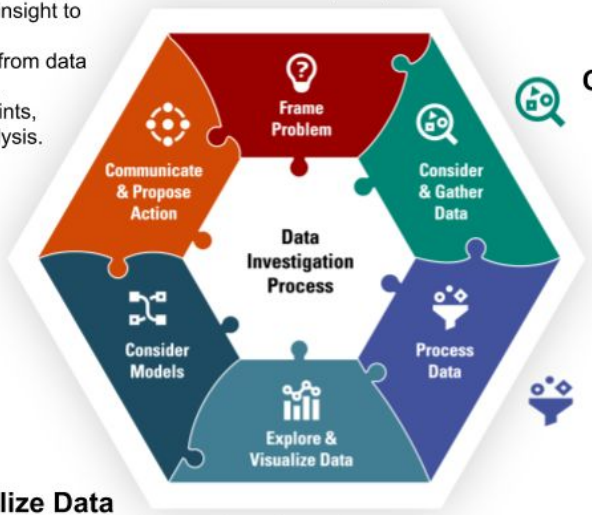
InSTEP

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

Teachers are designers

What makes a good task?

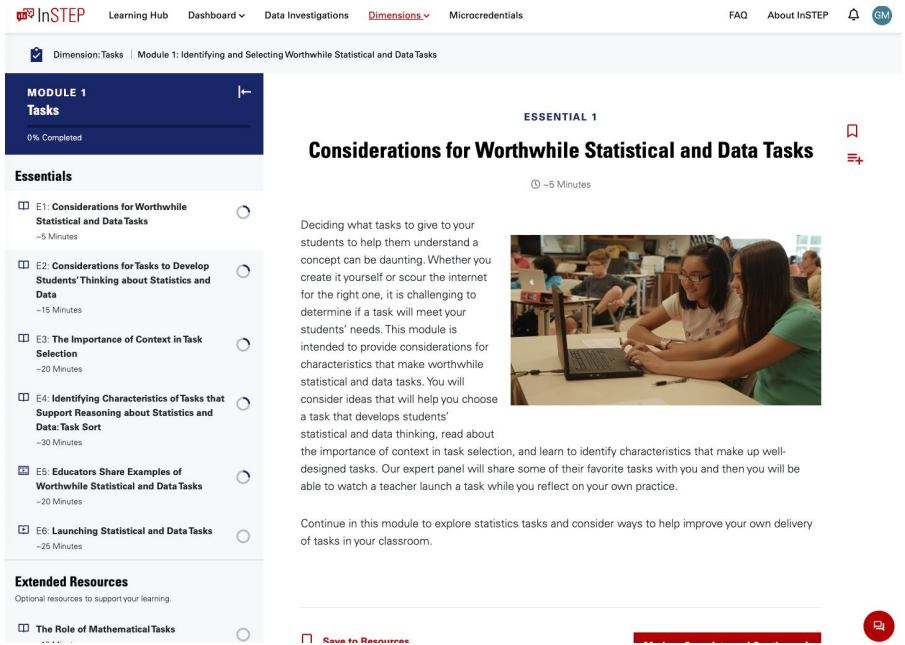
- ★ Low floor high ceiling tasks (Boaler, 2014)
- ★ Cognitively demanding tasks (Smith & Stein, 2011)

What makes a good *statistical/data* task?

Considerations for Tasks to Develop Students' Thinking about Statistics and Data

https://bit.ly/cdistframework

Identifying and Selecting Worthwhile Statistical and Data Tasks Module



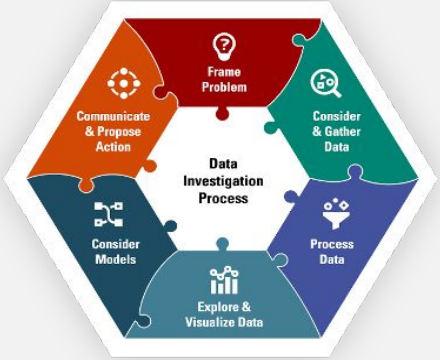
InSTEP

instepwithdata.org

FREE Professional Learning Platform to Build Teacher Expertise related to Data and Statistics in grades 6-12

Data Investigation: Popular Cereal

Framing the Problem



Let’s watch a commercial …

What are your reactions to what you just watched?
What message do you think they are trying to convey?
What did you notice?
Do you have any wonderings?

Did you know?

- In the late 1800s, cereal was created as a healthy alternative to the typical breakfast of the time (Cablevey, 2020).
- Starting in the 1950s, companies started adding sugar to their cereal.

- Introduction of the Nutrition Labeling and Education Act of 1990.
- Cereals started placing slogans such as “part of a complete breakfast” on their boxes to advertise the health of their cereals.

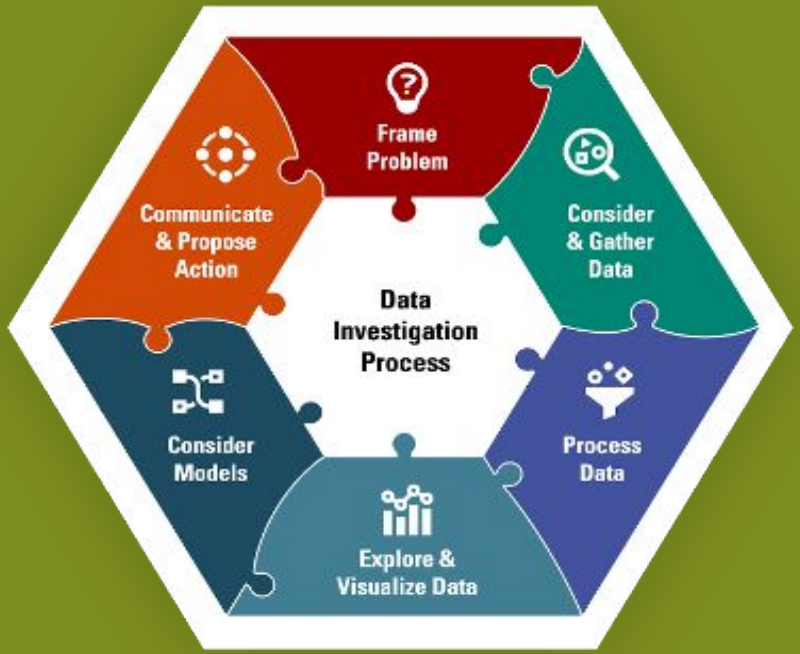
Examining the Context

You may be wondering what aspects make food healthy?

The following websites from the U.S. government provide information from experts on nutritional guidelines. These can help you narrow from a broader question or problem to a more specific investigative question. This can also inform your exploration, data analysis, modeling, interpretations, and recommendations later on in the investigation.

- General Health Guidelines
- Grains Guidelines
- Sugar Guidelines
- Fats Guidelines

How healthy are cereals?



Considering & Gathering Data

Examine some nutrition labels of common cereals. Do you consider these healthy cereals? Explain.

Lucky Charms

Nutrition Facts

About 8 servings per container
Serving size 1 cup (36g)

	Lucky Charms	with 1/2 cup skim milk
Calories	**140**	**190**
	% Daily Value*	% Daily Value*
Total Fat 1.5g	2%	2%
Saturated Fat 0g	0%	0%
Trans Fat 0g		
Polyunsaturated Fat 0.5g		
Monounsaturated Fat 0.5g		
Cholesterol 0mg	0%	1%
Sodium 230mg	10%	12%
Total Carbohydrate 30g	11%	13%
Dietary Fiber 2g	7%	8%
Total Sugars 12g		
Includes Added Sugars 12g	24%	24%
Protein 3g		
Vitamin D 2mcg	10%	10%
Calcium 130mg	10%	20%
Iron 3.6mg	20%	20%
Potassium 0mg	0%	6%
Vitamin A	10%	15%
Vitamin C	10%	10%
Thiamin	20%	20%
Riboflavin	10%	10%
Niacin	10%	10%
Vitamin B_6	20%	20%
Folate (45 mcg folic acid)	20%	20%
Vitamin B_{12}	20%	20%
Phosphorus	8%	15%
Magnesium	8%	10%
Zinc	20%	20%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Corn Chex

Nutrition Facts

About 8 servings per container
Serving size 1 1/4 cup (39g)

	Corn Chex	with 1/2 cup skim milk
Calories	**150**	**190**
	% Daily Value*	% Daily Value*
Total Fat 1g	1%	1%
Saturated Fat 0g	0%	0%
Trans Fat 0g		
Polyunsaturated Fat 0.5g		
Monounsaturated Fat 0g		
Cholesterol 0mg	0%	1%
Sodium 280mg	12%	14%
Total Carbohydrate 33g	12%	14%
Dietary Fiber 2g	7%	7%
Total Sugars 4g		
Includes Added Sugars 4g	7%	7%
Protein 3g		
Vitamin D 2mcg	10%	15%
Calcium 130mg	10%	20%
Iron 10.8mg	60%	60%
Potassium 0mg	0%	6%
Vitamin A	10%	15%
Vitamin C	10%	10%
Thiamin	20%	20%
Riboflavin	10%	25%
Niacin	10%	10%
Vitamin B_6	20%	20%
Folate (45 mcg folic acid)	20%	20%
Vitamin B_{12}	20%	40%
Phosphorus	4%	15%
Magnesium	4%	8%
Zinc	20%	20%

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Honey Nut Cheerios

Nutrition Facts

About 8 servings per container
Serving size 1 cup (37g)

	Honey Nut Cheerios	with 1/2 cup skim milk
Calories	**140**	**180**
	% Daily Value*	% Daily Value*
Total Fat 2g	3%	3%
Saturated Fat 0g	0%	3%
Trans Fat 0g		
Polyunsaturated Fat 0.5g		
Monounsaturated Fat 0.5g		
Cholesterol 0mg	0%	2%
Sodium 210mg	9%	11%
Total Carbohydrate 30g	11%	13%
Dietary Fiber 3g	10%	10%
Soluble Fiber <1g		
Total Sugars 12g		
Includes Added Sugars 12g	24%	22%
Protein 3g		
Vitamin D 2mcg	10%	15%
Calcium 130mg	10%	20%
Iron 3.6mg	20%	20%
Potassium 150mg	4%	8%
Vitamin A	10%	20%
Vitamin C	10%	10%
Thiamin	20%	25%
Riboflavin	10%	25%
Niacin	10%	10%
Vitamin B_6	20%	20%
Folate (45 mcg folic acid)	20%	20%
Vitamin B_{12}	20%	30%
Phosphorus	8%	15%
Magnesium	8%	10%
Zinc	20%	20%

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Coco Puffs

Nutrition Facts

About 15 servings per container
Serving size 1 cup (36g)

	Coco Puffs	with 1/2 cup skim milk
Calories	**140**	**180**
	% Daily Value*	% Daily Value*
Total Fat 2g	2%	3%
Saturated Fat 0g	0%	0%
Trans Fat 0g		
Polyunsaturated Fat 0.5g		
Monounsaturated Fat 1g		
Cholesterol 0mg	0%	1%
Sodium 130mg	6%	8%
Total Carbohydrate 31g	11%	13%
Dietary Fiber 2g	7%	7%
Total Sugars 12g		
Includes Added Sugars 12g	24%	24%
Protein 2g		
Vitamin D 2mcg	10%	15%
Calcium 130mg	10%	20%
Iron 3.6mg	20%	20%
Potassium 100mg	2%	6%
Vitamin A	10%	15%
Vitamin C	10%	10%
Thiamin	20%	20%
Riboflavin	10%	25%
Niacin	10%	10%
Vitamin B_6	20%	20%
Folate (45 mcg folic acid)	20%	20%
Vitamin B_{12}	20%	40%
Phosphorus	4%	15%
Magnesium	6%	8%
Zinc	20%	20%

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Trix

Nutrition Facts

About 12 servings per container
Serving size 1 1/4 cup (39g)

	Trix	with 1/2 cup skim milk
Calories	**160**	**200**
	% Daily Value*	% Daily Value*
Total Fat 2g	3%	3%
Saturated Fat 0g	0%	0%
Trans Fat 0g		
Polyunsaturated Fat 0.5g		
Monounsaturated Fat 1g		
Cholesterol 0mg	0%	1%
Sodium 180mg	8%	10%
Total Carbohydrate 33g	12%	14%
Dietary Fiber 1g	5%	5%
Total Sugars 12g		
Includes Added Sugars 12g	24%	24%
Protein 3g		
Vitamin D 2mcg	10%	15%
Calcium 130mg	10%	20%
Iron 3.6mg	20%	20%
Potassium 0mg	0%	6%
Vitamin A	10%	15%
Vitamin C	10%	10%
Thiamin	20%	20%
Riboflavin	10%	25%
Niacin	10%	10%
Vitamin B_6	20%	20%
Folate (45 mcg folic acid)	20%	20%
Vitamin B_{12}	20%	40%
Phosphorus	6%	15%
Magnesium	4%	8%
Zinc	20%	20%

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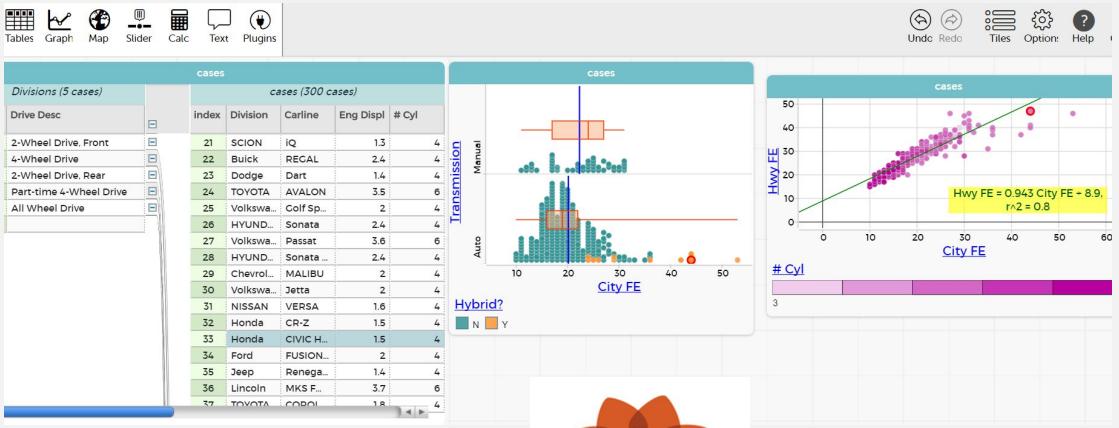
Examine Data in Our Favorite Data Tool: CODAP

Free
No login required
Easy to use
Under continual development



Works best in Chrome or FireFox
Optimal on computer or chromebook or large tablet
NOT optimal on iPads or phones

codap.concord.org

Explore and Visualize Data & Consider Data

Now that we have examined some cereal labels, we might want to continue to consider how healthy cereals are by exploring a dataset of 77 common cereals.

- This data was collected in 1993 during an American Statistical Association competition.
- It contains 15 attributes.

https://bit.ly/77Cereals

Consider and Gather Data

- Do I trust this data?
- How were these 77 cereals picked?
- Who collected this data?
- Do I understand the attributes?
- Do the measurements match their attributes?
- Do new cases need to be added to the data set?
- Are there any important attributes that are missing?
- Will this data help answer the investigative question?

DATA INVESTIGATION 3

Popular Cereals

Engage in a data investigation to examine trends in nutritional characteristics of over 250 popular cereals in a multivariate dataset using CODAP, a technology tool.

InSTEP Data Investigation 3
Popular Cereals

Popular Cereals Data

Data Origin:
All cereals and their nutritional information were scraped off the website of a randomly selected grocery story from a suburban town near Raleigh, NC in March 2021. We used other data sources to add some missing data. For example, to help fill some of the missing magnesium and selenium values, we used the website eatthismuch.com.

https://go.ncsu.edu/269cereals

Communicate and Propose Action

Let's examine some student work …

You will be provided with 3 samples of student work related to the Popular Cereals data investigation using CODAP.

- The ***questions*** learners focused on to motivate their work are different, where two focused on a bigger problem/issue and one focused on a more narrow statistical question.
- The amount of ***time*** that learners spent on their investigation also varied.
- The ***format*** in which learners share their work is very different with respect to the final product.

Do not attend to these differences in your discussion.

In small groups …

Compare and contrast the student work (Sample 1, Sample 2 & Sample 3). Here are some ideas to help focus your discussion:

- What do you think students understand about key statistics and data concepts? Justify.
- What phases of the Data Investigation Process did students engage with? Provide evidence from the student work to support your ideas.
  - How might this have supported or limited their work?
- How would you respond to each student or what feedback would you provide? Explain.

Other InSTEP Resources

- Popular Cereals Data Investigation
- Cereal Lesson Plan
- US Roller Coasters Data Investigation
- Data Investigation Process
- Data Investigation Process Poster
- Thinking Through the Data Investigation Process
- Considerations for Tasks to Develop Students' Thinking about Statistics and Data

Stay Connected

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