

Mind the Gap: An incomplete picture of statistics, statisticians, & statistics education

Matthew Beckman
Penn State University

June 25, 2023
Maleny, Australia

A complete picture of statistics, statisticians, & statistics education

Matthew Beckman
Penn State University

June 25, 2023
Maleny, Australia

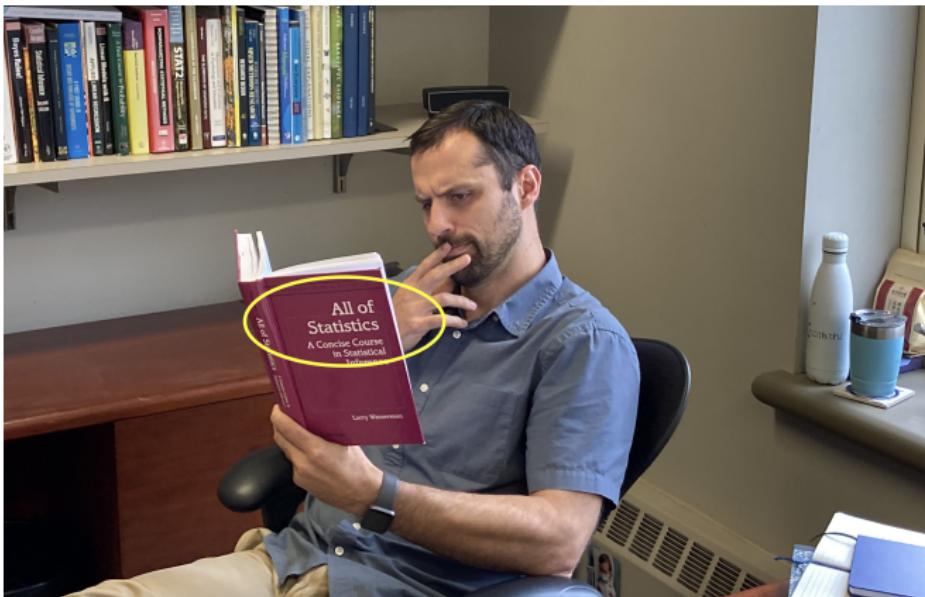


Figure 1: Getting ready to “Provide the perspective of the discipline...” as promised in the SRTL announcement.

- ... on “reconceptualising data and data-ing”

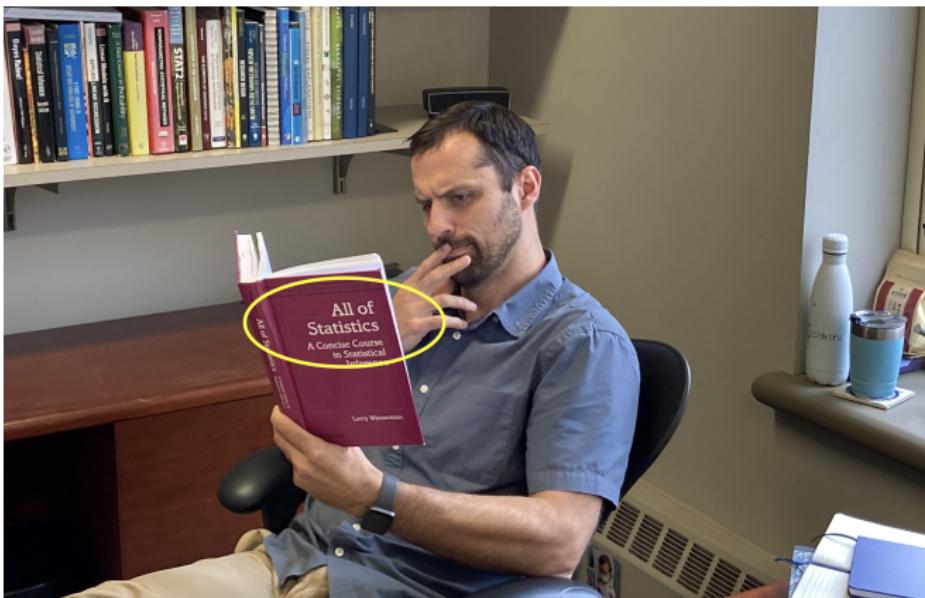


Figure 1: Getting ready to “Provide the perspective of the discipline...” as promised in the SRTL announcement.

- ... on “reconceptualising data and data-ing”
- “data-ing?”

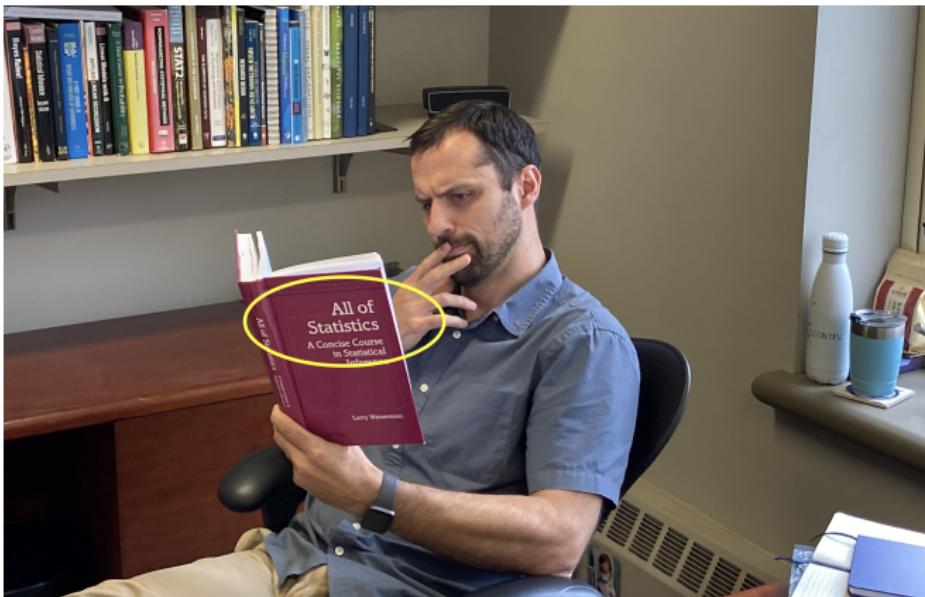


Figure 1: Getting ready to “Provide the perspective of the discipline...” as promised in the SRTL announcement.

- ...on “reconceptualising data and data-ing”
- “data-ing?”
- that wasn’t in the book...

Mind the Gap: An incomplete picture of statistics, statisticians, & statistics education

Matthew Beckman
Penn State University

June 25, 2023
Maleny, Australia

“Data...ing?”

- I'm usually not one to “verb” my nouns (then use as a gerund)

“Data...ing?”

- I'm usually not one to “verb” my nouns (then use as a gerund)
- [checks list of participants for “grammarian-in-residence”]

“Data...ing?”

- I'm usually not one to “verb” my nouns (then use as a gerund)
- [*checks list of participants for “grammarian-in-residence”*]
- but I've heard this kind of thing happens on Twitter

ADULTING

What Is the Meaning of Adulting?



- Gerund that stems from the use of the word adult as a verb.
- Means behaving maturely or acting like an adult.
- A lighthearted term used to highlight the mundane or comical activities being mature and responsible can bring about.

grammarist.com

Adulting is a fairly new gerund that stems from the use of the word adult as a verb. A gerund is a verb form ending in -ing that acts as a noun. *Adulting* simply means behaving maturely or acting like an adult.

Figure 2: image credit: Grammarist. URL:
<https://grammarist.com/new-words/adulting/>

But “Data” as a verb?

- I've heard of *data verbs*, just not “data” as a verb

But “Data” as a verb?

- I've heard of *data verbs*, just not “data” as a verb
- Amelia McNamara helpfully pointed out (to my surprise) this too has precedent!

But “Data” as a verb?

- I've heard of *data verbs*, just not “data” as a verb
- Amelia McNamara helpfully pointed out (to my surprise) this too has precedent!
- Who would do such a thing?

Jer Thorp



Roman Makhmutov

Jer Thorp is an artist, a writer, and a teacher. He was the first data artist in residence at *The New York Times*, is a *National Geographic Explorer*, and served as the innovator in residence at the Library of Congress in 2017 and 2018. He lives under the Manhattan Bridge with his family and his awesome dog, Trapper John, MD. *Living in Data* is his first book. You can sign up for email updates [here](#).

Coming around. . .

- “the pair data and data-ing refers to a similar conceptualization of the relation between sample and sampling, or model and modeling, where the first is the statistical concept and the second refers to the process of engaging or reasoning with this concept.”

Coming around. . .

- “the pair data and data-ing refers to a similar conceptualization of the relation between sample and sampling, or model and modeling, where the first is the statistical concept and the second refers to the process of engaging or reasoning with this concept.”
- *This* resonates with me. . .

Coming around. . .

- “the pair data and data-ing refers to a similar conceptualization of the relation between sample and sampling, or model and modeling, where the first is the statistical concept and the second refers to the process of engaging or reasoning with this concept.”
- *This* resonates with me. . .
- and it's starting to sound like something I've observed before

What perspective can I offer?

The birth of an academic



Figure 4: (Academic) offspring of Joan Garfield & Bob delMas

- if any of you know me, it's probably thanks to my parents PhD advisors Joan Garfield & Bob delMas

The birth of an academic



Figure 4: (Academic) offspring of Joan Garfield & Bob delMas

- if any of you know me, it's probably thanks to my parents PhD advisors Joan Garfield & Bob delMas
- there's plenty more to my upbringing before I ever got involved with Statistics Education, including lots that has almost nothing to do with academia!

Rebellious phase

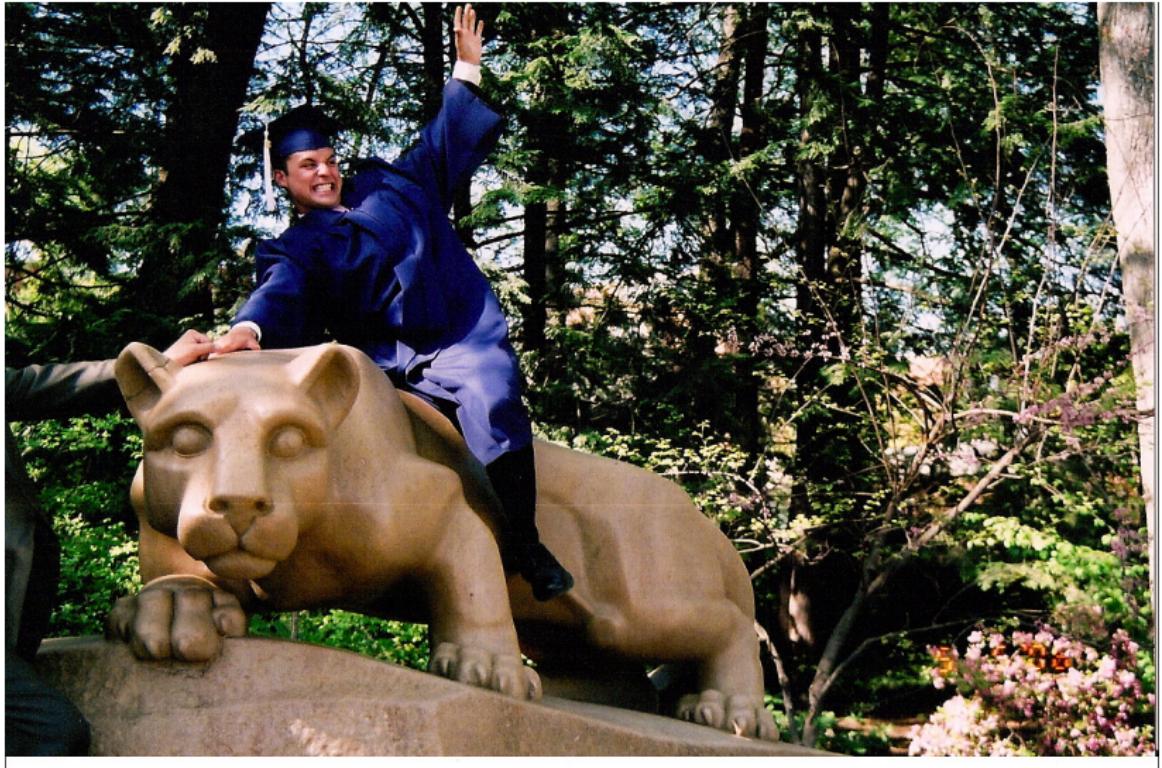


Figure 5: Who knows...

Social life



Figure 6: Sneaking onto the football field with a friend.

My actual Mum & Dad



Figure 7: Marian & Don Beckman

Got an education. . .



Getting more serious. . .

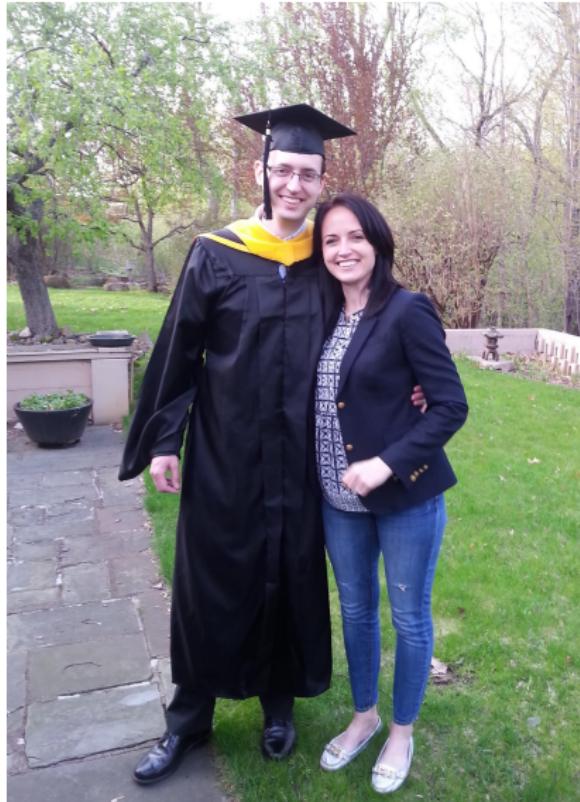


Figure 8: Met my wife in Minnesota and began a career in statistics.

Where the magic happens. . .

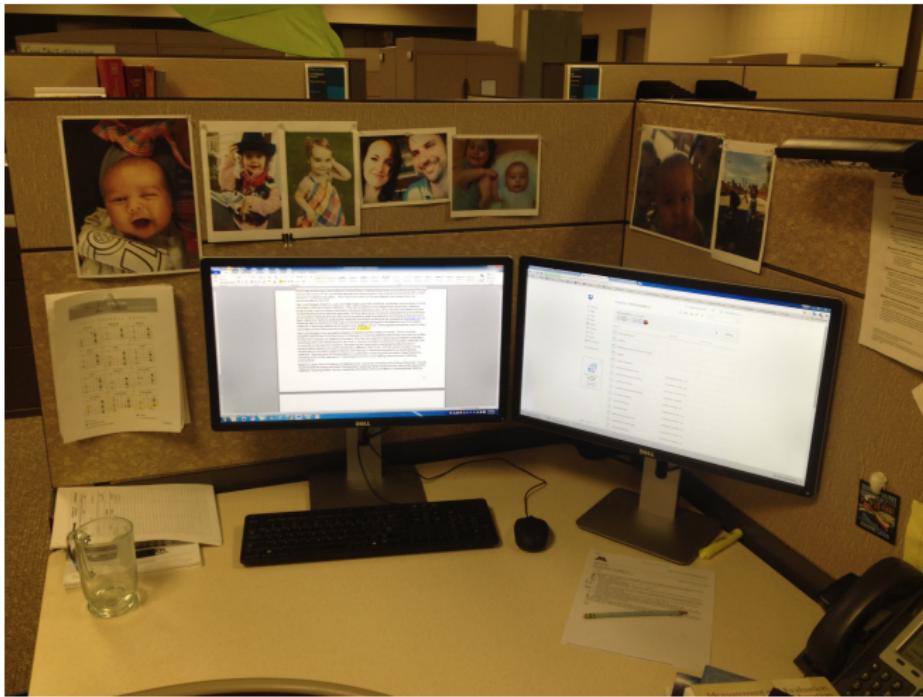


Figure 9: Working late. . .

Ecolab, Inc.



Figure 10: Image credit: Patrick Kennedy, Star Tribune²

- Started out at Ecolab working in R&D (+ Eng)
- Interned with a small team of staff statistical consultants
- Typical Data: Lots of design & analysis of experiments
- Assist teaching in-house statistics courses for Engineers, Mgmt, scientists, etc (Intro, DOE, MSA, SPC, RDSA)

²Kennedy, P., (6 Feb 2023). Ecolab now selling products at Home Depot — the first time available at retail stores. Star Tribune. URL:

[https://www.startribune.com/ecolab-now-selling-products-at-home-depot-the-](https://www.startribune.com/ecolab-now-selling-products-at-home-depot-the/)

8 yrs in Medical Technology



Figure 11: image credit:

<https://asiapac.medtronic.com/xp-en/about.html>

- Hired due to commitment to government regulators!
- Typical data: verbatim complaints from call center, manufacturing lines, clinical, sales & registration data, engineering diagnostics from in-house returned product analysis, lots more!
- Promoted to Senior Statistician; broader involvement including Quality, Manufacturing, R&D, Marketing, HR/Personnel, Six Sigma
- Regularly tasked with discussing/explaining statistical methodology and procedures to government regulators (e.g., post-market surveillance)

Nonin Medical. Inc



Figure 12: image credit: Michael Heisson³

- Senior Biostatistician (“only” statistician...)
- Internal & external collaborations (e.g., anesthesiology research, clinical trial design, etc)

³Lee, E., (4 Oct 2022). The Best Pulse Oximeter for Home Use. New York Times Wirecutter. URL: <https://www.nytimes.com/wirecutter/reviews/best-pulse-oximeter-for-home-use/>

Back to Medtronic!?

- Back to Medtronic for a lame duck session
- Goals: clean up special projects, train new statisticians (& business analysts) and help automate my own job away (!)
- Next Stop: Penn State!
- When I was a few years younger, people gave me puzzled looks when I described my background...

Back to Medtronic!?

- Back to Medtronic for a lame duck session
- Goals: clean up special projects, train new statisticians (& business analysts) and help automate my own job away (!)
- Next Stop: Penn State!
- When I was a few years younger, people gave me puzzled looks when I described my background. . .
- You know that look when someone is calculating your age while you talk with them?

Back to Medtronic!?

- Back to Medtronic for a lame duck session
- Goals: clean up special projects, train new statisticians (& business analysts) and help automate my own job away (!)
- Next Stop: Penn State!
- When I was a few years younger, people gave me puzzled looks when I described my background...
- You know that look when someone is calculating your age while you talk with them?
- *college grad at 21 yrs + 2 yrs (MS Statistics) + 8 yrs industry + 5 yrs (PhD) + yrs as Penn State faculty...*

Back to Medtronic!?

- Back to Medtronic for a lame duck session
- Goals: clean up special projects, train new statisticians (& business analysts) and help automate my own job away (!)
- Next Stop: Penn State!
- When I was a few years younger, people gave me puzzled looks when I described my background...
- You know that look when someone is calculating your age while you talk with them?
- *college grad at 21 yrs + 2 yrs (MS Statistics) + 8 yrs industry + 5 yrs (PhD) + yrs as Penn State faculty...*
- *hmm... he doesn't look old enough for all that*

Back to Medtronic!?

- Back to Medtronic for a lame duck session
- Goals: clean up special projects, train new statisticians (& business analysts) and help automate my own job away (!)
- Next Stop: Penn State!
- When I was a few years younger, people gave me puzzled looks when I described my background...
- You know that look when someone is calculating your age while you talk with them?
- *college grad at 21 yrs + 2 yrs (MS Statistics) + 8 yrs industry + 5 yrs (PhD) + yrs as Penn State faculty...*
- *hmm... he doesn't look old enough for all that*
- *... but I don't think he's a boy-genius that finished college at 16 either*

Back to Medtronic!?

- Back to Medtronic for a lame duck session
- Goals: clean up special projects, train new statisticians (& business analysts) and help automate my own job away (!)
- Next Stop: Penn State!
- When I was a few years younger, people gave me puzzled looks when I described my background...
- You know that look when someone is calculating your age while you talk with them?
- *college grad at 21 yrs + 2 yrs (MS Statistics) + 8 yrs industry + 5 yrs (PhD) + yrs as Penn State faculty...*
- *hmm... he doesn't look old enough for all that*
- *... but I don't think he's a boy-genius that finished college at 16 either*
- Life hack: I earned my PhD *while* working full-time

Personal reflections from industry

- I began to notice gaps between my expectations/assumptions for my contributions at work and the reality of my experiences on the job...
- *Expectation:* UMN Statistics Dept filled my toolbox with advanced methods & fancy models... that's what they'll expect me to do at work.
- *Mind the gap:* At work, I generally used 10-20% of the fancy things I learned in those courses

Personal reflections from industry

- I began to notice gaps between my expectations/assumptions for my contributions at work and the reality of my experiences on the job...
- *Expectation:* UMN Statistics Dept filled my toolbox with advanced methods & fancy models... that's what they'll expect me to do at work.
- *Mind the gap:* At work, I generally used 10-20% of the fancy things I learned in those courses
- Lots of the fancy methods that I needed at work, I *learned* at work. This is a common refrain among professional statisticians.

Personal reflections from industry

- *Mind the gap:* The statisticians on my team were regularly requested to engage with myriad issues that were **not at all statistical** in nature.

Personal reflections from industry

- *Mind the gap:* The statisticians on my team were regularly requested to engage with myriad issues that were **not at all statistical** in nature.
- **Bad** reason this gap might emerge: management may not understand how statisticians best contribute to the organization⁴

⁴Deming, W. E. (2000). *Out of the Crisis*. MIT Press.

Personal reflections from industry

- *Mind the gap:* The statisticians on my team were regularly requested to engage with myriad issues that were **not at all statistical** in nature.
- **Bad** reason this gap might emerge: management may not understand how statisticians best contribute to the organization⁴
- **Good** reason this gap might emerge: (coming up later...)

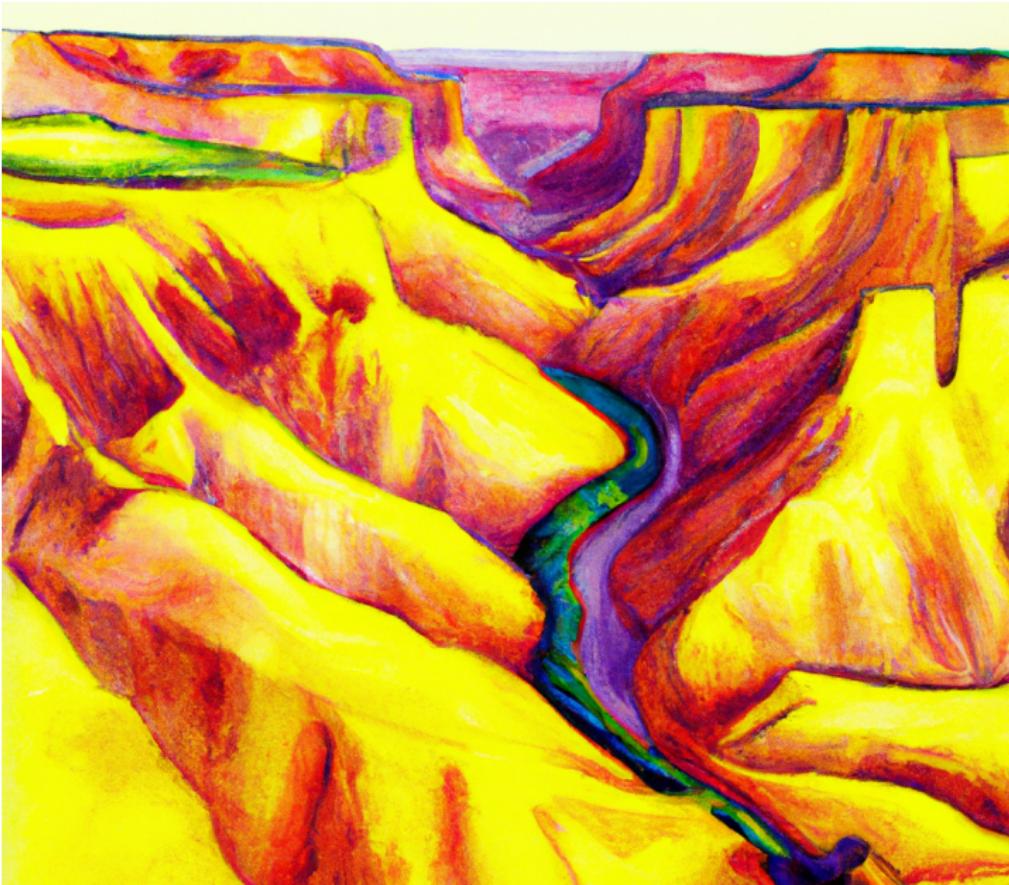
⁴Deming, W. E. (2000). *Out of the Crisis*. MIT Press.

Mind the Gap: An incomplete picture of statistics, statisticians, & statistics education

Matthew Beckman
Penn State University

June 25, 2023
Maleny, Australia

Mind the gap



Mind the gap



Figure 14: image created with assistance of DALL·E 2 by Open AI

- Role of statisticians at work
- Public perception of Statistics
- Student perception of EDA
- Opportunities for research

Mind the gap: In the public

statistics vs Statistics

Mind the gap: EDA

Perceived value vs potential contribution of EDA⁵

⁵Exploratory Data Analysis

Mind the gap: EDA

- My solution?

Mind the gap: EDA

- My solution?
- my students need a framework for a careful EDA

Mind the gap: EDA

- My solution?
- my students need a framework for a careful EDA
- with an acronym to help remember it

EDA Framework (1st attempt)

Get in “B-E-D” with your data

- Become acquainted with the data

EDA Framework (1st attempt)

Get in “B-E-D” with your data

- **B**ecome acquainted with the data
- **E**xplore intuition for your research question(s)

EDA Framework (1st attempt)

Get in “B-E-D” with your data

- **B**ecome acquainted with the data
- **E**xplore intuition for your research question(s)
- **D**iscover features in the data that impact modeling decisions

EDA Framework (2nd attempt)

... not a great acronym

Let's just reuse "EDA" instead

- **Examine the data source(s):** data provenance, variable types, coding, missingness, summary statistics/plots;

EDA Framework (2nd attempt)

... not a great acronym

Let's just reuse "EDA" instead

- **Examine the data source(s):** data provenance, variable types, coding, missingness, summary statistics/plots;
- **Discover features that influence modeling decisions:** investigate potential outliers, consideration for recoding variables (e.g., numeric data that's functionally dichotomous), evaluate correlation structure (e.g., autocorrelation, hierarchy, spatial/temporal proximity);

EDA Framework (2nd attempt)

... not a great acronym

Let's just reuse "EDA" instead

- **Examine the data source(s):** data provenance, variable types, coding, missingness, summary statistics/plots;
- **Discover features that influence modeling decisions:** investigate potential outliers, consideration for recoding variables (e.g., numeric data that's functionally dichotomous), evaluate correlation structure (e.g., autocorrelation, hierarchy, spatial/temporal proximity);
- **Address research questions:** build intuition and note preliminary observations/conclusions related to each research question. Also, note observations that prompt you to refine your research questions or add new questions to investigate

EDA Framework (2nd attempt)

... not a great acronym

Let's just reuse "EDA" instead

- **Examine the data source(s):** data provenance, variable types, coding, missingness, summary statistics/plots;
- **Discover features that influence modeling decisions:** investigate potential outliers, consideration for recoding variables (e.g., numeric data that's functionally dichotomous), evaluate correlation structure (e.g., autocorrelation, hierarchy, spatial/temporal proximity);
- **Address research questions:** build intuition and note preliminary observations/conclusions related to each research question. Also, note observations that prompt you to refine your research questions or add new questions to investigate
- p.s. Lonneke's work included a concise summary of literature that I think improves upon the "E" step!

Mind the gap: Opportunity for research?

Mind the gap: Statistical Thinking

International Statistical Review (1999), 67, 3, 223–265, Printed in Mexico
© International Statistical Institute

Statistical Thinking in Empirical Enquiry

C.J. Wild and M. Pfannkuch

Department of Statistics, University of Auckland, Private Bag 92019, Auckland, New Zealand

This paper had its genesis in a clash of cultures. Chris Wild is a statistician. Like many other statisticians, he has made impassioned pleas for a wider view of statistics in which students learn “to think statistically” (Wild, 1994). Maxine Pfannkuch is a mathematics educator whose primary research interests are now in statistics education. Conception occurred when Maxine asked “What *is* statistical thinking?” It is not a question a statistician would ask. Statistical thinking is the touchstone at the core of the statistician’s art. But, after a few vague generalities, Chris was reduced to stuttering.

Figure 15: Opening vignette from one of my all-time favorite papers.⁶

⁶Wild, C. J., Pfannkuch, M. (1999). Statistical thinking in empirical enquiry. *International Statistical Review*, 67(3), pp 223-265.

Thinking Statistically

- Recall: *Mind the gap*: Statisticians like me were regularly requested to engage with myriad issues at Medtronic that were **not at all statistical** in nature...

Thinking Statistically

- Recall: *Mind the gap*: Statisticians like me were regularly requested to engage with myriad issues at Medtronic that were **not at all statistical** in nature...
- *Bad reason*: management unclear what contribution statisticians offer to the organization

Thinking Statistically

- Recall: *Mind the gap*: Statisticians like me were regularly requested to engage with myriad issues at Medtronic that were **not at all statistical** in nature...
- *Bad reason*: management unclear what contribution statisticians offer to the organization
- **Good reason**: perhaps my colleagues recognized that *statistical thinking transfers*

Thinking Statistically

- Recall: *Mind the gap*: Statisticians like me were regularly requested to engage with myriad issues at Medtronic that were **not at all statistical** in nature...
- *Bad reason*: management unclear what contribution statisticians offer to the organization
- **Good reason**: perhaps my colleagues recognized that *statistical thinking transfers*
- Disciplined approach to problem solving & critical thinking

Thinking Statistically

- Recall: *Mind the gap*: Statisticians like me were regularly requested to engage with myriad issues at Medtronic that were **not at all statistical** in nature...
- *Bad reason*: management unclear what contribution statisticians offer to the organization
- **Good reason**: perhaps my colleagues recognized that *statistical thinking transfers*
- Disciplined approach to problem solving & critical thinking
- Due consideration for uncertainty, alternate explanations, and practical implications

Mind the gap: Data & Data-ing

"the pair data and data-ing refers to a similar conceptualization of the relation between sample and sampling, or model and modeling, where the first is the statistical concept and the second refers to the process of engaging or reasoning with this concept."

- So, why verb the noun??

Mind the gap: Data & Data-ing

"the pair data and data-ing refers to a similar conceptualization of the relation between sample and sampling, or model and modeling, where the first is the statistical concept and the second refers to the process of engaging or reasoning with this concept."

- So, why verb the noun??
- Maybe because a verb for the action we're describing *doesn't exist!*

What *IS* data-ing?

- Something new to be explored?

What *IS* data-ing?

- Something new to be explored?
- Something familiar by another name?

What *IS* data-ing?

- Something new to be explored?
- Something familiar by another name?
- Is my framework for EDA better described as data-ing?

What *IS* data-ing?

- Something new to be explored?
- Something familiar by another name?
- Is my framework for EDA better described as data-ing?
- Is data-ing a superset of all ways one might act upon data??

What actions might data-ing include?

- data collection (Yannik & Susanne)
- variable creation/recognition (Amelia & Sibel)
- modeling and interpretation of data (Lucia)
- data cleaning (Many SRTL-ers)

How else might we “engage with data”

- Andee & Michal probe evaluation of which data **needed** to achieve the scientific purposes?
- Carl & Kym evoke notions about data and empowering students to uncover rich (multivariate) stories
- Alyssa seeks to examine the interface between computational thinking and data-ing

How else might we “engage with data”

- Andee & Michal probe evaluation of which data **needed** to achieve the scientific purposes?
- Proxy variables when we encounter a gap in the available (or accessible) data to achieve the scientific purpose of our analysis—really important part of “data-ing” as an applied statistician, but these are motivated by the scientific domain
- Carl & Kym evoke notions about data and empowering students to uncover rich (multivariate) stories
- Alyssa seeks to examine the interface between computational thinking and data-ing

How well-defined is “data”

- Jill & Lonneke discuss consuming and evaluating evidence—and implications of data-ing when engaged with forms of evidence more broadly conceived than has been typical for classical data analysis
- Is “messy” data well-defined?
 - any deviation from tidy data⁷?
 - Amelia & Kym discuss intuition of data cards
- Ronit remarked on “big data” and “big data-ing”
 - is this different?
 - how?

⁷Wickham, H. (2014). Tidy data. *Journal of Statistical Software*, 59(10). DOI: 10.18637/jss.v059.i10

RESTAURANT FORUM

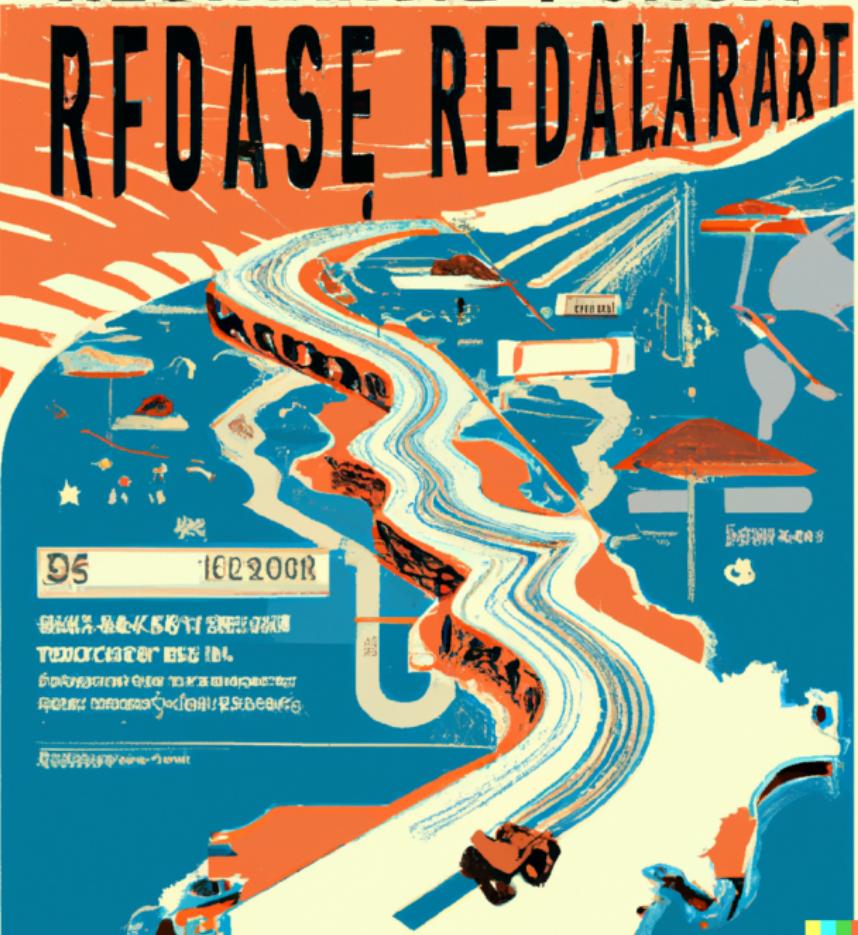
RFDASE REDALARART

DS

1002008

Restauranterne
Tilskud til restauranterne
Rabatter til restauranterne
Mere om restauranterne

Restauranterne



Mind the Gap: An incomplete picture of statistics, statisticians, & statistics education

Matthew Beckman
Penn State University

June 25, 2023
Maleny, Australia