Rigor in Data Science

Dr. Rachel Levy (Ray)
Executive Director, Data Science Academy
Professor of Mathematics
NC State University
A little about my career trajectory and “why”


Why? To grow educational environments that empower learners and benefit society.
NC State Data Science Academy

At NC State, an academy identifies a true university-wide effort involving all 10 colleges. It encompasses multiple departments, centers and institutes and addresses all three pillars of the university’s land-grant mission: education, research and service to the state of North Carolina.
ABOUT

First NC State Academy
Launched July 2021

Mission: The DSA empowers people to use data ethically, effectively and accessibly.

Vision: The DSA connects people with ideas to make data and technology work for everyone.

Goal: Operationalize the idea that Data Science is for EVERYONE!
ABOUT - The DSA Offers

- COURSES (DSC)
- INTERNSHIPS
- SEED GRANTS
- PROGRAMS
- COLLABORATIVE CONSULTING
- K-12 OUTREACH
The DSA offers 1-credit hour, project-based courses at three levels ensuring we reach all interested learners.

ADAPT course levels
All-campus Data science Accessible Project-based Teaching and learning

Researchers Required
Students are invited to use their own research data to complete course activities. Courses may focus on "hot topics" for academic, industry, non-profit or community-based research.

Suggested Skills
Course descriptions include suggested skills and/or topical knowledge. Suggested skills can be acquired by coursework, self-directed study, work or other experiences.

No Prerequisites
Courses do not require any previous data science knowledge or skills.

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<thead>
<tr>
<th>Level</th>
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<tbody>
<tr>
<td>1</td>
<td>DSC 200</td>
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<td>2</td>
<td>DSC 400</td>
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<td>3</td>
<td>DSC 500</td>
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ADAPT Model Share Fair!

Virtual, free and open to the public.

- Date: May 1, 2024
- Time: 12pm to 3:30pm
- Registration Link available [here](https://datascienceacademy.ncsu.edu/courses/course-model/ds-edu-share-fair/)
Rigor
What comes to mind when you think of rigor in your work and life?
Contexts for Rigor

Etymology
Disciplinary views
Mathematics
Mathematics Education
Data Science
Etymology of the word Rigor
Definitions from Oxford Languages · Learn more

**rig·or**

/ˈrɪɡər/

**Origin**

LATIN    LATIN

rigere → rigor → rigor
be stiff    late Middle English

stiffness

late Middle English: from Latin, literally ‘stiffness’, from *rigere* ‘be stiff’.
**ríg·or**

/ ríːɡər/

**noun**

noun: **rígør**; noun: **rigóur**

the quality of being extremely thorough, **exhaustive**, or accurate.

"his analysis is lacking in rigor"

- severity or **strictness**.
  "the full rigor of the law"

- demanding, difficult, or extreme conditions.
  plural noun: **rigors**; plural noun: **rigours**
  "the rigors of a harsh winter"

**Origin**

LATIN  OLD FRENCH  

rigor  rigour  rigur  late Middle English

stiffness

late Middle English: from Old French **rigour** from Latin **rigor** 'stiffness'.
Rigor Definition & Meaning
8 days ago — The meaning of RIGOR is harsh inflexibility in opinion, temper, or judgment: severity. How to use rigor in a sentence.

Meaning of rigor in English - Cambridge Dictionary
rigor noun [U] (CARE). formal approving. the quality of being detailed, careful, and complete: Her arguments lacked intellectual rigor.

Rigor - Definition, Meaning & Synonyms
Rigor means thoroughness and exhaustiveness — the gold standard for a good teacher. You may have heard of "rigor mortis" — which is a medical term describing ...
Use of the word rigor (not rigorous)
The Google Books Ngram Viewer graph shows the usage of the term "rigor" from 1800 to 2019. The term gained popularity around the mid-1800s, dropped significantly in the early 1900s, and has seen a resurgence since then.
What constitutes rigorous writing?
What constitutes rigorous science?
“Harris makes a strong case that the biomedical research culture is seriously in need of repair.”
—Nature

RIGOR MORTIS

How SLOPPY SCIENCE Creates WORTHLESS CURES, CRUSHES HOPE, and WASTES BILLIONS

RICHARD HARRIS
NPR Science Correspondent
What Constitutes Rigor in Mathematics?
What Constitutes Rigor in Applied Mathematics?
Are there parallels between rigor in pure and applied mathematics?

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What Constitutes Rigor in Mathematics Education?
Rigor in Algebra I, II, Precalc, Calc, Diffeq

Ability to explain a concept from multiple perspectives:

- Symbols (such as functions)
- Graphs (other representations)
- Language (formal and informal)
- Relationships (between ideas or variables)
- Connections (with other concepts and applications)

Would you know a ________________ if you met it “on the street?”
Rigor means more than correct.

(Guesses can be correct and determined through faulty logic or none at all.)
Can something be rigorous and easy?

I think about all of the Geometry Proofs in grade school...

They seemed obvious... but they were probably also rigorous.
What Constitutes Rigor in Data Science (Education)?
What are hard parts of data science?

- Explainability
- Uncertainty quantification
- Bias identification
- Complexity
- Transparency
- Policy
Rigor AND Relevance

Ties into the “why”:

Why? To grow educational environments that empower learners and benefit society.

How?
Three components of the ADAPT model

Project-based Learning | 10 Common Learning Elements | Identity-conscious Choices
Kristin: Going back to my work experience ...

- Have we scoped this thoughtfully?
- Have we been really careful about data preparation?
- What data prerequisites are there for this to even work?
- What are all the ethical considerations?
- Who are all the stakeholders
- How are we going to explain this all?
- What is the value of what we’re trying to do here?
- What are the limitations of how results are going to be used?
- How might results be used in a different way than we intended?
Predictive Analytics for Improving Services

Milestone 1: Code of Ethics

Milestone 2: Data Summary

Milestone 3: Data Preparation

Milestone 4: Learner Specification

Milestone 5: Training and Validation

Milestone 6: Testing

Milestone 7: Communication Plan

What is the workflow of predictive analytic projects?
ADAPT
10 Common Learning Elements

Data Perspectives
Data Practices
Data Discoveries
10 Common Learning Elements

Data Perspectives

1. Recognizing **data as information - not truth** - with error, variability, and degrees of inclusion/exclusion.

2. Explaining **what it means to be a data scientist** and data-enabled

3. Observing a **diverse** collection of data scientist **role models and careers**.
10 Common Learning Elements

Data Practices

4. Examining **how data are created**, and the related assumptions and collection practices.

5. Practicing during **curation, wrangling, and cleaning**.

6. Assessing **validity of data, methods, results and communication**.

7. Employing **accessibility practices**.

8. Investigating **ethical issues** and ways to approach them.
Data Discoveries

9. Articulating **current issues or open questions** in data science, and

10. Specifying **exciting discoveries or impacts** of data science.
Key Ideas

Definitions and enactment of rigor differ by discipline.

In some mathematical disciplines rigor focuses exactness, thoroughness and correctness.

In data science and applied mathematical sciences, it focuses on transparency, explainability, reducing error and bounding uncertainty.
THANK YOU!
STAY CONNECTED

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