Important Issues in Responsible Data Science

AU Winter Institute in Data Science

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Introduction

Privacy, security, and ethics all fall within the realm of **Responsible Data Science.**

We will discuss Responsible Data Science through four topics:

- **I. Legal, Professional, and Ethical Considerations**
- **II. Ethical Frameworks**
- **III. Identifying Ethical Issues**
- **IV. What Can You Do? What Should You Do?**

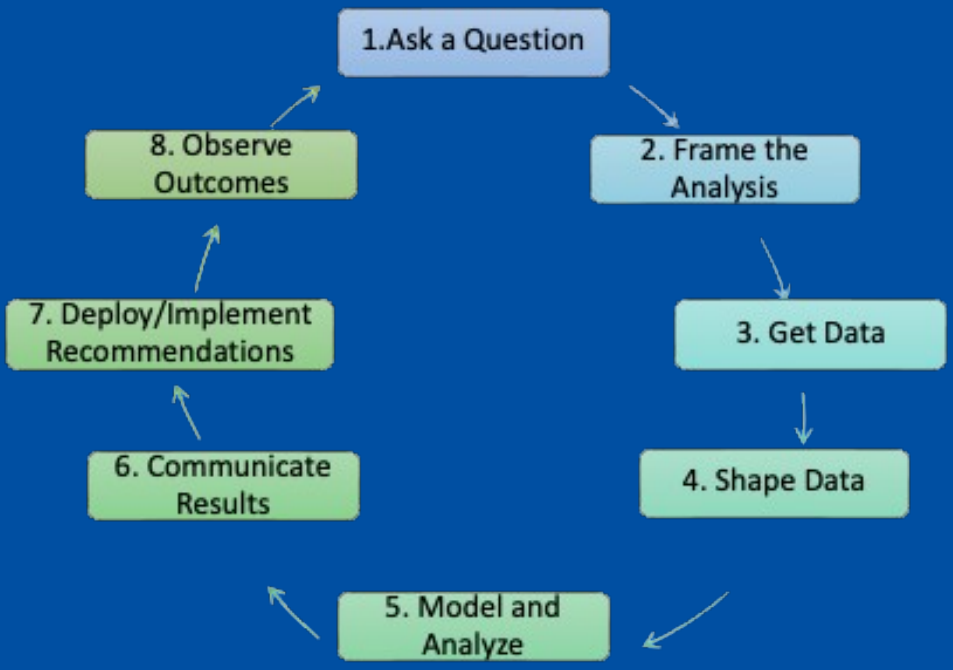
The goal is to help you practice responsible data science from legal, professional, and ethical perspectives.

CAVEAT: This presentation provides general background to facilitate educational discussion. It does not offer any form of legal advice or recommendations.

I. Legal, Professional, and Ethical Considerations

Data Science Follows a Life Cycle

A Data Science Life Cycle | Responsible Data Science Affects the Whole Life Cycle



The DS Life Cycle is about answering a question.

Data Scientists Make Choices

- What kinds of projects do I work on and What questions do I analyze?
- Who are the **Stakeholders**?
- Towards what goals do I optimize my models? Accuracy, Fairness, Equity, Equality, …?
- **How do I get my data**? How do I **protect** my data?
- Is my data **representative** of the population?
- What do I do about "bad" or missing data or "outliers" that "mess up" my results?
- What **variables/features/attributes** do I use?
- How much effort do I put into checking my results? Are they **repeatable**?
- How do I leverage/credit other people's work?
- How do I report my results - what is **intellectual property** and what should be public?
- …
- Choices can involve Legal, Professional, or Ethical Considerations

Choices have consequences, with benefits and risks.

Legal Considerations

- Legal considerations address the **criminal/civil risks** for violating laws.
- **Laws (statutes)** specify **permissible and/or impermissible activities as well as potential punishments** (judicial, e.g., imprisonment).
- **Policies (regulations)** **provide guidance** on implementing activities (within legal constraints) along with adjudication procedures and potential punishments (non-judicial, e.g., debarment).
- Legal issues in big data include **how you gather, protect, and share data, and increasingly, how you use it.**
- **Laws are "local" not universal**: Pirates or Privateers

- Laws do not keep pace with technology (generative AI anyone?) and can be difficult to interpret.

When in doubt, ask a lawyer competent in the issue.

Laws Proscribe Some Choices

- Health Insurance Portability and Accountability Act (HIPAA) (US DHHS 2015). See Big Data Analytics under HIPAA (Coy and Hoffman 2016)
- Family Educational Rights and Privacy Act (FERPA) (US DOEd 2017)
- Fair Credit Reporting Act (FTC 2013b). See FTC Credit Reporting Information (FTC 2018).
- Fair Housing Act (DHUD 2021)
- Equal Employment Opportunity Act (EEOC 2021b)
- Children's Online Privacy Protect Act (COPPA) and Rule (FTC 2013a)
- Genetic Information Nondiscrimination Act (GINA) (EEOC 2021a)
- European General Data Protection Regulation (GDPR) (Wikipedia 2022)
  - See What is GDPR (Burgess 2020)
- On 1 August 2024, the European Artificial Intelligence Act (AI Act) went into force to foster responsible AI development and deployment in the EU. Artificial Intelligence Act. (Commission n.d.)
- 2020 California Consumer Protection Act (Edelman 2020)
- In 2024, at least 45 states, Puerto Rico, the Virgin Islands and Washington, D.C., introduced AI bills, and 31 of them adopted resolutions or enacted legislation. ("AI for Legislative Work Has Arrived. Now Comes the Hard Part." n.d.)
- **And many more … with the expectation of more to come …**
  - Congressional interest in Section 230 of the Communications Decency Act of 1996 - Censorship .
  - Significant Court Cases: TikTok Ban, Antitrust cases for Meta And Google (2), and many more …

Ignorantia juris non excusat

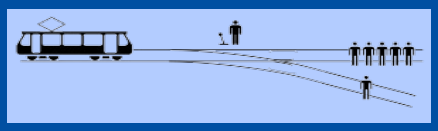
Professional Considerations

- Professional considerations address the **risk of activities related to organizations with which you affiliate.**
  - Professional Organizations
  - Employer or Volunteer Organizations
- Organizational bylaws or policies identify and manage **risk to the institution**.
- These may include professional "Codes of Conduct" or "Codes of Ethics".
  - American Statistical Association (ASA 2021)
  - Association of Computing Machinery (ACM 2021)
  - INFORMS Ethical Guidelines (INFORMS 2021)
  - Data Science Association (Association 2021)
- **Organizational behavior and ethics may conflict with individual ethics**
  - Choices can include trying to change the organization or offending individuals; or leaving or being forced to leave the organization, with potential legal issues as well.

When in doubt, ask a mentor or manager you trust.

Ethical Considerations

- Ethical considerations arise when asking
  - **What should I do?**
  - **What is the "right" or "moral" thing to do?**
- **Ethical Choices can be hard**, especially when choices may require violating a law, regulation, and/or professional guideline.
- **Individual principles and cultural norms shape options and guide choices in complex situations.**
- Often, there is **no universally-accepted or even a good "right answer".**
- **May have to choose between two bad outcomes.**
  - The Trolley Problem variations. ("Trolley Problem" 2024)



- May have to **choose between individual and group outcomes.**
- Ethical choices can lead to feelings of guilt, group reprobation, civil action (torts), or criminal charges.

Many, many, frameworks attempt to guide Ethical Choices.

II. Ethical Frameworks

Three (of many) Ethical Frameworks [1]

- **Consequentialist or Utilitarianism: greatest balance of good over harm** (groups/individual).
  - Choose the future outcomes that produce the most good.
  - Compromise is expected as *the end justifies the means*.
- **Duty: Do your Duty**, Respect Rights, Be Fair, **Follow Divine Guidance**:
  - Do what is "right" regardless of the consequences or emotions.
  - Everyone has the same duties and ethical obligations at all times.
- **Virtues: Live a Virtuous Life by developing the proper character traits.**
  - Ethical behavior is **whatever a virtuous person would do**.
  - Tends to reinforce local cultural norms as the standard of ethical behavior.

Frameworks can conflict with each other or are "wrong" in the extreme.

No single or simple right answer!

1 [illegible] (2021)

Using Frameworks in Ethical Decisions

1. **Recognize There May Be an Ethical Issue.**
   - Assess the underlying definitions, facts, and assumptions and constraints
2. **Consider the Parties Involved**, the stakeholders.
   - What individuals or groups might be harmed or benefit, and by when.
3. **Gather all Relevant Information**. Are you missing key facts? Are they knowable?
4. **Formulate Actions and Evaluate under Alternative Frameworks.**
   - What will produce the most good and do the least harm? (**Utilitarian**)
   - What respects the rights of everyone affected by the decision? (**Rights**)
   - What treats people equally or proportionately? (**Justice**)
   - What serves the entire community, not just some members? (**Common Good**)
   - What leads me to act as the sort of person I want to be? (**Virtues**)
5. **Examine Alternatives and Make a Decision.**
6. **Act and Observe.**
7. **Assess and Reflect on the Outcomes.**

If you don't like the outcomes, restart the process.

III. Identifying Ethical Issues

Our Biased Brains Helped Us Survive

- Our brains have evolved mechanisms to make quick decisions.
- These are the source of **"Unconscious Biases"** or **"Implicit Biases"**.
  - Unconscious stereotypes, prejudices, or attitudes that affect our decision-making, perception, and social behavior ("Implicit Bias Vs Unconscious Bias: Types Ways to Prevent Them" 2022).
  - Friend or Threat, Familiar or Strange, Us versus Them
  - Learn more and test yourself at Project Implicit (Implicit 2022).
- Under stress, we tend to **bypass the higher-level cognitive centers** that evolved later and take more time to reason.
- Humans get comfortable with patterns which can lead to systematic deviations from making rational judgments.
  - 12 Major Types of Cognitive Bias Explained (Psychology 2017)
  - Many potential biases could affect our decisions (Desjardins 2017)
- Ethical Challenges can arise from **our own implicit biases or the implicit biases of others** affecting our data, thoughts, and actions.

Short-term choices under stress may be bad in the long run ....

Given Bias in Data and Algorithms are DS Systems Ethical?

Not a new issue - goes back decades. However, the explosive growth of AI systems to support and **even make decisions** is generating concerns.

- **Bias in the (training) data** (historical, sampling, …) **can drive biased outcomes.**
- **Are algorithms really less biased than people?** It depends …
  - How do you measure fairness? See Tutorial: 21 Definitions of Fairness …
  - How can you tell with "black box" models? See Machine learning transparency and … A Toolkit for Transparency in Dataset Documentation
  - **Algorithms find "hidden" relationships among proxy variables** that can distort the results and interpretations.
  - What are the trade offs among accuracy, explainability, and transparency?
    - **Increasing "fairness" will generally decrease accuracy.**
- **Active area for research and publication**.
  - Machine Learning Evaluation: Towards Reliable and Responsible AI (Japkowicz and Boukouvalas 2024)
  - Algorithmic Bias Playbook (Obermeyer et al. 2021)
  - Understand, Manage, and Prevent Algorithmic Bias (Baer 2019)

Three Articles for Consideration

1. Higher error rates in classifying the gender of darker-skinned women than for lighter-skinned men (O'Brien 2019)
2. Big Data used to generate unregulated e-scores in lieu of FICO scores for Credit in Lending (Bracey and Moeller 2018)
3. Learning Analytics Can Violate Student Privacy (Raths 2018)

- Discussion Questions
  - Is there an ethical issue or more than one? What is it?
  - Who is affected and who is responsible?
  - Pick on of the Professional Codes of Conduct or Guidelines. How would it apply?
  - What would you do differently or recommend?

More Examples of Ethical Issues

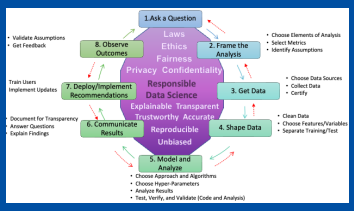
- Contradictions and competition among legal, professional, and ethical guidelines.
- Using biased data (**even unknowingly**)
- **Eliminating extreme values or combining small groups.**
- **Using Proxies for "Protected" Attributes** (even unknowingly).
- **Protection of Intellectual Property versus Explainability, Transparency and Accountability**
- ***Law of Unintended Consequences*** - people will use your products and solutions in "creative" ways that
  - May not align with your principles, or,
  - Be technically inappropriate.

So what can you do? What should you do?

IV. Practicing Responsible Data Science

What Can You Do? What Should You Do?

Consider Ethical Choices Across the DS Life Cycle



Ask a question: Equity or equality? Stakeholders and Trade offs? What are our interests? Recency or Confirmation Bias?

Frame the Analysis: What is the population? Role of proxy variables? How are metrics for "fairness" affecting groups/individuals? Do we need an IRB (APA 2022)?

- **Get Data:** How was it collected? Was informed consent required/given? Is there balanced representation? Selection Bias? Availability Bias? Survivorship Bias?
- **Shape Data:** Are we aggregating distinct groups? How do we treat missing data? Are we separating training and testing data?
- **Model and Analyze:** How are we documenting assumptions, treating extreme values, or checking over-fitting? Are we checking multiple fairness and performance metrics?
- **Communicate Results:** Are the graphs misleading? Did we cherry pick or data snoop? Are we reporting p-values and hyper-parameters?
- **Deploy/Implement:** Is the deployment accessible to all?
- **Observe Outcomes:** Can we check assumptions and analyze outcomes for bias?

Are we following professional guidelines from ASA, ACM, INFORMS, …?

Consider Other Frameworks for Responsible Data Science

UK Government | US DoD | Google | IBM | The 5 C's Framework

Published by the Royal Statistical Society and the Institute and Faculty of Actuaries in A Guide for Ethical Data Science

1. Start with clear user need and public benefit
2. Be aware of relevant legislation and codes of practice
3. Use data that is proportionate to the user need
4. Understand the limitations of the data
5. Ensure robust practices and work within your skill set
6. Make your work transparent and be accountable
7. Embed data use responsibly

(RSS-IFA 2021)

To Be an Ethically Responsible Data Scientist …

Integrate ethical decision making into your environment.

- **Recognize legal, professional, and ethical issues** surround your work.
  - See *Weapons of Math Destruction* for multiple scenarios. (O'Neil 2017)

- **Ask Questions** of Peers, Managers, Mentors, and Experts to get guidance.
- **Document your sources and approach**: assumptions, data, code, and references.
  - **Use Literate Programming.** e.g., with Quarto. (Posit 2022) quarto
- **Protect data:** especially HIPPA or Personal Identifiable Info (PII). (Us Dept of Labor 2024)
  - Consider Differential Privacy (Devaux 2022) à la the Census Bureau. (Bureau 2023)
- Create **reproducible analysis** and **solicit appropriate reviews and feedback**.
  - Avoid "Spurious Correlations". (Vigen 2021), produce results that Reveal, Don't Conceal. (Weissgerber Tracey L. 2019) and don't create Examples of Misleading Statistics.(Calzon 2021)
- Follow Publishing and Conference Ethical Guidelines e.g., AutoML's. (AutoML 2022)
- **Consider your own biases**. (Acton 2022)

As Davy Crockett might say, "Try to be sure you are right, then Go Ahead!"

"Davy Crockett" (2024)

Stay Current on Emerging Ideas

- Stanford 's Human-Centered AI Index for 2024 Report (HCAI 2024)
- Review articles on Big Data/Data Science/AI Ethics, e.g.,
  - Addressing equity and ethics in artificial intelligence (Abrams 2024)
  - Ethical debates amidst flawed healthcare artificial intelligence metrics (Gallifant et al. 2024)
- Review the International Inventory of Awesome AI Guidelines (IEAI-ML 2021)
- Investigate Academic Centers, e.g.,
  - Georgetown Center for Digital Ethics (Fleisher 2024)
  - Markkula Center at SCU Intro Course in DS Ethics (SCU 2022)
- Consider popular press articles
  - Top 12 AI Ethics Dilemmas: Real-life examples & Tips to mitigate (Dilmegani 2024)
  - AI Governance In 2025: Expert Predictions On Ethics, Tech, And Law (Spehar 2025)
  - The Ethical AI Dilemma: Innovation vs. Sustainability (Vadgama 2024)
- Check out think tanks or strategy/technology consulting firms:
  - Aspen Institute, Atlantic Council, Brookings, CCSIS, Global AI Ethics Institute, …
  - Accenture, Bain & Company, BCG, Booz Allen, Deloitte, EY, McKinsey, … . . .

Try to stay on the fast moving train that is Responsible Data Science.

Module Summary

After completing this module you should now be able to demonstrate the LOs:

- Differentiate **legal, professional, and ethical considerations.**
- Identify and interpret **professional Codes of Conduct.**
- Apply **Philosophical Frameworks** for ethical reasoning.
- Identify sources of **potential ethical issues** in Data Science.
- **Practice responsible data science** from legal, professional, and ethical perspectives.

You should also have greater competence in **considering choices that practice and promote responsible data science today, and in the future.**

Finally, when it comes to responsible Data Science, Jane Addams reminds us that just thinking about ethics is not enough, …

"Action indeed is the sole medium of expression for

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