Evaluating Data Science Contributions in Teaching and Research

Or…

How can I get promoted/tenure as a Data Scientist?

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Outline

- Me, you, and your promotion/tenure process
- The evidence: Your dossier (Research, Teaching, and Service)
- The standards of evidence in your dossier (Exhibits 1, 2, 3)
- Data Science Research: What's different and how do you document it?
- Data Science Teaching: What's different and how do you document it?
- Bringing it all together

Me: I wanted to be cool…

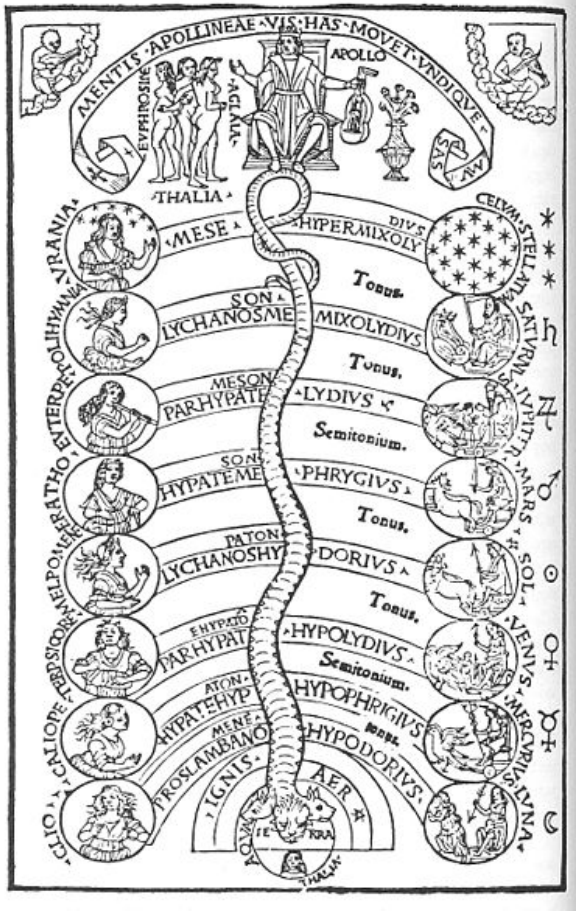
What actually happened…

- Biostatistics Professor
- Department Chair
- Faculty Hiring and Mentoring
- Promotion and Tenure (one step of the process)
- My goal: A slam-dunk promotion from Biostatistics and Bioinformatics, every time.
- What about Data Science?
  - JSM 2014: Presentation on Data Science to Chairs' Workshop by Jeff Leek.
  - Conversations with Roger Peng, Brian Caffo, others over past 12 months.

You:

- Cool.
- Doing Data Science, generating scholarly productivity in new areas of:
  - Research
  - Teaching
  - Service
- Your goal: A slam-dunk promotion.

Steps in the Pre-Copernican (academic) promotion process



- Trustees/Regents/etc.
- President
- Advisory Committee(s)
- Dean
- P&T Committee
- Chair
- Department
- You

Key steps in the promotion process

- Know the rules, know the rules, know the rules.
- Who will be evaluating you?
  - What fields do they represent?
  - What represents quality to them and their field?
- What documentation is required? Expected? Allowed?
- Discuss the process with your chair, your Promotion and Tenure Committee representative, your colleague who just went through the process, your Dean.

Boyer's *Scholarship Reconsidered*

- An important resource: In 1990, Earnest Boyer of the Carnegie Foundation authored a report entitled *Scholarship Reconsidered: Priorities for the Professorate*
  - Available on Amazon
- Widely cited, well known to the upper spheres of influence.
- What's so important about it for this conversation?

Boyer's *Scholarship Reconsidered*

- Boyer defined four types of academic scholarship
  - The **scholarship of discovery**
  - The **scholarship of integration**
  - The **scholarship of application** (scholarship of engagement); and
  - The **scholarship of teaching and learning**
    - https://en.wikipedia.org/wiki/Boyer%27s_model_of_scholarship
- **Provides a broader context for scholarship.**
- Deans, Provosts, and Presidents talk about this.

Evidence: The Dossier

- Key components:
  - Exhibit 1: Personal statement
  - Exhibit 2: CV highlighting accomplishments in Research, Teaching, and Service
  - Exhibit 3: External letters from experts in the field

Exhibit 1: Personal Statement

- Tell your story, put work in context.
- **Highlight past accomplishments**.
- Highlight focus and recognition.
- Highlight unique features and motivators.
- Highlight goals and **establish future trajectory**.

Exhibit 2: CV (typical measures of success)

- Research success
  - Peer-reviewed publications
  - Competitive grant funding
  - Invitations to speak
- Teaching success
  - Courses (with evaluations by students, peers)
  - New ideas? Did they work?
- Service success
  - Completed projects (publications again)
  - Strong collaborations

Exhibit 3: Letters of support

- "Arm's length"
- Comment on accomplishments, unique features, and likelihood of continued success
- Three components to each letter:
  - Letter **content** (must be clear to all levels)
  - Letter **writer** (matters more at first few levels, recognized expert in the field?)
  - Letter**head** (matters more at higher levels…"peer institution"?)
- Need good writers, peer institutions, insightful comments.
- Chair and Dean will summarize for higher levels.

Out of the box…

- Challenge: How to package "out of the box" success so that those both inside AND outside of the box appreciate the accomplishments.
- Discuss with your chair.
- Discuss with your mentor(s).
- Discuss with Promotions and Tenure committee members.

Evidence of Research Success

- Peer-reviewed, citable publications!
- Authorship, order matter.
- Journal quality matters.

What about…

- Blogs?
- Social media?
- Key question: Are you having an impact? Can you show it?
  - Reposts? Media?
  - Will letter writers notice? Will they comment?
  - Can you impress reviewers?
- Still evolving…

Data Science Twist

- Duncan Temple Lang notes data preparation often takes 80% of a data scientist's time. (NRC Report 2015, *Training Students to Extract Value from Big Data*)
- How to document this effort?
- Key research scholarly products expanded to include:
  - Software
  - Data

Review committees

- Recognize peer review publications
  - Some variation between disciplines
    - Computer science: Conference papers great!
    - Statistics: Conference papers? Peer review journals!
    - Biology: Journals? High impact factor journals!
- Software?
- Data?

Downloads vs. citations

- Parallel to journal publications.
- Downloads = how many people read it (or intended to read it)?
- Citations = how many people used it?

Citation is key, but evolving

- Need to present productivity in forms familiar to reviewers (letter writers and review committees).
- A first step: Link software and data to motivating peer review publication.
  - In **publication list, add note regarding related software** (and download/citation statistics) along with motivating publication, if allowed.
  - **Mention your contribution** to data development (personal statement **and** near citation, if allowed).
  - **Separate section of CV** ("Software"). Discuss metrics of interest with review committee members early (and prepare for changes!). The weakest of the three…
- Other developments…

Software as a Publication

- Some peer-review journals (e.g., *Journal of Statistical Software*).
- The software works and people are using it. Do I *have* to write a paper?
- GitHub as publication?
- Downloads as citations?
- Software is dynamic, but for reproducibility, we need citable versions of software.
- Moving target but some recent developments of note…

2015 NSF Workshop

- *NSF Workshop on Supporting Scientific Discovery through Norms and Practices for Software and Data Citation and Attribution*
  - Meeting: January 28, 2015, Final Report: April 20, 2015
  - https://softwaredatacitation.org/Pages/home.aspx
- One of three action items: "…the research community develop a primary consistent data and software citation record format (e.g., analogous to BibTex or RIS bibliography formats used in journal publishing) to support D/S citation. Journals and professional societies need to take a more active role in curating citation style files."

Original Software Publications

- July 2015: In collaboration with GitHub, Elsevier announced a new academic content class: Original Software Publications
  - http://www.journals.elsevier.com/science-of-computer-programming/call-for-software/a-new-software-track-on-original-software-publications-scico/
- **"All software and code published is, and will remain, fully owned by their developers."**
- "All software and code submitted for review and evaluation must be released under a number of pre-approved licenses" (e.g., GPL, Apache-2.0, MIT, etc.)

Data as a Publication

- Data dissemination plan required for most major research grants.
- Post to your or a lab's website?
- Post to public repository (e.g. genetics, imaging)?
- Details in Supplementary Materials?
- Also evolving rapidly…

Citing Data

- GenBank and others.
- DataCite: https://www.datacite.org/
- Research Data Alliance: Data Citation Working Group
  - https://rd-alliance.org/groups/data-citation-wg.html
- American Geophysical Union
  - https://agu.confex.com/agu/fm14/meetingapp.cgi/Paper/19292
- Joint Declaration of Data Citation Princples (2014)
- NCI Webinar (October 2015)
  - LECTURE TITLE: Data-Level Metric DATE: Wednesday, October 28, 2015, 11AM – 12PMSPEAKER: Martin Fenner Martin Fenner has been the DataCite Technical Director since August 2015. From 2012 to 2015 he was the technical lead for the PLOS Article-Level Metrics project. Dr. Fenner has a medical degree from the Free University of Berlin and is a Board-certified medical oncologist.
- Statistics?

Joint Declaration 2014

- Joint Declaration of Data Citation Prinicples (2014)
  - 1. Importance
  - 2. Evidence
  - 3. Unique Identification
  - 4. Access
  - 5. Persistence
  - 6. Specificity and Verifiability
  - 7. Interoperability and Flexibility

- When citing this document please use: Data Citation Synthesis Group: **Joint Declaration of Data Citation Principles**. Martone M. (ed.) San Diego CA: FORCE11; 2014 [https://www.force11.org/group/joint-declaration-data-citation-principles-final].

Data as a Publication: Two recent examples

- Dryad (www.datadryad.org/)
  - Abstract, ReadMe.txt, Data in .zip
- *Scientific Data* (www.nature.com/sdata/)
  - Online, open-access, peer-reviewed publication from Nature Publishing Group for descriptions of scientifically valuable datasets.
  - Peer-reviewed content on how the dataset was constructed.
  - Narrative and data.
- Both provide DOIs for data sets.
- Developing citation protocol:
  - Cite original paper (peer review journal).
  - Cite data.

Example: Dryad Citation

- When using this data, please cite the original publication:
  - Yoshimi K, Kumada S, Weitemier A, Jo T, Inoue M (2015) Reward-induced phasic dopamine release in the monkey ventral striatum and putamen. PLOS ONE 10(6): e0130443. http://dx.doi.org/10.1371/journal.pone.0130443
- Additionally, please cite the Dryad data package:
  - Yoshimi K, Kumada S, Weitemier A, Jo T, Inoue M (2015) Data from: Reward-induced phasic dopamine release in the monkey ventral striatum and putamen. Dryad Digital Repository. http://dx.doi.org/10.5061/dryad.r14bv

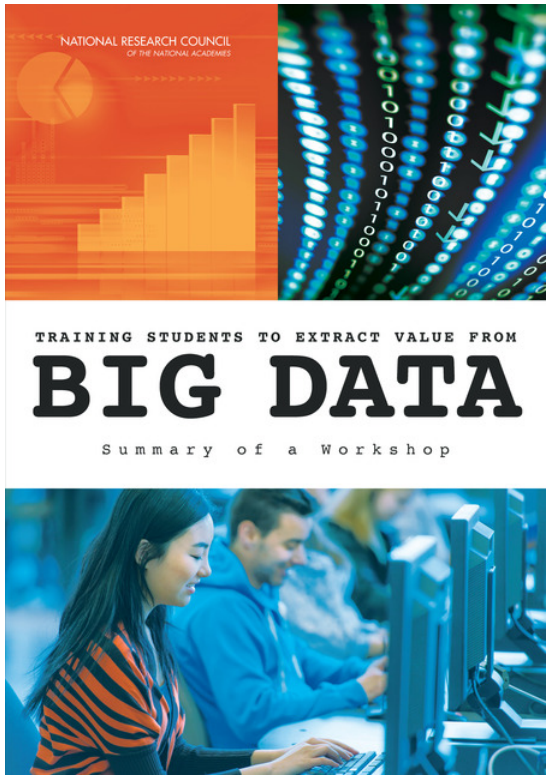
Example: *Scientific Data* citation

- *Scientific Data* citation:
  - Roelfsema, C. M. et al. Field data sets for seagrass biophysical properties for the Eastern Banks, Moreton Bay, Australia, 2004–2014. *Sci. Data.* 2:150040 doi: 10.1038/sdata.2015.40 (2015).
  - Author Contributions: Chris Roelfsema, design (70%), methods (70%), field data collection (60%), writing (50%).Eva M. Kovacs, design (10%), methods (10%), field data collection (40%), writing (30%).Stuart R. Phinng, design (20%), methods (20%), field data collection (10%), writing (20%).
- Data Citation:
  - Roelfsema, C. M., Kovacs, E. M., Lyons, M. & Phinn, S. PANGAEA http://doi.pangaea.de/10.1594/PANGAEA.846147 (2015).
- **These are in addition to the motivating article.**

Teaching Data Science

- Who are the students?
- What do they want to know?
- What do they need to know?
- Skills vs. core concepts.

Teaching



- National Research Council, Committee on Applied and Theoretical Statistics (CATS)
- *Training Students to Extract Value from Big Data: Summary of a Workshop*
- What do data science jobs require?
- Where/how do we teach it?

Training Opportunities

- www.mastersindatascience.org
  - (Currently) 23 great schools with Masters in Data Science
  - List of skills: Hadoop, Python, R, SQL, Tableau.
  - List of careers: Business Analyst, Data Analyst, Data Architect, Data Engineer, Marketing Analyst, Quantitative Analyst, Statistician.
- New courses in traditional format.
  - Good: Review committees know what to do with this.
  - Challenge: Not the only nor necessarily the most popular approach with instructors and trainees.

Novel teaching modalities

- MOOCs
  - Lots written, some strong opinions, Hopkins program.
- Boot camps
  - Short term, coding principles, set baseline for training.
- Hackathons
  - Weekend "analytic challenge".
  - Pre-internship, teamwork, focus, short-term results.
  - Long-term impact?
- YouTube tutorials.

Challenge: Documentation

- Enrollees vs. participants vs. completers.
  - Downloads vs. citation all over again.
- Lots of analytics available. Which are compelling and to whom?
- Can/will letter writers comment?
- Be aware of and pre-empt preconceptions of voting faculty, review committee members, higher administrators.

Bringing It All Together: General Prinicples

- Informative personal statement.
  - Highlight accomplishments.
  - Highlight unique features and define as strengths.
  - Establish goals and clearly identify trajectory.
- Letter writers, Letter content, Letterhead.
- Frame accomplishments as evidence.
  - Novel elements as extensions of standards of evidence.
- Link all together. Chair makes your case.

Key ideas

- Know the rules.
- Know what counts as evidence, and by whom.
- Recognize your own research and teaching productivity.
- Provide context for your scholarly accomplishments (*Scholarship Reconsidered*).
- Think citations. DOI is your friend.
- Discuss with your Chair, early and often.
- Discuss with faculty, early and often.

Questions?


Schema huius præmissæ diuisionis Sphærarum.
EMPIREVM
HABITACVLVM
DEI
ET
OMNIVM
ELECTORVM
COELVM
Primum Mobile
Nonū Cœlum
Octauum
Firmamentū
Cœlū
SATVRNI
IOVIS
MARTIS
SOLIS
VENERIS
MERCVRII
LVNÆ

Data Scientists vs. Statisticians

- From www.mastersindatascience.org/careers/statistician/ (emphasis added)
- "…a great debate about **whether data science is just statistics, sexed up."**
- "Those who argue against the "sexing up" theory note that:
  - **Statisticians and Data Analysts are primarily concerned with set tasks. …** They are given parameters and do their best to collect and analyze information from conventional sources…
  - **Data Scientists think outside the structured box**. They create their own questions/ projects and use a **much wider range of tools – only some of which are statistical** – in order to establish unique connections between big data."
- "Of course, experienced statisticians have been thinking outside the box since the dawn of the field. However, thanks to the surge of technology, **those who wish to call themselves data scientists must now have formidable software engineering, machine learning and predictive analytics skills**."