JSM 2016

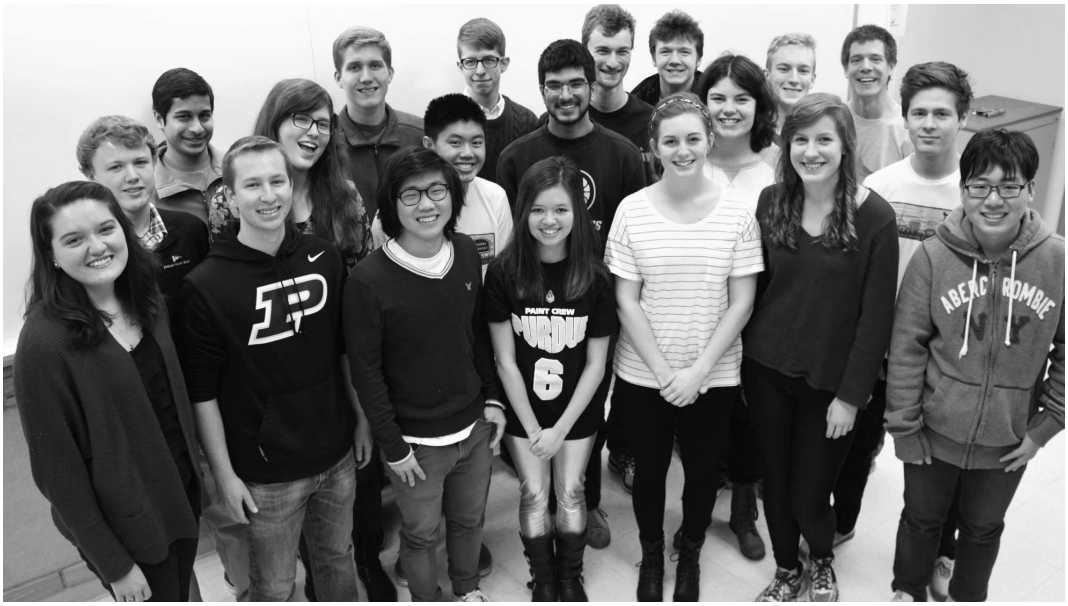
Learning Communities: An Emerging Platform for Research in Statistics

August 2, 2016

Mark Daniel Ward
Purdue University

2014-15 STAT-LLC students

2015-16 STAT-LLC students



Introduction

- MCTP: Sophomore Transitions: Bridges into a Statistics Major and Big Data Research Experiences via Learning Communities

Purdue Statistics Living-Learning Community (STAT-LLC)

- Sponsored by National Science Foundation, Division of Mathematical Sciences
- $1.5 million grant
- fall 2014 through spring 2019
- Vision: Complete revamp of how we teach data analysis at the undergraduate level

Living Learning Community

- 20 sophomore undergraduates per year
- 100 students (altogether) by 2018
- 12-month experience for each sophomore (August to August)
- 12 Co-PI's and Senior Personnel from Purdue Statistics plus 56 letters of collaboration

Why did we choose sophomores?

- At Purdue: 55 first-year learning communities with 78 total sections…..
- but only 3 sophomore-year LC's !
- Only 13% of universities offer sophomore/junior seminars, while 90% offer first-year and senior seminars. (Berrett, 2012)
- "*In 2002-03, only 8 percent of NSF-funded undergraduate researchers were sophomores*" —Wilson and Crowe, 2010

Sophomore Slump

- Sophomores are referred to in literature as:
  - "Abandoned"
  - "Forgotten"
  - "Invisible to the institution"
- Sophomore year is a time of transition:
  - Finish(ing) calculus
  - Diving into most foundational courses in major
  - Identifying or refining long-term job goals

Attrition

- The sophomore slump leads to attrition of
  - Females
  - Minorities
  - Students with disabilities
  - First-generation students
- Especially in the mathematical sciences…
- Sophomore year is a time of transition!

Prerequisites (or lack thereof!)

- Only 1 prerequisite: Calculus III (MA 26100) before the start of their sophomore year.
- No computational or statistics requirements
- US Citizens/Nationals/Permanent Residents
- Students from any major can apply
- For 2016-17, ≈ 60 apply, but only 20 stipends

Blended Experience

- Sophomore year experiences that blend these 4 are unknown, nationwide.
- Academic (Curricular)
- Research
- Residential Life
- Professional Development

Research with Faculty

- *Students choose* from 50+ research projects, each with a dedicated faculty mentor.
- They all have relevance to Big Data analysis.
- Not a large spreadsheet, but (often) gigabytes or terabytes of data.

Research Thrusts

- Atmospheric Science
- Biostatistics
- Healthcare Engineering
- Probability/Theoretical Statistics
- Human Development and Family Studies
- Consulting
- Coastal Margin Observation and Prediction
- Saving Nature with Statistics (Forestry and Natural Resources)

Other Department Collaborators

- Biology, and Biomedical Engineering
- Chemical Engineering, and Chemistry,
- Coastal Margin Observation and Prediction,
- Computer Science,
- Economics,
- Electrical and Computer Engineering,
- Forestry and Natural Resources,
- Health and Human Sciences,
- Mathematics, and Physics,
- Regenstrief Center for Healthcare Engineering

Research Groups

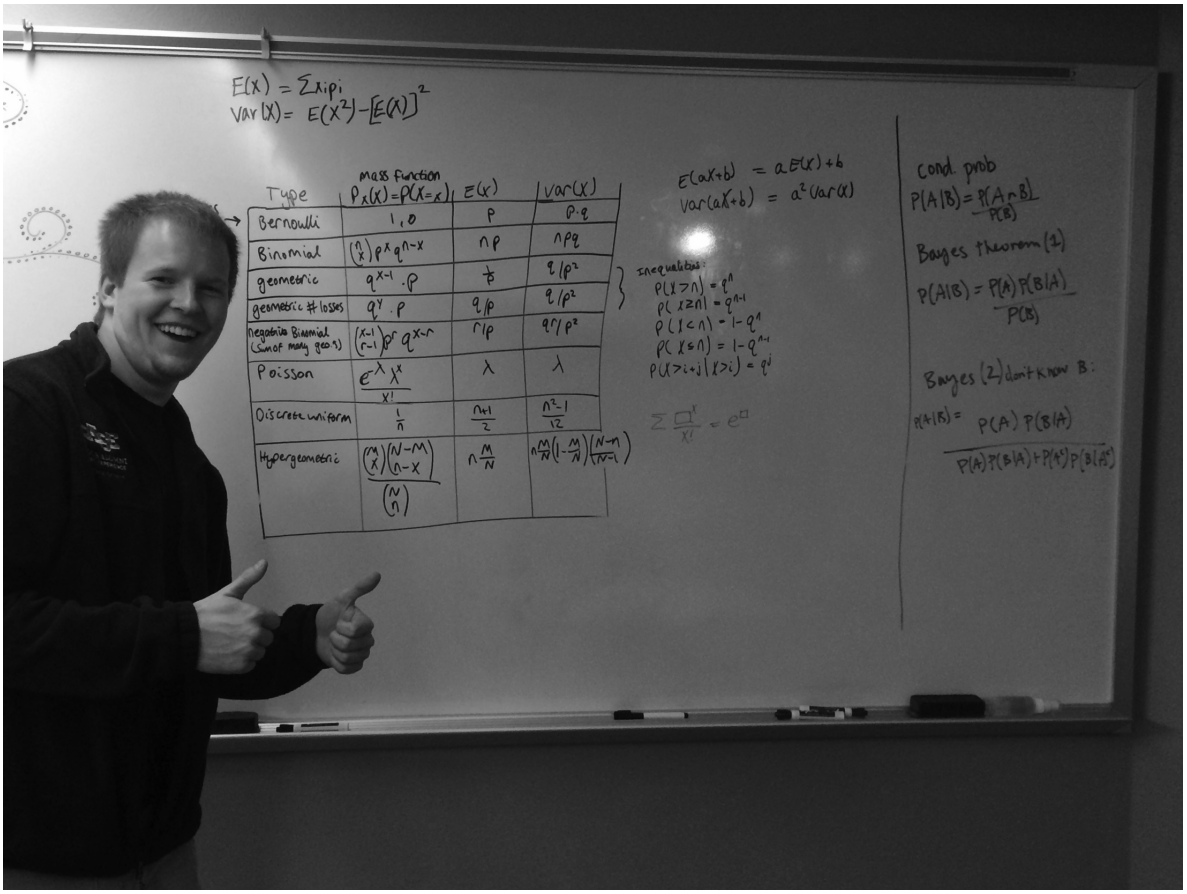
- Students are encouraged to participate in
  - Research literature groups
  - Computational projects
  - Large research group / laboratory meetings
  - Conference calls
  - Meetings with research visitors
  - Discussions with clinicians/practitioners
- Basically, students should learn all aspects of research and be valued team members.

Big Data research; supported by curriculum

- Probability:
  - fundamental; random variables
- Statistical Theory:
  - also fundamental; builds on Probability course
- Introduction to Big Data Analysis (new!)
  - directly impacts the research effort;
  - allows students to build comfort with comp. stat.

"Flipped" Courses

- Big Data Analysis and Probability are both taught in a "flipped" style
- 237 videos for probability theory
- Each video has full page of notes
- Big Data Analysis is project-oriented and students work in teams all semester.



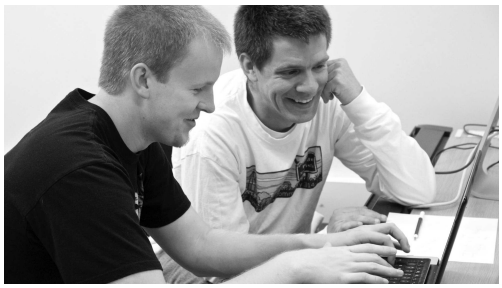
Introduction to Big Data Analysis

- Platforms/tools taught in nuts and bolts style:
  - R (6 weeks)
  - visualizing data (2 weeks)
  - UNIX (1 week)
  - awk/regular expressions (1 week)
  - SQL (2 weeks)
  - XML (1 week)
  - Final presentations from students (2 weeks)

Introduction to Big Data Analysis

- Students have a paradigm shift
- The data will not fit in laptop / desktop
- Rack-mounted (*remote access*) server with 384 GB of RAM, 50 TB of disk, and 24 processing cores, for data analysis needs.
- Become very *comfortable* with computing

Introduction to Big Data Analysis



Hillenbrand Residence Hall

Residential Life

- Faculty as mentors beyond class/research.
- The life of a faculty can include family.

Residential Life

Faculty Fellow: Impacting students' lives outside of the classroom

- Student dinners
  - Hillenbrand every Thursday
  - Occasionally at Ward family home.
- Makes a scientist's non-academic life be more tangible
  (grasp full picture
  of being a scientist)

Wearing Many Different Hats

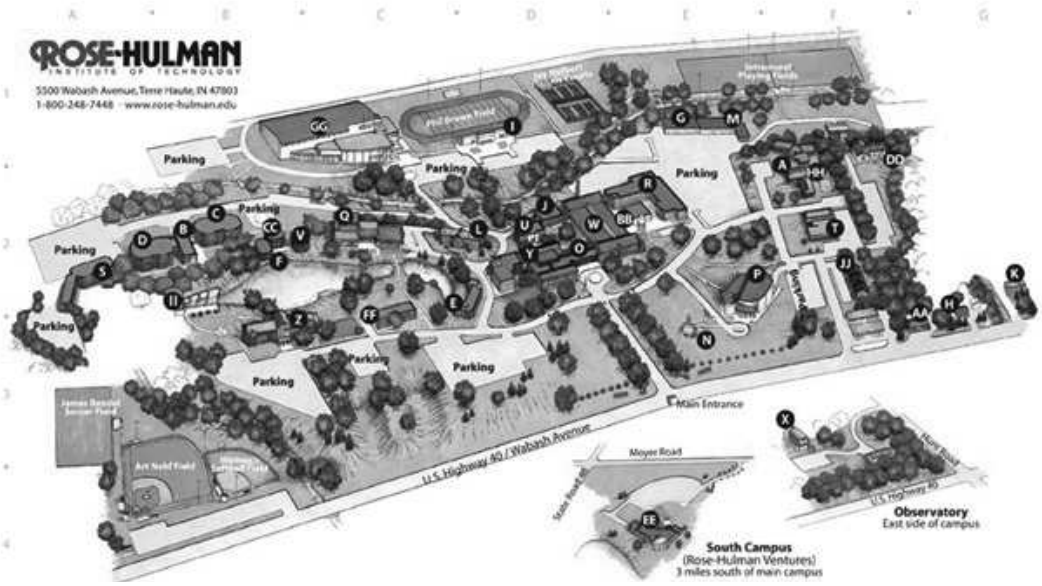
Wearing Many Different Hats

Wearing Many Different Hats

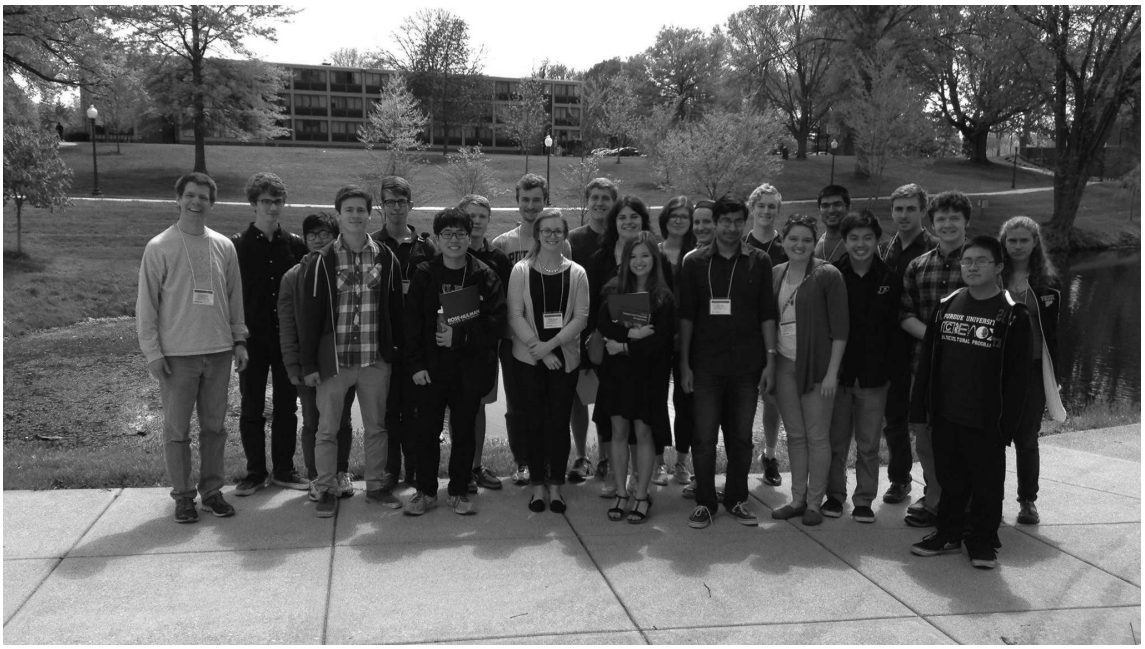
Big Data Workforce

- Students are prepared for data-driven workforce
  - Data Scientists
  - Graduate school (Stat, Math, CS, many applied areas)
  - Consulting, R&D, analytics, databases, etc…
- Also learn from networking with alumni
- Big picture of what matters in the workforce:
  - how to partner with teammates
  - communicate their results
  - problem solving (e.g., how to get unstuck)

Overnight Visit to Math Conf. at Rose-Hulman Inst. of Tech. in April



Overnight Visit to Math Conf. at Rose-Hulman Inst. of Tech. in April



New ASA DataFest competition

1st Annual Purdue Statistics branch of ASA DataFest

ASA DataFest

Long Term Future

- The Department of Statistics would love to keep the STAT-LLC operating, long after the NSF grant has expired.
- We have approximately 450 students pursuing a Statistics major.
- Purdue Statistics is one of the largest UG Stat programs… and many students are interested in pursuing data science!

Statistics Living Learning Community

Questions: Mark Daniel Ward mdw@purdue.edu