Involving STEM Faculty

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Questions

• What does a statistician need to understand about real-world contexts related to VAM?

• What does a mathematician/scientist need to understand about VAM?

• How can complex ideas and models be communicated effectively?

• In what ways should the “messiness” of real data influence statistical models?
Overview

• Background
• Introductions
• Abstract Questions
  – Brief thoughts
  – Open discussion
• Follow-up Questions
NebraskaMATH
A university-wide, state-wide partnership

• University Support
  – Center for Science, Mathematics and Computer Education
    – Permanent infrastructure (1998)

• NSF Grants
  – Math in the Middle (2004) - $5.9M
  – NebraskaMATH (2009) - $9.3M
    • Primarily Math
    • Nebraska Algebra
    • New Teacher Network
  – Data Connections (2011) - $1.2M
  – NebraskaNOYCE (2010) - $3M
  – Noyce Midwest Regional Connections (2014) - $800K
NebraskaMATH
Sustaining the Partnership

• Nebraska Math and Science Summer Institutes (2007)
  – Teachers get a 20% tuition discount
  – We award about $75,000 in supplemental fellowships each year to further lower the cost of graduate education
• Omaha Public Schools Teacher Leader Academy (2013)
  – $5.45M from The Sherwood Foundation® & Lozier Foundation
• Math Early On (2013)
  – $528K from The Buffett Early Childhood Fund
• Improving Teacher Quality grant (2014)
  – $70K for professional development for teachers in Nebraska’s Panhandle
• UNL-LPS Title I Partnership (2014)
  – $538K that funds graduate courses for LPS teachers
NebraskaMATH
Diverse expertise for a complex partnership

• Leadership/Research Teams
  – UNL Faculty:
    • Mathematicians
    • Statisticians
    • Psychologist
    • Teacher Educators
    • Early Childhood Educators
    • Mathematics educational researchers
  – School District Leadership:
    • District curriculum & math supervisors
    • District psychometrician/assessment specialist
  – Other Educators:
    • Educational Service Units staff developers and administrators
NebraskaMATH Example

• Leadership/Research Team Support
  – CSMCE staff & undergraduate student workers
  – Interdisciplinary group of graduate students
    • Statistics
    • Mathematics
    • Mathematics education
    • Psychology
    • Educational psychology
    • Child, youth and family
  – Master teachers
  – Math coaches
  – Retired teachers
Broad engagement of the university community in working to strengthen K-12 math education

Many people are involved in NebraskaMATH

UNL faculty 36
Other collegiate faculty 15
UNL graduate students 87
UNL undergraduates 33
Master teachers 76
Introductions

• Name
• Affiliation
• (Desired/current) role (with/as) STEM faculty
• What you hope to take away from this session
Questions

- What does a statistician need to understand about real-world contexts related to VAM?
- What does a mathematician/scientist need to understand about VAM?
- How can complex ideas and models be communicated effectively?
- In what ways should the “messiness” of real data influence statistical models?
What does a statistician need to understand about real-world contexts related to VAM?
Statisticians + Real-World Contexts

• Quality research = Quality study & data design
  – Every measure measures *something*, but is it what you want?

• Real-world contexts
  – In education, sometimes you have to work with what you have.
    • *Example*: CRTs and NRTs
  – How proceed appropriately?
Statisticians + Real-World Contexts

• Model choice
  – Statistical properties & assumptions
  – Purpose of analyses

• Real-world contexts
  – Don’t use a VAM just to use a VAM
    • Appropriate & purposeful
  – Remain open to other options given real-life constraints
    • **Example**: Longitudinal TEMA-3 data on K-3 students over several years not feasible
Statisticians + Real-World Contexts

• Statistician = Modeling “expert”
• Real-world contexts
  – Interdisciplinary teams provide invaluable insight
    • Look at analyses with a different lens
    • Alternative ideas, perspectives & approaches
  – What is the big picture?
Statisticians + Real-World Contexts

• Researching statistical problems takes time
• Real-world contexts
  – Projects are on a timeline
    • Careful balance of research & project needs
    • Example: Exploring how limitations of data impact VAM estimates of program effects
  – How package statistical results (or lack thereof) in honest, but “attractive” ways for stakeholders & funders?
Discussion

What do you think statisticians need to understand about real-world contexts?
What does a mathematician/scientist need to understand about VAM?
Mathematicians + VAM

• “Teacher” effects
  – Unexplained classroom-level heterogeneity
  – Estimated relative to avg. teacher in sample

• Variability
  – Estimates involve a mean **AND** a standard error
  – Standard errors tend to be large enough that precise statements about individual teachers require extreme caution
  – Improvement vs. High-stakes evaluation
Mathematicians + VAM

• Need high-quality data
  – Longitudinal (multiple years)
  – Assessment(s) aligned with program goals & able to score all levels of achievement
  – Accurate teacher links

• Evaluating program effectiveness
  – Need counterfactual (e.g., comparison group)
  – May not detect significant program effect using “teacher” VAM estimates

• Use multiple metrics for evaluation, not just student achievement
Discussion

What do you think mathematicians/scientists need to understand about VAM?
How can complex ideas and models be communicated effectively?
Communicating Complex Ideas

• Know your audience: What is important?
• K.I.S.S.
  – Use a simple example
    • “Highlight” key aspects of the more complex idea/model
  – Use pictures
  – Use words instead of symbols
Example:
What is a layered, value-added model?
What is Value-Added?

Test Score

Diff between student score & district avg.

Year

g

Expected growth for student

District avg.

g + 1

Ballou, Sanders, & Wright (2004)
What is Value-Added?

Ballou, Sanders, & Wright (2004)
What is a Layered Model?

- Above district avg. growth
- Equal to district avg. growth

Which teacher?

Teacher 1

Teacher 2

District avg.
Layered vs. Non-layered Models

- **Layered Model:**
  - Links past teachers to subsequent student outcomes
  - Student Score = overall mean + cumulative effects of previous and current teachers + random residual variation

- **Non-layered Model:**
  - Links current teachers to student outcomes, so ignores effects of instruction in earlier years
  - Student Score = overall mean + effects of current teachers + random residual variation
Layered vs. Non-layered Models

• Layered Model:
  – Links past teachers to subsequent student outcomes

\[
\text{score}_{g+1} = \text{district mean}_{g+1} + \text{teacher}_1 + \text{random error}_{g+1}
\]

\[
\text{score}_{g+2} = \text{district mean}_{g+2} + \text{teacher}_1 + \text{teacher}_2 + \text{random error}_{g+2}
\]

• Non-layered Model:
  – Links current teachers to student outcomes, so ignores effects of instruction in earlier years

\[
\text{score}_{g+1} = \text{district mean}_{g+1} + \text{teacher}_1 + \text{random error}_{g+1}
\]

\[
\text{score}_{g+2} = \text{district mean}_{g+2} + \text{teacher}_2 + \text{random error}_{g+2}
\]
Discussion

How have you communicated complex ideas effectively (ineffectively)?

What else could be done to make VAM more transparent?
In what ways should the “messiness” of real data influence statistical models?
“Messy” Data Examples

• Teacher links
  – Multiple (or no) teachers linked to a single student for a single subject
  – Teacher of record ≠ Actual teacher
  – Teacher name changes, life events (e.g., married, maternity leave, etc.)

• Student mobility

• Missing data

• Assessments
  – Timing (end-of-year, mid-year, etc.)
  – Different purposes, content, etc.
  – Ceiling effects
Discussion

What are some “messy” real data issues you (or others) have encountered, and how have you (or your team) addressed them?
Summary

• What does a statistician need to understand about real-world contexts related to VAM?

• What does a mathematician/scientist need to understand about VAM?

• How can complex ideas and models be communicated effectively?

• In what ways should the “messiness” of real data influence statistical models?
Follow-up Questions

• How do you involve STEM faculty in research? What role(s) should/can they assume?

• As STEM faculty, how do you get involved in education programs and research?

• If you are not in a place to learn how to do VAM yourself, how could/should you support statisticians and others who will model project data?

• Others?
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