



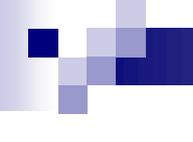
**PROJECT-SET**  
Statistics Education for Teachers

# Statistics Education for Teachers: A Professional Development Project

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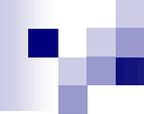
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# The Push for More Statistics

- Society has become increasingly interested in data and data driven decision-making
- It is now crucial for us as educators to consider how we can prepare a statistically literate population
- Statistical literacy refers to the ability to think and reason in the presence of uncertainty
- Nationally there is a strong push for increasing statistics education for K-16

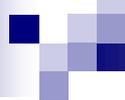


# Answering the Call in K-12

- The Common Core State Standards for Mathematics (CCSSM) include a large amount of statistics content in the middle and high school grades and a smaller amount at the elementary school level
- The Mathematics Education of Teachers Reports (MET I and MET II) have identified statistics as a large area of concern for teacher preparation

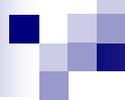
# What statistics is in the CCSS?

- At the elementary level, a small amount of statistics is included in the Measurement and Data strand
- At the middle school level, a large amount of statistics is introduced
- At the high school level, statistics is
  - interwoven in all courses,
  - in a stand alone AP course,
  - in a stand alone non-AP course, and
  - in the modeling strand



# Pre-service Teacher Prep in Statistics

- At the elementary level, teachers at best take 3 courses in mathematics departments with possibly only 1 chapter/unit dedicated to stats
- At the middle level, teachers may have more math courses or they may have only what the elementary teachers have
- At the high school level, teachers typically are undergraduate math majors or math minors during which they may or may not have statistics courses depending on their program



# In-service Teacher Prep in Statistics

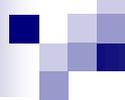
- In-service teachers at all levels were for the most part trained before the CCSS
- Little to no statistics was present in their teacher preparation
- There is a large need to help in-service teachers, as well as pre-service teachers, with statistical preparation
  - Note: their needs are similar



# PROJECT-SET

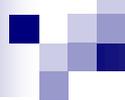
Statistics Education for Teachers

- Project-SET is a project that aims to develop innovative materials to enhance the ability of teachers to foster students' statistical learning
- The materials are structured around two topics: sampling variability and regression
- For each topic, the project team constructed and validated a learning trajectory (LT)



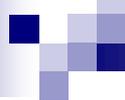
# Learning Trajectories

- The LTs provide a model for successive and gradual thinking about the topics that a student (in our case, teachers) must go through to achieve deep understanding
- Project-SET defines a LT for a topic as a curricular framework that serves as a map for how to achieve different cognitive learning levels or student (teacher) learning outcomes
- Project-SET LTs have a loop structure where each loop represents the increased levels of sophistication as a student (teacher) progresses through the loops



# Professional Development Design

- Professional development was designed *around* the LTs
- Each week focused on a single loop of a LT
- Each weekly meeting was 3 hours long
- 7 meetings focused on sampling variability and 7 meetings focused on regression
- Participants were presented with the LTs at the end of the PD



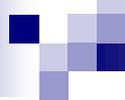
# Project-SET Professional Development Materials

- Sample syllabus
- Two LTs
- Sample PowerPoint slides for lessons
- Activities/lesson plans
- Open-ended assessment and grading rubric
- Sample homework
- All available to download on the website

[www.project-set.com](http://www.project-set.com)

# PD Pilot Participants & Structure

- 12 high-school teachers in West TN participated
- Structuring the PD around the loops enabled learning *depth* of the concepts
- The loops of the LTs uncovered teacher misunderstandings and beliefs
- The depth of coverage enabled PD participants to
  - have discussions about their beliefs and misunderstandings
  - Focus on developing their conceptual knowledge



# Today: Regression

- To provide a better sense of the materials, today we will focus on regression only
- In particular, we will focus on loop 1 of the regression LT and the PD around it
- Lets begin by looking at the lesson plan/activity

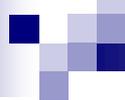


# The Context

- An eighth grade student in a physics class asked the teacher whether the same object dropped from different heights would bounce different heights. Specifically, the student was interested in how the drop height and the bounce height are related. She hypothesized that the higher the drop height, the higher the bounce would be. The class decided to investigate this question by using a golf ball. Students were given eight set heights to drop the ball from. Then they dropped a golf ball from each of those heights and measured how high the ball bounced back up.

# Thinking about informal line of best fit

- Below is a scatterplot which shows the data about how high the golf ball bounced when it was dropped from different heights.
- Using the piece of spaghetti, determine the line of best fit for the data. Be cognizant of your thoughts as you decide where to place the line on the graph.



# Thinking about informal line of best fit

- What things did you consider when you were deciding where to place it?
- Why did you choose to put the line there?
- What is your definition of the line of best fit?

What do teachers need to know in order to help students do this well?

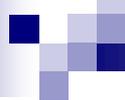
# Students make their own informal line of best fit

- Analyze student's criterion. Will the criterion always work to produce a line that accurately models any data set? If it will, explain why. If it won't, draw at least one example of a scatterplot with the line placed using that criterion and explain why the criterion produces a bad line of best fit.
- What can a teacher do to prevent or address student misunderstandings?

# Results

- Video clip: 3 teachers' approaches to finding line of best fit





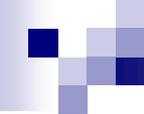
# Assessments

- An open ended assessment aligned with loop 1 in the regression LT was given to each teacher to complete as homework
- Analyzed data regarding number of coffee shops and number of property crimes across eight counties
- The assessments were graded by two independent graders according to a pre-determined rubric

# Assessment Results Loop 1

Teachers struggled to explain the *inherent variability in data*

- No exactness to crime rates (measurement issue) vs. natural variability
- “There is scatter in the plot because there are various amounts of crimes that occur in each county.” -explains why there are different y-values, but doesn’t explain the scatter
- “not all counties have the same number of shops and crimes”-explains why they don’t all have the same point but not the scatter



# Assessment Results Loop 1

Teachers struggled to *determine appropriate criteria for finding the line of best fit*

- had to pass through at least one point
- Used subset of points (cluster of lowest 6)
- Force through first point

# Assessment Results Loop 1

Teachers struggled to *interpret the slope of the line of best fit*:

- Deterministic interpretation of slope: for every increase in two shops crime increases by 1 thousand
- Doesn't interpret slope as a rate *of change*; "it represents the number of property crimes per coffee shop"

# Discussion Question

- Why is it valuable for teachers to explore concepts (e.g., line of best fit) informally before learning formal approaches?





# Discussion Question

- What are the affordances of organizing PD around LTs?

# What we learned

- Following the LTs promoted in-depth learning that allowed for:
  - misunderstandings and beliefs to surface
  - going beyond procedural knowledge but instead reaching at understanding
  - Teachers to ask questions that they would not have otherwise realized they had
- The activities must be well-designed to support teacher conceptual connections highlighting and perhaps probing at potential misunderstandings
- In general, we have a tendency to want to cover a lot but we really get more bang for the buck when we go with depth
- Fine tuning our ears to misconceptions...as experts it is sometimes hard for us to really listen

# Ways to Implement these Materials

- Approximately 60-70 hours of PD are ideal to cover both topics
- The PD could be delivered in an intensive summer workshop, weekend meetings, graduate course, etc.
- Ideally, teachers would have PD covering both topics, however, topics could be split up
  - Sampling variability PD (includes formal inference such as confidence intervals and hypothesis testing)
  - Regression PD

# Thanks for coming!



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Download Materials at: [www.project-set.com](http://www.project-set.com)

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