STATISTICAL KNOWLEDGE FOR TEACHING ACTIVITIES AND ASSESSMENTS

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Overview

* Get to know the participants
* Statistical Knowledge for Teaching (SKT) framework
* 2 tasks used to develop SKT statistical association
* Assessments used to assess teachers' SKT
* Feedback and discussion

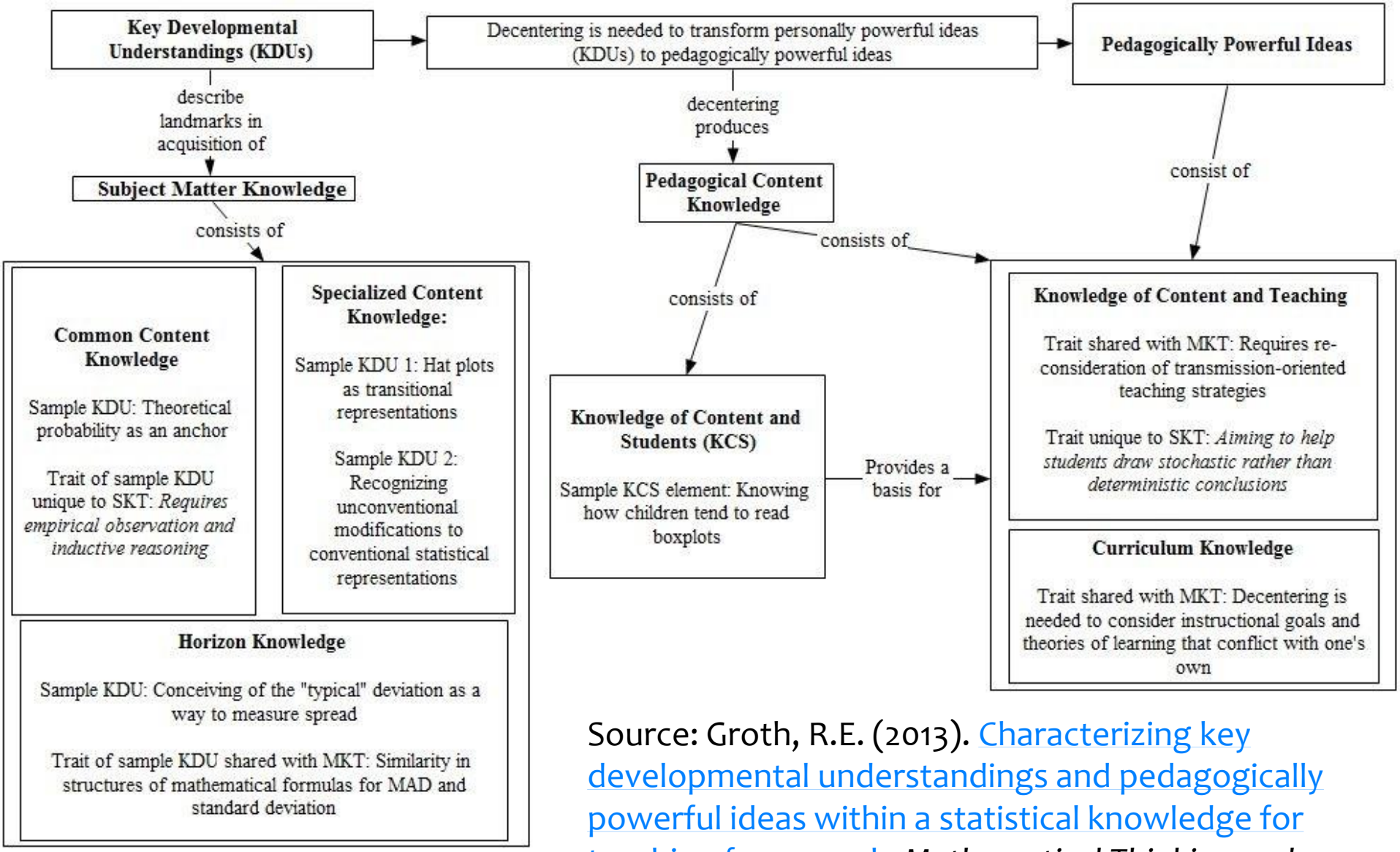
Statistical Knowledge for Teaching Framework

Construct	*Authors*	*Brief Definition*	*Role Within the Framework*
Statistical knowledge for teaching	Groth (2007)	Knowledge required for teaching statistics	Premise that statistics and mathematics are not equivalent disciplines
Common content knowledge	Hill, Ball, & Schilling (2008)	Knowledge that teachers are responsible for teaching their students	Component of subject matter knowledge
Specialized content knowledge	Hill, Ball, & Schilling (2008)	Knowledge of various representations and unusual student strategies	Component of subject matter knowledge
Horizon knowledge	Hill, Ball, & Schilling (2008)	Knowledge of the broader content landscape in which curriculum is situated	Component of subject matter knowledge
Knowledge of content and students	Hill, Ball, & Schilling (2008)	Knowledge of common student difficulties with content and their thinking patterns	Component of pedagogical content knowledge
Knowledge of content and teaching	Hill, Ball, & Schilling (2008)	Knowledge of content-specific teaching strategies	Component of pedagogical content knowledge
Curriculum knowledge	Hill, Ball, & Schilling (2008)	Knowledge of how to arrange curricula to enhance student learning	Component of pedagogical content knowledge

Statistical Knowledge for Teaching Framework

Construct	*Authors*	*Brief Definition*	*Role Within the Framework*
Key developmental understandings (KDUs)	Simon (2006)	Cognitive landmarks in the learning of fundamental ideas needed to understand content	Mechanism to identify cognitive landmarks in subject matter knowledge development
Pedagogically powerful ideas	Silverman & Thompson (2008)	Ideas that occur as the result of transforming KDUs (i.e., personally powerful ideas) into ideas that facilitate students' learning of the KDUs	Mechanism to identify cognitive landmarks and mechanisms in pedagogical content knowledge development

Developmental Structure of the Statistical Knowledge for Teaching Framework



Source: Groth, R.E. (2013). Characterizing key developmental understandings and pedagogically powerful ideas within a statistical knowledge for teaching framework. *Mathematical Thinking and Learning, 15,* 121-145.

Statistical Knowledge for Teaching Statistical Association

* Casey and Ross have created and used curriculum materials for the statistical association units (quantitative and categorical) addressing statistical knowledge for teaching with preservice secondary teachers
* Based on and situated in the work of teaching
* You will engage in 2 of the tasks developed for the quantitative association unit

CCSS: Statistical Association Grade 8 Quantitative

* Construct and interpret scatter plots
* Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
* For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.
* Use the equation of a linear model to solve problems, interpreting the slope and intercept.

8th-grade example

To start a lesson on informal line of best fit, you are following the curriculum guide and have presented your students the following data set about the pounds of beans eaten by families of different sizes when traveling on the Overland Trail:

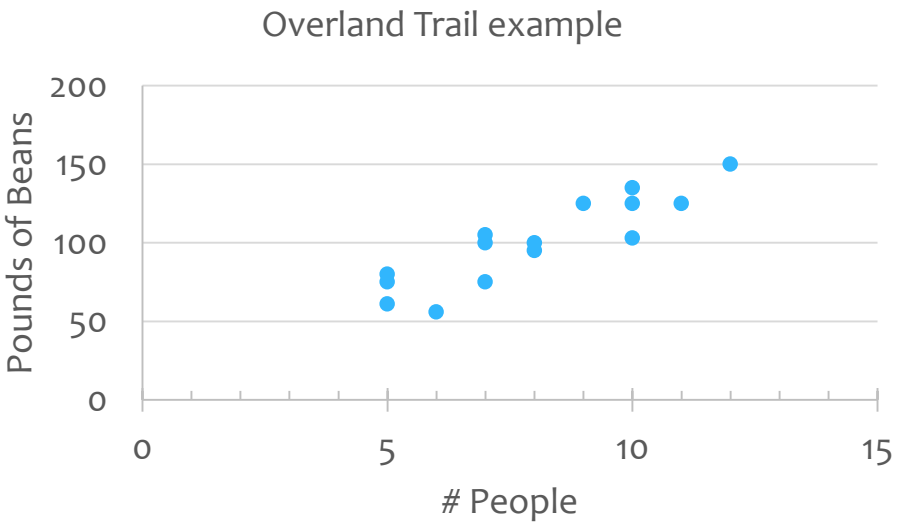
#people	5	8	6	7	11	10	5	7	10	5	8	7	9	12	10
Pounds of beans	61	95	56	75	125	135	80	100	103	75	100	105	125	150	125

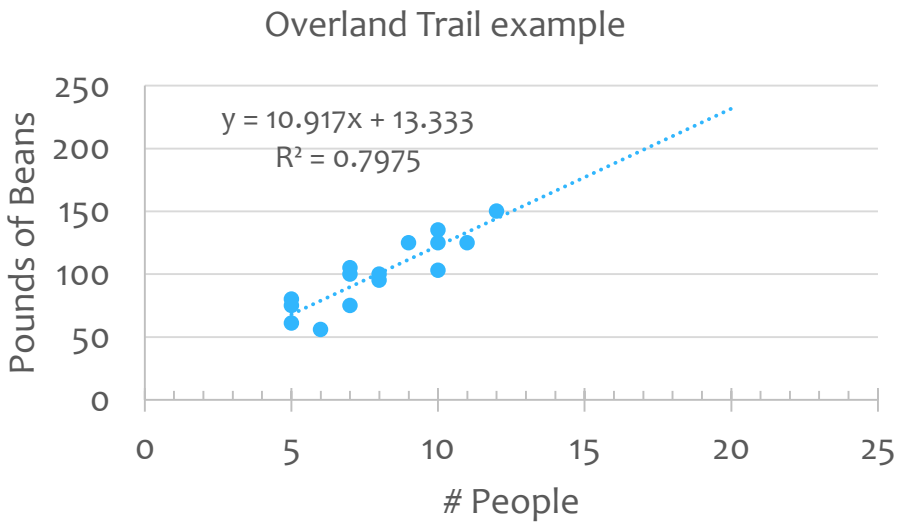
Students are asked to discuss ways to decide how many pounds of beans a family with 20 people would actually eat.

As the teacher, you already know what the plots look like, but the students haven't seen these yet:

#people	5	8	6	7	11	10	5	7	10	5	8	7	9	12	10
Pounds of beans	61	95	56	75	125	135	80	100	103	75	100	105	125	150	125

Students are asked to discuss ways to decide how many pounds of beans a family with 20 people would actually eat.
As the teacher, you already know what the plots look like, but the students haven't seen these yet.
The true best-fit line is shown, but this lesson is about informal fit.





A. Mary responds first, stating "You could look at people with like 10 people in their families and just double that amount that they use."

How would you respond to this student? Please type your answer in the Webinar question box.

Overland Trail, continued

B. The class is convinced that Mary's strategy is the best one to take. However, the curriculum writers designed this question to be an introduction to the informal line of best fit, which is the focus of the day's lesson.

How would you:

* convince the students that Mary's strategy is not the best one?
* transition from this "scaling" method to "best fit line" method?
* help the students look at the data from an aggregate view (looking at data set as a whole) as opposed to a case-oriented view (looking at one data point at a time)?

Please type your thoughts in the Webinar question box.

CCSS: Statistical Association High School, Quantitative

* CCSS.Math.Content.HSS-ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
* CCSS.Math.Content.HSS-ID.B.6c Fit a linear function for a scatter plot that suggests a linear association.
* CCSS.Math.Content.HSS-ID.C.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.

High School: Regression

* You are leading the class in analyzing the relationship between GPA and ACT scores for a data set. You have asked your students to use technology to find the correlation coefficient, coefficient of determination, and regression line for the data set. One pair of students asks for your help. They worked independently and are comparing their answers. They have the same correlation coefficient & coefficient of determination, but their regression lines are different. They are asking you for help to understand how this could be possible.
* What is the most likely thing these students did?

Please type your answer in the Webinar question box.

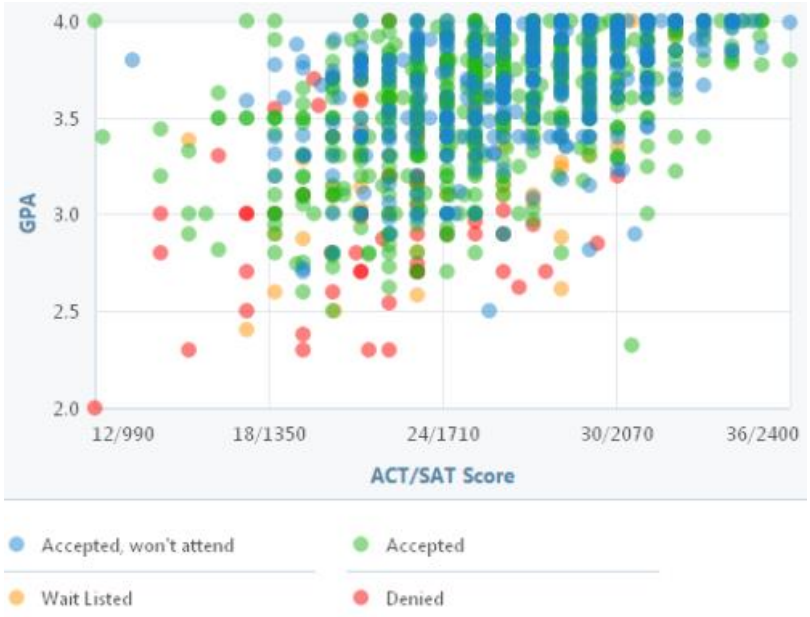
* **Without giving away the answer to them**, what would you say/do in responding to them?

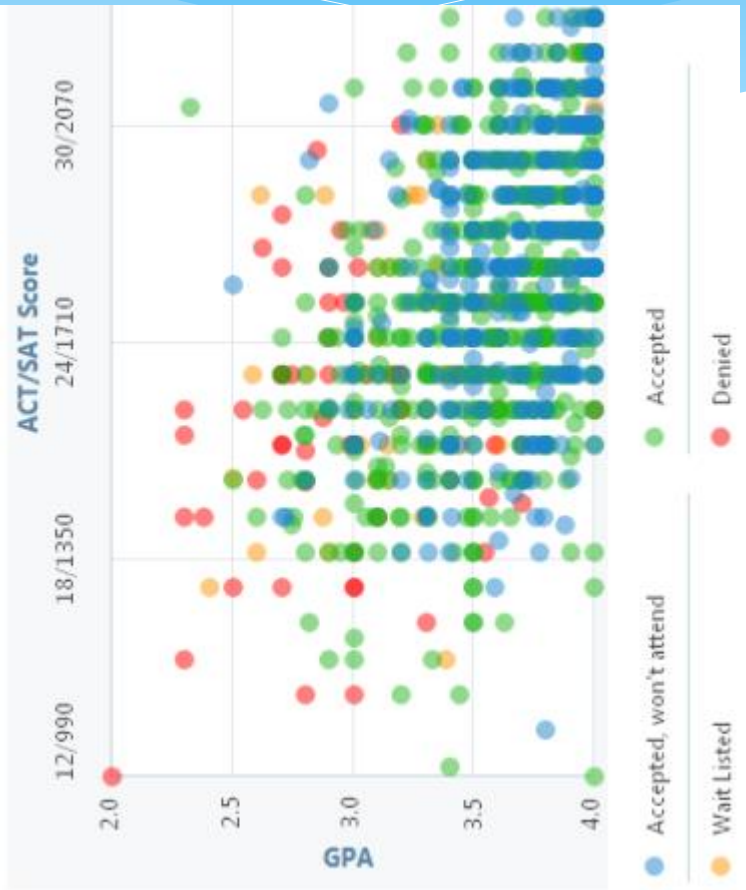
Please type your answer in the Webinar question box.

Possible Responses

* Ask both students to use their regression line to predict the ACT score of a student with a 3.0 GPA
  * One will have an easy time of it, the other will take a while. They also will not get the same predicted value!
  * Ask each to explain their steps to the other one.
  * What are they trying to predict?
* Ask both students to draw a scatterplot of their data.
  * Their graphs will not be the same.

GPA and ACT for Admission





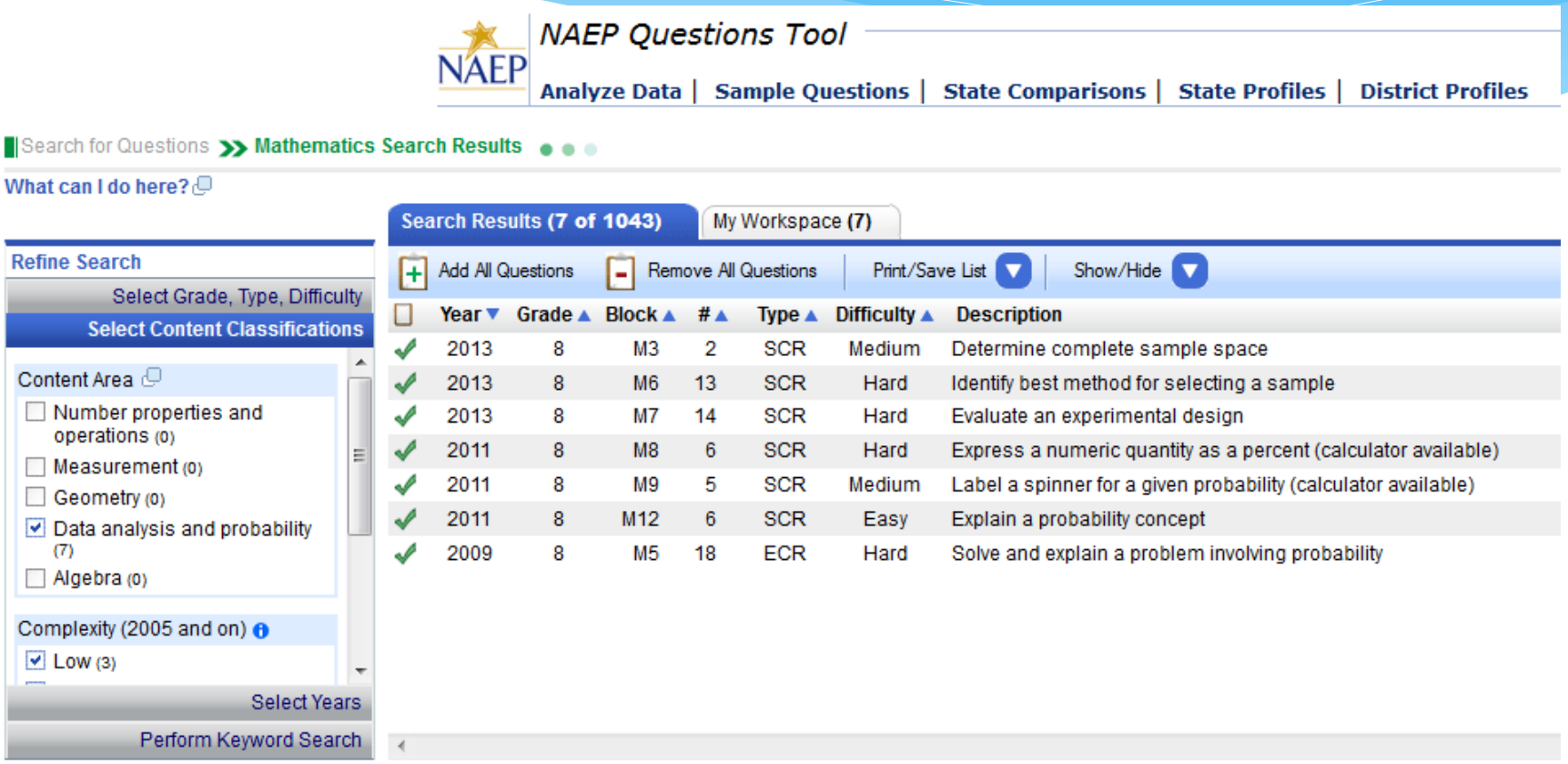
Labels on the axes help sort out the confusion—but calculators often can't do that.

Elementary School

SKT tasks involving analysis of children's thinking

* One approach researchers have used to develop and assess content knowledge for teaching is to have prospective and practicing teachers analyze and respond to children's thinking.
* Some assessments present common misconceptions and patterns of thinking from children and ask respondents to comment on children's work and describe ways to help their thinking develop.

Producing SKT tasks with the help of the NAEP website (see handout)



SKT tasks to try (see handouts)

* Mean and median (handout)
  * Reflection questions:
    * What difficulties might prospective teachers have in responding to these tasks?
    * What kinds of SKT might the tasks help prospective teachers develop?
    * Which kinds of SKT might the tasks assess?
* Also see sample tasks based sampling and bivariate data NAEP items (handouts)

What I learned about my students' KCT from the mean and median task

Student 2

No additional support or challenge for the child is suggested.	Additional practice problems to help retain knowledge are suggested	Response acknowledges the need for more challenging work for the child General probing questions are suggested to prompt the child to explain further	Content-specific probing questions are suggested to prompt the child to explain further	The response suggests altering the original task given to the child in order to enhance the challenge of the task and extend the child's thinking

Student 3

No teaching intervention is proposed	Response proposes a direct explanation approach consisting of learning rules and practicing procedures	Content-specific probing questions are suggested to prompt the child toward relevant features of data set for the given task	A sequence of tasks designed to help the child understand underlying statistical ideas is proposed, with teacher prompts to help the child reflect on the structures of the tasks

Feedback

* Thoughts on the use of tasks like these to develop teachers' SKT
* Thoughts on the use of items like these to assess SKT
* Ideas on implementing tasks and assessment items into your courses

Discussion

* What resources do you need to help you address teacher preparation for teaching the CCSS-M statistics standards?
* How can we help teachers who are primarily experienced and trained in mathematics teach statistics in a way that is faithful to the discipline?

PANEL DISCUSSION FRIDAY, MAY 23RD 1:30-2:00 EST

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Middle/Secondary, Helpful Links, Resources, etc. :

* http://bit.ly/StatEdCoursepackEMU