EVALUATING EVIDENCE OF STUDENT UNDERSTANDING

USCOTS 2019

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Introductions

- **Camille Fairbourn**
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- **Take 5 minutes to introduce yourselves!**

Warm Up! k = 2 clustering problem

- At your table, there is a list of 14 exercises you might find in an introductory statistics course.
- With your neighbors, sort these 14 exercises into two mutually-exclusive groups. Use the following questions to guide your sorting.

    What would a successful student response look like for this question?

    What are the qualities of the questions in this group that promote these responses?

- Prepare for an accordion conversation!

Open-ended tasks: a framework for formative assessments

Framework developed by Thomas Cooney, Wendy Sanchez, Keith Leatham, and Denise Mewborn.

- Many questions call for a single number, figure, or object.

Example 1: Camille & John are invited to a conference. There is an 80% chance Camille will attend, a 75% chance John will attend, and a 95% chance that at least one of them will attend. How likely is it that neither of them will attend?

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Example 1: Camille & John are invited to a conference. There is an 80% chance Camille will attend, a 75% chance John will attend, and a 95% chance that at least one of them will attend. How likely is it that John will attend the conference if he *knows* Camille has already registered?

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- Many questions call for a single number, figure, or object.

Example 1 Revised: Describe two events A and B so that $P(A|B) = \frac{1}{3}$. Show that your two events satisfy the condition.

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- Many questions call for a single number, figure, or object.

Example 2: Compute the standard deviation of the set of data below:

1 4 5 5 5 10 11 13

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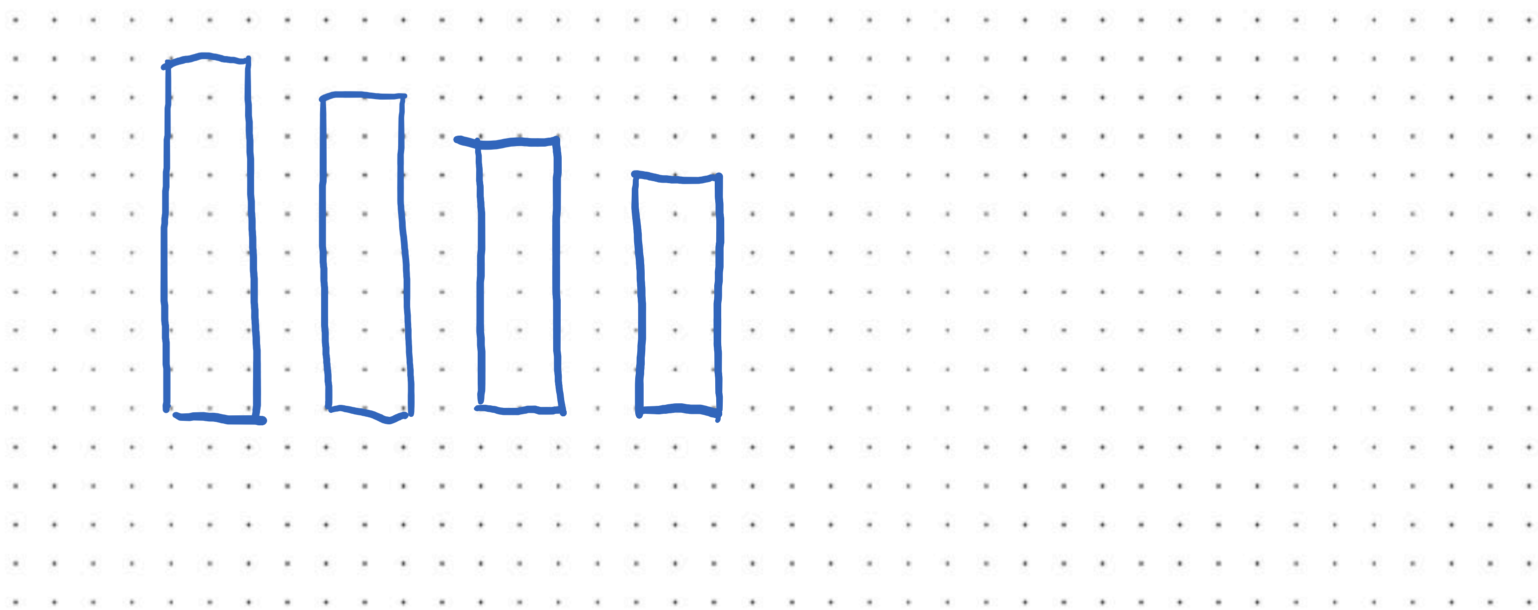
- Many questions call for a single number, figure, or object.

Example 2 Revised: In space provided, draw 4 rectangles for which the standard deviation of the rectangles' heights would be greater than the standard deviation of their widths.

Why use open-ended tasks?

Draw 4 rectangles for which the standard deviation of the rectangles' heights would be greater than the standard deviation of their widths.



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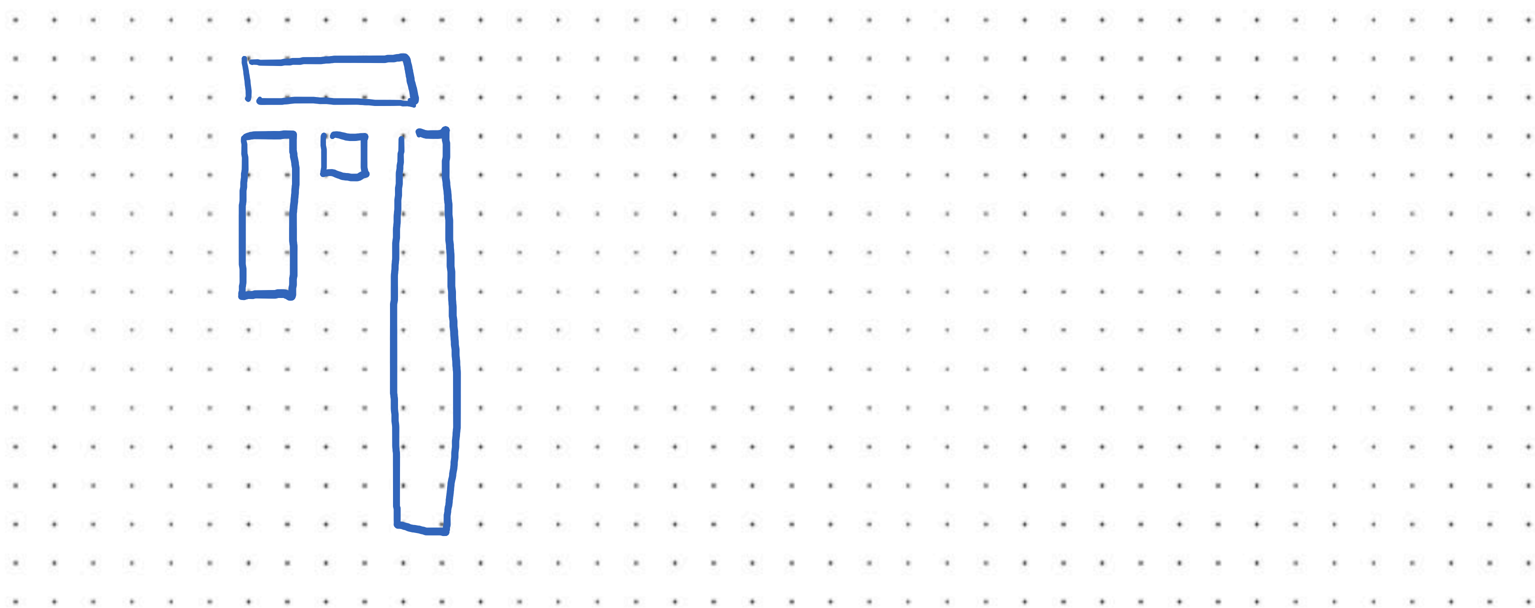

Open-ended tasks allow a variety of correct responses and require students to communicate their thinking. It provides instructors with more evidence of student understanding.

Why use open-ended tasks?

Draw 4 rectangles for which the standard deviation of the rectangles' heights would be greater than the standard deviation of their widths.

Open-ended tasks also help us address another need. Often we pay a great deal more attention to *how* to do statistical procedures than to *when* to do them.

Why use open-ended tasks?

Ex. Consider a hypothetical vaccine for malaria. Suppose this vaccine is tested with 500 volunteers in a village who are malaria free at the beginning of the trial. Two hundred will be randomly selected to receive the vaccine and the rest will not be vaccinated. Suppose that the chance of contracting malaria is 10% for those who are not vaccinated.

Do the results below suggest the vaccine is effective at reducing the risk of contracting malaria? Provide at least two statistical procedures as justification for your decision.

	Contracts Malaria	Does not contract Malaria
Vaccinated	13	187
Not Vaccinated	37	263

Why use open-ended tasks?

- Tasks chosen in introductory statistics courses influence the formation of students' mindsets about statistics.
- When students are given closed questions with singular correct answers, they learn that statistics is more about *performance* than it is about *process* and growth.
- Open tasks give students space to learn rather than just preparation for assessment and offer instructors much more data on how students are engaging with course content.

Why use open-ended tasks?

- Both closed-ended and open-ended questions are appropriate for assessing students' thinking.
- A test consisting solely of open-ended questions would be difficult to grade and might not cover the curriculum adequately.
- But closed-ended questions do not require successful student responses to communicate student thinking processes as well as open-ended questions.

Characteristics of Open-Ended tasks

1. <u>Involve significant statistics</u>. Assessment items, particularly open-ended ones, tell students what is valued and what is important. Open-ended items often have several objectives, thereby giving students opportunities to demonstrate their understanding of connections across statistical topics and how they can model real world phenomena.
2. <u>Elicit a range of responses</u>. Unfortunately, when the answer to a task is a single number or mathematical object, students often conclude there is only one way to solve the problem. There must be multiple successful student responses to the task.

Characteristics of Open-Ended tasks

3. Require communication. By design, students communicate their thinking, allowing instructors a better chance of understanding what they know and can apply in a given scenario.
4. Be clearly stated. The fact that a question is open-ended should not blur its intent. The question should have a clear purpose even though there might be many possible responses. Further, students should know what is expected of them and what the teacher expects as a good and complete response. Beware the dangling "Explain!"

Creating Open-Ended Tasks

- Creating open-ended tasks for students (or tasks for students, generally) can be time consuming.
- Common strategies include:

1. Ask students to create a situation that satisfies certain conditions.
2. Ask students to explain which is correct among contradicting claims.
3. Ask students to solve a problem / answer a question in two or more ways.

Creating Open-Ended Tasks

1. Ask students to create a situation that satisfies certain conditions.

   Ex. Create a data set of at least 5 numbers such that the median is larger than the range.

   Ex. Draw two histograms that have the same mean and same range, but different standard deviations.

Creating Open-Ended Tasks

2. Ask students to explain who is correct among contradicting claims.

Ex. Two teaching assistants are grading midterm exams. When they calculate final grades, one TA notices a student was placed in the wrong lab section.

When he makes the correction, the average midterm score *increases* in both lab sections. This leads the other TA to think the first has miscalculated scores and needs to redo his work. Do you agree?

Creating Open-Ended Tasks

2. Ask students to explain who is correct among contradicting claims.

Ex. John and Camille are analyzing two data sets they each collected and find that they have the same five-number summaries.

John thinks Camille must have copied his data. Do you agree with him? Create at least two example data sets to justify your opinion.

Creating Open-Ended Tasks

3. Ask students to solve a problem in two or more ways.

Ex. You wish to have a sample of 50 students at an elementary school. Describe 2 different ways of constructing a stratified sample of the students.

Enough talking - break-out time!

Work with neighbors to draft your own open-ended tasks.
Submit your drafts to **bit.ly/EESU19**

Three options:

1. Work on ‘opening’ closed tasks you currently use in class.
2. Develop new open tasks using intro stats learning objectives as a guide.
3. Revise exercises from original set of 14 sample tasks.

Submitted files should include authors’ names and be titled to indicate the topic / learning objective assessed.

Break-out time.

Work with neighbors to draft your own open-ended tasks.
Submit your drafts to **bit.ly/EESU19**

Common ways of creating ‘open’ tasks:

1. Ask student to create an example that satisfies parameters.
2. Ask students to determine which is correct among competing claims.
3. Ask students to answer a question in more than one manner.
4. Others?

Submitted files should include authors’ names and be titled to indicate the topic / learning objective assessed.

Contact Information

- https://msu.edu/~fairbour/Presentations.html