



Teachers Teaching with Technology™
Professional Development from Texas Instruments

Professional Development Webinars

What's Typical?

Sampling Distributions and Simulation

Fall 2017

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Moderator Bio



Mike Houston

**T³ National Instructor
Riverside High School
Ellwood City, PA**

Mike is in his twelfth year of teaching high school mathematics in Ellwood City, PA. While participating in a TI-Navigator™ Fast-Track in 2007, he learned how technology can effectively cultivate students' wide range of learning styles. During this time, Mike has served as a T³ National Instructor and a contributing author for MathForward™.

Panelists' Bios



Landy Godbold

T³ National Instructor

Atlanta, GA

Landy holds BS and MS degrees in Applied Mathematics from Georgia Tech and retired after 40 years of teaching mathematics at The Westminster Schools in Atlanta, GA. He introduced statistics as an elective course early in his tenure there and has actively promoted the teaching of statistics since his participation in the Woodrow Wilson Summer Mathematics Institute (focus on statistics) in 1984. He continues to look for new ways to use technology to help students understand subtle statistical concepts.



Gloria Barrett

T³ National Instructor

Durham, NC

Recently retired from the classroom, Gloria Barrett taught secondary mathematics for 30 years, most of them at the North Carolina School of Science and Mathematics in Durham, NC. She has served as a T³ national instructor and College Board* consultant for many years. Gloria has conducted numerous workshops for teachers, both nationally and internationally, focused primarily on mathematical modeling and strategies for teaching statistical concepts using TI-84 calculators.

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Agenda

- Welcome & introductions
- Why do we need sampling distributions?
- Example using categorical data: AP* Statistics Exam 2005, FR #4 – Prob Sim APP with TI-84 Plus CE
- Example using numerical data: AP* Statistics Exam 2009 Form B, FR #5 – Simulation with TI-Nspire™ CX
- Online Resources
- **Win registration for two to the 2018 T³™ International Conference**
Attend this webinar for a chance to win complimentary registration for two to the 2018 T³™ International Conference, March 2-4, 2018, in San Antonio, Texas.

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Expected Outcomes

Understand Key Concepts:

- **Hypothesis tests** embody the “what’s typical” logic.
- Identifying what’s typical requires a **distribution** that allows comparison of what’s possible to what has actually occurred.
- Sampling distributions are integrally **connected to the hypothesis** being tested.

Explore Technology Skills:

- **Design simulations** to generate reference distributions for given hypothesis test scenarios.
- **Implement simulations** using TI-84 tools such as **ProbSim App** and **randnorm** or TI-nSpire™ tools such as **randnorm** and **capture**.
- **Make hypothesis test decisions** using simulated reference distributions.

Previous Webinars

- Graphical Displays of Data
- Sampling and Design
- Probability
 - On-demand webinars can be found at <http://education.ti.com/tiwebinars>

Tonight

- Sampling Distributions
 - why we need them
 - how we get them

AP* Statistics Exam 2006B, FR #6e (essence)

Sunshine Farms wants to know **whether there is a difference in consumer preferences** for two new juice products. In a blind taste test, 6 of 8 randomly chosen consumers preferred “Tropical Taste” to “Citrus Fresh.”

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Questions to consider:

- Do the taste results provide *any* evidence to support the existence of a difference?

sample proportion preferring TT = 6/8, not 0.5

- Do the taste results provide *convincing* evidence to support the existence of a difference?

hmm???

- How can we decide?

What's typical?

The Logic of Hypothesis Tests

- The (null) hypothesis defines some “world”— a hypothetical population
- We observe the value of a sample statistic (in the “real” world) that measures a feature of interest
- We decide whether that real value is *typical* for the “world” of the hypothesis—is reality consistent with hypothesis?

- Sampling distributions show what sample values are typical!

Where do sampling distributions come from?

- The null hypothesis
- Theory
- Simulation

AP* Statistics Exam 2005, FR #4 (Abridged)

Some boxes of a certain brand of cereal include a voucher for a free video rental inside the box. The company that makes the cereal claims that a voucher can be found in 20 percent of the boxes. However, based on their experiences eating this cereal at home, a group of students believes that the proportion of boxes with vouchers is less than 0.2. This group of students purchased 65 boxes of the cereal to investigate the company's claim. The students found a total of 11 vouchers for free video rentals in the 65 boxes.

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AP* Statistics Exam 2005, FR #4 (Abridged)

Suppose it is reasonable to assume that the 65 boxes purchased by the students are a random sample of all boxes of this cereal. Based on this sample, is there support for the students' belief that the proportion of boxes with vouchers is less than 0.2?

We want to think about how we can answer this question without performing a formal significance test.

Questions to consider

- What is the parameter of interest?

the proportion of boxes with vouchers in the population

- What would the null hypothesis claim about this parameter's world?

the value of the population proportion is 0.20

- What is the value of the statistic that measures the sample proportion?

$11/65 \approx 0.17$

- Do the sample results provide *any* evidence to support the students' belief?

Yes, sample proportion of boxes with vouchers < 0.20

- Do the sample results provide *convincing* evidence to support the students' belief?

Do the sample results provide convincing evidence to support the students' belief?

We need to decide whether the sample value 0.17 is typical for the “world” where the true proportion is 0.20.

We can use simulations to generate the distribution of values of sample proportions that we get in samples of size 65 in the world where the population proportion is 0.20.

Think about how you could use a container of marbles to simulate the proportion of boxes containing vouchers that we would get in a sample of 65 boxes if the null hypothesis is true and the company puts vouchers in 20% of the boxes.

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Probability Simulation APP

Available for TI-83 Plus, TI-84 Plus, TI-84 Plus C, and
TI-84 Plus CE

Can download from:

<https://education.ti.com>

AP* Statistics Exam 2009 Form B, FR #5

A bottle-filling machine is set to dispense 12.1 fluid ounces into juice bottles. To ensure that the machine is filling accurately, every hour a worker randomly selects four bottles filled by the machine during the past hour and measures the contents. If there is convincing evidence that the mean amount of juice dispensed is different from 12.1 ounces or if there is **convincing evidence that the standard deviation is greater than 0.05 ounce**, the machine is shut down for recalibration. It can be assumed that the amount of juice dispensed into bottles is normally distributed.

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AP* Statistics Exam 2009 Form B, FR #5

During one hour, the mean number of fluid ounces of four randomly selected bottles was 12.05 and the standard deviation was 0.085 ounce.

Questions to consider:

- Do the sample results provide *any* evidence that population standard deviation exceeds 0.05 ounces?

sample standard deviation = 0.085, which is greater than 0.05

- Do the sample results provide *convincing* evidence that population standard deviation exceeds 0.05 ounces?

hmm???

AP* Statistics Exam 2009 Form B, FR #5

(b) To determine whether this sample of four bottles provides convincing evidence that the standard deviation of the amount of juice dispensed is greater than 0.05 ounces, a simulation study was performed. . .

How???

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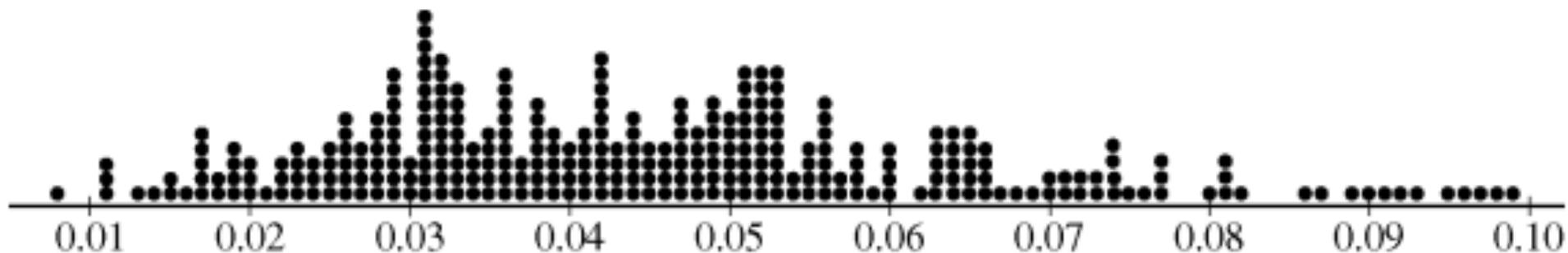
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“If there is convincing evidence that the **mean amount of juice dispensed is different from 12.1 ounces** or if there is **convincing evidence that the standard deviation is greater than 0.05 ounce**, the machine is shut down for recalibration. It can be assumed that the **amount of juice dispensed into bottles is normally distributed.**”

Let's take that to TI-*nSpire*[™] . . .

. . . In the simulation study, 300 samples, each of size 4, were randomly generated from a normal population with a mean of 12.1 and a standard deviation of 0.05. The sample standard deviation was computed for each of the 300 samples. The dotplot below displays the values of the sample standard deviations.

AP* Statistics Exam 2009 Form B, FR #5



Use the results of this simulation study to explain why you think the sample provides or does not provide evidence that the standard deviation of the juice dispensed exceeds 0.05 fluid ounce.

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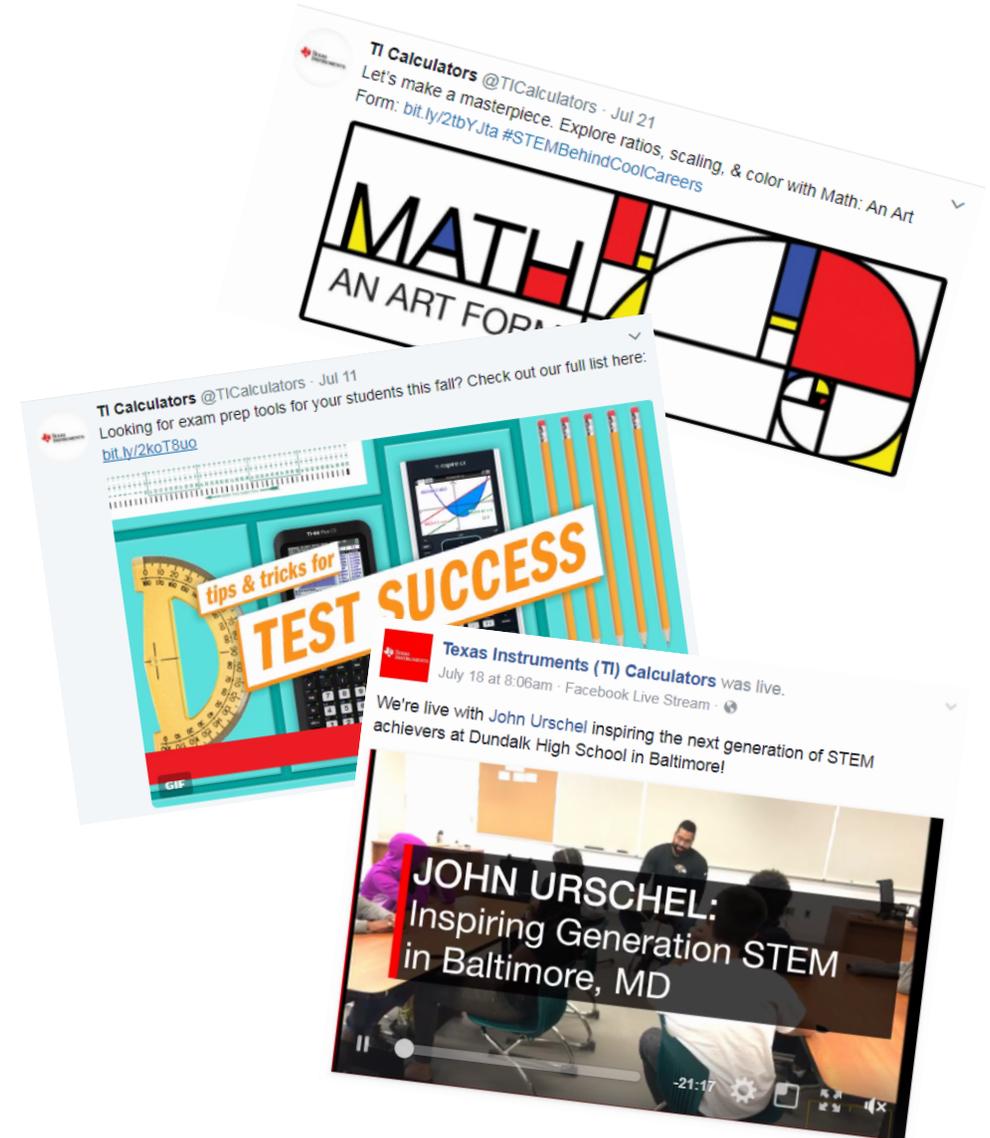
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Certificate of Attendance

- To generate a Certificate of Attendance with your name and information about the webinar, go to <http://bit.ly/2eLs5MH>

The image shows a screenshot of the Texas Instruments Education Technology website. The top navigation bar includes the Texas Instruments logo and the text 'Education Technology'. Below this, the heading 'Generate Your Certificate · 获取证书 · Generar Certificado de Asistencia' is displayed. The main content area is divided into two columns. The left column contains information about TI-Nspire technology, including a section titled 'What's New and Tried & True with TI-Nspire(tm) Technology' and a 'Go · 获取证书 · Ir' button. The right column contains a form for entering the user's name, with fields for 'Your Name · 您的姓名 · Su Nombre:' and a 'Go · 获取证书 · Ir' button. A large red arrow points from the 'Go' button to a sample certificate. The certificate is titled 'Math Nspired Resource Center: Calculus' and 'CERTIFICATE OF ATTENDANCE'. It is presented to 'Your Name' and dated 'March 8, 2011'. The certificate also includes the Texas Instruments logo and the tagline 'Your Passion. Our Technology. Student Success.™'.

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Technical Questions: 972-917-8324
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Thank you!

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