

Student Self-Assessments in a Computational Data Analysis Course

I teach basic (undergraduate) statistics and data analysis to students at the graduate level. The purpose of my course is to prepare students for computational data analysis they will see in their downstream courses, as well as in their future careers as military officers and US Department of Defense civilians.

As I describe my methods to allow the students to self-assess their computational thinking skills, I'm going to also describe a current research project at the Naval Postgraduate School called CHUNK Learning. I've been given an opportunity to integrate my teaching methods and materials with the software proof-of-concept we developed and I currently have 27 students learning computational statistics and data analysis using the CHUNK Learning platform in an enriched classroom environment (the quarter ends at the end of September, so feel free to ask me in October how it went).

The screenshot shows the CHUNK Learning interface for the topic "Conducting One-Sample Hypothesis Tests". The interface is divided into four columns: Why, How, Methodology, and Assessment. Each column contains a list of activities with a "MATCH METER" icon and a progress indicator. The "Why" column has two activities, "How" has two, "Methodology" has one, and "Assessment" has two. The interface also includes a user profile for Michelle Isenhour, a navigation menu, and a "CHUNK TIME" indicator showing 43 hr 54 min 29 sec.

Column	Activity Title	Duration	Match Meter	Progress
Why	Roger Clemens, Barry Bonds, Performance-Enhancing Drugs, and Hypothesis Testing	10 min	0/0	0/0
	The Statistical Discovery Thanks to a Guinness Brewer	2 min 49 sec	0/0	0/0
How	Crash Course Statistics: What are some problems encountered in the use of p-values?	12 min 13 sec	0/0	0/0
	Crash Course Statistics: How can p-values go wrong?	12 min 14 sec	0/0	0/0
Methodology	Conducting One-Sample Hypothesis Tests	1 hr 6 min	1/1	1/1
Assessment	Assessment: Conducting One-Sample Hypothesis Tests	30 min	2/2	2/2
	Blog Entry - Reflections on Conducting One-Sample Hypothesis Tests	3 min	2/2	2/2

Because the majority of my students come from a variety of backgrounds and academic programs, I try to give them a broadening experience (prior to the assessment) using a three-pronged approach. First, I try to find motivational videos, papers, or blog articles. In CHUNK Learning, these activities motivate the learner by attempting to answer the “Why should I learn this?” or “How will I use this in real life?” questions before the student engages with the learning material. The following table lists some examples that I typically use when covering hypothesis testing. The intent is that the student will watch or read those activities that best align with his/her interests (in fact, the CHUNK Learning environment presents the materials to the student so that the ones with the highest “match” to the student profile is on top).

Topic	Type	Title	URL
Hypothesis Tests	Why?	Which Hypothesis Test to Perform	https://towardsdatascience.com/which-hypothesis-test-to-perform-89d7044d34a1
One-sample Hypothesis Tests	Why?	Roger Clemens, Barry Bonds, Performance-Enhancing Drugs, and Hypothesis Testing	https://sigmazone.com/clemens_bonds_hypothesis_test/
One-sample Hypothesis Tests	Why?	The Statistical Discovery thanks to a Guinness Brewer	https://youtu.be/U9Wr7VEPGXA
One-sample Hypothesis Tests	How?	Crash Course Statistics: How can p-values go wrong?	https://youtu.be/WWagtGT1zH4
Two-sample Hypothesis Tests	How?	Does the Nike Vaporfly Running Shoe Make a Difference?	http://www.nytimes.com/interactive/2018/07/18/upshot/nike-vaporfly-shoe-strava.html
Two-Sample Hypothesis Tests	How?	Which Movie is the Best?	https://towardsdatascience.com/hypothesis-testing-in-real-life-47f42420b1f7
Two-Sample Hypothesis Tests	How?	Cryptocurrencies are Less Correlated with Bitcoin in 2019	https://blockonomi.com/cryptocurrencies-are-less-correlated-with-bitcoin-in-2019/
Two-Sample Hypothesis Tests	How?	Preferred Leadership Styles of Student Athletes in a Midwest NAIA Conference	https://thesportjournal.org/article/preferred-leadership-styles-of-student-athletes-in-a-midwest-naia-conference/

Then, when creating the lesson plan (referred to as the Methodology in CHUNK Learning), I program a pre-class assignment that is intended to serve as a self-assessment for the student. The student first reads/reviews the text and tries the assignment. The student is then presented with the solution, along with my MATLAB script file (or Live Notebook). This allows the student to determine where he/she is deficient prior to attending the class lecture. Additionally, in the Methodology portion, I tend to provide a variety of resources (tools for their toolbox) from the internet (MATLAB documentation, how-to videos, etc.). The in-class lecture includes additional practical exercises or hands-on experience before the student returns to CHUNK Learning to attempt the assessment.

The assessment consists of a computer-based assessment that provides immediate feedback to the student. All assessments are open book, open notes and the use of a calculator or any statistical software package is authorized. Additionally, students may retake the computational assessment an unlimited number of times. Originally, the students were only allowed one attempt at the assessment, but I found that by allowing the student multiple attempts, they are able to learn from their mistakes and reinforce their computational skills.

The second part of the assessment consists of an individual blog entry which requires the student to conduct a final self-assessment by answering specific questions. The questions typically require the students to map the content to real-world examples and explain how they would utilize the techniques. Their blog responses allow me to gauge their comfort with the material as well as their comfort with computation using the statistical software package.

The focus at the individual topic level is centered around the student; all assessments allow the student to assess how well he/she understands the material. The course capstone project and final exam allow me, as the instructor, to assess overall learning.