

Using a Practicum as the Cumulative Assessment in Introductory Statistics

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Cumulative / Final Assessments in the Introductory Statistics Course



What do you do? <https://forms.gle/XXnHZjVGfgnnpbB9M9>

Introduction to Statistics @ Rose-Hulman

Engineering Statistics (MA223)

Required for several engineering majors on campus

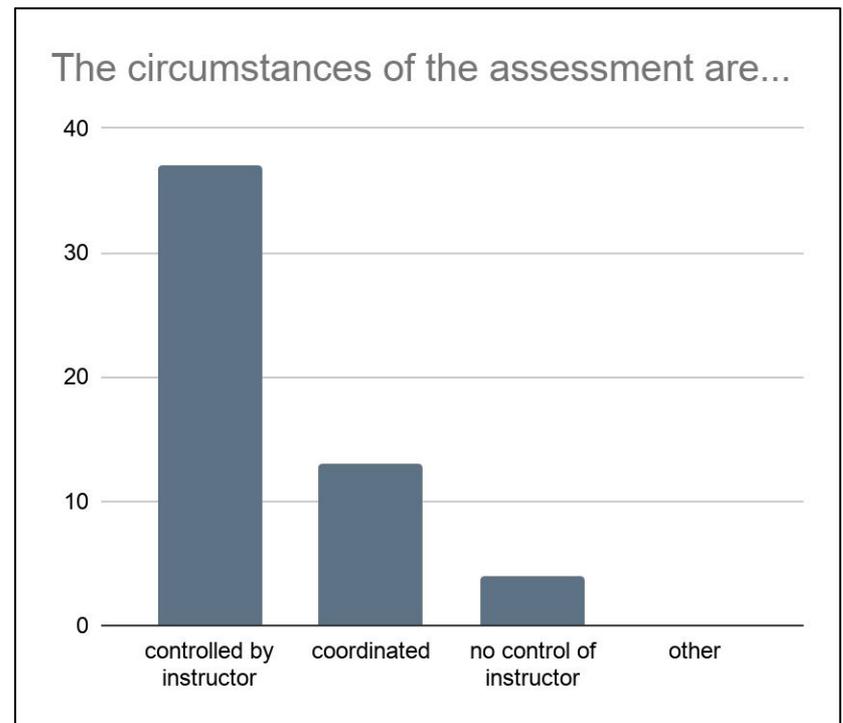
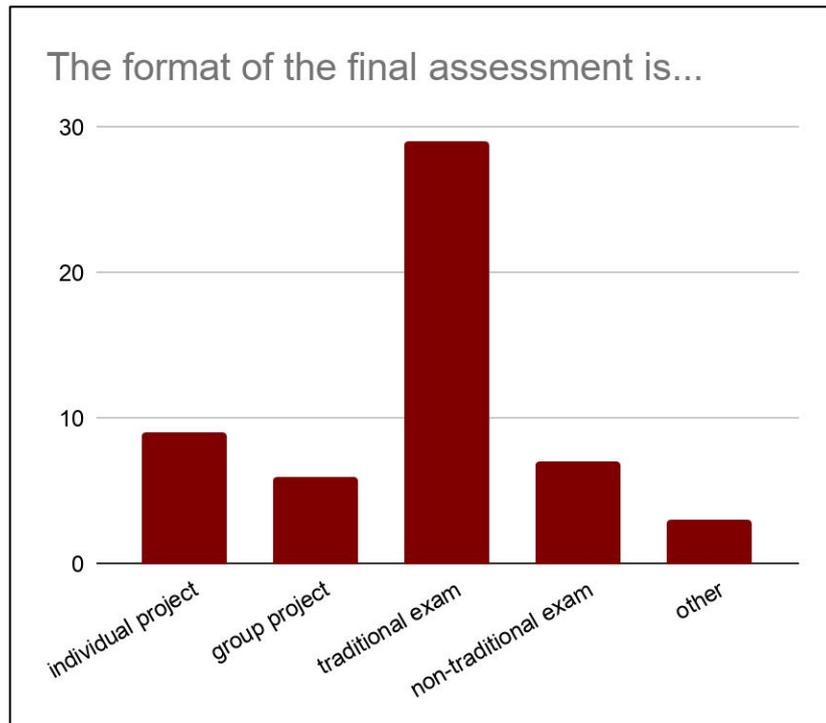
Offerings: Fall (3 x 25 students), Winter (3 x 25 students), Spring (6 x 20 students)

Informal coordination during the term

Final exam coordination -- required by departmental policy

- Jointly written by all instructors that term
- Held during an institute-assigned 4 hour time slot
- Consist of two separate “parts” (by-hand, computer-assisted)

Finals... What can you do?



Our Challenge #1: Student Engagement + Departmental / Institute Policy

Departmental and institute policies are not changing in the near future

We perceived students in the traditional, closed-notes individual final exam as

- Anxious
- Alone
- Apathetic to statistics (mostly worried about earning points)



The last time students are in our classroom, we want to see them

- Engaged
- Enthusiastic
- Experiencing statistics in an authentic way



Our Solution to Challenge #1: Statistical practicum



Does the average longest piece of a broken pasta noodle differ across different snapping techniques?

- Materials: ruler; up to 50 pieces of spaghetti
- Groups: 2-3 students
- Time: 2.5 hours
- Deliverable: completed “report” submitted through our LMS

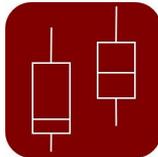
Report: Set of 12 Questions Guiding them Through an Analysis



Hypotheses



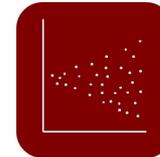
Study Design



Graphical Summary



Methodology



Checking Assumptions



Conclusions

Cumulative Assessment Options

	Exam	Project	Practicum
Coverage	Nearly Complete	Partial	Partial
Collaboration	Individual	Group	Group
Timing	Synchronous	Asynchronous	Synchronous
Assessment Type	Summative	Formative	Summative
Solutions	Fixed	Variable	Directed
Impact on Curriculum	High	Low	High

We see the practicum engaging students...

Curiosity

“Describe rattleback motion through a statistical model.”

Through Data Creation

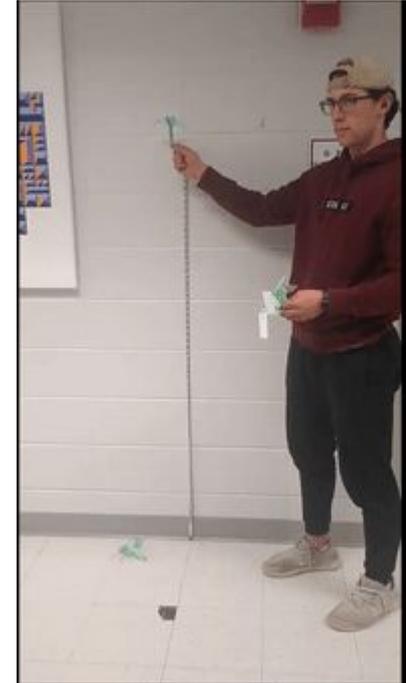
“Implement your recommended data collection procedure.”

With Peers

“Students work in teams... from start to finish.”

To Perform A Statistical Analysis

“Interpret the results of your investigation.”



STEM students directly engage with data analysis

Goal:

Provide students with a statistical experience similar to what they will see in their careers.

(STEM students are consumers and producers of statistics)

Responses: Matched 189, out of 300 initial and 237 final, survey responses. A total of 338 students over 5 terms and 16 sections have experienced the practicum. Two spring 2018-19 sections did not participate in the surveys.



We see student skills tested in the practicum

“It gave a way to show our skills in what we used for most of the class...”



“It applied all of our knowledge of statistics and we learned as well as being assessed.”

Example questions

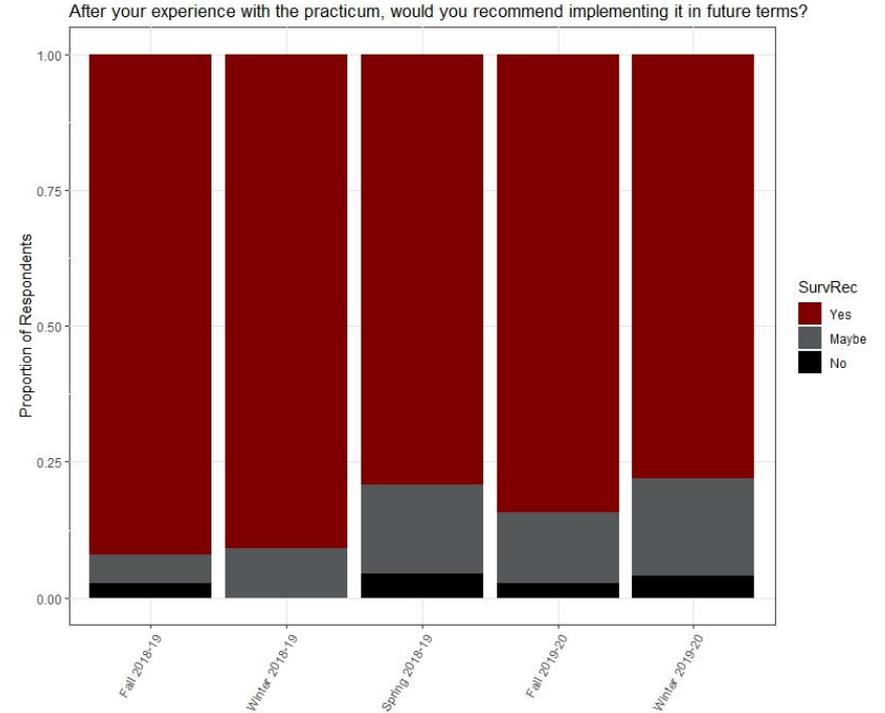
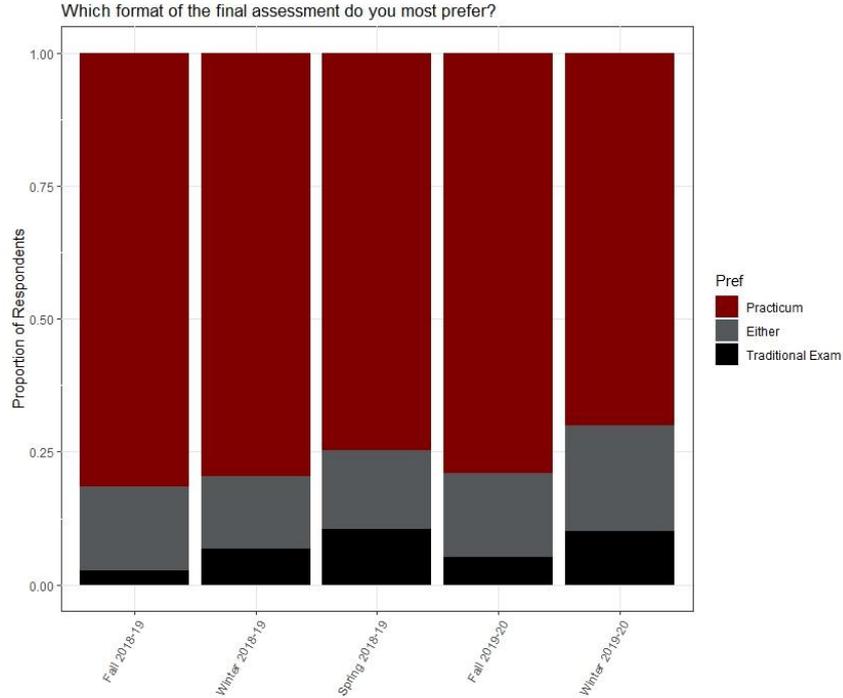
In order to complete your study during this time and use a method that we have seen, you will need to impose limitations to the scope of your study. For example, one universal limitation today is that all time measurements in your dataset were created only by group member(s). **Describe two more limitations that were imposed in your study.**

Provide two recommendations to improve the data collection process if you were to conduct a similar study in the future. Recommendations such as “buy more/better equipment” or “obtain a larger dataset” aren’t helpful and won’t receive credit, since they may not be feasible in practice.

“The lab part seemed very open ended and I feel there are many areas where we could have gone wrong.”

“It felt like it tested what you know as a whole (about experimental design, as well as statistical inference), and not just memorized definitions.”

Students tend to prefer the practicum



Response Rates: Fall 2018-19 (38/46) Winter 2018-19 (44/69) Spring 2018-19 (67/104) Fall 2019-20 (38/48) Winter 2019-20 (50/71)

We see happy students during the practicum

“I enjoyed getting to approach a problem from scratch and then exploring it over an extended period of time with peers.”

“Very relaxed, low-stress environment”

“I believe the collaboration in small groups worked extremely well...”

“I liked being able to bounce ideas off of each other to produce a more thorough experiment and assessment of data.”

“I felt much more relaxed and less pressured. I enjoyed applying what I had learned in the class rather than just regurgitating information on to a piece of paper.”

“I liked working in groups, and being able to incorporate a lab as it really captures all the concepts of the class without the pressure of an exam.”

“...Also it was kind of fun. It felt like a puzzle almost.”

What didn't seem to go well?

Working in groups. Course material was difficult. Collecting data is tedious. Wish could collect more data.

Our Challenge #2: Obtaining Necessary Supplies

For students to perform the data collection portion of the practicum, they will need access to materials.

We've been extremely fortunate to have support from both our department and a small institute grant. All supplies we've requested for this endeavor have been purchased for us.

What types of materials may your institution have on-hand for students to perform the data collection in your classroom?

<https://forms.gle/cQLjo2rdbiq5Edjm8>

What about remote learning?



Our Challenge #2: Obtaining Necessary Supplies

Items audience members came up with:

Rulers	Paper clips	Dice	Paper	Spinners
Rainbow Cubes	Poker chips	Rubber bands	Water	Post It Notes
Cell phones	Stop watch	Leaves	Online surveys	Resistors
Capacitors	Writing utensils	Food Items		

Google Doc (LMS survey)

Airsoft bead and 3-D printed paddles for sampling

Recycled paper from nearby printers

Boiling water with pots and pans + stove or hot plate

Themselves (e.g. shoe size, height, # siblings) as long as the info gathered doesn't violate student comfort level and/or FERPA

More ideas:

Calipers	3-D printed rattle backs	Coins
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Other Potential Challenges

Setting up the practicum assessment does take effort

Provide interesting or new topics each term

Create scenarios that may be addressed in less than 2 hours

Accommodating students with disabilities

Finding an appropriate space to host the practicum (classroom format & size)

Coordinating across multiple sections or instructors

Preparing students for the assessment during the term

What goals do you feel are most important for a final assessment in introductory statistics?

To get us started, here are a couple of ours:

- We want our exam to be authentic with regard to how students will use the material in their discipline (generally, senior design).
- We want our exam to reflect the structure of our course (both statistical reasoning/literacy as well as statistical design/analysis).

I want students to understand the usefulness and necessity of statistics in our everyday lives.

Retention of the material and being able to apply it to their career

Synthesis of topics learned and understand how this learning may be encountered in their academic/professional future

Fair and challenging assessment of what was covered during the semester

For students to be critical consumers of statistical research.

Comprehensive reflection on the full semester

What goals do you feel are most important for a final assessment in introductory statistics?

Thinking about data collection, variables, controls, various data analysis techniques. What questions they are trying to answer. Understand precision

With guided, leading questions, apply general concepts to a new experiment or hypothesis test design

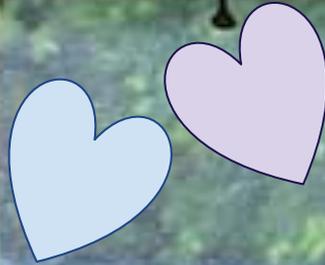
I want my project to be relatable to the students - topics they are interested in - but also show understanding of the concepts.

I want them to be able to communicate in writing statistical results in context, whether they actually analyze the data or read it in a report/article.

Give students an opportunity to look back over the course, synthesize -- and I can see what they've gotten from the big ideas of the course.



**Moderator
John Gabrosek**



**eCOTS
organizers**



**Session
attendees**



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Additional: Practicum Objects

Fall 2018-19: Pasta Breaking

Winter 2018-19: Frog & Bunny hoppers

Spring 2018-19: Rattlebacks

Fall 2019-20: Spider hoppers

Winter 2019-20: Classic helicopters

Spring 2019-20 (online): Design + Open-ended data analysis of circuit printing --
no data collection component.

Others potentially on the horizon:

Tiddly winks, Catapults, Mini rockets, Task repeatability