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TEACHING PORTFOLIO

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FORMATTING NOTES

- All text in purple is hyperlinked to internet resources.
- A digital version of my teaching portfolio is available at https://kimberlywebb.github.io/teaching_portfolio/

TEACHING PHILOSOPHY

As a statistics instructor, my goal is to prepare students to apply quantitative skills to real-world problems. Teaching is not just about showcasing a new topic in the classroom. Instead, it is about giving students the skills they need to continue learning and using statistics in their future classes and careers. I accomplish this goal of **instilling lifelong learning** through an emphasis on **real-world examples, consistent in-class practice, and transferable skills**.

The field of statistics does not exist in a vacuum, and nor should a class on statistics. In order for students to be able to use the skills they gain in my classes in their future careers, they need to practice selecting and deploying appropriate techniques and methods on **real-world problems**. As a TA in computing labs for graduate and undergraduate students, I accomplished this goal by helping students develop exploratory data analysis and assumption checking practices, using examples from public health disciplines. For instance, after I introduce students to methods for paired samples (i.e. Permutation tests, Wilcoxon Signed Rank tests), I ask them to select the appropriate statistical test for a study of new clinical guidelines on radiation dosages for lung cancer patients. We begin the example with exploratory data analysis exercises, where students examine distributions and summary statistics of clinic-average radiation doses from before and after the introduction of new practice guidelines. They answer questions that help them check the assumptions of the tests, like: *Is the shape of the distribution of dosages constant across time? What is the mean dosage before and after the change? What about the median?* With intuition from the plots, students conclude that a Wilcoxon Signed Rank test is *not* meaningful for their analysis, as the median radiation dosage remains constant across the guideline change, but the variance of the dosages narrows substantially. In the future, if they struggle to identify the appropriate statistical method for a problem at hand, they can repeat this exercise to explore their data and verify the assumptions of a given analysis.

My practice of including real-world projects, examples, and datasets in course material is complemented by my emphasis on **consistent in-class practice and feedback**. In larger classes, I will incorporate real-time practice and feedback with low-stakes iClicker and PollEverywhere questions. For every new concept or learning outcome, these formative assessments not only help students identify areas they need to study, they also inform my lesson planning. I will be able to adapt the amount of time I spend on concepts based on the results of in-class quizzing. In smaller courses, I plan to implement in-class practice in different ways. For example, in a course I have designed, entitled *Statistical Graphics and Communication*, one of my learning goals is for students to be able to verbally describe and critique a statistical graphic from the media. When I teach this class, I will scaffold this skill by providing students a graph from the media each week, along with a standard set of guidelines for interpreting the plot. During a lab or active learning session, I will pull aside a sample of students, one at a time, to practice verbally presenting the graph to me. This practice is deliberately low-stakes – students receive credit for participating, and I provide feedback that helps them excel on later presentations and summative assessments.

In the same way that frequent practice and feedback makes expectations clear for students, my course organization makes the **transferability of statistical concepts** clear for students' future careers. For example, I will not only state what the learning goals are for

my class, I will also explain *why* those goals are important for professionals in a variety of fields. Specifically, I will discuss how students can use course materials to continue learning in an advanced course or show their knowledge to a future employer. This practice helps students understand how their learning experience can help them achieve their unique professional goals. In my *Statistical Graphics and Communication* syllabus, I connect the core components of the course, like lecture notes, lab exams, and final projects, to the skills that students should have by the end of the semester. Moreover, I emphasize tangible products that students can take from the class and use in application materials, including formal statistical reports, a research poster, and a web application. I find that this transparency helps students understand the importance of course topics and assignments, while providing clear evidence of the transferability of classroom skills in future careers.

Commitment to Teaching Excellence

To refine my own teaching approach and practices, I have engaged in thorough pedagogical training at multiple institutions. While a student at the University of Michigan, I took a course on *Effective Teaching in Public Health*, which prepared me for my TA roles in introductory biostatistics classes for graduate and undergraduate students. At Cornell University, I have served as a Graduate Senior Lead Teaching Fellow with the Center for Teaching Innovation (CTI) since 2021. In this program, I reflected on my teaching practice through biannual teaching training, biweekly teaching discussions, and periodic teaching exercises. These experiences give me a toolkit to evaluate my own teaching success, and to continue developing and refining my teaching practice throughout my career.

I am also passionate about sharing teaching strategies and techniques with my broader community. Through my work with the CTI, I currently develop and facilitate multiple teaching workshops and conferences, with a focus on graduate and post-doctoral level trainees. In addition, through a competitive *Belonging at Cornell* grant, a colleague and I developed an in-depth program for early-career graduate TAs at Cornell, entitled the *Advanced Graduate Teaching Cohort*. As part of the intensive, multiday program, I developed materials and exercises on evidence-based inclusive teaching strategies, creating high-structure classrooms, and further developing teaching strategies for the cohort members. Given my prior experiences in the area of teaching training, I welcome opportunities to mentor early-career colleagues in their teaching development.

Teaching Experience and Preparedness

At Cornell University, I served as a TA for multiple graduate and undergraduate courses and led various TA development programs. I have worked with class sizes between 15 and 125 students, and my teaching modality has been both in-person and online (with both synchronous and asynchronous components).

I am prepared to teach introductory statistics and data science courses for undergraduate, graduate, and professional students. In addition, due to the nature of my research, I would also gladly teach graduate courses on categorical data analysis, measurement error methods, and statistical consulting and communication. My commitment to teaching excellence and my past pedagogical training also prepares me to teach pedagogy skills at the graduate and post-doctoral level, including TA trainings. In addition, I look forward to teaching students through research experiences.

TEACHING EXPERIENCE

Statistical Methods I, Cornell University

Role: Graduate Teaching Assistant
Instructor: Sumanta Basu, Ph.D.
Term: Fall 2020
Course Level: Graduate
Number of Students: ~ 110

Course Description: Students will learn to develop and use statistical methods to analyze data arising from a wide variety of applications. Students should learn to apply methodologies including descriptive statistics, point and interval estimation, hypothesis testing, inference for a single population, comparisons between two populations, one- and two-way analysis of variance, comparisons among population means, analysis of categorical data, and correlation and regression analysis.

Course Components: This class met twice a week, virtually, for lectures on statistical methodologies. The class also met for smaller, virtual, lab sections once a week. Typically, these lab sections consisted of code demonstrations and problem-solving related to the previous lecture's content. Students were assessed via weekly homework assignments completed in R as well as two take-home midterm examinations and a take-home final examination. Students also completed a data analysis project on a topic relevant to their own research.

My role: As a graduate teaching assistant, I led one lab section per week for approximately 30 students. In these labs, I developed lessons demonstrating code and problem-solving strategies in R, based on provided topics that were recently covered in lecture. For each lab topic, I developed supplementary slides where students filled-in definitions, equations, and core concepts throughout the lab, leading greater engagement and understanding of the material than coding alone. I also graded student problem sets, exams, and data analysis projects. In addition, I monitored student questions on Piazza (an anonymous question and answer platform) and hosted office hours once a week.
Selected lessons presented: Properties of random variables, confidence intervals, hypothesis testing, categorical data analysis

Sample materials: Slides from a "Categorical Data Analysis" lab that I developed are provided in the following pages.

Student Reviews: Anonymous reviews were elicited from students at mid-semester and at the end of the semester. Reviews were obtained for the entire course and for individual lab sections. My lab section evaluations are provided below for mid-semester and then the end-of-the-semester, respectively.
End-of-semester overall teaching rating: 4.89 / 5.0

BTRY 6010: Statistical Methods I

PRELIM 2 REVIEW SESSION: 4:55 PM – 6:10 PM

TA: KIM HOCHSTEDLER (SHE/HER)

NOVEMBER 17, 2020

WELCOME!

TODAY'S TOPIC: CATEGORICAL DATA ANALYSIS (CHI-SQUARED TESTS)

CALENDAR REMINDER

Tuesday, 11/17 @ 8:00 am EST: Inference on proportions with Dave

Tuesday, 11/17 @ 3:00 pm EST: Inference on means with Indra

Tuesday, 11/17 @ 4:55 pm EST: Categorical data analysis with Kim

Wednesday, 11/18 @ 3:00 pm EST: ANOVA with Steve

Wednesday, 11/18 @ 5:00 pm EST: OH with Dave

Thursday, 11/19 @ 8:00 am EST: Non-parametric inference and regression with Sumanta

Thursday, 11/19 @ 5:00 pm EST: OH with Sumanta

Friday, 11/20 @ 5:00 pm EST: OH with Kim

Sunday, 11/22 @ 7:30 pm EST: Prelim 2

TODAY'S SESSION

1. Overview and example of chi-square test for goodness-of-fit
2. Overview and example of chi-square test for independence
3. Question and answer time!

Please turn your camera on if you can and you are comfortable with it

Be ready to chat in your questions when we reach the Q&A time

Chi-squared tests of goodness-of-fit

OVERVIEW OF CHI-SQUARED TEST OF GOODNESS-OF-FIT

Ex. jury problems

When is this test appropriate?

We want to know if the **distribution of a variable in our sample** matches what we would expect from the **distribution of the population**.

General hypotheses

Null hypothesis: $p_1 = x, p_2 = y, \ldots, p_k = z$ (given)

p_i = proportion of some group in our sample

$x, y, \ldots z$ = known population proportions

Alternative hypothesis: At least one of the probabilities differs from those listed in the null hypothesis.

OVERVIEW OF CHI-SQUARED TEST OF GOODNESS-OF-FIT

Test Statistic

$$X^2 = \sum_{i=1}^{k} \frac{(O_i - E_i)^2}{E_i} \overset{H_0}{\sim} \chi^2_{df}$$

O_i: observed in our sample

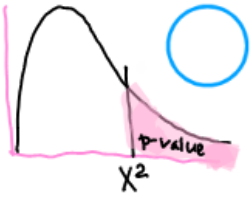
E_i: expected number

Always list the degrees of freedom

Degrees of freedom = $k - 1$, number of groups $- 1$

P-value determined by:

pchisq(X^2, df, lowertail = F)



OVERVIEW OF CHI-SQUARED TEST OF GOODNESS-OF-FIT

Assumptions

1. Independent observations

Check: Simple random sample

2. Expected cell counts of at least 5

Check: $n \cdot p_i$

Observed $n=100$

Population: 33%, 33%, 34%
33 33 34

PROBLEM #1: SET-UP

In 2018, the city of Ithaca took a census where they asked residents which ice cream shop was their favorite: Purity, Sweet Melissa's, or Cornell Dairy Bar. The results of the census were as follows.

- 56% of Ithacans preferred Purity.
- 25% of Ithacans preferred Cornell Dairy Bar.
- 19% of Ithacans preferred Sweet Melissa's.

In 2019, Cornell asked a simple random sample of 250 graduate students to answer the same question. They found the following results.

- 102 Cornell graduate students preferred Purity.
- 70 Cornell graduate students preferred Cornell Diary Bar.
- 78 Cornell graduate students preferred Sweet Melissa's.

Question: Are the ice cream shop preferences of Cornell Graduate Students different from the population of Ithacans?

PROBLEM #1: HYPOTHESES

In 2018, the city of Ithaca took a census where they asked residents which ice cream shop was their favorite: Purity, Sweet Melissa's, or Cornell Dairy Bar. The results of the census were as follows.

- 56% of Ithacans preferred Purity.
- 25% of Ithacans preferred Cornell Dairy Bar.
- 19% of Ithacans preferred Sweet Melissa's.

p_1 = probability that a Cornell grad student prefers Purity

Question: Are the ice cream shop preferences of Cornell Graduate Students different from the population of Ithacans?

p_2 = Cornell Daiy Bar p_3 = Sweet Melissa's

Null hypothesis:

$p_1 = .56$, $p_2 = .25$, $p^3 = .19$

Alternative hypothesis:

Any of the probabilities differ from those listed in the null hypothesis.

PROBLEM #1: TEST

Question: Are the ice cream shop preferences of Cornell Graduate Students different from the population of Ithacans?

Conclusion: $\alpha = 0.05$

```
# Run a chi-square goodness-of-fit test.
cornell_students_icecream <- c(102, 70, 78)
ithacans_icecream <- c(.56, .25, .19)

chisq.test(x = cornell_students_icecream,
           p = ithacans_icecream)
```

sample data (#'s)

population proportions

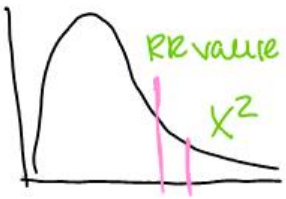
```
##
##  Chi-squared test for given probabilities
##
## data:  cornell_students_icecream
## X-squared = 30.798, df = 2, p-value = 2.052e-07
```

p-value < .05, reject the null

X^2 $k-1$

PROBLEM #1: TEST

Question: Are the ice cream shop preferences of Cornell Graduate Students different from the population of Ithacans?



Rejection region

```
##  Chi-squared test for given probabilities
##
## data:  cornell_students_icecream
## X-squared = 30.798, df = 2, p-value = 2.052e-07
```

Interpretation:

Since the p-value was $< .05 = \alpha$, at the 5% level of significance we have sufficient evidence to conclude that Cornell grad students have a different distribution of ice cream preferences than that given in the 2018 census of all residents of Ithaca.

PROBLEM #1: ASSUMPTIONS

Question: Are the ice cream shop preferences of Cornell Graduate Students different from the population of Ithacans?

1. Independent observations

Check: SRS of Cornell grad students ✓

2. Expected cell count of at least 5

Check:

$n = 250$, sample size

$p_1 = .56$ $\times 250$ $\quad p_2 = .25$ $\times 250$ $\quad p_3 = .19$ $\times 250$

$140 \geq 5 \quad 62.5 \geq 5 \quad 47.5 \geq 5$ ✓

Chi-squared tests of independence

OVERVIEW OF CHI-SQUARED TEST OF INDEPENDENCE

When is this test appropriate?

We want to know if **two responses/measures/variables** are **independent** of one another in a **single population**.

- Statistical independence occurs when an observed response of one variable does not depend on the response of another variable.

$$P(A|B) = P(A)$$

General hypotheses

Null hypothesis: There is no association between the variables (they are *independent*).

Alternative hypothesis: The variables are associated.

OVERVIEW OF CHI-SQUARED TEST OF INDEPENDENCE

Test Statistic

n_{ij}

$$X^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(n_{ij}-E_{ij})^2}{E_{ij}} \overset{H_0}{\sim} \chi^2_{df}$$

row and column

Degrees of freedom = $(r-1)(c-1)$, r = rows, c = columns

P-value determined by:

same as χ^2 GOF

OVERVIEW OF CHI-SQUARED TEST OF INDEPENDENCE

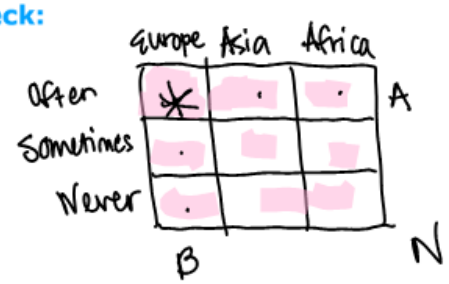
Assumptions

1. Independent observations

Check: SRS

2. Expected cell counts ≥ 5

Check:



$$\frac{\text{row sum} \times \text{column sum}}{\text{total}}$$

$$\frac{A \times B}{N} = * \geq 5$$

PROBLEM #2: SET-UP

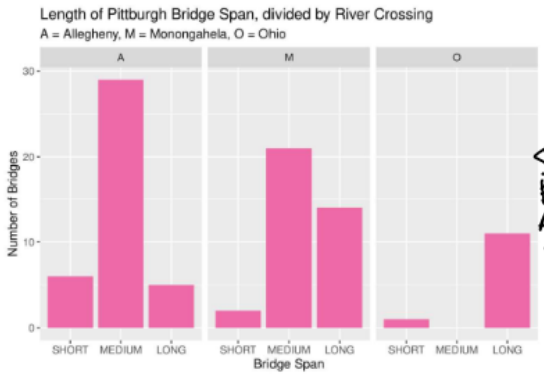
We have data on a simple random sample of 89 bridges in Pittsburgh. The following columns are present in the dataset, with one observation per bridge.

- **River:** which of 3 rivers the bridge crosses (M = Monongahela, A = Allegheny, or O = Ohio)
- **Purpose:** bridge purpose, including 3 categories ("Highway", "Aquduct", or "RR" = Railroad)
- **Material:** primary type of material the bridge is made of ("wood", "iron", or "steel")
- **Span:** categorical length of bridge span ("short", "medium", or "long")

Question: Are the span of the bridge and the river over which the bridge crosses independent? Provide statistical evidence.

PROBLEM #2: SET-UP

Question: Are the span of the bridge and the river over which the bridge crosses independent? Provide statistical evidence.



River

SPAN

	Allegheny	Monongahela	Ohio
SHORT	6	2	1
MEDIUM	29	21	0
LONG	5	14	11

PROBLEM #2: HYPOTHESES

Question: Are the span of the bridge and the river over which the bridge crosses independent? Provide statistical evidence.

Null hypothesis:

There is no association between bridge span and river

Alternative hypothesis:

The bridge span and the river are associated.

PROBLEM #2: TEST

Question: Are the span of the bridge and the river over which the bridge crosses independent? Provide statistical evidence.

M, L, S

M, A, O

```
# Run a chi-square test of independence.
chisq.test(x = pitt_bridges$span, y = pitt_bridges$river)
```

```
##  Pearson's Chi-squared test
##
## data:  pitt_bridges$span and pitt_bridges$river
## X-squared = 27.917, df = 4, p-value = 1.297e-05
```

Conclusion: p-value $< .05$

Reject the null hypothesis

PROBLEM #2: TEST

Question: Are the span of the bridge and the river over which the bridge crosses independent? Provide statistical evidence.

```
##  Pearson's Chi-squared test
##
## data:  pitt_bridges$span and pitt_bridges$river
## X-squared = 27.917, df = 4, p-value = 1.297e-05
```

Interpretation: Since the p-value < .05, at the 5% significance level, we have sufficient evidence of an association between bridge span (variable 1) and the river it was built over (variable 2) for bridges in Pittsburgh (setting)

PROBLEM #2: ASSUMPTIONS

Question: Are the span of the bridge and the river over which the bridge crosses independent? Provide statistical evidence.

1. Independent observations

Check: SRS

2. Expected cell count of at least 5

Check:

	Short	Medium	Long	Total
Allegheny	4	22.5	13.5	40
Monongahela	3.7	20.8	12.5	37
Ohio	1.2	6.7	4.0	12
Total	9	50	30	89

$$\frac{40 \cdot 9}{89} = 4$$

College of Agriculture and Life Sciences
Office of Academic Programs
Custom Course Evaluation

FALL 2020

Course
BTRY 6010 LAB 405

Instructor
/Hochstedler, Kim

Gender

3	Male
9	Female
0	Declined

Student Year

0	Freshmen
0	Sophomores
0	Juniors
0	Seniors
12	Grad Students
0	Other/Declined

School or College

7	Ag & Life Science
0	Arch, Art & Plan
0	Arts & Sciences
1	Engineering
0	Hotel
2	Human Ecology
0	ILR
0	Unclassified/ExMu
2	Graduate School
0	Declined

Course Intended/Required for Major

7	Yes
4	No
1	Undecided
0	Declined

Approximate Grade in Course

8	A	0	D
4	B	0	F
0	C	0	S
0	U		
0	Declined		

Approximate Cum Average

1	4.0	0	2.5	0	1.0
5	3.5	0	2.0	6	n/a
0	3.0	0	1.5	0	declined

Average is:

9	Cornell Ave.
1	Transfer Ave.
2	Declined

Reason for Taking Course

6	Required for Major
2	Has Great Reputation
4	Subject Matter of Interest
5	Required for Grad Work
0	Other

	Resp. 1	Resp. 2	Resp. 3	Resp. 4	Resp. 5	No Resp	Mean	Std Dev
The instructor is well-prepared for each class	0	0	0	1	11	0	4.92	0.29
The instructor is responsive to student questions	0	0	0	1	11	0	4.92	0.29
The course is intellectually challenging	0	0	0	4	8	0	4.67	0.49

College of Agriculture and Life Sciences
Office of Academic Programs
Custom Course Evaluation

FALL 2020

Course
BTRY 6010 LAB 405

Instructor
/Hochstedler, Kim

What have you liked best about the course so far?	What have you liked least about the course so far?	In the time remaining, is there anything about the course that could be improved?
She is very open to questions and also to schedule meeting to solve questions about the class.	It is very challenging and it is great to watch it online because we can watch it over and over until we understand.	
That every lab she sums up lectures and always makes us understand the problem, instead of going directly to R.		sometimes the HWs are not release on time (the solutions) so we make mistakes that can be corrected if we have the solutions or the corrections earlier.
She cares about us learning and is always willing to help	sometimes I feel lost	
This lab section has really helped me understand the concepts of this course	N/A	
Good organization and material taught.	Homework assignments are pretty time consuming.	N/A
The instructor is well-prepared.	In the limited discussion time, the problem set could not be finished.	Go through problem set more efficiently.
Kim is a wonderful TA and she is rather detailed and slow-paced about her session.	N/A	

College of Agriculture and Life Sciences
Office of Academic Programs
Custom Course Evaluation

FALL 2020

Course
BTRY 6010 LAB 405

Instructor
/Hochstedler, Kim

Instructor-Designed Questions

(response of 0 means no answer)

Average Standard Dev.

Instructor-Designed Open-Ended Questions

Student Comments

I think Kim is very comprehensive and a great instructor, she is always worried that everyone understands each lab. You can contact her and she always responds quickly.

Kim is an excellent TA. She is clearly a gifted teacher and would be an amazing professor. She teaches the material much more clearly than the actual lecture. We really rely on her to understand the material each week. It is clear she prepares carefully for each lab and dedicates attention to pedagogy which makes me feel comfortable asking questions.

Kim is truly one of the best TAs I have ever had. I really don't think I would be doing as well in the course without her.

College of Agriculture and Life Sciences
Office of Academic Programs
Student Appraisal of Teaching Assistant

FALL 2020

Course
BTRY 6010 LAB 405

Instructor
/Hochstedler, Kim

Gender

5	Male
14	Female
0	Declined

Student Year

0	Freshmen	0	Seniors
0	Sophomores	19	Grad Students
0	Juniors	0	Other/Declined

School or College

7	Ag & Life Science	5	Human Ecology
0	Arch, Art & Plan	0	ILR
0	Arts & Sciences	0	Unclassified/ExMu
1	Engineering	6	Graduate School
0	Hotel	0	Declined

Course Intended/Required for Major

14	Yes	0	Undecided
5	No	0	Declined

Approximate Grade in Course

9	A	0	D	0	U
8	B	0	F	0	Declined
1	C	1	S		

Approximate Cum Average

3	4.0	1	2.5	0	1.0
7	3.5	0	2.0	6	n/a
1	3.0	0	1.5	1	declined

Average is:

15	Cornell Ave.
2	Transfer Ave.
2	Declined

Reason for Taking Course

10	Required for Major	11	Required for Grad Work
1	Has Great Reputation	0	Other
9	Subject Matter of Interest		

1=very low or never; 2=low or rarely; 3=medium or sometimes; 4=high or frequently; 5=very high or always

		Resp. 1	Resp. 2	Resp. 3	Resp. 4	Resp. 5	No Resp.	Mean	Std. Dev.
8.	Seems knowledgeable in the subject matter	0	0	0	2	17	0	4.8900	0.3200
9.	Is well prepared for class	0	0	0	1	18	0	4.9500	0.2300
10.	Uses class time efficiently	0	0	0	4	15	0	4.7900	0.4200
11.	Stimulates deeper thinking about the subject	0	1	0	3	15	0	4.6800	0.7500
12.	Makes me feel free to ask questions	0	0	0	1	18	0	4.9500	0.2300
13.	Provides clear and comprehensive explanations	0	0	0	0	19	0	5.0000	0.0000
14.	Communicates interest in helping students learn	0	0	0	1	18	0	4.9500	0.2300
15.	Is willing to help students outside of class	0	0	0	2	17	0	4.8900	0.3200
16.	Coveys enthusiasm in teaching the material	0	0	0	1	18	0	4.9500	0.2300
17.	Is organized in presenting the material	0	0	0	1	18	0	4.9500	0.2300
18.	Involves everyone in class	0	0	0	2	17	0	4.8900	0.3200

College of Agriculture and Life Sciences
Office of Academic Programs
Student Appraisal of Teaching Assistant

FALL 2020

Course BTRY 6010 LAB 405

Instructor /Hochstedler, Kim

1=very low or never; 2=low or rarely; 3=medium or sometimes; 4=high or frequently; 5=very high or always

		Resp. 1	Resp. 2	Resp. 3	Resp. 4	Resp. 5	No Resp.	Mean	Std. Dev.
19.	Grades Equitably	0	0	0	2	17	0	4.8900	0.3200
20.	Comments on my work in ways that help me learn	0	0	0	3	16	0	4.8400	0.3700
21.	Realizes when students do NOT understand	0	0	2	2	15	0	4.6800	0.6700
22.	Overall the quality of my TA's teaching is:	0	0	0	2	17	0	4.8900	0.3200
Self-reported Info about Student:									
23.	Your interest in taking the course before you enrolled	1	3	3	4	8	0	3.7900	1.3200
24.	Your effort to learn in this course (studying, doing assignements, thinking about ideas)	0	0	2	6	11	0	4.4700	0.7000
25.	The amount that you have learned in the course thus far	0	0	2	6	11	0	4.4700	0.7000

	Average	Standard Dev

College of Agriculture and Life Sciences
Office of Academic Programs
Student Appraisal of Teaching Assistant

FALL 2020

Course
BTRY 6010 LAB 405

Instructor
/Hochstedler, Kim

Student Comments

Kim was a wonderful TA, super accessible, always ready to help:)

Kim was perfect, very patient and super organized! Also very open to schedule meetings to solve questions and discuss problems.

Overall, I think Kim was one of, if not the best TAs I have ever had. I think I honestly learned most of this course's materials because of her. I have absolutely no critiques or suggestions to change.

Kim was a great TA and she exerted such a positive energy that made lab interesting.

Kim is an outstanding TA! She was always well-prepared for our lab sessions, conveyed the material clearly, and was always willing to pause to make sure that everyone had a chance to ask questions. Her teaching style was rooted in empathy and enthusiasm, which was refreshing during this hectic time.

Kim is an amazing TA. She is a gifted teacher. Every lab session, she was so prepared and organized, you could tell she put a lot of work into structuring the lab session and thinking about pedagogy. She was so kind and approachable, which made us feel comfortable asking questions. She was respectful about concluding the lab on-time, even when that meant we didn't have time to finish all of the questions she made sure we got the most important parts, and she was even willing to stay late after class sometimes to answer more questions. I felt that she really cared about all of the students and wanted us to succeed. Because her explanations and summaries were so clear and helpful, I really relied on her lab section for most of my learning in the course, as it was much more helpful than lecture. Kim should really consider a career as a teacher because she is a blessing to her students.

Kim is exceptional! a great teacher very helpful!...Sometimes very hard on grading but overall I couldn't get over this course without her!

LOVE KIM, BEST TA EVER!! Kim was a fantastic TA. She had great mastery of the subject matter, would encourage us to ask questions, would always answer my emails, and would stay after class to make sure we understand the material. Kim put a lot of effort into her class and for that I did a lot better than I thought I would. I considered myself to be bad at math but when Kim was my TA I thought I maybe could do this! Overall, I learned most of the course from her not our professor. Kim also held office hours and would stay longer (~30minutes) to help us even more!
Great TA, I hope to be as great as a TA as her when I teach.

Thanks for Kim's contribution, her instruction is very helpful and clear.

Kim was seriously the best TA ever. Extremely knowledgeable. Very confident. Loved how she would work through problems with us during lab and walk through her thought processes. 10/10 would sign up for her lab again. I hope she's teaching 6020 next semester! Amazing!

Having you as a TA was a very positive experience in taking this class. You're a clear and enthusiastic communicator, and you definitely engaged my interest in wanting to learn more about applying stats to my research. You are a stats queen! Go Kim!

Biological Statistics II, Cornell University

Role: Graduate Teaching Assistant
Instructor: Jeremy Entner, Ph.D.
Term: Spring 2021
Course Level: Undergraduate
Number of Students: $\sim$ 75

Course Description: Students will learn to apply linear statistical methods to quantitative problems addressed in biological and environmental research. Methods include linear regression, inference, model assumption evaluation, the likelihood approach, matrix formulation, generalized linear models, single-factor and multifactor analysis of variance (ANOVA), and a brief foray into nonlinear modeling. Students will carry out applied analysis in a statistical computing environment.

Course Components: This class met twice a week, virtually, for lectures on statistical methodologies. The class also met for smaller, virtual, lab sections once a week. Typically, these lab sections consisted of code demonstrations and problem-solving related to the previous lecture's content. Students were assessed via weekly homework assignments completed in R as well as two take-home midterm examinations and a take-home final examination.

My role: As a graduate teaching assistant, I led one lab section per week for approximately 30 students. In these labs, I gave lessons demonstrating code and problem-solving strategies in R, based on provided topics that were recently covered in lecture. I also recorded a video of each lab section for asynchronous learners. I graded student problem sets and exams using rubrics that I developed. In addition, I hosted office hours once a week.
Selected lessons presented: Linear regression in R, building regression models, performing multiple hypothesis tests

Student Reviews: Anonymous reviews were elicited from students at the end of the semester. Reviews were obtained for the entire course and for individual lab sections. My final lab section evaluations are provided below.
End-of-semester overall teaching rating: 4.82 / 5.0

College of Agriculture and Life Sciences
Office of Academic Programs
Student Appraisal of Teaching Assistant

SPRING 2021

Course
BTRY 3020 LAB 404

Instructor
Kim

Gender

6	Male
12	Female
0	Declined

Student Year

2	Freshmen	2	Seniors
12	Sophomores	0	Grad Students
2	Juniors	0	Other/Declined

School or College

7	Ag & Life Science	0	Human Ecology
1	Arch, Art & Plan	0	ILR
10	Arts & Sciences	0	Unclassified/ExMu
0	Engineering	0	Graduate School
0	Hotel	0	Declined

Course Intended/Required for Major

11	Yes	0	Undecided
6	No	1	Declined

Approximate Grade in Course

11	A	0	D	0	U
5	B	0	F	1	Declined
1	C	0	S		

Approximate Cum Average

11	4.0	0	2.5	0	1.0
3	3.5	0	2.0	1	n/a
2	3.0	0	1.5	1	declined

Average is:

15	Cornell Ave.
0	Transfer Ave.
3	Declined

Reason for Taking Course

11	Required for Major	0	Required for Grad Work
0	Has Great Reputation	0	Other
10	Subject Matter of Interest		

1=very low or never; 2=low or rarely; 3=medium or sometimes; 4=high or frequently; 5=very high or always

		Resp. 1	Resp. 2	Resp. 3	Resp. 4	Resp. 5	No Resp.	Mean	Std. Dev.
8.	Seems knowledgeable in the subject matter	0	0	1	5	11	1	4.5900	0.6200
9.	Is well prepared for class	0	0	0	4	13	1	4.7600	0.4400
10.	Uses class time efficiently	0	0	1	3	13	1	4.7100	0.5900
11.	Stimulates deeper thinking about the subject	0	0	1	5	11	1	4.5900	0.6200
12.	Makes me feel free to ask questions	0	0	0	3	14	1	4.8200	0.3900
13.	Provides clear and comprehensive explanations	0	0	0	5	12	1	4.7100	0.4700
14.	Communicates interest in helping students learn	0	0	0	4	13	1	4.7600	0.4400
15.	Is willing to help students outside of class	0	0	0	4	13	1	4.7600	0.4400
16.	Coveys enthusiasm in teaching the material	0	0	0	5	12	1	4.7100	0.4700
17.	Is organized in presenting the material	0	0	0	3	14	1	4.8200	0.3900
18.	Involves everyone in class	1	0	3	4	9	1	4.1800	1.1300

College of Agriculture and Life Sciences
Office of Academic Programs
Student Appraisal of Teaching Assistant

SPRING 2021

Course BTRY 3020 LAB 404

Instructor Kim

1=very low or never; 2=low or rarely; 3=medium or sometimes; 4=high or frequently; 5=very high or always

		Resp. 1	Resp. 2	Resp. 3	Resp. 4	Resp. 5	No Resp.	Mean	Std. Dev.
19.	Grades Equitably	0	0	1	4	12	1	4.6500	0.6100
20.	Comments on my work in ways that help me learn	0	0	1	3	12	2	4.6900	0.6000
21.	Realizes when students do NOT understand	0	0	2	4	11	1	4.5300	0.7200
22.	Overall the quality of my TA's teaching is:	0	0	0	3	14	1	4.8200	0.3900
Self-reported Info about Student:									
23.	Your interest in taking the course before you enrolled	0	1	5	4	6	2	3.9400	1.0000
24.	Your effort to learn in this course (studying, doing assignements, thinking about ideas)	0	1	1	4	11	1	4.4700	0.8700
25.	The amount that you have learned in the course thus far	0	0	3	5	9	1	4.3500	0.7900

	Average	Standard Dev

College of Agriculture and Life Sciences
Office of Academic Programs
Student Appraisal of Teaching Assistant

SPRING 2021

Course	**Instructor**
BTRY 3020 LAB 404	Kim

Student Comments

Great TA

Kim is an absolutely lovely TA! She is so helpful, passionate about the subject material, willing to respond to emails and walk you through problems, and she always seems excited for our section.

Kim was an amazing TA! She was always super organized and cheerful, she also made sure we knew exactly what was going on at each step in the lab and if we needed some background information about techniques she was happy to explain and was super knowledgable about the class material

The TA was amazing and did a great job, she was always so prepared and explained things very well.

Kim was an amazing TA, probably one of the best TAs I have had at Cornell. She was always encouraging, especially when the class felt tough, and I always felt like Kim was willing to advocate for the students.

Kim, you're a great TA, thank you for all of your time and work into this class! I learned so SO much!!

Introductory Statistics, Cornell University

Role: Graduate Teaching Assistant
Instructor: Thomas DiCiccio, Ph.D.
Terms: January 2022, Summer 2022, January 2023, Summer 2023
Course Level: Undergraduate
Number of Students: 75-125

Course Description: Statistics is about understanding the world through data. We are surrounded by data, so there is a lot to understand. This course covers data exploration and display, data gathering methods, probability, and statistical inference methods through contingency tables and linear regression. The emphasis is on thinking scientifically, understanding what is commonly done with data (and doing some of it for yourself), and laying a foundation for further study. Students learn to use statistical software and simulation tools to discover fundamental results. They use computers regularly; the test includes both multimedia materials and a software package. This course does not focus on data from any particular discipline, but will use real-world examples from a wide variety of disciplines and current events.

Course Components: This class met daily, virtually, for lectures on statistical methodologies. Students were assessed via three take-home exams.

My role: As a graduate teaching assistant, I graded take-home exams and led daily office hour sessions.

Student Reviews: Student evaluations were not collected for this course.

Hungry in America - Building Skills to Feed Communities, University of Michigan

Role: Course Designer
Instructors: Kate Bauer, Ph.D. and Susan Aaronson, M.A., R.D.
Terms: Spring 2020
Course Level: Undergraduate

Course Description: Food insecurity, or a lack of consistent access to enough food for an active, healthy life, affects 1 in 8 Americans, and nearly 1 in 3 University of Michigan students. Food insecurity is caused by the intersection of a wide range of factors, from personal cooking skills to neighborhood food access to federal food policies. For this reason, fighting food insecurity in the US requires advocates with diverse skills, knowledge, and perspectives working together. This course seeks to provide students at the University of Michigan with these skills, knowledge, and perspectives, allowing them to become leaders to improve their own health and wellbeing and that of their communities and nationwide. To accomplish this, the course will integrate community visits; in-classroom, hands-on activities; and instructor-guided seminars to help students understand the experience and impacts of food insecurity across critical life stages of development (children, young adults, seniors).

Course Components: This class once a week for interactive and innovative lessons on food insecurity, with a particular focus on communities near the University of Michigan. In addition to traditional class meetings, students also participated in visits to relevant community centers including local grocery stores and the on-campus food pantry.

My role: As a course designer, I incorporated existing assignments and course materials into a comprehensive online learning platform using Canvas. My job was to ensure all materials and assignments contributed to course goals, while developing user-friendly webpages for each course meeting.

Sample materials: The Canvas site homepage and a daily course page that I developed are provided in the following pages.

Course Objectives (https://umich.instructure.com/courses/358525/pages/course-goals) Syllabus (https://umich.instructure.com/courses/358525/pages/syllabus) Instructors (https://umich.instructure.com/courses/358525/pages/instructors)

Hungry in America: Building Skills to Feed Communities

Food insecurity, or a lack of consistent access to enough food for an active, healthy life, affects 1 in 8 Americans, and nearly 1 in 3 University of Michigan students. Food insecurity is caused by the intersection of a wide range of factors, from personal cooking skills to neighborhood food access to federal food policies. For this reason, fighting food insecurity in the US requires advocates with diverse skills, knowledge, and perspectives working together. This course seeks to provide students at the University of Michigan with these skills, knowledge, and perspectives, allowing them to become leaders to improve their own health and wellbeing and that of their communities and nationwide. To accomplish this, the course will integrate community visits; in-classroom, hands-on

activities; and instructor-guided seminars to help students understand the experience and impacts of food insecurity across critical life stages of development (children, young adults, seniors).

Class resources, including food and transportation, have been generously provided by the University of Michigan's Poverty Solutions.

Course Schedule & Topics

I. Unit 1: Children

1/14: Course Introduction (https://umich.instructure.com/courses/358525/pages/1-slash-14-course-introduction)
1/21: Causes and Impacts of Food Insecurity (https://umich.instructure.com/courses/358525/pages/1-slash-21-causes-and-impacts-of-food-insecurity)
1/28: Resources to Alleviate Food Insecurity (https://umich.instructure.com/courses/358525/pages/1-slash-28-resources-to-alleviate-food-insecurity) (**Child Case Study - Part 1** (https://umich.instructure.com/courses/358525/assignments/905763) due today)
2/4: Food Planning and Access (https://umich.instructure.com/courses/358525/pages/2-slash-4-food-planning-and-access) (**Child Case Study - Part 2** (https://umich.instructure.com/courses/358525/assignments/905765) due today)
(https://umich.instructure.com/courses/358525/pages/2-slash-4-food-planning-and-access)
2/11: Food Preparation (https://umich.instructure.com/courses/358525/pages/2-slash-11-food-preparation) (**Op-Ed** (https://umich.instructure.com/courses/358525/assignments/905769) due today)

II. Unit 2: Young Adults

2/18: Causes and Impacts of Food Insecurity (https://umich.instructure.com/courses/358525/pages/2-slash-18-causes-and-impacts-of-food-insecurity)
2/25: Resources to Alleviate Food Insecurity (https://umich.instructure.com/courses/358525/pages/2-slash-25-resources-to-alleviate-food-insecurity) (**Young Adult Case Study - Part 1** (https://umich.instructure.com/courses/358525/assignments/906053) due today)
(https://umich.instructure.com/courses/358525/pages/2-slash-25-resources-to-alleviate-food-insecurity)
3/3: Spring Break (No class)
3/10: Food Planning and Access (https://umich.instructure.com/courses/358525/pages/3-slash-10-food-planning-and-access) (https://umich.instructure.com/courses/358525/pages/2-slash-25-

resources-to-alleviate-food-insecurity) (Young Adult Case Study - Part 2 (https://umich.instructure.com/courses/358525/assignments/906054) due today)
3/17: Food Preparation (https://umich.instructure.com/courses/358525/pages/3-slash-17-food-preparation) (https://umich.instructure.com/courses/358525/pages/2-slash-25-resources-to-alleviate-food-insecurity) (Op-Ed (https://umich.instructure.com/courses/358525/assignments/906055) due today) (https://umich.instructure.com/courses/358525/pages/3-slash-24-causes-and-impacts-of-food-insecurity)

III. Unit 3: Seniors

3/24: Causes and Impacts of Food Insecurity (https://umich.instructure.com/courses/358525/pages/3-slash-24-causes-and-impacts-of-food-insecurity)
3/31: Resources to Alleviate Food Insecurity (https://umich.instructure.com/courses/358525/pages/3-slash-31-resources-to-alleviate-food-insecurity) (Seniors Case Study - Part 1 (https://umich.instructure.com/courses/358525/assignments/906056) due today)
4/7: Food Planning and Access (https://umich.instructure.com/courses/358525/pages/4-slash-7-food-planning-and-access) (https://umich.instructure.com/courses/358525/pages/2-slash-25-resources-to-alleviate-food-insecurity) (Seniors Case Study - Part 2 (https://umich.instructure.com/courses/358525/assignments/906057) due today)
4/14: Food Preparation (https://umich.instructure.com/courses/358525/pages/4-slash-14-food-preparation) (https://umich.instructure.com/courses/358525/pages/week-14-overview-topic) 4/21: Final Class Wrap-Up (https://umich.instructure.com/courses/358525/pages/4-slash-21-final-class-wrap-up)

2/4: Food Planning and Access

Class Announcements

During this class, we will take public transportation to Kroger 2641Plymouth Rd. for a grocery store tour. The **AATA route 23 (https://www.theride.org/Portals/0/Documents/1SchedulesMapsAndTools/RGs_InfoGuides/RGEng_2020Winter.pdf?ver=2020-01-09-124501-867)** goes directly to the Plymouth Mall where Kroger is located. Kate and Susan will catch the bus ~ 2pm on Medical Center Drive (bus stop at the back end of Markley Hall across from the entrance to Mott Hospital). Students can also pick up the bus at CCTC. Our plan is to meet in the lobby by 2:30pm. We ask that all students ride the bus even if you have a car, as this is also an exercise on the challenges of shopping.

Learning Objectives

1. Demonstrate ability to access and purchase low-cost, nutritionally adequate food for children that aligns with federal food assistance requirements.

Required Readings

- Read: **No Kid Hungry Report (https://www.nokidhungry.org/who-we-are/hunger-facts)**

Assignments

- **Child Case Study - Part 2 is due today. (https://umich.instructure.com/courses/358525/assignments/905765)**

TEACHING TRAINING AND DEVELOPMENT

Effective Teaching in Public Health, University of Michigan

Role: Student
Instructor: Olivia S. Anderson, PhD, MPH, RD
Term: Fall 2019
Course Level: Graduate

Course Description: Students will engage in a community of graduate students to explore/prepare for a faculty career, focusing on teaching at a university-level specifically in the public health field. Students will immerse in literature, discussion, and workshops on state-of-the-art pedagogical techniques. Course tangibles include: teaching philosophy statement, course syllabus, and teaching demonstration.

Course Components: This course met weekly, in-person for discussion-based lessons on effective teaching strategies for public health classes. Course competencies were evaluated through participation in class sessions, including providing feedback to peers on in-class activities and multi-week projects. Assessments also included a teaching philosophy, course syllabus, Scholarship of Teaching and Learning (SoTL) presentation, midterm reflection, teaching method speed talk, and teaching demonstration.

Sample materials: Slides and feedback from my teaching demonstration are provided in the following pages.

Statistical Graphics and Communication

INTRODUCTION TO DATA VISUALIZATION

KIM HOCHSTEDLER

NOVEMBER 20, 2019

GOALS

I. The importance of data visualization
- **Describe** why data visualization is important.
- **Identify** the main goal of data visualization.

II. General principles of statistical graphics
- **Explain** 3 principles to keep in mind when making graphs.

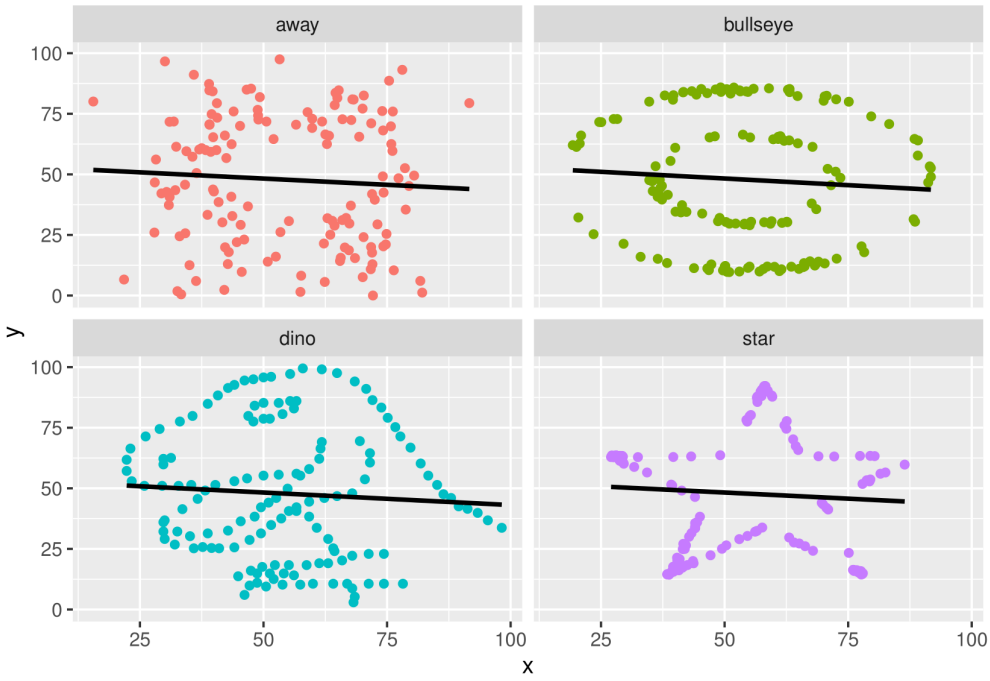
The importance of data visualization

WHAT DO WE GET FROM TABULAR DATA?

VARIABLE	MEAN	STANDARD DEVIATION	CORRELATION
Salary (thousands of $)	54.2	16.7	-.06
Driving time to work (minutes)	47.8	26.9	

REGRESSION STATISTICS
Intercept = 53.4, Slope = -0.10

WHAT DO THE DATA ACTUALLY LOOK LIKE?



Example from DatasauRus

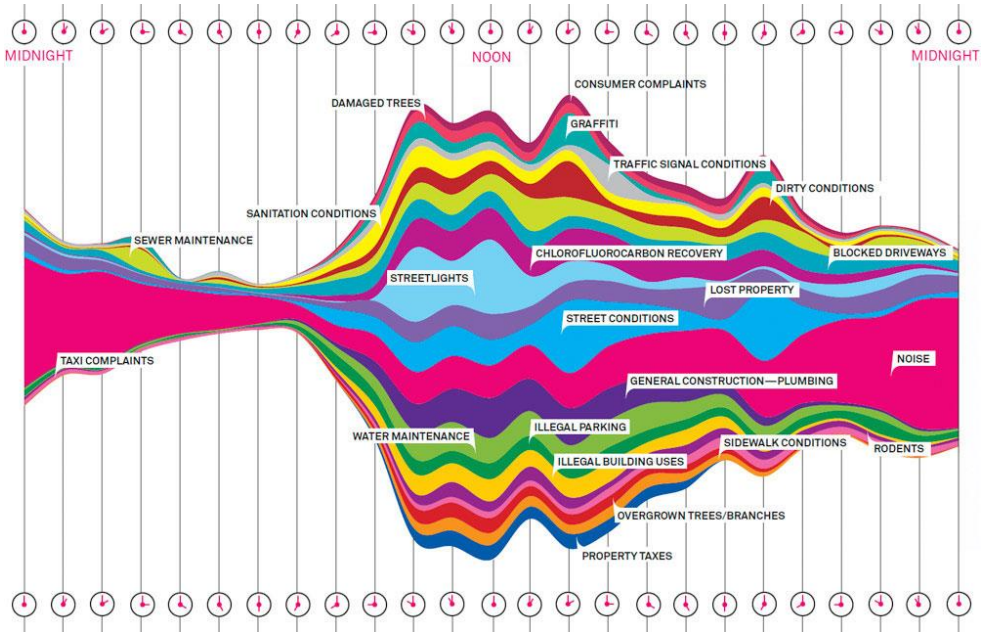
STATISTICAL GRAPHICS

GRAPHICS: visually display data using…

- points
- lines
- coordinate systems
- numbers
- symbols
- words
- color, etc.

-**Balance** aesthetics and information.

-**Goal:** show the data so viewers can make appropriate conclusions.



Ex. Type of 311 calls by time of day in NYC.

Example from JunkCharts

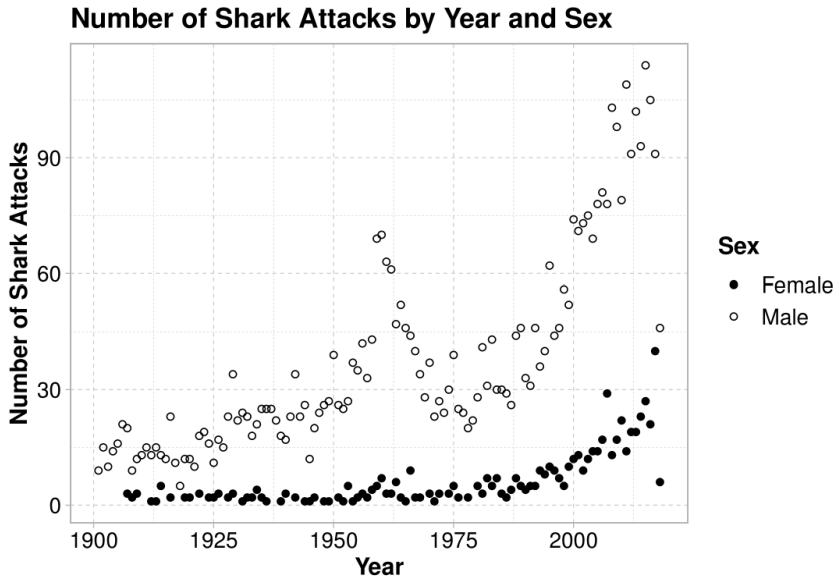
General principles for making graphs

1. GRAPHS SHOULD **STAND ALONE**.
2. AVOID **DISTORTION**.
3. USE **DATA INK** EFFECTIVELY.

1. GRAPHS SHOULD STAND ALONE.
EXAMPLE

What trends do you notice in this graph?

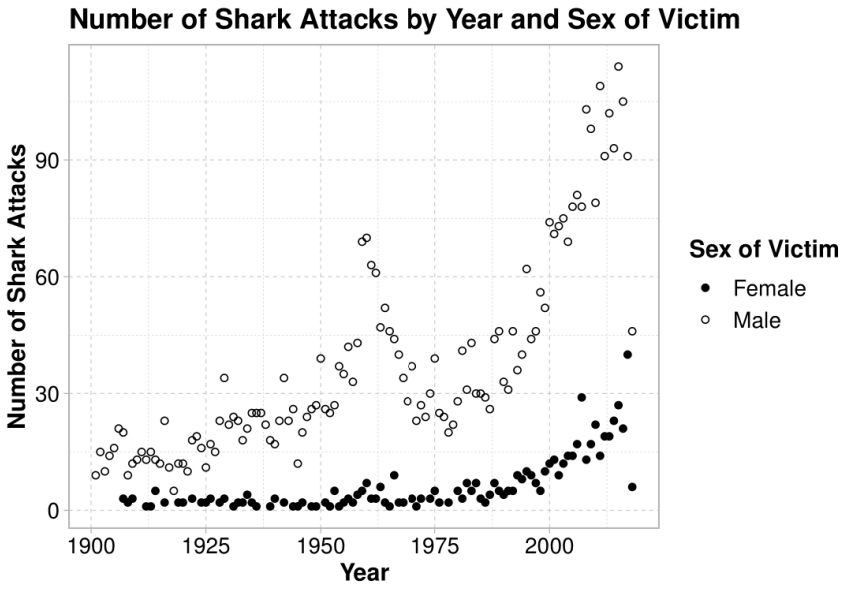
What explanations could you suggest for your observations?



1. GRAPHS SHOULD STAND ALONE.

Readers should be able to draw meaning from the graph in isolation.

- Readers do not need extensive supplementary text to understand the graph.
- Think like an "outsider" when making a graph.



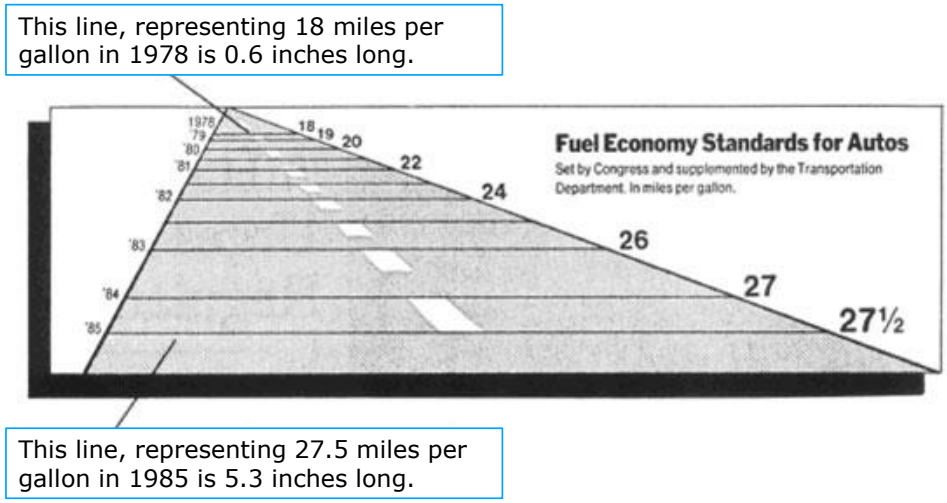
2. AVOID DISTORTION.

Distortion: graph does not match the data.

We can numerically represent distortion…

Lie factor = $\frac{Size\ of\ effect\ in\ graph}{Size\ of\ effect\ in\ data}$

- Should be near 1.



Ex. LF = $\frac{\%\ increase\ in\ length}{\%\ increase\ in\ data} = \frac{(5.3 - .6)/.6}{(27.5 - 18)/18} = \frac{783\%}{52.8\%} = \mathbf{14.83} > 1$

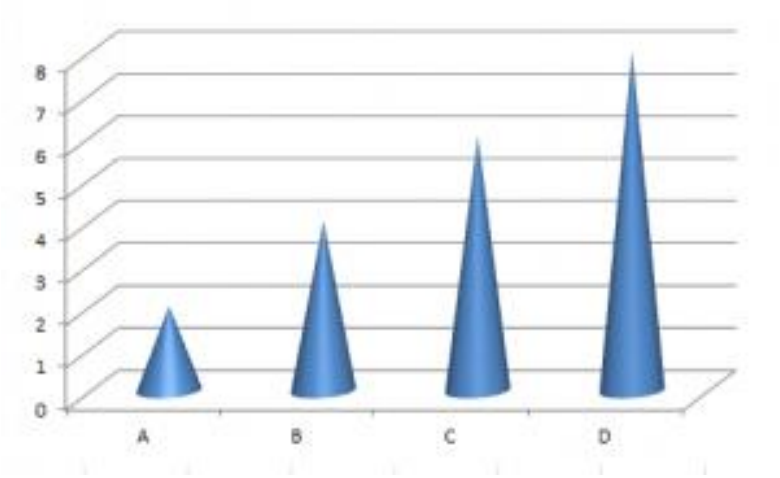
Lie Factor: InfoVis Wiki

3. USE DATA INK EFFECTIVELY.

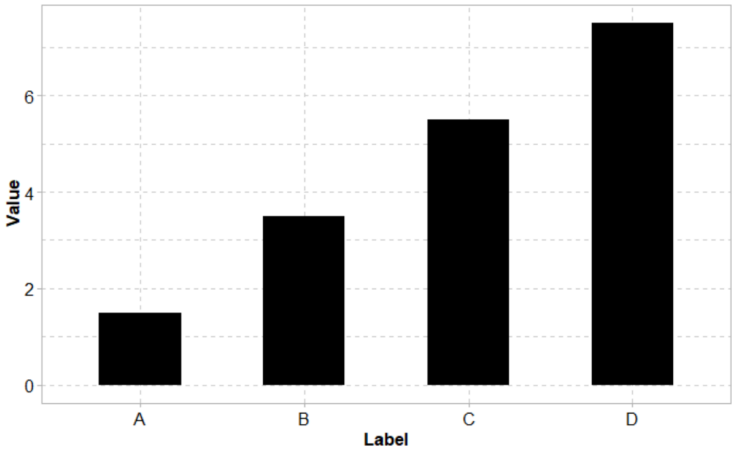
Data ink: "non-erasable" and "non-redundant" core of the graphic.

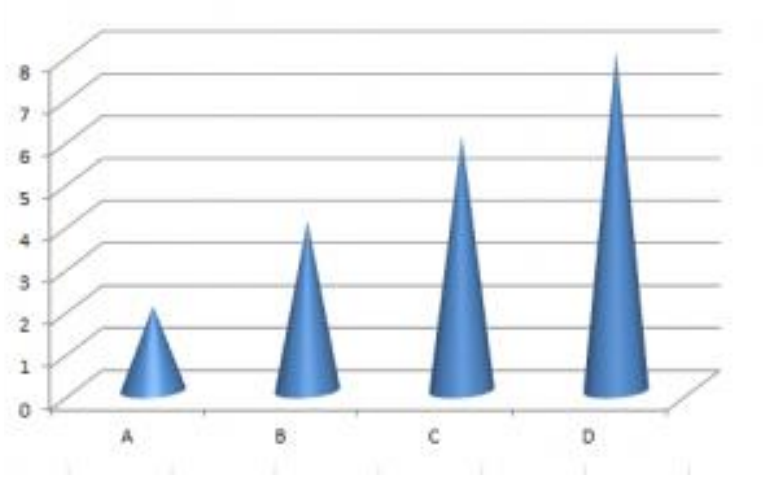
-Data ink should present information about the data.

-Avoid unnecessary decoration.



3. USE DATA INK EFFECTIVELY.





CONCLUSIONS

It is important to **visualize data** … summary statistics are not enough!

Good graphics should…

1. Stand alone.
2. Avoid distortion.
3. Use "data ink" effectively.

Consider these principles in **your own work** and when you see data visualizations in the **media**.

Any questions or final thoughts?

8:03:00 AM - 8:18

Name of presenter: Kim

	Strongly agree	Agree	Somewhat Agree	Somewhat disagree	Disagree	Strongly disagree
Overall, this was an excellent demonstration	x					
Overall, the instructor was an excellent teacher	x					
Overall, I learned a great deal from this demonstration	x					
The learning goals of the demonstration were clear	x					
The instructor's presentation material aligned with the learning goals	x					
I was engaged for the duration of the demonstration	x					

Please comment on the following questions about the quality of the teaching demonstration:

What worked well?

excellent intro and background, you talked at a pace that allowed us to follow along without falling behind
slides were clear and easy to follow
what is data ink? - just never heard of it, now I know!
great exanple with shark attacks - very engaging

What could be improved?

can think about walking around room when students are doing the student activity
Defining lie factor on slide 10 was really helpful, but initially the slide was overwhelming
maybe animations would have helped as you built up to some of the info on the slide pertaining to lie factor

Name of presenter: Kim

	Strongly agree	Agree	Somewhat Agree	Somewhat disagree	Disagree	Strongly disagree
Overall, this was an excellent demonstration	x					
Overall, the instructor was an excellent teacher	x					
Overall, I learned a great deal from this demonstration	x					
The learning goals of the demonstration were clear	x					
The instructor's presentation material aligned with the learning goals	x					
I was engaged for the duration of the demonstration	x					

Please comment on the following questions about the quality of the teaching demonstration:

What worked well? Clearly presented, simple and not too much. Engaging visuals :) nice slides. I learned a lot in a short period of time!

What could be improved? * Interaction in first activity - perhaps asking what people drew on their graphs.

Name of presenter: Kim

	Strongly agree	Agree	Somewhat Agree	Somewhat disagree	Disagree	Strongly disagree
Overall, this was an excellent demonstration	✓					
Overall, the instructor was an excellent teacher	✓					
Overall, I learned a great deal from this demonstration		✓				
The learning goals of the demonstration were clear		✓				
The instructor's presentation material aligned with the learning goals		✓				
I was engaged for the duration of the demonstration	✓					

Please comment on the following questions about the quality of the teaching demonstration:

What worked well?

- Very engaging use of graphics and information!
- Stay positive!

What could be improved?

NA

Name of presenter: Kim

	Strongly agree	Agree	Somewhat Agree	Somewhat disagree	Disagree	Strongly disagree
Overall, this was an excellent demonstration	✓					
Overall, the instructor was an excellent teacher	✓					
Overall, I learned a great deal from this demonstration	✓					
The learning goals of the demonstration were clear		✓				
The instructor's presentation material aligned with the learning goals		✓				
I was engaged for the duration of the demonstration		✓				

Please comment on the following questions about the quality of the teaching demonstration:

What worked well?

Super organized & polished! Your verbal presentation was excellent!
Awesome topic ☺

What could be improved?

I was not 100% clear on the data like example. Maybe give a second set of examples? Maybe ask more questions of the audience throughout your talk?

Name of presenter: KIM

	Strongly agree	Agree	Somewhat Agree	Somewhat disagree	Disagree	Strongly disagree
Overall, this was an excellent demonstration	✓					
Overall, the instructor was an excellent teacher	✓					
Overall, I learned a great deal from this demonstration	✓					
The learning goals of the demonstration were clear	✓					
The instructor's presentation material aligned with the learning goals	✓					
I was engaged for the duration of the demonstration	✓					

Please comment on the following questions about the quality of the teaching demonstration:

What worked well?

- Clearly explained the examples
- Very clear and easy to follow structure
- Good conclusion with necessary info aligned to the learning goals

What could be improved?

- Great job !

Name of presenter:

Kim	Strongly agree	Agree	Somewhat Agree	Somewhat disagree	Disagree	Strongly disagree
Overall, this was an excellent demonstration	✓					
Overall, the instructor was an excellent teacher	✓					
Overall, I learned a great deal from this demonstration	✓					
The learning goals of the demonstration were clear	✓					
The instructor's presentation material aligned with the learning goals	✓					
I was engaged for the duration of the demonstration	✓					

Please comment on the following questions about the quality of the teaching demonstration:

What worked well?

I liked how each slide had a new visualization + small amount of ~~text~~ on each slide - it made it easy to read + to stay engaged the whole time

What could be improved?

- Thought you did great overall, maybe you could show us what your graph w/ 10 pts looked like. Otherwise, there weren't many improvements to be made

Name of presenter: Kim

	Strongly agree	Agree	Somewhat Agree	Somewhat disagree	Disagree	Strongly disagree
Overall, this was an excellent demonstration	✓					
Overall, the instructor was an excellent teacher	✓					
Overall, I learned a great deal from this demonstration	✓					
The learning goals of the demonstration were clear	✓					
The instructor's presentation material aligned with the learning goals	✓					
I was engaged for the duration of the demonstration	✓					

Please comment on the following questions about the quality of the teaching demonstration:

What worked well?

introduced topics in lecture before diving in to a full explanation - I liked having a preview & knowing where we were in the lecture

Lots of examples

Conclusions were a good wrap-up of the content presented in the presentation

What could be improved?

I really liked the activity - if there was more time, I think another activity would be great.

From a presentation standpoint, I thought there was a good amount of text on the slides, but as a student, maybe adding more text so it's easier for students to use the slides as references.

Name of presenter: Kim

	Strongly agree	Agree	Somewhat Agree	Somewhat disagree	Disagree	Strongly disagree
Overall, this was an excellent demonstration	✓					
Overall, the instructor was an excellent teacher	✓					
Overall, I learned a great deal from this demonstration	✓					
The learning goals of the demonstration were clear	✓					
The instructor's presentation material aligned with the learning goals	✓					
I was engaged for the duration of the demonstration	✓					

Please comment on the following questions about the quality of the teaching demonstration:

What worked well?

The examples really brought the concepts to life in an understandable way even for a non statistics student

What could be improved?

Some theory behind the 3 points in the 2nd half of the presentation would have helped put it into context more.

Name of presenter: Kim

	Strongly agree	Agree	Somewhat Agree	Somewhat disagree	Disagree	Strongly disagree
Overall, this was an excellent demonstration	✓					
Overall, the instructor was an excellent teacher	✓					
Overall, I learned a great deal from this demonstration	✓					
The learning goals of the demonstration were clear	✓					
The instructor's presentation material aligned with the learning goals	✓					
I was engaged for the duration of the demonstration	✓					

Please comment on the following questions about the quality of the teaching demonstration:

What worked well?

This was a great presentation! Wonderful examples, nicely put-together powerpoint, and useful (and new) information conveyed in such a short time period.

What could be improved?

The only thing I would say is to be aware of saying "Um" when presenting. Everything else regarding presentation (body language, eye contact, volume, etc.) was great!

Name of presenter: Kim

	Strongly agree	Agree	Somewhat Agree	Somewhat disagree	Disagree	Strongly disagree
Overall, this was an excellent demonstration	✓					
Overall, the instructor was an excellent teacher	✓					
Overall, I learned a great deal from this demonstration	✓					
The learning goals of the demonstration were clear	✓					
The instructor's presentation material aligned with the learning goals	✓					
I was engaged for the duration of the demonstration	✓					

Please comment on the following questions about the quality of the teaching demonstration:

What worked well?

- the presentation slides contained just enough info to be informative but not too crowded
- great eye contact and talking points

What could be improved?

N/A

Teaching and Learning in the Diverse Classroom (Student), Cornell University

Role: Student
Term: Fall 2021

Course Description: U.S.-based and higher education-centered, the Teaching & Learning in the Diverse Classroom MOOC is a self-paced online course for anyone with teaching responsibilities, at any level of diversity expertise. Modules explore strategies for inclusive course design, social identity and self-reflection, and pedagogical practices that effectively support student engagement and a sense of belonging across difference.

Course Components: This was an asychronous course comprised of five modules. Course participation was evaluated in group discussions within Cornell's Center for Teaching Innovation's Graduate Teaching Fellows Program.

Teaching and Learning in the Diverse Classroom (Facilitator), Cornell University

Role: Discussion Facilitator
Term: Fall 2022, Spring 2024

Course Description and Components: Same as above.

My role: As a discussion facilitator, I created discussion questions pertaining to modules from the course. Within a meeting of the Center for Teaching Innovation's Graduate Teaching Fellows, I led small groups through the discussion questions and facilitated a large group discussion.

Sample materials: My discussion questions for a course module entitled "Institutional Change" are provided below:

1. Think of a diversity, equity, or inclusive teaching initiative you have seen at Cornell that operates across multiple departments, an entire college, or the university as a whole (Examples: DEI offices in a college, Belonging at Cornell, Diversity Programs in Engineering, etc.). What are the **challenges** and **benefits** of these broader initiatives?

2. Consider the same program(s) as in question #1. How do you think the impact of these programs can be **improved** or **maintained** in the future?

3. After this course, what do you want to continue to learn more about?

Ivy+ Teaching Transformations Summit

Role: Participant
Term: May 2022, May 2023

Summit Description: The Teaching Transformations Summit is a yearly gathering of graduate students across Ivy Plus institutions who are especially committed to improving the support, discourse, and practice of pedagogy in higher education. Each year, Cornell sends a select group to share teaching approaches and engage in a series of frank and generative discussions with colleagues at other institutions. The summit is a unique chance to form national connections with graduate students actively working to transform the academy through teaching development.

GRADUATE TEACHING FELLOWSHIP

Cornell University's Center for Teaching Innovation (CTI) Graduate Teaching Fellows program brings together experienced, creative graduate students with teaching experience at Cornell and an interest in teaching and learning. To join the program, prospective CTI Fellows must submit an application and participate in an interview process. Teaching fellows work closely with CTI staff to design and implement teaching workshops, events, and resources to foster teaching excellence, innovation, and networking across the university. The program offers participants an opportunity to reflect on their teaching and communication skills as they develop leadership, mentorship, and interdisciplinary collaborative skills.

I participated in the CTI Fellows program for three of my four years at Cornell, taking on a greater leadership role in each year. I detail my role, responsibilities, and experience for each year in the program below.

Graduate Teaching Fellow, Cornell University

Term: 2021-2022

My role: As a Graduate Teaching Fellow, I had the following responsibilities:

- Attend CTI Fellows training in the Fall and Spring.
- Prepare for and attend biweekly CTI Fellows meetings.
- Prepare and present two teaching workshops for graduate students and postdocs at Cornell.
- Facilitate a University-Wide teaching conference.
- Complete the online Teaching and Learning in the Diverse Classroom MOOC and participate in associated group discussions.
- Conduct peer workshop observations.
- Prepare and present a "microteaching" lesson to peers.
- Serve as a CTI Liaison within my department.

Workshops created and facilitated: "Effective grading and feedback", "Essentials of teaching: Peer review", "Exploring innovative teaching in STEM"

Sample materials: Slides and a Google Jamboard activity from the "Exploring innovative teaching in STEM" workshop are provided below.

Exploring Innovative Teaching in STEM

Workshop #2

Center for Teaching Innovation

RINK Tacoma-Fogal

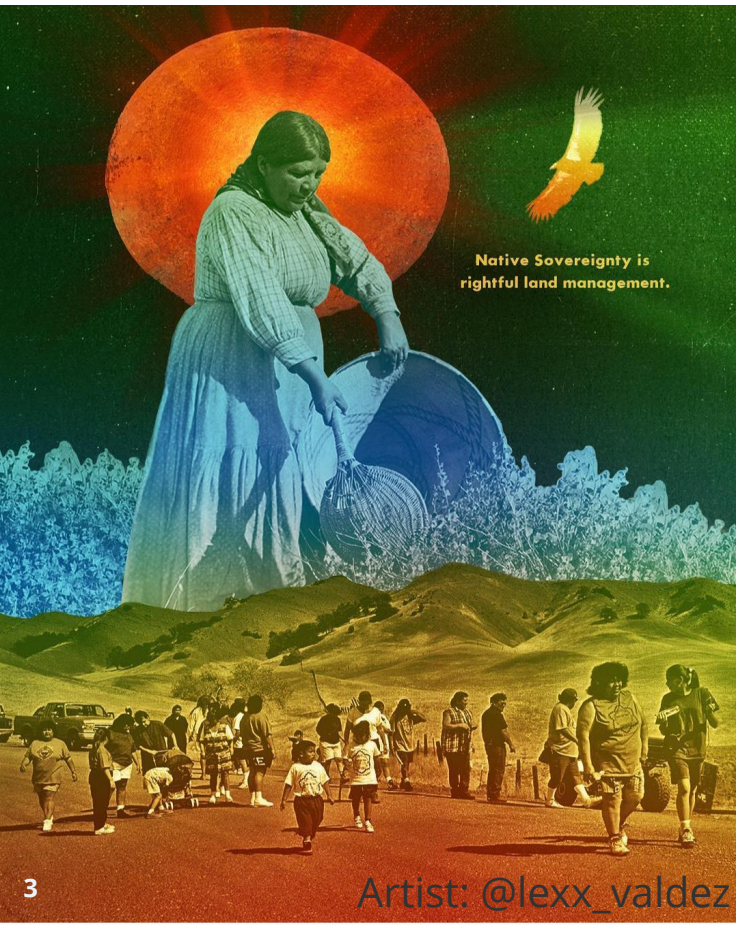
PhD Candidate in Animal Science

CTI Fellow

KIM Hochstedler

PhD Student in Statistics

CTI Fellow



Land Acknowledgement

Cornell University is located on the traditional homelands of the Gayogo̱hó:nǫ' (the Cayuga Nation). The Gayogo̱hó:nǫ' are members of the Haudenosaunee Confederacy, an alliance of six sovereign Nations with a historic presence on this land. The Confederacy precedes the establishment of Cornell University, New York State, and the United States of America. We acknowledge the painful history of Gayogo̱hó:nǫ' dispossession, and honor the ongoing connection of Gayogo̱hó:nǫ' people, past and present, to these lands and waters.

Text your zip code or your city and state to (907) 312-5085 and get the names of the Native lands that correspond to that region.

TABLE OF CONTENTS

Learning Outcomes

1. To identify what innovative teaching looks like and common innovative strategies used in the discipline

2. To connect innovative teaching strategies to student learning outcomes.

Activity #1

We will break you all up into breakout rooms. Share the following with others in your breakout room:

- Introduce yourself.
- Are you a TA this semester? If so, what course are you teaching? If not, what have you taught in the past?
- Think about a class where a teacher used a useful and unique teaching strategy that helped your learning
  - What did they do?
  - Why did it leave an impression on you?


DISCUSS
Tell us about your responses
teaching.cornell.edu
Center for Teaching Innovation

DEFINING INNOVATION

Teaching innovation is the practice of employing **unique** strategies that...

- **Engage** students
- Increase classroom **participation**
- Lead to better student **learning outcomes**.
- Helps to create an **inclusive** classroom environment

Innovation is **adjusting the status quo teaching methods** to **meet the needs** of your students and learning outcomes of your course

Importance of Innovation

- To increase student **attention, build curiosity, interest** and **passion** to the material being taught
- Helps build a **supportive** learning classroom environment
- **Levelling** the classroom playing field
- Improve student achievement through engaging **active learning**
- Exposes students to **real-world experiences**

INNOVATIVE TEACHING STRATEGIES

- New strategies to try in your STEM classroom

Just-in-time teaching

Team-based learning

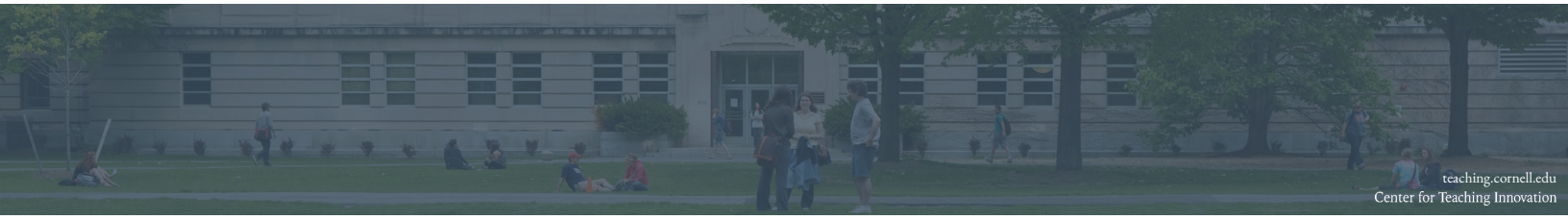
Interdisciplinary teaching

Case studies

Student portfolios

Just-in-Time Teaching

- Students complete pre-class material and **answer questions right before class**
- Instructors analyse student responses and tailor lesson plans **“just in time”**
  - Targeted instruction



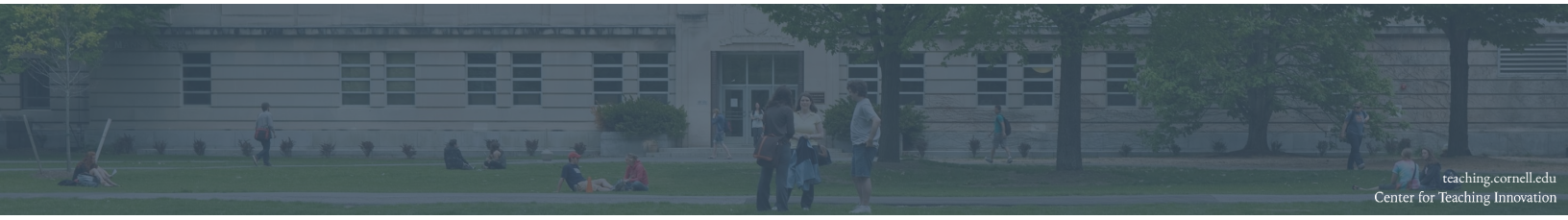
Just-in-Time Teaching

- Students complete pre-class material and **answer questions right before class**
- Instructors analyse student responses and tailor lesson plans **“just in time”**
  - Targeted instruction

STEM Example: Use a class Slack channel to elicit questions about course material right before class.

Team-based learning

- **Strategically formed teams** work on an assignment or project spanning the whole semester
- **Accountability** for the team (as a whole and individually) and instructor
- Builds a **supportive** classroom environment



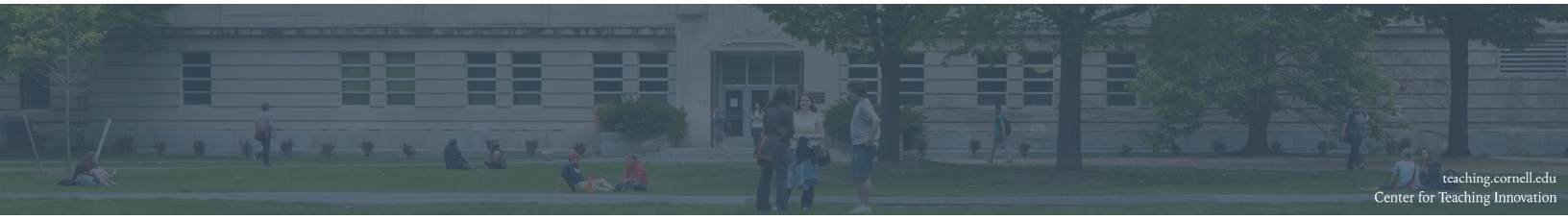
Team-based learning

- **Strategically formed teams** work on an assignment or project spanning the whole semester
- **Accountability** for the team (as a whole and individually) and instructor
- Builds a **supportive** classroom environment

STEM Example: Develop lab groups that work together on team assignments throughout the semester.

Interdisciplinary teaching

- Teaching from a perspective that draws insights from **multiple disciplines**
- Applies other disciplines to the instructor's own field
- Challenges traditional notions and enriches learning
- **Workshop #5**



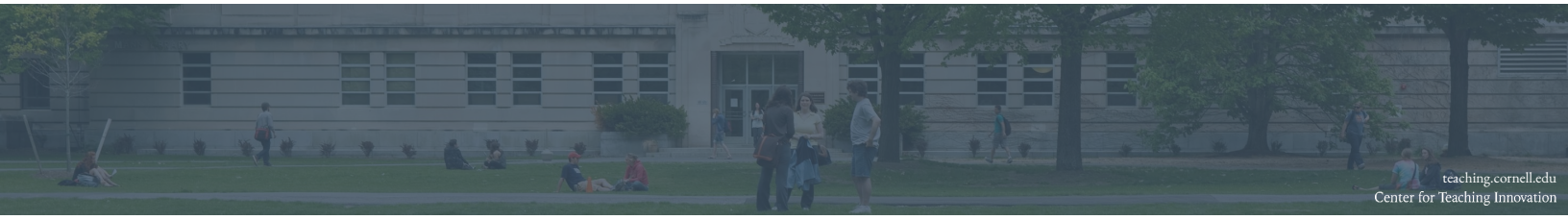
Interdisciplinary teaching

- Teaching from a perspective that draws insights from **multiple disciplines**
- Applies other disciplines to the instructor's own field
- Challenges traditional notions and enriches learning
- **Workshop #5**

STEM Example: Bring in a **guest speaker** to discuss communication principles in a science course.

Case studies

- A **real-world problem** or event that motivates a course topic
- Guided problem-solving helps develop **critical thinking** skills
- Requires consideration for ethics and practicalities of the problem



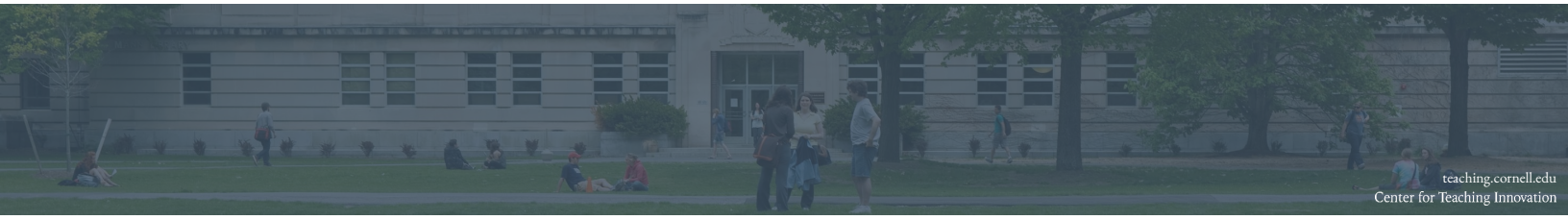
Case studies

- A **real-world problem** or event that motivates a course topic
- Guided problem-solving helps develop **critical thinking** skills
- Requires consideration for ethics and practicalities of the problem

STEM Example: Lead the class through the decision-making process for a community designing a renewable energy system.

Student portfolios

- Online portfolios where students **share and collaborate** on classroom artifacts
- Includes materials that can **continue to be developed or used outside of the course**
- Represents and personalizes learning experiences



Student portfolios

- Online portfolios where students **share and collaborate** on classroom artifacts
- Includes materials that can **continue to be developed or used outside of the course**
- Represents and personalizes learning experiences

STEM Example: Have students set up a GitHub repository and publish their code.

Combining Strategies

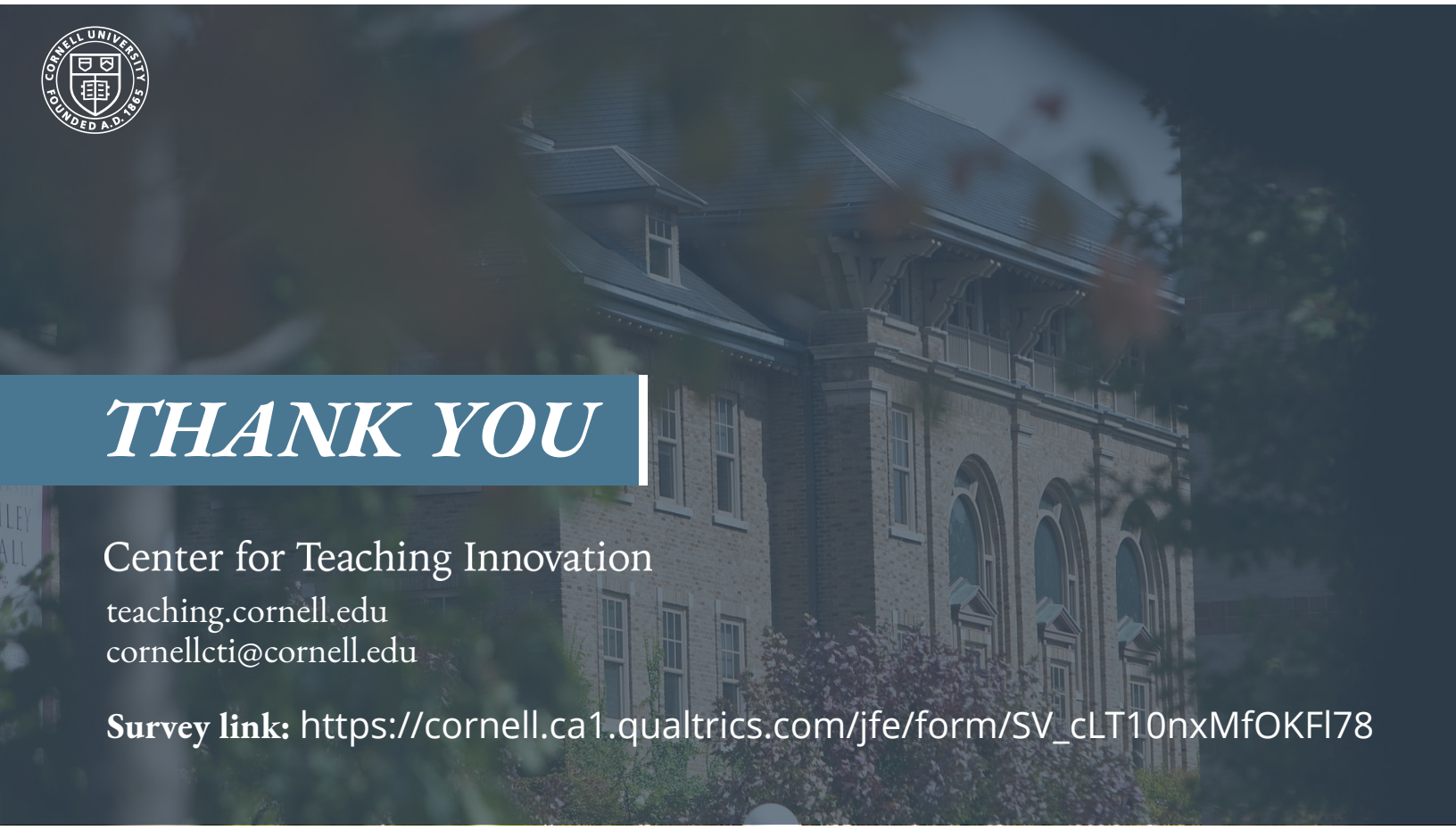
- Remember, you can **combine strategies**.
- Integrate multiple teaching strategies in ways that you feel **benefit** your students and your classroom.

Innovative Teaching

1. What innovative strategies are you interested in trying in your classroom?
2. How are you thinking of implementing the strategy?

Add your thoughts on our Jamboard (5 minutes)

https://jamboard.google.com/d/1Ap0V2KHC4eQbGxPQqtwOUfLm6OSpJ3U98XWiZ7QzxL4/viewer?f=1



THANK YOU

Center for Teaching Innovation

teaching.cornell.edu
cornellcti@cornell.edu

Survey link: https://cornell.ca1.qualtrics.com/jfe/form/SV_cLT10nxMfOKFl78

U-WIDE *GET SET* TEACHING CONFERENCE

Saturday, March 5th, 2022

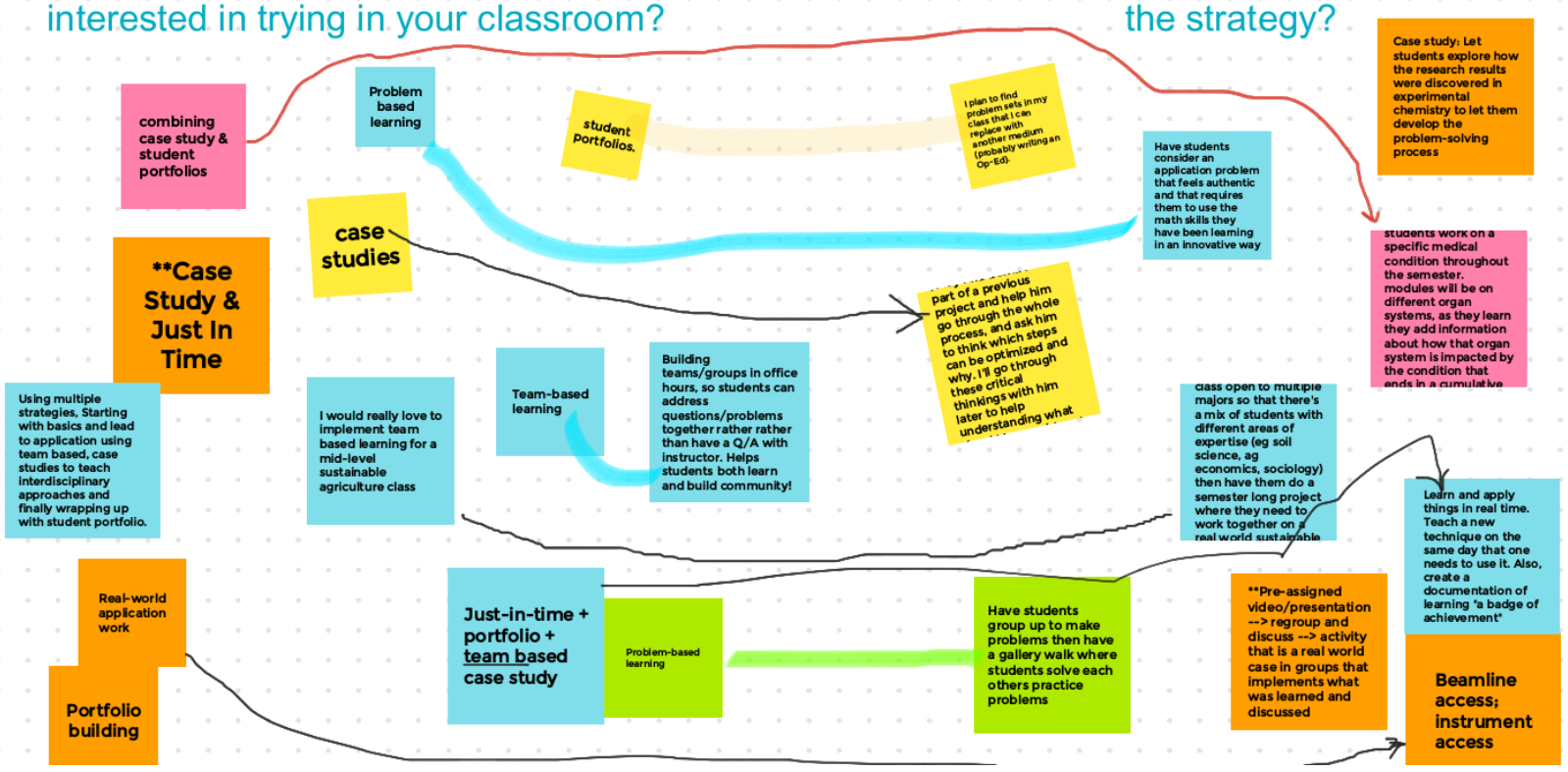
The Center for Teaching Innovation (CTI) is pleased to offer the Spring 2022 University-wide (U-wide) GET SET Teaching Conference, open to all graduate students, TAs, and postdocs at Cornell. This program provides an opportunity for interdisciplinary discussions on teaching with faculty and peers from a

9:00-9:10	**Check-in & Opening Remarks**			
9:10-10:00	**Concurrent Workshop - Session I**	**Exploring Innovative Teaching in *Humanities & Social Sciences*** Zoom link: https://cornell.zoom.us/j/91550959342?pwd=VFh6MWlSd0xra0tNQ0xzQ1ZRcWwxZz09 Passcode: **374561**	**Exploring Innovative Teaching in *STEM*** Zoom link: https://cornell.zoom.us/j/96656201038?pwd=bWVza1I5T0ZVRC9rL3Q5eFFLUmNoUT09 Passcode: **735105**	
10:00-10:10	**Break**			
10:10-11:10	**Plenary Session - *Innovations to Support Classroom Connections*** Dr. Andrea Stevenson Won, Dept of Communications, Cornell University			
11:10-11:20	**Break**			
11:20-12:10	**Concurrent Workshop - Session II**	**Innovative Strategies for Evaluating Student Learning** Zoom link: https://cornell.zoom.us/j/98175575099?pwd=V1RwV05ON2xmSCtLdThQViQ2UDdydz09 Passcode: **984913**	**Integrating Innovative Technologies in the Classroom** Zoom link: https://cornell.zoom.us/j/92704878552?pwd=bWNma0lPNDBZWkc3RGRibiQ5dEwwdz09 Passcode: **445752**	**Interdisciplinary Teaching** Zoom link: https://cornell.zoom.us/j/98086201457?pwd=Tid3R2tvck9uSi9WU1IONC80QU1CZz09 Passcode: **062000**
12:10-12:20	**Reflection activity**	Interactive Session		
12:20-12:30	**Wrap-up**			

Workshop #2: Exploring Innovative Teaching in STEM

1. What innovative strategies are you interested in trying in your classroom?

2. How are you thinking of implementing the strategy?



Lead Graduate Teaching Fellow, Cornell University

Term: 2022-2023

My role: Successful Graduate Teaching Fellows are invited to return to the program for a second year as Lead Graduate Teaching Fellows. In this role, I completed all of the responsibilities associated with my previous role as a Graduate Teaching Fellow. In addition, I had the following responsibilities:

- Lead discussions for three biweekly CTI Fellows meetings.
- Prepare for and attend biweekly CTI Lead Fellows meetings.
- Mentor a new Graduate Teaching Fellow in preparing for two teaching workshops for graduate students and postdocs at Cornell.
- Coordinate with peers to ensure that all four workshops within a given "Institute" are cohesive and culminate in an artifact for participants.
- Facilitate a "microteaching" lesson for peers, including providing constructive feedback.
- Coordinate and attend smaller working group meetings, focused on professional development topics.
- Review draft workshops from Fellows in my institute or conference group.

Workshops created and facilitated: "Supporting student learning as a TA", "Essentials of teaching: Peer review", "Teaching portfolio institute: Peer review", "Backward course design: Developing learning outcomes", "Course design: Peer review", "Inclusive teaching strategies in the humanities"

Sample materials: I designed a Google Jamboard activity for the "Backward course design: Developing learning outcomes" workshop. In this activity, participants were presented with a learning outcomes and associated assessment ideas. Together with breakout room groups, the participants identified which assessments *did not align* with the learning outcome. To indicate their choices, the group could move red arrows to point to the assessment option that they selected. Upon completion of this Jamboard activity, we debriefed with a larger group discussion emphasizing the alignment of learning outcomes and assessment strategies.

ROOM 1

Formative Assessment

By the end of this lesson, students will be able to use the "rise over run" formula to find the slope of a line.

Clicker question ideas:

Select the correct formula for the slope of a line.

A. Rise - Run
B. Rise + Run
C. Rise * Run
D. Rise / Run

Exit card ideas:

Present students with the graph of a line, with two points labeled with their x- and y-coordinates. Ask students to compute the slope on their exit card.

Other ideas:

Compute the slope of a line from two supplied points. After one minute, check your answer with a partner. One group will be asked to share their answer with the class.

Summative Assessment

By the end of this course, students will be able to create linear graphs from an equation.

Project ideas:

Create a portfolio of 5 artistic graphs that you can make on a graphing calculator. Record the equations you used to make the graphs.

Exam question ideas:

Using the supplied graph paper, plot the following line: y = (-2)x + 3.

Other ideas:

On an exam, ask students to draw the graph of a line with a slope of 1 and an x-intercept of 5.

Put the red arrows next to the assessments that **do not** align with the learning outcome.

Discuss why the assessment you selected is not well-aligned with the learning outcome.

Topic information: https://flexbooks.ck12.org/cbook/ck-12-interactive-algebra-2/section/3.2/primary/lesson/graphing-quadratic-functions/

ROOM 2

Formative Assessment

By the end of this lesson, students will be able to identify all components of the water cycle.

Clicker question ideas:

Select which component is NOT in the water cycle.

A. Evaporation B. Perspiration
C. Condensation D. Precipitation

Exit card ideas:

Ask students to list the components of the water cycle that they remember from class that day.

Other ideas:

In an after-class Canvas quiz, ask students to identify the component of the water cycle would be impacted by increased atmospheric temperature due to climate change.

Summative Assessment

By the end of this course, students will be able identify how a change in one component of the water cycle will affect the whole system.

Project ideas:

Create a diagram of the water cycle, including at least four stages. Use arrows to show how water moves through the cycle.

Exam question ideas:

Ask students to identify the component of the water cycle would be impacted by increased atmospheric temperature due to climate change, and justify their answer.

Other ideas:

In an exam, ask students to describe how an extended drought would impact the amount of surface runoff and infiltration that would occur at the next rain.

Topic information: https://www.mtvt.org/lesson-plan-the-water-cycle/

Put the red arrows next to the assessments that **do not** align with the learning outcome.

Discuss why the assessment you selected is not well-aligned with the learning outcome.

ROOM 3

Formative Assessment

By the end of this lesson, students will be able to describe how Thomson developed the "plum pudding" atomic model.

Clicker question ideas:

To test the properties of atomic particles, Thomson placed two plates of the SAME electric charge around the cathode ray
A. True B. False

Exit card ideas:

Sketch Thomson's "plum pudding" atomic model, and label all parts of your drawing.

Other ideas:

On an exit card, sketch Thomson's cathode ray tube experimental setup. Include the behavior of the cathode ray that led Thomson to conclude that there were electrons in the atom.

Summative Assessment

By the end of this course, students will be able to identify the five main atomic models developed since 1800.

Project ideas:

Select one of the five major atomic models and create a 3D representation of the model for a Carbon atom.

Exam question ideas:

Match the name of the atomic model to the corresponding sketch.

Other ideas:

In a take-home exam, ask students to list the five main atomic models, including the new development that each model contributed to scientific knowledge.

Topic information: https://medium.com/@lntlink.edu/a-timeline-of-atomic-models-cb2607b1da85

Put the red arrows next to the assessments that **do not** align with the learning outcome.

Discuss why the assessment you selected is not well-aligned with the learning outcome.

ROOM 4

Formative Assessment

By the end of this lesson, students will be able to identify important milestones in the Civil Rights Movement and in the Cold War during the 1950s and 1960s.

Clicker question ideas:

Which of these court cases desegregated US public schools?
A. Brown vs. Board of Education
B. Brown vs. Louisiana
C. Bates vs. Little Rock

Exit card ideas:

List at least one supreme court case that, while focused on civil rights, referenced Soviet "propaganda mills" in the decision.

Other ideas:

Design a large poster that represents the timeline of at least four key milestones during the Civil Rights Movement and Cold War. Prepare a corresponding 15 minute presentation of your timeline.

Summative Assessment

By the end of this course, students will be able to analyze the points of view of primary sources from the Civil Rights Movement and Cold War period.

Project ideas:

Read the provided amicus brief. Do you think the author views the Brown vs. Board case as a cause or effect in relation to the US's actions in the Cold War? Explain your position in 500 words.

Exam question ideas:

Name the Supreme Court justice in Brown vs. Board who is related to the lone dissenter in Plessy vs. Ferguson.

Other ideas:

In a take-home exam, ask students to read "Labor Day Weekend at Communist Training School". In 500 words, describe why you think this article was published and whose point of view is missing.

Topic information: https://edsitement.neh.gov/lesson-plans/civil-rights-and-cold-war

Put the red arrows next to the assessments that **do not** align with the learning outcome.

Discuss why the assessment you selected is not well-aligned with the learning outcome.

ROOM 5

Formative Assessment

By the end of this lesson, students will be able to compute the mean, median, and mode of a given data set.

Clicker question ideas:

Provide students with a dataset with 10 observations. Ask them to select which quantity is larger, the mean or the median.
A. Mean B. Median

Exit card ideas:

Write down the formula to find the mean of a dataset.

Other ideas:

Provide students with an ordered dataset. Ask them to find the mode, and enter their answer anonymously on Poll Everywhere.

Summative Assessment

By the end of this course, students will be able to evaluate which measure of central tendency is most appropriate for a given data set and research question.

Project ideas:

Give students a dataset of US incomes. Ask them to compute either the mean or the median and justify why their chosen measure is best to describe the income of an "average" American family.

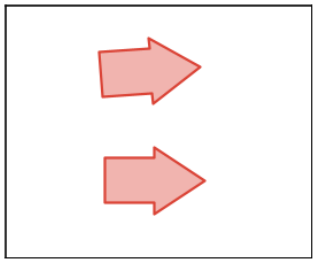
Exam question ideas:

You are a banker with lots of small accounts and one very large account. You want to show off the amount of money you manage. Which metric should you provide?
A. Mean B. Median C. Mode

Other ideas:

Use a clicker question to ask students whether the mean or median will be larger, based on a histogram of US incomes.

Put the red arrows next to the assessments that **do not** align with the learning outcome.



Discuss why the assessment you selected is not well-aligned with the learning outcome.

Topic information: https://www.gs.washington.edu/academics/courses/akey/56008/lecture/lecture2.pdf

ROOM 6

Formative Assessment	Summative Assessment
By the end of this lesson, students will be able to introduce themselves in Spanish.	By the end of this course, students will be able to talk and write about future plans in Spanish.
Clicker question ideas: Which statement would you use to introduce yourself in Spanish? A. Me gusta ____. B. Je suis ____. C. Me llamo ____. D. Soy ____.	**Project ideas:** Read an essay in Spanish and highlight all the sentences that are written in future tense.
Exit card ideas: Write down the part of the lesson that you found most challenging today.	**Exam question ideas:** Translate the following sentence into Spanish: "I will go swimming tomorrow".
Other ideas: Ask students to find a partner and introduce themselves to one another in Spanish.	**Other ideas:** In an oral exam, ask students to describe one goal they have for next year.

Topic information: https://spanport.washington.edu/spanish-101-course-objectives

Put the red arrows next to the assessments that **do not** align with the learning outcome.

Discuss why the assessment you selected is not well-aligned with the learning outcome.

ROOM 7

Formative Assessment

By the end of this lesson, students will be able to identify the structure of a Haiku.

Clicker question ideas:

Which poem structure matches that of a haiku?
A. 3 lines, with 5, 7, and 5 syllables per line
B. 4 lines, with 5, 7, 5, and 7 syllables per line
C. 3 rhyming lines, each with 5 syllables

Exit card ideas:

Project three poems for students to read, and ask them to write the name of the poem that is a haiku on their exit card.

Other ideas:

For a quick homework assignment, ask students to compose a haiku poem before the next class.
Do it during class instead? Identify, not create

Summative Assessment

By the end of this course, students will be able to effectively use similes and metaphors in their own compositions.

Project ideas:

Write a freeverse poem on a topic of your choice, including at least one simile and one metaphor. Evaluate your own work by explaining what you think are the strengths and weaknesses of your poem.

Exam question ideas:

Read the following poem and highlight any similes you see.

This is for identifying, not creating
Revision: read the following passage and revise by adding effective similies and metaphors

Other ideas:

Create a song, speech, or poem where you use at least one simile and one metaphor and recite it in front of the class.

Put the red arrows next to the assessments that **do not** align with the learning outcome.

Discuss why the assessment you selected is not well-aligned with the learning outcome.

Topic information: https://wscs7thgradepoetryunit.weebly.com/goals--objectives.html

ROOM 8

Formative Assessment

By the end of this course, students will be able to identify the scientific and common names of major animal agriculture species in New York.

Clicker question ideas:
Which of these is the scientific name for a Holstein Cow?
A. Bos taurus
B. Bos aries
C. Bos pisces

Exit card ideas:
Write down the common name and scientific name of one animal used for agriculture in New York State.

Other ideas:
Work with a partner to create a song that helps you remember the scientific names for pigs, sheep, and chickens. Perform it in front of the class. Songs with accompanying dances receive bonus points.

Summative Assessment

By the end of this course, students will be able to explain domestication and its contributions to animal agriculture.

Project ideas:
Create a poster that showcases at least one benefit and one downside for agriculture of domesticating an animal of your choice. Be sure to include a definition of domestication in your display.

Exam question ideas:
Write the definition of domestication.

Other ideas:
Pick a major agricultural species and write an essay describing the 1) process of the species' domestication and 2) one contribution to agriculture that this species' domestication made.

Topic information: https://www.uen.org/core/core.do?courseNum=20211

Put the red arrows next to the assessments that **do not** align with the learning outcome.

Discuss why the assessment you selected is not well-aligned with the learning outcome.

ROOM 9

Formative Assessment

By the end of this lesson, students will be able to describe the process of printmaking.

Clicker question ideas:

Select the appropriate order of the steps of printmaking.

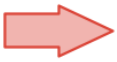
A. Draw, carve, ink, stamp
B. Carve, ink, stamp, draw
C. Draw, ink, carve, stamp

Exit card ideas:

When print making, should you carve out the negative space or the positive space of your design?

Other ideas:

On an exit card, write your initial impressions when you see the print displayed on the screen.



Summative Assessment

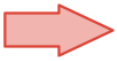
By the end of this unit, students will be able to create original objects of art using ceramic.

Project ideas:

Create a flower pot in the shape of an animal of your choice using clay.

Exam question ideas:

Describe how the development of ceramics helped early civilizations thrive.



Other ideas:

Use a throwing wheel to create a ceramic mug. Glaze and design in the style of your choosing.

Put the red arrows next to the assessments that **do not** align with the learning outcome.

Discuss why the assessment you selected is not well-aligned with the learning outcome.

Topic information: https://www.lehman.edu/academics/arts-humanities/art/learning-goals.php

ROOM 10

Formative Assessment

By the end of this lesson, students will be able to describe the development of "Theory of Mind" in children.

Clicker question ideas:
Which psychologist(s) developed the "Theory of Mind"?
A. Premack & Woodruff
B. Piaget
C. Erikson & Freud

Exit card ideas:
List a task that helps scientists detect development of "Theory of Mind" (ToM). Describe what a child who has and has not developed ToM might do in the task.

Other ideas:
Write down what you think ToM is and one step that helps children develop it. After 1 minute, share your answer with a partner and work together to refine your answers. Be prepared to share with the class.

Summative Assessment

By the end of this course, students will be able to evaluate how current research supports and critiques major theories of child development.

Project ideas:
Read the provided research article. Describe one research finding from the article that supports Bowlby's Attachment Theory and one that critiques it.

Exam question ideas:
A recent study found that children often swipe on all screens (TV, phone, etc.) at electronics stores despite not being told or taught to do so. How would Badura use Social Learning Theory to explain this?

Other ideas:
Develop a proposal for a research study that you could use to evaluate whether children in a preschool class have developed Theory of Mind or not.

Topic information: https://www.middlesex.mass.edu/cslos/psy.aspx

Put the red arrows next to the assessments that **do not** align with the learning outcome.

Discuss why the assessment you selected is not well-aligned with the learning outcome.

ROOM 11

Formative Assessment

By the end of this lesson, students will be able to use the "rise over run" formula to find the slope of a line.

Clicker question ideas:

Select the correct formula for the slope of a line.

A. Rise - Run
B. Rise + Run
C. Rise * Run
D. Rise / Run

Exit card ideas:

Present students with the graph of a line, with two points labeled with their x- and y-coordinates. Ask students to compute the slope on their exit card.

Other ideas:

Compute the slope of a line from two supplied points. After one minute, check your answer with a partner. One group will be asked to share their answer with the class.

Summative Assessment

By the end of this course, students will be able to create linear graphs from an equation.

Project ideas:

Create a portfolio of 5 artistic graphs that you can make on a graphing calculator. Record the equations you used to make the graphs.

Exam question ideas:

Using the supplied graph paper, plot the following line: y = (-2)x + 3.

Other ideas:

On an exam, ask students to draw the graph of a line with a slope of 1 and an x-intercept of 5.

Put the red arrows next to the assessments that **do not** align with the learning outcome.

Discuss why the assessment you selected is not well-aligned with the learning outcome.

Topic information: https://flexbooks.ck12.org/cbook/ck-12-interactive-algebra-2/section/3.2/primary/lesson/graphing-quadratic-functions/

Senior Lead Graduate Teaching Fellow, Cornell University

Term: 2023-2024

My role: Each year, one Lead Graduate Teaching Fellow is invited to return to the program in their third year as the Senior Lead Teaching Fellow. In this role, I will complete all of the responsibilities associated with my previous role as a Lead Graduate Teaching Fellow. In addition, I have the following responsibilities:

- Lead an information session for the CTI Fellows program.
- Serve on the CTI Fellows selection committee (review applications and conduct interviews for all applicants).
- Plan and facilitate CTI Fellows training in the Fall and Spring.
- Plan the graduate student and postdoctoral scholar teaching workshop program.
- Lead biweekly CTI Fellows meetings.
- Lead biweekly CTI Lead Fellows meetings.
- Review draft workshops from all Fellows.
- Coordinate all communication and announcements within the CTI Fellows group.
- Coordinate quarterly newsletters for the entire teaching community at Cornell.

Workshops created and facilitated: ”Steps to developing a strong workshop”, ”Roles and responsibilities of CTI Fellows”, ”Role of TAs in cultivating an inclusive classroom”, ”Effective grading and feedback”, ”Essentials of teaching: Peer review”

Sample materials: I created a workshop on the ”Roles and responsibilities of CTI Fellows” as part of the Fall 2023 CTI Fellows training. The workshop included a ”jigsaw” group activity, where Fellows first learned about a new topic from a Lead Fellow, and then shared their knowledge with a new group. The jigsaw activity worksheet is provided below.

Center for Teaching Innovation
Cornell University

Roles and responsibilities of CTI Fellows

Odds & Ends

- Incorporate checking the **CTI Slack** in your daily routine. **Tip:** It is helpful to have notifications turned on during working hours.

- Be ready to attend, participate in, and prepare for **biweekly (every 2 weeks) CTI Fellows meetings**.
    - Meeting day/time: _____
    - Date of first meeting: _____

- We will all complete the **Teaching and Learning in the Diverse Classroom** online course. Discussions from this course will occur during our biweekly meetings.

- Even if you are not facilitating the **U-Wide Conference**, please be prepared to attend as a participant.

- As you prepare for workshops, **please save all your materials in the CTI Box**!

Jigsaw Activity

We will introduce the remaining roles and responsibilities of CTI Fellows through a jigsaw activity, led by the Lead Fellows. The instructions for this activity are listed below.

1. Navigate to your first group, where a designated Lead Fellow will share information on a role/responsibility of CTI Fellows.
2. Record notes on the role/responsibility on the following pages in this document.
3. Navigate to your second group, which is composed of one person from each of the groups in (1). Everyone will take turns teaching the group about the role/responsibility that they just learned about.

Group 1: Workshop Observations

Record the answers to the following questions as you learn about Workshop Observations. Note that more details on observations can be found in the CTI Box!

Why are Workshop Observations useful? (Consider this question for both the observers and the Fellows being observed!)

Who will be observing your workshop in the Fall vs. the Spring?

Fall workshop observations	_____ CTI Staff	_____ CTI Fellows	(select one)
Spring workshop observations	_____ CTI Staff	_____ CTI Fellows	(select one)

Where can you find the observer for your workshop?

What will your observer do *before* the workshop?

During the workshop, what will the observer be doing?

What will the observer do *after* the workshop?

Other notes:

Group 2: Microteaching

Record the answers to the following questions as you learn about Microteaching. Note that more details on microteaching can be found in the CTI Box!

What *is* microteaching? As a fellow, what do you need to do during the microteaching session?

Why is microteaching useful? (Consider this question for both the teacher and as someone observing a microteaching session!)

Who will you practice microteaching with?

How will you know when and where your microteaching session takes place?

Other notes:

Group 3: Professional Development Groups

Record the answers to the following questions as you learn about Professional Development Groups. Note that more details on the groups can be found in the CTI Box!

What *are* Professional Development Groups?

What is the purpose of having Professional Development Groups within the CTI Fellows Program?

How will you learn which Professional Development Group you are in?

How often will your Professional Development Group meet (on average)?

Where will Professional Development Group meetings take place?

Other notes:

Group 4: CTI Liaisons

Record the answers to the following questions as you learn about the CTI Liaison role. Note that more details on the liaison role can be found in the CTI Box!

What is your goal as a CTI Liaison?

Who can you share CTI Resources with?

How often should you engage in CTI Liaison activities?

What are some examples of CTI Liaison activities?

Where can you record your CTI Liaison activities?

Other notes:

PROGRAM DEVELOPMENT

Advanced Graduate Teaching Cohort, Cornell University

Role: Co-creator and Co-Facilitator, with Rink Tacoma-Fogal, Ph.D. (Dr. Tacoma-Fogal was a graduate student during program development and facilitation)
Advisor: Derina Samuel, Ph.D.
Term: Spring 2023
Program Level: Graduate
Number of Participants: 20

Program Description: Graduate students with an interest in teaching were invited to explore resources and build community within a cohort of graduate teaching assistants by applying to join the "Advanced Graduate Teaching Cohort" (AGTC) program. The program offered the selected group of participants an opportunity to participate in a diverse graduate student teaching community, develop their individual teaching skills, and discuss effective and inclusive teaching practices.

Program Components: This program consisted of two in-person cohort sessions. The first 3-hour, hands-on session consisted of three parts: (1) a workshop on evidence-based inclusive teaching, (2) a group discussion on challenges and solutions for TAs, and (3) independent work on an individual development plan (IDP). The second 2-hour, discussion-based session consisted of two parts: (1) group discussion on the value of a high-structure classroom, based on a chapter from "Inclusive Teaching" by Kelly A. Hogan and Viji Sathy and (2) group discussion on the IDP. Both sessions were evaluated through anonymous surveys completed by the AGTC members.

My role: As a co-creator and co-facilitator of the AGTC program, Dr. Tacoma-Fogal and I had the following responsibilities:

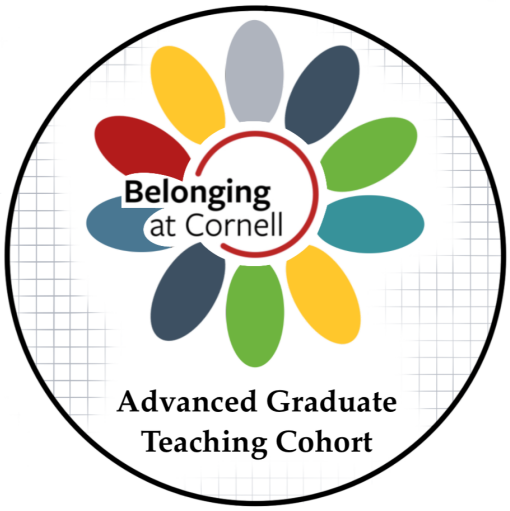
- Write a Belonging at Cornell Mini-Grant proposal, requesting funding for the AGTC.
- Develop budget for all program costs.
- Create AGTC marketing and branding* materials.
- Advertise AGTC program to relevant departments, offices, and student organizations.
- Create AGTC application and web portal.
- Create rubric and selection criteria for AGTC applications.
- Read all AGTC applications and select participants.
- Create AGTC Session 1 program activities.
- Create Individual Development Plan (IDP) document* and associated materials*.
- Create AGTC Session 2 program activities.

- Facilitate Session 1 and 2 of the AGTC.
- Create post-session evaluation surveys for Session 1 and Session 2.
- Write final evaluation of the AGTC program.

* Marked items were completed independently.

Program outcomes: The AGTC program received positive feedback in both the Session 1 and Session 2 surveys. AGTC participants also continued to engage in teaching and mentorship opportunities after completion of the AGTC program. For instance, the AGTC led to strong interest in the CTI Graduate Teaching Fellows program, where CTI leaders reported one of the largest and strongest groups of applicants in program history – including numerous AGTC members. The success of the AGTC program was noticed by the CTI, which is planning on offering the AGTC program annually.

Sample materials: The AGTC's Individual Development Plan (IDP) worksheet and AGTC Final Report are provided below.



Individual Development Plan (IDP)

Advanced Graduate Teaching Cohort – 2023

Name: _____

Welcome to your individual development plan!

This document is designed to help you grow in your teaching practice during your time as a graduate student at Cornell.

Table of Contents

Professional and career goals

This IDP begins by giving you a chance to articulate your professional and career goals.

1. What types of jobs match your interests and the skills you will have by the time you graduate? List 1-3 careers that interest you below.

Reflection on current skills and competencies

In this section of your IDP, you will reflect on your current skills and competencies with regard to teaching. Through this process, you will identify areas of improvement to target during your graduate training at Cornell.

1. Think about your experiences as a teacher. What are your strengths? What skills do you think you have developed? List 2-3 examples.

2. Think about your experiences as a teacher. What areas of your teaching practice do you think could be improved? What aspects of teaching do you want to learn more about? List 2-3 examples.

3. Based on your answers to 1 and 2, rank the following growth opportunities from (1) highest priority to (7) lowest priority. The highest priority ranking should identify an opportunity that you think is very important for you to take advantage of while you are at Cornell. Write your ranking in the blank next to each category.

   ____ Teaching training, certifications, and networking opportunities

   ____ For-credit graduate courses on teaching

   ____ Teaching experience (not including TAing!)

   ____ Teaching awards and grants

   ____ Mentorship and leadership training and certifications

   ____ Mentorship experience

   ____ Academic career development and preparation

Selection of development opportunities

In this section of your Individual Development Plan, you will use your reflection to identify teaching opportunities at Cornell that will help you reach your goals. Use the **"Teaching Resources at Cornell"** document to help you complete this section.

1. List the highest priority opportunity category that you chose from the "Reflection on current skills and competencies" section, question #3:

   _____

   Navigate to the section of the "Teaching Resources at Cornell" that matches your highest priority opportunity category. Select 1-2 opportunities that you want to pursue at Cornell, and fill out the questions below.

Opportunity 1: _____

Skills/experiences I hope to gain from this opportunity:

Target time of completion (month and year):_____

Target time of application (month and year, if applicable): _____

Eligibility requirements that I need to take action to complete:

Questions I have about this opportunity:

Contact information:

Opportunity 2: _____

Skills/experiences I hope to gain from this opportunity:

Target time of completion (month and year):_____

Target time of application (month and year, if applicable): _____

Eligibility requirements that I need to take action to complete:

Questions I have about this opportunity:

Contact information:

2. List the second-highest priority opportunity category that you chose from the "Reflection on current skills and competencies" section, question #3:

_____

Navigate to the section of the "Teaching Resources at Cornell" that matches your second-highest priority opportunity category. Select 1-2 opportunities that you want to pursue at Cornell, and fill out the questions below.

Opportunity 3: _____

Skills/experiences I hope to gain from this opportunity:

Target time of completion (month and year):_____

Target time of application (month and year, if applicable): _____

Eligibility requirements that I need to take action to complete:

Questions I have about this opportunity:

Contact information:

Opportunity 4: _____

Skills/experiences I hope to gain from this opportunity:

Target time of completion (month and year):_____

Target time of application (month and year, if applicable): _____

Eligibility requirements that I need to take action to complete:

Questions I have about this opportunity:

Contact information:

3. List the third-highest priority opportunity category that you chose from the "Reflection on current skills and competencies" section, question #3:

_____

Navigate to the section of the "Teaching Resources at Cornell" that matches your third-highest priority opportunity category. Select 1-2 opportunities that you want to pursue at Cornell, and fill out the questions below.

Opportunity 5: _____

Skills/experiences I hope to gain from this opportunity:

Target time of completion (month and year):_____

Target time of application (month and year, if applicable): _____

Eligibility requirements that I need to take action to complete:

Questions I have about this opportunity:

Contact information:

Opportunity 6: _____

Skills/experiences I hope to gain from this opportunity:

Target time of completion (month and year):_____

Target time of application (month and year, if applicable): _____

Eligibility requirements that I need to take action to complete:

Questions I have about this opportunity:

Contact information:

4. Are there any other opportunities in the “Teaching Resources at Cornell” that would help you achieve your goals and address your areas of improvement? List them below!

My timeline

Using your selected development opportunities, fill out the following timeline for your time at Cornell. Be sure to include the following milestones in your graduate career, if applicable:

A-Exam Qualifying Exams Certification Exams B-Exam Graduation!

	2023	2024	2025	2026	2027
Spring	✅ Advanced Graduate Teaching Cohort				
Summer					
Fall					

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Evaluation of progress

In this section, you will consider how you can evaluate your own progress on your IDP.

1. Select at least one of the following strategies for making progress and checking your progress on your IDP by putting an X in the appropriate blank.

_____ Block out an hour on your Google or Outlook calendar at least three months from now to review your timeline and selected opportunities. At this time, check if you need to take any action to enact your plan.

_____ “Schedule send” an email to yourself that includes at least one action to take on a development opportunity you are interested in (i.e. reminder to apply, to sign up, or to ask your questions).

_____ Write down important dates from your timeline in a physical planner or journal.

_____ Schedule a meeting with your advisor to discuss teaching-related opportunities that you are interested in.

_____ Contact a peer who has completed one of the opportunities you are interested in, and conduct an informational interview with them.

_____ Find a friend to be your “accountability buddy”. Have coffee with them in 1-3 months to discuss progress on your IDPs together.

2. Go do one of your selections from question 1!

Advanced Graduate Teaching Cohort (AGTC) Final Report, 2023

Overview of project implementation

Our program built a diverse community within the Cornell teaching assistant (TA) graduate student body. We identified a gap in existing graduate TA programs – in particular, there was a need for support networks and community for those interested in further developing their teaching skills beyond TA orientation programs. The Advanced Graduate Teaching Cohort (AGTC) was created to fill this gap and provide the framework for graduate students to further develop their teaching skills, learn what it takes to become a more effective teacher, and most importantly, network with peers who have expertise in a wide range of subjects within the university. A call for applications to join the AGTC was generated and distributed to over 40 different organizations within Cornell including departmental DEI organizations, departmental graduate student associations (statistics, engineering, mathematics, chemistry, public policy, architecture, computer science, animal science, plant science, ILR school), Latin American student societies, the CTI listserv, and enclosed in the weekly announcements from the Graduate School. Distribution was achieved through email and by hanging up flyers in department buildings. Our goal was to reach out to as many graduate students as possible at Cornell, with a particular focus towards reaching those from backgrounds historically underrepresented in academia.

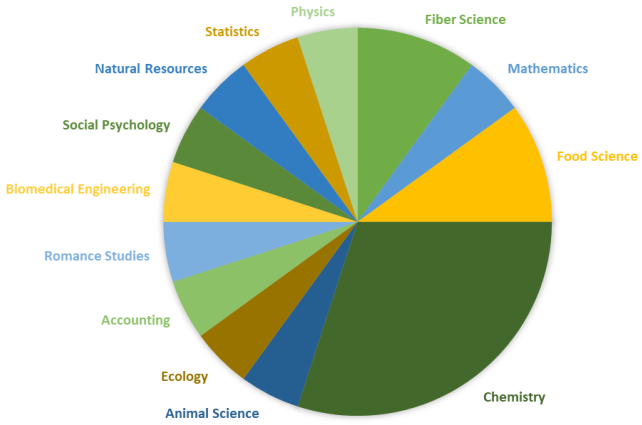


Figure 1: Departmental representation of participants selected for the 2023 AGTC program.

Twenty seven graduate students applied and **twenty applicants** were selected from many different departments across the university (Figure 1). An application evaluation rubric was created based on the instructions outlined in the call for applications. We required participants to be available to attend both in-person program sessions, to have TAed at least one semester at Cornell, and to *not* be graduating before the Fall 2023 semester. Cover letters from applicants were evaluated based on their interest in teaching, their commitment to DEI initiatives, their TA experiences, and their explanations of how participating in AGTC would enhance their professional development goals.

Work completed, outcomes, and impacts realized

In this section, we will describe the AGTC program in detail. We first describe the content and results of Session 1 of the program. Then, we detail our agenda and outcomes from Session 2. Finally, we conclude with outcomes and impacts of the program as a whole.

Session 1

Our first session within the AGTC program was a 3 hour, in-person, hands-on meeting. The session had three parts, each with associated learning objectives (listed below):

1. Evidence-based inclusive teaching for TAs (Workshop)
    a. *Objective:* Describe evidence-based inclusive teaching practices that TAs can employ in their classroom.
    b. *Objective:* Identify classroom scenarios where individual TAs can employ these new practices.
2. Challenges and solutions for TAs (Group Discussion)
    a. *Objective:* Identify and discuss challenges that TAs face in their disciplinary classroom setting
    b. *Objective:* Identify and discuss solutions to the challenges that TAs face in their disciplinary classroom setting
3. Individual development plan (IDP) for teaching-related opportunities (Independent work)
    a. *Objective:* Identify resources and programs for advancing individual teaching goals at Cornell**.**
    b. *Objective:* Make a plan of action for utilizing Cornell's teaching/mentoring resources.

In part 1 (Evidence-based inclusive teaching for TAs), participants reflected on their own experiences of feeling included or excluded in a classroom setting. After a discussion of the impact of inclusive teaching on student learning, participants brainstormed successful inclusive teaching strategies that they have seen as a student or tried as a TA. This activity gave participants ideas of new teaching strategies they could adopt in their own classroom. In our post-session survey, **all participants** indicated that they agreed or somewhat agreed with the statements: "*I can describe various inclusive teaching strategies*" and "*I can describe how to employ an inclusive teaching strategy in my classroom, as a TA.*" One respondent to the survey commented that they "*will use a lot of the techniques [they] learned in the classroom environment*". **This outcome reinforces the *Belonging at Cornell* goal of promoting fair treatment**, as our AGTC participants are now better equipped to practice evidence-based, inclusive, and fair teaching practices as TAs .

In part 2 (Challenges and solutions for TAs), participants worked in groups to identify challenges that they have seen or experienced as TAs. Participants then brainstormed ideas to address the identified challenge of their group and of other groups, based on the previous discussion of inclusive teaching strategies. Despite time constraints in this section, **over 75% of participants** expressed agreement with the statement "*I can find solutions to challenging classroom situations*" in our post-session survey. Participants also cited the benefits of learning with fellow TAs, with one survey respondent saying "*I appreciate the sharing by fellow members … and how [they] handle situations while TAing*".

In part 3 (IDP for teaching-related opportunities), participants were presented with an informational packet and associated worksheet for mapping out teaching-related opportunities that they could engage in while at Cornell. The post-session survey indicated a **strong positive response to this activity**, with participants commenting that they encountered "*lots of resources [they were] not aware of*". This part of the program is an example of the **long-lasting impact of the AGTC** – participants are now equipped to continue advancing their graduate student experience while at Cornell.

During Session 1, our Belonging at Cornell grant funding provided coffee and tea, lunch, and AGTC branded mugs for the group. We also used the funding to pay room rental at PSB 401.

Session 2

Our second session involved a 2-hour program that focused on continued community building and professional development within the cohort. The session was made up of 2 parts, each with associated learning objectives (listed below):, discussing the value of high structured instruction followed by IDP discussion. Objectives for this session were to:

1. The value of high-structure instruction (group discussion)
    a. *Objective:* Describe the role of high-structure in creating an inclusive classroom, using the book chapter "The value of Structure" by Kelly A. Hogan and Viji Sathy.
2. Individual development plan (IDP) for teaching-related opportunities (group discussion)
    a. *Objective:* Discuss completed IDPs among peer groups.
    b. *Objective:* Develop connections and community between cohort members.

For part 1 (The value of high-structure instruction), participants read a chapter, "The value of high structure", from the book "Inclusive Teaching" by Kelly Hogan and Viji Sathy. In groups based on their PhD field of study, participants discussed their answers to questions about the text. During this time, participants had the opportunity to communicate their ideas and listen to others about what they learned from reading the chapter. In addition, they discussed the importance of incorporating high structure into a course and how high structure courses can help build inclusivity within a classroom community. After the group discussion, we connected our lesson on high-structure instruction to an activity from Session 1. In Session 1, participants were asked to write down inclusive teaching strategies they had tried or wanted to try in their classroom. In Session 2, we asked the participants, after reading the book chapter, to select a teaching strategy they would like to use in their classroom and convert it into a "high-structure" strategy.

When we surveyed participants after this session, **94% of respondents** agreed that they could identify high-structure classroom strategies and **89% of respondents** agreed they could discuss the impact of high-structure instruction on students. Participants also had positive comments on the lesson: "*I think it was super helpful and allowed me to learn more about high structured courses and see what is being done and what can be improved*" and " *I enjoyed discussing how to implement high structures; it was very helpful to hear what people from other departments have done"*. Integrating the book chapter and "homework" discussion questions allowed for participants to build on what they had learned in Session 1 and take time to think about new concepts that were presented to them. During session 2, we facilitated further discussion and built on ideas participants had come up with. One participant commented: "*the reading and the following discussion was very helpful. I actually didn't know the concept of high structure in learning….and this helped me to identify why some courses I TA in are successful and others not as much*".

Part 2 (Individual development plan (IDP) for teaching-related opportunities) of Session 2 involved further examination of each participant's IDP. For this part of the session, participants were arranged into pre-assigned groups based on their year in graduate school. In these groups, they discussed their IDP documents and brought up any questions or challenges they had after working on their IDP. Feedback from this portion of the session was positive with **all participants agreeing that they knew where to find more teaching resources at Cornell.** Some written feedback included: "*great compilation of the resources that are available for TA*s", "*I really appreciated compiling all the opportunities in a list!",* and "*The IDP is such a great resource. Not only provides "high structure" for my future plans, but also provides many opportunities that I am excited to apply*." During this session, our hope was to encourage discussion amongst peers where they could learn from each other and come up with ideas for future opportunities and engagement at Cornell. A comment from the post-survey feedback

highlights that this was in fact achieved: "*I think it was **interesting to hear other students' perspectives on the next steps to get to the next level in their teaching journey,** especially at different levels in their academic journey and **to gain inspiration from them**.***"*
During Session 2, our Belonging at Cornell grant funding provided ice cream for the group. We also used the funding to pay room rental at the Big Red Barn.

Overall
Taken together, Sessions 1 and 2 of the **AGTC had a positive impact on the sense of belonging and on the professional development aspirations of the participants**. For instance, **all participants** agreed or somewhat agreed with the statement, "The AGTC formed a community after Sessions 1 and 2" in our final evaluation survey. Importantly, there was considerable growth in the closeness of the AGTC community between Sessions 1 and 2. After Session 1, only about 50% of participants agreed with the statement: "If I have questions during my TA career, I would consider reaching out to an AGTC member". By the end of Session 2, **94% of participants** either agreed or somewhat agreed with the statement. These results show that **the AGTC program achieved the *Belonging at Cornell* goal of fostering a sense of belonging** within the Cornell community.

AGTC participants continued to engage in teaching and mentorship opportunities after completion of the AGTC program. Many AGTC participants also attended the Center for Teaching Innovation's (CTI) University-Wide Teaching Conference, the Graduate School's Future Faculty Institute, and the Colman Inclusive Leadership Program, just to name a few. The AGTC also led to strong interest in the CTI Graduate Teaching Fellows program, where CTI leaders reported one of the largest and strongest groups of applicants in program history – including numerous AGTC members. Importantly, **AGTC members are also giving back to new graduate TAs at Cornell**. Over a quarter of the AGTC participants have volunteered their time with the Graduate School's new TA orientation welcome event, to be hosted in August 2023. This result shows that **the AGTC program also supported a major goal of *Belonging at Cornell*, as our participants show a willingness to recommend Cornell as a great place to be for incoming graduate students**.

Explanation of challenges and obstacles to meeting program objectives
While the AGTC program enjoyed numerous successes, we also learned of ways to make the program better in the future. The amount of time (5 hours total) that we had with participants made developing a community challenging. We found that time constraints limited our fruitful group discussions – resulting in less connection between members of the cohort. It is also important to note that our participants were very busy graduate students! We had many applicants note that they would have loved to join the cohort, but our program dates interfered with previous commitments. Thus, simply increasing the time commitment of the program may *not* be a sure-fire way to build the AGTC in the future.

Another challenge in the program was the distribution of fields of study of applicants. While we are proud of the diversity of fields that joined the AGTC, it is notable that over 25% of the group was from the Chemistry department. These members did an excellent job branching out to meet other AGTC participants, but having fewer individuals from any one department might have created more incentive for participants to network with their peers.

Lessons learned and next steps

The success of the AGTC program was noticed by the Center for Teaching Innovation (CTI). AGTC members took part in CTI workshops and applied for the CTI Graduate Teaching Fellows program in large numbers. As such, the CTI is currently exploring ways to continue offering the AGTC program annually.

The AGTC program also served as a valuable lesson in participant recruitment. We enjoyed strong interest in our application, which we attribute to advertising to student organizations and DEI offices/committees directly. Teaching and professional development opportunities are typically advertised most strongly by Graduate Field Assistants and within-department communication, but student organizations and DEI offices/committees proved to be excellent partners in spreading the word about our AGTC program. In addition, we hung up numerous flyers in graduate student spaces (i.e. student offices). These flyers contained QR codes, and we could track the scanning of those codes. Our tracking shows that the QR codes were scanned hundreds of times, showing the utility of that method of advertising!

COURSE DEVELOPMENT

I have independently developed two statistics courses (one introductory and one advanced), including course descriptions, learning goals, assessments, and schedules. These course proposals are detailed below.

Statistical Graphics and Communication

Course Level: Graduate or advanced undergraduate
Number of Students: $\sim$ 30-60

Course Description: There are many ways to graphically display quantitative information that help biostatisticians and clinical collaborators understand the conclusions drawn from data and statistical models. This course will introduce first- and second-year graduate students in biostatistics to state-of-the-art graphical displays and appropriate ways to communicate statistical results. Students will learn how to create graphical displays of data in RStudio and how to compile those displays into professional reports. Through in-class practice, a midterm, and a final project, students will also develop skills to critique and speak about graphics in a statistically sound manner. Each student will be required to complete a midterm and projects using graphical methods to understand data from real health science problems.

Course Components: This class is designed to meet twice a week, for interactive lectures on statistical methodologies. The class will also include for smaller lab sections once a week. These lab sections consist of code demonstrations and problem-solving related to the previous lecture's content. Students will be assessed via weekly lab assignments completed in R as well as a lab exam, a poster presentation, and an oral presentation of an R Shiny application.

Sample materials: The syllabus for this course, developed in the Fall of 2019, is provided below.

Statistical Graphics and Communication

COURSENUMBER: Fall 2020

Teaching Team

Instructor
Kim Hochstedler
(hochsted@umich.edu)
Office: M4141, SPH II

Insert photo of TA. ☺

Teaching Assistant
Name

Insert photo of TA. ☺

Teaching Assistant
Name

Insert photo of TA. ☺

Teaching Assistant
Name

Lectures, Labs, and Office Hours

	Monday	Tuesday	Wednesday	Thursday	Friday
9:00 am					
10:00 am	Lecture	TA Office Hour	Lecture		TA Office Hour
11:00 am					
12:00 pm					
1:00 pm					
2:00 pm	TA Office Hour	Kim's Office Hour		Lab	
3:00 pm					

*****All TA Office Hours will be located in ROOM NUMBER.**

Textbooks: None required. Useful references listed below.
Advanced R, by Hadley Wickham (https://adv-r.hadley.nz/index.html)
ggplot2: Elegant Graphics for Data Analysis, by Hadley Wickham
Introductory Statistics with R, by Peter Delgaard
R Cookbook, by Paul Teetor

Lab Exam: There will be one lab exam on Wednesday, October 7th.

Static Graphics Project: After mid-semester, there will be a group project involving a poster presentation of static graphics. Presentations will take place on November 20th.

Interactive Graphics Project: There is no final exam. There will be a final project, which will culminate in an oral presentation (due during finals week).

Pre-requisites: BIOSTAT 600 or another introductory undergraduate statistics course.

Course Website: www.umich.instructure.com/courses/mycoursenumber.html
Course Discussion Board: piazza.com/umich/fall2020/coursenumber/home

Course Description

There are many ways to graphically display quantitative information that help biostatisticians and clinical collaborators understand the conclusions drawn from data and statistical models. This course will introduce first- and second-year graduate students in biostatistics to state-of-the-art graphical displays and appropriate ways to communicate statistical results. Students will learn how to create graphical displays of data in RStudio and how to compile those displays into professional reports. Through in-class practice, a midterm, and a final project, students will also develop skills to critique and speak about graphics in a statistically sound manner. Each student will be required to complete a midterm and projects using graphical methods to understand data from real health science problems.

Course Goals

1. **Understand the fundamentals of data and reproducible data analysis.**
    - Distinguish between data types.
    - Write easily readable and reproducible code to explore and analyze data sets using R, R Studio, and R Markdown.
2. **Create statistical graphics.**
    - Learn strategies to develop easily readable and understandable statistical graphics.
    - Incorporate statistical information (i.e. results of statistical tests) into data visualizations.
    - Create both static and interactive graphics.
3. **Think critically about statistical graphics.**
    - Complete objective analyses of data to form thoughtful and meaningful conclusions.
    - Understand the extent to which you should draw conclusions and make claims about statistical graphics and analyses.
    - Review others' statistical graphics objectively and professionally.
    - Describe the advantages and disadvantages of a given data visualization choice.
4. **Write about statistical graphics.**
    - Accurately and concisely describe statistical graphics.
    - Incorporate appropriate statistical language into written descriptions of graphics.
5. **Speak about statistical graphics.**
    - Give oral presentations of statistical graphics to both technical and non-technical audiences.
    - Demonstrate the features of interactive graphics.

Course Competencies

- **Evidence-based Approaches to Public Health-3:** Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate.
- **Evidence-based Approaches to Public Health-4:** Interpret results of data analysis for public health research, policy, or practice.
- **Evidence-based Approaches to Public Health-19:** Communicate audience-appropriate public health content, both in writing and through oral presentation.

Course Components

1. **Lectures:** Lectures will cover the main topics of the course. Printed lecture outlines (to be annotated and filled in during lecture) will be available for you at the beginning of class. You are responsible for any announcements and materials covered in lectures.
   Most (but not all) lecture outlines and example code will be posted on the course website.

2. **Labs:** Lab sessions are designed to add context and allow hands-on practice of topics covered in lecture. These sessions allow you to begin working on lab assignments for the upcoming week. The instructor and TA(s) are in lab to help you, so please ask questions when you need assistance. Additionally, feel free to talk with other students, ask other students for help, and help other students with the lab.
   You are encouraged to use either the computers in the computer cluster, or to use your own personal computer during lab.
   Lab attendance is mandatory. Please see additional details under "Oral Evaluations" below.

3. **Oral Evaluations:** In each lab session, a random selection of students will be asked to give a short, one-on-one presentation of a single graphic to the instructor. The graphic will be provided to you before lab. During the first week of the course, the instructor will give an example of what is expected for these oral presentations. No students will be required to give presentations during Lab 1.
   These oral evaluations are strictly for your benefit and will be graded on **completion only**. If you are not in lab when you are selected to give a presentation, you will lose credit. You may be selected for oral evaluations multiple times during the semester. The instructor will provide feedback on these presentations in order to help you improve their oral presentation skills.

4. **Lab Assignments (Homework):** Lab assignments give you the opportunity to apply and practice the data analysis and report writing, based off of material covered in lecture. As such, it is expected that you treat lab assignments like formal reports. All material covered in lab assignments may show up in later lab assignments and in the lab exam and projects.
   Lab assignments are designed to be started in Thursday lab sessions. Lab assignments will be released Wednesday after lecture so that you may prepare for the assignment and bring specific questions to lab if you so choose. Lab assignments are due on Wednesdays at 9:59 am, submitted through the course website as a single .Rmd file, unless otherwise specified.

5. **Code:** All code should be written in R and R Markdown, freely available at https://cran.r-project.org/. You should follow Hadley Wickham's Advanced R Style Guide (http://adv-r.had.co.nz/Style.html). If your submitted code does not adhere to this style guide, you will lose up to 10% credit on that assignment. If you are an experienced R programmer who wishes to use a different (but well-defined) style guide, please discuss this with the instructor.

6. **Lab Exam:** There is one lab exam during the semester. The lab exam is designed to assess your proficiency in R coding for statistical analysis. There will be a practice lab exam the week before the exam date (Wednesday, October 7th). More details about the content and the format of the lab exam will be made available closer to the exam date.

7. **Static Graphics (Midterm) Project:** Groups of students will select a data set to analyze with respect to a research question of interest. Your group will create a poster describing their work. A public group presentation of the posters will take place on Friday, November 20th. As part of your grade on this

project, you will evaluate your own group performance and will peer review the work of another group. More details about the expectations and guidelines for the static graphics project will be made available after Fall Break.

8. **Interactive Graphics (Final) Project:** You will select a data set to analyze with respect to a research question of interest. You will create an R Shiny web application displaying interactive graphics that serve to answer their research question. A presentation of the app will occur during the regularly scheduled final exam period. As part of your grade on this project, you will reflect on your own work and will peer review the work of another student. More details about the expectations and guidelines for the interactive graphics project will be made available after Thanksgiving Break.

What can you take away from these Course Components after this semester?

- Lecture notes will serve as a reference guide for coding and analysis for later classes and projects.
- Oral evaluation feedback (provided during lab sessions) will guide students to become better presenters.
- Lab assignments will serve as example statistical reports that students can use as (1) guides for later projects and (2) evidence of proficiency in report writing and coding to employers.
- Adherence to a style guide will allow your code to be easily read and reproduced by others.
- The lab exam will serve as evidence of your efficiency in coding and simple analyses.
- The static graphics project gives you an opportunity to make and present a scientific poster, and work effectively in a group (Hint: put this presentation on your CV!)
- The interactive graphics project gives you an opportunity to make and present an R Shiny web application (Hint: put this on your CV too!)

Grading Policies

- All numeric grades are on a scale from 0 to 100.
- Final grades will be computed according to the following weights:

Average Lab Assignment Score	50.0%
Oral Evaluations (completion only)	5.0%
Lab Exam Score	12.5%
Static Graphics Project	12.5%
Interactive Graphics Project	20.0%

- Final letter grades will be determined according to the following rules (subject to change at the instructor's discretion, though lower bound of each letter grade cut off will *not* increase).

A	≥ 90
B	[80, 90)
C	[70, 80)
D	[60, 70)
R	< 60

- The lowest lab assignment score is not included in the calculation of final grades.

Administrative Procedures and Logistics

Lectures: Much of the learning in lecture will be done through active participation, so you should be prepared to participate during class. Use common courtesy: please arrive on time, do not leave early, and do not be disruptive in class. You are responsible for any announcements and materials covered in lectures.

Course Materials, Canvas: The syllabus, lab assignments, oral evaluation graphics, assignment solutions, assigned readings, any supplementary material, grades, and announcements for the course can be found on the course web page on Canvas: www.umich.instructure.com/courses/mycoursenumber.html. **Please check Canvas regularly.**

Discussion Board: All class discussions that take place outside of lecture and lab should occur on Piazza: piazza.com/umich/fall2020/coursenumber/home

Communication: If you have questions related to the class material, lab assignments, the lab exam, or projects, feel free to ask the instructor during class or, preferably, the instructor and TA(s) during office hours. Questions concerning the current homework assignment submitted by email will not be answered. Please use email only to address administrative and logistic issues, or personal questions. **Please include COURSENUMBER in the subject line of all emails.** You should expect a reply within 3 days, with the exception of Fall Break and Thanksgiving Break. Questions about lab assignments should be submitted to the course discussion board. **Emails to TAs will not be answered.**

Lab Assignment (Homework) Format: Lab assignments should have the students name and uniqname at the very top and should be written using R Markdown. Students should use Hadley Wickham's Advanced R Style Guide to write their code. All answers should be clearly labeled. Lab assignments should be treated as formal reports. This means that proper spelling and grammar is expected. Deviating from this format may result in your assignments not being graded.

You are encouraged to discuss homework problems and collaborate with your classmates (both on the discussion board and in person). However, the work you submit must be your own. This means that each student must independently write up each problem, including all code and written responses. Instances of identical, nearly identical, or copied lab assignments will be considered cheating and plagiarism.

Extensions: In general, extensions will not be granted for students (because they are behind on work, had a busy week, etc). Extensions for **reasonable academic purposes** (e.g. job interview, conference attendance) or **extreme circumstances** (e.g. family emergency) may be granted at the instructor's discretion. If you have a request for an extension, please request this at least 48 hours before the assignment is due, if possible. Students should submit proof of the issue when requesting an extension. If you require special accommodations via disability services or for religious observance, please see "Student Accommodations" below.

Regrades: If you believe a mistake was made when your assignment was graded, you must write a clear description of the issue. Please include your name, and the number of points under consideration at the top of the page. Please submit this, along with a copy of your assignment to the instructor's mailbox (SPH II) or via email **within one week of when the assignment was graded**.

Academic Integrity: The faculty and staff of the School of Public Health believe that the conduct of a student taking courses in the School should be consistent with that of a professional person. Courtesy, honesty, and respect should be shown by students toward faculty members, guest lecturers, administrative support staff, community partners, and fellow students. Similarly, students should expect faculty to treat them fairly, showing respect for their ideas and opinions and striving to help them

achieve maximum benefits from their experience in the School.

Student academic misconduct refers to behavior that may include plagiarism, cheating, fabrication, falsification of records or official documents, intentional misuse of equipment or materials (including library materials), and aiding and abetting the perpetration of such acts. Please visit http://sph.umich.edu/student-resourses/mph-mhsa.html for the full SPH Code of Academic Integrity and further definition of these terms.

Cell Phones, Laptops, Tablets, etc: Students may bring a laptop or tablet to lectures, though handwritten lecture notes are provided. Students may utilize a personal computer during lab sessions if they choose. Please no cell phone use during class.

Phone, Audio, and Video Recording: Photo, audio, and video recordings of the course lectures, lab session, lab exam, and all other course materials are strictly prohibited.

SPH Writing Lab: The SPH Writing Lab is located in 5025 SPH II and offers writing support to all SPH students. The Lab can also help answer questions on academic integrity. To learn more or make an appointment, please visit https://sph.umich.edu/writing-lab/.

Student Well-being: SPH faculty and staff believe it is important to support the physical and emotional well-being of our students. If you have a physical or mental health issue that is affecting your performance or participation in any course, and/or if you need help connecting with university services, please contact the instructor of the Office of Graduate and Postdoctoral Studies. Please visit https://sph.umich.edu/student-life/wellness.html for more information.

Student Accommodations: Students should speak with the instructor before or during the first week of classes regarding any special needs and no later than two weeks before an exam or assignment due date. Students can also visit the SPH Office for Student Engagement and Practice for assistance in coordinating communications around accommodations. Students seeking academic accommodations should register with Services for Students with Disabilities (SSD). SSD arranges reasonable and appropriate academic accommodations for students with disabilities. Please visit https://ssd.umich.edu/topic/our-services for more information on student accommodations.

Students who expect to miss classes, examinations, or other assignments as a consequence of their religious observance shall be provided with a reasonable alternative opportunity to complete such academic responsibilities. It is the obligation of the student to provide faculty with two weeks' notice of the dates of religious holidays on which they will be absent. Please visit https://www.provost.umich.edu/calendar/religous_holidays.html#conflicts for the complete university policy.

Diversity, Equity, and Inclusion: I am committed to creating an equitable learning environment in this class. The goal of this course is to bring together people from diverse backgrounds (be it educational, social, regional, etc.) and promote the different perspectives that each person brings to the art of data science. Regardless of an individual's prior experience with statistical visualization and communication, students will have the tools they need to become a proficient member of the classroom community. In that community, we value the diversity of opinions and approaches to data science that everyone brings to the table. That diversity enriches everyone's educational experience and results in a creative atmosphere where all student's efforts and perspectives are valued. After learning the core principles of statistical graphics and communication, students are encouraged to adapt the course material to benefit their own needs and interests. Fellow students are expected to respectfully and constructively comment on the data science methods other students employ in their work.

Course Schedule

- Course schedule is subject to change, but the dates of the **lab exam and the poster presentation** for the static graphics project are **fixed**.

Date	Class Session	Topic	Assignment Due
9/2	Lecture 1	Course introduction, goals of graphics	Reading: "Same Stats, Different Graphs" by Matejka and Fitzmaurice
9/3	Lab 1	Introduction to R and R Markdown, style guides, dplyr	Download RStudio
9/7	Lecture 2	Goals of graphics, core components of a plot, tables vs. plots	
9/9	Lecture 3	What is data?, types of data	Lab 1 due
9/10	Lab 2	Data manipulation and R Markdown, tables	
9/14	Lecture 4	1-dimensional categorical data	
9/16	Lecture 5	1-dimensional continuous distributions	Lab 2 due
9/17	Lab 3	1-dimensional graphics	
9/21	Lecture 6	2-dimensional categorical data	
9/23	Lecture 7	2-dimensional categorical data	Lab 3 due
9/24	Lab 4	2-dimensional graphics	
9/28	Lecture 8	2-dimensional continuous data	
9/30	Lecture 9	2-dimensional continuous data **Last day of material on lab exam**	Lab 4 due
10/1	Lab 5	Practice lab exam	**Lab 5 due**
10/5	Lecture 10	2-dimensional kernel estimation	
10/7	**Lab Exam**		**Lab Exam to be completed during lab session**
10/8	No class, fall break		
10/12	No class, fall break		
10/14	Lecture 12	3-dimensional data, maps and projections	
10/15	Lab 6	3-dimensional graphics I	
10/19	Lecture 13	Clustering, PCA	
10/21	Lecture 14	Longitudinal and time series data	Lab 6 due
10/22	Lab 7	3-dimensional graphics II	Select Static Graphics Project group
10/26	Lecture 15	Format of a statistical report	
10/28	Lecture 16	Format of a statistical report	Lab 7 due
10/29	Lab 8	General report outline	Select Static Graphics Project data set
11/2	Lecture 17	Format of a statistical presentation	
11/4	Lecture 18	Use of color in graphics	Lab 8 due
11/5	Lab 9	Making a presentation in R	
11/9	Lecture 19	Format of a statistical poster	Lab 9 due

11/11	Lecture 20	Work on static graphics project	
11/12	**Static Graphics Lab Session**	Work on static graphics project	
11/16	Lecture 21	Presentation skills for a poster	
11/18	Lecture 22	Practice poster presentation	**Print your poster before class**
11/19	**Static Graphics Poster Project Presentation**		Static Graphics Project group evaluation and reflection
11/23	No class, Thanksgiving break		
11/25	No class, Thanksgiving break		
11/26	No class, Thanksgiving break		
11/30	Lecture 23	Natural language processing, text data	Select Interactive Graphics Project data set
12/2	Lecture 24	Networks	
12/3	Lab 10	Special Topics	
12/7	Lecture 25	Interactive graphics, introduction to R Shiny	
12/9	Lecture 26	Presentation skills for a web application	Lab 10 due
12/10	**Interactive Graphics Lab Session**		
12/14	Lecture 27	Work on interactive graphics project	

- Interactive Graphics Presentations will take place during **the week of 12/14 to 12/18**.
- Interactive Graphics Project evaluation and reflection **due 12/18.**

Skills Checklist

- Use this checklist as you go through the semester to keep track of the skills you have mastered.

Before the lab exam: I can …

1-Dimensional Graphics: these skills are useful for exploratory data analysis.

- □ Make a bar plot.
- □ Make a histogram.
- □ Determine an appropriate binwidth for the data displayed in a histogram.
- □ Make a box plot.
- □ Explain why I shouldn't actually make a box plot very often.
- □ Print an aesthetically pleasing "Table1" using a package of my choice in R.
- □ Perform a t-test or chi-squared test in R.
- □ Identify when it is appropriate to use a t-test or chi-squared test.
- □ Interpret t-test and chi-squared test results

2-Dimensional Graphics: these skills are useful for exploratory data analysis, model diagnostics, and can be used in presenting analysis results.

- □ Make a stacked bar chart.
- □ Make a side-by-side bar chart.
- □ Make a scatter plot.
- □ Compute a correlation.
- □ Interpret a correlation.
- □ Perform a 2-sample t-test in R.
- □ Interpret the results of a 2-sample t-test.
- □ Print the results of a 2-sample t-test in an aesthetically pleasing way.
- □ Print an aesthetically pleasing contingency table using a package of my choice in R.

Before the static graphics project: I can…

Regression: this analysis technique is commonly used in statistical analyses.

- □ Fit a linear model in R.
- □ Fit a generalized linear model in R.
- □ Identify when it is appropriate to transform variables, and how I should transform them.
- □ Add error bars to my plots.
- □ Understand when and how to implement smoothing features in regression.
- □ Put a trend line on a scatter plot.
- □ Interpret the results of a linear regression…
    - Intercept.
    - Slope coefficient for a continuous variable.
    - Slope coefficient for a categorical variable.
    - Interaction term.

3-Dimensional Graphics and Special Topics: exploring new types of graphs helps you become fluent in R programming and ggplot2. These skills help you create more complex visual displays for reports and projects.

- □ Facet my graphs.
- □ Make a time series plot.
- □ Make a network diagram.
- □ Make a heat map.
- □ Add error bars to my plots.
- □ Include the results of statistical tests in my graphs.

***Not all special topics will be covered before the static graphics project. Please see course schedule for details, though this is subject to change.**

Before the interactive graphics project: I can …

Interactive Graphics: these skills will allow you to create an RShiny app that is useful for understanding a biomedical research question.

- □ Code an R Shiny app that actually launches.
- □ Add at least 2 interactive elements to a plot.
- □ Make multiple pages in my app.
- □ Design my R Shiny application to be aesthetically pleasing and user-friendly.
- □ Present the elements of an R Shiny app to non-technical audiences.
- □ Present the elements of an R Shiny app to technical audiences.

Throughout the semester: I can …

Skills in R: these skills will make you a better R programmer who can continue to learn new coding skills, even after this course ends.

- □ Install and use new statistical packages.
- □ Find and use R documentation and R help pages.
- □ Load data into R from multiple file formats (i.e. .csv, .sas7bdat, .txt)
- □ Export a .csv from R.
- □ Use the pipe "%>%" to manipulate data.
- □ Adhere to a style guide when coding.
- □ Document / comment my code.
- □ Find out the data type I working with using R.

Statistical Graphics (ggplot2) Skills: these skills will allow you to make professional looking statistical graphics.

- □ Change axis, legend, and graph titles.
- □ Add a caption to my graphics.
- □ Alter text size, angle, and color.
- □ Use appropriate colors and shapes in my graphics.
- □ Make my own theme for graphs I produce in ggplot2 / R.
- □ Use the annotate( ) feature to add text to my graph.

Writing and Speaking Skills: these skills will allow you to feel comfortable describing statistical graphics and statistical results in writing and in oral presentations.

- □ Identify the key take-aways from a statistical graphic, even if I did not make it.
- □ Give constructive feedback on the strengths and weaknesses of a given graphical choice.
- □ Identify potential sources of bias in graphs.
- □ Present a statistical graphic to a non-technical audience.
- □ Present a statistical graphic to a technical audience.
- □ Generate a statistical report in R Markdown.
- □ Generate presentation slides in R Markdown.

Statistics for Future Presidents

Course Level: Undergraduate
Number of Students: $\sim$ 30-80

Course Description: Numerical analysis and statistical claims are present in much of the media, journalism, and research that we consume. This course is designed to introduce undergraduates in humanities disciplines to the general principles of statistical reasoning. Students will learn about common statistical methods, study designs, and data presentation techniques. Importantly, students will learn how to evaluate the appropriateness of a variety of statistical analyses and assumptions for real-world questions. Each student will be required to complete projects critiquing popular news reporting of statistical results. The focus of this course will be on *statistical literacy* (reading, writing, and speaking about statistics) rather than statistical computation (use of software packages, data analysis, etc.). As such, students who anticipate being consumers, but not practitioners, of statistical analyses should enroll in this course.

Course Components: This class is designed to meet twice a week, for interactive lectures on quantitative methods and data literacy. The class will also include for smaller lab sections once a week. Typically, these lab sections will consist of problem-solving and case studies related to the previous lecture's content. Students will be assessed via mini assignments (every 2-3 weeks), a "statistical fallacies" midterm project, and a "statistics in the wild" final project. Students will also participate in completion-based oral evaluations of statistical claims and graphics throughout the semester.

Sample materials: The syllabus for this course is provided below.

Statistics for Future Presidents

COURSENUMBER: Fall 2022

Instructor
Kim Hochstedler, MS
(kah343@cornell.edu)
Office: Malott Hall 301

TA #1

TA #2

TA #3

Lectures, Labs, and Office Hours

	Monday	Tuesday	Wednesday	Thursday	Friday
9:00 am					
9:30 am					
10:00 am	TA Office Hour				
10:30 am		TA Office Hour		Lab	
11:00 am					
11:30 am					
12:00 pm					
12:30 pm					
1:00 pm					TA Office Hour
1:30 pm					
2:00 pm	Lecture		Lecture		
2:30 pm					
3:00 pm		Kim's Office Hour			
3:30 pm					

All TA Office Hours will be located in ROOM NUMBER.

Textbooks: None required. Useful references listed below.

- *Statistics done wrong* by Alex Reinhart
- *Statistical thinking* by Russell Poldrack

Statistical Fallacies Project: The midterm will consist of individual projects on "statistical fallacies".

"Statistics in the Wild" Project: There is no final exam. There will be a final project, which will culminate in a written report (due during finals week).

Pre-requisites: None.

Course Website: www.cornell.instructure.com/courses/mycoursenumber.html

Course Description

Numerical analysis and statistical claims are present in much of the media, journalism, and research that we consume. This course is designed to introduce undergraduates in humanities disciplines to the general principles of statistical reasoning. Students will learn about common statistical methods, study designs, and data presentation techniques. Importantly, students will learn how to evaluate the appropriateness of a variety of statistical analyses and assumptions for real-world questions. Each student will be required to complete projects critiquing popular news reporting of statistical results. The focus of this course will be on **statistical literacy** (reading, writing, and speaking about statistics) rather than statistical computation (use of software packages, data analysis, etc.). As such, students who anticipate being consumers, but not practitioners, of statistical analyses should enroll in this class.

Course Goals

1. **Identify appropriate statistical analyses for a given problem or question.**
    - Describe and discern between various data types (continuous, categorical).
    - Describe general assumptions of various statistical methods (t-test, ANOVA, linear regression, etc.)
    - Evaluate the appropriateness of various analysis methods for a given research problem or question.
2. **Evaluate the strengths and weaknesses of various methods of data collection for a given problem or question.**
    - Define and distinguish between probability and non-probability sampling.
    - Describe various sampling strategies.
    - Evaluate the appropriateness of sampling strategies based on population size and the research goal.
    - List different methods for writing survey questions, including strengths and weaknesses.
3. **Evaluate the validity and appropriateness of statistical claims and assumptions made in media and research articles.**
    - Define and distinguish between traditional aspects of research validity (external validity, internal validity, and construct validity).
    - Interpret statistical results in problem context.
    - Critique statements conveying statistical results.
4. **Read and interpret statistical graphics and visualizations.**
    - Accurately and concisely describe statistical graphics.
    - Incorporate appropriate statistical language into written descriptions of graphics.
    - Give oral presentations of statistical graphics to both technical and non-technical audiences.

Course Components

1. **Lectures:** Lectures will cover the main topics of the course. Printed lecture outlines (to be annotated and filled in during lecture) will be available for you at the beginning of class. You are responsible for any announcements and materials covered in lectures.
   Most (but not all) lecture outlines and examples will be posted on the course website.

2. **Labs:** Lab sessions are designed to add context and allow hands-on practice of topics covered in lecture. The instructor and TA(s) are in lab to help you, so please ask questions when you need assistance. Additionally, feel free to talk with other students, ask other students for help, and help other students with the lab.
   Lab attendance is mandatory. Please see additional details under "Oral Evaluations" below.

3. **Oral Evaluations:** During each lab session, a random selection of students will be asked to give a short, one-on-one presentation of a single statistical claim or graphic to the instructor. The claim or graphic will be provided to you before lab. During the first week of the course, the instructor will give an example of what is expected for these oral presentations. No students will be required to give presentations during Lab 1. In addition, students who are giving their "Statistical Fallacies" presentation in lab are not eligible to be selected for that day's oral evaluation.
   These oral evaluations are strictly for your benefit and will be graded on **completion only**. If you are not in lab when you are selected to give a presentation, you will lose credit. You may be selected for oral evaluations multiple times during the semester. The instructor will provide feedback on these presentations in order to help you improve your oral presentation skills.

4. **Mini Assignments (Homework):** Mini assignments give you the opportunity to apply and practice statistical reasoning, based off of material covered in lecture. For each 2-3 week long course unit, you will be required to complete 2-3 mini assignments from a bank of assignment options. One mini assignment option will be required for all students. You may choose which options you want to complete for the remaining mini assignments in the unit.
   Students may turn in their self-selected mini assignments at any point during the unit period. Feedback will be provided on a *weekly basis*, so if you turn in assignments throughout the unit, you will receive grades and updates on your progress periodically. To facilitate this schedule, recommended deadlines are provided in the course calendar. The required mini assignment is due at the end of each unit, and no intermittent feedback is provided.

5. **"Statistical Fallacies" (Midterm) Project:** The "Statistical Fallacies" project is designed to assess your understanding of statistical reasoning and your skill at communication of statistical topics. Within your lab section, you will select a statistical fallacy from a provided list of options. Options are ordered by their appearance in class material. This means that earlier items on the list will relate to material in the first few class lectures. For items appearing later in the list, project material will not be covered until the end of the course and grading criteria will reflect this for students that select these topics. All statistical fallacy options are of equal difficulty, so please base your selection on your schedule to ensure that you can produce your best work for this project. For their selected topic, each student will produce a communication piece (i.e. podcast, poster, report, presentation, etc.) explaining the fallacy, when it occurs, and how to avoid it. Communication pieces will be assembled into a "Statistical Fallacy Portfolio" for each lab. As part of your grade on this project, you will evaluate your own performance

and will peer review the work of two other students. More details on project expectations will be provided in an assignment document within the first week of the class.

6. **"Statistics in the Wild" (Final) Project:** Students will select a news or research article ("article" is used loosely here – it can be a podcast, video piece, PowerPoint presentation, etc. as long as it is publically available) of interest that includes statistical claims. Your job is to investigate the claims made in this article. Are the claims accurate? Are they fair? Is there a better way of presenting the results? You will create a report that describes the claims made in your selected article and critiques the methods and conclusions that are presented. More details about the expectations and guidelines for the "Statistics in the Wild" project will be made available after Fall Break.

What can you take away from these Course Components after this semester?

- Lecture notes will serve as a reference guide for evaluating statistical methods for later classes and projects.
- Oral evaluation feedback (provided during lab sessions) will guide students to become better presenters.
- Mini assignments will serve as examples of statistical reasoning that students can use as (1) guides for later projects and (2) evidence of proficiency in statistical communication for employers.
- The "Statistical Fallacies" project and resulting portfolio will alert you to common pitfalls in statistical analysis, and how to avoid them in future work.
- The "Statistics in the Wild" project will take you through the entire process of evaluating and critiquing a statistical claim.

Grading Policies

- All numeric grades are on a scale from 0 to 100.
- Final grades will be computed according to the following weights:

Average Selected Mini Assignment Score	20.0%
Average Required Mini-Assignment Score	25.0%
Oral Evaluations (completion only)	5.0%
"Statistical Fallacies" Project	25.0%
"Statistics in the Wild" Project	25.0%

- Final letter grades will be determined according to the following rules (subject to change at the instructor's discretion, though lower bound of each letter grade cut off will *not* increase).

A	≥ 90
B	[80, 90)
C	[70, 80)
D	[60, 70)
R	< 60

- The lowest self-selected *and* required mini assignment scores are not included in the calculation of final grades.

Administrative Procedures and Logistics

Lectures: Much of the learning in lecture will be done through active participation, so you should be prepared to participate during class. Use common courtesy: please arrive on time, do not leave early, and do not be disruptive in class. You are responsible for any announcements and materials covered in lectures.

Course Materials, Canvas: The syllabus, lab assignments, oral evaluation graphics, assignment solutions, assigned readings, any supplementary material, grades, and announcements for the course can be found on the course web page on Canvas: www.cornell.instructure.com/courses/mycoursenumber.html. **Please check Canvas regularly.**

Discussion Board: All class discussions that take place outside of lecture and lab should occur on Ed: Ed.com/cornell/fall2022/coursenumber/home

Communication: If you have questions related to the class material, lab assignments, the lab exam, or projects, feel free to ask the instructor during class or, preferably, the instructor and TA(s) during office hours. Questions concerning the current mini assignments submitted by email will not be answered. Please use email only to address administrative and logistic issues, or personal questions.

Please include COURSENUMBER in the subject line of all emails. You should expect a reply within 3 days, with the exception of Fall Break and Thanksgiving Break. Questions about mini assignments should be submitted to the course discussion board. **Emails to TAs will not be answered.**

Mini Assignment (Homework) Format: Mini assignments take various forms. Specific details about submitting a mini assignment will be given within the assignment's instructions. In general mini assignments, all answers should be clearly labeled. Mini assignments should be treated as formal reports. This means that proper spelling and grammar is expected.

You are encouraged to discuss mini assignment problems and collaborate with your classmates (both on the discussion board and in person). However, the work you submit must be your own. This means that each student must independently complete each answer. Instances of identical, nearly identical, or copied mini assignments will be considered cheating and plagiarism.

Extensions: In general, extensions will not be granted for students (because they are behind on work, had a busy week, etc). Extensions for **reasonable academic purposes** (e.g. job interview, conference attendance) or **extreme circumstances** (e.g. family emergency) may be granted at the instructor's discretion. If you have a request for an extension, please request this at least 48 hours before the assignment is due, if possible. Please recognize that the rolling nature of mini assignment deadlines is designed to ensure that you have a great deal of flexibility in determining your work schedule. Please use this flexibility and/or your dropped lowest mini assignment grades if you foresee a busy week around deadlines. If you require special accommodations via disability services or for religious observance, please see "Student Accommodations" below.

Regrades: If you believe a mistake was made when your assignment was graded, you must write a clear description of the issue. Please include your name, and the number of points under consideration at the top of the page. Please submit this, along with a copy of your assignment to the instructor's mailbox (Malott) or via email **within one week of when the assignment was graded**. The instructor reserves the right to regrade the entire assignment during the regrade review process.

Academic Integrity: The faculty and staff of the Bowers C-IS College believe that the conduct of a student taking courses in the School should be consistent with that of a professional person. Courtesy, honesty, and respect should be shown by students toward faculty members, guest lecturers, administrative support staff,

community partners, and fellow students. Similarly, students should expect faculty to treat them fairly, showing respect for their ideas and opinions and striving to help them achieve maximum benefits from their experience in the School.

Student academic misconduct refers to behavior that may include plagiarism, cheating, fabrication, falsification of records or official documents, intentional misuse of equipment or materials (including library materials), and aiding and abetting the perpetration of such acts.

Cell Phones, Laptops, Tablets, etc: Students may bring a laptop or tablet to lectures, though handwritten lecture notes are provided. Please no cell phone use during class.

Phone, Audio, and Video Recording: Photo, audio, and video recordings of the course lectures, lab session, lab exam, and all other course materials are strictly prohibited.

Student Well-being: I believe that your physical and emotional well-being is very important. If you have a physical or mental health issue that is affecting your performance or participation in any course, and/or if you need help connecting with university services, please contact the instructor or Cornell Health and CAPS [include websites].

Student Accommodations: Students should speak with the instructor before or during the first week of classes regarding any special needs and no later than two weeks before an exam or assignment due date. Students seeking academic accommodations should register with Studen Disability Services (SDS). SDS arranges reasonable and appropriate academic accommodations for students with disabilities. Please visit https://sds.cornell.edu/ for more information on student accommodations.

Students who expect to miss classes, examinations, or other assignments as a consequence of their religious observance shall be provided with a reasonable alternative opportunity to complete such academic responsibilities. It is the obligation of the student to provide faculty with two weeks' notice of the dates of religious holidays on which they will be absent.

Students are multifaceted individuals, and I cannot hope to name every type of accommodation that might be required for your unique needs. If you require additional accommodations to succeed in this class, besides those that are listed, please make an appointment to speak with the instructor. We will make a plan to ensure that you are able to fully participate in the classroom.

Diversity, Equity, and Inclusion: I am committed to creating an equitable learning environment in this class. The goal of this course is to bring together people from diverse backgrounds (be it educational, social, regional, etc.) and promote the different perspectives that each person brings to the art of statistical reasoning. Regardless of an individual's prior experience with statistics, students will have the tools they need to become a proficient member of the classroom community. In that community, we value the diversity of opinions and approaches to statistics that everyone brings to the table. That diversity enriches everyone's educational experience and results in a creative atmosphere where all student's efforts and perspectives are valued. After learning the core principles of statistical methods, students are encouraged to adapt the course material to benefit their own needs and interests. Fellow students are expected to respectfully and constructively comment on the data science methods other students employ in their work.

Course Schedule

- Course schedule is subject to change.

Date	Class Session	Topic
UNIT 1: Sampling and study designs		
8/22	Lecture 1	Goals of statistics, populations and samples
8/24	Lecture 2	Sampling techniques I
8/25	Lab 1	Population and sample mismatch
8/29	Lecture 3	Sampling techniques II
8/31	Lecture 4	Experimental vs. observational studies, experimental design I
9/1	Lab 2	Evaluating sampling techniques
9/5	Labor Day – No class!	Do not come to class
9/7	Lecture 5	Experimental design II, observational study design I
9/8	Lab 3	Identifying the appropriate study design
9/12	Lecture 6	Observation study design II, quasi-experimental design
UNIT 2: Human research and measurement		
9/14	Lecture 7	Research ethics, validity
9/15	Lab 4	Threats to internal validity
9/19	Lecture 8	Validity, reliability
9/21	Lecture 9	Scaling, question wording
9/22	Lab 5	Writing survey questions
UNIT 3: Displaying data		
9/26	Lecture 10	Data types
9/28	Lecture 11	Summary statistics, outliers
9/29	Lab 6	Lying with summary statistics
10/3	Lecture 12	Goal of graphics, tables vs. plots, univariate graphics
10/5	Lecture 13	2D graphics
10/6	Lab 7	Presenting a statistical graph
10/10	Indigenous Peoples Day – No class!	Do not come to class
10/12	Lecture 14	3D graphics and data visualization principles
10/13	Lab 8	Lying with a plot
UNIT 4: Probability		
10/17	Lecture 15	Probability axioms
10/19	Lecture 16	Conditional probability
10/20	Lab 9	Evaluating probabilistic claims
10/24	Lecture 17	Risk assessment bias
UNIT 5: Analysis		
10/26	Lecture 18	Hypothesis testing
10/27	Lab 10	What is a p-value?
10/31	Lecture 19	Halloween! One parameter hypothesis testing
11/2	Lecture 20	Two-group hypothesis testing
11/3	Lab 11	Statistical fallacies portfolio assembly and peer review
11/7	Lecture 21	Linear Regression I
11/9	Lecture 22	Linear Regression II
11/10	Lab 12	Interpreting regression coefficients

11/14	Lecture 23	Chi-square
11/16	Lecture 24	ANOVA
11/17	Lab 13	Appropriateness of statistical tests II
UNIT 6: Applications		
11/21	Thanksgiving Break – No class!	
11/23	Thanksgiving Break – No class!	
11/24	Thanksgiving Day – No class!	
11/28	Lecture 25	Case study I
11/30	Lecture 26	Case study II
12/1	Lab 14	Work time for "Statistics in the Wild" project
12/5	Lecture 27	Last day of class!

- "Statistics in the Wild" Project report **due 12/18.**

Assignment Deadlines

Unit	Assignment	My assignment choice (fill in)	Optional deadline	Final deadline
1	Self-selected 1		8/26 at 5:00 pm	9/13 at 5:00 pm
1	Self-selected 2		9/2 at 5:00 pm	9/13 at 5:00 pm
1	Required	Fill in by instructor		9/13 at 5:00 pm
2	Self-selected 1		9/16 at 5:00 pm	9/23 at 5:00 pm
2	Required	Fill in by instructor		9/23 at 5:00 pm
3	Self-selected 1		9/30 at 5:00 pm	10/14 at 5:00 pm
3	Self-selected 2		10/7 at 5:00 pm	10/14 at 5:00 pm
3	Required	Fill in by instructor		10/14 at 5:00 pm
4	Self-selected 1		10/21 at 5:00 pm	10/25 at 5:00 pm
4	Required	Fill in by instructor		10/25 at 5:00 pm
5	Self-selected 1		10/28 at 5:00 pm	11/18 at 5:00 pm
5	Self-selected 2		11/4 at 5:00 pm	11/18 at 5:00 pm
5	Self-selected 3		11/11 at 5:00 pm	11/18 at 5:00 pm
5	Required	Fill in by instructor		11/18 at 5:00 pm
6	Required	Fill in by instructor		12/2 at 5:00 pm
	“Statistical Fallacy” project			10/28 at 5:00 pm
	“Statistics in the Wild” report			12/18 at 5:00 pm

LESSON PLANS

I have independently developed a lesson plan for introducing hyopthesis testing logic and general procedures to introductory-level statistics and biostatistics students. A description and sample materials for this lesson plan are provided below.

Introduction to Hypothesis Testing

Course Level: Introductory undergraduate (or graduate)
Number of Students: $\sim$ 10-50
Class Time: 50 minutes

Lesson Plan Description: This lesson is designed to introduce students to the process of and intuition behind hypothesis testing through a case study and active learning group activity. Students will also practice writing statistical hypotheses as sentences and using symbolic representations. Before this lesson, students should be able to compute basic descriptive statistics and should be familiar with the concepts of population parameters and sampling distributions. Knowledge of confidence intervals is not required. Specific procedures for a hypothesis test and quantities such as test statistics, null distributions, and p-values would be covered in later class periods.

Learning goals: By the end of this class session, students will be able to:

1. Specify statistical hypotheses to test, given a word problem.
2. Describe the process of hypothesis testing.

Sample materials: The slides (blank and annotated versions), student handout (blank and annotated versions), and instructor agenda for this lesson plan are provided below.

Testing Statistical Hypotheses

Kimberly A. H. Webb

Sample Course

Date

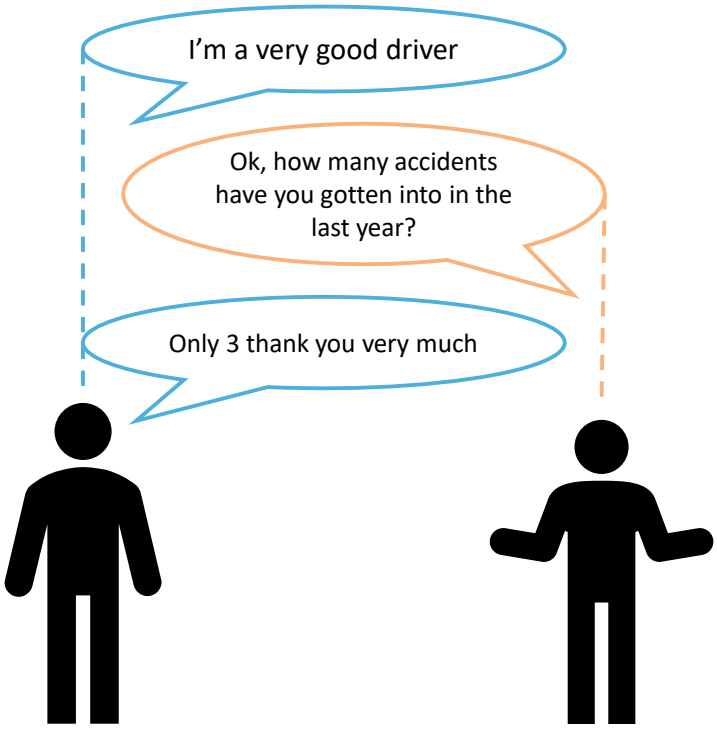
Using Statistics to Call Out Nonsense

Kimberly A. H. Webb

Sample Course

Date

Using statistics to call out nonsense



- If your friend was *actually* a good driver, do you think it is likely that they would have three car accidents in a year?

Learning Goals

- By the end of this class session, you will be able to:

1. Specify statistical hypotheses to test, given a word problem.
2. Describe the process of hypothesis testing.

1. Specifying statistical hypotheses

Specifying statistical hypotheses

- **Goal:** Use the process statistical testing to determine if a hypothesis provides a plausible explanation for the data that we collected.

- As a first step in that process, *we must specify the hypotheses* that we are testing.

Definitions

- **Hypotheses:**
  - **Null hypothesis:**
  - **Alternative hypothesis:**
- Writing hypotheses with symbols:

Setting the hypotheses: Example

Background: It is known that 10% of the population is left-handed. A professor at Z University speculates that students at Z are more likely to left-handed than people found in the general population. The professor asks a sample of students at Z University if they are left-handed or right-handed and records the results.

- **Research question:**

- **Parameter of interest:**

Setting the hypotheses: Example

Background: It is known that 10% of the population is left-handed. A professor at Z University speculates that students at Z are more likely to left-handed than people found in the general population. The professor asks a sample of students at Z University if they are left-handed or right-handed and records the results.

	Words	Symbols
Null hypothesis		
Alternative hypothesis		

2. The process of hypothesis testing

Case Study: Background

Acute myocardial infarction (MI, or heart attack) is a common cause of hospitalization, and its early and accurate diagnosis is critical for successful treatment and improved patient outcomes. To investigate MI misdiagnosis rates, Wu et al. (2018) conducted a national cohort study including all National Health Service (NHS) hospitals in England and Wales that provide care for adult patients. Of the 564,412 patients discharged with a final diagnosis of myocardial infarction, 168,534 (29.9%) patients had an initial diagnosis that was not the same as their final diagnosis.

Study: https://www.bmj.com/content/bmj/354/bmj.i4713.full.pdf

Case Study: Our study

Imagine you are the director of a large hospital in Wales. You want to show that your hospital has a better MI misdiagnosis rate than that found in Wu et al. (2018). To investigate this, you select a random sample of 50 patients who were discharged with an MI diagnosis in 2021 and investigate their medical records. For each selected patient, you record whether their initial diagnosis was MI, or something else.

Case Study: Setting the hypotheses

Answer the questions in your groups:

1. What is the research question in this study?

2. What is the parameter of interest in this study?

3. Fill in the hypotheses in the provided table.

Case Study: Setting the hypotheses

Answer the questions provided in your groups:

1. **Research question:**
2. **Parameter of interest:**
3. **Hypotheses:**

	Words	Symbols
Null hypothesis		
Alternative hypothesis		

Collecting data and calculating a statistic

Our strategy: You select a random sample of 50 patients who were discharged with an MI diagnosis in 2021 and investigate their medical records. For each selected patient, you record whether their initial diagnosis was MI, or something else.

Results: Of the 50 records in your sample, 38 had an initial diagnosis of MI and 12 had an initial diagnosis that *was not* MI.

Sample statistic:

Collecting data and calculating a statistic

Results: Of the 50 records in your sample, 38 had an initial diagnosis of MI and 12 had an initial diagnosis that *was not* MI.

Sample statistic: 12 / 50 → 24%

Based on these results, answer the following question individually:

4. Based on the evidence you have so far, do you think the initial MI misdiagnosis rate at your hospital is lower than that of Wu et al. (2018)? How certain are you about your answer?

Compare your sample results to the null distribution

- Imagine that the initial MI misdiagnosis rate at our hospital *is actually the same* as that of Wu et al. (2018).
  - Our initial MI misdiagnosis rate is 29.9%

Compare your sample results to the null distribution

- Imagine that the initial MI misdiagnosis rate at our hospital *is actually the same* as that of Wu et al. (2018).
  - Our initial MI misdiagnosis rate is 29.9%

- If this is the case, what could our sample results look like?
  - Use a web application to generate samples of 50 medical records from a hospital where the true initial MI misdiagnosis rate is 29.9%.
  - For each sample you will see the number that were initially misdiagnosed and the number that were originally correctly diagnosed.

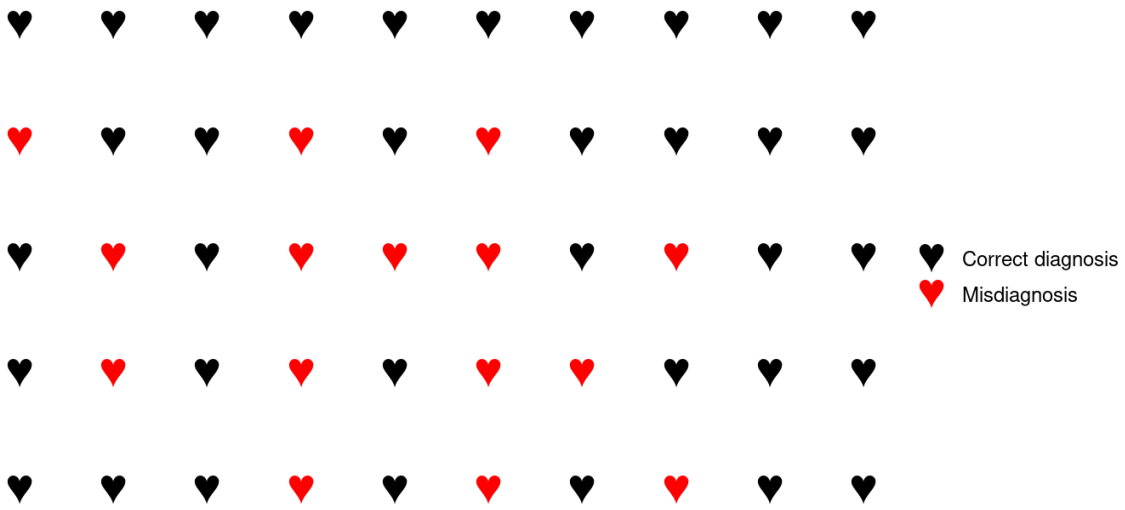
MI MISDIAGNOSIS | Null sample generator

Null sample generator

Click the button below to generate a sample under the null distribution. The plot to the right will display the 50 discharged MI patients in the sample. Patients are represented by heart icons. Hearts that are colored black indicate that the individual had a correct initial diagnosis. Hearts colored in red indicate that the individual was initially misdiagnosed. This sample is generated assuming that the percentage of patients who are initially misdiagnosed is 29.9%.

Generate a null sample

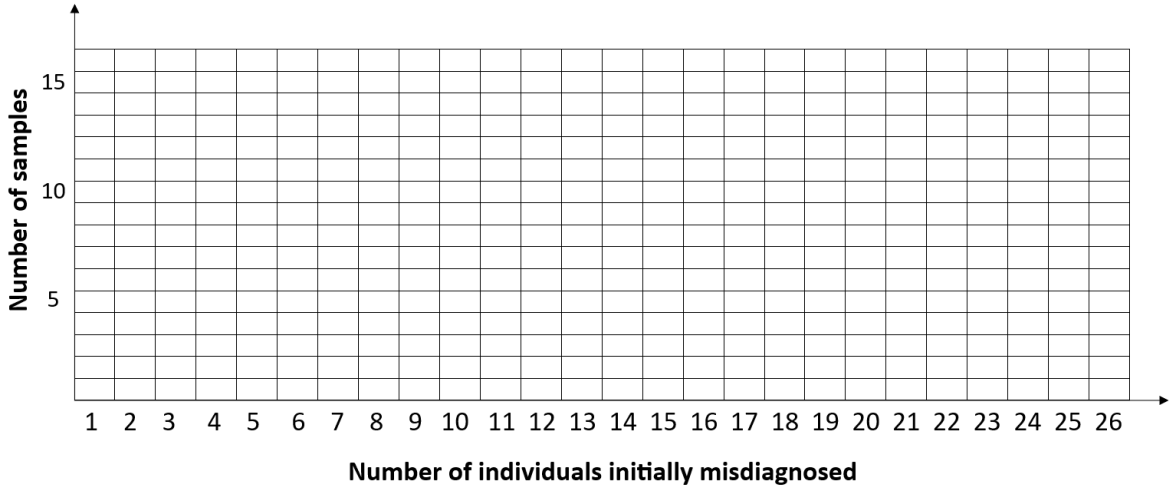
The number of people who were initially misdiagnosed: 15



Compare your sample results to the null distribution

In your groups, generate samples using the app and record your results in the provided graph.

- Fill in a box above the number you record for each sample.
- Draw enough samples to arrive at a conclusion (at least ~20).



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- Fill in a box above the number you record for each sample.
- Draw enough samples to arrive at a conclusion (at least ~20).

Each group member should have a unique role:

- **Sampler:** This individual generates the samples using the web application.
- **Recorder:** This individual records the sample result on the histogram.
- **Tracker:** This individual keeps track of how many samples were drawn.

Compare your sample results to the null distribution

In your groups, generate samples using the app and record your results in the provided graph.

- Fill in a box above the number you record for each sample.
- Draw enough samples to arrive at a conclusion (at least ~20).

Each group member should have a unique role:

- **Sampler:** This individual generates the samples using the web application.
- **Recorder:** This individual records the sample result on the histogram.
- **Tracker:** This individual keeps track of how many samples were drawn.

URL for the app: **https://bit.ly/MI_app**

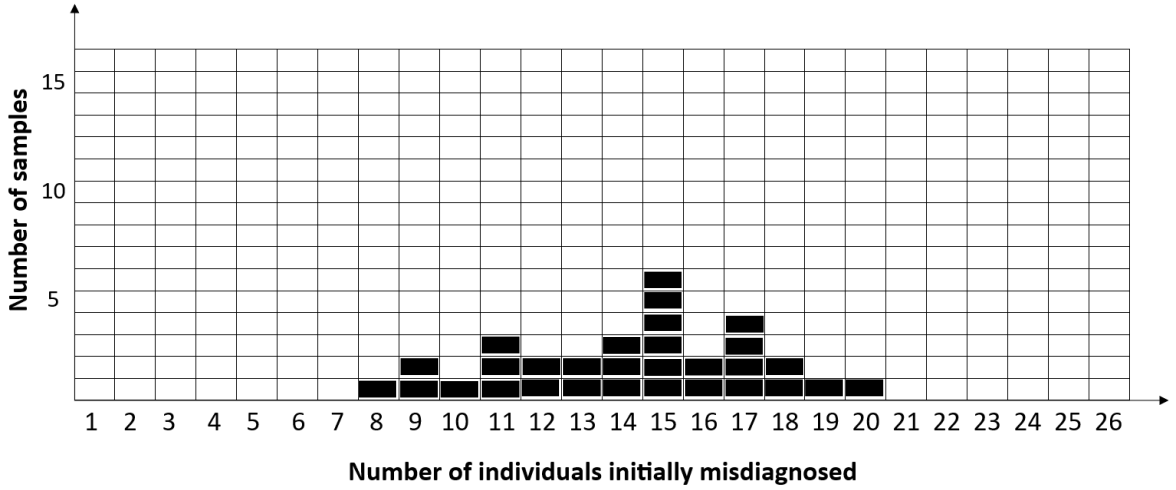
Decide if the null hypothesis is plausible

Group questions:

5. Look at the graph that your group made using the null samples. Compare this to the results you obtained from your own hospital sample. As a group, what do you think this suggests about the hypotheses in this study? Do you think the initial MI misdiagnosis rate at your hospital is lower than that of Wu et al. (2018)?

6. Discuss your individual answers to question #4. Did you change your mind after generating null samples?

Decide if the null hypothesis is plausible



Reviewing the hypothesis testing process

1. Identify the research question.
2. Identify a quantity related to the research question that we do not know. This quantity is called a **parameter**.
3. Write the **statistical hypotheses** in terms of the parameter of interest.
4. Collect data and calculate a statistic.
5. Compare your calculated statistic to the null distribution.
6. Decide if the null hypothesis is a plausible explanation for the data, compared to the alternative hypothesis.

Testing Statistical Hypotheses

Kimberly A. H. Webb

Sample Course

Date

Using Statistics to Call Out Nonsense

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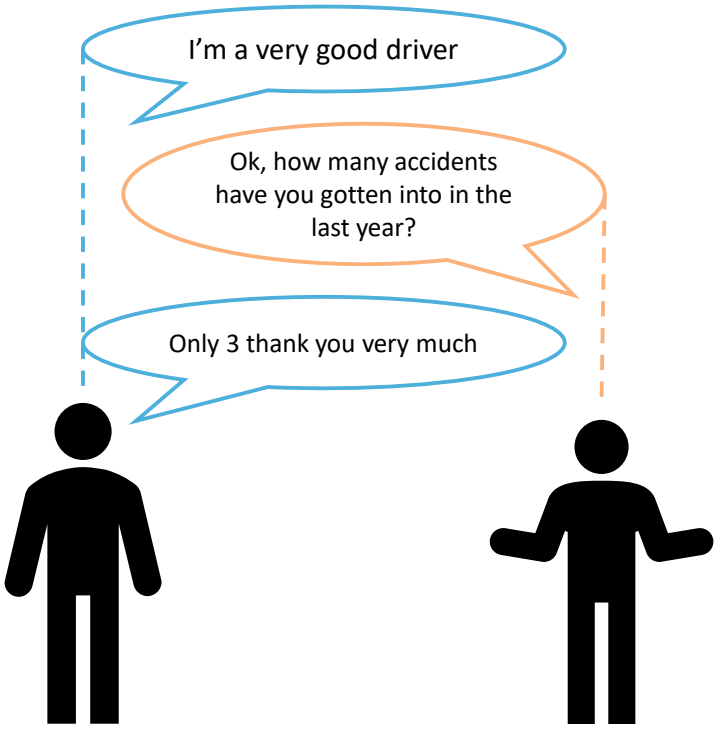
Using statistics to call out nonsense



- If your friend was *actually* a good driver, do you think it is likely that they would have three car accidents in a year?

Learning Goals

- By the end of this class session, you will be able to:

1. Specify statistical hypotheses to test, given a word problem.
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1. Specifying statistical hypotheses

Specifying statistical hypotheses

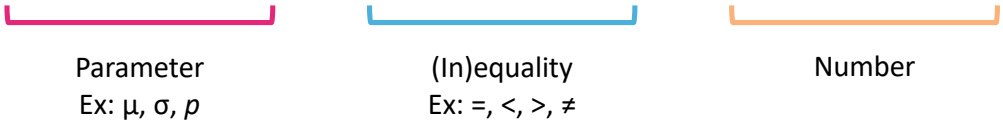
- **Goal:** Use the process statistical testing to determine if a hypothesis provides a plausible explanation for the data that we collected.

- As a first step in that process, *we must specify the hypotheses* that we are testing.

Definitions

- **Hypotheses** are statements about a **parameter** (a numerical characteristic of the population).
  - **Null hypothesis:** A statement about the population parameter that specifies the "status quo".
    - No difference in the population.
  - **Alternative hypothesis:** A statement about the population parameter that specifies the research hypothesis of interest.
    - Opposite – there is a difference in the population.

- Writing hypotheses with symbols:



Setting the hypotheses: Example

Background: It is known that 10% of the population is left-handed. A professor at Z University speculates that students at Z are more likely to left-handed than people found in the general population. The professor asks a sample of students at Z University if they are left-handed or right-handed and records the results.

- **Research question:** Are Z University students more likely to be left-handed than people from the general population?
- **Parameter of interest:** *p,* the true proportion of all Z University students who are left-handed.

Setting the hypotheses: Example

Background: It is known that 10% of the population is left-handed. A professor at Z University speculates that students at Z are more likely to left-handed than people found in the general population. The professor asks a sample of students at Z University if they are left-handed or right-handed and records the results.

	Words	Symbols
Null hypothesis	Z University students are just as likely to be left-handed as people in the general population.	p = .10
Alternative hypothesis	Z University students are more likely to be left-handed than people in the general population.	p > .10

2. The process of hypothesis testing

Case Study: Background

Acute myocardial infarction (MI, or heart attack) is a common cause of hospitalization, and its early and accurate diagnosis is critical for successful treatment and improved patient outcomes. To investigate MI misdiagnosis rates, Wu et al. (2018) conducted a national cohort study including all National Health Service (NHS) hospitals in England and Wales that provide care for adult patients. Of the 564,412 patients discharged with a final diagnosis of myocardial infarction, 168,534 (29.9%) patients had an initial diagnosis that was not the same as their final diagnosis.

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Imagine you are the director of a large hospital in Wales. You want to show that your hospital has a better MI misdiagnosis rate than that found in Wu et al. (2018). To investigate this, you select a random sample of 50 patients who were discharged with an MI diagnosis in 2021 and investigate their medical records. For each selected patient, you record whether their initial diagnosis was MI, or something else.

Case Study: Setting the hypotheses

Answer the questions in your groups:

1. What is the research question in this study?

2. What is the parameter of interest in this study?

3. Fill in the hypotheses in the provided table.

Case Study: Setting the hypotheses

Answer the questions provided in your groups:

1. **Research question:** Does our hospital have a better MI misdiagnosis rate than that found in Wu et al. (2018)?
2. **Parameter of interest:** *p,* the proportion of initially misdiagnosed MI patients at our hospital.
3. **Hypotheses:**

	Words	Symbols
Null hypothesis	Our hospital has the same MI misdiagnosis rate as Wu et al. (2018).	$p = .299$
Alternative hypothesis	Our hospital has a better MI misdiagnosis rate than Wu et al. (2018).	$p < .299$

Collecting data and calculating a statistic

Our strategy: You select a random sample of 50 patients who were discharged with an MI diagnosis in 2021 and investigate their medical records. For each selected patient, you record whether their initial diagnosis was MI, or something else.

Results: Of the 50 records in your sample, 38 had an initial diagnosis of MI and 12 had an initial diagnosis that *was not* MI.

Sample statistic: 12 / 50 → 24%

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- If this is the case, what could our sample results look like?
  - Use a web application to generate samples of 50 medical records from a hospital where the true initial MI misdiagnosis rate is 29.9%.
  - For each sample you will see the number that were initially misdiagnosed and the number that were originally correctly diagnosed.

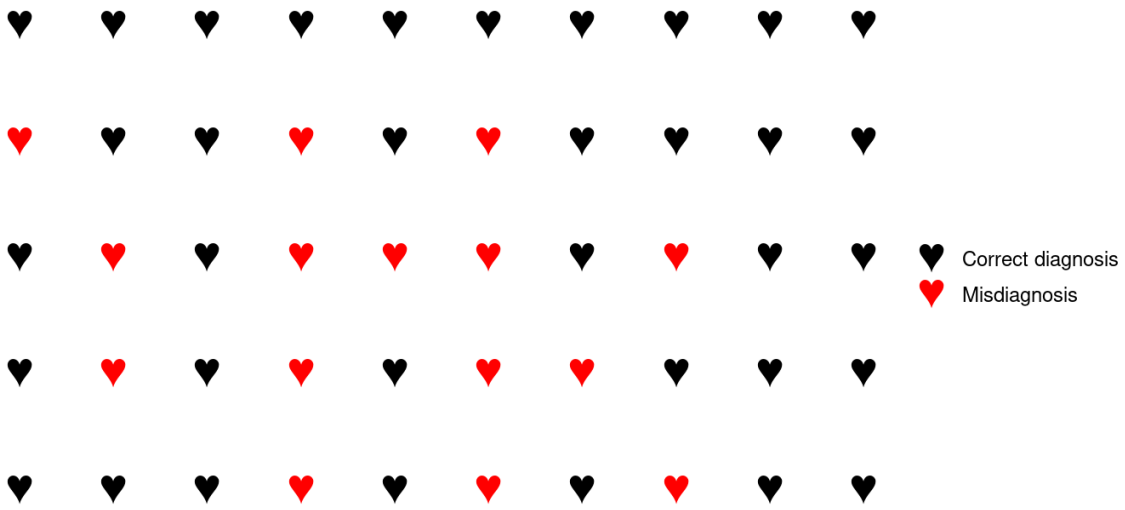
MI MISDIAGNOSIS | Null sample generator

Null sample generator

Click the button below to generate a sample under the null distribution. The plot to the right will display the 50 discharged MI patients in the sample. Patients are represented by heart icons. Hearts that are colored black indicate that the individual had a correct initial diagnosis. Hearts colored in red indicate that the individual was initially misdiagnosed. This sample is generated assuming that the percentage of patients who are initially misdiagnosed is 29.9%.

Generate a null sample

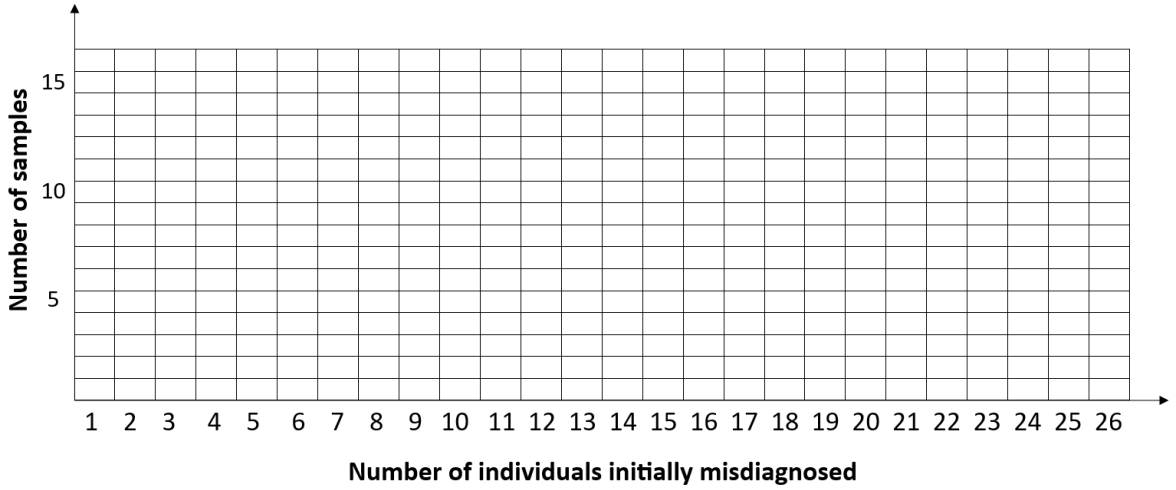
The number of people who were initially misdiagnosed: 15



Compare your sample results to the null distribution

In your groups, generate samples using the app and record your results in the provided graph.

- Fill in a box above the number you record for each sample.
- Draw enough samples to arrive at a conclusion (at least ~20).



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- Fill in a box above the number you record for each sample.
- Draw enough samples to arrive at a conclusion (at least ~20).

Each group member should have a unique role:

- **Sampler:** This individual generates the samples using the web application.
- **Recorder:** This individual records the sample result on the histogram.
- **Tracker:** This individual keeps track of how many samples were drawn.

Compare your sample results to the null distribution

In your groups, generate samples using the app and record your results in the provided graph.

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URL for the app: **https://bit.ly/MI_app**

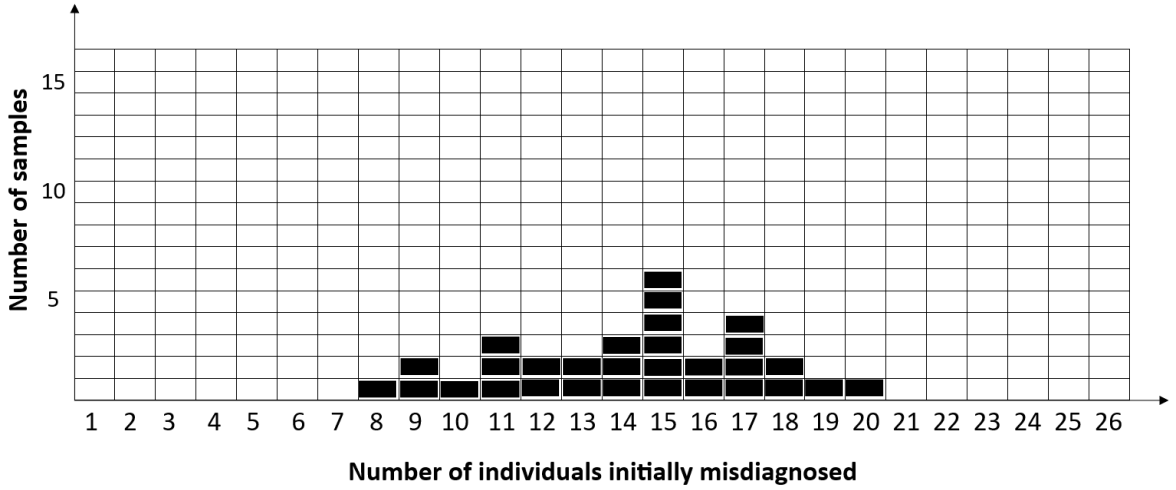
Decide if the null hypothesis is plausible

Group questions:

5. Look at the graph that your group made using the null samples. Compare this to the results you obtained from your own hospital sample. As a group, what do you think this suggests about the hypotheses in this study? Do you think the initial MI misdiagnosis rate at your hospital is lower than that of Wu et al. (2018)?

6. Discuss your individual answers to question #4. Did you change your mind after generating null samples?

Decide if the null hypothesis is plausible



Reviewing the hypothesis testing process

1. Identify the research question.
2. Identify a quantity related to the research question that we do not know. This quantity is called a **parameter**.
3. Write the **statistical hypotheses** in terms of the parameter of interest.
4. Collect data and calculate a statistic.
5. Compare your calculated statistic to the null distribution.
6. Decide if the null hypothesis is a plausible explanation for the data, compared to the alternative hypothesis.

Topic: Testing Statistical Hypotheses

Learning goals: By the end of this class session, you will be able to:

1. Specify statistical hypotheses to test, given a word problem.
2. Describe the process of hypothesis testing.

PART 1: Specifying statistical hypotheses

Background and vocabulary

- **Goal:** Use the process of statistical testing to determine if a hypothesis provides a plausible explanation for the data that we collected.
- As a first step in that process, *we must specify the hypotheses* that we are testing.

- **Hypotheses:**

    - **Null hypothesis:**

    - **Alternative hypothesis:**

- Writing hypotheses with symbols:

Example

- **Background:** It is known that 10% of the population is left-handed. A professor at Z University speculates that students at Z are more likely to left-handed than people found in the general population. The professor asks a sample of students at Z University if they are left-handed or right-handed and records the results.

- **Research question:**

- **Parameter of interest:**

- Fill in the hypotheses in the table below.

	Words	**Symbols**
Null hypothesis		
Alternative hypothesis		

PART 2: The process of hypothesis testing
Case Study

- **Background:** Acute myocardial infarction (MI, or heart attack) is a common cause of hospitalization, and its early and accurate diagnosis is critical for successful treatment and improved patient outcomes. To investigate MI misdiagnosis rates, Wu et al. (2018) conducted a national cohort study including all National Health Service (NHS) hospitals in England and Wales that provide care for adult patients. Of the 564,412 patients discharged with a final diagnosis of myocardial infarction, 168,534 (29.9%) patients had an initial diagnosis that was not the same as their final diagnosis.
    - https://www.bmj.com/content/bmj/354/bmj.i4713.full.pdf
- **Our study:** Imagine you are the director of a large hospital in Wales. You want to show that your hospital has a better MI misdiagnosis rate than that found in Wu et al. (2018). To investigate this, you select a random sample of 50 patients who were discharged with an MI diagnosis in 2021 and investigate their medical records. For each selected patient, you record whether their initial diagnosis was MI, or something else.

Case Study: Setting the hypotheses
Answer the following questions in your groups:

1. *What is the research question in this study?*

2. *What is the parameter of interest in this study?*

3. *Write down the hypotheses being investigated in this study in both words and symbols.*

	Words	**Symbols**
Null hypothesis		
Alternative hypothesis		

Case Study: Collecting data and calculating a statistic

- **Our strategy:** You select a random sample of 50 patients who were discharged with an MI diagnosis in 2021 and investigate their medical records. For each selected patient, you record whether their initial diagnosis was MI, or something else.

- **Results:** Of the 50 records in your sample, 38 had an initial diagnosis of MI and 12 had an initial diagnosis that *was not* MI.

    - **Sample statistic:**

Answer the following question individually:

4. *Based on the evidence you have so far, do you think the initial MI misdiagnosis rate at your hospital is lower than that of Wu et al. (2018)? How certain are you about your answer?*

Case Study: Compare your sample results to the null distribution

- Imagine that that the initial MI misdiagnosis rate at our hospital *is actually the same* as that of Wu et al. (2018).
    - Our initial MI misdiagnosis rate is 29.9%.

- If this is the case, what could our sample results look like?
    - Use a web application to generate samples of 50 medical records from a hospital where the true initial MI misdiagnosis rate is 29.9%.
    - For each sample you will see the number that were initially misdiagnosed and the number that were initially correctly diagnosed.

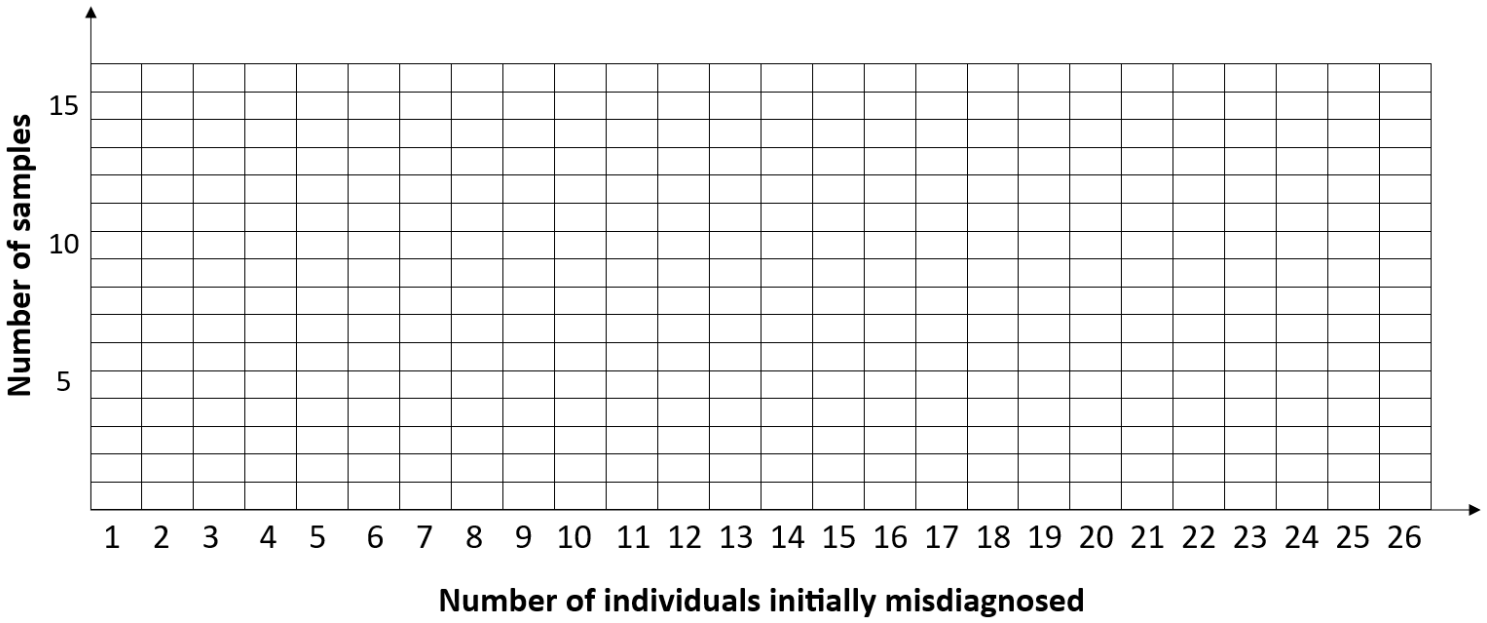
Group work

- In your groups, generate samples using the app and record your results in the provided graph (on the next page).
    - Fill in a box above the number you record for each sample.
    - Draw enough samples to arrive at a conclusion (at least ~20).

- Each group member should have a unique role:
    - **Sampler:** This individual generates the samples using the web application.
    - **Recorder:** This individual records the sample result on the histogram.
    - **Tracker:** This individual keeps track of how many samples were drawn.

- Record the name of the group member in each role:
    - **Sampler:**
    - **Recorder:**
    - **Tracker:**

- URL for the app: https://bit.ly/MI_app



Case Study: Decide if the null hypothesis is plausible
Answer these questions as a group, after you fill in the graph:

5. *Look at the graph that your group made using the null samples. Compare this to the results you obtained from your own hospital sample. As a group, what do you think this suggests about the hypotheses in this study? Do you think the initial MI misdiagnosis rate at your hospital is lower than that of Wu et al. (2018)?*

6. *If you have time, also discuss your individual answers to question #4. Did you change your mind after generating null samples?*

Reviewing the hypothesis testing process

1. Identify the research question.
2. Identify a quantity related to the research question that we do not know. This quantity is called a **parameter**.
3. Write the **statistical hypotheses** in terms of the parameter of interest.
4. Collect data and calculate a statistic.
5. Compare your calculated statistic to the null distribution.
6. Decide if the null hypothesis is a plausible explanation for the data, compared to the alternative hypothesis.

Topic: Testing Statistical Hypotheses

Learning goals: By the end of this class session, you will be able to:

1. Specify statistical hypotheses to test, given a word problem.
2. Describe the process of hypothesis testing.

PART 1: Specifying statistical hypotheses

Background and vocabulary

- **Goal:** Use the process of statistical testing to determine if a hypothesis provides a plausible explanation for the data that we collected.
- As a first step in that process, *we must specify the hypotheses* that we are testing.

- **Hypotheses:** statements about a parameter (a numerical characteristic of the population).

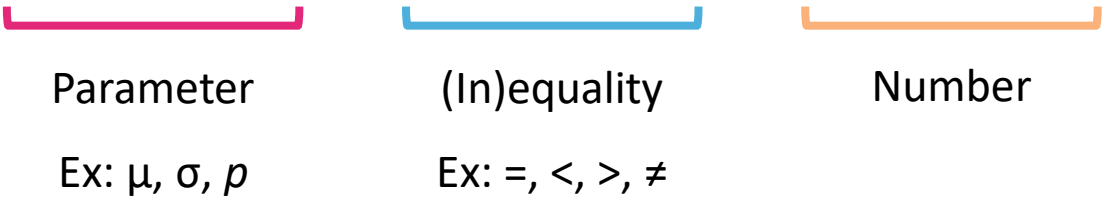
    - **Null hypothesis:** A statement about the population parameter that specifies the "status quo".

        - No difference in the population.

    - **Alternative hypothesis:** A statement about the population parameter that specifies the research hypothesis of interest.

        - Opposite – no difference in the population.

- Writing hypotheses with symbols:



Example

- **Background:** It is known that 10% of the population is left-handed. A professor at Z University speculates that students at Z are more likely to left-handed than people found in the general population. The professor asks a sample of students at Z University if they are left-handed or right-handed and records the results.

- **Research question:** Are students at Z University more likely to be left-handed than people from the general population?

- **Parameter of interest:** p, the true proportion of all Z University students who are left-handed

- Fill in the hypotheses in the table below.

	Words	Symbols
Null hypothesis	Z University students are just as likely to be left-handed as people in the general population.	$p = .10$
Alternative hypothesis	Z University students are more likely to be left-handed than people in the general population.	$p > .10$

PART 2: The process of hypothesis testing
Case Study

- **Background:** Acute myocardial infarction (MI, or heart attack) is a common cause of hospitalization, and its early and accurate diagnosis is critical for successful treatment and improved patient outcomes. To investigate MI misdiagnosis rates, Wu et al. (2018) conducted a national cohort study including all National Health Service (NHS) hospitals in England and Wales that provide care for adult patients. Of the 564,412 patients discharged with a final diagnosis of myocardial infarction, 168,534 (29.9%) patients had an initial diagnosis that was not the same as their final diagnosis.
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Case Study: Setting the hypotheses
Answer the following questions in your groups:

1. *What is the research question in this study?*

   Does my hospital have a better MI misdiagnosis rate than that found in Wu et al. (2018)?

2. *What is the parameter of interest in this study?*

   p, the true proportion of MI patients who were misdiagnosed in my hospital.

3. *Write down the hypotheses being investigated in this study in both words and symbols.*

	Words	Symbols
Null hypothesis	My hospital has the same MI misdiagnosis rate as Wu et al. (2018).	$p = .299$
Alternative hypothesis	My hospital has a better MI misdiagnosis rate than that found in Wu et al. (2018).	$p < .299$

Case Study: Collecting data and calculating a statistic

- **Our strategy:** You select a random sample of 50 patients who were discharged with an MI diagnosis in 2021 and investigate their medical records. For each selected patient, you record whether their initial diagnosis was MI, or something else.

- **Results:** Of the 50 records in your sample, 38 had an initial diagnosis of MI and 12 had an initial diagnosis that *was not* MI.

    - **Sample statistic:** p_hat = proportion of sample that had initial diagnosis that *was not* MI = 12 / 50 = .24

Answer the following question individually:

4. *Based on the evidence you have so far, do you think the initial MI misdiagnosis rate at your hospital is lower than that of Wu et al. (2018)? How certain are you about your answer?*

   Potential answers: .24 < .299, so there is evidence that our hospital does have a lower MI misdiagnosis rate, varying degrees of certainty…

Case Study: Compare your sample results to the null distribution

- Imagine that that the initial MI misdiagnosis rate at our hospital *is actually the same* as that of Wu et al. (2018).
    - Our initial MI misdiagnosis rate is 29.9%.

- If this is the case, what could our sample results look like?
    - Use a web application to generate samples of 50 medical records from a hospital where the true initial MI misdiagnosis rate is 29.9%.
    - For each sample you will see the number that were initially misdiagnosed and the number that were initially correctly diagnosed.

Group work

- In your groups, generate samples using the app and record your results in the provided graph (on the next page).
    - Fill in a box above the number you record for each sample.
    - Draw enough samples to arrive at a conclusion (at least ~20).

- Each group member should have a unique role:
    - **Sampler:** This individual generates the samples using the web application.
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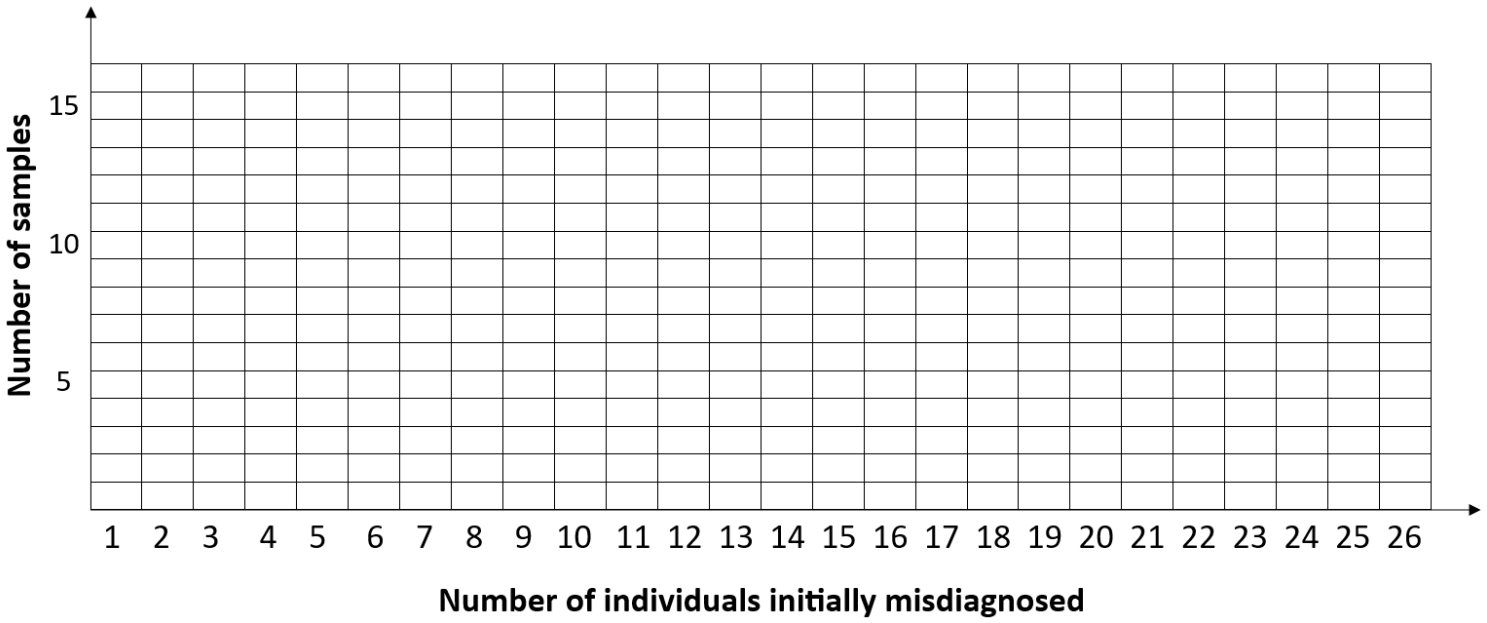
    - **Tracker:** This individual keeps track of how many samples were drawn.

- Record the name of the group member in each role:
    - **Sampler:**
    - **Recorder:**
    - **Tracker:**

- URL for the app: https://bit.ly/MI_app



Case Study: Decide if the null hypothesis is plausible
Answer these questions as a group, after you fill in the graph:

5. *Look at the graph that your group made using the null samples. Compare this to the results you obtained from your own hospital sample. As a group, what do you think this suggests about the hypotheses in this study? Do you think the initial MI misdiagnosis rate at your hospital is lower than that of Wu et al. (2018)?*

   Potential answers: We got 12 misdiagnoses in our sample. This was also likely from the null sample. This suggests that the claim that the misclassification rate at our hospital is the same as Wu et al. (2018) is plausible. I don't think our MI misdiagnosis rate is lower than 29.9% for sure.

6. *If you have time, also discuss your individual answers to question #4. Did you change your mind after generating null samples?*

   Potential answers: Perhaps don't feel as certain as before, perhaps minds changed, etc.

Reviewing the hypothesis testing process

1. Identify the research question.
2. Identify a quantity related to the research question that we do not know. This quantity is called a **parameter**.
3. Write the **statistical hypotheses** in terms of the parameter of interest.
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Backstage Agenda: Testing Statistical Hypotheses

Part	Time	Slides	Topic	Notes
0	0:00 – 1:00	1-3	Introduction and goals	
	1:00 – 3:00	4	Learning goals	
1	3:00 – 8:00	5-7	Specifying statistical hypotheses, Background and vocabulary	Fill in definitions for hypotheses, null, alt, hypothesis as symbols
	8:00 – 15:00	8-9	Specifying statistical hypotheses, Example	Fill in research question, parameter, null, alt
	15:00 – 17:00		Pause for questions	
2	17:00 – 18:00	10-12	The process of hypothesis testing, Case Study: Background	
	18:00 – 19:00	13	The process of hypothesis testing, Case Study: Setting the hypotheses	Introduce questions and form groups
	19:00 – 24:00			5 min for group work
	24:00 – 27:00	14		5 min to get responses for each question
	27:00 – 28:00		Pause for questions	
	28:00 – 30:00	15	The process of hypothesis testing, Case Study: Collecting data and calculating a statistic	Fill in sample statistic calculation
	30:00 – 31:00	16		Introduce individual question
	31:00 – 32:00			1-2 min to answer question
	32:00 – 33:00	17-18	The process of hypothesis testing, Case Study: Compare your sample results to the null distribution	
	33:00 – 34:00	19		Introduce Shiny app
	34:00 – 35:00	20		Introduce graph
	35:00 – 36:00	21-22		Introduce group task
	36:00 – 40:00			4 min for group task
	40:00 – 43:00	23	The process of hypothesis testing, Case Study: Decide if the null hypothesis is plausible	3 min to answer question
	43:00 – 48:00	24		Debrief case study
	48:00 – 50:00	25	Reviewing the hypothesis testing process	

RECOGNITION

Outstanding Graduate Teaching Assistant in the Department of Statistics and Data Science, Cornell University

Award: Outstanding Graduate Teaching Assistant in the Department of Statistics and Data Science
Term: 2020-2021
Courses taught during award term: Statistical Methods I and Biological Statistics II

Award Description: Each year, the College of Agriculture and Life Sciences (CALS) selects one graduate TA from each department to receive an outstanding TA award. Selections are made via recommendations from faculty members and students. The award recognizes TA competence, responsibility, and dedication to Cornell CALS instructional programs.