

# TEACHING A LARGE INTRODUCTORY STATISTICS COURSE: MAKING IT WORK!

JSM 2016  
Section on Statistical Education

**Chair:** Roger Woodard ~ North Carolina State University

## Panelists

- Megan Mocko ~ University of Florida
- Stacey Hancock ~ University of California at Irvine
- Christopher Wild ~ University of Auckland
- Brenda Gunderson ~ University of Michigan

## Megan Mocko ~ University of Florida

- 49,785 students
- 32,008 undergraduate students
- 16,272 graduate students
- Historically a residential campus but growing online program since 2014

## Course

### Megan Mocko ~ University of Florida

Fall Offerings	Spring Offerings	Summer Offerings
<b>HYBRID:</b> 46 sections of 40 students – 1920 students total (live/online lectures with in class labs)	<b>HYBRID:</b> 47 sections of 40 students – 1960 students total (live/online lectures with in class labs)	<b>In Class Only:</b> 150 – 250 students Live Lecture
<b>Completely Online:</b> 100 UF Online students	<b>Completely Online:</b> 100 UF Online students	<b>Completely Online:</b> 125 students X 2 (100 students UF residential and 20-30 UF Online )
25 student section for students with registered learning disabilities	25 student section for students with registered learning disabilities	

## Staff for Hybrid

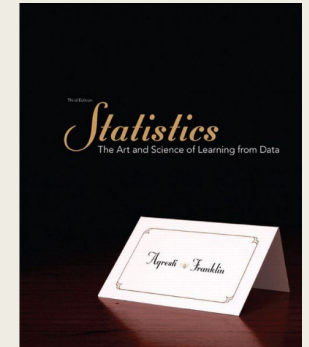
Megan Mocko ~ University of Florida

Course Coordinator – student centered (1 FTE)	Lab Coordinator – TA centered (.5 FTE)	Teaching Assistants (16-18 full time)
Responsible for weekly quizzes	Responsible for labs, lab materials, technology issues	Teach 3 -4 labs per week
Writes, proofs and grades exams	Trains TAs	Holds 2 -3 tutoring hours (For a total of over 40 tutoring hours available for the students.)
Responds to most students emails	Handles any student related problems in the lab	Grades short answer labs
Submits final grades	Coordinates grading of labs	Proctor Exams

## Textbook

Megan Mocko ~ University of Florida

- *Statistics: The Art and Science of Learning from Data*
- By Alan Agresti and Christine Franklin
- Used 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> editions
- Will use 4<sup>th</sup> edition in the Fall



## Stacey Hancock ~ University of California at Irvine

- ~ 32,000 students
- ~ 25,000 undergraduate students
- ~ 7,000 graduate students



Founded in 1965; one of ten UC campuses

## Course

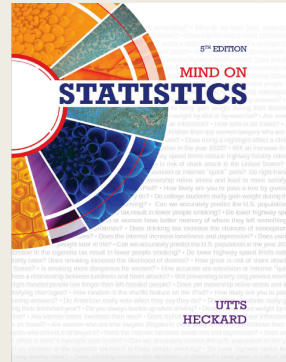
Stacey Hancock ~ University of California at Irvine

- Stats 7: Basic Statistics
- 3 sections per quarter; 220 students per section
- Lecture meets three times per week for 50 minutes
- GTAs run weekly 50 minute discussion sections of 55 students each
- Service course for wide range of undergraduate students: e.g., biological sciences, political science, psychology, business, drama, art

## Materials Stacey Hancock ~ University of California at Irvine

Textbook:

- *Mind on Statistics* (5<sup>th</sup> ed.) by Jessica Utts and Robert Heckard



Audience response system:

- iClicker remotes
- UCI classrooms have base stations
- students use remotes for several courses

## Chris Wild ~ University of Auckland, New Zealand

- 40,000 students
- 29,000 undergraduate students
- 11,000 graduate students
- Residential campus

## Course Chris Wild ~ University of Auckland

- Stats 10x
- 5,000 students/year (~70% of each cohort)
  - 1<sup>st</sup> Semester: 2,500 students
  - Class sizes (Lecture Rooms) 300-600
- Reputation for **best organized** and one of the best-taught courses on campus
  - (national teaching award in 2003 helped establish rep)
  - Reputation for high levels of support
  - All teachers rate **very highly** with students
- Big component of departmental budget
  - if this course sneezes the Dept catches cold
- Teaching team are “professionals”
  - If you are not an excellent teacher you won't be let near this course

## Course Chris Wild ~ University of Auckland

- Team teaching for over 25 years
- Uses a **single set of team-developed materials**.
  - Perfect consistency across sections
  - Can focus on innovation and “performance” (not reinventing wheels)
- Weekly team meeting looking back and looking forward
- Strong all-one-team culture built and preserved over 25 years
  - Team gets a lot of fun from working together
  - (core troops out to morning coffee together every morning)
- Very welcoming to newcomers and visitors
- Aim for steady improvement rather than massive leaps (guard against unpredictable effects on numbers)
- Efficiencies gained here allow smaller teaching loads esp to research academics

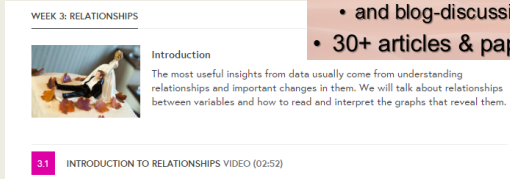
## Course

Chris Wild ~ University of Auckland

### ■ FutureLearn MOOC: *Data to Insight*

(Another experience to draw on)

- 24 hours' online study materials in 111 "steps":
- 41 videos, 16 exercises,
- 16 quizzes, 8 tests,
- 10+ discussions
  - and blog-discussions on almost every page
- 30+ articles & papers



## Personnel

Chris Wild ~ University of Auckland

- Lecturers (~5 in 1<sup>st</sup> semester)
- Administrator
- Help-room tutors
- Computer Lab tutors
- Student markers (large numbers)

## Materials

Chris Wild ~ University of Auckland

- Workbook (updated yearly)
- Lectures – all recorded live and videos posted online
- Canvas site using most features
- Assignments & Lab sheets

Brenda Gunderson ~ University of Michigan



- ~ 45,000 students
- ~ 29,000 undergraduate students
- ~ 16,000 graduate and professional students
- Residential campus but growing online programs and learning options:  
Digital Education & Innovation (DEI),  
Coursera, edX, and more

## Course

Brenda Gunderson ~ University of Michigan

- **Stats 250: Introduction to Statistics and Data Analysis**  
Covers **descriptive statistics to hypothesis testing**

- Primarily Freshmen/Sophomores

- Psych, Econ, Business, PolySci

Freshman	13%
Sophomore	45%
Junior	28%
Senior	11%
Other	1%

Psychology BA	22%
Neuroscience BS	13%
Biopsych, Cognit & Neurosci BS	12%
Economics BA	11%
Business Administration BBA	10%
Political Science BA	10%
International Studies BA	8%
English BA	5%
Communication BA	4%
Environment BS	4%

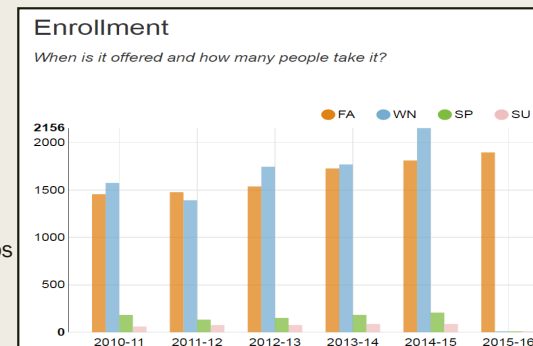
## Course

Brenda Gunderson ~ University of Michigan

- **LARGE** = ~ 2100 students

- **Weekly:**  
**3 hours of lecture,**  
**1.5 hour computer lab**

- **Coordinated**  
across 6 lectures  
of 150 to 400 students,  
~ 64 GSI led computer labs  
(30 to 35 students).



## Materials

Brenda Gunderson ~ University of Michigan

### Required:

- Stats 250 **Coursepack**: Lecture Notes and Lab workbook  
(Dollar Bill or print/use from Canvas or Open.Michigan)
- Online **homework** tool (Course.Work)

- **iClicker**

- **Calculator**

### (Highly) Recommended:

- **ECoach**
- Text **Mind on Statistics** (MOS) 5e


## Some "Prepared" Questions to start us out

- If someone were thrust into the position of teaching a 500+ student class what practical considerations would they need to understand?
  - *What course structures have you found to be particularly helpful?*
  - *What pitfalls should you avoid in such a large class?*
- How to handle assessments?
- How to prepare teaching assistants?
- How to incorporate active learning?
- How to get to know students?
- How to address academic integrity?

## Some “Prepared” Questions to start us out

- Are any quality checks done for the course?  
If so, describe how it works?
- What types of technology do you use?
- What is special about trying to apply the newly revised GAISE guidelines in large classes?
- What is special about applying new environments (face-to-face, MOOC, hybrid, flipped, etc.) in large classes?
- How team teaching can improve the teaching of large courses?
- What does teaching a large number of students inform us about teaching in general? Are there truths to be learned that apply to small classes as well?”

Megan Mocko ~ University of Florida

If someone were thrust into the position of teaching 500+ students what practical considerations would they need to understand? 

- Detailed Syllabus
  - 16 pages long
- Be consistent!
- Double, Triple check everything!
- Be Organized – Tell the students where we are going and how we are going to get there.

## Weekly Reminders

Weekly Reminders for Monday, November 16<sup>th</sup> to Friday, November 20<sup>th</sup>

**Lectures: MWF** : Available: 9th period in NRN 137, 7<sup>th</sup> period in Norman G520 or online

[Quiz 9](#)

- Offered: Monday, November 16<sup>th</sup> 8am until Thursday, Nov. 19<sup>th</sup> 11:59pm
- Three Attempts, highest counts
- Covers Material: Chapter 9 Section 3 – Chapter 9 Section 5, pages 86 - 95 in the lab workbook

**Lab:** Lab 9: Activity 18 Monday - Friday

- You must attend the section for which you are registered.
- Be on time. You have a 5 minute grace period.
- If one of your lab scores was uploaded incorrectly to Canvas, please talk to your ta in lab. You must bring a copy of the lab worksheet in question. All grades changes must be done by Wed., Dec. 9th. 5pm (the last day of classes).

## Weekly Reminders (Part Two)

MM

### Suggested HW problems

Ch 9 Statistical Inference: Significance Tests About Hypotheses	
9.1 Steps for Performing a Significance Test	9.1 9.2 9.3 9.4 9.8
9.2 Significance tests About Proportions	9.9 9.11 9.12 9.15 9.17 9.19 9.20 9.21 9.23

### Supplemental Videos

Chapter 9 Section 2 (Finding the p-value for a Significance Test for the Population Proportion)

### Grades posted in Canvas

Quiz	EC	1	2	3	4	5	6	7			
Lab		1	2	3	4	5	6				
Exam		1									

## What course structures have you found to be particularly helpful?

MM

- Instructions in writing
- Predictable pattern each week
- Posting extra help videos



## What pitfalls should you avoid in such a large class?

MM

- Be careful what you ask for.
  - “Please let me know if you think of a good memory aid to help remember the difference between Type I and Type II error definitions. I will share them with the class.” **SUCCESS!**
  - “So far, I have received zero questions for the Q and A tomorrow, if I don't receive any there won't be a review.” **Success, yes, manageable, no**

## What pitfalls should you avoid in such a large class?

MM

- It helps to be little bit paranoid.
  - “Tell students for two weeks prior to the exam that there will be an extra set of questions on the exam. Explain on the exam that there is an extra set of questions on the exam. 30+ students stopped at “33” the typical number of questions on our exams.” **Not good!**
  - “Do all of the above and add a question on the exam that asks how many questions are on the exam” **Success!!**

## How to Handle Assessments?

MM

- **3 multiple choice exams**
  - Check and Re-Check Exams before Printing
  - Have five other people complete and check the exam as well
  - Across 15 – 18 rooms around campus
  - All graduate students help proctor
- **10 (weekly) multiple choice quizzes**
- **10 (weekly) labs**
  - Labs include short answer questions and interpretation statements
  - Active Learning Environments

## Exam Nights

MM

- Meet with all graduate students 1.5 hours prior to exam.
- Eat pizza together before going out to exam rooms.
- Explain the procedure verbally and in writing.
- Have a policy for late students to the exam.
- Extra calculators, pencils, etc. for each room.



## How to Prepare Teaching Assistants?

MM

- Two hour Training Session at the beginning of the Semester
- Ten one hour training sessions before each lab
- One hour training about entering grades for new graduate students
- One hour “Best Practices” activity in the Spring

## “Scripts” for Lab

MM

- **TALK:** *The purpose of today's lab is to talk about calculating and interpreting the confidence interval for the population mean. Suppose that I am interested in determining the average numbers of hours that students spend sleeping. So, I decided to randomly select 100 students at UF and ask them how many hours they slept last night. Out of that sample, the sample average number of hours slept was 7.1.*
- **ASK:** *Does this mean that all UF students sleep 7.1 hours a night on average? No.*
- **TALK:** *We want to determine what the mean number of hours slept for the population of UF students. To do this, we can make a confidence interval for the population mean. This will give us a region in which the population mean is likely to be.*
- **TALK:** *The general format of the confidence is estimator  $\pm$  (z or t) stderr .*
- **WRITE:** estimator  $\pm$  (z or t) std error }



## “Scripts” for lab (con’t)



### Part 3 and Part 4 –

- **WALK:** Talk to the groups and see if they have any questions.
- **SHOW:** Now, do this in Minitab. Go to Stat > Basic Statistics > One Sample t. Select the value of C1 as “Samples in Columns” value. Select the Graph options and choose “Boxplot”. The 95% confidence interval is the default setting for Minitab, but if you want to change it, go to Options and enter a new value.
- **TALK:** Now, work through part 5 of the lab worksheet.
- **WALK:** Talk to the groups and see if they have any questions.
- **WAIT:** After they have been working on it for about five minutes.
- **TALK:** There are two statements that are true.
- **DISCUSS:** Go over the answers.

## Slides (optional)



2

Suppose that I was interested in finding out what proportion of UF students planned on going on a vacation over Spring Break. I randomly asked 100 students and asked them if they plan on going on a vacation.

Suppose that my sample mean was 0.30. If you took a random sample of 100 UF students, would you get the same value?

No, not likely

What about if your friend took another random sample of 100 students as well, would it be the same?

No, not likely

In order to study this, we need to study the sampling distribution of the sample proportion.

What is the distribution?

Normal, under certain conditions

What are the conditions?

- Both np and n(1-p) are greater than or equal to 15.
- Original Population is Normal.

What is the mean?

$p$

What is the standard deviation?

$\sqrt{\frac{p(1-p)}{n}}$

## TA evaluation visits

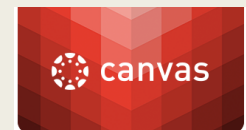


- Once per year.
- Rated on following classroom procedure.
- Engaging the class.
- Rotating between groups of students.
- Explanation of the material.

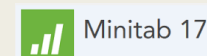
STA 2023 TA Classroom Visit Form	TA Visited _____ Date: _____ Evaluator: _____
	COMMENTS
Lab starts on time.	
Attendance taken and old worksheets returned during first 5 minutes.	
Course announcements displayed and any important ones emphasized.	
Late students were handled appropriately.	
Lab purpose and background material explained appropriately.	
TA is prepared to teach the activity.	

## What Types of Technology do You Use?

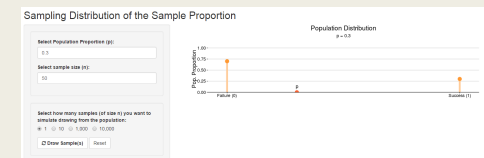
- Canvas Course Management System
  - Email based on grade of assignment



- Minitab



- Applets



## What is special about trying to apply the newly revised GAISE guidelines in large classes?

MM

- Change is very hard!
- Two new emphases
  - *Give students experience with multivariable thinking.*
    - I added an example to the lecture last year.
    - This Fall, we updated the example and will re-enforce it with quiz and exam questions.
  - *Teach statistics as an investigative process of problem-solving and decision-making.*
    - Challenge the status quo. This will be more difficult.

## Also, what does teaching a large number of students inform us about teaching in general?

MM

- Format of assessments (electronic versus paper)
- Multiple Attempts for Assignments (actually practice more)
- Feedback (although I can give more feedback on written returned paper assignments, the automatic feedback for large classes is helpful here as well.)

Stacey Hancock ~ University of California, Irvine

## How to get to know students?

SH

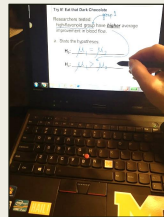
- Beginning quarter survey
- Office hour log
- Active learning – move around the room during clicker questions or group work



## How to Incorporate Active Learning? BG

### ■ Coursepack: Lecture Notes and Labs

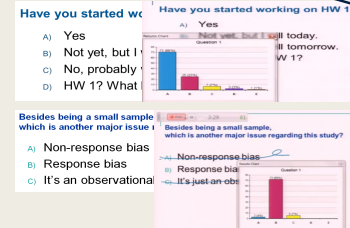
- Initially incomplete, students are co-authors work with instructors to complete and create own study guide
- Instructors use doc cam or tablet to guide



## How to Incorporate Active Learning? BG

### ■ iClickers: Lectures and Labs

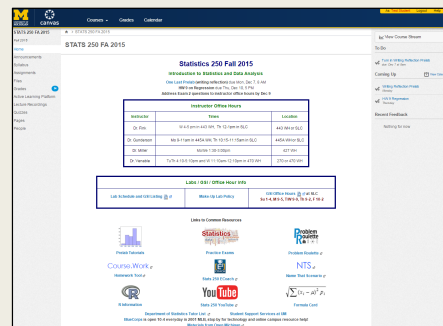
- Offers Low Stakes Assessments in class
- Provides useful, actionable data
- Incentive = cartwheel



## What Types of Technology do You Use? BG

### ■ Canvas Course Management System

- Homepage = one stop shopping for resources
- Announcements
- Groups
- Virtual Office Hours
- Admin GSI helps to maintain site



## What Types of Technology do You Use? BG

### ■ R / R Commander (since Spring 2015)

- Drop-In R Install Sessions
- R Help Email
- Prelab Videos each week

### ■ HyFlex Lecture and Make Up Lab Option Dr. Jackie Miller (jabmille@umich.edu)

#### Histograms and Boxplots Prelab

After completing this prelab, you will be able to:

- Open data sets in R Commander
- Create histograms using R
- Create boxplots and side-by-side boxplots using R
- Use R to calculate descriptive statistics for quantitative variables
- Save your graphs from R

**Video:**

Note: The following video makes use of the "StudyHours.RData" data set. This is one of the sample data sets included with R, and is also available on Canvas in the Data Sets folder in Files. Your short prelab assignment has you work with a different data set "StudyHours.RData", also available on Canvas.

**Correlating Data with R**

**Prelab Assignment (to be submitted via Canvas Assignments):**

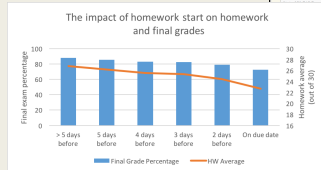
1. Download the "StudyHours.RData" data set.
2. Use R and create a histogram of the "Hours per week studying (as reported by student)" (StudyHours) variable. Think about it: how would you describe the histogram in terms of shape, center, spread, and any outliers?
3. Add an appropriate title for your graph and include attribution (by your name).
4. Save your graph (both title and content) as a .png and upload it.
5. In the comments, provide a sentence that describes the distribution of study hours per week. Your sentence should include some aspect of shape, center, spread, and if any outliers.

Ready for the assignment? Click here to go to the assignment for this prelab activity.

## What Types of Technology do You Use? BG

### ■ Online HW Tool = Course.Work

- Open/close at same time
- GSI graded with rubric and feedback given
- No “lost” HW
- Instructors can ‘see’ any HW
- Lots of data



**Question:** Before conducting the hypothesis test of interest, you need to determine if all conditions are met. Clearly state the additional required to be able to perform the one sample t-test.

**Answer:** We need to assume that the population of all the exam times (in seconds) has a normal distribution.

**Student answer:** 0.8, 0.0, 1.0, 0.0, 0.0

**Student feedback:** We need to make sure that the distribution is normal.

## What Types of Technology do You Use? BG

### ■ Online Applets and GSI created Shiny Apps

### ■ Home-Grown Practice Resources

- Problem Roulette and Name That Scenario

**Question:** Before conducting the hypothesis test of interest, you need to determine if all conditions are met. Clearly state the additional required to be able to perform the one sample t-test.

**Answer:** We need to assume that the population of all the exam times (in seconds) has a normal distribution.

**Student answer:** 0.8, 0.0, 1.0, 0.0, 0.0

**Student feedback:** We need to make sure that the distribution is normal.

**Question 1/10:** A college administrator is concerned that students who take the exam are not taking it seriously. They have a sample of 100 exam times (in seconds) and want to test if the distribution is normal.

**Correct! The answer is CHI-SQUARE GOODNESS OF FIT TEST.**

## What Types of Technology do You Use? BG

### ■ ECoach ~ personalized tool

**Too much material?**

There are a lot of resources available in Stats 250. I would not advise for students to do them all (i.e. the supplemental homework, textbook problems, etc.).

**Brenda, here is your GTD (Get Things Done) List for Dec 6-12:**

- ✓ After checking that you submitted the last **Weblog Reflection Project**, **calibrate** that there are no more **Problem assignments**.
- ✓ Take two minutes and check your **gradbook** entries. Apart from last few HW scores, are all entries correct? Report any issues in your lab set, **check buttons** in Dec 7-8.
- ✓ **Last Labs Now!** Dec 7-8 **Lab 11** on **More Regression** - calculator formulas and tables, and **Tables** Dec 14 as cases and that Monday. Watch for announcements about some optional lab reviews to be held on Tue, Dec 14 (5-7 by a new GSI).
- ✓ Use **CourseWork** to work on **required HW 9 about regression** - due **Tue, Dec 10 at 5 PM**. Note: Q2 requires R to perform a regression to make the home selling price depends on the home size with the **Household Income** data. **The Recommended HW 9** questions are good practice!
- ✓ **Exam 2 follow-up** - Look over that Exam 2 one more time and see if you have any questions you need to address to Dr. Venable, Dr. Park, Dr. Hilder, or Dr. Gundersen during office hours by **Wed, Dec 9**.
- ✓ **Print out and read over the HW 10 Chi-squared Test Questions** that will be available on Tue, Dec 8. These last required questions are due on **Tue, Dec 10 at 5 PM**.

**What is ECoach?**

ECoach is a tool to help you do your best in Stats 250.

Think of ECoach as your own personal coach. ECoach will offer you strategies and links:

- The best tools to use to study
- Study hints for exams
- A grade calculator tailored to Stats 250
- Evidence-based tools to help boost your exam performance

**Where you are now and where to go from here**

High score on getting 80%+.

High score on getting 80%+.

## How to Handle Assessments? BG

### ■ 10 (weekly) online HW required (also set of recommended questions)

### ■ 10-12 (weekly) labs

- Prelab Assignment (due before lab)
- Warm Up Questions
- Group ILP (in-lab project often using R/Rcmdr)
- Cool Down Questions
- Ticket (out the door)

### ■ 2 semester exams and 1 comprehensive final

- Paper Exams (not all MC)
- Exam 101 session to train grad students (monitor Yak Yak exam day/night)
- Group Grading Session (rubrics)
- Future = Scanning in graded exams

Two Methods for Final Grade: differ in weighting of exams

**250a 2007 Spring 2006 Exam 2**

Page Number	Problem Number	Points Possible	Points Received	Grade
1	1.8.2	15	15	100%
2	2.8.3	3	22	733%
4	4.8.5	4	21	525%

**What did everyone get for the turkey question on stats?**

**I put down "I don't know"**

**I'm sorry**