Workshop objectives

- Participate in a live panel discussion between biologists and statisticians talking about
  - How statistics is taught in biology courses
    - Goals and Objectives
    - Assessments
    - Opportunities for innovation
    - Communicating across disciplines
- Goals
  - Experience models of cross-disciplinary communication
  - Think harder about how to engage client departments and how to bring these ideas back to your campus
  - Answer audience questions about how to communicate across disciplines more effectively in general and in biology more specifically

Who you are (among those who took survey)

▶ Mainly statisticians, with a low percentage of folks with some limited biology training

▶ About 50/50 on whether regularly talk with biologists about their statistics course

▶ Most people described biology students as fairly 'typical' of students in their introductory statistics, with approximately equal numbers considering the students more/less engaged/interested

▶ Wide diversity of students in the stats courses being taught

▶ General lack of awareness about trends in biology practice and biology education by the audience

▶ ~3/4 of audience no specific stats course for bio students; rest have one housed in stats department

Who you are (among those who took survey)

- Summarized listing of goals reported:
  - Hear about national and local trends
  - Hear about innovative ideas for teaching/collaboration
  - Learning about representing multi-disciplinary perspectives
  - Contrasting biology specific content vs. general statistics content (pros/cons)

A little about us

Panelists:

- Biology
  - Mark Condon – Dutchess County Community College
  - Elena Keeling – Cal Poly San Luis Obispo
  - Noa Pinter - Wollman - UCLA
  - Jeff Ploegstra - Dordt College
- Statistics
  - Beth Chance – Cal Poly San Luis Obispo
  - Barbara Dolansky – Dutchess County Community College
  - Jill VanderStoep – Hope College
- Moderator
  - Nathan Tintle – Dordt College

More broadly speaking…

- …we are on the steering committee of the recently formed

    Statistical Thinking in Undergraduate Biology (STUB) network

    Also includes Rob Gould (UCLA) and Greg Murray (Hope College)

Ten people – 5 bio; 5 stats; 5 diverse institutions

STUB network motivation and goals

- NSF- DBI – 17306

- RCN-UBE: Statistical Thinking in Undergraduate Biology (STUB) Network: A network for coordinating the teaching and assessment of statistical thinking in introductory biology

- **Biology**
  - Practice of biology is changing – more reliant on quantitative approach to drawing conclusions from data; including computational approaches
  - Bio 101 – over 1.2 million students annually – now typically includes an introduction to both descriptive and inferential statistics
  - Dearth of active discussion about teaching and assessment when integrating statistical thinking into biology courses

STUB network motivation and goals

- **Statistics**
  - Statistics education community has guidelines for assessment and instructional best practices
  - Growing move to use computationally intensive methods (simulation, randomization tests and bootstrapping) in intro statistics
    - Growing evidence of positive impact on student learning
  - Limited venues to discuss and coordinate best practices for the teaching and assessment of statistical thinking for biology students
    - Intro stats? Never? After? Before? Same time? Varies greatly (even within institutions)

STUB network motivation and goals

- **Network goals**
  - Workshops with statisticians and biologists in attendance; online community (website forthcoming)
    - Develop and share curricular materials and strategies for communicating
    - Develop and share assessments and assessment results
  - As a network be 'flat' and facilitate sharing and communication

Today's workshop structure

- Eastern time (all times are approximate!)
  - 11:00 – 11:15 – Workshop goals, introductions, motivation and structure
  - 11:15 – 11:40 – Statistical content in biology courses
  - 11:40 – 11:50 – Pedagogical approach to stats in bio courses
  - 11:50 – 12:00 – Assessment of stats in bio courses
  - 12:00 – 12:15 – Statistical training of biology instructors
  - 12:15 – 12:25 – Gaps between stats courses and biology practice
  - 12:25 – 12:35 – Models for collaboration and communication
  - 12:35 – 12:45 – Next steps and moving forward

Today's workshop structure

- **In each session you can expect**
  - One or two biologists responding to a question on behalf of the group
  - Initial response by one or two statisticians
  - Further back and forth discussions among panelists

- **Your role**
  - **Active participation** throughout the workshop by making comments; asking the panel questions using the comment feature in GoToMeeting

Q1. How does statistical content come up in your biology courses?

Biologist Elena Keeling responding for the group

► Not as much as it should

► Concepts: Drawing conclusions from data; variation in biological system; hypotheses and predictions; presenting data in logical ways; not 'proving' things (correlation vs. causation); statistical significance; randomization; replication; sampling; pooling

► Topics: Statistical tests like regression, chi-square, t-tests; some probability

► Concerns: Button pushing without understanding meaning and inability to transfer to other contexts

Q1. How does biological content come up in your statistics courses?

Statistician Beth Chance responding for the group

- Similar concerns to what we face in intro stats and earlier approaches to statistical learning
- Would be good to have more reinforcement between what they see in statistics courses (if take) and biology courses
  - e.g., Use of statistical tables
- In general we don't really bring up biological concepts in stats class, tending to view biology as a source of data vs. concepts
  - e.g., variation in biological systems, pooling
- Statistical thinking does improve with practice
  - Randomization approach allows for more focus on big picture

Q+A

- Questions/comments from the audience?

Q2. What teaching approach do you take for statistics content in a biology course?

Biologist Mark Condon responding for the group

► Some try to make it similar to other content – logical explanation; examples; connect to big picture

► Some students struggle with anything quantitative; or think they will struggle with it

► Comes up along the way (just in time) to answer a specific biological question

► Comes up more in labs

Q2. What teaching approach do you take for biology content in a statistics course?

Statistician Jill VanderStoep responding for the group

- We often have similar struggles with students thinking they can't do a biological example (also many students who tell us they are bad at math)

- A just-in-time approach may also be a good idea in a stats course

- Trying to push back against the 'memorize an algorithm/template' philosophy is also something we struggle with

Q+A

- Questions/comments from the audience?

Q3. What about assessment of statistics in biology courses?

Biologist Jeff Ploegstra responding for the group

▶ Stats doesn't have much impact on grade

▶ Often in labs its group work, so stronger students can carry weaker

▶ Seems important, rarely assessed directly

▶ May be frequently assessed implicitly (e.g., interpreting figures/graphs; doing calculations); may depend on the course

Q3. What about assessment of biology in statistics courses?

Statistician Barbara Dolansky responding for the group

▶ We don't really assess biology in statistics courses

▶ Meaningful, conceptual assessment (vs. rote, algorithmic assessment) in statistics is hard, although recent shift to SBI approach helps

▶ Would bio students revolt against stats assessments in their courses?

▶ But, if we don't assess it, how else will we convey it's importance? Should we assess what matters?

Q+A

- Questions/comments from the audience?

Q4. How do you feel about your statistical training?

Biologist Noa Pinter-Wollman responding for the group

- Most of us haven't had much, but some variation in amount – at least one undergraduate course and at least one graduate course is typical; some courses taught by biologists

- A lot of 'here are a bunch of tests' kinds of courses

- In research practice need to understand concept vs. mathematical details

Q4. How do you feel about your biological training?

Statistician Jill VanderStoep responding for the group

► Most statistician's haven't had biology training either

► Many people teaching statistics courses haven't had much statistics either (e.g., mathematics trained individuals teaching statistics) unless teaching in a statistics dept.

Q+A

- Questions/comments from the audience?

Q5. Gaps between teaching statistics and practicing biology

Biologist Elena Keeling responding for the group

► Most biologists are unaware of exactly what is taught in introductory statistics at their institutions

► Students often perceive it as learning a bunch of tests

► Students seem more intrigued/happy with second courses in statistics which do multiple regression/multi-factor design/multivariable topics/thinking; modern data analysis methods

► Would be good for statisticians to better understand design/context of the study matters (vs. just a lot of numbers)

Q5. Gaps between teaching statistics and practicing biology

Statistician Beth Chance responding for the group

- Sounds like GAISE[1] (focus on conceptual understanding; use data with a context that matters; multivariable thinking)

- Recommendations have been around for a while…
    - Some feel resistance from client disciplines ("but my students need to know what a t-test is…", "You can't not include XXX (ANOVA) in the intro course")
    - Can biologists help us trim "content" in favor of concepts to be reinforced in subsequent courses? Can biologists help us find some interesting applications that only require introductory material?

- Once have basic concepts, "advanced" material can go much more quickly

[1]GAISE = Guidelines for Assessment and Instruction in Statistics Education

Q+A

- Questions/comments from the audience?

Q6. Collaborative models worth exploring between statistics and biology?

Biologist Mark Condon responding for the group

- Learning communities – stats profs into bio courses and vice versa; simultaneous course offerings (stats paired with biology)
- More one on one conversations about content in courses and expectations
- Sharing of data sets/methods/language

Q6. Collaborative models worth exploring between statistics and biology?

Statistician Barbara Dolansky responding for the group

- ▶ Awareness is the first step

- ▶ Already have learned more just by listening in today and having had a few other conversations with this group

- ▶ Looking forward to talking more about simulation/computational methods and our approach here and how we can be more synergistic

- ▶ Theme-based statistics

Q+A

- Questions/comments from the audience?

Next steps

- ▶ Website
- ▶ Continuing the conversation
- ▶ Talk to biologists at your institution
- ▶ Working on scheduling numerous workshops – Cal Poly, September 7-8, 2018 (first one); more anticipated
  - ▶ Training the trainer – see how stats can be taught conceptually; spread to others
- ▶ Assessment initiative – what learning; attitudes; in stats courses; in bio
- ▶ Curriculum development initiative

- ▶ Parting shots from the panel?