W08 - Improving students communication about data using online statistical games

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Getting to know each other

Please fill out this Google Jamboard (anonymous).

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Workshop Outline

- Introductions

- Results from our Spring 22 study with Greenhouse

- Greenhouse - Play and Discuss

- Break at 10 AM

- Why play games?

- Racer - Play and Discuss

- Exercise on implementing these games and activities

- Wrap-up

Pre-Workshop Survey Results

What do you hope to take away from this workshop?

Pre-Workshop Survey Results

What are the most challenging concepts for students to understand in this course?
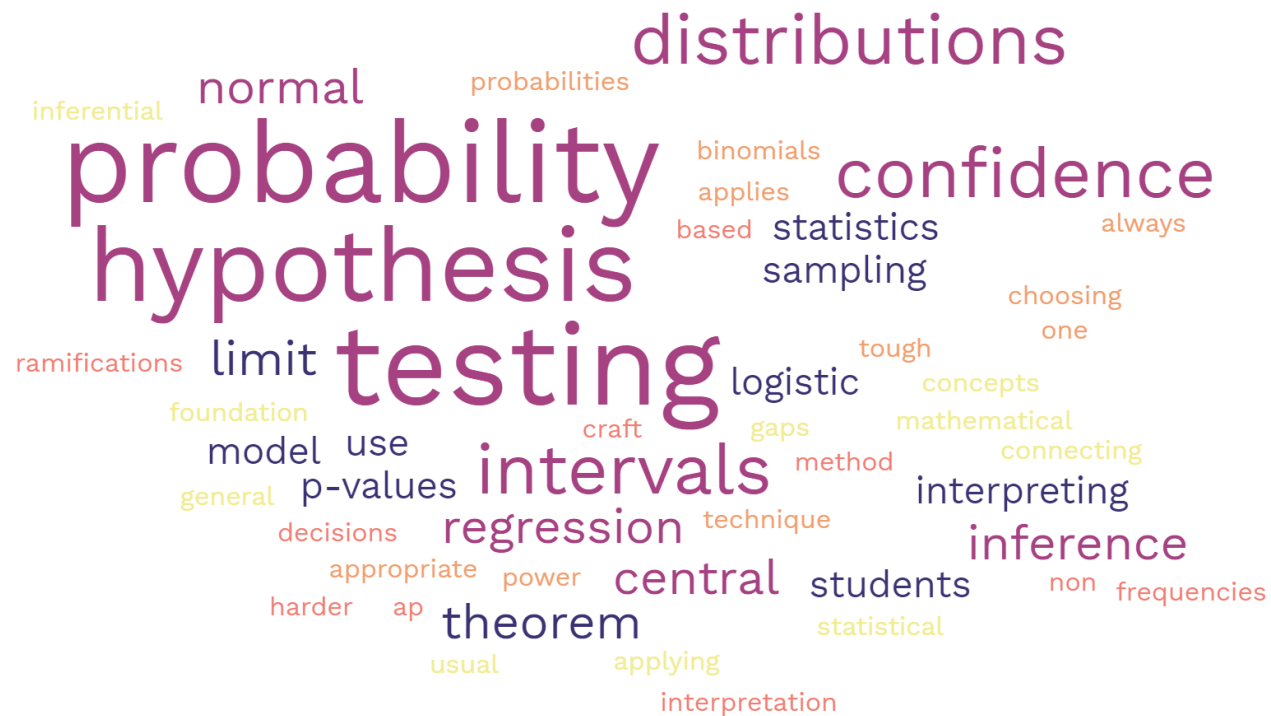
Games

The suite of games and related activities is freely available www.stat2games.sites.grinnell.edu/.

Greenhouse

Inspired by Iowa farmlands, this game simulates crop growth under multiple conditions.

Racer

Inspired by Formula One, NASCAR, etc., this game shows how data analysis can affect racing performance.

Greenhouse Game

Study With Greenhouse Game

We class-tested the Greenhouse game during Spring 22 across multiple institutions and different class levels (Intro, Intermediate, Advanced).

The feedback from students is summarized in the following slides.

Evaluation of Free Response Questions

Students were asked to report their agreement (agree, disagree, unsure) on the following seven items:

- Q1 - The Greenhouse **activity was fun**.

- Q2 - This activity **helped me see something about statistics** that I did not see before.

- Q3 - The activity helped me understand the **importance of visualizations** to see patterns in data.

- Q4 - My instructor should **use this activity the next time** they teach this course.

- Q5 - This activity was a **good way to learn about statistics**.

- Q6 - The activity and instructions were **easy to understand**.

- Q7 - This activity prompted me to **think about the challenges** that can occur when trying to draw conclusions with data.

Evaluation of Free Response Questions
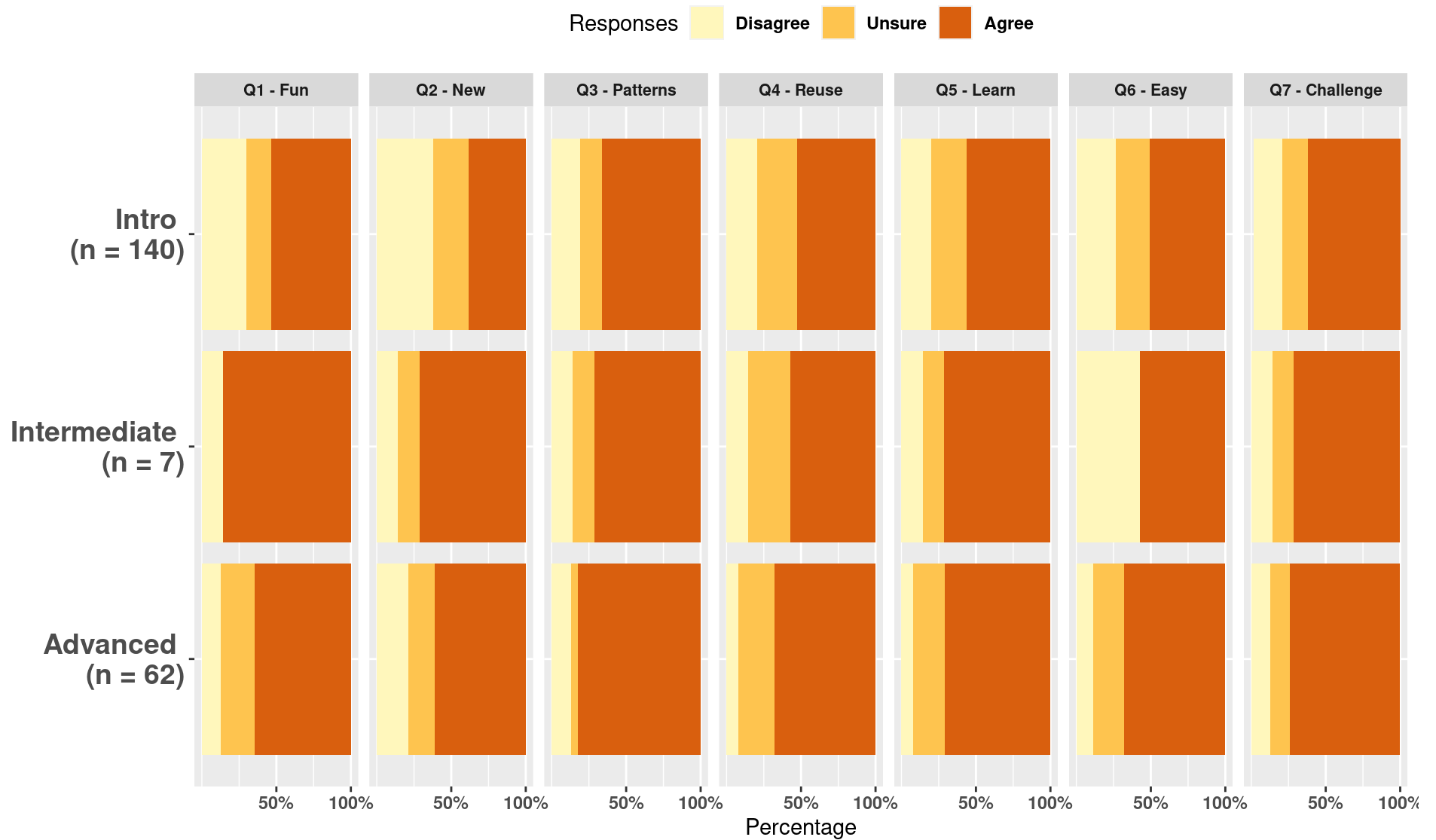
Summary of student responses to the seven choice-feedback questions.

What did students like most?

Theme 1: Applying stats to real data

22% mentioned they liked applying stats knowledge to real-world/practical data.

"The Greenhouse activity was interesting because it applied what we learned in class to a real problem."

Theme 2: Improved understanding of stats

17% talked about how it improved their statistical knowledge.

"It allowed me to not only find the answer to the problem but explain why. I think that helped me better understand linear regression."

What did students like most?

Theme 3: Data visualizations

17% mentioned the visualization and graphs.

"I enjoyed seeing the information being learned in the course integrated into a game with visualizations as I am an auditory and visual learner."

Theme 4: Interactivity

16% liked that they could interactively change variables and see the effect.

"I liked how we could go back and try different combinations as many times as we wanted and see how much the profit changed with each alteration."

What did students like most?

Theme 5: Activity outline was appreciated

14% appreciated how the activity was outlined.

"The step-by-step procedure that helped me better understand what was being asked of me."

Theme 6: Activity was fun

12% thought the gaming aspect of the activity was fun.

"I thought it was fun to play around with the program, it reminded me of little farming games like Stardew valley that I used to play and it was fun to just have an activity to engage in."

What did students like least?

Theme 1: Activity instructions

24% found the instructions confusing.

"I think the instructions were a bit hard to understand."

Theme 2: Issues with the user interface

12% had issues with the website or the user interface.

"The interface was moderately confusing and there wasn't any confirmation that your work had been saved."

What did students like least?

Theme 3: Activity was onerous

10% of students found the activity to be onerous.

"I felt that a lot of it was almost like busy work."

Other Student Comments:

"Using the data to answer questions I did not understand how to answer at the time."

"I thought the activity was confusing in how it related to statistics."

"Some of the questions seem rather simple and felt more like a waste of time."

What did students say should be improved?

Theme 1: Activity instructions

49% wanted improved activity instructions.

"The activity's instructions could have been clearer."

Theme 2: Technical Improvements

16% suggested technical improvements.

"Probably it'll be better if the speed of uploading the data could be faster."

What did students say should be improved?

Theme 3: Instructor's use of the activity

12% of the students suggested the instructor could improve their use of the activity.

"Teaching all the topics before asking students to complete."

Other Student Comments:

"Make it longer and more comprehensive to cover more topics in statistics, because I learn best hands on and this is exactly the type of activity that makes things click for me."

"There could be a more specific plan. Like the neighbor wants to spend only this much but make this much. It would add a more critical thinking aspect as well as make students really analyze the data."

"Increase the number of plots."

Analysis of Instructor Feedback

Summary of responses from 7 instructors (1 - Disagree, 3 - Neutral, 5 - Agree)

Statement	1	2	3	4	5
This activity was an effective way for students to learn about linear regression.	0	0	1	1	5
This activity was an effective way for students to learn about making decisions with data.	0	0	1	1	5
This activity improved my students' ability to see the full process of statistics, from asking questions and data collection to drawing conclusions.	0	0	1	4	2
This activity improved my students' interest/engagement in the course.	0	0	2	2	3
This activity improved my students' skill in interpreting and communicating statistical results.	0	0	3	3	1
The level of difficulty was appropriate for my students.	0	0	2	2	3

Let's play

Greenhouse Game: https://www.stat2games.sites.grinnell.edu/

Greenhouse Game Lab:
https://dataspace.sites.grinnell.edu/greenhouse1.html

Use Group ID: **USCOTS23**

Why play games (part 1/2)

"In addition to developing skills, play can also uniquely motivate students to develop basic competencies and interest in more specialized domains of knowledge" (Jenkins, 2005)

- Example: Pokemon (Prensky, 2001)

- GAISE (Guidelines for Assessment and Instruction in Statistics Education)

Why play games (part 2/2)

Jenkins (2005) identified import aspects of games

- lower the threat of failure

- foster a sense of engagement

- sequence tasks to allow early success and maintain a threshold at which players feel challenged but not overwhelmed

- link learning to goals and roles

- support early steps into a new domain

Why Greenhouse

- The Greenhouse game and activities **incorporate research-like experiences** into the classroom

- They **engage** students

- They are easy to incorporate into your classes

- Encourage students confronting and correcting **misconceptions in statistics**

Research-Like Experiences (part 1/2)

"Teach statistics as an investigative process of problem-solving and decision making" (GAISE College Report, Carver et al. 2016)

Greenhouse involves students in the investigative process of statistical analysis
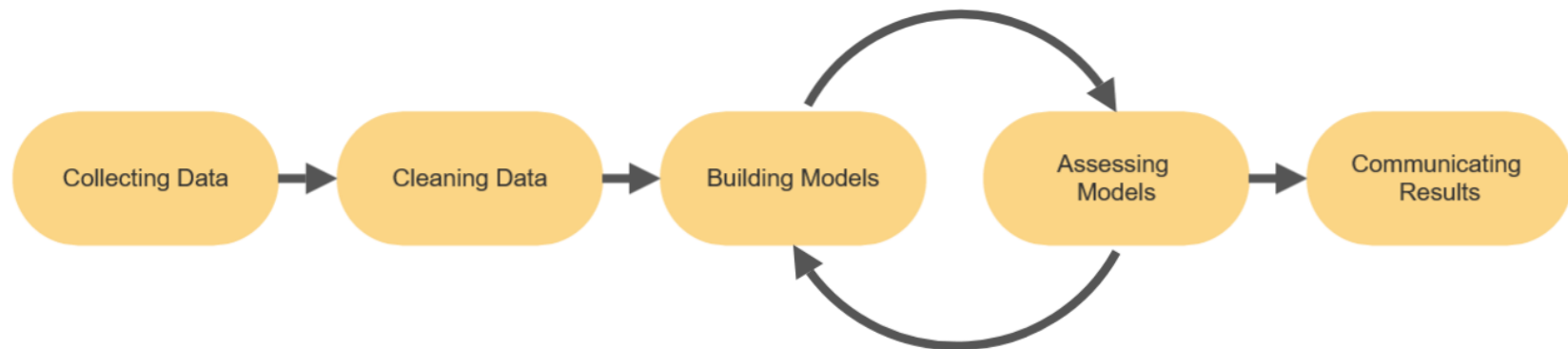
Research-Like Experiences (part 2/2)

- Greenhouse activities guide students to

    - Engage with statistical thinking

    - Produce analyses mimicking real-world research

    - Experiment with multiple strategies and "think with data"

    - Communicate with their peers about data and results

    - Practice written communications to a prospective client

Greenhouse emphasizes clearly and accurately communicating statistical information, as recommended in GAISE Pre-K–12 Report (Bargagliotti et al. 2020, p. 2)

Engaging Materials

- Games are **FUN**

- Greenhouse facilitates an environment where students are actively engaged in the same concept and ready to be involved in class discussion

- Greenhouse fosters active learning, as recommended in the GAISE College Report (Carver et al. 2016, p. 3)

Confronting Misconceptions

· Data fixed, not variable

· Collecting data results in consistent, reliable results from small samples

· Thinking about variables individually - a need for multivariable thinking & confounding

· Simple relationships between variables - the necessity of needing more advanced models

"…give students experience with multivariable thinking" (GAISE College Report, Carver et al. 2016)

Racer

Racer Game: https://www.stat2games.sites.grinnell.edu/

Racer Game Lab: https://dataspace.sites.grinnell.edu/racer1.html

Use Group ID: **USCOTS23**

People Invovled

- Shonda Kuiper
- Abhishek Chakraborty
- Scott Crawford
- Tyler George
- Lisa Kay

- Larry Lesser
- Ginger Rowell
- Dennis Pearl
- Anna Olsen
- Rodney Sturdivant

Even more helped in class testing and working on the apps.

Ending Credits

Email **Shonda Kuiper** at *kuipers@grinnellcollege.edu* to contribute!

See all the games at **stat2games.sites.grinnell.edu**

References

Jenkins, H. (2005), "Get Into the Game," **Educational Leadership**, 62, 7, pp. 48-51, https://www.learntechlib.org/p/63638/.

Prensky, M. (2001), "Digital Natives, Digital Immigrants Part 1," On the Horizon 9, 5, pp. 1-6.

Carver, R., et. al. (2016). **Guidelines for Assessment and Instruction in Statistics Education College Report 2016**. American Statistical Association. https://www.amstat.org/docs/default-source/amstat-documents/gaisecollege_full.pdf.

Bargagliotti, A., et. al. (2020). **Pre-K-12 Guidelines for Assessment and Instruction in Statistics Education II (GAISE II)**. American Statistical Association. https://www.amstat.org/docs/default-source/amstat-documents/gaiseiiprek-12_full.pdf.

Future Work

- More class testing

- Online data visualizations for more games

- New labs for most games

    - Example: Some teachers using the Greenhouse game have students download the class data, clean it, and then use it. Having an explicit lab for this could be beneficial.

- Speeding the availability of class collected data

Post-Workshop Survey

Please fill out the post-workshop survey (anonymous).

bit.ly/STATGAMES