Activities and Demos for improved understanding of statistical concepts

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Outline

- Why use activities and demos in a course?
- Some favorite activities in probability
- How to design, test, and carry out an activity

Why use demos and activities?

- Assessment
- Engagement
- Alternative mode of learning

Assessment

- Immediate feedback to instructor
  - Find out what is unclear
  - Tailor instruction to current situation to make it more effective
- Correct misconceptions sooner
  - Students get confusions cleared in the moment
  - Misunderstandings don't interfere with new material

Engagement

- Promote discussion
  - Student participation can lead to better understanding
  - Students more likely to identify points of misunderstanding at other times
- Foster group work for team projects

Alternative Approach to Learning

- Activities involve verbalizing approach, trying out test cases
- Demos involve watching a simple example unfold
- Offer multiple modes of instruction to increase likelihood of understanding
- Reference point for future development of ideas

Sample Activities

What does it mean to be Random?

- Haphazard - lacking any obvious principle of organization
- Unplanned - First person you run into on the street
- Without thinking - Off the top of head

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What does it mean to be Random?

TRY THIS –
MAKE UP 100 TOSSES OF A FAIR COIN

Find the length of the longest run of either heads or tails

Count the number of times that the flips switch back and forth between heads and tails

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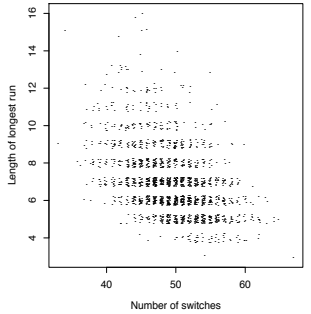

Randomness can look suspicious
It's Hard To Look Accidental on Purpose

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Resolution

- "To be random" in statistics and probability has a formal definition
- It's not easy to act like a chance process
- Using chance devices is important if we want things to behave as if they are random
- Later we will see why this might be important (reference point)

Birthday Bingo

My birthday June 28

Was anyone else in the room born on this day?

TRY THIS

Are there any birthday buddies in the room?

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An important difference between these two questions:

- First Question:
  - Looking for a match in the group to a particular day
  - Success is a match to June 28
- Second question:
  - Look for a match between any pairs in the group
  - Success is a match for any pair

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Outcome space:

- Think about it from the opposite direction – No birthday buddy
- Chance no one has my birthday in a group of 20:

$$\left(\frac{364}{365}\right)^{19} = 0.95$$

- Chance no buddies in the group is:

$$\left(\frac{364}{365}\right)\times\left(\frac{363}{365}\right)\times\cdots\times\left(\frac{346}{365}\right) = 0.59$$

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Resolution

- Be careful with the outcome space
- Finding the chance of the complement of an event can be easier than the direct calculation
- We have made some approximations to compute this chance – ignore leap year, assume independence, others.

Surprisingly Predictable OR Full of Surprises????

We filter out the misses and keep track of the matches

TRY THIS

Chat with your neighbor until you find something in common

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Resolution

- There are many rare events, e.g. the chance that you and I both like singer Roy Orbison, if you look for enough rare events then it's highly likely that one will occur
- Caution in attributing meaning to findings
- This concept is related to data snooping

Conditioning comes Naturally

Pick 1 person to be a liar.

The rest of us tell the truth.

Lie detector mistakes:

Liars: roll 1-5 = fail

Truth: roll 6 = fail

All of those who failed stand up.

What's the chance one of those standing is a liar?

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Conditioning comes Naturally

$$P(fail \mid liar) = \frac{5}{6} \qquad P(fail \mid truth-teller) = \frac{1}{6}$$

That's natural to compute.

But we want:

$$P(liar \mid fail) = \frac{P(liar \text{ and } fail)}{P(fail)} = \frac{\frac{5}{6}l}{\frac{5}{6}l + \frac{1}{6}(1-l)}$$

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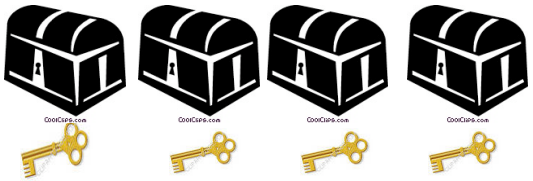
Why not just do the calculation on the board?

- AHA! element is visceral and brings the point home
- We have a population that we can examine to get at the finer points
- Can connect the event to later calculations – types of errors, likelihood, etc.

Random permutations (advanced)



- Keys are jumbled, each is tossed in chest, lid is shut.

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- You are on your own to find the solution
- Sometimes we just give students problems for fun

Probability Activities Summary:

- Random not same as haphazard
- Outcome space: Me versus Anyone
- Rare events do happen
- Conditional: direction matters
- Hard fun problems

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Preparing your own activities

Can you afford the class time?

- Advance preparation is key to pare down the activity to the essential parts
- Closely Integrate the activity into the lecture so it's not time-away from learning
- Have students multi-task if activity involves sharing materials

How to prepare

- Plan
- Materials list and activity template
- Handouts that ensure activity is done correctly and lengthy calculations avoided
- Dry run, adjust for classroom size and arrangement
- Notes for next time

5 E - Template

- *Engage*: Object/event used to engage students.
- *Explore:* What will students do?
- *Explain*: What is the key point?
- *Elaborate*: Connect to other topics, extend understanding.
- *Evaluate*: Assess knowledge, skills, and lesson effectiveness.

Common Mistakes

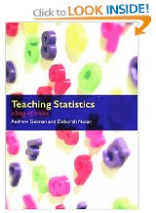
- Don't run overtime – no activity is so compelling that the punch-line can wait for the next class meeting
- Avoid unnecessary details – if you can't easily connect the activity to the course material, then drop it.
- Confidentiality – choose activities that students will readily and safely engage in
- Respect – choose activities that students do not feel are demeaning

Other types of activities

- Introductions – online bios with pics
- Think – pair – share
- One minute paper
- Latest news, blog, video
- Pop "quizzes" – people now use clickers

Resources:

Teaching Statistics: A Bag of Tricks, Gelman & Nolan



50 Challenging problems in Probability, Mosteller

Clicker Videos:
http://www.cwsei.ubc.ca/resources/SEI_video.html

BLOGS:
http://www.statsblogs.com/
http://teachingwithdata.blogspot.com/

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