Teaching Statistics with Wo/man’s Best Friend
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Echo on his 165-mile Tahoe Rim Trail journey (TRT)
Montbleu Hotel Room – TRT respite
What it Means to be Statistically Educated


• Students should develop statistical literacy and the ability to think statistically.

• Specific techniques and procedures are not as important as the knowledge that comes from going through the process of learning them.

• Conceptual understanding is supported by components used in statistical problem solving (formulating questions, collecting data, analyzing data, and interpreting results).
GAISE Recommendations

1. Emphasize statistical literacy and develop statistical thinking.
2. Use real data.
3. Stress conceptual understanding, rather than mere knowledge of procedures.
4. Foster active learning in the classroom.
5. Use technology for developing conceptual understanding and analyzing data.
6. Use assessments to improve and evaluate student learning.
Why did I choose dogs?

• I am often looking for real data.
• Dogs offer a natural and familiar source of variability.
• Students tend to find these projects motivating and interesting and are therefore engaged in the learning process.
• Fosters active learning in the classroom.
• I am often reading about, working with, talking about, and spending time with DOGS!
Contexts for Statistical Activities

• Splash Dogs Dock Diving
• Chaser - The Smartest Dog in the World
• Black Dog Syndrome
• Damn Lies and Cat Statistics
Splash Dogs Dock Diving

Photo by Lori Maloney
Splash Dogs Dock Diving: Goals for Instruction

• Students should believe and understand why variability is natural, predictable, and quantifiable

• Students should know how to graph data as the first step in analyzing data

• Students should know how to interpret numerical summaries and graphical displays of data
2010 Splash Dogs Lap Dog Rankings

Photo by Lori Maloney
Record Jumps by Breed

Photo by Lori Maloney
Corgi photo by Splash Dogs; All others by Lori Maloney
Student’s Thinking and Reasoning about Splash Dogs

1. Are there any outliers? Explain how you know.
2. How do their means compare numerically and is this result expected? Explain.
3. How do their standard deviations compare? What does that tell us about the variability in the two groups?
4. Give your observations/findings about these two data sets in terms of their real world contexts.
5. Construct a box and whisker plot for each data set in such a way that they have the same scale, but the 2010 Splash Dogs Lap Dog Rankings plot is above the Record Jumps by Breed plot.
Chaser- The border collie who knows a thousand words

“Chaser” by Chris Bott
Chaser: Goals for Instruction

• How to interpret statistical results in context.
• How to determine when a cause-and-effect inference can be drawn from an association based on how the data were collected (e.g., the design of the study).
• How to communicate the results of a statistical analysis.
Chaser- The smartest dog in the world

• "Chaser is the most scientifically important dog in over a century. Her fascinating story reveals just how sophisticated a dog's mind can be." Brian Hare

• "The genius of Chaser, and of Professor Pilley’s work, is not only about how they have schooled the world on the hidden intellectual capabilities of the canine, but about how they have revealed to us all, in quantifiable terms, the true depth of the bond between humans and dogs." Steve Duno
The Research Study

John Pilley and Alliston Reid answered two central questions with their research:

• Q1: How large can a dog’s vocabulary become if given extensive training?

• Q2: What do dogs actually understand when we use human language to communicate with them?
First experiment

• Demonstrates Chaser learned the names of over 1000 objects.
• Each of Chaser’s 1022 toys has a unique proper noun name.
• Chaser has demonstrated the ability to deduce the name of a novel object when it is placed among a group of familiar toys.
Second Experiment

• Demonstrated Chaser understands the difference between nouns and verbs.
• In order to test independence of meaning, the researchers randomly combined nouns with commands in each trial.
• Chaser responded to each combination correctly, even on the first trial.
• The dog understood that names refer to particular objects, independent of the action requested involving that object.
Third Experiment

- Demonstrated Chaser understands names for categories of objects.
- For instance, she learned that name “toy” referred to the 1022 objects she was allowed to play with, each with a proper noun name.
- Chaser knows the proper noun names of over 100 individual balls, which she can also identify by the category labels “ball” and “toy”.
- Chaser also demonstrated that she could map up to three labels onto the same object without error. Ex. “Toy” => “Ball” =>”Baseball”.
Fourth Experiment

• Demonstrated Chaser could also learn names by inferring the name of a novel object by exclusion of familiar objects.

• Just as is common with young children, Chaser’s retention of names using this procedure was limited to short periods.
Q1: How large can a dog’s vocabulary become if given extensive training?

• Chaser, learned the names of 1022 objects. They stopped training her after three years due to their time constraints, not because she could not learn more names.

• This study demonstrates Chaser’s ability to learn the names of proper nouns. Her extensive vocabulary was tested repeatedly under carefully controlled conditions.

• The authors admitted that she remembered the names of each of her 1022 toys better than they could.
Q2: What do dogs actually understand when we use human language to communicate with them?

• “This research is important because it demonstrates that dogs, like children, can develop extensive vocabularies and understand that certain words represent individual objects and other words represent categories of objects, independent in meaning of what one is asked to do with those objects.” -Alliston Reid, researcher
Chaser: Student Project

• Diagram the experiment(s).
• Describe methods: Question(s) of interest, study design, variables, findings, conclusions.
• Why do we care? (What does this study contribute to the field?)
• What additional research is needed?
Black Dog Syndrome
Claim: Black dogs are euthanized at a horrifying rate at many pounds & shelters because people pass them up for lighter colored dogs.
What is Black Dog Syndrome (BDS)?

• “For a black dog in an animal shelter in the United States, the difficulty with adoption does not stem from their health, breed, sociability, or temperament – it is the color of their coat” (Hipp, 2008).

• “The general public is not aware of how doomed black dogs are when they are brought to a pound.” The Bark, 2012.

• “Black Dog Syndrome is a phenomenon that is well known to shelter workers and rescue organizations across the nation. Black dogs are much more difficult to find homes for. They are the last dogs to find homes and often among the first to be euthanized.” blackdogrescueproject.com
Is Black Dog Syndrome real?

So, is it true?

“Mikey” by Jen DeHaan
BlackPearlDogs.com

- “Are there statistics to prove this really exists?”

- “None that we have seen or provided by a professional, objective statistician collected at the national level presented in a variety of terms.”

- “Additionally, we have been trying to find any stats to help us understand better what this is all about within the kennel/shelter setting.”
BDS: Goals for Instruction

• Students learn how to obtain or generate data.
• How to determine when a cause-and-effect inference can be drawn from an association based on how the data were collected (e.g., experiment versus observational study design).
• Students learn that data beats anecdotes.
From Curiosity to Questions About Parameters

The Investigative Cycle

• What is happening?
• What studies (if any) have been conducted?
• What explanation do the “experts” give?
• How would we investigate this phenomenon?
Black Dogs Do Not Photograph Well

• “Darker-colored pups, it's said, have a hard time finding homes -- in part because their adoption photos don't always turn out so great.” The Huffington Post, (2015)

• “Many animal shelters are faced with an all too common problem: Black Dog Syndrome. Whether it’s because they don’t photograph well or because there is some unfounded stigma about them being evil, black dogs are overlooked by potential adopters.” Life with Dogs, (2014)

• “One reason ...for dark coated dogs being overlooked is a bad photograph.” Black Pearl Dogs.
Problem- Plan-Data- Analysis

• We are curious as to whether or not black dogs do not photograph well (or as well as other dogs).

• Design a study that allows for us to collect data in a trustworthy fashion. Create a scale to decide on the quality of the photograph; include “dog” traits.

• We will collect data in the form of photographs from shelters and owned dogs to see what effect “color” of dog has on the quality of the photograph.

• Perform statistical data analysis to see if black dogs in shelters are not photographed as well as other dogs.
Jasmine and Benny

“Jasmine” and “Benny” by Susan Roper
Jasmine and Benny

“Jasmine” and “Benny” by Susan Roper
So how bad can the pictures of black dogs in shelters really be?

http://www.petharbor.com/pet.asp?uaid=YOLO.A132599
Small black dogs in shelters
Large black dogs in shelters

petharbor.com
Bad pics of non-black dogs in shelters
Black Dogs with Bandanas!

L:”Gigi” by Adorable Mutts; R: “Scout” by Born Again Pit Bull Rescue
COCOA

“Cocoa” by San Francisco Animal Care and Control
Black Cat Syndrome?

http://www.petharbor.com/pet.asp?uaid=REDS.A031511
Do black dogs and cats suffer the same fate?

Can you see me now?

Black dogs and cats are “invisible” in shelters, killed at far higher rates than pets of other colors. Please don’t overlook them.

ellen graben, advocate
Black Cats Less Than Half As Likely To Be Adopted As Gray Cats
Damn lies and cat statistics

“We’ve got the Big Data report, we did the competitive analysis, and nobody thought to include cats?!”
Cat fertility: Goals for Instruction

• Students should know how to critique news stories and journal articles that include statistical information.
• Students should recognize common sources of bias in surveys and experiments.
• Students should understand how to interpret numerical summaries and graphical displays of data—both to answer questions and to check conditions (to use statistical procedures correctly).
Reproduction “facts” about dogs and cats:
Watauga Humane Society, Boone, NC

Why spay or neuter dogs and cats?
• In six years, one un-spayed female dog and her un-spayed offspring can theoretically produce 67,000 dogs.
• One un-spayed female cat and one un-neutered male cat and their offspring can result in 420,000 kittens in 7 years.
• A female cat can have 29 litters in 10 years.
• A male cat can sire as many as 2,500 kittens in a single year, and a male dog can sire almost as many puppies.
• Only 1 in 9 cats and dogs born in the US will find homes
Cat fertility, er, statistics?

TWO UNCONTROLLED BREEDING CATS plus all their kittens and all their kittens' kittens, if none are ever neutered or spayed, add up to:

- 2 litters per year
- 2.8 surviving kittens per litter
- 10-year breeding life
- In 10 years multiply to 80,399,780

First year: 12
Second year: 66
Third year: 382
Fourth year: 2,201
Fifth year: 12,680
Sixth year: 73,041
Seventh year: 420,715
Eighth year: 2,423,316
Ninth year: 13,958,290
Tenth year: 80,339,780
Can an unspayed cat really result in 420,000 cats in seven years?

http://attackofthecute.com/on/?i=16098
“Damn lies and cat statistics”, Christie Keith, SFGate

• Did you find yourself hip-deep in cats the last time you left the house?
• If the so-called "facts" about feline reproduction often cited by many local animal welfare organizations were true we'd need feline-resistant biohazard suits just to cross the street.
Statistical Investigation

• What assumptions is the oft cited model based on in order to result 420,000 cats in 7 years (or even 5 years depending on the “source”)?

• What assumptions are used to create alternative models that debunk the claim?

• What are the repercussions of touting faulty cat fertility statistics that are off by several orders of magnitude?
Debunking the Myth

• Mathematician Carl Bialik of the Wall Street Journal routinely examines the basis of statistics used in the media. Bialik consulted veterinary and wildlife management experts to create a model of cat fertility. He estimates between a 98 and 5,000 cats for the 7 years.

• There are numerous other internet sources that examine the claim, e.g. Snopes, Humanewatch.org, the Feral Cat Project.
Take the estimates of how many birds are killed by cats each year.

• An oft cited 1993 Wisconsin Study puts the number between 8 and 219 million.

• Yet in 2013 the Washington Post cited a study saying the range is 14 billion and 37 billion.
Why does it matter?
• Inaccurate numbers suggesting rampant feline reproduction and predation rates can adversely affect policy issues, which can be a matter of life and death for feral and free-roaming cats.
• Public policy based on bad ends up becoming the story rather than resulting in an actual solution.
Summary

• Using carefully selected real world contexts can engage students in statistical thinking and reasoning.

• Classroom activities based on real data designed with the GAISE recommendations in mind can support deep understanding of statistical concepts.

• Authentic applications can provide students with a way to better critique statistical findings presented by the media.
Thank You
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