Evidence That CS Grades Are Not Bimodal

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September 9, 2016

MOTIVATION

"Geek genes, prior knowledge, stumbling points and learning edge momentum: parts of the one elephant?" – Ahadi & Lister

Section 2

Study 1: Statistical Analysis

DATA TESTED

- UBC final grades, 1996-2013
- Undergrad CS classes
- 778 different lecture sections
- Alpha: 0.05

WERE THE CLASSES MULTIMODAL?

- Hartigan's Dip Test on classes with kurtosis < 3
- H_0: population is unimodal
- 45 classes were multimodal
- 5.8% of all the 778 classes

WERE THE CLASSES NORMAL?

- Shapiro-Wilk test for normality
- H_0: is normally distributed
- 106 classes were not normal
- Bootstrapping: 85.1% of classes were normal

Discussion

- Most grades were normal
- Bimodality was rare
- Threats to validity: final grades only, one institution
- Replicate us!

Section 3

Study 2: Psychology Experiment

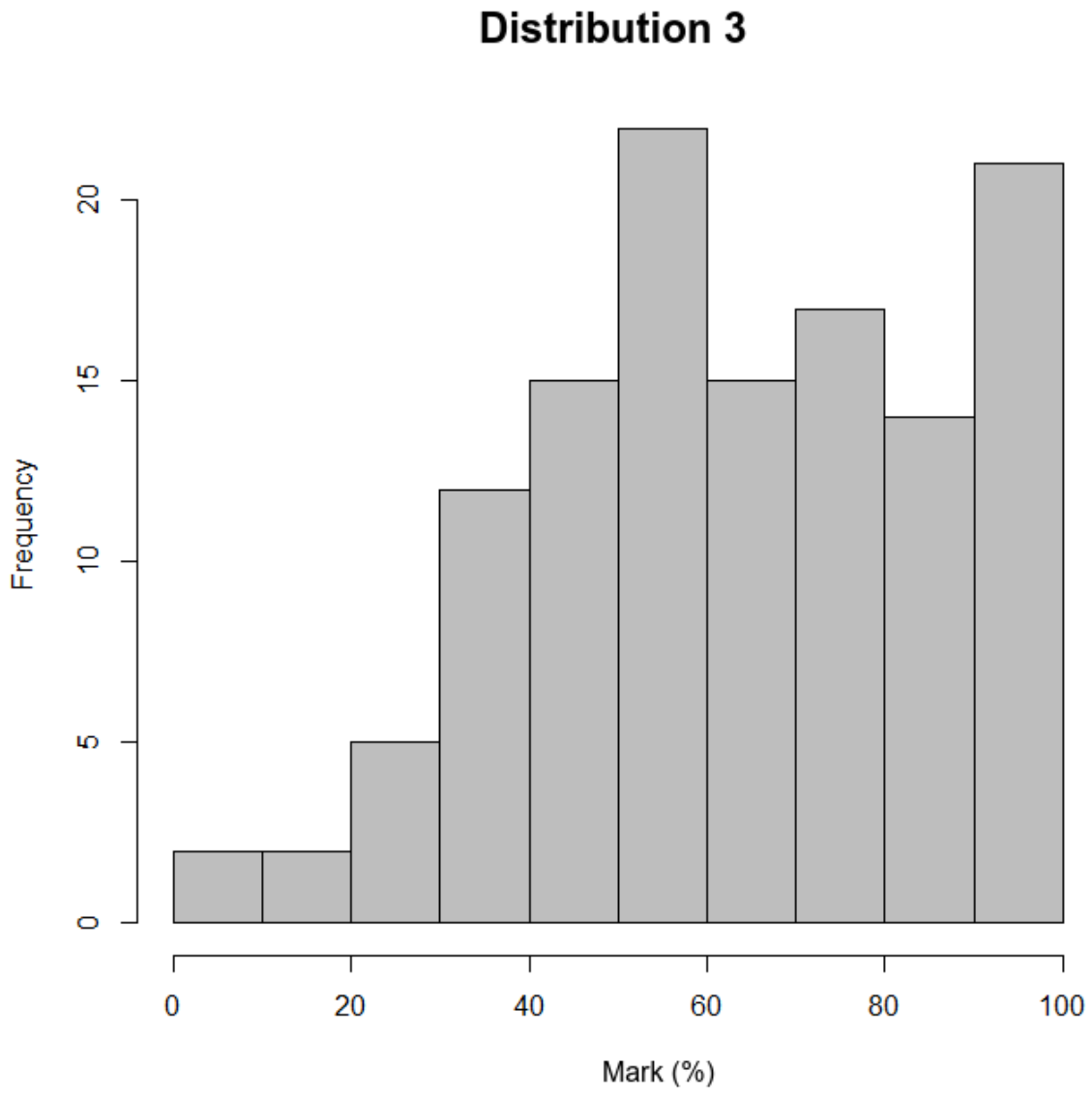
If grades aren't bimodal...

- What makes people perceive bimodality?

AMBIGUITY AND BIAS

- Apophenia: human tendency to see patterns in noise
- Biases more salient in situations with more ambiguity
- e.g. ambiguously qualified job candidate, person with ambiguous object

WHAT KIND OF DISTRIBUTION IS THIS?



Study

- Participants shown 6 histograms
- Asked to categorize them
- 60 participants recruited from CS ed communities

TWO TREATMENTS

Treatment 0

1. Agree with Geek Gene Hypothesis?
2. Categorize distribs
3. Bimodality is common...

Treatment 1 ("Primed")

1. Bimodality is common...
2. Categorize distribs
3. Agree with Geek Gene Hypothesis?

Analysis

- Computing a "seeing-bimodality"
- Non-parametric ANCOVA
  - Ordinal logistic regression on each treatment
  - ANOVA to compare the two regressions
- Šidák correction: alpha = 0.002

REGRESSION ON SEEING-BIMODALITY

- Predictive for both treatments:
  1. "Nearly everyone is capable of succeeding in computer science if they work at it"
  2. "Some students are innately predisposed to do better at CS than others"
  3. "When teaching, how often do you look at histograms of your students' grades? (This applies both to term work and final grades.)"
- For #1 and #2 the effect was stronger in Treatment 1

Interpretation

- Belief in Geek Gene predicts whether people see bimodality in the noise
- Priming increases this belief

Looking at grades?

- Looking at grades makes you see more bimodality
- Solidifies a view that grades are bimodal

Explaining the belief in bimodality

- Geek Gene Hypothesis: defense mechanism when students don't get it
- Teacher self-efficacy isn't tied to teaching ability (Guzdial, 2016)

Social Defense

- A *social defense*: set of organizational structures/narratives that function to protect members from internal psychological conflict caused by their work
- Geek Gene / Bimodality: a social defense of CS educators
- Gives educators an "out" for when students don't learn

Findings

- Bimodal grades appear to be rare
- Likelihood of "seeing bimodality" based on:
  - Belief in Geek Gene Hypothesis
  - Confirmation bias
- Bimodality/GGH provides a social defense for when students don't learn