Teaching a Prestatistics Course: Propelling Non-STEM Students Forward

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What is it?
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Teaching Prestatistics Concepts Is in the Details
Outline

1. Motivation for Prestatistics Course
2. Prestatistics Content
3. Structure of Course
4. Teaching Concepts
5. Cool Data Sets
6. Student Experiences
Non-Accelerated Students Through Dev Math

Ten-year study:
- Elementary algebra: 53.1% success rate
- Persistence into intermediate algebra: 65.8%
- Intermediate algebra: 56.4% success rate

Complete path: 19.7%
Non-Accelerated Students Through Dev Math

Ten-year study for **split courses**:
- First half of elementary: 58%
- Persistence into second half of elementary: 90%
- Second half of elementary: 53%
- Persistence into first half of intermediate: 65.8%
- First half of Intermediate: 61%
- Persistence into second half of intermediate: 90%
- Second half of intermediate: 61%

Complete path: 6.1%
Traditional algebra sequence is
• an inefficient preparation for statistics.
• not in line with most non-STEM majors’ careers.
Departments’ Use of Prestatistics

Two different options:

- Prestatistics can replace both elementary and intermediate algebra.
- Prestatistics can replace just intermediate algebra.
Chapter 1: Arithmetic review that foreshadows statistics
Chapters:

2: Observational studies and experiments
3: Statistical diagrams
4: Measures of center and spread
5: Probability laws and normal distribution
6: Linear regression
Algebra Tied to Statistics

Chapters 7 and 8:

- Simplify linear expressions
- Solve linear equations
- Solving formulas
- Solve linear inequalities
- Graph linear equations
- Interpret slope and vertical intercept
- Use two points to find an equation of a line
More Descriptive Statistics

Chapters:

9: More linear regression
10: Exponential regression
Course Structure

- 6-unit course
- 2 hours on Tuesdays, 1 hour other weekdays
- Some lecture, some group work
- StatCrunch
- Online homework
- 7 tests, 10 quizzes, 1 project, 1 final
A Typical Day
Who Can Take the Course?

- Prerequisite: Arithmetic
- Students who will take statistics and no other math courses.
Current Students’ Majors

Major
- administration of justice, 3, 12%
- art, 1, 4%
- art therapy, 1, 4%
- broadcasting, 1, 4%
- communications, 1, 4%
- criminal justice, 1, 4%
- english, 1, 4%
- ethnics, 1, 4%
- film, 1, 4%
- graphic design, 2, 8%
- history, 1, 4%
- human resources, 1, 4%
- political science, 1, 4%
- psychology, 5, 20%
- sociology, 3, 12%
- undecided, 3, 12%
Learn From Our Mistakes

What did we learn from math reform in the 90s?
What the Course Should Not Be

Acceleration should not mean . . .

- Deleting topics because they are challenging.
- Dumbing-down remaining topics.
- Duplicating the first half of a statistics course.

Avoid the 3 Ds!
Goal of Course

Propel students’ understanding of crucial concepts beyond what’s typically attained in statistics.
Implementation

But How?
Teaching Prestatistics Concepts Is in the Details
What’s the Connection?

Frequency Histograms

Normal Curve
The Missing Ingredient

Density histograms
A proportion is a fraction of the whole.
Properties of Proportions

- A proportion is always between 0 and 1, inclusive.

The sum of the proportions of the parts equals 1.

- Proportion of the rest property
Find the proportion of the disk that is green.
Collaborative Activity: Complement Rule

- The total area of the object is 1.

- The object has not been drawn to scale.

- Find the area of the red bar.
Definition of Density Histogram

- **density** = \( \frac{\text{relative frequency}}{\text{class width}} \)

- The area of each bar is the relative frequency of the bar’s class.
Television Viewing Durations
1. Compute the area of each of the five bars.
2. Find the total area.
3. What is the total area of any density histogram? Explain.
Average Ticket Prices at MLB Stadiums
Find the proportion of stadiums whose average price of 2014 MLB tickets are between $30 and $39.99.
Find the proportion of stadiums whose average price of 2014 MLB tickets are at least $20.
Collaborative Activity: Transformation of Density Histogram

Television Viewing Durations in the Summer by College Students

In the fall:
- The mean viewing time decreases by 2 hours.
- The standard deviation decreases.
- Sketch a density histogram.
Collaborative Activity: Transformation of Density Histogram

Television Viewing Durations in the Summer by College Students

Density

Hours

0 2 4 6 8 10

0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40
Mean Response Time to Fix Potholes in Chicago
1. Interpret the area of the red region as a probability, a proportion, and a percentile.

2. How well has Chicago met its goal of fixing potholes within 7 days?
Song Lengths Played by Live 105
Motivating the Normal Curve

What is the probability of randomly selecting a song length between 170 and 230 seconds?
Introducing the Normal Curve

Song Lengths

Seconds

Density

0.008
0.006
0.004
0.002

0 50 100 150 200 250 300 350 400 450 500

0.19
0.42
0.27
0.07
Using Smaller Class Sizes

Song Lengths

Seconds

Density
Area of a Bar versus Area Under Normal Curve

Song Lengths

Seconds

Density

0.008

0.006

0.004

0.002

0.19

0.27

0.07

0.42

0

50

100

150

200

250

300

350

400

450

500
Area of a Bar versus Area Under Normal Curve

Density

0.008
0.006
0.004
0.002

Seconds

0 50 100 150 200 250 300 350 400 450 500

Song Lengths

0.28
The area is equal to the probability that a randomly selected observation is in the interval.
The total area under a normal curve is equal to 1.
Normal Distributions with Different Standard Deviations

Density

Smaller standard deviation

Larger standard deviation

![Image of Normal Distributions with different standard deviations]
Teaching Prestatistics Concepts Is in the Details
Other Examples

- Residuals, regression, residual plots, and coefficient of determination
- Two-way tables, proportion, and probability
- Shape, center, spread, and outliers
- Four characteristics of an association between two numerical variables
Earlier Cool Data Sets

- Baseball ticket prices
- Filling potholes
- Song lengths
UFO Sightings

Reported to UFO National Reporting Center during the period May 14–31, 2014
UFO Sightings

Describe the shape of the distribution.
Which is larger, the mean or the median?
Which is the better measure of the center? Explain.
Guess why there are spikes at the following times (in minutes): 5, 10, 15, 20, and 25.
Comparing Histograms

By inspecting both histograms, is it reasonable to assume that the mean is even greater than the median than if one were to inspect only the first histogram? Explain.
Each observation more than 25 minutes is an outlier. How could the entire right tail consist of outliers?
For More Information
Student Experiences

- Jenny
- Dan
- Kate
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Teaching a Pre-statistics Course: Propelling Non-STEM Students Forward

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