Statistics for All: Nearer Our Destination or Slip Sliding Away?

Ann Watkins

The Three Commandments

- Emphasize statistical thinking
- More data and concepts
- Foster active learning

Defining Our Problems

- **What particular goals will there be toward which the leading spirits of coming generations will strive?**

Problem #1

Decide what *all* citizens need to know about statistics.

#1 What should every student understand by the end of high school?

A. How to collect, organize, and display data
B. Correlation and regression
C. Variability and that it's possible to generalize from a sample to a population, with some error
D. Inference (conceptual only): margin of error, "statistical tie"
E. Construct confidence intervals and perform significance tests

#1 Audience Vote $n = 162$

(A vote for C, for example, would include A and B.)

A. How to collect, organize, and display data 16%
B. Correlation and regression 2%
C. Variability and that it's possible to generalize from a sample to a population, with some error 46%
D. Inference (conceptual only): margin of error, "statistical tie" 30%
E. Construct confidence intervals and perform significance tests 6%

Problem #2

Statistics has not caught on in K-12 (AP Statistics excepted).

EMPHASIS INDEX
Robert Reys, University of Missouri

Ratio of the emphasis placed on the topic by 39 middle school teachers to the emphasis placed on the topic by the text

	Number	Algebra	Geometry	Data Analysis
NSF Material	1.33	1.13	0.91	0.72
Commercial Material	1.25	1.00	0.87	0.70

#2 How should we resolve the problem that statistics has not caught on in K-12?

A. Stay the course
B. Coordinate our current grassroots efforts
C. Change emphasis to showing teachers how to fit stat into their math curriculum
D. Apply pressure from the top down, working with mathematicians
E. Remove statistics from the math curriculum
F. Give it up

#2 Audience Vote *n* = 163

A. Stay the course 1%
B. Coordinate our current grassroots efforts 16%
C. Change emphasis to showing teachers how to fit stat into their math curriculum 67%
D. Apply pressure from the top down, working with mathematicians 6%
E. Remove statistics from the math curriculum 10%
F. Give it up 1%

Problem #3

Much of the statistics in state frameworks and assessments is awful.

California Framework

Students know the central limit theorem and can use it to obtain approximations for probabilities in problems of finite sample spaces in which the probabilities are distributed binomially. (12th grade)

Identify different ways of selecting a sample (e.g., convenience sampling, responses to a survey, random sampling) and which method makes a sample more representative for a population. (6th grade)

Identify data that represent sampling errors and explain why the sample (and the display) might be biased. (6th grade)

California High School Exit Examination, 2003 Released Data Analysis Question

Smithburg town library wanted to see what types of books were borrowed most often.

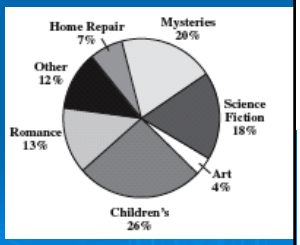
According to the circle graph—

A more Children's books were borrowed than Romance and Science Fiction combined.

B more than half of the books borrowed were Children's, Mysteries, and Art combined.

C more Mysteries were borrowed than Art and Science Fiction combined.

D more than half of the books borrowed were Romance, Mysteries, and Science Fiction combined.



#3 How should we improve the statistics in K-12 state documents?

A. Stay the course—
largely ignore state documents

B. Coordinate our grassroots efforts

C. Apply pressure from the top down

D. Move statistics from the math curriculum

E. Educate the people who write them

#3 Audience Vote *n* = 142

A. Stay the course—
largely ignore state documents 2%

B. Coordinate our grassroots efforts 18%

C. Apply pressure from the top down 13%

D. Move statistics from the math curriculum 6%

E. Educate the people who write them 61%

Problem #4

Even with GAISE, we will not have a grade-by-grade sequence of objectives for K-12 statistics.

California Framework and the Mode

1st Represent and compare data (e.g., É m ost often ...

2nd Identify features of data sets (É and mode).

4th Identify the mode(s) for sets of categorical data and the mode(s) for numerical data sets.

5th Know the concepts of mean, median, and mode; compute and compare simple examples to show that they may differ.

6th Compute the mode of data sets. Know why a specific measure of central tendency (mean, median, mode) provides the most useful information in a given context.

8-11 Students know the definition of the mode of a distribution of data and can compute it.

12 Students know the definition of the mode of a distribution of data and can compute it.

H.S. Teachers
Compute and interpret the mode of both discrete and continuous distributions

#4 Who should take the leadership and responsibility for developing grade-by-grade standards?

A. "Individual" efforts such as GAISE

B. ASA

C. NCTM

D. CBMS or MSEB

E. State departments of education

F. It's not important to develop them

#4 Audience Vote *n* = 140

A. "Individual" efforts such as GAISE 4%
B. ASA 50%
C. NCTM 23%
D. CBMS or MSEB 7%
E. State departments of education 16%
F. It's not important to develop them <1%

Problem #5

Some mathematicians say that there is no room for statistics in K-12 and young kids can't understand it anyway. Statistics can wait.

#5 Should we build a research base towards substantiating that we can and must teach statistics early and often?

A. Absolutely, such a research base does not exist
B. Such a research base partially exists—more work is needed
C. A research base does exist but it needs to be summarized and publicized
D. Such research is important but I don't know what has been done
E. A research base is not important

#5 Audience Vote *n* = 140

A. Absolutely, such a research base does not exist 11%
B. Such a research base partially exists—more work is needed 24%
C. A research base does exist but it needs to be summarized and publicized 9%
D. Such research is important but I don't know what has been done 56%
E. A research base is not important 1%

Problem #6

We haven't changed our expectations for students entering the intro college course.

Remedial Statistics?
The Implications of the
Changing Secondary School Curriculum

Statistics for the Twenty-First Century
MAA, 1992

#6 Should we work towards assuming prerequisite knowledge for intro stats?

A. No
B. Collect, summarize, and display data
C. Correlation and regression
D. Variability and that it's possible to generalize from a sample to a population, with some error
E. Inference (conceptual only): margin of error, "statistical tie"
F. Construct confidence intervals and perform significance tests

#6 Audience Vote *n* = 155

(A vote for C, for example, would include A and B.)

A. No 15%
B. Collect, summarize, and display data 34%
C. Correlation and regression 11%
D. Variability and that it's possible to generalize from a sample to a population, with some error 31%
E. Inference (conceptual only): margin of error, "statistical tie" 6%
F. Construct confidence intervals and perform significance tests 3%

Problem #7

The basic content of the introductory statistics course has not changed in 30 years.

Changes in the Last 30 Years

- **Leading books now written by statisticians**
- **More real data**
- **Activity-based**
- **Technology-using**
- **More graphics and simulation**
- **Regression diagnostics**
- **Cleaned up theory**

#7 How should we teach inference in intro stats?

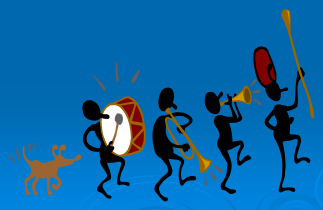
A. Continue to teach the "standard" methods
B. Move to computer-intensive methods: randomization tests, bootstrap
C. This isn't our decision—it depends on what client disciplines use in follow-up courses
D. Don't teach any method — teach concepts and intelligent use of software

#7 Audience Vote *n* = 152

A. Continue to teach the "standard" methods 16%
B. Move to computer-intensive methods: randomization tests, bootstrap 22%
C. This isn't our decision—it depends on what client disciplines use in follow-up courses 13%
D. Don't teach any method — teach concepts and intelligent use of software 49%

Problem #8

We still aren't teaching statistics to all that many college students.



Enrollments in elementary statistics in math and stat departments and in TYC math programs ÷ college population (in thousands)

Fall 1990: 171/13819 = .012
Fall 2000: 264/15312 = .017

In Two-Year Colleges only

Fall 1980: 28/4526 = .006
Fall 2000: 74/5847 = .013

#8 What is the main problem preventing more students from taking more statistics?

A. Students think statistics isn't important
B. Students think statistics is too difficult
C. Reform has backfired—students want less active learning and fewer concepts
D. Other disciplines don't value statistical thinking in their students
E. Too many people teaching intro stat who shouldn't be

#8 Audience Vote *n* = 133

A. Students think statistics isn't important 15%
B. Students think statistics is too difficult 32%
C. Reform has backfired—students want less active learning and fewer concepts 3%
D. Other disciplines don't value statistical thinking in their students 29%
E. Too many people teaching intro stat who shouldn't be 21%