MA/CS 109

Art and Science of Quantitative Reasoning
A course in the Mathematical Sciences

• Mathematics

• Statistics

• Computer Science
Questions:

1. What is Mathematics?
   (or What are the Mathematical Sciences?)
   What makes Mathematics different from other subjects? How can we tell when we are doing Mathematics?

   First step: Mathematics is a verb—it is something you “do” not something you watch.
2. Why did you take Mathematics all through school? Why is there a “Quantitative” SAT exam, but not a “Scientific” SAT exam. What is it about Mathematics (or the Mathematical Sciences) that make it (them) so important?
Good News

You already know more mathematics than 90% (maybe 99%) of the humans who have ever lived. You have studied mathematics since you were little. Learning more “techniques” is always useful...but better to learn why you’ve learned what you already know.

So we will remind you of techniques and facts and definitions—but “remind” is the key....
Three Components

1. Mathematics: Look at 2 problems—one “pure” and one “applied”, but......

   All math starts with a problem, so all math is “applied math”.—It used to be that the study of prime numbers was the “purest of the pure” in Mathematics. Now the study of prime numbers is one of the Big Money fields in computer security and encryption.
Three Components

1. Mathematics

2. Statistics: (and Probability)

   Using data to make predictions—or better—”Quantifying uncertainty”. Our focus will be on what it means to quantify uncertainty and what can and can not be done with statistics.
Three Components

1. Mathematics
2. Statistics
3. Computer Science (Professor Wayne):
Nuts and Bolts

Text: None...BUT...The may be minimal expense if we use a classroom response system...we won’t do it if it is more than $20.

Good news and bad news: Save some money, BUT...
SO...Attendance in lecture and discussion are mandatory!

If/when we use the classroom response system, we will know if you are here...I may use some more primitive systems (note cards!) But it will be easy to tell who showed up to class in body and spirit by looking at the exam scores!
Grades

Exams:
  Midterm: 40% (middle of the semester)
  Final: 50%

Homework/classroom-discussion work 10%
Questions?

1.
What is Computer Science and why does it matter?

What will we do in the last third of the course?

Wayne Snyder(waysnyder@gmail.com)
What is Mathematics?

- Describe reality using numbers and symbols
- Find out new information using proofs and manipulations of numbers and symbols using exact rules

Sampling distribution of $x$:
$$N(\mu, \sigma/\sqrt{n}) = N(15, 4/8)$$

Population distribution:
$$\mu = 15, \sigma = 4$$

$$\sigma_x = 4/\sqrt{64} = 4/8$$

$n=64$
N=64 account executives are randomly selected. What is the probability that the sample mean exceeds $20,500?

answer \( E(x) = $20,000, SD(x) = $5,000 \)

\[
E(\bar{x}) = $20,000, \quad SD(\bar{x}) = \frac{SD(x)}{\sqrt{n}} = \frac{5,000}{\sqrt{64}} = 625
\]

By CLT, \( \bar{X} \sim N(20,000, 625) \)

\[
P(\bar{X} > 20,500) = P\left(\frac{\bar{X} - 20,000}{625} > \frac{20,500 - 20,000}{625}\right) = P(z > .8) = 1 - .7881 = .2119
\]
What is Computer Science?

- Computer science is one of the *practical aspects* of mathematics: how do we actually apply the rules to manipulate numbers and symbols?
- “Describe reality using numbers and symbols” => encode information using symbols
- Discover new information using rules to manipulate number and symbols => manipulate symbols using an algorithm (an exact, step by step description of a process)

N=64 account executives… etc.

0.234!
What will we study in CS 109?

- How do we represent information in symbolic form? Analog vs digital information:

- What are algorithms and how do we run them using a machine?
What will we study in CS 109?

- What are the limits of computation?  Complexity of algorithms....

1, 2, 3, 4, 5, 6, ....
1, 2, 9, 16, 25, 36, ....
1, 2, 4, 16, 32, 64, ....

- Whither computing?  Can computers be intelligent?