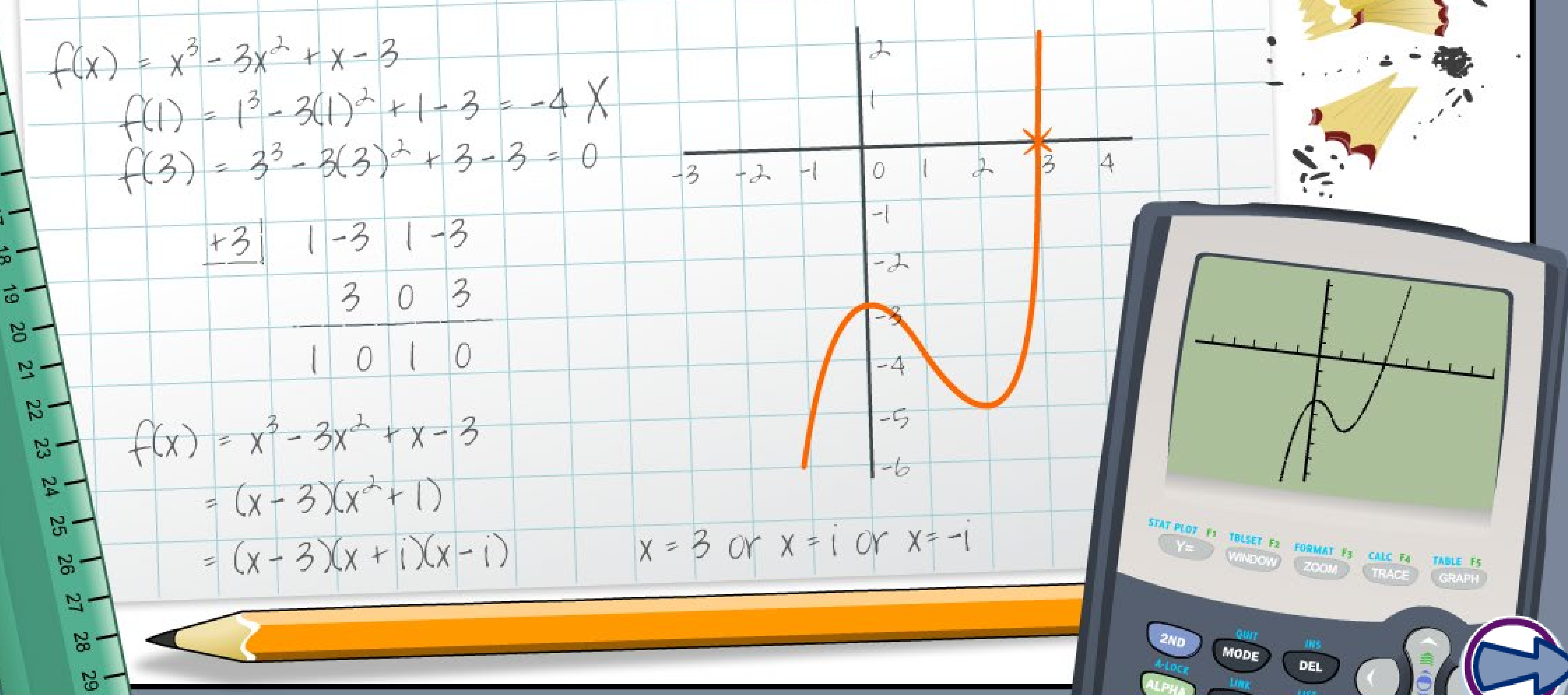
Introduction to Statistics



Information

Common core icons

This icon indicates a slide where the Standards for Mathematical Practice are being developed. Details of these are given in the Notes field.

MODELING

Slides containing examples of mathematical modeling are marked with this stamp.

This icon indicates an opportunity for discussion or group work.

The **Standards for Mathematical Practice** outlined in the Common Core State Standards for Mathematics describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

These are:

1) **Make sense of problems and persevere in solving them.**
2) **Reason abstractly and quantitatively.**
3) **Construct viable arguments and critique the reasoning of others.**
4) **Model with mathematics.**
5) **Use appropriate tools strategically.**
6) **Attend to precision.**
7) **Look for and make use of structure.**
8) **Look for and express regularity in repeated reasoning.**

This icon indicates that the slide contains activities created in Flash. These activities are not editable.

This icon indicates teacher's notes in the Notes field.

Collecting data

- experiment
- observational study
- sample survey
- census
- simulation

Statistics is a branch of mathematics where data is analyzed in order to make inferences about the processes or population behind the data.

Data can be obtained in many different ways.

Press one of the data sources to find out more.

Which data collection method?

Drag the situation into the correct data collection method

experiment	observational study

survey	census

Researchers studied men and women with major depression and men and women with no depression. The subjects were shown a sad film to see whether or not they cried.

Look at the information about the data for each study.
How reliable are the headlines?

85% OF AMERICANS WANT TO INCREASE FUNDING FOR SCIENCE*

*Data: 341 responses to a poll on the website of a US popular science magazine.

next

–5 –4 –3 –2 –1 0 1 2 3 4 5

totally unreliable — not sure — very reliable

An experiment

Aaron: "When you throw a die sixty times you get 10 sixes, because the probability of getting a six is $\frac{1}{6}$."

Monica: "But I've just thrown a fair die sixty times and these are my results!"

result	1	2	3	4	5	6
frequency	12	10	8	14	5	11

How can Monica's results be explained?

Monica: experimental probability

Monica's results can be expressed using **relative frequencies** – also called **experimental probabilities**.

result	1	2	3	4	5	6
frequency	12	10	8	14	5	11
exp. prob. (rel. freq.)	$\frac{12}{60}$	$\frac{10}{60}$	$\frac{8}{60}$	$\frac{14}{60}$	$\frac{5}{60}$	$\frac{11}{60}$

Experimental probability is found by dividing each frequency by the total number of trials. The sum of experimental probabilities always equals 1.

Each time Monica repeats her experiment, she may get slightly different results.

Aaron: theoretical probability

Aaron's argument is based on **theoretical probability**.

Since the die is fair, each side has an equal chance of showing up, but this does not mean that in every instance a die is thrown 60 times, each number shows up 10 times.

Calculate the probability that each number shows up exactly once in six throws.

$(1/6)^6 \times 6! = \mathbf{0.0154}$

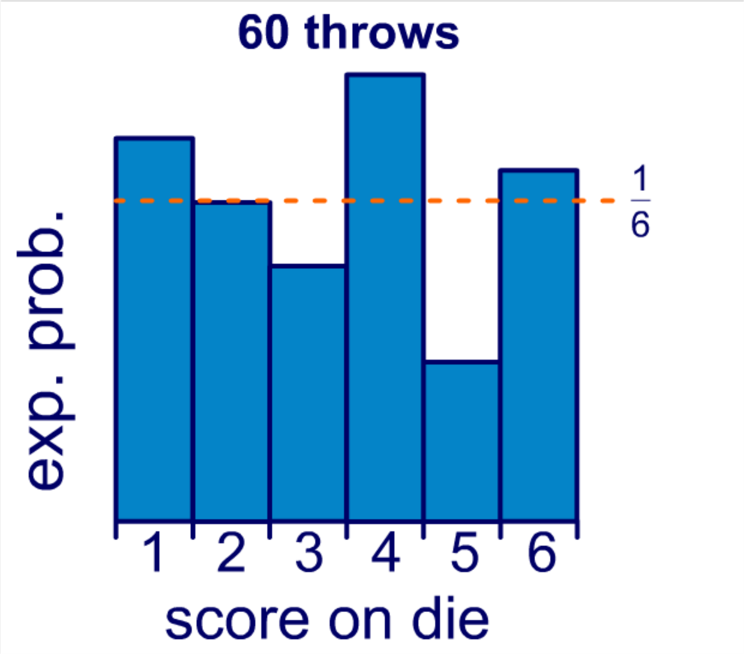
It is possible that a number doesn't show up at all.

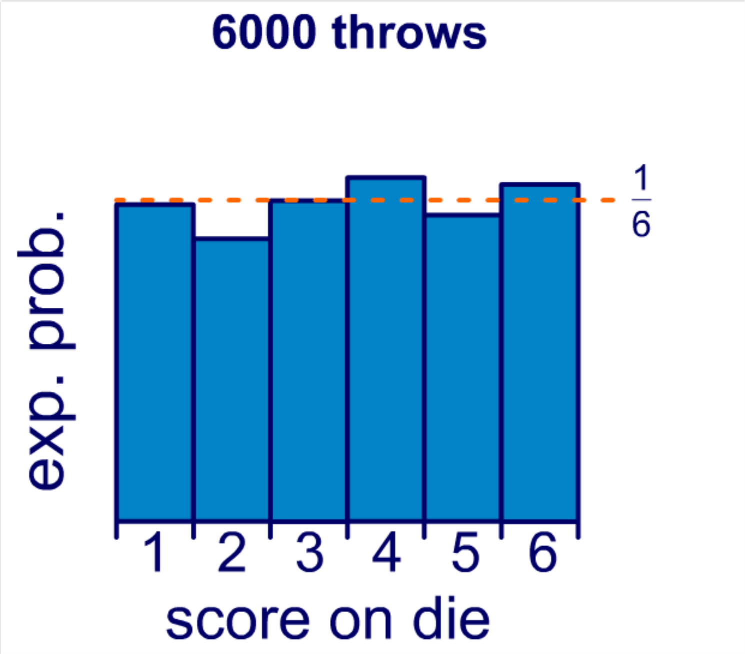
Calculate the probability that one number never shows in six throws.

$(5/6)^6 = \mathbf{0.3349}$

These histograms represent the experimental probabilities of throwing a fair die 60 times and 6000 times.

Which histogram best approximates the theoretical probabilities?





The law of large numbers

The experimental probability varies each time an experiment is repeated, but the more times the experiment is repeated, the closer the results get to the theoretical probability.

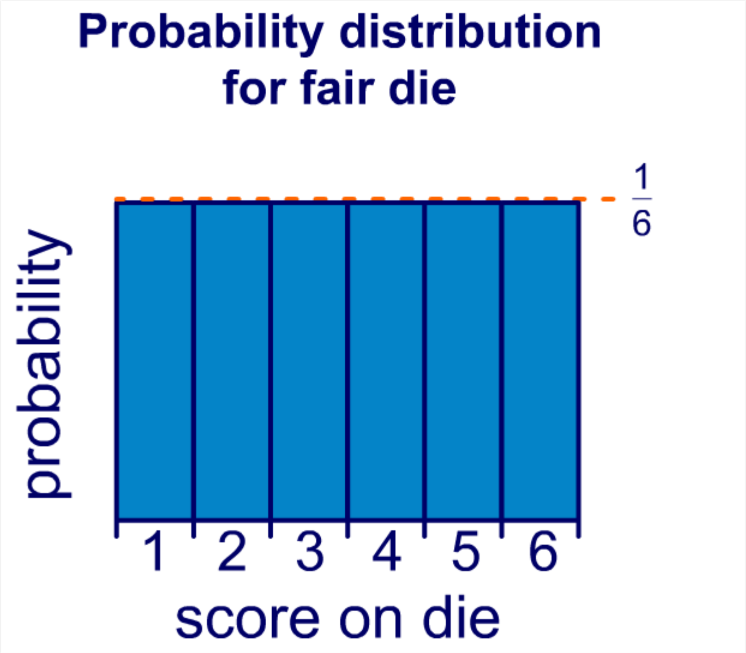
What would happen if the die could be thrown an infinite number of times?

If a die could be thrown an infinite number of times, the experimental probability would equal the theoretical probability: $\frac{1}{6}$

This idea is called the **law of large numbers**.

Probability distribution

A **probability distribution** describes an underlying process or population – it gives the theoretical probabilities.



For example, when rolling a die, the probability of each number showing is $\frac{1}{6}$.

In a discrete probability distribution, each probability is between 0 and 1 inclusive, and the sum of all the probabilities must be 1.

Dropping buttered toast

Explore the experimental probability of toast falling on the buttered side. Drag the hand over to the toast then press on the toast to try picking it up.

Careful though, it's very slippery!
The table will record your results.

Press **start** to begin.

start

Coin game

In this game the counter starts in the bottom-left square of the grid. On each turn a coin is thrown: on heads the counter moves right; on tails it moves up. Are the outcomes "win" and "lose" equally likely?

It's hard to find the probability theoretically, but it can be tested experimentally.

Press **start** to begin.

start

Coin game results

As the number of games increases, the experimental probability should get closer to the theoretical probability of winning a game.

# of games	# of wins	exp. prob.
100	39	0.390
200	94	0.470
300	131	0.437
400	182	0.455
500	210	0.420
600	261	0.435
700	312	0.446
800	356	0.445
900	391	0.434
1000	439	0.439