

Algebra 2 · Statistical Experiments, Simulation and Decisions · Lesson

Common Core S-IC.A.2, S-IC.B.5, S-IC.B.6, S-MD.B.6, S-MD.B.7 · mathovore.fr

This algebra 2 inference decisions lesson explains statistical experiments, simulation and decisions in one printable page, with definitions, a method and a worked example.

Statistical decisions compare results with what chance alone would produce. A simulation repeats a random process many times to test whether a result is consistent with a model. In a randomized experiment, a difference is significant when re-randomizing rarely matches it. Expected value and fair random choices apply probability to decisions.

Algebra 2 Common Core: S-IC.A.2 · S-IC.B.5 · S-IC.B.6 · S-MD.B.6 · S-MD.B.7

Algebra 2 Inference Decisions Lesson: key facts

- Standards S-IC.A.2, S-IC.B.5, S-IC.B.6, S-MD.B.6 and S-MD.B.7: simulation, experiments, reports and decisions.
- A result is inconsistent with a model when simulated sets rarely produce one that extreme (often under 5%).
- Random assignment lets a significant difference be credited to the treatment, not to luck.
- A choice is fair when every option has the same probability; expected value is the sum of payoff times probability.
- Check a report's sample, assignment, size and presentation before trusting its claim.

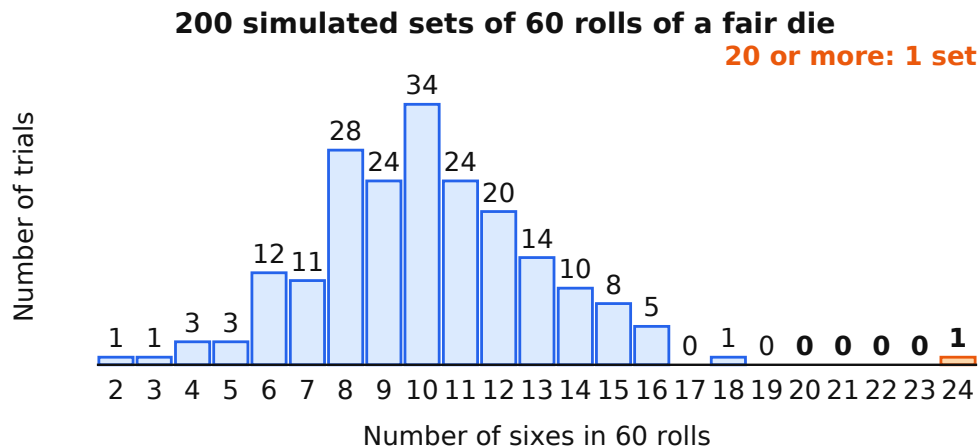
How do you decide whether a result fits a model?

A **model** is a probability claim, such as "this die is fair." A result is **consistent with the model** if it could easily happen by chance when the model is true. To check, run a **simulation**: repeat the random process many times with random digits or software and record each outcome.

1. State the model and the expected result.
2. Simulate many sets with the same number of trials.
3. Count the sets as extreme as the real result.
4. If that share is below about 5%, the model is doubtful.

Liam rolled a die 60 times and got 20 sixes. A fair die gives about $60 \cdot \frac{1}{6} = 10$. In 200 simulated

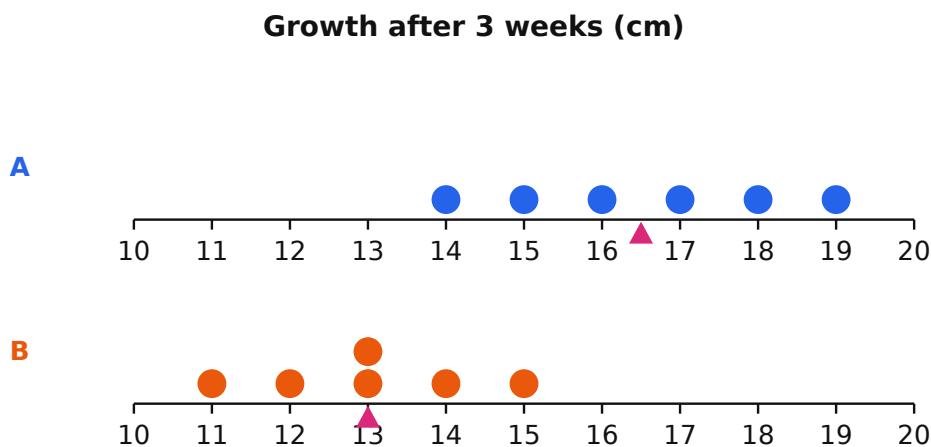
sets, only 1 set had 20 or more sixes, so the die is probably not fair.



Each bar counts simulated sets of 60 rolls. The orange bar is the only set with 20 or more sixes.

How do you compare two treatments?

In a **randomized experiment**, chance assigns subjects to treatments. Maya grew 12 seedlings, 6 with fertilizer A and 6 with B. The means were 16.5 cm and 13 cm, a difference of 3.5 cm.

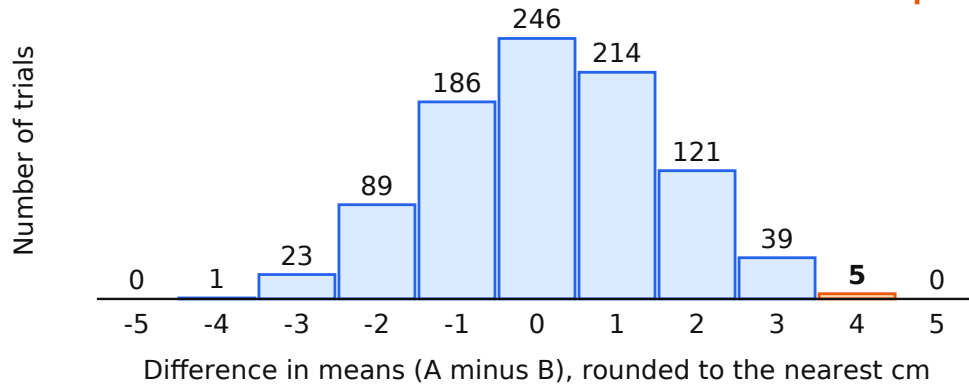


Pink triangles mark the means: 16.5 cm for A and 13 cm for B.

To see whether luck alone could do this, pool the 12 heights and split them into two groups of 6 in every possible way. Only 5 of the 924 splits gave a difference of 3.5 cm or more, about 0.5%. A difference this rare is **statistically significant**.

All 924 ways to split the 12 seedlings

3.5 cm or more: 5 splits



Each bar counts splits whose difference rounds to that value. The orange bar holds the 5 splits at least as large as the observed 3.5 cm.

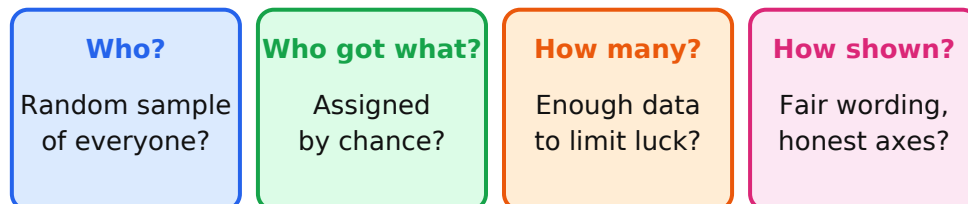
Statistically significant

A difference is statistically significant when re-randomizing rarely produces one as large, commonly less than 5% of the time.

How do you evaluate a report based on data?

A random sample supports claims about a population. Random assignment supports cause and effect. A study that only observes groups shows association. Small samples, loaded wording and graphs with a cut-off axis can all mislead.

Four questions to ask about any report

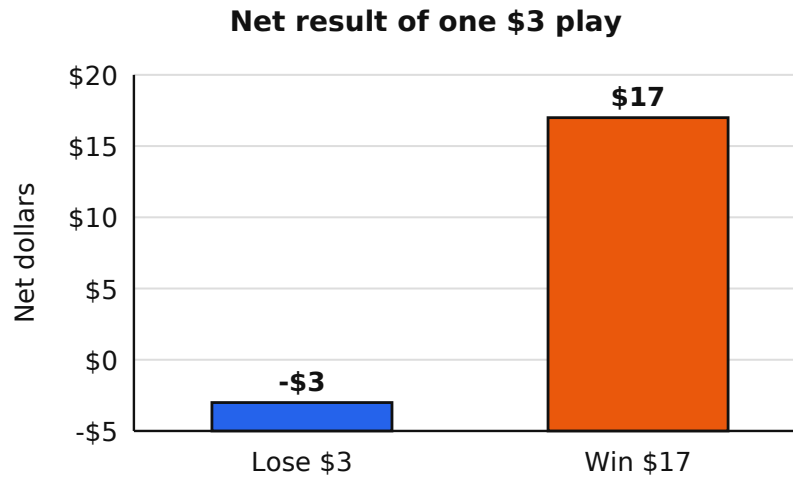


Run every report through these four questions before trusting its conclusion.

How can probability make fair and wise decisions?

A choice is **fair** when every option has the same probability. To pick one of three friends, roll a die: 1 or 2 for the first, 3 or 4 for the second, 5 or 6 for the third. The **expected value** is the sum of each payoff times its probability.

Noah pays \$3 to play a game that wins \$20 with probability 0.1. His expected net result is $0.1 \cdot 17 + 0.9 \cdot (-3) = -\$1.00$ per play, so the game favors the school, not Noah.



The game loses \$3 nine times out of ten and nets \$17 once in ten.

Statistical Experiments, Simulation and Decisions: frequently asked questions

What does it mean for a result to be consistent with a model?

It means the result could easily occur by chance if the model were true. If simulations of the model often produce results this extreme, the model is not contradicted.

What does statistically significant mean?

A difference is statistically significant when it would rarely happen by chance alone, often less than 5% of the time. It does not mean the difference is large or important.

Why is random assignment so important in an experiment?

Chance spreads other differences among the groups about evenly. A large difference in outcomes is then unlikely to be luck or a hidden factor, so the treatment is the likely cause.

How do you make a fair decision with a die or coin?

Assign the options equally likely outcomes, such as two die faces for each of three people. If some outcomes are left over, roll again.

What is expected value and how does it help decide?

Expected value is the average result over many repeats: multiply each payoff by its probability and add. A positive expected net result favors playing, and a negative one does not.

How to use this algebra 2 inference decisions lesson

Use this algebra 2 inference decisions lesson before the worksheet, then check what you learned with the quiz.

