

AP Statistics · Probability and Random Variables · Lesson

Common Core AP Statistics Unit 2 (2026-27) · mathovore.fr

This ap statistics probability lesson explains probability and random variables in one printable page, with definitions, a method and a worked example.

Probability measures how likely an event is, from 0 to 1. Two-way tables give joint, marginal and conditional relative frequencies, the addition and multiplication rules combine events, and independence means one event does not change the other's probability. A discrete random variable has a mean and standard deviation.

AP StatisticsCommon Core: AP Statistics Unit 2 (2026-27)

AP Statistics Probability Lesson: key facts

- Joint, marginal and conditional relative frequencies come from dividing by the grand total, a row or column total, or the given group.
- Complement rule: $P(\text{not } A) = 1 - P(A)$. Addition rule: $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$.
- Conditional probability: $P(B|A) = P(A \text{ and } B)/P(A)$. Events are independent when $P(B|A) = P(B)$.
- A simulation estimates a probability by repeating a random process many times with a clear digit assignment.
- A discrete random variable has mean sum of x times $P(x)$, and standard deviation the square root of the weighted squared deviations.

How do two-way tables show probabilities?

A survey of 200 students records grade group and how each student gets to school. Dividing by different totals gives three kinds of relative frequency.

Group	Bus	Car	Walk	Total
Grades 9-10	54	26	40	120
Grades 11-12	20	44	16	80
Total	74	70	56	200

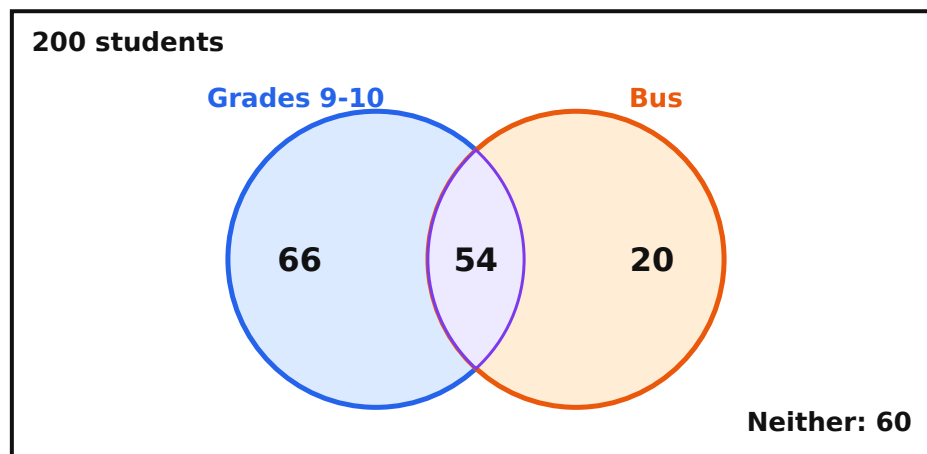
Yellow: joint (54). Blue: marginal total for bus (74). Orange: the row of grades 11-12 used for a conditional probability.

Joint, marginal and conditional

- **Joint:** cell $\div$ grand total. $P(9-10 \text{ and bus}) = \frac{54}{200} = 0.27$
- **Marginal:** row or column total $\div$ grand total. $P(\text{bus}) = \frac{74}{200} = 0.37$
- **Conditional:** cell $\div$ total of the given group. $P(\text{bus}|11-12) = \frac{20}{80} = 0.25$

What are the basic probability rules?

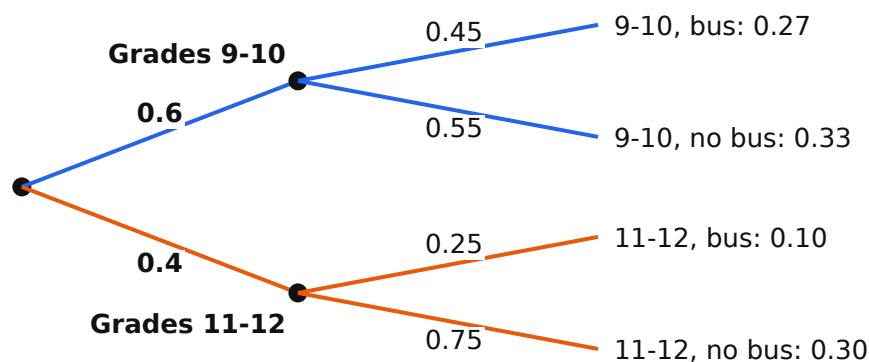
The complement rule is $P(\text{not } A) = 1 - P(A)$. The addition rule is $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$. Events are **mutually exclusive** if they cannot happen together, so $P(A \text{ and } B) = 0$ and the last term disappears. In the survey, $P(9-10 \text{ or bus}) = \frac{120 + 74 - 54}{200} = 0.70$.



Grades 9-10 total 120, bus riders total 74, overlap 54.

What are conditional probability and independence?

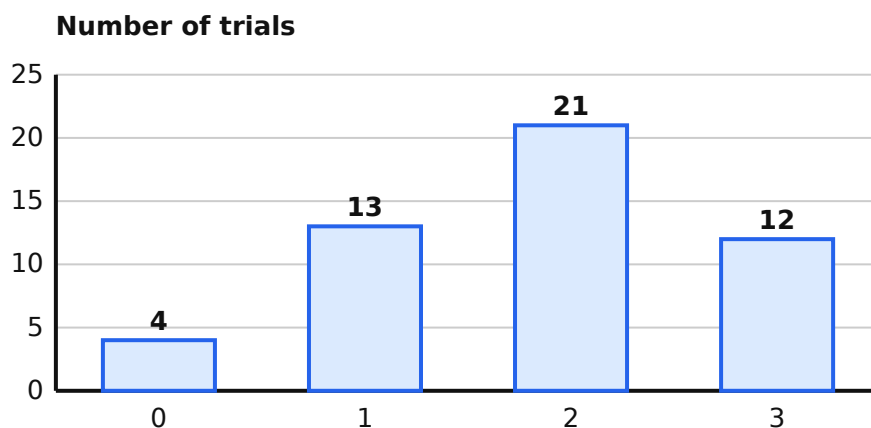
$P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$ and $P(A \text{ and } B) = P(A) \cdot P(B|A)$. Events are **independent** when knowing one happened does not change the probability of the other: $P(B|A) = P(B)$. Here $P(\text{bus}|11-12) = 0.25$ but $P(\text{bus}) = 0.37$, so grade group and bus use are not independent.



Multiply along a branch to get a joint probability.

How does simulation estimate a probability?

A simulation uses chance devices to imitate a random process many times. A player makes 60% of free throws. To estimate the chance of making at least 2 of 3 shots, let digits 0 to 5 mean a make and 6 to 9 a miss, read three digits per trial, record the number of makes, and repeat. With 33 successes in 50 trials, the estimate is $\frac{33}{50} = 0.66$. More trials give a more stable estimate.



Makes in 3 shots, 50 trials. At least 2 makes occurred in $21 + 12 = 33$ trials.

What are the mean and standard deviation of a discrete random variable?

A discrete random variable X has a probability for each value x , and the probabilities sum to 1.

Formulas

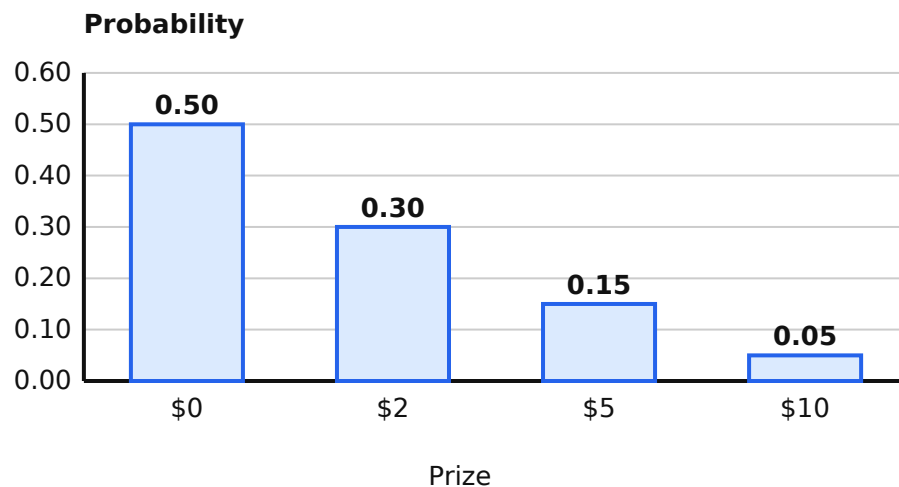
$$\mu_X = \sum x \cdot P(x) \quad \sigma_X = \sqrt{\sum (x - \mu_X)^2 \cdot P(x)}$$

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1. List each value with its probability and check that the sum is 1.
2. Multiply each value by its probability and add to get μ_X .
3. Square each deviation, weight it by its probability, add, and take the square root.

Example. A carnival game pays \$0, \$2, \$5 or \$10 with probabilities 0.50, 0.30, 0.15 and 0.05. Then $\mu_X = 0.60 + 0.75 + 0.50 = 1.85$ dollars and $\sigma_X = \sqrt{6.5275} \approx 2.55$ dollars. The mean is the long-run average prize per play, not a prize anyone wins on one play.



Prize distribution. The mean prize, \$1.85, is not one of the possible prizes.

Probability and Random Variables: frequently asked questions

What is the difference between joint and conditional probability?

A joint probability is the chance that two things happen together, found by dividing a cell by the grand total. A conditional probability restricts attention to a known group, so the cell is divided by that group's total.

What is the difference between mutually exclusive and independent events?

Mutually exclusive events cannot both happen, so $P(A \text{ and } B) = 0$. Independent events can happen together, and knowing one happened does not change the other's probability. Two events with positive probabilities cannot be both.

How do you check whether two events are independent?

Compare $P(B|A)$ with $P(B)$, or check whether $P(A \text{ and } B)$ equals $P(A)$ times $P(B)$. If either equality fails, even by a little, the events are not independent.

What does the mean of a random variable tell us?

It is the long-run average value of the variable over many repetitions. It need not be a possible value of the variable on a single trial.

Why does a simulation need many trials?

The relative frequency of an outcome settles near its true probability only after many repetitions. A few trials can be far from the true value by chance alone.

How to use this ap statistics probability lesson

Use this ap statistics probability lesson before the worksheet, then check what you learned with the quiz.

