

Mean, SD, t-test

Your goal: Compute the mean and standard deviation and explain the purpose of a t-test for your data.

One product: Statistics practice: mean and standard deviation calculated for each condition with steps shown, plus a written explanation of what a t-test compares and whether it applies to the data.

Question: What do each condition's mean and spread describe, and does this paired design justify a t-test conclusion?

Start the work

A raw table needs units and a clear participant/trial structure. D1 supplies those for original practice without claiming to be your lab data.

1. Read D1's design and units. Complete the five-number W1 mean warmup and review M1's different worked example.
2. For each D1 condition, show its sum, n and mean.
3. For each condition, show every deviation and squared deviation, their sum, the n-minus-1 divisor, variance and sample SD.
4. Explain a t-test's purpose and whether a paired or independent approach fits D1. State n and the missing assumptions.
5. Check C1's claim without inferring significance or importance from means and SD alone.
6. Submit the calculation record with the written test explanation. End by explaining what greater SD says about spread.

If the assignment is unavailable, keep the calculation record and request the correct route. If an actual lab table is required, recover that input before claiming its analysis is complete. D1 remains labeled instructional practice.

Words you will use

Mean

The sum of values divided by their count.

Standard deviation / SD

A measure of spread around the mean in the data's original units.

Sample / population

The observations being analyzed; the wider group a study might aim to describe.

n / sample size

The count of observations for a calculation. In a paired test, count pairs.

Deviation

A value minus the sample mean.

Square / square root

Multiply a number by itself; the nonnegative number whose square equals the starting number.

Variance

For sample variance, the sum of squared deviations divided by $n - 1$.

Condition

A labeled measurement setting or comparison category.

Paired observations

Two linked measurements, such as one value in each condition from the same participant.

Independent observations

Observations not linked by repeated measurement or other dependence in the study design.

t-test

A statistical test of a hypothesis about a mean or mean difference using estimated uncertainty.

Hypothesis / assumption

A claim being evaluated; a condition needed for a method's interpretation.

Normal distribution

A bell-shaped population distribution used in certain test assumptions.

Statistical significance

Evidence against a specified statistical hypothesis at a chosen threshold under the test's assumptions. It is not proof of importance or cause.

Practical importance / causation

Whether a difference matters for the purpose; whether changing one factor produces an effect.

bpm / count-unit

bpm means beats per minute, a heart-rate unit. A count-unit is an arbitrary unit used only in these practice sets.

E1: D1 paired instructional dataset

D1 is an invented numerical practice dataset. It is not the missing March 4 raw lab table. Do not collect pulse readings or perform an intervention for this task.

The modeled variable is pulse rate in beats per minute, abbreviated bpm. A and B are labels for two conditions; no treatment or physical procedure is assigned.

Each row represents a different fictional participant with one value in A and one in B. The two values in a row are paired. Each condition has five values; there are five pairs, not ten independent participants.

P1: A = 66 bpm; B = 68 bpm.

P2: A = 68 bpm; B = 70 bpm.

P3: A = 70 bpm; B = 74 bpm.

P4: A = 72 bpm; B = 76 bpm.

P5: A = 74 bpm; B = 82 bpm.

For the modeled design, participants are distinct and no participant is repeated across rows. Treat pairs as independent for the structure exercise. Within a pair, A and B are linked.

No random sampling, randomized condition order or distribution for the population of paired differences is supplied. The values do not establish those assumptions. No real population was sampled.

E2: Mean and sample SD formula sheet

Use the sample SD convention today. Mean = sum of values divided by n. Here n is the number of values within the condition.

Sample SD = square root of [sum of (each value minus mean) squared, divided by (n minus 1)]. This formula needs at least two values.

In symbols written as text: x is a value, $\bar{x}$ is the sample mean, n is the count, and s is sample SD. Sum means add every indicated term.

Step 1: add the values and divide by n to find the mean. Step 2: subtract that mean from each value to find each deviation.

Step 3: square each deviation by multiplying it by itself. Step 4: add the squared deviations.

Step 5: divide that sum by n minus 1. This is sample variance. Step 6: take its square root to obtain sample SD.

A square root reverses squaring: the square root of 4 is 2. Variance has squared units; SD returns to the original units.

Population SD uses n in the divisor when describing an entire defined population. Do not switch formulas mid-calculation. This practice requests sample SD even though its numbers are invented.

Keep exact values or several decimal places during calculation. Round final mean and SD to two decimals and include units. A calculator is allowed; retain the steps.

E3: What a t-test can and cannot answer

A t-test assesses evidence about a population mean or mean difference under a stated hypothesis and assumptions. It does not label a difference real or imaginary.

For linked A/B observations, a paired t-test uses each within-pair difference. It asks about the population mean difference, often compared with zero.

Independent two-sample t-tests concern separate groups. Their uncertainty depends on both group sizes and spread. They must not treat repeated readings from one person as independent people.

For a paired t-test with a small sample, independent pairs and an approximately normal population of differences are important assumptions. Normal here means a bell-shaped population distribution.

D1 has only five pairs. Its design points toward a paired approach, but no population-difference distribution or sampling basis is supplied. Do not claim a justified population test or significant result from D1.

To decide, check whether each A value is linked to one B value in the same row. A linked design calls for comparing the within-row differences, not two independent groups. Then name each assumption D1 does not supply.

No t statistic or probability calculation is required today. Explain purpose, design fit, n and what is still unknown. Describing the dataset does not require running an inferential test.

Warmup and recovery inputs

W1 warmup: 2, 4, 6, 8, 10 count-units. These five invented values are separate from D1. Find their mean by hand, then describe their spread before calculating any SD.

Spread needs a comparison or scale. Name the distance between low and high values rather than calling spread large without context. SD describes spread around the mean; it does not by itself show measurement quality.

R1 recovery: 8, 10, 12 count-units, with the mean given as 10 and $n = 3$. Use E2 to compute sample SD and explain what a larger SD would mean.

R1 is a short recovery practice. Return to both D1 conditions for the full product unless your teacher explicitly assigns a different scope.

Work independently with the same supplied numbers and a calculator or spreadsheet. If using a spreadsheet, show the values, mean, deviations, squared deviations, sum and divisor; a single output cell is not all the steps.

Checks and optional comparison

Check C1 is a separate hypothetical summary: A mean = 81, SD = 3; B mean = 75, SD = 3. No units, sample sizes, pairing or sampling design are provided.

The mean gap is 6, twice the stated SD. Before judging the claim, list what a significance, overlap, importance or cause judgment would need, and check whether C1 supplies it.

Optional extension X1: compare invented independent groups X = 9, 10, 11 and Y = 6, 10, 14 count-units. Each has $n = 3$ and mean = 10; their sample SDs are 1 and 4.

For this mathematical comparison only, assume independent observations from normal populations. The two group means are equal, so their observed mean gap is zero. Different spread does not turn that zero gap into evidence of a mean difference.

Explain why the original question “which spread makes this a real difference?” is not valid for equal means. If a nonzero gap and n were held fixed, spread would affect uncertainty. That is a different comparison.

No actual population effect is established by X1. Do not run a full test for this optional explanation.

Keep original practice and prior work separate

Use D1 for this original statistics practice. If your teacher instead requires your actual authorized lab table, ask for that table and its participant/trial design before analyzing it.

Do not label D1 as data you collected. It does not finish the March 4 sensor lab or establish that its raw table is complete.

The weekly Research design ticket and Study critique packet remain separate work. Check their actual materials, instructions and whether Schoology shows Submitted with your teacher. This calculation record does not complete them.

The official statistics activity and Activity 2.1.2 directions also need teacher confirmation. Save this practice separately; do not mark official work complete merely because these calculations are finished.

M1: Different data, every calculation step

M1 is a different, invented example: three lengths, 2 cm, 4 cm and 6 cm. It is not D1, W1 or R1.

Mean: $\text{sum} = 2 + 4 + 6 = 12 \text{ cm}$. $n = 3$. Mean = $12 / 3 = 4 \text{ cm}$.

Deviations: $2 - 4 = -2 \text{ cm}$; $4 - 4 = 0 \text{ cm}$; $6 - 4 = 2 \text{ cm}$.

Squared deviations: $(-2)^2 = 4 \text{ cm squared}$; $0^2 = 0 \text{ cm squared}$; $2^2 = 4 \text{ cm squared}$.

Sum of squared deviations = $4 + 0 + 4 = 8$ cm squared. Sample divisor = $n - 1 = 2$.

Sample variance = $8 / 2 = 4$ cm squared. Sample SD = square root of 4 = 2 cm.

Record the answer as mean 4.00 cm and sample SD 2.00 cm. SD describes these lengths' spread; it does not prove the ruler was accurate.

Use the same calculation sequence separately for A and B in D1. Do not copy M1's answers into D1.

Try the decision

A student sees different A/B means in D1 and wants to report a real treatment effect. Which response fits the data?

- Report the descriptive calculations, check how the A and B values are linked, and explain the missing assumptions before making an inferential claim.
- Call the difference real because the means differ, then treat all ten values as independent people.
- Use whichever SD divisor gives the smaller spread to strengthen the claim.

Explain your choice using the reading. Discuss it or say it to yourself. This practice does not add another submission.

Your 80-minute flow

0–10 minutes	Find the W1 mean, predict spread and follow the different model.
10–30 minutes	Read D1/E3 and calculate both means with steps.
30–50 minutes	Complete both sample-SD tables, using R1 first if needed.
50–65 minutes	Write test-purpose/applicability and C1 explanations; optional X1 if ready.
65–77 minutes	Check and submit the same calculation record, or retain it with access check.
77–80 minutes	Add the brief spread statement to the same record.

Your response record

Use these labels on paper or in your document. The space below also works when this page is printed.

W1 mean and spread prediction

Find the mean of the five W1 values by hand. Describe their spread using the low and high values.

Show the sum divided by five. This warmup is separate from D1.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

D1 means, A and B

For each condition, list the five values, add them, state n and divide to find the mean. Include bpm.

Keep A and B separate. Each condition has five values.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

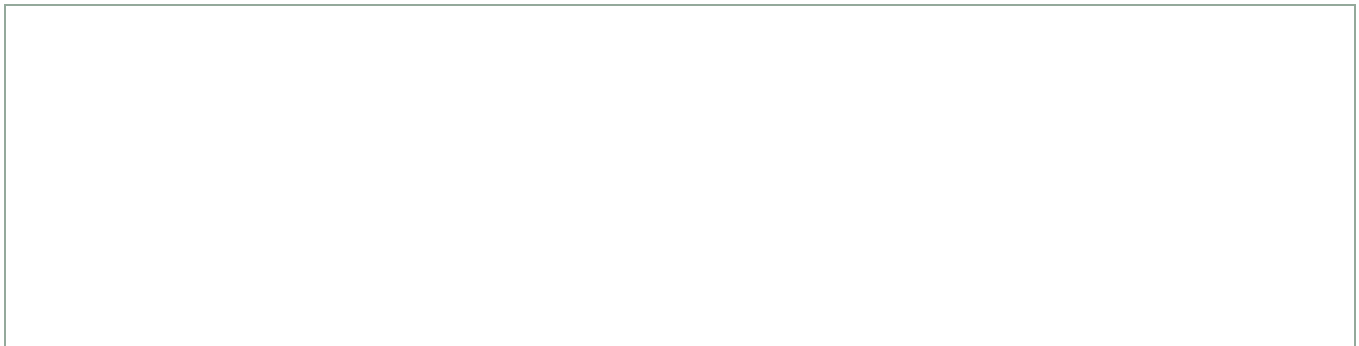


D1 A sample SD steps

Show each A value minus its mean, each squared deviation, their sum, the sample divisor, variance and sample SD.

Use the n-minus-1 formula. Preserve units and round only the final SD to two decimals.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.



D1 B sample SD steps

Repeat the full sample SD sequence for B. Compare its spread with A using the SD values.

Use B's own mean. A larger SD describes greater spread here, not proof that the measurements are wrong.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

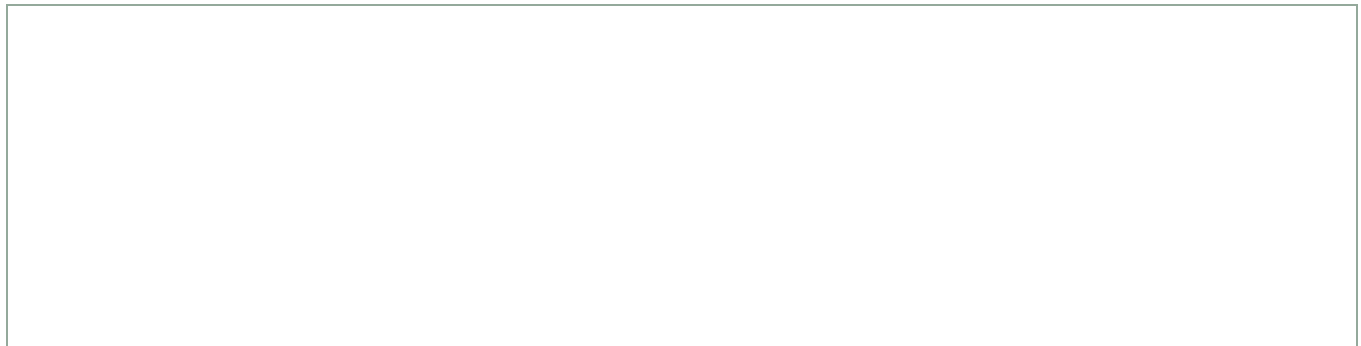


t-test purpose and applicability

Explain what a t-test compares. For D1, name the relevant paired design, its n, and why the missing assumptions block a population conclusion.

Paired differences, not ten independent people. No t statistic or significance calculation is required.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.



C1 check and SD exit statement

Explain why C1's six-point gap and SDs alone cannot settle importance or significance. Then state what a larger SD tells you about values in the same units.

List what C1 does not report that such a judgment would need. Keep both answers in the same calculation record.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

Check your product

- Each condition has a mean and sample SD with all calculation steps and units.
- The written explanation identifies the t-test purpose and D1's paired structure with five pairs.
- Claims about significance, importance and causation stay within the supplied evidence.

Keep the limit: All numbers in this packet are invented instructional values, not student or patient measurements. Means and sample SD describe those numbers. No calculation proves a physiological effect, clinical importance, instrument accuracy or causation. A t-test needs a suitable design and assumptions; mean and SD alone cannot settle its result.

Turn in your work

Save the D1 statistics practice with both conditions' steps and the written test explanation. Use the linked BI statistics assignment. Follow its posted file format and deadline, then check the preview. After uploading, check that Schoology shows Submitted.

If the assignment is unavailable, keep the calculation record and request the correct route. If an actual lab table is required, recover that input before claiming its analysis is complete. D1 remains labeled instructional practice.

[Open this assignment in Schoology.](#)

Carry forward

Describe the values first. Choose a test from the design and its assumptions, not from the mean gap alone.

Keep the calculation steps and test-assumption questions with the dataset label. Real research needs its actual design and evidence. What assumptions would you need to check before interpreting a statistical test?

Sources and resources

[Open today's page](#)

NIST-SD · Measures of Scale

NIST/SEMATECH e-Handbook of Statistical Methods

<https://www.itl.nist.gov/div898/handbook/eda/section3/eda356.htm>

NIST-PAIRED · Analysis of paired observations

NIST/SEMATECH e-Handbook of Statistical Methods

<https://www.itl.nist.gov/div898/handbook/prc/section3/prc311.htm>

NIST-T · Two-Sample t-Test for Equal Means

NIST/SEMATECH e-Handbook of Statistical Methods

<https://www.itl.nist.gov/div898/handbook/eda/section3/eda353.htm>

OPENSTAX · Matched or Paired Samples

OpenStax, Rice University, Statistics textbook

<https://openstax.org/books/statistics/pages/10-4-matched-or-paired-samples-optional>