

Part A — One-Sample t-Test

A construction company claims that the **average daily output of a bricklaying crew is 520 bricks**. A supervisor collects a sample of 12 days:

Sample (bricks laid): 505, 522, 498, 540, 515, 529, 510, 501, 495, 532, 520, 508

Tasks

1. State the **null (H_0)** and **alternative (H_1)** hypotheses.
2. Calculate the **sample mean** and **sample standard deviation**.
3. Compute the **t-statistic**.
4. Determine the **degrees of freedom**.
5. At the **5% significance level**, decide whether to **reject or fail to reject** the claim.
6. Interpret the conclusion in context.

Part B — Independent Two-Sample t-Test

Two concrete mixing teams (Team A and Team B) claim to have similar average mixing times.

Team A mixing times (minutes): 14, 16, 15, 13, 17, 18, 16

Team B mixing times (minutes): 12, 15, 14, 13, 14, 15, 13

Assume the samples are **independent** and come from normally distributed populations.

Tasks

1. State H_0 and H_1 .
2. Compute the **sample means** for both teams.
3. Compute the **sample standard deviations**.
4. Calculate the **t-statistic**.
5. Determine the **degrees of freedom**.
6. At the **5% significance level**, decide whether there is a **significant difference**.
7. Write a conclusion in context of the construction site.

Part C — Paired Sample t-Test

A construction manager wants to test whether a new training program improves the speed of operating a cutting tool.

Cutting time before training (seconds): 42, 38, 40, 36, 39, 41, 37

Cutting time after training (seconds): 38, 34, 36, 33, 35, 36, 34

Tasks

1. State H_0 and H_1 .
2. Compute the **differences** (Before – After).
3. Calculate the **mean difference** and **standard deviation of differences**.
4. Compute the **t-statistic**.
5. Determine the **degrees of freedom**.
6. Decide whether the training program resulted in a **significant improvement**.
7. Interpret the conclusion.

Formulae:

Mean $\bar{x} = \frac{\sum x}{n}$	x - Sample Point n – Number of samples
Standard Deviation $s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$	x - Sample Point $\bar{x}$ - Sample Mean n – Number of samples
One Sample T-Test $t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$ $df = n - 1$	$\bar{x}$ - Sample Mean μ – Reference Value s – Standard Deviation n – Number of samples
Independent Samples T-Test $t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$ $df = n_1 + n_2 - 2$	$\bar{x}_1$ - Sample 1 Mean $\bar{x}_2$ - Sample 2 Mean s_1 – Standard Deviation Sample 1 s_2 – Standard Deviation Sample 2 n_1 – Number of samples 1 n_2 – Number of samples 2
Paired Samples T-Test $t = \frac{\bar{x}_d - 0}{\frac{s}{\sqrt{n}}}$ $df = n - 1$	$\bar{x}_d$ - Mean Sample Difference s – Standard Deviation n – Number of Samples